How Much Does HANK Spend?
Consumption Dynamics with Lumpy Durables

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Abstract

This paper studies how the distribution of the Marginal Propensity to Spend (MPX) shapes the effectiveness of stimulus checks and interest rate cuts in a Heterogeneous-Agent New-Keynesian (HANK) model with lumpy durable consumption. The model generates an MPX distribution that exhibits an asymptotic power-law, with a non-negligible share of households displaying MPXs well above one. These households systematically amplify the response of aggregate spending to macroeconomic policy more than liquidity-constrained households. Moreover, their lumpy adjustment of durables generates state-dependent policy effects. Pent-up demand shapes the policy effectiveness in the early stages of a recession relative to later stages.

Keywords: Heterogeneous Agents, MPX Distribution, Fiscal Policy, Monetary Policy.

JEL Classification: E21, E32, E52, D30

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1 Introduction

The macroeconomy is increasingly viewed as the joint distribution of micro variables as income, wealth, and consumption across households. A growing body of empirical and structural research has demonstrated that the distribution of the Marginal Propensity to Spend (MPX) plays a central role in shaping the aggregate effects of both fiscal policy and monetary policy (Kaplan, Moll, and Violante (2018), Auclert, Rognlie, and Straub (2024), Lewis, Melcangi, and Pilossoph (2026)). The distribution of MPXs emerges as a key endogenous equilibrium object in state-of-the-art heterogeneous-agent models.[1] Importantly, the presence of durable goods has particularly important implications for this distribution, as it generates a Pareto tail of households with MPXs well above one. Accordingly, explicitly incorporating durable spending can help reconcile model predictions with the cross-sectional heterogeneity in the MPX observed in micro data (Beraja and Zorzi (2025)). Surprisingly, however, the literature lacks a systematic quantification of how these high-MPX households contribute to the transmission of fiscal policy and monetary policy. This paper provides a first step in this direction by asking how the Pareto right tail of the MPX distribution shapes the response of aggregate demand to macroeconomic policy during demand-driven recessions.

To address this question, I leverage a continuous-time Heterogeneous Agent New Keynesian (HANK) model with a smooth adjustment hazard. The model generates lumpy durable-goods purchases that can produce MPXs exceeding unity, as an increase in income may trigger durable consumption decisions, leading households to spend more than the initial income increment. I show that it is possible to link the extent of the Pareto tail of the MPX distribution to the shape of the adjustment hazard through a scale parameter. This result allows me to construct counterfactual MPX distributions that share similar central properties but differ in their right-tail behavior. Using these counterfactuals, I assess the macroeconomic role of high-MPX households.

This paper presents two main results. First, I find that these high-MPX households amplify the response of aggregate demand to a range of macroeconomic policies more than liquidity constrained households. Whereas liquidity constraints attenuate monetary policy, lumpy durable adjustment amplifies it. Second, I show that their importance extends beyond the impact effects and also shapes consumption dynamics. Lumpy durable-goods adjustments imply that aggregate demand responses are state-dependent during downturns. Intuitively, policies implemented closer to the recovery stage tend to reallocate demand over time rather than generating additional demand due to the release of pent-up demand accumulated during the downturn.

[1] For non-durables, consumption and expenditure coincide, but for durables they differ because spending happens at purchase while consumption flows over time through use. Since GDP depends on total spending rather than service flows, macroeconomic analysis focuses on the MPX instead of the Marginal Propensity to Consume (MPC). Even in models that do not explicitly separate durables and non-durables, calibration often targets aggregate spending, reinforcing the relevance of MPX.

The MPX distrbution. I begin the analysis by studying spending responses to macroeconomic policy across different MPX distributions.[2] These counterfactual distributions differ primarily in the behavior of the upper tail, which I define as encompassing all households with total MPXs greater than or equal to 100%. First, I study the impact of a $500 stimulus check distributed to all households. I find that the presence of high-MPX households can increase the response of total spending by approximately 10-30%. Second, I consider a 100 basis point interest rate cut. Models with a thicker right tail generate an increase in the response of total spending of around 15%. The amplification effects for fiscal policy are somewhat unsurprising, as by construction we are considering distributions with a larger share of households exhibiting a higher propensity to spend out of current income gains. What is perhaps more striking is the amplification of monetary policy shocks. In principle, this is not an obvious result, since higher MPXs strengthen income effects but weaken substitution effects, so that the net effect is ambiguous. Indeed, existing results in the literature generally point toward a mitigation of monetary policy effects (Aguiar, Bils, and Boar (2024)). However, higher MPXs arise through a greater role of the extensive margin of adjustment. As a result, with more adjusters, durable expenditure becomes more responsive to changes in interest rates than nondurable consumption, leading to an amplification of monetary policy effects.[3]

However, while a thicker right tail in the MPX distribution can substantially amplify the immediate impact response of aggregate spending, it does not necessarily translate into a proportionally larger cumulative effect over long horizons. This is because the same households that generate the initial surge in spending tend to exhibit lower propensities to spend in subsequent periods, leading to a partial reversal over time.

Most high-MPX households are not liquidity constrained and contribute more to the aggregate demand response than low-liquidity households. It is important to emphasize that the response of high-MPX households is still influenced by liquidity constraints. These households finance their durable purchases using their own liquid wealth, implying that in subsequent periods they move closer to their borrowing constraint. This increases their MPX in the current period. Accordingly, these results should not be interpreted as evidence that liquidity is unimportant. Rather, they highlight a deeper structural feature of models that explicitly incorporate lumpy durable purchases. The tail behavior of the MPX distribution appears to be substantially more consequential for aggregate dynamics than the share of liquidity constrained households.

[2]Initially I focus on consumption-saving decisions in isolation from the rest of the economy. This partial equilibrium approach keeps the model as simple and as transparent as possible and isolates the mechanisms driving household spending behavior. I then turn to a fully specified general equilibrium HANK model. I find that, even in general equilibrium, the effects of policy depend primarily on the direct response of aggregate spending to the policy intervention. As a result, the main mechanisms and conclusions derived in partial equilibrium continue to hold in the full general equilibrium framework.

[3]It is also worth noting that, in general equilibrium, the MPX distribution remains relevant for the response to interest rate cuts, because of indirect income effects operating via labor market outcomes.

State dependence. My second contribution concerns the effectiveness of policy interventions across different stages of the business cycle. In practice, macroeconomic stabilization policies designed to stimulate aggregate demand during demand-driven recessions are typically implemented with lags and in a staggered manner over time. In particular, monetary policy rate cuts are often deployed in successive rounds across different phases of the downturn. This feature raises an important question: whether subsequent rounds of policy implementation are more or less effective relative to earlier interventions.

To examine this question, I introduce a demand-driven recession into the model and decompose the downturn into distinct phases. The recession begins with an initial stage characterized by a contraction in aggregate demand, followed by an intermediate stage in which demand continues to decline at a constant rate. The final stage corresponds to the trough of the recession, after which a recovery phase begins. Given this path for aggregate spending, I analyze the effects of a sequence of exogenous policy interventions. First, I consider a set of unexpected fiscal stimulus payments of identical magnitude, designed to raise aggregate demand during the downturn. In parallel, I examine a sequence of unanticipated monetary policy shocks in the form of 25 basis point interest rate cuts. Each policy instrument is implemented in isolation and is repeatedly introduced across all stages of the recession, allowing for a comparison of their effects over the course of the business cycle.

I find that policy effectiveness varies systematically across stages of the recession: interventions become progressively less effective as the economy approaches the recovery phase. This state dependence is driven by a pent-up demand mechanism. In the early stage of the downturn, households optimally postpone adjustments in durable consumption in response to negative income shocks, awaiting improved economic conditions. Policy interventions implemented at this stage therefore tend to generate substantial additional demand. As the recession evolves, however, this mechanism weakens. In the late stages of the downturn, an increasing share of households begins to anticipate the durable purchases that were previously deferred. Crucially, these expenditures are financed not through current income, but through savings accumulated during the downturn. As a result, policy interventions increasingly function by bringing forward future demand rather than as a true stimulus: they shift the timing of already-planned expenditures forward rather than generating new spending. In early stages, policy primarily creates additional demand. In later stages, it predominantly reallocates existing demand across time.

These results provide a rationale for the notion of "keeping the powder dry". Implementing policy measures while the economy is in a phase where interventions are more likely to generate new additional demand rather than intertemporal substitution can yield larger aggregate effects than deploying equivalent stimulus in later stages when demand is increasingly pre-committed. This channel warrants further empirical investigation and greater attention from policymakers, given its implications for the timing and effectiveness of stabilization policy.

Literature. This paper contributes to several strands of the literature on the macroeconomic implications of micro-level household consumption behavior.

Let me begin by discussing the papers most directly related to this work. The starting point of my analysis is a continuous-time version of the model in Beraja and Zorzi (2025) of lumpy durables with random utility. In this model, the right tail of the MPX distribution is well approximated by a Pareto distribution. The large MPXs above unity are generated by the combination of non-durable consumption and lumpy durable purchases. I show that the shape of the hazard function directly governs the behavior of the right tail of the MPX distribution. I leverage this result to construct several counterfactual MPX distributions with different tail behavior and quantify their implications for the transmission of both fiscal policy and monetary policy. Closely related, McKay and Wieland (2021) and McKay and Wieland (2022), also employ quantitative models with durables to analyze macroeconomic policy. However, these papers do not study the MPX distribution and instead focus primarily on monetary policy transmission. In a recent contribution, Laibson, Maxted, and Moll (2022) derive a mapping between the MPC and the MPX in tractable continuous-time models with frictionless durable adjustment. By contrast, my approach focuses on a quantitative analysis of the MPX distribution and its macroeconomic implications within a fully-fledged general equilibrium framework.

More broadly, the second contribution of the paper relates to the literature that explicitly models consumption expenditure with lumpy durable adjustments. Traditionally, models with durables were developed to capture the fact that durable purchases are large and infrequent, that durable goods are particularly sensitive to interest rate movements, and that they can be substituted intertemporally more easily than nondurable consumption (Mankiw (1985), Caballero (1993), Eberly (1994), Ogaki and Reinhart (1998)). More recent papers, investigate the cyclicality of durable spending (Berger and Vavra (2014), Attanasio, Larkin, Ravn, and Padula (2022)), how it interacts with business cycles (Gavazza and Lanteri (2021), Beraja and Wolf (2022)), and how it affects the transmission of macroeconomic policy (Sterk and Tenreyro (2018), Partsch, Petrella, and Santoro (2026)). Relative to these papers, my second contribution is to show that pent-up demand arising from the postponement of durable expenditure alters the effectiveness of macroeconomic policies implemented during recessions. In practice, most policies, particularly interest rate cuts, are not one-off interventions but are implemented systematically over the course of a demand-driven downturn. This typically requires multiple rounds of policy action over time. In this paper, I systematically study the rollout of policy measures across different stages of a recession. This analysis reveals pronounced state-dependent policy effects, showing that the transmission of policy varies substantially across different phases of the downturn. In a similar spirit, Berger and Vavra (2015) study the overall cyclicality of durable spending and document pro-cyclical variation. The result in this paper complements their analysis by examining variations within a given economic downturn.

This paper also draws heavily on the empirical literature on durable expenditure and MPC heterogeneity. A large body of empirical work has analyzed the effects of stimulus payments from an empirical perspective and documents that durable spending represents a significant share of the total spending response to these transfers (Souleles (1999), Parker, Souleles, Johnson, and McClelland (2013), Orchard, Ramey, and Wieland (2025)). This literature provides useful estimates of plausible average effects of stimulus payments, which I use to calibrate and validate the quantitative models employed in this paper. Other papers have focused on documenting key properties and stylized facts about the distribution of MPCs and MPXs, with an emphasis on heterogeneity in consumption responses rather than average effects (Jappelli and Pistaferri (2014), Fagereng, Holm, and Natvik (2021), Boehm, Fize, and Jaravel (2025), Borusyak, Jaravel, and Spiess (2024), Lewis, Melcangi, and Pilossoph (2026)). My analysis builds directly on this body of work, which provides key empirical inputs used to discipline important moments of the MPX distribution in the model. In particular, these studies deliver detailed evidence on the cross-sectional heterogeneity in consumption responses to income changes. This information is essential to discipline the upper tail behavior of the MPX distrbution, which I show to be central to aggregate dynamics. Overall, the quantitative analysis in this paper relies on these findings to ensure that the model is broadly consistent with the micro estimates. Moreover, Gross, Notowidigdo, and Wang (2020) show that the total MPX is countercyclical. The model employed in this paper is consistent with this empirical finding. Several contributions also develop quantitative models that help rationalize some of the empirical findings on MPC and MPX heterogeneity (Kaplan and Violante (2022), Commault (2022), Aguiar, Bils, and Boar (2024), Graham and McDowall (2026)). My analysis shows that explicitly modeling durable expenditure is important to capture certain aspects of the MPX distribution, particularly for the range of the Pareto tail.

Finally, I contribute more broadly to the recent and growing HANK literature (Kaplan, Moll, and Violante (2018), Bayer, Luetticke, Pham-Dao, and Tjaden (2019), Auclert, Rognlie, and Straub (2024), Ferriere and Navarro (2025a)). I show that, in these models, the share of high-MPX households is at least as important as the share of liquidity-constrained households.

Outline. The paper is organized as follows. Section 2 presents a model with lumpy durables. Section 3 characterizes key properties of the MPX distribution and their macroeconomic implications in partial equilibrium. Section 4 discusses how durable expenditure generates state dependence in policy effects. Section 5 develops a quantitative HANK model with lumpy durables. Section 6 analyzes additional general equilibrium implications of MPX heterogeneity. Section 7 concludes.

2 A model with lumpy durables

In this section I present a heterogeneous agent model of household spending with lumpy durable adjustment. I begin by analyzing the consumption-saving problem in isolation from the rest of the economy. I leverage this model in order to study the role of the distribution of MPX for the consumption response to fiscal policy and monetary policy.

2.1 Model

Households consume non-durables $c_t \geq 0$ and durables $d_t \geq 0$. Time is continuous and there is no aggregate risk. One time period corresponds to a quarter. Households accumulate liquid wealth a_t, face idiosyncratic income risk e_t, a potentially binding borrowing limit, and incomplete markets. I consider a model with random utility and a flexible adjustment hazard that captures both time and state dependence in durable adjustment as in Beraja and Zorzi (2025). In this model households are subject to taste shocks ϵ_t. These shocks are independent over time and distributed according to a logistic with mean κ and variance η^2. This formulation generates lumpy purchases of durable goods. When a durable good depreciate and income permits a new purchase households buy a new durable good. Specifically, the sequential formulation of the household problem is given by

$$v(a_0, d_0, e_0) = \max_{c_t, \tau} \ \mathbb{E}_0 \left[\int_0^\tau e^{-\rho t} u(c_t, d_t) dt + e^{-\rho \tau} \mathbb{E}(v^*(a_\tau, d_\tau, e_\tau) - \epsilon_t) \right] \tag{1}$$

$$\text{s.t.} \quad \dot{a}_t = e_t + r_t a_t - c_t - \chi \delta d_t,$$

$$\dot{d}_t = -(1-\chi)\delta d_t,$$

$$a_t \geq \underline{a}, \quad d_t \geq \underline{d}$$

where conditional on adjusting we have the problem

$$v^*(a_t, d_t, e_t) = \max_{d'_t} v(a'_t, d'_t, e_t) \ \text{ s.t. } \ a'_t + d'_t = a_t + d_t \tag{2}$$

Equations (1), (2) fully characterize the households' decision problem. Durables depreciate at rate δ, have a maintenance cost χ, and the interest rate on liquid assets is given by r_t. The expected value of adjustment is given by $v^*(a_t, d_t, e_t) - \kappa$. For the utility function $u(c, d)$ I follow the literature and use a Cobb-Douglas functional form with non-durable parameter α. Therefore, the elasticity of substitution between durables and non-durables is equal to 1. I close the model with a lognormal Ornstein–Uhlenbeck process for earnings e_t. The Online Appendix A reports the recursive formulation of the problem and the numerical solution.

Aggregate spending and MPX. Having presented the model, I am now ready to discuss the main objects of interest to understand the response of aggregate spending to macroeconomic policy. Let μ_t denote the distribution of idiosyncratic states $(a, d, e) \in X$. Aggregate spending in this economy is given by

$$X_t = \int_X c_t(a_t, d_t, e_t) d\mu_t + \int_X \mathcal{H}_t(a_t, d_t, e_t) x_t(a_t, d_t, e_t) d\mu_t,$$

where c_t is non-durable consumption, $\mathcal{H}_t$ is the adjustment hazard reflecting the probability of adjustment between t and $t + dt$, and x_t is durable spending conditional on adjustment, i.e. the choice of $d_t' - d_t$ that solves the maximization problem in v^*. Note that this definition of durable spending is based on changes in durable stocks at the household level. In this framework, durable spending represents purchases of durable goods minus sales of those goods. Accordingly, our definition of durable expenditure aligns with the national accounts' measurement. This expression clarifies that, in the context of durable spending, I can distinguish between an extensive margin of adjustment, reflecting whether individuals choose to adjust their durable holdings $\mathcal{H}_t$, and an intensive margin of adjustment, capturing the amount they decide to spend, x_t. In the model, both margins are important to understand the response of aggregate spending to stimulus payments.

Following the literature, I define the MPX as the average spending response across individuals divided by the size of the income changes. Let $\tau > 0$ denote a one-time stimulus check and μ_t the distribution of idiosyncratic states. The marginal propensity to spend on non-durables is

$$\text{MPX}^c = \frac{1}{\tau}\left(\int_X c_t(a_t, d_t, e_t; \tau) d\mu_t - \int_X c_t(a_t, d_t, e_t) d\mu_t\right),$$

notice that for non-durables consumption and spending coincide. Hence, MPC $=$ MPX^c. Therefore, I will refer interchangeably to the marginal propensity to spend on non-durables as the marginal propensity to consume. For durable goods, spending and consumption are distinct concepts. Durables typically involve an upfront spending, while consumption reflects the flow of services that durable goods provide over time. For the purposes of aggregate demand stabilization, what ultimately matters is the total level of spending, as this is the component directly recorded as income in the national accounts. The marginal propensity to spend on durables is

$$\text{MPX}^d = \frac{1}{\tau}\left(\int_X x_t^h(a_t, d_t, e_t; \tau) d\mu_t - \int_X x_t^h(a_t, d_t, e_t) d\mu_t\right),$$

where x_t^h is the spending on durables $\mathcal{H}_t x_t$. The total MPX is given by the sum of MPC and MPX on durables, that is Total MPX $:=$ MPX^c $+$ MPX^d. The aim of this paper is to shed light on key properties of the distribution of the total MPX and their implications for policy.

2.2 Parametrization

I calibrate the model to match key features of consumer durables such as cars, appliances, furniture, and electronic devices. I exclude housing from the analysis following the definition of consumer durable spending in the national accounts. The main target are the micro estimates of MPXs by Borusyak, Jaravel, and Spiess (2024), Lewis, Melcangi, and Pilossoph (2026).

A set of parameters are calibrated externally using common values in the literature. For the preference parameters I set the CRRA coefficient $\gamma = 1$ and the discount factor $e^{-\rho} = 0.98$. The parameters describing the evolution of the households' income process are also broadly in line with the empirical estimates and values commonly used in the literature. I set the persistence of income shocks to match an annual autocorrelation $e^{-4\nu}$ of 0.9 and the variance to 0.04. I set the depreciation rate δ to 5% quarterly so that durable goods approximately loose their market value after five years and the annualized depreciation rate is around 20%. I set the annualized interest rate to 1%. The remaining parameters $\kappa, \eta, \alpha, \chi$ are internally calibrated. I set the maintenance rate χ to obtain a ratio of maintenance spending on consumer durables to household earnings of about 1%. I calibrate the non-durable parameter α to match the ratio of durable to non-durable spending between 15% and 20%.[4] The location parameter κ and the scale parameter η are calibrated to match the total MPX between 25% and 37% and the range or support of the Pareto tail of the MPX distribution given by the interval [100%,300%].

Table 1: Model parameters

Parameter	Description	Value	Source
Households			
γ	CRRA/Inverse IES	1	External
ρ	Discount rate (p.a.)	0.09	External
κ	Location parameter	1	Internally calibrated
η	Scale parameter	0.1	Internally calibrated
ν	Mean reversion coeff.	0.0263	External
σ	S. D. of innovations	0.2	External
δ	Depreciation rate	0.05	External
χ	Maintenance	0.02	Internally calibrated
α	Non-durable preference	0.78	Internally calibrated

[4] I compute these statistics from NIPA data on motor vehicle maintenance and repair, individuals personal income, and PCE on durables and non-durables (excluding housing).

Overall, the model provides a good fit of the targeted statistics. Table 2 reports the main steady-state statistics. The ratio of non-durable spending to durable spending is around 20%. The average MPX is 23% and the Pareto tail of the distribution is within the range [1,3] of empirical estimates. Maintenance costs are equal to 0.3% of household income. This is somewhat below the level observed in the data. However, since maintenance expenditure represents only a small share of household income, the baseline calibration remains a reasonable approximation. The MPX of non-durables is around 8%, while the MPX of durables is 15%. These values for the MPXs are consistent with the empirical estimates.

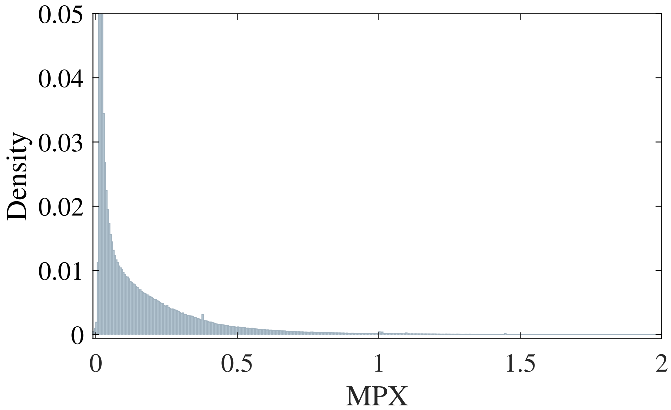


Figure 1: The distribution of MPXs.

Note: The figure shows the distribution of the spending responses to a stimulus payment of $500.

Table 2: Steady- state moments

Description	Data	Model	Description	Data	Model
Durables to non-durables ratio	15%-20%	20%	Quarterly total MPX	25%-37%	23%
Range of the Pareto tail	[1,3]	[1,3]	Non-durables MPX	10%	8%
Share with MPX ≥ 1	10%	5%	Durables MPX	15%	15%

Note: The first line in the second column of the table reports the average quarterly total MPX out of $500 for the overall population. The second and third lines report the decomposition between durables and non-durables.

Figure 1 illustrates the distribution of MPXs generated by the model. As is evident from the figure, the distribution exhibits a pronounced right-skewness characterized by a thick upper tail. As discussed in greater detail in Section 3, the behavior of this upper tail is well approximated by a Pareto distribution. Thus, the MPX distribution displays an asymptotic power-law property.

3 The distribution of MPX

In this section, I demonstrate that the model incorporating durable goods exhibits a Pareto right tail in the MPX distribution. I then leverage the model to quantify the aggregate impact of the spending decisions of high-MPX households. Specifically, I study how changes in the Pareto tail of the distribution of total MPXs affects the response of aggregate demand to fiscal policy and monetary policy.

3.1 The right tail of the distribution

Figure 2 reports the right tail of the distribution of the total MPX out of an income gain of $500 at impact. In particular, the figure plots the MPXs equal or above 1. This figure shows that the distribution of MPXs exhibit an asymptotic power-law. The log of the complementary CDF plotted against the log of MPXs displays an approximately linear relationship. Therefore, the distribution features a right tail that is well approximated by a Pareto distribution.

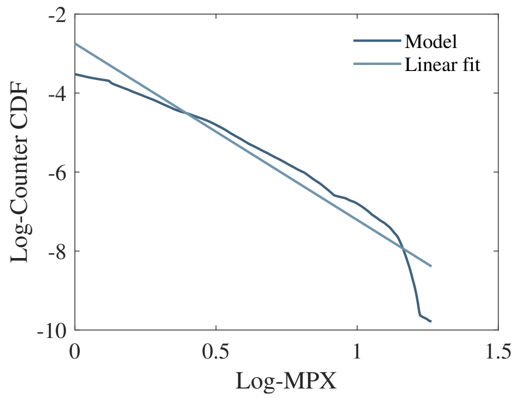


Figure 2: The right tail of the MPX distribution.

Note: The figure shows the right tail of the spending responses to a stimulus payment of $500. The tail is linear within the range of empirical estimates [1,3] and quickly decay around MPX of 300%.

The tail behavior of the MPX distribution is primarily driven by durable purchases. Because adjustments in durables are lumpy, a windfall income gain can induce some households to adjust their durable stock in addition to non-durable purchases, resulting in spending that exceeds the full amount of the stimulus payment. In the baseline calibration, around 80% of households have an MPX below 25%. The share of households with an MPX above 1 is around 5% in the model. Lewis, Melcangi, and Pilossoph (2026) find that around 11% of households consumed more than the entirety of the 2008 tax rebate. In this section, I also consider alternative parameterizations of the model that lead to a thicker tail, with a greater mass of households exhibiting MPXs well above 1.

To what extent does the thick right tail of the distribution influence aggregate spending? In order to answer to this question, I consider alternative calibrations of the scale parameter η. This parameter governs the steepness of the hazard function. As $\eta \to 0$ the model becomes a purely state-dependent with (s, S) bands, as $\eta \to \infty$ the hazard becomes flat and independent from the idiosyncratic states, as in purely time-dependent models. When the hazard function becomes smoother, durable adjustments are less lumpy, and large jumps in durable spending become less likely. As a result, the right tail of the MPX distribution contracts. Table 3 shows the implications for the MPX distribution of different calibrations of the scale parameter η. For high values of η, the Pareto tail disappears, as the share of households with MPXs above 1 becomes negligible, and the log-counter CDF exhibits greater curvature. For low values of η, the Pareto tail thickens, the share of households with high MPXs increases, and the extent of the tail expands.

Table 3: The right tail of the MPX distribution

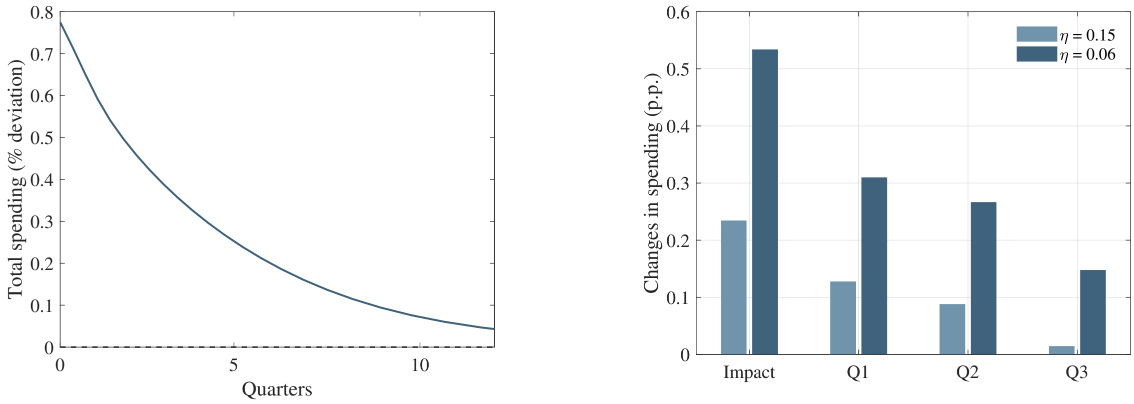
Description	$\eta = 0.15$	$\eta = 0.1$	$\eta = 0.06$
Quarterly total MPX	20%	23%	32%
Range of the Pareto tail	[1,2]	[1,3]	[1,4]
Share with MPX ≥ 1	2%	5%	8%

Note: The Table shows how the distribution of MPX changes with the scale parameter η. The first line of the table reports the average quarterly total MPX out of $500 for the overall population.

The remainder of the MPX distribution exhibits comparatively modest changes relative to the pronounced adjustments observed in the upper tail. The average MPX falls from 23% in the baseline calibration to 20% in the model with a thinner tail and increases to 32% in the model with a thicker tail. To what extent do these differences translate into differences in the aggregate spending response to macroeconomic policy? To analyze the implications of these consumption dynamics for the response of aggregate spending to fiscal policy and monetary policy, I consider two policy experiments. First, I assume that households receive stimulus payments of $500 at impact. Second, I consider an interest rate cut of 100 basis points at impact. The persistence of each policy shock is calibrated such that the shocks revert to zero within a one-year horizon. For each policy, I compare the response of aggregate spending under the three different MPX distributions. This comparison allows me to quantify the contribution of high-MPX households to aggregate spending. This experiment highlights the macroeconomic role of heterogeneity in the MPX. It underscores how differences in the tails can shape aggregate spending responses.

3.2 Stimulus checks

Figure 3 shows the response of aggregate spending X_t to stimulus payments. Panel (a) plots the response of aggregate spending in the baseline calibration with $\eta = 0.1$. Panel (b) shows the percentage-point increase in the aggregate spending response due to the presence of high MPX households in the Pareto tail of the MPX distribution.[5] Overall, the impact of high MPX households on the response of aggregate spending is significant. In particular, the spending response can increases by 0.1 percentage points up to 0.3 percentage points due to the presence of high-MPX households.[6]



(a) (b)

Figure 3: Spending responses to \$500 stimulus checks.

Note: The figure shows the response of aggregate spending to fiscal stimulus. Panel (a) presents the response of spending in the baseline calibration ($\eta = 0.1$). Panel (b) shows the percentage-point increase in the response of total spending when we move from the model with a thinner tail to the baseline case (light blue bars) and when we move from the baseline case to the model with a thicker tail (dark blue bars). Panel (b) shows the impact response and the cumulative responses from the start up to the first, second, and third quarters.

At impact, the response is larger and front-loaded in the model that includes high-MPX households. In contrast, in the models with less high-MPX households, the response of aggregate spending is weaker at impact and smoother over time. This pattern arises because high MPXs reflect adjustments in durable spending. The stimulus payments induce a series of durable goods adjustments, which lead to lower durable spending in subsequent periods. By

[5]Thus, this panel reports only the absolute magnitude of the changes in spending, without indicating their sign. As expected, the model with a thinner tail ($\eta = 0.15$) exhibits a reduction in spending relative to the baseline (negative values), whereas the model with a thicker tail ($\eta = 0.06$) shows an increase in the spending response relative to the baseline (positive values).

[6]In Online Appendix E, I conduct an additional robustness check by extending the range of the Pareto tail of the MPX distribution until the total MPX reaches the upper bound of the empirical estimates reported in Borusyak, Jaravel, and Spiess (2024). In this extreme scenario, the response of aggregate spending to stimulus checks increases by up to 0.4 percentage points.

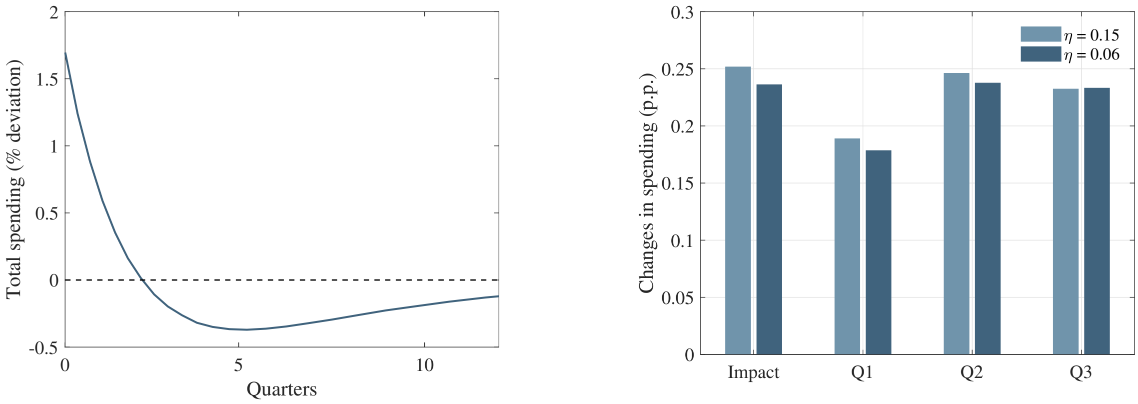
contrast, in the model with a smoother hazard function, durable spending is less lumpy, generating more smooth aggregate responses. These dynamics are clearly reflected in the cumulative change in aggregate spending, which diminishes as the time horizon lengthens. Models featuring households with high MPXs tend to generate a front-loaded spending response. As a result, spending in later periods is comparatively lower, leading to a smaller overall increase in cumulative spending over time. In other words, as the right tail of the MPX distribution thickens, the model trades off higher MPXs at impact against lower MPXs in subsequent periods.

To better understand the mechanisms underlying the response of aggregate spending, it is useful to decompose the overall effect into three components: non-durable consumption, the extensive margin of durable expenditure, and the intensive margin of durable expenditure. This decomposition clarifies how different behavioral channels contribute to the aggregate dynamics. The results indicate that the majority of the amplification arises from the extensive margin of durable spending. In particular, the share of households that adjust their durable purchases following the receipt of a stimulus payment is substantially larger in specifications featuring a thicker right tail of the MPX distribution. This pattern reflects a steeper adjustment hazard in those calibrations, implying that households are more likely to transition into an adjustment state when liquidity increases. By contrast, the response of non-durable consumption is remarkably similar across all calibrations, suggesting that heterogeneity in MPX plays a limited role along this margin. This finding is consistent with the observation that the thick right tail of the MPX distribution is primarily driven by discrete adjustments in durable goods rather than by variations in non-durable consumption. Finally, along the intensive margin, that is, the amount spent by households that do adjust, the spending response is actually larger in the model characterized by lower MPXs. This implies that differences in aggregate spending responses across calibrations are not driven by how much adjusting households spend, but rather by how many households choose to adjust. Taken together, these results highlight that a relatively small fraction of households, those at the margin of adjustment, can exert a disproportionate influence on the aggregate spending response.

Overall, these experiments suggest that the contribution of high-MPX households to aggregate spending is quantitatively meaningful. At impact, the presence of high-MPX households generates an increase in aggregate spending that lies in the range of approximately [0.1, 0.3] percentage points. This variation reflects the extent to which thicker right tails concentrate a larger mass of households with a high propensity to spend, thereby amplifying the contemporaneous effect. This amplification is also present when evaluated over a longer horizon. When cumulative spending responses are measured over the course of one year, the incremental effect attributable to high-MPX households lies in a range of roughly [0, 0.1] percentage points. This attenuation is consistent with the intertemporal reallocation of spending. A thicker right tail tend to generate front-loaded responses offset by weaker spending in later periods.

3.3 Interest rate cuts

Figure 4 shows the response of aggregate spending X_t to an interest rate cut of 100 basis points. Panel (a) plots the response of aggregate spending in the baseline calibration with $\eta = 0.1$. Panel (b) shows the percentage-point increase in the aggregate spending response due to the presence of high MPX households in the Pareto tail of the MPX distribution. Overall, the impact of high MPX households on the response of aggregate spending is significant. In particular, the spending response can increases by approximately 0.2 percentage points up to 0.25 percentage points because of the presence of high-MPX households.



(a) (b)

Figure 4: Spending responses to a 100 bp interest rate cut.

Note: The figure shows the response of aggregate spending to an expansionary monetary policy shock. Panel (a) presents the response of spending in the baseline calibration ($\eta = 0.1$). Panel (b) shows the percentage-point increase in the response of total spending when we move from the model with a thinner tail to the baseline case (light blue bars) and when we move from the baseline case to the model with a thicker tail (dark blue bars). Panel (b) shows the impact response and the cumulative responses from the start up to the first, second, and third quarters.

In this case, I also find aggregate effects similar to the ones highlighted earlier for stimulus payments. Aggregate spending is substantially front-loaded and exhibits the largest increase in the model featuring a large share of high-MPX households, relative to the alternative specification with a smoother adjustment hazard. This difference reflects the stronger immediate response of households with high MPXs, which leads to a more pronounced short-run increase in spending. Relative to the previous results for fiscal policy, the impact effects in this case are somewhat smaller when expressed as a share of the overall increase in aggregate spending. This also implies that the subsequent decline in spending is more muted, resulting in a more persistent increase in aggregate spending over the course of the year. Consistent with this interpretation, Panel (b) of Figure 4 shows that the cumulative spending response does not diminish over time. Instead, the initial increase is largely sustained throughout the horizon, indicating limited intertemporal reallocation of aggregate spending relative to the fiscal policy case. The dynamics in this case suggest a more persistent shift in the level of spending.

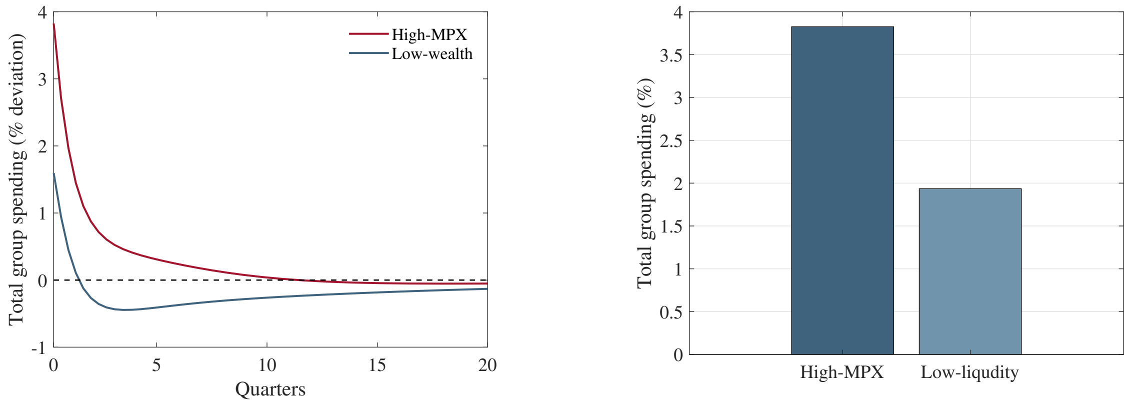
The mechanisms driving the aggregate spending response to monetary policy are broadly similar to those observed in response to stimulus payments. Across all calibrations, the response of non-durable consumption is essentially similar. This stability indicates that the main transmission channels operate through lumpy or infrequent expenditure categories rather than through smooth adjustments in non-durable consumption. As in the case of fiscal transfers, the amplification of aggregate spending is primarily driven by a stronger response along the extensive margin. In particular, the fraction of households that choose to adjust their durable stock following a monetary policy expansion is significantly higher in calibrations with a thicker right tail of the MPX distribution than in those with a thinner tail. This pattern reflects the fact that a larger mass of households is located in regions of the state space with steep adjustment probabilities, so that even moderate changes in liquidity conditions induced by monetary policy are sufficient to trigger durable purchases. The steeper adjustment hazard in these calibrations therefore translates into a higher incidence of discrete spending events at the aggregate level. Turning to the intensive margin, I find that spending conditional on adjustment tends to decline as the right tail of the MPX distribution thickens. This pattern reflects compositional effects among adjusting households: when the distribution places greater mass on high-MPX individuals, the marginal adjusters induced by monetary policy are disproportionately drawn from low-wealth regions of the state space and undertake smaller durable purchases. As a result, while the likelihood of adjustment increases, the size of each adjustment is reduced on average.

This monetary policy experiment indicates that aggregate spending increases by approximately [0.2, 0.25] percentage points both on impact and cumulatively over a one-year horizon. Taken together, these results underscore that heterogeneity in MPX is a key determinant not only of the transmission of fiscal interventions but also of the propagation of monetary policy shocks. In both contexts, aggregate dynamics are shaped less by the intensity of individual responses and more by the fraction of households that are pushed over the adjustment margin, highlighting the central role of extensive-margin responses in aggregate fluctuations.

Overall, the results of this section highlight that the MPX distribution plays a crucial role not only in determining the impact response of aggregate spending, but also in shaping its subsequent dynamic adjustment following policy interventions. When durable purchases are strongly front-loaded, the impact response of aggregate spending is large, but the amplification tends to be partially offset by weaker spending in subsequent periods. By contrast, when durable purchases are more gradually distributed over time, the immediate amplification is more muted, but the resulting increase in aggregate spending is more persistent, leading to stronger cumulative effects. Fiscal transfers tend to trigger the first type of adjustment. In contrast, changes in saving incentives induced by interest rate movements lead to the second type of adjustment.

3.4 Cross-sectional responses

Most households with high MPXs are not liquidity constrained. This raises the question of the relative importance of liquidity-constrained households compared with high-MPX households that populate the right tail of the MPX distribution. In this section, I study the relative role of the share fo liquidity constrained households and the share of high-MPX households for both fiscal stimulus checks and interest rate cuts. I define liquidity-constrained households as those holding less than \$2500 in liquid wealth, consistent with the definitions employed in the literature (Weidner, Kaplan, and Violante (2014), Kaplan and Violante (2014)). I consider the case in which $\eta = 0.06$. Among the 8% of households located in the Pareto tail of the MPX distribution, only 1% are liquidity constrained. Most households in the upper tail of the MPX distribution are middle-income households with moderate liquid wealth, not hand-to-mouth consumers. Instead, their high MPX primarily reflects a relatively low stock of durable goods and the resulting adjustment in durable expenditures.



(a) (b)

Figure 5: Spending responses to \$500 stimulus checks among different groups.

Note: Panel (a) shows the response of total spending for a broadly defined low-wealth group and the households in the Pareto tail of the MPX distribution that are not liquidity constrained. Panel (b) shows the response of total spending at impact for liquidity-constrained households and the other households in the Pareto tail.

Panel (b) in Figure 5 shows the response of liquidity constrained households and the response of high-MPX households at impact. The former group accounts for 24% of the population, whereas the latter comprises only 7% of the population. Despite these differences the latter group is substantially more responsive to policy. In terms of aggregate demand amplification, for stimulus checks high-MPX households increase aggregate demand by almost 1% versus 0.1% for liquidity constrained households, while for monetary policy they account for almost 0.1% versus 0.04% for low-liquidity households.

4 State-dependence

Stimulus payments and interest rate cuts are typically implemented during demand-driven recessions. I therefore examine how the effects of these policies evolves over the business cycle. This analysis provides insight into whether the effectiveness of these policies depends on the state of the economy, as shifts in households' consumption behavior during the recession can amplify or dampen the aggregate impact of fiscal and monetary interventions. This analysis is also useful for understanding in which stages of the recession policy measures are most effective at raising aggregate demand, particularly when the economy requires it most. Moreover, stimulus payments and interest rate cuts are often implemented in repeated policy rounds during a recession. It is therefore useful to analyze these policies sequentially.

To this end, I consider an exogenous decline in household earnings that depresses aggregate demand. Specifically, I calibrate the earnings process to generate a 4% contraction in total expenditure on impact, inducing a recession that persists for six quarters and is followed by a gradual recovery over the subsequent three years. The earnings process is governed by three parameters, which I calibrate to match these moments. For comparison, the Great Recession lasted 18 months, during which real GDP contracted cumulatively by approximately 3.5% to 4% from peak to trough.[7] I partition the recession into three stages of equal length, two quarters each. In the initial phase, aggregate expenditure falls on impact. In the intermediate phase, spending continues to decline at the same pace. In the final phase, the contraction in aggregate demand decelerates, the economy reaches the trough of the recession, and the recovery begins. Thus, the first four quarters are characterized by a full recessionary episode, while the trough is reached at the end of the sixth quarter, at which point the recovery starts.

In the main experiment of this section, I analyze separately the effects of stimulus checks and interest rate cuts implemented in repeated rounds. In particular, I assume that the government sends stimulus payments of $500 to all households and that the central bank reduces the interest rate by 25 basis points. Each policy is repeatedly implemented at three different points during the recession, specifically in quarters 2, 4, and 6. I hold the policy design fixed across implementation dates in order to ensure comparability, thereby allowing a clean assessment of how policy interventions affect aggregate demand over the course of the recession. For monetary policy, since interest rate cuts tend to raise household labor earnings through several channels, such as better employment opportunities, increased hours worked, and higher real wages, I augment the monetary policy experiment by increasing the real wage in addition to reducing the interest rate. This reinforces the income effects of monetary policy in addition to the intertemporal substitution incentives associated with lower interest rates, thereby providing a more comprehensive picture of the transmission mechanism of monetary policy.

[7] Christiano, Eichenbaum, and Trabandt (2015) provide a macroeconomic analysis of the Great Recession.

Figure 6 illustrates the path of aggregate spending in the model under the baseline calibration. Panel (a) shows that total spending declines by 4% during the recession, reaches a trough one year after the initial shock, and recovers gradually over a period of three years. Panel (b) displays the response of aggregate spending on durables and non-durables. Non-durable consumption follows a relatively smooth path and remains broadly stable throughout the recession, whereas durable expenditure exhibits a pronounced Z-shaped cycle. It declines substantially in the initial phase of the recession but rebounds rapidly and even overshoots during the subsequent recovery phase.

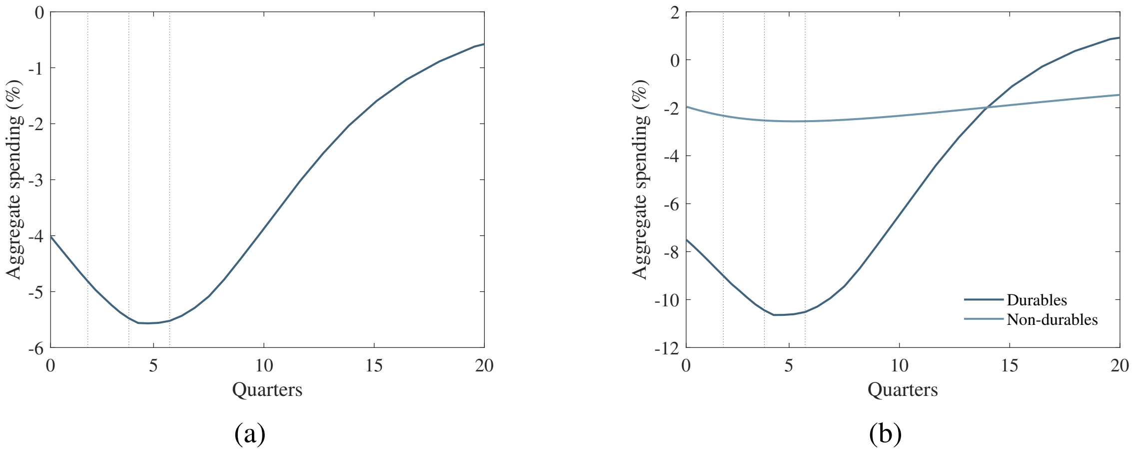
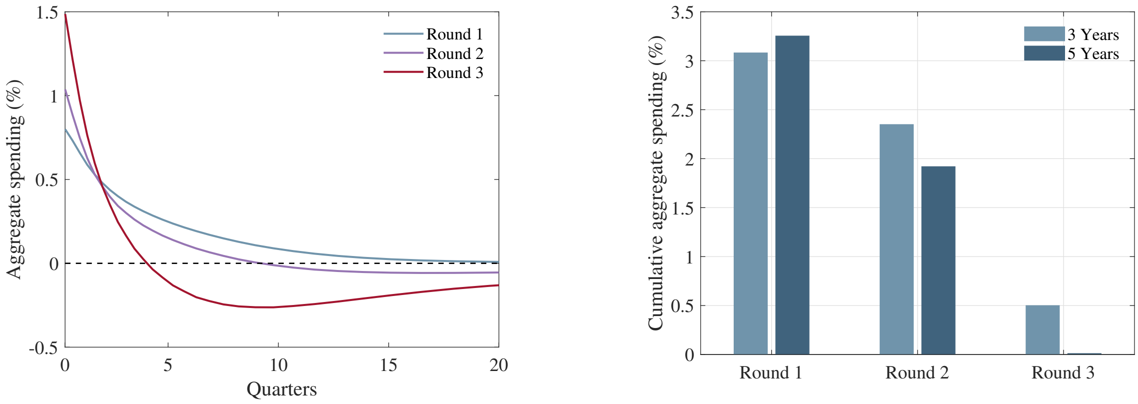


Figure 6: Spending responses to a demand-driven recession.

Note: The figure shows the response of aggregate spending to a negative income shock. Panel (a) presents the response of total spending. Panel (b) shows the response of spending on durables and non-durables.

Importantly, this Z-shaped cycle is driven by the lumpy nature of durable goods adjustments and generates state-dependence in the response of aggregate demand to macroeconomic policies. In the model, when the recession hits, households reduce their spending in response to deteriorating balance sheets and optimally postpone the purchase of durable goods. This intertemporal reallocation of expenditure generates a build-up of pent-up demand, which is subsequently released during the recovery phase as households resume durable consumption and gradually rebuild their desired stock of durables. A key implication of the model is that pent-up demand attenuates the effectiveness of both fiscal policy and monetary policy in generating additional aggregate demand in the late stages of the recession. The reason is that in the late stages households anticipate the durable purchases that would have occurred during the recovery phase, policy interventions primarily induce an intertemporal reallocation of demand rather than new spending. In other words, stimulus measures implemented in the later stages of the downturn tend to bring forward future consumption rather than increase total demand. Consequently, policy interventions are most effective in the early stages of the recession, when households respond to higher current income by raising their expenditure rather than shifting planned purchases across time.

First, I analyze the effects of fiscal policy. Figure 7 illustrates the transmission mechanism of macroeconomic policy described above by showing the response of total spending to \$500 stimulus checks implemented at different stages of the recession. Specifically, round 1 corresponds to quarter 2, round 2 corresponds to quarter 4, and round 3 corresponds to quarter 6. Panel (a) shows the response of aggregate spending over time after policy in each round. Panel (b) reports the cumulative response three years and five years after policy in each round.



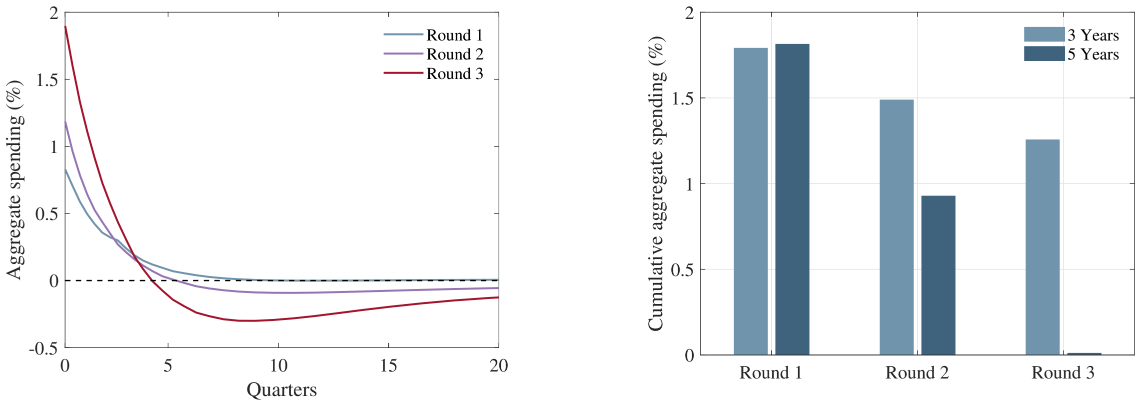
(a) (b)

Figure 7: Spending responses to \$500 stimulus checks during the recession.

Note: The figure shows the response of aggregate spending to fiscal policy. Panel (a) presents the response of spending across policy rounds. Panel (b) shows the cumulative response of spending across policy rounds.

Panel (a), shows that the impact responses tend to increase across successive rounds. This pattern is driven by a higher total MPX, which is countercyclical in the model: as the recession deepens, an increasing share of households becomes liquidity constrained. This mechanism is consistent with existing empirical evidence on the cyclical behavior of the MPX. However, the key source of state dependence lies in the fact that, as the economy approaches the end of the downturn, the responses become increasingly front-loaded. The stronger increase in spending on impact is offset by lower spending in subsequent periods, indicating a pronounced intertemporal reallocation of consumption. This effect is driven by pent-up demand for durable goods during the recovery. Panel (b) shows that the cumulative effect of stimulus checks on aggregate demand tends to decline with the stage of the downturn. As the economy approaches the later stages of the recession, the overall impact of the policy on aggregate demand weakens. This state dependence is stark and quantitatively significant. The cumulative impact of the policy can range from 3% to 0.5% depending on the state of the economy. Explicitly modelling durable adjustments alters household spending behavior and the aggregate dynamics.

Second, I turn to the effects of interest rate cuts. Figure 8 plots the response of aggregate demand to this policy in the case in which the monetary authority cuts the interest rate throughout the recession. As for fiscal policy, the timing of the policy intervention is critical for its effectiveness. Interest rate cuts implemented early in the recession can prevent spending reductions and stimulate aggregate demand far more effectively than equivalent cuts implemented in the later stages of the economic downturn. Quantitatively, however, the effects are smaller in magnitude relative to fiscal policy. The cumulative response can range from 1.7% to close to zero. This confirms the importance of durable spending, showing that it plays a crucial role not just in determining the effectiveness of fiscal policy but also in shaping the impact of monetary policy interventions. It is important to recognize that the timing of policy interventions affects not only the immediate response of aggregate spending but also its subsequent dynamics.



(a) (b)

Figure 8: Spending responses to 25 bp interest rate cuts during the recession.

Note: The figure shows the response of aggregate spending to monetary policy. Panel (a) presents the response of spending across policy rounds. Panel (b) shows the cumulative response of spending across policy rounds.

Overall, these policy experiments suggest that macroeconomic policy is most effective at generating new demand in the early stages of the recession, whereas toward its end it primarily operates by shifting the timing of aggregate demand across periods. The findings presented in this section underscore the importance of considering not just the presence of high-MPX households, but also the extent to which these households change their behavior over time depending on the evolution of the economic conditions. Lumpy adjustments of durables can critically shape the effectiveness of policy interventions over the different stages of the business cycle. In this sense, deploying stimulus too late can potentially reshuffles spending across time rather than increasing it. This provides a rationale for the idea of “keeping the powder dry”, in that preserving policy capacity until conditions are most conducive to generating new demand may be more effective than late-stage intervention.

5 General equilibrium model

In this section, I extend the analysis presented in the preceding sections to incorporate general equilibrium effects. To this end, I develop a quantitative HANK model featuring lumpy durable goods adjustment. Households are heterogeneous in their holdings of liquid assets, durable goods, and income. The supply side of the model is characterized by a standard sticky-wage Phillips curve. Monetary policy follows a Taylor rule and the government sets public spending, transfers, and income taxes. I leverage this framework to study the response of aggregate spending to stimulus payments and interest rate cuts in general equilibrium. This setup allows for a quantitative assessment of how micro-level frictions interact with endogenous movements in prices, earnings, and interest rates and translate into macroeconomic adjustment following policy interventions.

5.1 Households

The household block of the economy is almost identical to the one introduced in Section 2. The model features idiosyncratic income risk and a borrowing constraint. Households have three states: liquid assets a_t, durable goods d_t, and labor market productivity e_t. The sequential formulation of the household problem is given by

$$v_0 = \max_{c_t,\tau} \ \mathbb{E}_0\left[\int_0^\tau e^{-\rho t}(u(c_t,d_t) - v(n_t))dt + e^{-\rho\tau}\mathbb{E}(v^*(a_\tau,d_\tau,e_\tau) - \epsilon_t)\right] \tag{3}$$

$$\begin{aligned} \text{s.t.}\quad \dot{a}_t &= y_t + r_t a_t + \tau_{x,t} - c_t - \chi\delta d_t, \\ \dot{d}_t &= -(1-\chi)\delta d_t, \\ a_t &\geq \underline{a}, \ \ d_t \geq \underline{d} \end{aligned}$$

where conditional on adjusting we have the problem

$$v^*(a_t,d_t,e_t) = \max_{d'_t} v(a'_t,d'_t,e_t) \ \text{ s.t. } \ a'_t + d'_t = a_t + d_t \tag{4}$$

Equations (3), (4) fully characterize the households' decision problem. Earnings are given by workers income $y_t := (1-\tau_t)w_t e_t n_t$. The real wage is given by w_t and labor supply n_t is homogeneous and intermediated by unions. The government sets proportional income taxes with tax rate τ_t and transfers $\tau_{x,t}$. As before, I denote as μ_t the distribution of idiosyncratic states $(a,d,e) \in X$ and as f_t the associated density function. The distribution of the utility shocks ϵ_t, the stochastic process for e_t, and the functional form of households' preferences are all the same as in Section 2.

5.2 Final good producers

A representative firm produces the final consumption good using a linear production technology

$$Y_t = N_t,$$

where N_t is aggregate labor services. Marginal pricing implies $w_t = 1$. Since the goods market is perfectly competitive and nominal prices are fully flexible real marginal costs are equal to one. This implies that real wages in this model are exogenous and household earnings only respond to changes in employment levels. From this relation we see that nominal wage inflation is equal to price inflation $\pi_t^w = \pi_t$. In this economy, unions set nominal wages by maximizing the average welfare of the households, and employ all households for an equal number of hours or number of workers n_t. In particular, a competitive recruiting firm aggregates a continuum of differentiated labor services indexed by $j \in [0,1]$ solving the maximization problem

$$\max_{N_{jt}} \quad W_t N_t - \int_0^1 W_{jt} N_{jt} dj,$$

$$N_t = \left(\int_0^1 N_{jt}^{\frac{\epsilon-1}{\epsilon}} dj\right)^{\frac{\epsilon}{\epsilon-1}}.$$

where W are the nominal wages and ϵ is the elasticity of substitution across differentiated labor inputs. This implies a demand for the labor services of type j equal to $N_{jt} = (W_{jt}/W_t)^{-\epsilon} N_t$.

For each labor input j a union sets the nominal wage to maximize the average welfare of the union members, taking their marginal utility of consumption $u_c(c,d)$ and the labor disutility $v(n) := \varphi n^{1+\phi}/(1+\phi)$ as given. I also introduce nominal wage rigidities in this model. Specifically, wage adjustment is subject to a quadratic utility cost. Let C_t be aggregate consumption, D_t the aggregate stock of durables, and P_t the consumer price index. The union solves

$$\max_{\dot{W}_{jt}} \int_0^\infty \left[\exp\left(-\int_0^t r_s ds\right)\left(\int_0^1 (1-\tau_t)\frac{W_{jt}}{P_t} N_{jt} - \frac{v(N_{jt})}{u_c(C_t, D_t)} - \frac{\theta}{2}\left(\frac{\dot{W}_{jt}}{W_{jt}}\right)^2 N_t dj\right)\right] dt$$

$$\text{s.t. } N_{jt} = \left(\frac{W_{jt}}{W_t}\right)^{-\epsilon} N_t.$$

Let $\mu_w := \epsilon/(\epsilon-1)$, and $mrs_t = v'(N_t)/u_c(C_t, D_t)$. In a symmetric equilibrium with $W_{jt} = W_t$ and $N_{jt} = N_t$ I obtain a wage Phillips Curve given by

$$\pi_t\left(r_t - \frac{\dot{N}_t}{N_t}\right) = \dot{\pi}_t + \frac{\epsilon}{\theta}(mrs_t - (1-\tau_t) w_t \mu_w^{-1}).$$

5.3 Monetary policy and fiscal policy

The public sector consists of a central bank and a fiscal authority. The central bank sets nominal interest rates i_t following a Taylor rule

$$i_t = r + \phi_\pi \pi_t + v_t,$$

where v_t is a monetary policy shock. The government sets income taxes τ_t, transfers $\tau_{x,t}$, and public expenditure G_t. Public debt evolves according to the government budget constraint

$$dB_t = \left(r_t B_t + \tau_{x,t} + G_t - \tau_t \int_X w_t e_t n_t d\mu_t \right) dt.$$

Over time income taxes adjusts to stabilize public debt $\tau_t = \tau(B_t/B)^{\gamma_B}$ where γ_B captures the speed at which the government adjusts taxes to stabilize public debt.

5.4 Equilibrium

The equilibrium of the economy is given by paths for household decisions $\{c_t, a'_t, d'_t\}$, aggregate variables $\{C_t, Y_t, G_t, N_t, B_t\}$, prices $\{r_t, \pi_t\}$, monetary policy $\{v_t\}$ such that in every period: (i) households solve the utility maximization problem given equilibrium prices, (ii) unions maximize households' utility, and firms maximize profits given equilibrium prices, (iii) the sequence of density functions $\{f_t\}$ over idiosyncratic states is consistent with the household saving decisions and income risk, (iv) monetary policy follows a Taylor rule and the government budget constraint holds, and (v) financial markets and the labor market clear

$$\int_X a_t d\mu_t = B_t,$$

$$\int_X n_t e_t d\mu_t = N_t.$$

I solve the full nonlinear model globally in sequence space using the model's Jacobians as in Auclert, Bardóczy, Rognlie, and Straub (2021) and the finite difference approach of Achdou, Han, Lasry, Lions, and Moll (2022). While this general equilibrium model remains stylized, it is sufficiently rich to capture several key transmission mechanisms of macroeconomic policy to aggregate demand. In particular, unlike the analysis in the previous sections, it now allows for the endogenous response of household earnings, interest rates, and fiscal variables, such as income taxes and transfers, to policy interventions. In this setup, macroeconomic policy affects household balance sheets through all three of these transmission channels, shaping consumption, savings, and durable adjustment.

5.5 Parametrization

Having presented the general equilibrium model, I now turn to a detailed discussion of its calibration. I try to maintain the calibration strategy as close as possible to that employed in Section 2. Time is measured in quarters and the definition of durable goods includes all consumer durables but housing. A subset of parameters is calibrated externally using standard values from the literature, while the remaining parameters are determined internally. The calibration strategy pursues one key objective. The model is designed to match the distribution of total MPX documented in microeconomic studies. Table 4 reports the parameter values together with the corresponding calibration procedures.

Table 4: Model parameters

Parameter	Description	Value	Source
Households			
γ	CRRA/Inverse IES	1	External
ϕ	Frisch elasticity	2	External
φ	Labor disutility	0.7	External
ρ	Discount rate (p.a.)	0.09	External
κ	Location parameter	1	Internally calibrated
η	Scale parameter	0.1	Internally calibrated
ν	Mean reversion coeff.	0.0263	External
σ	S. D. of innovations	0.2	External
δ	Depreciation rate	0.05	External
χ	Maintenance	0.02	Internally calibrated
α	Non-durable preference	0.78	Internally calibrated
Policy			
B	Steady state government debt	2	External
τ	Labor income tax rate	0.3	External
τ_x	government transfers	0.05	External
ϕ_π	Taylor coefficient	1.25	External
γ_B	Tax adjustment coefficient	0.5	External
Firms			
ϵ	Labor elasticity	10	External
θ	Wage adjustment	{200,2000}	External

It is important to emphasize that the calibration strategy generates an MPX distribution with a thicker right tail than the baseline distribution considered in the partial-equilibrium experiments of Section 3. In general equilibrium, the right tail of the MPX distribution is therefore substantially heavier, aligning more closely with the upper range of empirically plausible distributions. In the main experiment of this section, I compare the baseline calibration with an alternative calibration that is closer to the intermediate case considered in Section 3, in which approximately 5% of households exhibit MPXs above 100%. For completeness, Online Appendix F reports the general-equilibrium responses under an alternative calibration featuring high MPXs but a thinner right tail, such that only 2% of households have MPXs above 100%.

For the preference parameters I set the CRRA coefficient $\gamma = 1$, the inverse of the Frisch elasticity of labor supply $\phi = 2$, and the discount factor $e^{-\rho} = 0.98$. The parameters describing the evolution of the households' income process are the same as in Section 2. I set the depreciation rate δ to 5% quarterly. The parameter φ, which governs the disutility of labor supply, is calibrated so that aggregate labor supply is normalized to one in equilibrium. For the New Keynesian block of the model I also calibrate most parameters externally. I set the value of the elasticity of substitution between labor inputs ϵ to match a wage markup of 11%. I choose the degree of wage stickiness θ to match a Phillips curve slope of 0.05 as the baseline and 0.005 in a low-responsiveness scenario. These values are consistent with those used in the literature for the baseline case and with the estimates of Hazell, Herreño, Nakamura, and Steinsson (2022) for the case of a flat Phillips curve. Finally, in the policy block of the model, I set the Taylor-rule coefficient on inflation, ϕ_π, to 1.25, capturing a moderate monetary policy response to inflationary pressures. The labor income tax rate τ is set to 30%, as in Wolf (2025). The adjustment parameter for labor income taxes, γ_B, is set to 0.5, implying that additional public debt is repaid only gradually over time.[8] Government transfers are calibrated to approximately 1% of GDP, close to the 2.7% reported by Kaymak, Leung, and Poschke (2026) for disability benefits and veterans benefits. The remaining parameters $B, \kappa, \eta, \alpha, \chi$ are internally calibrated to match a short-term real interest rate of 1%, the ratio of maintenance spending on consumer durables to household earnings, the ratio of durable to non-durable spending, the total MPX, and the range of the Pareto tail of the MPX distribution. The choice for B implies that the public debt-to-output ratio is 50% in the model, consistent with the historical average observed in the United States. One could consider alternative calibrations that incorporate a broader set of liquid assets or higher levels of household wealth. However, doing so would tend to reduce the average MPX as well as compress the Pareto tail of its distribution. Another extension would be to include housing within the stock of durable assets and treat it as part of household wealth. Exploring these specifications is left for future work, as it lies beyond the scope of the present paper.

[8] Under this parameterization, the additional public debt generated by the fiscal shock is fully repaid after more than five years. I experimented with alternative parameter values, and the results remain quantitatively similar.

Table 5 reports both targeted and untargeted moments used in the model's calibration. Overall, the model provides a good fit to the targeted statistics. It successfully matches the ratio of durable to non-durable spending, as well as key features of the MPX distribution. In particular, the model generates a high average MPX and a long Pareto tail in the MPX distribution, as illustrated in Figure 9. As noted in the previous sections, this tail behavior is driven by durable purchases. The model can also match the short term interest rate.

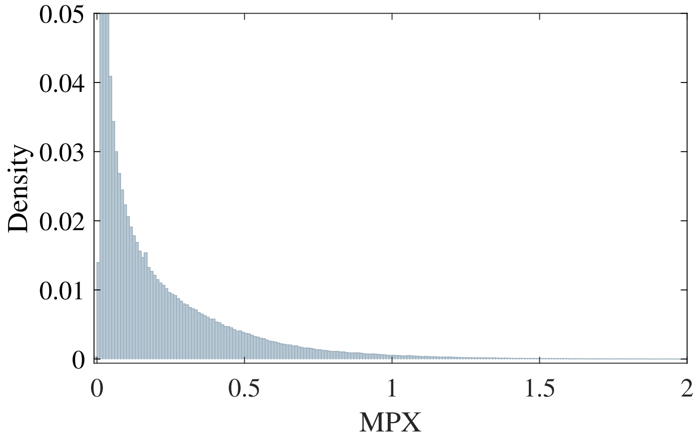


Figure 9: The distribution of MPXs in general equilibrium.

Note: The figure shows the distribution of the spending responses to a stimulus payment of $500.

Table 5: Steady- state moments

Description	Data	Model	Description	Data	Model
Real rate (p.a.)	1%	1%	Quarterly MPX	25%-37%	28%
Durables to non-durables ratio	15%-20%	19%	Range Pareto tail	[1,3]	[1,4]
Maintenace costs	1%	0.25%	Share with MPX ≥ 1	10%	8%

Note: The first line in the second column of the table reports the average quarterly MPX out of $500 for the overall population. Maintenace costs are measured relative to average earnings.

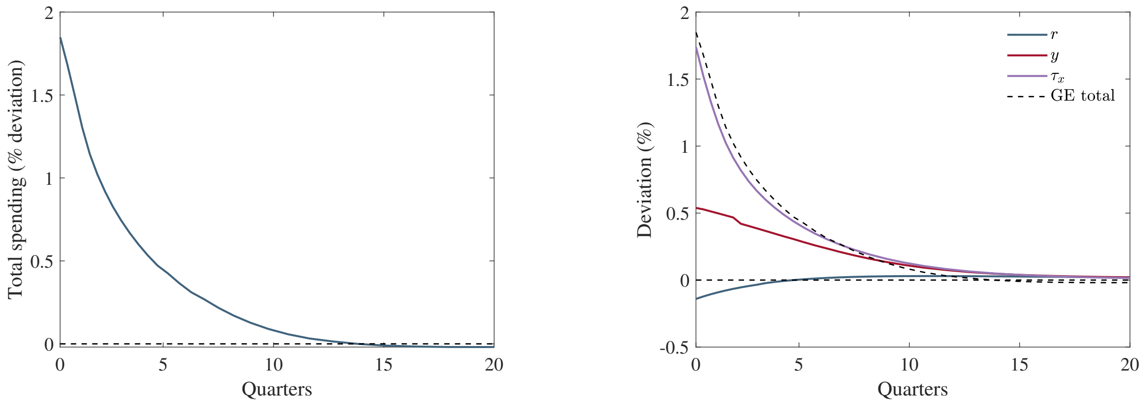
Having calibrated the model, I turn in the next section to policy experiments. In particular, the objective is to analyze the response of aggregate demand to fiscal and monetary stimulus in a general equilibrium setting. This exercise allows us to assess how the presence of high-MPX households shapes the response of aggregate demand to macroeconomic policy when household balance sheets endogenously adjust to policy shocks, taking into account general-equilibrium feedback effects and indirect policy transmission channels.

6 Macro-stabilization policy

In this section, I analyze the macroeconomic implications of heterogeneous households' spending decisions. First, I revisit the effects of stimulus payments and interest rate cuts on aggregate demand in general equilibrium. Second, I quantify the role of different transmission channels.

6.1 Stimulus checks

I begin the analysis by considering the effects of stimulus payments. As before, I assume that all households receive a stimulus check of \$500 upon impact. Figure 10 presents the response of aggregate spending and highlights the role of the different transmission channels operating through households' balance sheets.[9]



(a) (b)

Figure 10: Spending responses to \$500 stimulus checks in general equilibrium.

Note: The figure shows the response of aggregate spending to fiscal stimulus. Panel (a) presents the response of total spending. Panel (b) shows how much of the aggregate spending response is due to changes in labor earnings, interest rates, and government transfers.

Aggregate spending increases by about 1.5% following the receipt of stimulus checks. An assessment of the transmission channels indicates that the rise in spending primarily reflects the direct effect of higher government transfers. However, there is also a significant contribution from labor earnings. As the policy stimulates economic activity, labor demand increases, ultimately generating higher income for households. On the other hand, higher public debt and inflation exert upward pressure on interest rates, which dampens consumer spending. Overall, this effect is quantitatively larger than in the partial-equilibrium analysis, reflecting the thicker right tail of the MPX distribution and the importance of general-equilibrium feedback effects.

[9]The decomposition in Panel (b) of Figure 10 abstracts from the role of taxation, which explains why the sum of all effects exceeds 100%. In particular, higher labor income taxes would partially offset the increase in labor earnings so that direct and indirect effects add up to the general equilibrium total response (black dashed line).

6.2 Interest rate cuts

In this section, I revisit the effects of monetary policy through the lens of the model. In particular, I consider, as before, an interest rate cut of 25 basis points upon impact. Figure 11 presents the response of aggregate spending and highlights the role of the different transmission channels of monetary policy.

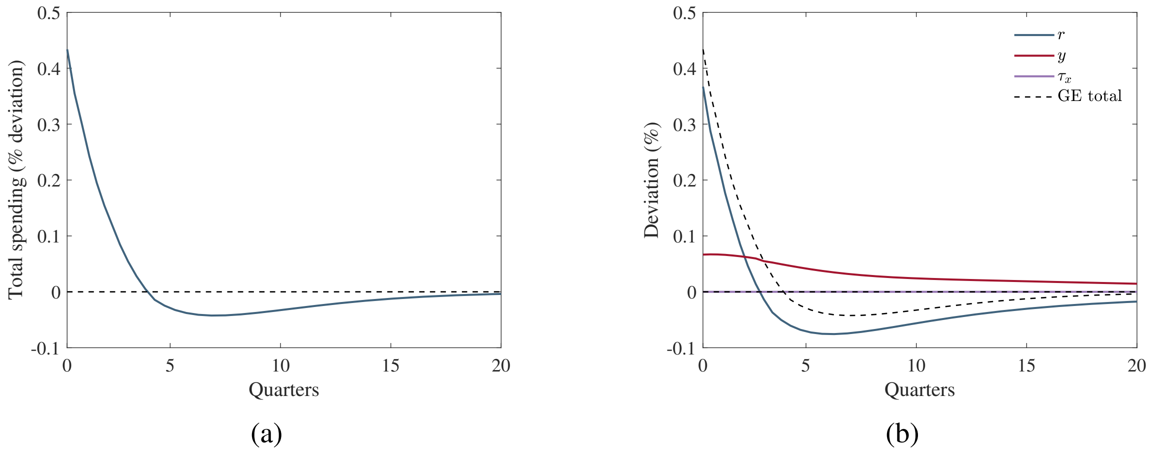


Figure 11: Spending responses to a 25 basis points interest rate cut in general equilibrium.

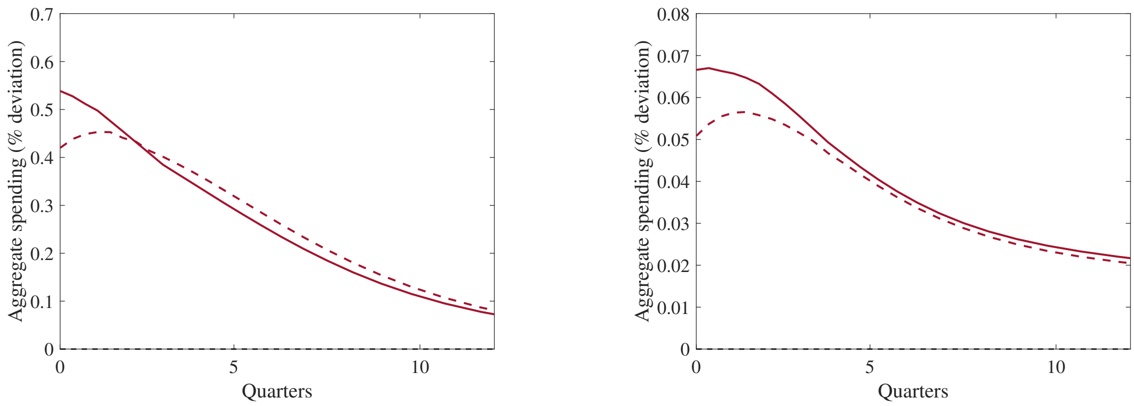
Note: The figure shows the response of aggregate spending to fiscal stimulus. Panel (a) presents the response of total spending. Panel (b) shows how much of the aggregate spending response is due to changes in labor earnings, interest rates, and government transfers.

Aggregate spending increases by 0.4% in response to the interest rate cut, with most of the rise driven by spending on durable goods. In particular, durable expenditures play a key role in shaping the dynamics of aggregate demand, as the increase in durable purchases is largely front-loaded and followed by lower spending in subsequent periods. An analysis of the transmission channels indicates that these effects are primarily driven by the direct impact of the policy through changes in interest rates. However, also in this case, general equilibrium effects operating through higher labor earnings significantly amplify the response of aggregate demand. The increase in aggregate spending is muted relative to the responses observed in partial equilibrium, primarily because monetary policy systematically reacts to higher inflation, resulting in a comparatively smaller reduction in the real interest rate.[10] Since government transfers remain unchanged in this case, the contribution of government income to aggregate spending is zero. Overall, although the model generates different dynamics, the magnitude of the aggregate demand response to fiscal and to a 100 basis point interest rate cut is similar.

[10]Additionally, in the partial equilibrium experiments, I also increased real wages by 0.1%, consistent with the empirical evidence from Christiano, Eichenbaum, and Evans (2005). In the general equilibrium model, however, real wages are fixed, so the increase in labor earnings does not contribute much beyond what is already captured in the partial equilibrium analysis.

6.3 Indirect income effects

As most of the response of total spending to fiscal and monetary policy is driven by direct effects, one should not expect substantial deviations from the partial-equilibrium analysis conducted in Sections 3 and 4. Instead, the key object of interest in this section is the extent to which the right tail of the MPX distribution amplifies general-equilibrium feedback effects operating through household labor income. These indirect effects are well known to be central to the magnitude of fiscal multipliers. Moreover, Kaplan, Moll, and Violante (2018) emphasize that these channels are particularly important also for monetary policy. The framework analyzed in this paper provides a natural laboratory to quantify how the MPX distribution shapes the indirect income effects of macroeconomic policy and thereby amplifies the response of aggregate demand. To this end, I consider a counterfactual MPX distribution with a Pareto tail spanning the range [1,3], an average quarterly MPX of 25%, and a 5% share of households in the tail. As in the previous partial equilibrium experiments, I obtain this distribution by slightly increasing the scale parameter η, while holding all other features constant.



(a) (b)

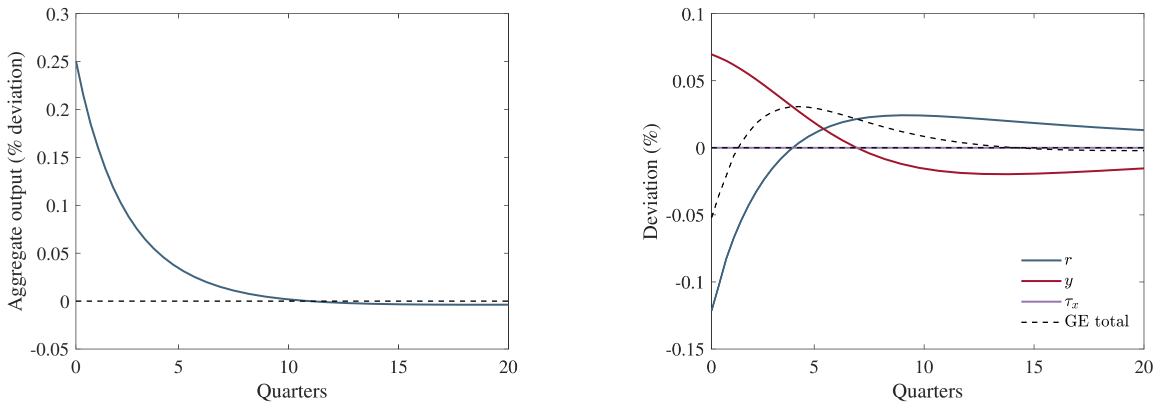
Figure 12: Indirect spending responses to fiscal policy and monetary policy.

Note: The figure shows the response of aggregate spending to changes in labor earnings. Baseline model (solid line), alternative calibration as presented in the main text (dashed line). Panel (a) presents the response of total spending to fiscal policy. Panel (b) presents the response of total spending to monetary policy.

Panel (a) in Figure 12 shows the indirect effects of fiscal policy. Panel (b) plots the same responses for monetary policy. On impact, the indirect effects increase by 25% under fiscal policy and by 35% under monetary policy. This amplification reflects both a stronger response of household earnings to changes in demand and higher consumption out of the income gains. These effects are striking given that the relevant households constitute 3% of the population. This result demonstrates that the distribution of MPX matters not only for the direct effects of policy interventions, but also for the magnitude of the general equilibrium effects.

6.4 Public spending

The general equilibrium framework also allows me to study the effects of public spending, which was not feasible in the partial equilibrium setting. In this section, I revisit the macroeconomic effects of a 1% increase in public spending. Panel (a) of Figure 13 displays the response of aggregate output to the fiscal stimulus, while Panel (b) presents the response of household spending together with a decomposition of the different transmission channels.



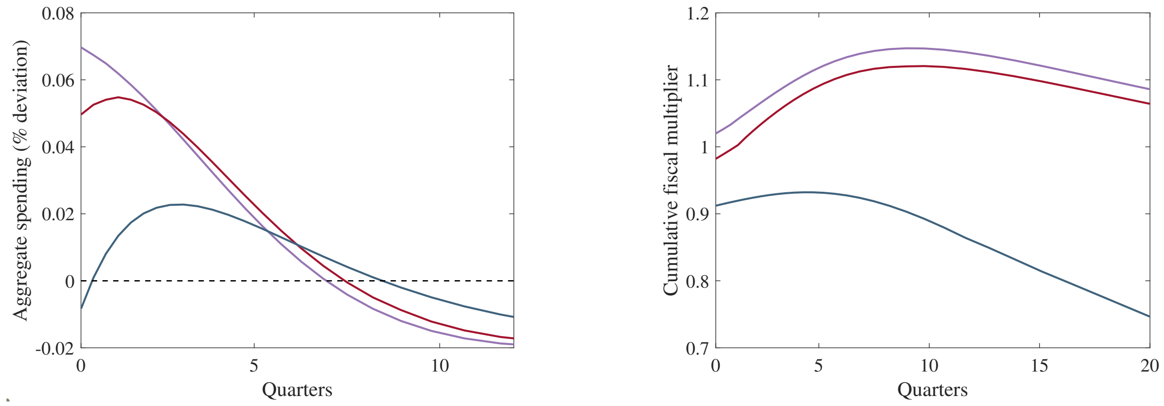
(a) (b)

Figure 13: Responses to a 1% increase in public spending.

Note: The figure shows the responses to a 1% increase in public spending. Panel (a) presents the response of aggregate output. Panel (b) shows the decomposition of the response of household spending due to changes in labor earnings, interest rates, and government transfers.

The increase in public spending raises aggregate demand and output. In the presence of nominal rigidities, firms respond to this shock by increasing labor demand, production, and prices. As a result, households experience higher labor earnings, but also face higher interest rates owing to both the central bank's response to inflationary pressures and the increase in the supply of government bonds. Panel (b) of Figure 13 clearly illustrates the effects of these opposing forces on household spending. For this experiment, I adopt a conservative benchmark by considering the baseline calibration of the Phillips curve, under which the shock generates a substantial increase in inflation and, consequently, a strong monetary policy response that counteracts the expansionary effects of fiscal stimulus. Quantitatively, the contractionary effect of higher interest rates dominates on impact, generating a crowding-out effect of public spending on private consumption. At the same time, it is noteworthy that the persistent increase in labor earnings, together with intertemporal demand shifting induced by the interest rate, tends to raise household spending in subsequent periods. The dynamics therefore exhibit crowding out on impact but crowding in at longer horizons. Overall, the cumulative effect of the fiscal stimulus is an increase in private spending.

The distribution of MPXs remains a critical determinant of the effects of public spending through the indirect general equilibrium changes in labor income that govern household spending dynamics as in the canonical Keynesian multiplier mechanism. As discussed in Section 6.3, the upper tail of the MPX distribution plays an important role in shaping the response of household spending to changes in labor income. This raises the question: to what extent does the right tail of the MPX distribution affect fiscal multipliers? To address this question, I again compare the baseline calibration of the model with the alternative calibration featuring a thinner right tail in the MPX distribution, as described in Section 6.3 and with a model that almost removes the right tail, as described in the Online Appendix F.



(a) (b)

Figure 14: Indirect income effects and fiscal multipliers.

Note: Panel (a) shows the response of household spending driven by changes in labor income induced by the fiscal stimulus. Panel (b) shows the cumulative output multipliers. Baseline model with 8% high-MPX households (purple line), model with 2% high-MPX households (blue line), model with 5% high-MPX households (red line).

Figure 14 shows that the weaker response of household spending to changes in labor income increases the degree of crowding out associated with public spending, leading to an impact multiplier below one and lower cumulative multipliers in the counterfactual economy with a thinner upper tail of the MPX distribution. This result demonstrates that even modest variations in the tail behavior of the MPX distribution can generate substantial macroeconomic effects on fiscal multipliers, with the cumulative multipliers declining by 10-30%.

A second important point to emphasize concerns the baseline specification of the model. Even when the micro-level MPXs are assumed to be extremely large, the model continues to generate plausible fiscal multipliers. For a discussion of empirical estimates of government spending multipliers, see Auclert, Bardóczy, and Rognlie (2023) and Ferriere and Navarro (2025b). This is reassuring because the model is consistent with both micro MPX estimates from micro data and the time-series evidence on fiscal multipliers from macro data. It therefore provides a coherent bridge between micro-level heterogeneity and aggregate fiscal responses.

6.5 Cross-sectional responses

How important is the share of low-liquidity households, relative to the tail behavior of the MPX distribution, in shaping the effects of stimulus checks? To address this question, I define liquidity-constrained households as discussed in Section 3.4. Among the 8% of households located in the Pareto tail of the MPX distribution, only 2% are liquidity constrained. The vast majority instead hold moderate liquid wealth and belong to the low-income to middle-income range. These households are therefore better characterized as middle-class households adjusting their durable purchases rather than as hand-to-mouth consumers. Consistent with this interpretation, the key idiosyncratic state associated with households in the upper tail of the MPX distribution is a relatively low stock of durables. Figure 15 compares the spending responses of liquidity-constrained households with those of high-MPX households that are not liquidity constrained. The former group accounts for 24% of the population, whereas the latter comprises only 6% of the population.

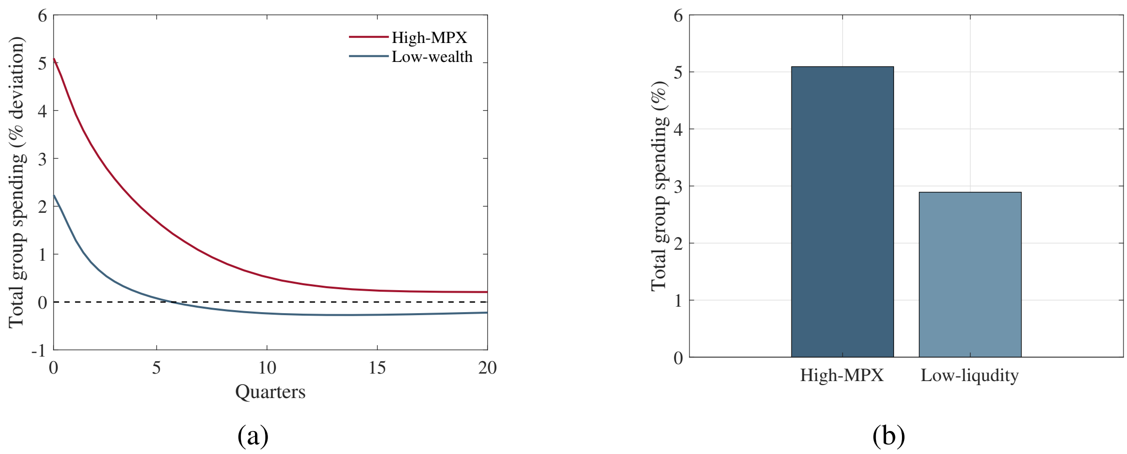


Figure 15: Spending responses to $500 stimulus checks among different groups.

Note: Panel (a) shows the response of total spending for a broadly defined low-wealth group and the households in the Pareto tail of the MPX distribution that are not liquidity constrained. Panel (b) shows the response of total spending at impact for liquidity-constrained households and the other households in the Pareto tail.

Panel (b) of Figure 15 shows that, on impact, total spending among high-MPX households that are not liquidity constrained increases by 5%, whereas total spending among liquidity-constrained households increases by only 3%. How important are these differences for aggregate dynamics? Despite constituting a much larger share of the population, liquidity-constrained households account for only a 0.2% increase in aggregate demand. By contrast, high-MPX households account for more than 1%. The bulk of the aggregate demand response in the model is driven by durable expenditure adjustments rather than by liquidity constrained households.

7 Conclusions

This paper analyzes how the distribution of the MPX shapes the transmission of fiscal policy and monetary policy in a quantitative HANK model with a smooth adjustment hazard and lumpy durables. By constructing counterfactual experiments that vary primarily in the tail behavior of the MPX distribution, I document that economies with a thicker right tail exhibit substantially larger responses of aggregate spending to both fiscal stimulus and monetary policy shocks. While higher MPXs are often associated with weaker intertemporal substitution and therefore muted monetary transmission, the presence of durable goods overturns this logic: monetary policy becomes more powerful precisely because of lumpy durable purchases.

From a business cycle perspective, the results highlight the importance of timing in the deployment of stabilization measures and the state dependence of their effectiveness. Policies implemented when pent-up demand is still building are more likely to generate additional aggregate spending, whereas late-stage interventions increasingly function through intertemporal reallocation. Specifically, as the economy approaches the recovery, a growing share of durable expenditure reflects anticipated purchases financed out of accumulated savings, so that policy increasingly operates through intertemporal reallocation rather than net demand creation. Consequently, identical policy interventions have declining effects over the course of the recession.

The results suggest that the distributional properties of the MPX are central to understanding aggregate stabilization policy. The findings shift emphasis from liquidity-constrained households toward the role of costly and lumpy adjustments. While liquidity constraints remain relevant, the analysis shows that the tail behavior of MPX has disproportionately large effects on aggregate dynamics and policy transmission. The MPX distribution's upper tail is a central object in heterogeneous agent models, one whose empirical measurement and structural determinants deserve greater attention from both researchers and policymakers.

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Online Appendix for “How Much Does HANK Spend? Consumption Dynamics with Lumpy Durables”

Valerio Pieroni

A Numerical implementation

In this section I discuss the recursive formulation and the numerical solution of the household dynamic program presented in Section 2. Let $m_a := e_t + r_t a_t - c_t - \chi\delta d_t$ denote the drift of the asset process and $m_d := -(1-\chi)\delta d_t$ denote the drift of the process for the durable stock. Similarly, let $m_e := (\nu(\mu - \ln e_t) + \sigma^2/2)e_t$ be the drift and $s_e := \sigma e_t$ the diffusion of the process for the idiosyncratic income risk. Then, I can define for any function g_t of the states $x_t = (a_t, d_t, e_t)$ the operator $\mathcal{A}$ as

$$\mathcal{A}g_t(x_t) := (\partial_e g_t)m_e + \frac{1}{2}(\partial_{ee} g_t)s_e^2.$$

The recursive formulation of the problem is given by the Hamilton-Jacobi-Bellman Quasi-Variational Inequality (HJBQVI)

$$\min\left\{\rho v_t - \max_{c_t}\Big(u(c_t, d_t) + \partial_a v_t m_a + \partial_d v_t m_d + \mathcal{A}v_t + \partial_t v_t\Big), v_t - (v^* - \kappa)\right\} = 0.$$

This can be efficiently solved as a linear complementarity problem (LCP). The formulation of Kolmogorov Forward (KF) equation with stopping is not straightforward. However, the model's smooth adjustment hazard considerably simplifies the analysis. Let λ_t denote the fraction of agents who do not adjust. The KF equation can be written as

$$\partial_t f_t = -\partial_a(\lambda_t f_t m_a) - \partial_d(\lambda_t f_t m_d) - \partial_e(\lambda_t f_t m_e) + \frac{1}{2}\partial_{ee}(\lambda_t f_t s_e^2) + (1-\lambda_t)(f_t(a', d', e) - f_t).$$

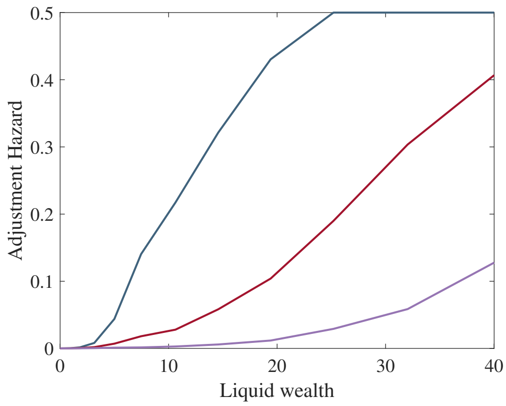
The model's solution methods are based on finite difference approximations. I use a non-uniform grid for each state and index with $i = 1, ..., I, j = 1, ..., J, m = 1, ..., M$ the grid points for a, d, e respectively. The main challenge in the solution method is that in general (a', d') will not be on the grid. Therefore, I use bilinear interpolation in order to move mass from the adjustment point (a', d') to points on the grid. This works well in practice given that the adjustment targets a', d' are within the bounds of the grids.

B Smooth adjustment hazard

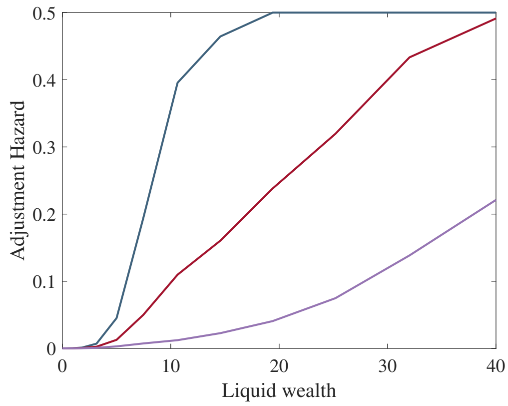
The model presented in Section 2 features a smooth adjustment hazard. In particular, the assumption of a logistic distribution of the utility shocks gives the following adjustment hazard

$$\mathcal{H}_t(a,d,e) = \frac{\exp\left(\frac{v^*(a,d,e)-\kappa}{\eta}\right)}{\exp\left(\frac{v^*(a,d,e)-\kappa}{\eta}\right) + \exp\left(\frac{v(a,d,e)}{\eta}\right)}.$$

The parameter κ determines the position of the hazard while the parameter η controls the shape of the hazard. If the adjustment is deterministic $\eta \to 0$ the model reduces to a pure state-dependent model with a steep hazard. If the adjustment is random $\eta \to +\infty$ then the model becomes purely time-dependent and the hazard is flat over the state space. In this section I present the shape of the hazard in the baseline calibration of the model. Figure A.1 plots the hazard function across the state space.



(a)



(b)

Figure A.1: Logistic hazard function by wealth, durable stock, and earnings.

Note: The figure shows the hazard function by liquid wealth for low-income households in panel (a) and high-income households in panel (b). The lines in each panel represent different levels of durable holdings. Low durable stock (blue line), medium durable stock (red line), and high durable stock (purple line).

All else equal, the probability of adjustment increases with income and wealth, while it decreases with the size of the durable stock. The figure also indicates that extreme probabilities, are relatively uncommon across the state space. Instead, adjustment behavior is characterized by smooth variation in probabilities. As a result, for any given combination of wealth, durable holdings, and earnings, the model predicts heterogeneity in behavior: some agents choose to adjust their durable stock, while others optimally remain inactive. This implies that adjustment decisions are probabilistic rather than governed by sharp thresholds.

C Intertemporal MPXs

Here I study the response of non-durable spending and durable spending to stimulus payments with a focus on the properties of the instantaneous intertemporal MPXs in the baseline model of Section 2. Specifically, I consider a $500 stimulus check at impact that mean reverts within one year with most of the payments concentrated in first quarter.

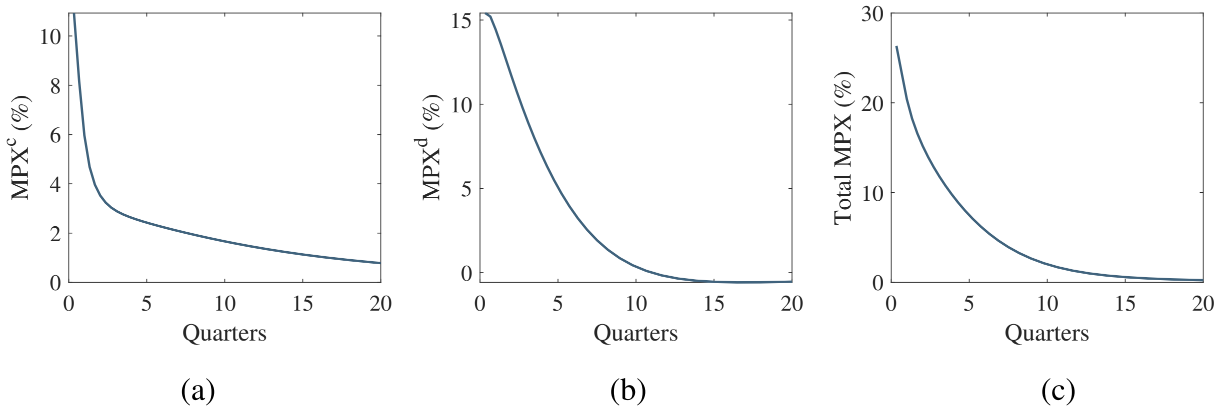


Figure A.2: Impulse responses to $500 stimulus checks

Note: The figure shows the intertemporal MPXs defined as the response of non-durable spending, durable spending, and total spending as a percentage of the stimulus check at impact.

The first two panels in Figure A.2 present the responses of non-durable and durable spending to the stimulus checks. The implied MPXs differ markedly across the two categories. In particular, the MPXs for non-durables are more front-loaded, displaying a larger impact response immediately following the transfer. These responses decay more rapidly over time compared to the spending response for durables, which tend to be more persistent. This pattern is a well-established feature of models with durable goods. It reflects the lumpy nature of durable consumption adjustments: households often respond to liquidity shocks by advancing the timing of infrequent durable purchases. This generates a more persistent spending response, as some households initially save most of the stimulus payment and only gradually decide to make significant durable purchases. Once households decide to adjust their stock of durables, the spending response tends to be higher than for non-durables, reflecting the higher costs of durable goods. These patterns imply that the impact response of aggregate spending is largely driven by purchases of durable goods. The strong but short-lived increase in non-durable expenditure generates a pronounced rise in total spending following the transfer. At longer horizons, however, the aggregate spending response increasingly reflects adjustments in durable consumption, which tend to be more gradual over time. From an empirical standpoint, the literature has yet to converge on a consensus regarding the persistence of the MPX and, in particular, the speed at which it declines over time following an income shock.

D Two-asset model

In this section, I further investigate how much differences in the tail of the MPX distribution can affect the response of aggregate demand to stimulus checks and interest rate cuts. To this end, I compare the model with durables to a canonical two-asset model. The two-asset model of aggregate spending does not differentiate between durable and non-durable consumption. Instead, it distinguishes between two types of assets, one liquid and one illiquid, following the framework of Kaplan and Violante (2014), Kaplan, Moll, and Violante (2018), and Kaplan, Maxted, and Moll (2020). The comparison between the model with durables and the two-asset model comes with an important limitation. The two models differ substantially in their underlying spending mechanisms: the two-asset framework does not feature lumpy adjustment in consumption, unlike the model with durables. However, comparing the two-asset model with the model with durables is instructive because the two-asset model does not generate a Pareto tail in MPXs. Instead, households are effectively bounded at a maximum MPX of 100%. This contrast allows me to isolate the role of high-MPX households in driving aggregate responses. Overall, I find that the Pareto tail of the distribution of MPXs is critical for the response of aggregate spending to fiscal policy and monetary policy. This result highlights how heterogeneity in consumption responses across households can have first-order macroeconomic implications.

I begin by describing a two-asset model with fixed adjustment costs. In this model households can choose between liquid assets a_t and illiquid assets k_t subject to a fixed adjustment cost κ. Given earnings e_t, interest rate r_t^a, and an illiquid return r_t^k, the sequential formulation of the household problem is

$$v(a_0, k_0, e_0) = \max_{c_t, \tau} \ \mathbb{E}_0 \left[\int_0^\tau e^{-\rho t} u(c_t) dt + e^{-\rho \tau} v^*(a_\tau, k_\tau, e_\tau) \right] \tag{D.1}$$

$$\text{s.t.} \quad \dot{a}_t = e_t + r_t^a a_t - c_t,$$

$$\dot{k}_t = r_t^k k_t,$$

$$a_t \geq \underline{a}, \quad k_t \geq 0$$

where conditional on adjusting we have the problem

$$v^*(a_t, k_t, e_t) = \max_{k_t'} v(a_t', k_t', e_t) \ \text{ s.t. } \ a_t' + k_t' = a_t + k_t - \kappa k_t \tag{D.2}$$

Equations (D.1), (D.2) fully characterize the households' decision problem. This model does not feature smooth adjustment, instead it follows strict (s, S) tresholds. Therefore, to solve the model I use an intervention operator that moves points that are in the adjustment region to their corresponding adjustment targets.

For the two-asset model, I aim to maintain the calibration strategy as closely aligned as possible with that of the baseline model featuring durable consumption. I set the illiquid return to 5% annually and the return on liquid wealth to 4% per year.[11] The income process is the same as in the baseline calibration. I also keep the parameters γ, ρ as in the baseline calibration. I set the adjustment cost κ to 10%. The calibration of the model with durables is the same as in the main text of Section 2. The primary distinction between the two-asset model and the model with durables lies in the distribution of MPXs, which plays a central role in shaping the transmission of policy shocks to aggregate demand.

Table A.1: Model parameters

Parameter	Description	Value	Source
Households			
γ	CRRA/Inverse IES	1	External
ρ	Discount rate (p.a.)	0.09	External
κ	Adj. cost parameter	0.1	External
ν	Mean reversion coeff.	0.0263	External
σ	S. D. of innovations	0.2	External

The average MPX is around 15% in the two-asset model and 23% in the model with durables. The model with durables generates a thick right tail in the distribution of MPXs, with values ranging from 1 to 3. By contrast, the two-asset model produces a distribution of MPXs that exhibits no Pareto tail.[12] This difference highlights how the presence of durable goods introduces substantially greater dispersion in marginal propensities to spend, particularly by allowing for large expenditure responses driven by durable goods purchases. In the two-asset model, the marginal propensity to consume is bounded above by one, with high MPXs concentrated among liquidity-constrained households. These households consume all additional income, resulting in a mass near one in the MPX distribution and no right tail.

[11]This specification is intended to reflect the fact that liquid assets include high-return investments such as stocks, whereas returns on illiquid assets primarily capture the rental return on home equity. These values are broadly in line with the estimates from Jordà, Knoll, Kuvshinov, Schularick, and Taylor (2019).

[12]The two-asset model features a Pareto tail if investment is included in the definition of aggregate demand. However, since the focus of this paper is on aggregate spending as measured by household consumption and there is no investment in illiquid assets in the model with durables, I consider only the marginal propensity to consume in the two-asset model, rather than the sum of the marginal propensity to consume and the marginal propensity to invest. This comparison allows me to highlight the importance of the tail behavior in the MPX distribution.

Figure A.3 illustrates the distribution of MPX within the two-asset model. The figure indicates that this distribution exhibits a point mass at when the total MPX is equal to 100% and lacks continuity in the tail. In the two-asset model, approximately 5% of the mass is concentrated at MPX equal to one. This magnitude is comparable to the mass in the long right tail of the MPX distribution under the baseline calibration of the model with durables. A notable feature of the two-asset model is its tendency to generate a trimodal MPX distribution. One mode occurs at zero MPX, corresponding to households with substantial liquid wealth that satisfy their Euler equation. A second mode appears around 50% MPX, capturing households in close proximity to the borrowing constraint. A third mode is located at MPX equal to one, representing liquidity-constrained households.

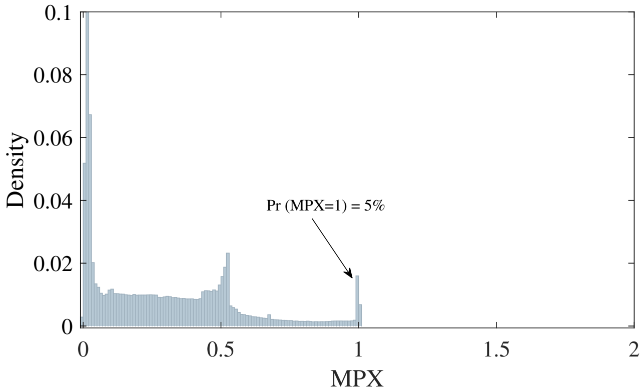
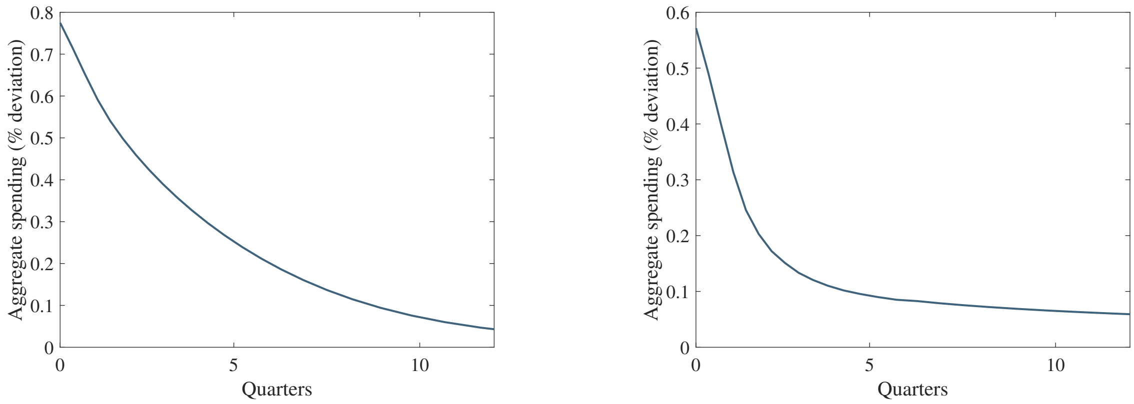


Figure A.3: The MPX distribution in the two-asset model

Note: The figure shows the distribution of the spending responses to a stimulus payment of $500.

A comparison of the cumulative distribution functions of MPX in the two-asset model and in the model with durables reveals a similar mass of households with close to zero MPXs and a clear shift in the central region of the distribution of MPX. In particular, the share of households with MPX below 25% is 80% in the model with durables, compared with 70% in the two-asset specification. This difference is mirrored by a greater concentration of mass around 50% MPX in the two-asset model. Importantly, however, these differences in the central region of the distribution do not account for the lower average MPX observed in the two-asset framework. Rather, the discrepancy is driven by differences in tail behavior. Indeed, shifts in the middle of the distribution would, if anything, exert upward pressure on the average MPX. The fact that the overall average is nevertheless lower in the two-asset model therefore underscores the dominant role of the tail in shaping aggregate outcomes. This observation implies that aggregate spending responses are disproportionately influenced by households with high MPX, whose behavior governs the transmission of policy to aggreagte demand. Consequently, the comparison isolates the macroeconomic importance of tail behavior across the two models.

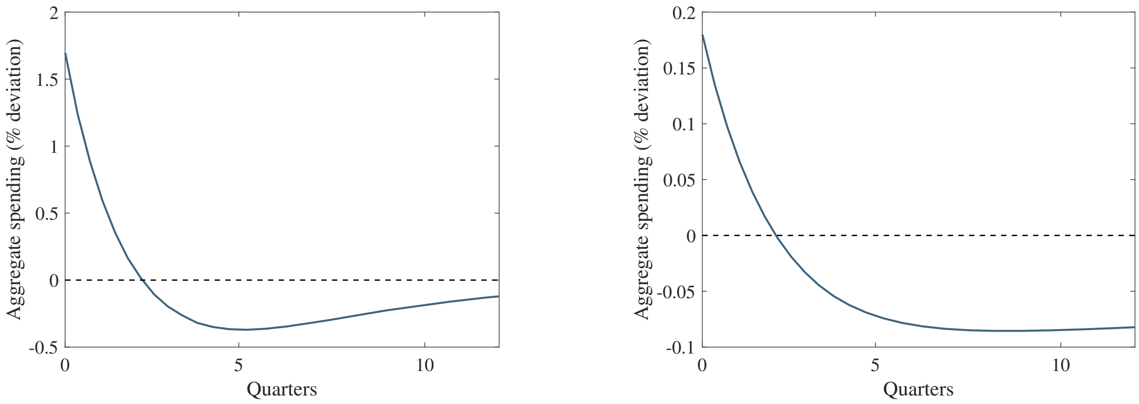
Figure A.4 shows the response of aggregate spending across the two models to stimulus payments. The model with durables exhibits a higher and more persistent response, whereas the response in the two-asset model is front-loaded. Figure A.5 shows the response of aggregate spending to a 100 basis point interest rate cut in both models. The effects of an interest rate cut are considerably larger in the model with a thick right tail in the MPX distribution compared to the two-asset model. This experiment shows the important role of the MPX distribution.



(a) (b)

Figure A.4: Spending responses to $500 stimulus checks.

Note: The figure shows the response of aggregate spending to fiscal policy. Panel (a) presents the response of spending in the model with durables. Panel (b) shows the response of spending in the two-asset model.



(a) (b)

Figure A.5: Spending responses to 100 bp interest rate cut.

Note: The figure shows the response of aggregate spending to monetary policy. Panel (a) presents the response of spending in the model with durables. Panel (b) shows the response of spending in the two-asset model.

E MPXs in the upper tail

In this section, I consider an additional experiment in which I further increase the MPXs of households in the Pareto tail of the MPX distribution. Table A.2 reports the model calibrations examined here. The first column shows the statistics of the MPX distribution for the baseline calibration. The second column reports the same statistics for the model with a thicker tail. The third column presents the new calibration explored in this section, in which the share of high-MPX households remains broadly constant while their MPXs increase, raising the average MPX from 32% to 36%, at the upper bound of the empirical estimates in Borusyak, Jaravel, and Spiess (2024).

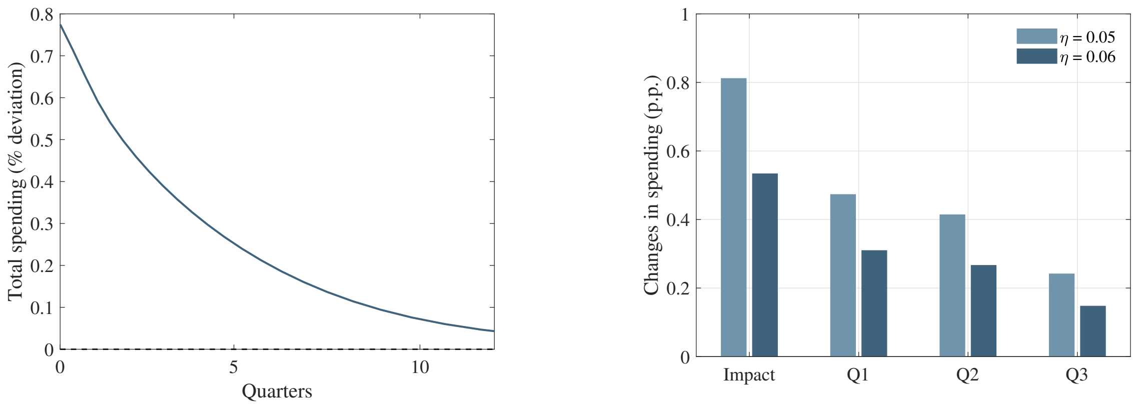
Table A.2: The right tail of the MPX distribution

Description	$\eta = 0.1$	$\eta = 0.06$	$\eta = 0.05$
Quarterly total MPX	23%	32%	36%
Range of the Pareto tail	[1,3]	[1,4]	[1,5]
Share with MPX ≥ 1	5%	8%	8%

Note: The Table shows how the distribution of MPX changes with the scale parameter η. The first line of the table reports the average quarterly total MPX out of \$500 for the overall population.

As shown in Table A.2, when the scale parameter η is already close to zero, varying this parameter further primarily affects the range of the right tail of the MPX distribution and, consequently, the aggregate MPX. In the baseline calibration ($\eta = 0.1$), the distribution features a Pareto tail with high MPXs in the interval [1,3]. Reducing η to 0.05 generates a thicker upper tail, expanding the support of high MPXs to the interval [1,5]. This highlights the importance of intensive-margin variation within the tail, rather than changes in its mass alone. The variation in the average MPX suggets that changes in the upper tail can have first-order effects on aggregate consumption dynamics. More generally, the findings emphasize that a relatively small group of high-MPX households can account for a disproportionate share of aggregate consumption responses, making the accurate characterization of the upper tail critical for quantitative analysis. In the model, these households tend to hold relatively low levels of liquid wealth. However, they are not the poorest households in the population nor tightly constrained, implying that adjustments in their spending behavior can be substantial and translate into meaningful changes at the aggregate level. Next, I turn to the quantification of these aggregate effects.

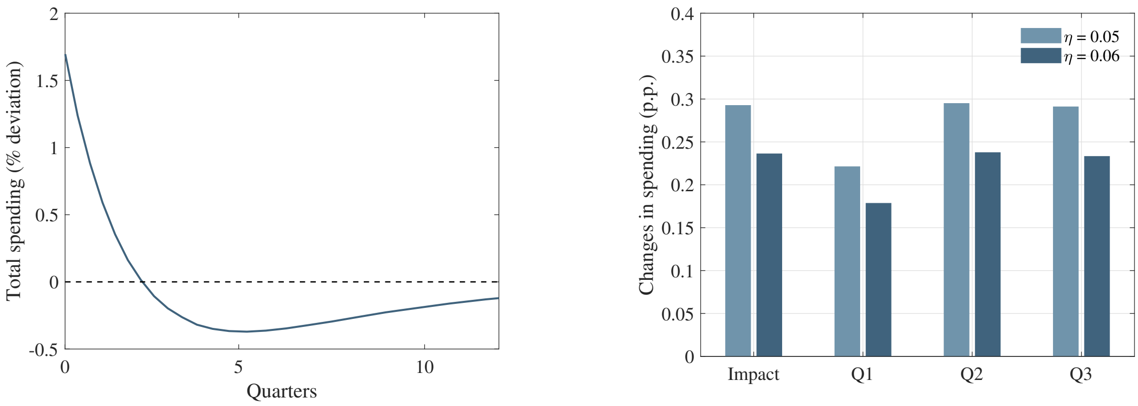
Figure A.6 shows the spending responses to stimulus payments across the different model calibrations, while Figure A.7 plots the responses to interest rate cuts. Overall, increasing MPXs in the upper tail of the distribution leads to significant changes in aggregate consumption. The cumulative response increases by 0.4 p.p. for fiscal policy and 0.3 p.p. for monetary policy.



(a) (b)

Figure A.6: Spending responses to \$500 stimulus checks.

Note: The figure shows the response of aggregate spending to fiscal stimulus. Panel (a) presents the response of spending in the baseline calibration ($\eta = 0.1$). Panel (b) shows the percentage-point increase in the response of total spending when we move from the baseline to the model with $\eta = 0.05$ (light blue bars) and when we move from the baseline to the model with $\eta = 0.06$ (dark blue bars). Panel (b) shows the impact response as well as the cumulative responses from the start up to the first, second, and third quarters.



(a) (b)

Figure A.7: Spending responses to a 100 bp interest rate cut.

Note: The figure shows the response of aggregate spending to an expansionary monetary policy shock. Panel (a) presents the response of spending in the baseline calibration ($\eta = 0.1$). Panel (b) shows the percentage-point increase in the response of total spending when we move from the baseline to the model with $\eta = 0.05$ (light blue bars) and when we move from the baseline to the model with $\eta = 0.06$ (dark blue bars). Panel (b) shows the impact response as well as the cumulative responses from the start up to the first, second, and third quarters.

F Alternative calibration

In this section, I consider an alternative calibration featuring a thinner tail in the MPX distribution. I obtain this specification by jointly increasing the location parameter, the scale parameters, and the real interest rate. Table 5 reports both targeted and untargeted moments used in the model's calibration. Figure A.8 shows the MPX distribution in this calibration.

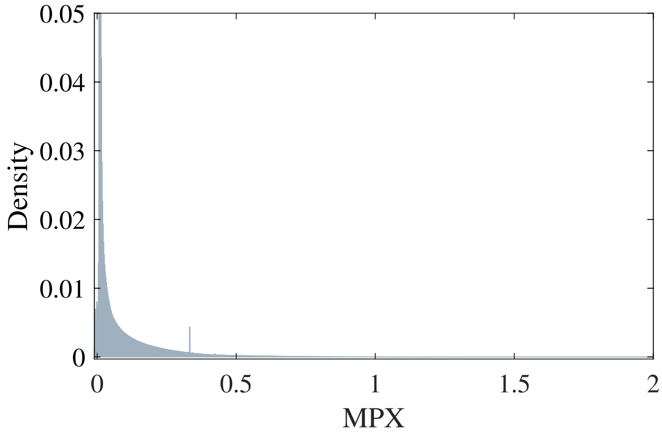


Figure A.8: The distribution of MPXs in general equilibrium.

Note: The figure shows the distribution of the spending responses to a stimulus payment of $500.

Table A.3: Steady- state moments

Description	Data	Model	Description	Data	Model
Real rate (p.a.)	3%	3%	Quarterly MPX	25%-37%	22%
Durables to non-durables ratio	15%-20%	23%	Range Pareto tail	[1,3]	[1,4]
Maintenace costs	1%	0.3%	Share with MPX ≥ 1	10%	2%

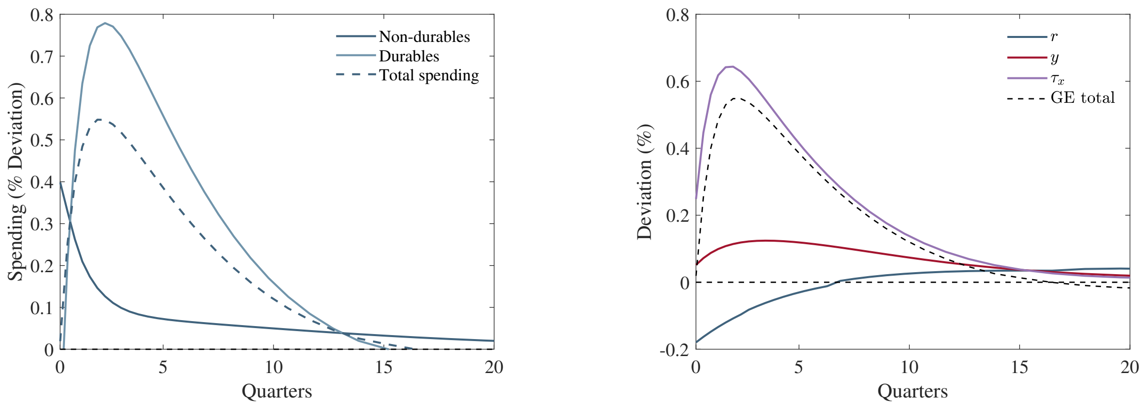
Note: The first line in the second column of the table reports the average quarterly MPX out of $500 for the overall population. Maintenace costs are measured relative to average earnings.

Overall, the model provides a good fit to the targeted statistics. The ratio of durable to non-durable spending is somewhat higher than in the data, despite an unchanged preference parameter, as the model generates higher wealth levels through increased returns, which in turn lead to greater durable-goods purchases, given that such expenditures are financed out of wealth.

Having calibrated the model, I turn in the next section to policy experiments. In particular, I analyze the response of aggregate demand to fiscal and monetary stimulus within the general equilibrium model with a thinner tail in the MPX distribution, and decompose the relative importance of the various balance-sheet channels.

F.1 Stimulus checks

I begin the analysis by considering the effects of stimulus payments. As before, I assume that all households receive a \$500 stimulus transfer on impact. Panel (a) of Figure A.9 presents the response of aggregate spending as well as the response of durables and non-durables. Panel (b) illustrates the contribution of the different transmission channels to total spending.



(a) (b)

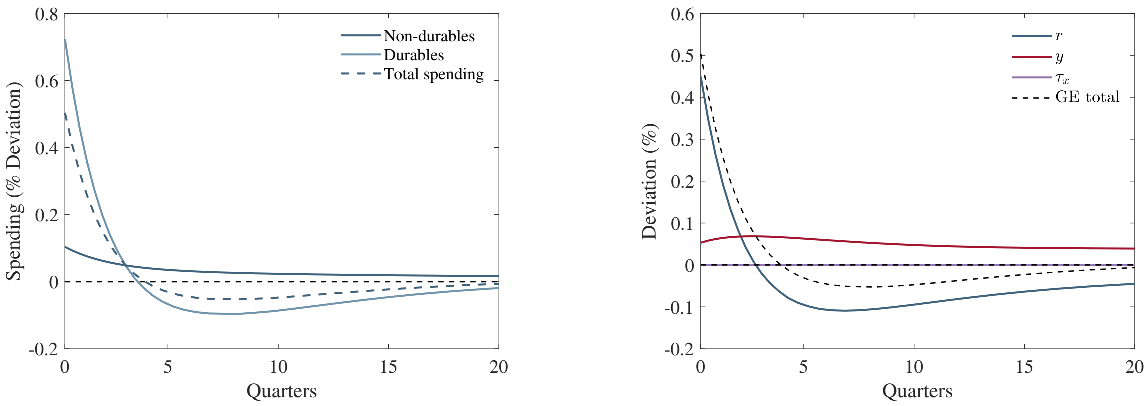
Figure A.9: Spending responses to \$500 stimulus checks in general equilibrium.

Note: The figure shows the response of aggregate spending to fiscal stimulus. Panel (a) presents the response of aggregate spending, spending on durables, and spending on non-durables. Panel (b) shows how much of the aggregate spending response is due to changes in labor earnings, interest rates, and government transfers.

Aggregate spending rises by 0.5% after households receive stimulus checks, indicating a modest increase in overall spending. The majority of this increase is concentrated in spending on durable goods rather than non-durable consumption categories. An assessment of the underlying transmission channels helps clarify the mechanisms driving the response. Consistent with the baseline model presented in Section 6 of the paper, the increase in spending mainly reflects the direct effect of higher government transfers. The stimulus payments therefore operate largely through an immediate income effect on households. Relative to the baseline calibration discussed in Section 6, however, the contribution from labor earnings is considerably weaker. In fact, labor income contributes almost nothing to the spending response at impact. At the same time, higher interest rates work in the opposite direction by discouraging household expenditures. As saving incentives rise, consumers reduce spending, which dampens the overall expansionary effect of the stimulus checks.

F.2 Interest rate cuts

In this section, I revisit the effects of monetary policy through the lens of the model. In particular, I consider, as before, an interest rate cut of 25 basis points upon impact. Panel (a) in Figure A.10 presents the response of aggregate spending over time following the policy shock, including the response of durables and non-durables separately. Panel (b) highlights the relative importance of the different transmission channels of monetary policy.



(a) (b)

Figure A.10: Spending responses to a 25 basis points interest rate cut in general equilibrium.

Note: The figure shows the response of aggregate spending to a monetary policy shock. Panel (a) presents the response of aggregate spending, spending on durables, and spending on non-durables. Panel (b) shows how much of the aggregate spending response is due to changes in labor earnings, interest rates, and government transfers.

Aggregate spending increases by approximately 0.5% following the 25 basis point reduction in interest rates, with the bulk of the response driven by expenditures on durable goods. An analysis of the transmission channels shows that the expansion is primarily driven by the direct effect of monetary policy operating through lower real interest rates. Since government transfers do not adjust following the monetary policy shock, the contribution of government income to aggregate spending is mechanically zero. Relative to the baseline model discussed in Section 6, the quantitative response of aggregate demand is broadly similar despite the alternative calibration considered here. This similarity arises because households in the alternative calibration hold higher levels of wealth, which strengthens intertemporal substitution motives in response to changes in interest rates. In this alternative calibration the public debt to output ratio is 140% significantly above the 50% of the baseline calibration. This explains why there is no evident mitigation of monetary policy effects. Although wealthier households display lower MPXs out of current income, the stronger substitution effects offset the weaker MPXs. As a result, the aggregate spending response remains quantitatively close to that obtained under the baseline calibration.

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