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Transfers, Excess Savings, and Large Fiscal Multipliers

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ABSTRACT: This paper seeks to show that a New Keynesian model can produce highly persistent and large output responses to fiscal transfers and excess wealth, in line with recent empirical literature. The introduction of myopia to households to allow realistic degrees of dissaving from wealth and accumulated transfers, alongside more standard Keynesian features, achieves this goal. Model IRFs closely match the high fiscal multipliers from the tax stimulus SVAR literature, and also have important inflationary consequences. An application of this model to the COVID era, where transfer payments in the United States supported an accumulation of ``excess savings", results in inflation rising by over 1 percentage point for several years as well as a persistent increase in output over the same horizon. Finally, under the same framework and calibration, it is found that high debt and a weak fiscal rule can dull the transmission of monetary policy due to the wealth effect from higher interest payments.

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WORKING PAPERS

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1 Introduction

GDP growth in the United States in the immediate years after the pandemic was unexpectedly strong, with real consumption in particular exceeding trend growth. Much of the debate around what fueled strong household consumption has focused on the role of 'excess savings' that were accumulated during the early stages of the pandemic (Aladangady et al., 2022; Aggarwal et al., 2023). This excess saving was almost entirely directly or indirectly the result of a substantial fiscal stimulus package during the pandemic that sustained incomes over this period through large cash transfers, unemployment payments, and employment support.

Standard New Keynesian macroeconomic models do not suggest that fiscal transfers can provide large or sustained stimulus to the economy. Optimizing households with infinite horizons save all fiscal transfer receipts, accounting for the future tax liability they generate in addition to the temporary boost to income. In New Keynesian models containing hand-to-mouth (HTM) households who spend all income received in the same period, implied multipliers are small and stimulus is short-lived. However, a limited set of microeconometric studies suggest that a substantial share of transitory income gains are spent after several years. In addition, a number of US and cross-country structural VAR estimates find evidence of large and persistent positive effects on output from tax-based stimulus (Ramey, 2019). While tax stimulus is not always conceptually equivalent to transfers, the SVAR literature nevertheless suggests that policies that temporarily boost disposable income can have significantly larger effects than captured in standard models. In this paper, myopic households spend windfalls to a degree that is absent in the canonical New Keynesian and even standard two-agent New Keynesian framework (TANK). The model provides insights into the general equilibrium transmission to output and inflation from 'excess savings' and transfers and is consistent with much of the recent empirical macroeconomic literature on the effects of tax stimulus. Tax stimulus (lower income taxes and lump-sum tax cuts) and transfers result in cumulative output multipliers significantly exceeding one over five years.

The analysis in this paper is centered around a two-agent New Keynesian model accounting for innovations to the literature that make the transmission of shocks more realistic than in the canonical framework (as described in Gali (2015)). These include HTM households and investment (Gali et al., 2007) and finite-life households that hold net positive wealth. The finite life horizon of these households is a mechanism to induce a myopic planning horizon rather than calibrated to match the lifecycle, as in Angeletos et al. (2024), Laxton et al. (2010) and Andrle et al. (2015). High MPC HTM agents and more slowly dissaving wealthy households generate multiplier-enhancing interactions, as spending on consumption and investment in turn fuel income gains. As in Angeletos et al. (2024), we draw upon the empirical microeconometric literature to calibrate the degree of myopia of these households and match the degree of dissaving observed following transitory income shocks. The model is additionally benchmarked against the emergent fiscal SVAR literature to identify plausible degrees of myopic discounting in addition to the microeconometric literature.

The general equilibrium effects of the large fiscal transfers provided early in the COVID-19 pandemic in 2020-21 are simulated in the calibrated model. These transfers supported the buildup of excess savings over this period.[1] In the model, these transfers result in a large response of output for several years after the final transfer receipt, with output 2-3% higher due to the transfers between 2024-2026 for a plausible calibration of the model.

The model also shows that fiscal transfers can have material implications for inflation over the medium term, adding to a new and growing literature on the topic (see for example Hazell and Hobler (2024)). In contrast to other work on the inflation surge post-pandemic, our framework does not require non-linearities to generate these sizable inflation responses to demand-driven shocks (for example, as in Benigno and Eggertsson (2023)), and the calibration of the model implies a shallow Phillips curve. Nevertheless, for a plausible calibration, the persistent nature of the shock results in inflation rising over 1 percentage point soon after the transfers were made, and only beginning to decline below this threshold in 2024.

The results in this paper are qualitatively close to a similar exercise by Bardoczy et al. (2024), where the macroeconomic effects of the drawdown of excess savings are examined in a heterogenous agent New Keynesian (HANK) framework in contrast to the TANK employed here. The response of output to government transfer shocks is more persistent and larger in the model employed in this paper, with effects lasting for many years after they fade in the HANK simulations. This reflects a more elastic response of labor supply and co-movement of investment and consumption, which further amplifies the impact of the shock. Additionally, the

[1] Throughout the paper, the presence of excess savings (defined as above-baseline household holdings of financial assets) and receipt of fiscal transfers are treated interchangeably. This is because both conceptually involve a decision at the household level as to how to spend a windfall of higher disposable income or accumulated assets. This enables the paper to draw together the large literature examining the effects of fiscal shocks with the relatively new phenomenon of households accumulating substantial quantities of wealth due to a mixture of fiscal transfers and forced saving during the pandemic (for example, see Aladangady et al. (2022)).

model in this paper is benchmarked against the tax-stimulus SVAR literature, which produces more persistent output effects than the government spending literature used by Bardoczy et al. (2024), and may provide a conceptually closer proxy to the impact of transfer receipts. In another closely related paper, Auclert et al. (2023) show that under certain conditions in a three-agent model, consumption can remain elevated for many years after a shock to savings.

In a final innovation of this paper, the wealth channel of interest payments on household assets are shown to be important in a model with myopia. The endogenous reaction of interest rates to transfer stimulus generate a wealth-driven increase in consumption, as future tax liabilities of a rising government interest burden are discounted more heavily than in standard models. This channel is intuitively more important in calibrations with higher steady–state levels of debt and where the fiscal rule is weak. The finding has important implications for monetary policy and its interactions with fiscal policy. It is shown that the transmission of monetary policy shocks is dulled in the presence of myopia (a plausible degree of which identified by the macro- and micro-econometric literature) by this interest rate wealth channel where debt is high and fiscal policy relatively unresponsive to rising debt.

2 A New Keynesian Framework

This paper seeks to show that a New Keynesian model can produce highly persistent and large output responses to fiscal transfers and excess wealth. The framework is similar in nature to one of the first demonstrations of a Two-Agent New Keynesian (TANK) model by Gali et al. (2007). It builds on this framework through the introduction of myopia to household decision making and a more explicit treatment of wealth. While full details are provided in the appendix (Appendix A), this model has the following standard and non-standard features:

Households and consumption Households are split into two types. The first are 'wealthy' households, who received wage income, dividends (profits), capital rental fees, and interest on government bonds, while paying lump sum taxes to the government. They are the only holders of government bonds and capital in the model. In contrast, hand-to-mouth (HTM) households consume all disposable income, which consists only of labor income after the payment of lump sum taxes (taxes are homogeneous across both household types). In addition to these sources of income and payment of taxes, both types of household can receive fiscal transfers, which are homogeneous across household types and exogenously determined by the government.

Aggregate consumption is the weighted sum of consumption of both household types (weight $\omega < 1$ is the share of HTM households):

$$C_t = \omega C_{H,t} + (1 - \omega) C_{W,t}$$

As in Gali et al. (2007), households of both types pool their labor supply decisions, with a union coordinating the selling price of labor. Wages are also sticky, with only a fraction of wages being reset in a given period. Both types of households supply the same quantity of labor, N. Unions account for the weighted utility of consumption and labor supply of both households in setting wages. If flexible wages were to prevail and if labor was undifferentiated, real wages (W) would be set to the marginal rate of substitution (MRS) between the weighted average utility of consumption (which is $\omega U'(C_H) + (1 - \omega) U'(C_W)$) and $U'(N)$.

The fraction $1 - \theta^w$ of wage contracts reset in each period and labor is differentiable. The pooling of labor across households to be set by the union avoids different labor market and wage dynamics across households affecting the results, and provides more realistic responses to fiscal shocks, as found in Gali et al. (2007). Sticky wages are key to the dynamics of the model, with the stickiness providing a stronger quantity adjustment response to fiscal shocks.

Wealthy households invest in capital as well as government bonds. They receive capital rental income and face investment adjustment costs of the form of those used in Christiano et al. (2005).

Firms and production A continuum of firms produce goods consumed by both households (for investment and consumption) and the government using capital and labor with a technology with a standard Cobb-Douglas representation.

$$Y_t(i) = A_t(i) K_t^{\alpha}(i) L_t^{1-\alpha}(i)$$

Production firms minimize costs according to the wealthy households' choice of investment and capital and union-set wages. They sell their products at marginal cost in a competitive market to retailers, who bundle the produced goods into differentiable final products. Retailers are subject to sticky Calvo price adjustment of their finished goods, with a probability θ that they will not be able to reset prices in each period, yielding the standard Phillips curve relation.

Fiscal and monetary policy The government borrows from wealthy households and uses lump sum taxes to finance government spending, G, transfers, $\mathcal{T}$, and interest payments. Both transfers and taxes are uniform across wealthy and HTM households. Outstanding real debt (B) is issued by the government and held by wealthy households. The government's budget constraint is:

$$B_t + T_t = \frac{R_{t-1}}{\pi_t} B_{t-1} + G_t + \mathcal{T}_t$$

Government spending and transfers are exogenously driven and follow an auto-regressive process, while the fiscal rule takes the form:

$$\frac{T_t}{Y_t} - \frac{T_{ss}}{Y_{ss}} = \phi_b \left(\frac{B_t}{Y_t} - \frac{B_{ss}}{Y_{ss}}\right)$$

The rule shows that taxes rise in proportion to the deviation of the government debt-to-GDP ratio relative to its steady state.

Monetary policy follows a standard Taylor-style rule, linking the policy rate to the steady state of real interest rates and the rate of inflation.

$$R_t = R_{ss} \Pi_t^{\phi^\pi}$$

Here, ϕ^π governs the degree of responsiveness of the policy rate to inflation.

Discounting A key difference relative to the standard framework is the introduction of myopia into household decision making in the model. Households have shorter planning horizons than is typical in TANK models through the introduction of higher discount rates using the framework of Blanchard (1985), modified according to Angeletos et al. (2024). This myopia generates realistic degrees of spending from excess wealth and responses to fiscal and monetary policy (Gabaix, 2020). Unlike Angeletos et al. (2024), our purpose is not to understand the conditions over which fiscal stimulus becomes self financing, but rather to understand the long-term macroeconomic implications of fiscal stimulus, and the effects of myopia on the monetary transmission mechanism.

Wealthy households discount future utility and budget constraints at rate $(1 - u)$ in addition to the the standard discount rate β. Households place a probability, u, of dying in each subsequent period at a compounding rate. They therefore maximize:

$$\sum_{\tau=0}^{\infty}((1-u)\beta)^{\tau}U(C_{W,t+\tau},N_{t+\tau})$$

Unlike standard OLG models, we do not use the typical household lifecycle to calibrate this parameter, but rather calibrate it to match the empirical evidence on dissaving from transitory income shocks and to match structural econometric estimates of the effects of fiscal tax shocks.

Under this framework, wealthy households spend accumulated assets in the form of government liabilities at a faster pace than in a standard model. This is in contrast to the Ricardian nature of households in the canonical model, where discounted future tax liabilities fully offset the wealth effect of government transfers.

A linearized form of the wealthy agent's consumption function shows that these households will spend $(1-\beta(1-u))$ of a windfall of fiscal transfers $\mathcal{T}$ in the absence of future liabilities, but that this spending will be reduced by discounted future tax liabilities associated with the transfers, t (Appendix A). Consumers will spend more of a windfall from government transfers, $\mathcal{T}$, for larger values of u, the degree of myopic discounting. The linearized consumption function is close to the standard permanent income representation. One exception is the inclusion of the term $(1-u)$, which accounts for myopic discounting. A second exception is the explicit presence of the impact of real interest rates (r) on the accumulation of wealth, with historical interest rates boosting consumption proportionately to the size of wealth (B) relative to consumption.

$$c_{w,t}=\frac{\beta}{1-\omega}\frac{B_{ss}}{C_{ss}}(1-\beta(1-u))(b_{t-1}+r_{t-1})+(1-\beta(1-u))\mathcal{T}_t+(1-\beta(1-u))\sum_{\tau=0}^{\infty}((1-u)\beta)^{\tau}(-\frac{1}{\sigma}r_{t+\tau}+y_{t+\tau}-t_{t+\tau})$$

2.1 Calibration

The focus of this paper is to demonstrate the large output effects that can be generated from fiscal transfers to households in the presence of myopia. As such, we use standard parameters in our baseline calibration, with the exception of the discounting parameter u. The discount rate β is set to closely match an annualized real steady state interest rate of 2%. The intertemporal elasticity of substitution and inverse Frisch elasticity of labor supply parameters take the standard logarithmic-preferences equivalent value of 1 (σ and χ). The capital share of production (α) is set at 0.3, closely matching the average in the United States over the past 50 years. The depreciation rate takes a standard value of 0.025 (δ), while the capital adjustment cost parameter of 5 is close to that estimated in Smets and Wouters (2007).

Price and wage stickiness parameters (θ) are set to 0.75. This implies that prices and wages are reset after 3 quarters on average. The Phillips curve slope in the model is shallow, evaluating at 0.08 ($\kappa = \frac{(1-\theta)(1-\beta\theta)}{(\theta)}$).

For the policy rules, we use the standard elasticity of policy rates to inflation of 1.5 (ϕ_π). For the parameter guiding the adjustment of taxes as a share of output to debt to the debt-to-GDP ratio (ϕ_b), we use a value of 0.05. This is close to the rule estimated in Gali et al. (2007).[2] This parameter results in a slow adjustment of taxes of just 5% of additional debt as a proportion of GDP each quarter. While this is a difficult to identify parameter in the literature, we use this primarily to approximate a relatively 'weak' fiscal rule, which delays a large proportion of the adjustment of taxes to fund transfers years into the future.

Table 1: Parameters used in baseline calibration

Parameter	*Name*	*Value*
β	Discount rate	0.995
σ	Intertemporal elasticity	1
θ	Calvo parameter, consumer goods	0.75
θ^w	Calvo parameter, wages	0.75
χ	Inverse Frisch elasticity of labour	1
α	Capital share in production	0.3
ϕ_k	Capital adjustment cost	5
δ	Depreciation rate	0.025
ϵ	Elasticity of demand for consumption varieties	10
ϵ^w	Elasticity of demand for labor varieties	10
ϕ_π	Taylor rule: inflation parameter	1.5
ϕ_b	Fiscal rule: elasticity of tax to debt	0.05

2.2 Calibrating the rate of dissaving from wealth and fiscal transfer shocks

The parameter of primary concern in this paper is the degree of myopia of wealthy households, and hence their disposition to spend in response to shocks to to their income or accumulated assets. In addition, we must calibrate the share of HTM and wealthy households (ω) to match the time-profile of the response, given that as we will see, empirical studies find spending from

[2] Over the full SVAR sample in Table 1 of the paper, which yielded a result of 0.06

unanticipated income is often front-loaded. Our approach to the calibration follows Angeletos et al. (2024), although we explicitly account for future tax liabilities in response to fiscal transfers when determining this calibration (which affect spending decisions even with elevated discounting rates). The micro-level literature on spending from transitory income shocks such as fiscal transfers is rich for the short term response but very limited at the medium to longer horizons.

The microeconomic empirical literature on the short run response of household consumption to transitory income shocks can guide the share of HTM households in the model (α), since they spend all income in the same period in which they receive it. In the empirical literature finds that about 1/4 of transfers and transitory income shocks are spent in the quarter in which they are received (Kaplan and Violante, 2014; Whalen and Reichling, 2015; Commault, 2022). Parker et al. (2022) have found short-term spending rates of close to 25% even during more recent COVID-related stimulus payments. This spending rate is not evenly distributed across consumers however. Misra and Surico (2014) find that around 20% of consumers spent the majority of their checks, with smaller spending rates for those with higher wealth and incomes.

The empirical literature on the longer-term time profile of spending transitory income shocks is limited but still informative for our calibration. Studies of lottery wins in Norway have found that about half of transitory income shocks are spent within one year, while approximately 90% of transitory income (lottery winnings) shocks are spent over 5 years (Fagereng et al., 2021), well above the initial impact found in shorter studies listed above. Colarieti et al. (2024) also find a substantial increase in spending intentions from transitory income shocks over longer periods, with an initial MPC of just 0.15 in the first quarter, rising to about 0.40 after one year, while Christelis et al. (2019) find evidence of MPCs of around 40% after one year based on surveys conducted in the Netherlands. These studies provide *prima facie* evidence that realistic modeling of the effects of transitory income shocks should involve wealthier households spending a material proportion of their transfer income over time in addition to HTM households spending all of the transfer received.

2.3 Calibrating the myopia of wealthy households

In this section, the empirical estimates of the spending profiles from transitory income are translated into the behavioral equations of the model. Specifically, we calibrate the values for myopic future discounting, u, and the share of HTM households (ω) to match the spending profiles suggested by the micro literature.

In the model, the partial equilibrium effect of a one-off government transfer, $\mathcal{T}$, on consumption for wealthy households is:

$$\Delta C_W = (1-\beta(1-u))(\mathcal{T} - \sum_{\tau=0}^{\infty}((1-u)\beta)^{\tau} t(\mathcal{T})_{t+\tau})$$

Where future additional expected tax liabilities are a function of this transfer, $t(\mathcal{T})$. If this transfer is debt financed, future discounted tax revenues must be equal to the debt incurred for debt to remain stable in the long-run:

$$\mathcal{T} = \sum_{\tau=0}^{\infty} Q_{t+\tau} T_{t+\tau}$$

On the basis that the government follows the above-described fiscal rule where taxes are levied in proportion to the deviation of debt from its desired level, $T_t - T_{ss} = \phi_b(B_t - B_{ss})$ (assuming constant output), the sequence of tax payments for incurring additional debt to pay for transfers $\mathcal{T}$ would be:

$$\sum_{\tau=0}^{\infty} t(\mathcal{T})_{t+\tau} = \phi_b \mathcal{T} \sum_{\tau=0}^{\infty} (1-\phi_b)^{\tau} \frac{1}{Q_{t+\tau}}$$

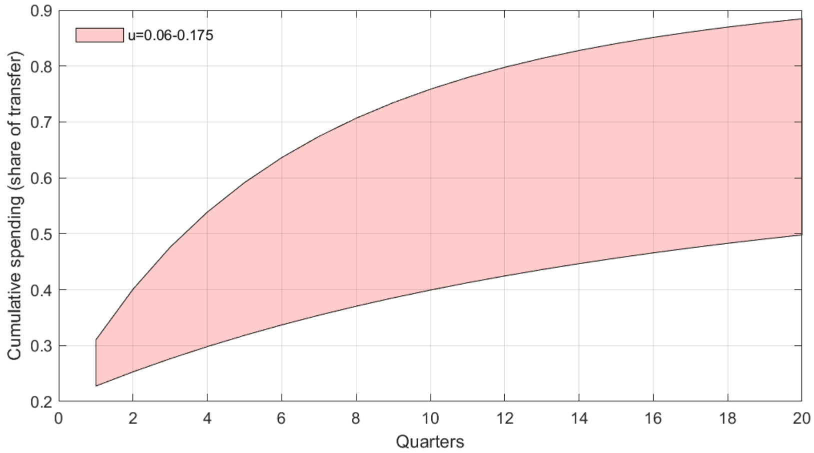
Substituting this into the consumption function in place of taxes, it is clear that the fiscal rule will play an important role in determining the degree to which transfers are spent when accounting for (myopically) discounted future expected tax liabilities. Therefore, for this specification of the tax rule, the impact multiplier for consumption spending as a proportion of the transfer is:

$$\underbrace{(1-\beta(1-u))(1-\frac{\phi}{1-(1-\phi)(1-u)})}_{\text{Impact coefficient, } \mu_0}\mathcal{T}$$

In the next period, households will have $(1-\mu_0)$ remaining of their initial transfer, but also earn interest and pay tax, while the outstanding balance of debt will decrease.

To match the spending profiles identified in the empirical literature, we must choose u in combination with ω. We assume that the share of HTM households, ω, is 0.2 in our baseline specification. Since these households spend all income immediately, in combination with the smaller initial spending profile of wealthy households, this will provide an initial impact multiplier of about 1/4-1/3 from a transitory income shock. This aligns well with the large body of empirical evidence supporting such estimates.

Figure 1: Implied cumulative spending under different values for u



Note: Proportion of transfer payment that is spent over time by HTM households (100% spent instantly) and wealthy households who dissave according to the myopia parameter u

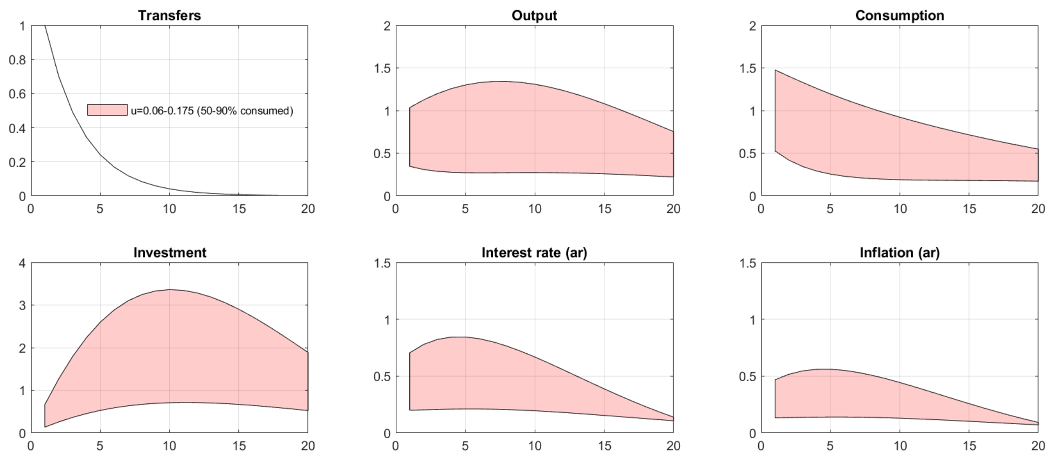
We assume a range of $u = 0.06 - 0.175$ in the IRFs and simulations that follow in the paper. This implies that wealthy households will spend about 3-14% of a windfall in the initial quarter in which it is received (impact coefficient μ described above). In combination with the choice of $\omega = 0.2$, the model suggests that at the top end of the range ($u = 0.175$), about 90% of the transfer receipt is spent over 5 years, in line with (Fagereng et al., 2021). For robustness, lower degrees of myopia such that only half of transfers are spent over 5 years ($u = 0.06$) are shown (Figure 1). This lower bound is a plausible alternative given micro-based empirical evidence that about 50% of households show little detectable change in spending following the receipt of transfers (see for example Misra and Surico (2014) and Kaplan and Violante (2014)). This range for u encompasses value of cognitive discounting used by Gabaix (2020) (0.15) and u used by Angeletos et al. (2024) (0.13). SVAR evidence on the general equilibrium effects of fiscal stimulus will later show that this range for u produces plausible IRFs.

2.4 Baseline response to a transfer shock

In response to a fiscal transfer shock, initially amounting to 1% of GDP and decaying at rate 0.7, output rises persistently, remaining above zero even at the 5 year (20-quarter) horizon (Figure

2). At the top of the range of myopic discounting factors, $u = 0.175$, the short term response of output is close to the size of the transfer shock as a share of GDP, even though the partial equilibrium MPC is just 1/3. The immediate impact multiplier from the case $u = 0.06$ is much smaller, at just 0.4. While this multiplier is closer to the empirically estimated multipliers from the micro econometric literature and standard DSGE models (for example, see Whalen and Reichling (2015); Ramey (2019)), this model produces much more persistent output effects.

Figure 2: Impulse response to a transfer shock



Note: Percent deviation from steady state following a fiscal transfer shock to HTM and wealthy households that is initially equivalent to 1% of output. Interest and inflation deviation is provided at annualized rates and is percentage point units rather than percent deviations.

3 Estimated multipliers and relation to the SVAR literature

In this section, we benchmark our model-produced IRFs for the impact of a fiscal transfer shock to the recent SVAR literature on the effects of tax cuts. Frequently, the literature uses point estimates of the ratio of the response of output at its peak to the size of spending on impact to establish fiscal multipliers, although this method can be misleading (Ramey, 2019). In particular, our peak response of GDP is at most a little above one, but the impact is highly persistent. Instead, multipliers are shown as calculated by the method of Mountford and Uhlig (2009), which uses the net present value (NPV) of the response of output to the net present value of the fiscal stimulus provided, represented as: $-\left(\frac{\sum_{t=0}^{T} \beta^t (\frac{Y_t}{Y_{ss}} - 1)}{\sum_{t=0}^{T} \beta^t (\frac{\mathcal{T}_t}{Y_{ss}} - \frac{\mathcal{T}_{ss}}{Y_{ss}})}\right)$, where $\mathcal{T}$ reflects the fiscal cost of the stimulus.

The recent literature has found substantial fiscal multipliers for the output effects of tax cuts in research conducted since the global financial crisis. Most of this literature uses narrative-restrictions to identify exogenous tax cuts, with output responses estimated using an SVAR or local projection methodology. These NPV multiplier estimates are consistently high across a range of identifications and countries (Table 2).

Table 2: Approximate 5-year tax multipliers (NPV basis for output to cost responses)

Paper	*Description*	*Tax multiplier*
Mertens and Ravn (2013, 2014)	US income tax - narrative restrictions	8
Mountford and Uhlig (2009)	US deficit-financed tax cut - sign restrictions	5
Alesina et al. (2018)[a]	Tax-based fiscal consolidation (OECD economies) narrative restrictions	3
Romer and Romer (2010)[b]	US general tax changes - narrative restrictions	2

[a]Calculated using figure 4's tax-based GDP IRF.
[b]Calculated using figure 6's output and tax responses

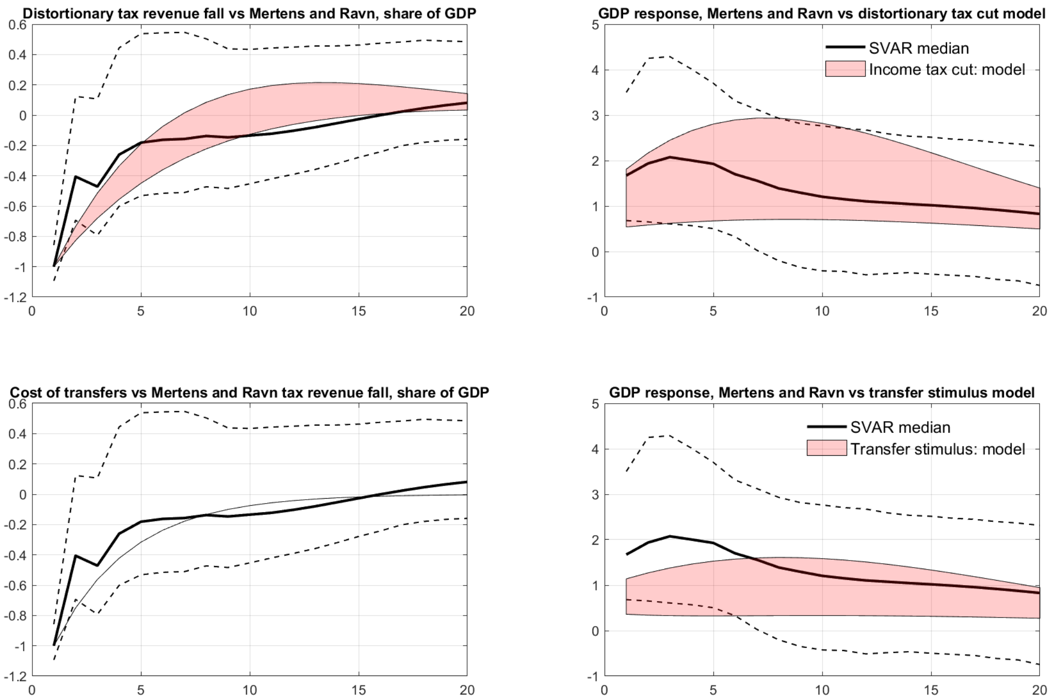
Multipliers in the tax-cut stimulus SVAR literature are much larger than those for government spending, which are found to be closer to 1 (Ramey, 2019). Given the lack of direct literature examining the impact of transfer stimulus, the tax-cut literature provides a conceptually-closer benchmark for our model than government spending. A government spending shock is likely to crowd-out consumption to some degree through its direct purchases, and only boost disposable income through second-round effects and wage and profit income of those whose goods and services are procured.

The tax-cut estimates listed in Table 2 do not focus specifically on transfers or lump-sum tax cuts (which are conceptually equivalent), but instead show multipliers for generalized tax-revenue based shocks or income tax-specific based shocks.[3] Many of these measures are likely to consist of distortionary income tax cuts. To account for the difference between these different types of tax cut, the model is modified to include a distortionary tax cut, where the incentive to supply labor is also affected by the stimulus as well as providing a boost to income (described in Annex B). Both the distortionary tax cut version of the model and the transfer stimulus are compared to the tax-cut SVAR literature. The relevant benchmark to the SVAR IRFs is the distortionary tax cut model, which can then provide insights for plausible impacts from

[3]Cloyne (2013) also finds highly persistent positive output responses to tax cuts in a narrative SVAR empirical design based on UK data. However, there are no reported tax responses to the shock for which to calculate a NPV-based multiplier. Guajardo et al. (2014) shows highly persistent output responses of over 1.5% of GDP in response to a 1% initial tax cut, but do not provide the profile of tax revenues past the second year.

non-distortionary tax cuts and transfers in the baseline model in this paper.

Figure 3: Comparison of model response to fiscal transfers or a distortionary tax cut and SVAR tax-cut IRFs



Note: SVAR median and error bands are taken from figure 2 in Mertens and Ravn (2013). IRFs from model show the range of IRFs for the transfer shock that initially reduces income tax revenues by 1% of GDP or a lump sum transfer payment shock of 1% of GDP. Red swathe shows model IRFs using $u = 0.06$ and $u = 0.175$. 95% confidence bands for the SVAR IRFs are shown.

The model based responses are consistent with the empirical estimates of personal income tax multipliers in Mertens and Ravn (2013), which focuses on income-tax based stimulus, but produces similar results to other tax-cut based papers. An advantage of the Mertens and Ravn (2013) IRFs is that they also explicitly show the impact of the tax cut on revenues, enabling a calibration of the persistence of the tax cut or transfer stimulus and NPV multiplier calculation. Mertens and Ravn (2013) find a large multiplier and highly persistent response of output to (potentially distortionary) personal income taxes (Figure 3).

For the model response to a distortionary tax cut, the value of the NPV multiplier ranges from 2.5 with the version of the model using $u = 0.06$ to 68 using the version of the model with $u = 0.175$. While the latter seems high, the IRFs for the revenue fall and output impact both generally fall within SVAR IRF confidence intervals. Given that the multipliers are highly sensitive to the revenue impacts of the tax cut (which turn positive in later periods as the tax base broadens), they cannot be ruled out. In Mountford and Uhlig (2009) for example, the cumulative revenue impact of a debt-financed tax cut is actually positive at the 5-year horizon, so that there is no fiscal cost to the stimulus.[4] The lower end of the range of model-produced multipliers closely matches the literature at the lower end of the range. In the middle of the range of discount factors used (u=0.11-0.12), the NPV multiplier is very close to the multiplier in Mertens and Ravn (2013), ranging between 8-11. The non-distortionary version of the model, which is applicable to fiscal transfer stimulus, also produces a highly persistent output response but a smaller 5-year NPV multiplier of 1.5-6.7 for the range of discount factors used.

Overall, the implied range of myopic discounting and time profile of spending from the microdata literature appears broadly consistent with the general equilibrium effects in the SVAR literature. However, the general equilibrium effects suggest that the very high MPCs found in Fagereng et al. (2021) are towards the top of the range of plausible general equiblrium outturns as judged by implied NPV multipliers and the IRF confidence intervals.

A second important reference for the model relative to the empirical literature is the response of investment. As shown in the previous section with the benchmark model IRFs, investment responds positively to transfer stimulus, in contrast to other models where investment is "crowded-out" by fiscal stimulus (such as Gali et al. (2007)). The model's positive response is consistent with the SVAR literature, where several papers also find a large and positive response of residential and non-residential investment to personal income tax cuts (Mertens and Ravn, 2013; Cloyne, 2013).

In summary, while the micro-based empirical literature provides loose guidance for spending from transitory income shocks such as fiscal transfers, the empirical general equilibrium macroeconomic evidence also supports the model calibration range. High rates of dissaving are required in a New Keynesian framework to generate the persistent response of output to tax shocks found in the SVAR literature. In the following section, we note that while the myopia applied to wealthy households is key to generating this persistence, several other standard features of the model are also important in generating the scale of second round effects required to replicate the empirical tax multipliers.

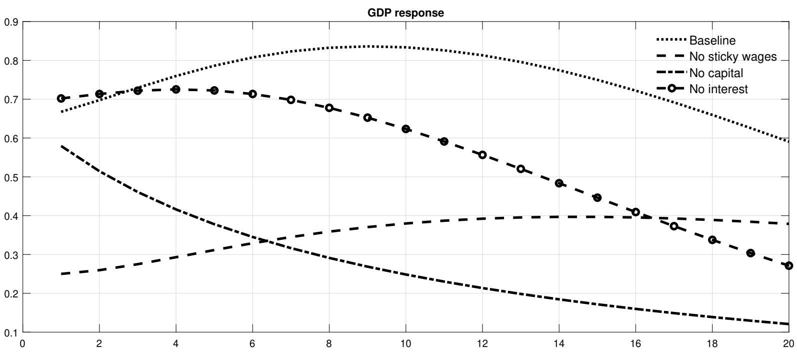
[4] This result is not found in our model, where the cumulative revenue fall from the tax cuts is negative throughout.

4 The importance of sticky wages, capital, and interest payments in generating large and persistent multipliers

In order to generate the scale and persistence of the output response suggested by the SVAR literature for tax stimulus, several features are required beyond the standard baseline labor-only New Keynesian model. In particular, sticky wages and the presence of investment and capital are important in significantly raising the multiplier on the response to a 1% of GDP transfer shock (Figure 4). In addition, the wealth effect of higher household interest receipts in response to the endogenous reaction of interest rates is key.

Staggered wage resetting allows for a substantially larger labor quantity adjustment in response to spending stimulus than would otherwise exist. To some extent, this can also be implemented by using a very low value for χ, the inverse elasticity of labor supply, such that labor quantities can rise without a large increase real wages and firm marginal costs. The markup on wages driven by the union supply of labor allows an elastic response of labor supply even where real wages change very little. Other papers have found wage stickiness to be important mechanisms to amplify monetary policy and fiscal shocks (Christiano et al., 2005; Drautzburg and Uhlig, 2015). The rapid expansion of hours worked in response to higher consumer spending in turn amplifies the increase in wage income and second-round spending.

Figure 4: Importance of sticky wages, capital, and interest payments to generate persistent IRFs from transfer shock



Note: IRFs show the response to a 1% of GDP transfer payment shock in the full baseline model, and separate variants where there is no capital in the model, wages are fully flexible, and where wealthy households are taxed on all of their government bond interest earnings (no interest). All variants shown use $u = 0.12$.

Second, the presence of capital provides an additional multiplier enhancement, with the response of investment to the long-lasting increase in consumption spending (and demand for the products of capital) in turn spurring production, wage, and capital income.

Finally, interest income received on wealth enhances the multiplier effect of transfers over the longer-horizon. Specifically, the Taylor-based monetary policy rule results in an increase in interest rates following the fiscal transfer as inflation rises. While this induces lower consumption through the inter-temporal substitution effect, it also increases the wealthy households' holdings of government debt due to higher real interest returns. The higher interest earnings apply not only to fiscal transfers received but also to households' steady state government debt holdings. In our calibration, we assume a steady state level of government debt equal to steady state output (a 100% debt-to-GDP ratio). As detailed later, in the presence of myopia, high debt and a weak fiscal rule make monetary policy less contractionary due to the wealth effect from higher interest payments.

This can be seen in the linearized wealthy household consumption function

$$c_{w,t} = \frac{\beta}{1-\omega}\frac{B_{ss}}{C_{ss}}(1-\beta(1-u))(b_{t-1}+r_{t-1}) + (1-\beta(1-u))\sum_{\tau=0}^{\infty}((1-u)\beta)^{\tau}(-\frac{1}{\sigma}r_{t+\tau}+y_{t+\tau}-t_{t+\tau})$$

Wealth increases in response to higher interest rates, with the immediate impact equivalent to the ratio of steady state government debt to consumption (offset by higher discounted future tax liabilities). In addition, this effect accumulates where interest rates are persistently higher, as interest payments compound. In the standard framework without myopic discounting, the wealth effect of higher interest receipts would be fully offset by higher future tax liabilities, since the interest receipts add to the national debt.

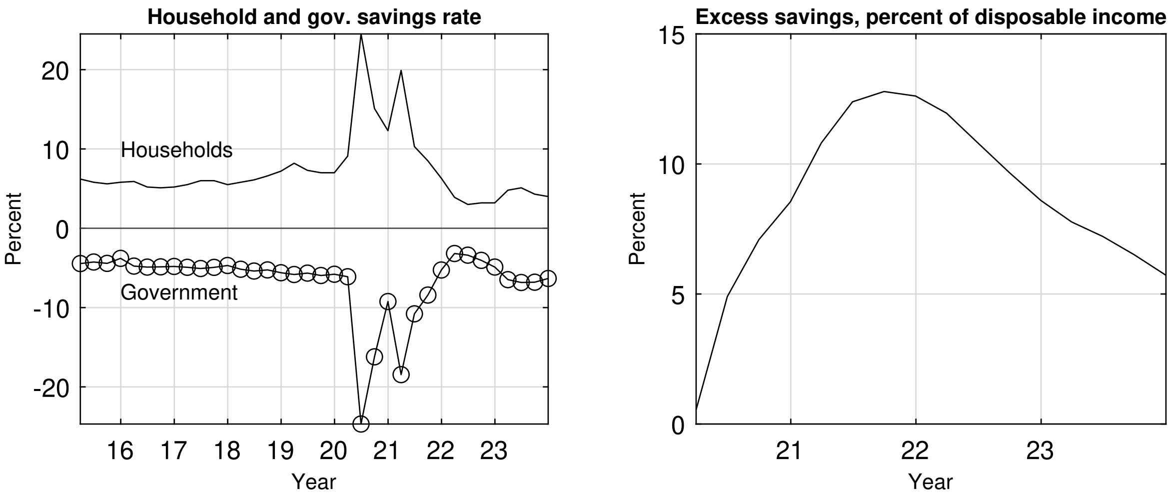
To demonstrate the importance of the wealth effect channel from higher interest rates, a counterfactual IRF is simulated in the case where government taxes are increased to recover all interest payments in each period. It is assumed that although wealthy households no longer earn interest on government debt (after tax), they are able to borrow and lend to one another at the policy interest rate (with net zero debt), so that the policy interest rate continues to influence inter-temporal spending decisions. The IRF is substantially less persistent when eliminating this wealth channel from higher interest rates, as households accumulate smaller total asset holdings without interest receipts.

5 Simulating the effects of the pandemic transfers on output

The above findings on the persistence and scale of the output response to transfers and tax cuts are informative for considering the broader macroeconomic effects of fiscal support during the COVID-19 pandemic. Households in the United States built up a substantial pool of assets during the pandemic, often referred to as 'excess savings'. These amounted to about 10% of household income at their peak, calculated as the cumulative difference in household savings relative to a counterfactual where the household savings rate remained at its pre-COVID (2016-19) average.

A range of factors supported the accumulation of financial assets during the pandemic. First, direct transfers from the federal government were provided to a wide range of households. These included Paycheck Protection Program (PPP) loans to support employment, economic impact payments (EIP) to send cash directly to households, and a range of income support measures including child tax credits, expanded healthcare subsidies, and food aid. In addition, households saved a substantially larger fraction of their income than normal due to legal and voluntary social distancing restrictions on consumption. The result was a substantial accumulation of 'excess savings' (Aladangady et al., 2022). The counterpart to this accumulation was, directly and indirectly, government spending that substantially exceeded revenues (Figure 5).

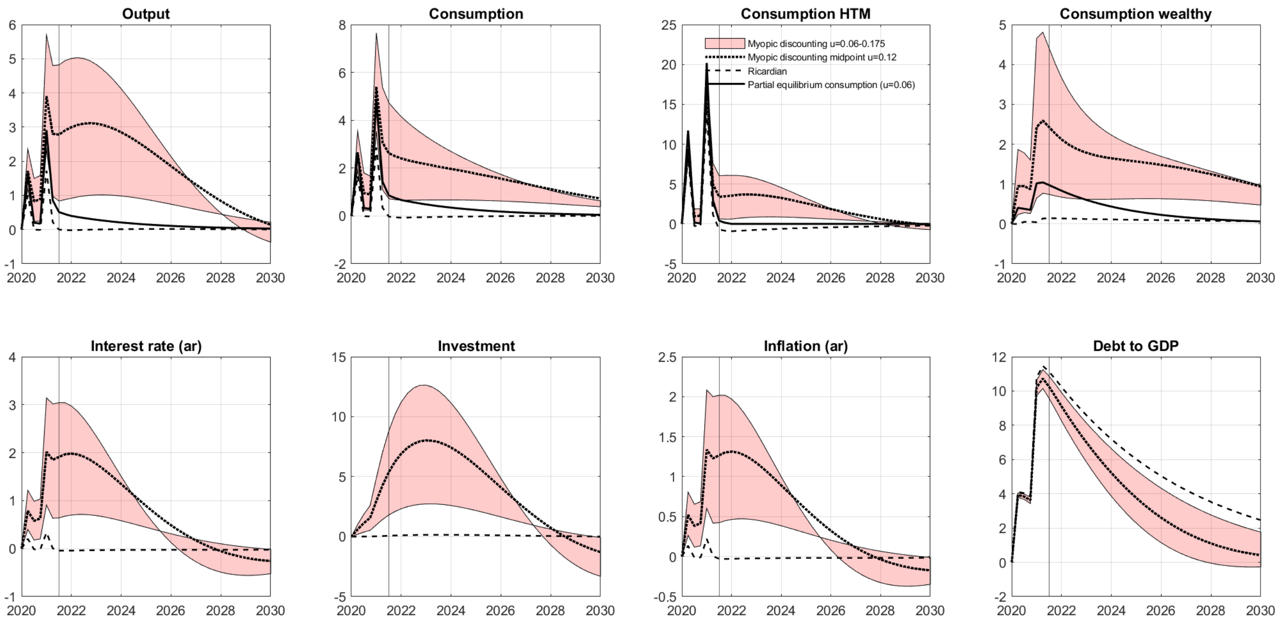
Figure 5: Excess savings developments and government counterpart



Note: Excess savings are calculated as a counterfactual, where the counterfactual assesses cumulative savings from 2020-Q1 to 2023-Q4 if the savings rate remained constant at its 2016-2019 average rate.

In the analysis presented here, only the EIP fiscal transfers that were sent out in 2020 and 2021 are simulated. In total, these amounted to \$850bn, or about 4% of US GDP (2019 levels). These payments were substantially larger than cash transfers paid out during the 2008 financial crisis, which only amounted to about \$100bn. The COVID-era transfer payments are simulated as a series of unanticipated shocks, the size of which are calculated using Bureau of Economic Analysis data on the quarterly profile of payments between 2020Q1-2021Q4 as a share of potential GDP (had it continued to grow at a rate of 2% instead of the sharp COVID-related contraction in 2020, avoiding distortions to the size of the shock driven by the temporary lockdowns and output collapse in the early stages of the pandemic).

Figure 6: Partial and general equilibrium impact of EIP payment transfer stimulus during the pandemic



Note: Simulations of the cumulative effects of economic impact payments in the model with myopia (myopic discounting, for $u = 0.06 - 0.175$), the non-general equilibrium effects on household consumption only with myopia (first round only effect on consumption from the transfers for $u = 0.06$), and the standard Ricardian TANK model where fiscal transfers are not spent except by hand-to-mouth households. Vertical line signals the end of major EIP disbursements after 2021 Q2 (very small payments made in Q3-4 also accounted for). Results are shows as deviations from the model steady state.

Figure 6 shows three separate versions of the impacts generated by the EIP payments. In each case, the chart shows the effects as deviations from steady state to demonstrate marginal effects rather than absolute paths of each variable. 1) The consumption spending by HTM and myopic wealthy households without accounting for any endogenous impacts of the spending (partial equilibirum consumption impact only). 2) the full general equilibrium model-based effects of the spending if wealthy households were fully Ricardian, as in the standard New Keynesian framework without myopia. 3) and finally, the general equilibrium effects of the transfers if the wealthy households were myopic households, calibrated in the preceding analysis for $u = 0.06$ and 0.175 shown as a range, also showing a midpoint calibration at $u = 0.12$.

It is clear that in the standard New Keynesian framework with HTM households and *Ricardian* wealthy households, the effect of these transfers is very short lived, with spending only materially increasing for HTM households and then drastically slowing. However, the transfers have much more material and prolonged effects once myopia is introduced. This is in part due to the first round effects of dissaving by the myopic wealthy households and immediate spending by HTM households. The pure partial equilibrium consumption effects, calculated as in Section 2.3, account for the tendency for households to dissave from transitory income gains over time, without accounting for general equilibrium effects on income, interest rates and inflation. The general equilibrium impacts are substantial and larger than the partial equilibrium impacts: investment rises sharply in response to persistent consumer spending increases, and HTM and wealthy households receive higher incomes, further amplifying spending. Finally, the endogenous monetary response of interest rates add to the assets of wealthy households, further stimulating consumption as the intertemporal substitution channel of higher interest rates becomes smaller as interest rates fall. However, initially, wealthy households actually consume less in general equilibrium than the partial equilibirum impact of the receipt of the transfer (the solid partial equilibrium line lies above the lower bound of the red general equilibrium swathe). This is because the immediate impact of the inter-temporal substitution effect from higher interest rates reduces the desire to spend.

The general equilibrium impacts on output and inflation are large and highly persistent for the entire plausible range of myopic discounting factors. The midpoint simulation, $u = 0.12$, shows output rising persistently above baseline by three percentage points for several years, fading only by 2030. Inflation is also persistently higher, rising by about 1 1/4 percentage points above baseline early in the simulation and only beginning to decline in 2024. These effects are in sharp contrast to the Ricardian model, where inflation is little changed except at the time of the EIP payment disbursements. While the Philips curve slope of about 0.08 used in the baseline model is within a plausible range (McLeay and Tenreyro, 2020; Schorfheide, 2008), the results are nonetheless sensitive to this parameterization. Choosing $\theta = 0.9$ and therefore $\kappa \approx 0.01$ lowers the average annualized inflation impact during 2021-2023 from 1.2 percentage points in the baseline calibration to 0.75 percentage points. Inflation remains about half a percentage point higher in 2024 even with the shallower curve.

Finally, it is worth noting that the IRFs from the model using the mid-point calibration for u, $u = 0.12$, does not always fall within the swathe encompassing the outer ranges of the myopic discounting assumptions (red swathe). This is because at the top of the range, dissaving progresses rapidly, but then slows sharply as households deplete their accumulated assets. At the midpoint of the myopic discounting assumption, consumption slows less rapidly given the slower drawdown of excess assets.

6 A final note on monetary policy transmission with myopia and high debt

It was earlier noted that the endogenous reaction of interest rates to fiscal transfer stimulus makes the output response more persistent due to the wealth effect from higher interest receipts. In this section, it is shown that by this same principle, monetary policy shocks are less contractionary in the presence of myopia due to the wealth effect they induce. The degree to which myopia affects monetary policy transmission depends on the initial level of debt to output and the fiscal rule.

Higher interest payments from the government to households could offset some of the contractionary effects of monetary policy that result from the inter-temporal substitution channel. The channel is amplified where households hold an elevated stock of debt, as government payments will be higher relative to output for a given rise in interest rates. As our wealthy households discount future tax liabilities heavily in the baseline calibration, a fiscal rule which delays paying down elevated debt will encourage households to spend a larger proportion of interest receipts.

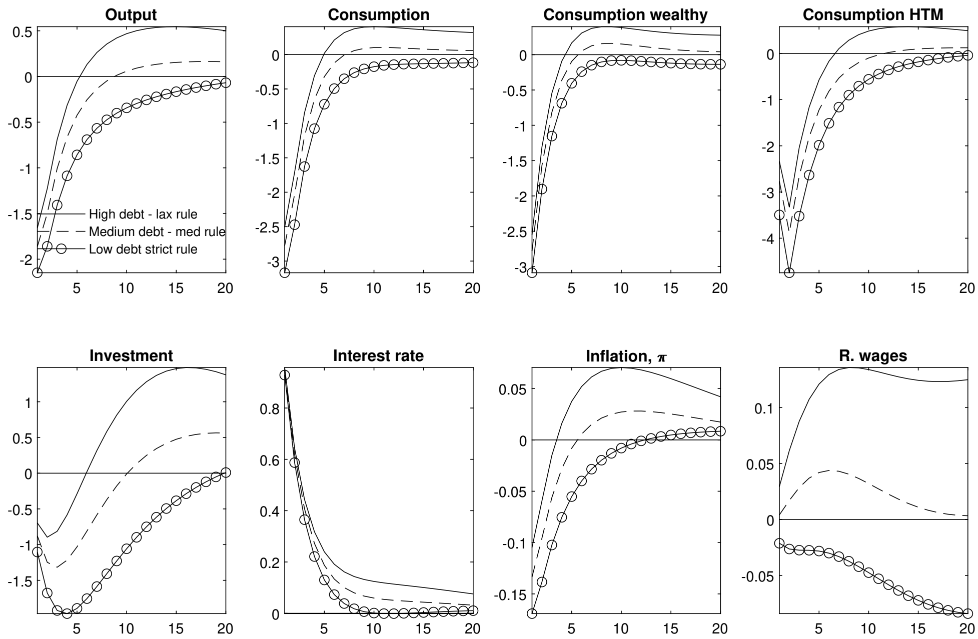
The model is currently missing any net debtors other than the government, and therefore a key transmission channel for monetary policy tightening is absent. Therefore, a small adjustment is made to the model so that HTM households are also credit-constrained net debtors, with wealthy households owning this debt. HTM households pay the central bank policy rate of interest on this debt, and their credit constraint, Ψ, is a hard limit so that current period borrowing (b^H) and the real interest burden cannot exceed a threshold:

$$\frac{R_t b_t^H}{\omega} \leq \Psi \pi_{t+1}$$

This threshold is binding (consider a discount rate for the HTM household that is lower than the rate for the wealthy households), such that HTM households will maintain debt at this level in each period. In this exercise, the threshold Ψ is set at 20% of GDP, roughly the average level of consumer credit outstanding in the United States according to the Flow of Funds. Mortgage debt is ignored in this simulation given its low sensitivity to interest rate changes in the United States.

Figure 7 shows the effect of different initial debt levels and fiscal rules on the transmission of contractionary monetary policy. The shock to the policy rate is one percentage point, and degrades in an autoregressive process at rate 0.5.

Figure 7: The effects of debt and the fiscal rule on the transmission of monetary policy with myopia



Note: Response to a 1 percentage point shock to the monetary policy rule. High debt, lax rule sets Debt:Output at 100% and the coefficient $\phi_b = 0.05$. Medium debt, medium rule sets Debt:Output at 75% and the coefficient $\phi_b = 0.1$. Low debt, strict rule sets Debt:Output at 50% and the coefficient $\phi_b = 0.3$. All simulations use u=0.12

The impulse response is simulated in the model for various steady states of government debt held by the wealthy households relative to output ($\frac{B_{ss}}{Y_{ss}}$). In addition, it varies the fiscal rule parameter guiding lump sum taxes as a function of the deviation of debt:GDP relative to steady state (ϕ_b). Figure 7 shows three cases: a high debt, lax fiscal rule case where debt:GDP is set to 100% and $\phi_b = 0.05$, a medium debt, medium fiscal rule case where debt:GDP is set to 75% and $\phi_b = 0.1$, and a low debt strict fiscal rule case where debt:GDP is set to 50% and $\phi_b = 0.3$. It is clear that at high levels of debt with a weak fiscal rule, higher interest rates are less contractionary and eventually somewhat stimulative as higher interest receipts and with a perception of low future discounted tax liabilities are spent by the wealthy. At lower levels of debt and with stricter fiscal rules, monetary policy functions in a more traditional manner, weighing on activity in the near and medium term.

In the calibration of the model produced in this paper, it is clear that fiscal-monetary interactions matter for the transmission of monetary policy. The effectiveness of monetary policy in influencing inflation and activity will depend to some degree on both the level of debt in the economy, and the extent to which fiscal policy reacts to higher debt generated by increasing interest payments.

7 Conclusion

In summary, we find that a New Keynesian (TANK) model with several key ingredients in addition to the standard labor-only baseline model can produce highly persistent output responses to shocks to wealth or the receipt of fiscal transfers. These ingredients are a) myopic households with realistic dissaving from accumulated wealth and transfers b) sticky wages which allow a large quantity response and subdued marginal cost response to increased demand, c) the presence of capital and investment with adjustment costs, which adds additional persistence to the output response. Overall, these features replicate VAR-based structural empirical estimates of the response of output to tax shocks that have emerged over the past decade, which find substantial multipliers. The model can also shed some light on the resilience of the US economy post-COVID during a period of rapid monetary policy tightening. The calibrated model finds a substantial and persistent output and inflationary response to the large fiscal transfers that were issued in 2020-21 in response to the COVID pandemic. This finding corresponds to the idea that consumers' large stocks of 'excess savings' built up during the pandemic from government transfers and forced saving have contributed to the resilient recovery of output and consumption in the US many years after they were received.

Finally, this paper finds that the wealth channel of interest payments is a key mechanism to generating a persistent response of transfer stimulus, as the endogenous response of interest rates compounds gains in wealth, and in turn, spending. By the same token, the wealth channel of interest rates can offset the contractionary effects of positive interest rate shocks where households are sufficiently myopic. This is particularly the case where steady state debt is high and taxes are relatively unresponsive to debt levels, and shows that fiscal-monetary policy interactions have important implications.

Appendix A Model setup

A.1 Households

There are two types of household, a hand-to-mouth (HTM) household (denoted with subscript "H") that consumes all income from their labor supply less tax liabilities in each period, and a wealthy saving agent (denoted with subscript "W"), who also supplies labor and in addition receives dividends from firm profits and returns on physical capital in each period. Both households can also receive fiscal transfer payments, $\mathcal{T}$. The wealthy agent holds net positive financial assets in the form of government debt and can inter-temporally optimize consumption as in the canonical New Keynesian framework. HTM households account for the fraction ω of all households, with wealthy households accounting for $1-\omega$.

Total consumption in the economy is the weighted sum of consumption of each type of household:

$$C_t = \omega C_{H,t} + (1-\omega)C_{W,t}$$

The HTM household's consumption is simply their post-tax wage income and transfer receipts:

$$C_{H,t} = W_t N_t - T_t + \mathcal{T}_t$$

Where N reflects hours worked, W, the real wage, and T real lump-sum taxes. Note that the wage rate and labor supply are consistent across each type of household. As will be explained shortly, labor is supplied across the two types of household by a union.

Wealthy households die with probability u in each period, but surviving households receive the assets of the dead, adding to asset returns. They discount future utility with the standard discount factor (β) and their likelihood of survival. In this framework, the lifespan of the agent is purely a motivation to induce a degree of myopia to the economic decisions of the individual. There is only one cohort of individual, rather than the OLG setup of different age groups with varying incentives to save dependent on their lifecycle stage. The wealthy household that has survived from the previous period (denoted W_s to distinguish from newly-formed households that begin with steady state holdings of capital and bonds) maximizes lifetime utility:

$$\sum_{\tau=0}^{\infty}((1-u)\beta)^{\tau}U(C_{W_s,t+\tau},N_{t+\tau})$$

Where the utility function takes the standard form:

$$U(C_{W_s},N)=\frac{C_{W_s,t}^{1-\sigma}}{1-\sigma}-\frac{N_t^{1+\chi}}{1+\chi}$$

The wealthy household budget constraint is:

$$C_{W_s,t}+B_{W_s,t}\frac{1}{1-\omega}+T_t+I_{W_s,t}\frac{1}{1-\omega}=W_tN_t+\frac{R_{t-1}}{\pi_t(1-u)}B_{W_s,t-1}\frac{1}{1-\omega}+\frac{R_t^k}{(1-u)}K_{W_s,t}\frac{1}{1-\omega}+\mathcal{T}_t-T_b-T_k$$

Here, B is real holdings of government bonds. These households earn interest R on government bonds and return R_k on capital. Households also receive additional return $1/(1-u)$ each period on their physical capital and government assets as a result of receiving transfers from estates of the dead. The variables B, K, and I are scaled by the share of wealthy households in the economy, since they also refer to variables that are relevant to the macroeconomy and production, but are owned solely by the wealthy households. We also assume that wealthy households pay a lump sum fixed tax of T_b and T_k each period to newly born households to endow them with steady state government bond holdings, as in Angeletos et al. (2024) (not featured in the above equation).

The first order conditions yield the standard Euler equation. This is because the higher discount rate of wealthy households (given their probability of death) is offset by the higher return to investing resulting from inheritance:

$$C_{W_s,t}^{-\sigma}=\beta\frac{R_t}{\pi_{t+1}}C_{W_s,t+1}^{-\sigma}$$

In order to present the household problem in a form that reflects spending out of wealth, the household problem is rewritten in the standard permanent-income and wealth form. Denoting income net of investment as $Y_{W_s,t}=W_tN_t+\frac{R_t^k}{(1-u)}K_{W_s,t}\frac{1}{1-\omega}+\mathcal{T}_t-I_t\frac{1}{1-\omega}-T_b-T_k$, the budget constraint is iterated forward to become the lifetime budget constraint:

$$\sum_{\tau=0}^{\infty}(1-u)^{\tau}Q_{t+\tau}(Y_{W_st}-C_{W_s,t}-T_t)+\frac{R_{t-1}}{(1-\omega)\Pi_t}B_{W_s,t-1}=\frac{B_{W_s,T}}{1-\omega}(1-u)^{T}Q_{t+T}$$

Where $Q_t=\frac{\Pi_t}{R_{t-1}}$, $Q_{t+1}=\frac{\Pi_{t+1}}{R_t}\frac{\Pi_t}{R_{t-1}}$ and so forth. We can re-write the budget constraint by substituting in the consumption Euler so that the lifetime budget constraint becomes

$$C_{W_s,t}\sum_{\tau=0}^{\infty}((1-u)\beta^{1/\sigma})^{\tau}(Q_{t+\tau})^{1-1/\sigma}=\frac{R_{t-1}}{(1-u)(1-\omega)\pi_t}B_{W_s,t-1}+\sum_{\tau=0}^{\infty}(1-u)^{\tau}Q_{t+\tau}(Y_{W_s,t}-T_t)$$

This is consistent with standard representations of the determinants of household consumption (permanent income and wealth representation) in other work such as Farhi and Werning (2019) and Bilbiie (2020) with the exception of the myopic discounting terms. Intuitively, present period consumption is dependent on current wealth, $\frac{R_{t-1}}{(1-u)(1-\omega)\pi_t}B_{t-1}$, and the discounted value of present and future post-tax income.

Note that in aggregate, newly born households (of mass u) will have only steady state government bonds from lump sum transfers from the rich, while households which have "survived" the previous period will own the remaining bonds. In aggregate across wealthy households, the consumption equation for wealthy households of all types will be:

$$C_{W,t}\sum_{\tau=0}^{\infty}((1-u)\beta^{1/\sigma})^{\tau}(Q_{t+\tau})^{1-1/\sigma}=\frac{R_{t-1}}{(1-\omega)\pi_t}B_{t-1}+\sum_{\tau=0}^{\infty}(1-u)^{\tau}Q_{t+\tau}(Y_t-T_t)$$

Linearizing this equation further improves intuition.

$$\frac{1}{1-\beta(1-u)}c_{w,t}=\frac{\beta}{1-\omega}\frac{B_{ss}}{C_{ss}}(b_{t-1}-q_{t-1})+\sum_{\tau=0}^{\infty}((1-u)\beta)^{\tau}(\frac{1}{\sigma}q_{t+\tau}+y_{t+\tau}-t_{t+\tau})$$

We have assumed that $C_{ss}\approx Y_{ss}-T_{ss}$, which is approximately true where wealth is sufficiently small as a share of lifetime income. This can be further simplified to:

$$c_{w,t} = \frac{\beta}{1-\omega}\frac{B_{ss}}{C_{ss}}(1-\beta(1-u))(b_{t-1}+r_{t-1}) + (1-\beta(1-u))\sum_{\tau=0}^{\infty}((1-u)\beta)^{\tau}(-\frac{1}{\sigma}r_{t+\tau}+y_{t+\tau}-t_{t+\tau})$$

Where the real interest rate, r, is substituted for $-q$. Wealthy consumers will therefore consume the fraction $(1-\beta(1-u))$ of additional wealth (scaled by its size relative to consumption), accounting for changes to discounted future net income (including higher tax liabilities). Additionally, we note the importance of interest rate developments in determining the size of wealth. Higher interest rates discourage consumption through the inter-temporal substitution effect (through the term $-\frac{1}{\sigma}r_t$), but also contribute to higher wealth through the generation of compounded real interest income. The relative importance of these channels is dependent on the parameter σ and the size of asset holdings relative to consumption and future discounting $(1-u)$.

A.2 Wage determination

As in Gali et al. (2007), both types of households collectively pool their labor via a union who negotiate their wages. Households of both types supply the same labor quantity N at the prevailing real wage, which is above their marginal rate of substitution due to a markup negotiated by the union. This provides more realistic responses of consumption to government spending and other types of shocks, and also simplifies our analysis by preventing differential labor market dynamics across consumers from interfering with our results.

In this section, we incorporate sticky price resetting, where the union supplies labor but can only reset a fraction of wages in each period. Labor is differentiated, with elasticity of demand parameter ϵ^w. Demand for an individual's labor given a particular wage is therefore:

$$N_t(i) = \left(\frac{W_t(i)}{W_t}\right)^{-\epsilon^w} N_t$$

The union maximizes newly set wages by their effect on the marginal disutility of labor supply (homogeneous across all households at N) and their effect on the average marginal utility of consumption (C). Their utility subject to the constraint that their choice of wages affects the demand for their labor.

In addition, given that labor is differentiated and also subject to stickiness with probability

θ^w in each period. Using the notation Π_{t+s} to denote $(1+\pi_{t+1})...(1+\pi_{t+s})$ gives the optimization problem for the union in setting real wages for those that reset in the present period $(w_t(i))$:

$$Max \sum_{s=0}^{\infty}((1-u)\beta\theta^w)^s \left(-\frac{N_t^{1+\chi}}{1+\chi} + \lambda_{t+s}\left(w_t(i)\Pi_{t+s}^{-1}\left(\frac{w_t(i)\Pi_{t+s}^{-1}}{w_{t+s}}\right)^{-\epsilon^w} N_{t+s}\right)\right)$$

The FOC with respect to resetting wages is:

$$w_t^{1+\epsilon^w\chi}(i) = \frac{\epsilon^w}{\epsilon^w - 1}\frac{\sum_{s=0}^{\infty}((1-u)\beta\theta^w)^s w^{\epsilon^w(1+\chi)}\Pi_{t+s}^{\epsilon(1+\chi)}N_{t+s}^{1+\chi}}{\sum_{s=0}^{\infty}((1-u)\beta\theta^w)^s \lambda_{t+s} w_{t+s}^{\epsilon^w}\Pi_{t+s}^{\epsilon^w-1}N_{t+s}}$$

The Lagrange multiplier λ reflects the weighted average of the marginal utility of consumption across households $\lambda_t = \omega C_{H,t}^{-\sigma} + (1-\omega)C_{W,t}^{-\sigma}$. All of the variables determining the optimal reset wages reflect aggregate quantities rather than anything specific to each individual household.

With $\theta^w = 0$, this optimality condition reduces to the standard flexible wage equation equalizing wages with the marginal rate of substitution between consumption and labor supply plus a markup ($w(i) = w$ as all wages are reset simultaneously).

$$w_t = \frac{\epsilon^w}{\epsilon^w - 1}\frac{N_t^{\chi}}{\lambda_t}$$

The FOC numerator and denominator from the equations with sticky price resetting can be written as:

$$x_t^1 = w_t^{\epsilon^w(1+\chi)}N_{t+s}^{1+\chi} + (1-u)\beta\theta^w(1+\pi_{t+1})^{\epsilon^w(1+\chi)}x_{t+1}^1$$

$$x_t^2 = \lambda_t w_t^{\epsilon^w} N_t + (1-u)\beta\theta^w(1+\pi_{t+1})^{\epsilon^w-1}x_{t+1}^2$$

Producing

$$w_t^{1+\epsilon^w\chi}(i) = \frac{\epsilon^w}{\epsilon^w - 1}\frac{x_t^1}{x_t^2}$$

Since the union will choose the same value $(w(i))$ for all resetting wages, the aggregate wage index:

$$w_t^{1-\epsilon^w} = \int_0^1 w_t^{1-\epsilon}(j)dj$$

Which becomes:

$$w_t^{1-\epsilon^w} = (1-\theta^w)w_t^{1-\epsilon^w}(i) + \theta_t^w(1+\pi_t)^{\epsilon^w-1}w_{t-1}^{1-\epsilon^w}$$

A.3 Investment

Wealthy households own capital and receive profits from firms as well as the rental of capital. Their budget constraint is as follows. Capital owners receive distributions from those that have died, equivalent to $1/(1-u)$ times the capital stock and return on capital each period. They also pay a fixed lump sum tax, T_k to fund newly born households with steady state capital (not shown below).

$$C_{W_s,t} + \frac{B_{W_s,t}}{1-\omega} + \frac{I_{W_s,t}}{1-\omega} = w_t N_t + \frac{\Pi_t}{(1-\omega)} + \frac{r_t^k K_{W_s,t}}{(1-u)(1-\omega)} + \frac{R_{t-1}}{\pi_t}\frac{B_{W_s,t-1}}{(1-\omega)(1-u)} + \mathcal{T}_t - T_b - T_k$$

Capital belonging to surviving wealthy households evolves according to investment and adjustment costs as follows:

$$\frac{K_{W_s,t+1}}{(1-\omega)} = \frac{I_{W_s,t}}{(1-\omega)} - \frac{\phi}{2}\left(\frac{I_{W_s,t}}{I_{t-1}} - 1\right)^2 \frac{I_{W_s,t}}{(1-\omega)} + (1-\delta)\frac{K_{W_s,t}}{(1-u)(1-\omega)}$$

Applying the lagrangian multipliers λ_t and Φ_t to the budget and capital adjustment constraints and maximizing $\sum_{t=0}^{\infty}(1-u))^t\beta^t[U_t(C_t,N_t) - \lambda_t Con_1 - \Phi_t Con_2]$, we have the following FOCs after combining with their newly formed households endowed with steady state capital and bonds:

$$\frac{\partial\mathcal{L}}{\partial K_{t+1}} : q_t = \beta\frac{\lambda_{t+1}}{\lambda_t}\left(R_{k,t+1} + (1-\delta)q_{t+1}\right)$$

$$\frac{\partial\mathcal{L}}{\partial I_t} : 1 = q_t\left(1 - \frac{\phi}{2}(\frac{I_t}{I_{t-1}})^2 - \phi(\frac{I_t}{I_{t-1}} - 1)(\frac{I_t}{I_{t-1}})\right) + (1-u)\beta\phi\left(q_{t+1}(\frac{\lambda_{t+1}}{\lambda_t})(\frac{I_{t+1}}{I_t} - 1)(\frac{I_{t+1}}{I_t})^2\right)$$

Where q is the standard "Tobin's Q", the ratio of the Lagrange multiplier on the law of motion of capital to the budget constraint Lagrange multiplier.

Among newly born households, there is no inherited capital, and the evolution of the total stock of capital evolves as:

$$K_{t+1} = I_t - \frac{\phi}{2}\left(\frac{I_t}{I_{t-1}} - 1\right)^2 I_t + (1-\delta)K_t$$

A.4 Government sector

The government borrows from wealthy households to fund government spending (G) and transfers ($\mathcal{T}$), financed through lump sum taxes (T) that are uniformly levied on all types of household. The government faces a budget constraint

$$B_t + T_t = \frac{R_{t-1}}{\pi_t} B_{t-1} + G_t + \mathcal{T}_t$$

Where B is the real stock of government debt. Government spending and assumed to be exogenously driven, while the fiscal rule takes the form ($t = T/Y$):

$$\frac{T_t}{Y_t} - \frac{T_{ss}}{Y_{ss}} = \phi_b\left(\frac{B_t}{Y_t} - \frac{B_{ss}}{Y_{ss}}\right)$$

Taxes rise in proportion to the deviation of the government debt-to-GDP ratio relative to its steady state.

A.5 Producing firms

Firm production involves the use of capital and labor. Firms maximize output subject to capital and labor costs. Capital is rented from wealthy households, who receive the capital rental cost from the firm, but also face depreciation and capital adjustment costs.

Firms maximize profits subject to a production constraint:

$$P_t(i)Y_t(i) - W_t L_t(i) - r_t^k K_t(i) - \lambda_t\left(Y_t(i) - A_t K_t^{\alpha} L_t^{1-\alpha}\right)$$

The FOCs with respect to labor and capital can be combined to show the optimal relationship between capital and labor inputs and factor costs:

$$\frac{K_t}{L_t} = \frac{\alpha}{1-\alpha}\frac{W_t}{r_t^k}$$

The real marginal cost of production is derived from the Lagrange multiplier as:

$$MC_t = \frac{(1-\alpha)^{-(1-\alpha)}\alpha^{-\alpha}w_t^{1-\alpha}r_t^{k,\alpha}}{A_t}$$

It is assumed that producing firms face a perfectly competitive market, selling their products to retailers, who package their output into goods that are sold to the government and consumers.

A.6 Retailers and final goods firms

Final goods firms produce output, Y, sold to the government, consumers and as investment goods. These firms aggregate differentiable retailers' product, who in turn aggregate production firms' output.

The final goods firm combines retailers' differentiable output as follows:

$$Y_t = \left(\int_0^1 Y_t(j)^{\frac{\epsilon-1}{\epsilon}} dj\right)^{\frac{\epsilon}{\epsilon-1}}$$

The first order conditions result in the following demand functions for retailers' varieties:

$$Y_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{-\epsilon} Y_t$$

And resulting in the following price index:

$$P_t^{1-\epsilon} = \int_0^1 P_t^{1-\epsilon}(j)dj$$

Retailers buy undifferentiated goods from producers at their marginal costs of production, but sell differentiable output to the final goods producers described above at a markup. Retailers can reset prices at frequency (1-θ), and the standard Calvo price setting condition emerges.:

$$P_{k,t}^{\#} = \frac{\epsilon}{\epsilon-1}\frac{\Sigma_{s=0}^{\infty}((1-u)\beta)^s\theta^s(C_{t+s}^{-\sigma})P_{t+s}^{\epsilon}MC_{t+s}Y_{t+s}}{\Sigma_{s=0}^{\infty}((1-u)\beta)^s\theta^s(C_{t+s}^{-\sigma})P_{t+s}^{\epsilon-1}Y_{t+s}}$$

The numerator and denominator can be rewritten:

$$P_t^{\#1} = \frac{\epsilon}{\epsilon-1}\frac{X\bar{M}C_t}{X_t}$$

Using the definitions:

$$X\bar{M}C_t = C_t^{-\sigma} P_t^{\epsilon} MC_t Y_t + (1-u)\beta\theta E\left[X\bar{M}C_{t+1}\right]$$

$$\bar{X}_t = C_t^{-\sigma} P_t^{\epsilon-1} Y_t + (1-u)\beta\theta E\left[\bar{X}_{t+1}\right]$$

Non-stationary price terms can be converted into terms for inflation by using $\frac{X\bar{M}C_t}{P^{\epsilon}} = xmc_t$ and $\frac{\bar{X}_t}{P_{k,t}^{\epsilon-1}} = x_t$:

$$x\bar{m}c_t = C_t^{-\sigma} Y_t MC_{k,t} + \beta\theta(1+\pi_{t+1})^{\epsilon} E\left[x\bar{m}c_{t+1}\right]$$

$$\bar{x}_t = C_t^{-\sigma} Y_t + \beta\theta(1+\pi_{t+1})^{\epsilon-1} E\left[\bar{x}_{t+1}\right]$$

Now, the optimal reset price term evolves as:

$$(1+\pi_t^{\#}) = \frac{\epsilon}{\epsilon-1}\frac{x\bar{m}c_t}{x_t}$$

Using the definition that $P_t^{1-\epsilon} = \int_0^1 P_t^{1-\epsilon}(j)$

$$P_t^{1-\epsilon} = (1-\theta)P_t^{\#1-\epsilon}(j) + \theta P_{t-1}^{1-\epsilon}$$

The rate of inflation can then be determined by dividing both sides of the equation by P_t:

$$1 = (1-\theta)(1+\pi_t^{\#})^{1-\epsilon} + \theta(1+\pi_t)^{\epsilon-1} \tag{1}$$

A.7 Full list of model equations

For convenience, we list all model equations below:

Household consumption and wage setting:

$$C_{W,t}\sum_{\tau=0}^{\infty}((1-u)\beta^{1/\sigma})^{\tau}(Q_{t+\tau})^{1-1/\sigma} = \frac{R_{t-1}}{(1-\omega)\pi_t}B_{t-1} + \sum_{\tau=0}^{\infty}(1-u)^{\tau}Q_{t+\tau}(Y_t^{w} - T_t + \mathcal{T}_t) \tag{2}$$

$$C_{H,t} = W_t N_t + \mathcal{T}_t - T_t \tag{3}$$

$$C_t = \omega C_{H,t} + (1-\omega) C_{W,t} \tag{4}$$

$$Y_t^w = W_t N_t + + \frac{R_t^k}{(1-u)} K_t \frac{1}{1-\omega} + \Pi_t \frac{1}{1-u} - I_t \frac{1}{1-\omega} \tag{5}$$

$$x_t^1 = \Psi w_t^{\epsilon^w(1+\chi)} N_{t+s}^{1+\chi} + \beta\theta^w (1+\pi_{t+1})^{\epsilon^w(1+\chi)} x_{t+1}^1 \tag{6}$$

$$x_t^2 = \lambda_t w_t^{\epsilon^w} N_t + \beta\theta^w (1+\pi_{t+1})^{\epsilon^w - 1} x_{t+1}^2 \tag{7}$$

$$w_t^{1+\epsilon^w \chi}(i) = \frac{\epsilon^w}{\epsilon^w - 1} \frac{x_t^1}{x_t^2} \tag{8}$$

$$w_t^{1-\epsilon^w} = (1-\theta^w) w_t^{1-\epsilon^w}(i) + \theta_t^w (1+\pi_t)^{\epsilon^w - 1} w_{t-1}^{1-\epsilon^w} \tag{9}$$

Capital accumulation and firm optimizing and pricing

$$K_{t+1} = I_t - \frac{\phi}{2} \left(\frac{I_t}{I_{t-1}} - 1 \right)^2 I_t + (1-\delta) K_t \tag{10}$$

$$q_t = \beta \frac{\lambda_{t+1}}{\lambda_t} \left(R_{k,t+1} + (1-\delta) q_{t+1} \right) \tag{11}$$

$$1 = q_t \left(1 - \frac{\phi}{2} (\frac{I_t}{I_{t-1}})^2 - \phi(\frac{I_t}{I_{t-1}} - 1)(\frac{I_t}{I_{t-1}}) \right) + (1-u)\beta\phi \left(q_{t+1} (\frac{\lambda_{t+1}}{\lambda_t})(\frac{I_{t+1}}{I_t} - 1)(\frac{I_{t+1}}{I_t})^2 \right) \tag{12}$$

$$\frac{K_t}{L_t} = \frac{\alpha}{1-\alpha} \frac{W_t}{r_t^k} \tag{13}$$

$$MC_t = \frac{(1-\alpha)^{-(1-\alpha)} \alpha^{-\alpha} w_t^{1-\alpha} r_t^{k,\alpha}}{A_t} \tag{14}$$

$$x\bar{m}c_t = C_t^{-\sigma} Y_t MC_{k,t} + \beta\theta (1+\pi_{t+1})^{\epsilon} E\left[x\bar{m}c_{t+1} \right] \tag{15}$$

$$\bar{x}_t = C_t^{-\sigma} Y_t + \beta\theta(1+\pi_{t+1})^{\epsilon-1} E\left[\bar{x}_{t+1}\right] \tag{16}$$

$$(1+\pi_t^{\#}) = \frac{\epsilon}{\epsilon-1}\frac{x\bar{m}c_t}{x_t} \tag{17}$$

$$1 = (1-\theta)(1+\pi_t^{\#})^{1-\epsilon} + \theta(1+\pi_t)^{\epsilon-1} \tag{18}$$

$$\Pi_t = (1-MC_t)Y_t \tag{19}$$

Aggregate constraints

$$Y_t = C_t + I_t + G_t \tag{20}$$

$$Y_t = A_t K_t^{\alpha} N_t^{1-\alpha} \tag{21}$$

Government and monetary policy

$$B_t + T_t = \frac{R_{t-1}}{\pi_t} B_{t-1} + G_t + \mathcal{T}_t \tag{22}$$

$$\frac{T_t}{Y_t} - \frac{T_{ss}}{Y_{ss}} = \phi_b\left(\frac{B_t}{Y_t} - \frac{B_{ss}}{Y_{ss}}\right) \tag{23}$$

$$R_t = R_{ss}\Pi_t^{\phi^{\pi}} \tag{24}$$

Appendix B Distortionary and non-distortionary taxes

In this section, we describe the difference between the current model and a setup in which the government primarily imposes taxes via a distortionary income taxes rather than a lump sum tax.

Households now face taxes at rate τ on wage income. The HTM household therefore receives $1-\tau$ of all wage income, while the wealthy household faces the same rate of taxation on wages, but is not taxed directly on returns from capital income and profits. This results in a different household budget constraint for wealthy households:

$$C_{W,t} + B_t \frac{1}{1-\omega} + T_t + I_t \frac{1}{1-\omega} = (1-\tau_t)W_t N_t + \frac{R_t^k}{(1-u)} K_t \frac{1}{1-\omega} + \frac{R_{t-1}}{\pi_t(1-u)} B_t \frac{1}{1-\omega}$$

While for HTM households the budget constraint becomes

$$C_{H,t} = (1-\tau_t)W_t N_t - T_t + \mathcal{T}_t$$

The union now faces an optimization problem where it takes into account post-income tax wage income:

$$\sum_{s=0}^{\infty} (\beta\theta^w)^s \left(-\Psi \frac{N_t^{1+\chi}}{1+\chi} + \lambda_{t+s}(1-\tau_t) \left(w_t(i) \left(\frac{w_t(i)\Pi_{t+s}^{-1}}{w_{t+s}} \right)^{-\epsilon^w} N_{t+s} \right) \right)$$

The first order condition with respect to resetting wages is:

$$w_t^{1+\epsilon^w \chi}(i) = \frac{\epsilon^w}{\epsilon^w - 1} \frac{\sum_{s=0}^{\infty} ((1-u)\beta\theta^w)^s \Psi w^{\epsilon^w(1+\chi)} N_{t+s}^{1+\chi}}{\sum_{s=0}^{\infty} ((1-u)\beta\theta^w)^s \lambda_{t+s}(1-\tau_t) w_{t+s}^{\epsilon^w} \Pi_{t+s}^{\epsilon^w - 1} N_{t+s}}$$

With $\theta^w = 0$, this reduces to the standard wage equation equalizing wages with the MRS of consumption utility and labor disutility, with a markup and adjusted for taxes.

$$w(i) = \frac{\epsilon^w}{\epsilon^w - 1} \frac{N_t^{\chi}}{(1-\tau_t)\lambda_t}$$

References

Aggarwal, R., A. Auclert, M. Rognlie, and L. Straub (2023). Excess savings and twin deficits: The transmission of fiscal stimulus in open economies. *NBER Macroeconomics Annual 37*, 325–412.

Aladangady, A., D. Cho, L. Feiveson, and E. Pinto (2022). Excess Savings during the COVID-19 Pandemic. FEDS Notes, Board of Governors of the Federal Reserve System.

Alesina, A., G. Azzalini, C. Favero, and F. Giavazzi (2018). Is it the "how" or the "when" that matters in fiscal adjustments. *IMF Economic Review 66*, 144–188.

Andrle, M., P. Blagrave, P. Espaillat, K. Honjo, B. L. Hunt, M. Kortelainen, R. Lalonde, D. Laxton, E. Mavroeidi, D. V. Muir, S. Mursula, and S. Stephen (2015). The Flexible System of Global Models: FSGM. Working Paper 2015/064, International Monetary Fund.

Angeletos, G.-M., C. Lian, and C. Wolf (2024). Can deficits finance themselves? Working Paper 31185, National Bureau of Economic Research.

Auclert, A., M. Rognlie, and L. Straub (2023, January). The trickling up of excess savings. Working Paper 30900, National Bureau of Economic Research.

Bardoczy, B., J. Sim, and A. Tischbirek (2024). The macroeconomic effects of excess saving. Working Paper 2024-062, Federal Reserve Board of Governors.

Benigno, P. and G. B. Eggertsson (2023, April). Itâs baaack: The surge in inflation in the 2020s and the return of the non-linear phillips curve. Working Paper 31197, National Bureau of Economic Research.

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

Blanchard, O. J. (1985). Debt, deficits, and finite horizons. *Journal of Political Economy 93*(2), 223–247.

Christelis, D., D. Georgarakos, T. Jappelli, L. Pistaferri, and M. van Rooij (2019). Asymmetric Consumption Effects of Transitory Income Shocks*. *The Economic Journal 129*(622), 2322–2341.

Christiano, Lawrence, J., M. Eichenbaum, and L. Evans, Charles (2005). Nominal rigidities and the dynamic effects of a shock to monetary policy. *Journal of Political Economy 113*(1), 1–45.

Cloyne, J. (2013). Discretionary Tax Changes and the Macroeconomy: New Narrative Evidence from the United Kingdom. *American Economic Review 103*(4), 1507–28.

Colarieti, R., P. Mei, and S. Stantcheva (2024). The How and Why of Household Reactions to Income Shocks. Working Paper 32191, National Bureau of Economic Research.

Commault, J. (2022). Does Consumption Respond to Transitory Shocks? Reconciling Natural Experiments and Semistructural Methods. *American Economic Journal: Macroeconomics 14*(2), 96–122.

Drautzburg, T. and H. Uhlig (2015). Fiscal stimulus and distortionary taxation. *Review of Economic Dynamics 18*(4), 894–920.

Fagereng, A., M. B. Holm, and G. J. Natvik (2021). MPC Heterogeneity and Household Balance Sheets. *American Economic Journal: Macroeconomics 13*(4), 1–54.

Farhi, E. and I. Werning (2019, November). Monetary policy, bounded rationality, and incomplete markets. *American Economic Review 109*(11), 3887–3928.

Gabaix, X. (2020). A Behavioral New Keynesian Model. *American Economic Review 110*(8), 2271–2327.

Gali, J. (2015). *Monetary Policy, Inflation, and the Business Cycle: An Introduction to the New Keynesian Framework and Its Applications*. Princeton, New Jersey: Princeton University Press.

Gali, J., J. D. Lopez-Salido, and J. Valles (2007). Understanding the effects of government spending on consumption. *Journal of the European Economic Association 5*(1), 227–270.

Guajardo, J., D. Leigh, and A. Pescatori (2014). Expansionary austerity? international evidence. *Journal of the European Economic Association 12*(4), 949–968.

Hazell, J. and S. Hobler (2024). Do Deficits Cause Inflation? A High Frequency Narrative Approach. Technical paper.

Kaplan, G. and G. L. Violante (2014). A Model of the Consumption Response to Fiscal Stimulus Payments. *Econometrica 82*(4), 1199–1239.

Laxton, D., D. V. Muir, S. Mursula, S. Stephen, and M. Kumhof (2010). The Global Integrated Monetary and Fiscal Model (GIMF) â Theoretical Structure. Working Paper 2010/034, International Monetary Fund.

McLeay, M. and S. Tenreyro (2020). Optimal inflation and the identification of the phillips curve. *NBER Macroeconomics Annual 34*, 199–255.

Mertens, K. and M. O. Ravn (2013). The Dynamic Effects of Personal and Corporate Income Tax Changes in the United States. *American Economic Review 103*(4), 1212–47.

Mertens, K. and M. O. Ravn (2014). A reconciliation of SVAR and narrative estimates of tax multipliers. *Journal of Monetary Economics 68*, S1–S19.

Misra, K. and P. Surico (2014). Consumption, Income Changes, and Heterogeneity: Evidence from Two Fiscal Stimulus Programs. *American Economic Journal: Macroeconomics 6*(4), 84–106.

Mountford, A. and H. Uhlig (2009). What are the effects of fiscal policy shocks? *Journal of Applied Econometrics 24*(6), 960–992.

Parker, J. A., J. Schild, L. Erhard, and D. Johnson (2022). Economic Impact Payments and Household Spending During the Pandemic. Working Paper 30596, National Bureau of Economic Research.

Ramey, V. A. (2019). Ten Years after the Financial Crisis: What Have We Learned from the Renaissance in Fiscal Research? *Journal of Economic Perspectives 33*(2), 89–114.

Romer, C. D. and D. H. Romer (2010). The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks. *American Economic Review 100*(3), 763–801.

Schorfheide, F. (2008). DSGE Model-Based Estimation of the New Keynesian Phillips Curve. *Economic Quarterly 94*, 397–433.

Smets, F. and R. Wouters (2007). Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach. *American Economic Review 97*(3), 586–606.

Whalen, C. and F. Reichling (2015). The Fiscal Multiplier and Economic Policy Analysis in the United States. Technical report, Congressional Budget Office.

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