Nominal Maturity Mismatch and the Liquidity Cost of Inflation

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Abstract

We document a liquidity channel through which unexpected inflation generates substantial welfare losses. Households hold nominal liabilities with longer duration than their nominal assets. Due to this mismatch, losses from unexpected inflation concentrate over short horizons while gains accumulate over the long run, harming liquidity-constrained households who cannot borrow against future gains. The 2021–2022 inflation shock caused welfare losses valued at 1.1% of lifetime wealth for the lower half of the wealth distribution—equivalent in dollar terms to 47% of annual consumption. More than three-quarters of this loss comes from our liquidity channel rather than the traditional wealth channel.

JEL: E2, E3, G5

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1 Introduction

We measure how unexpected inflation affects households' welfare through their balance sheets. It is widely understood that inflation redistributes wealth from nominal lenders to nominal borrowers, with many papers documenting how households gain from reduced debt burdens or lose from eroded savings based on the net present value of their nominal assets and liabilities. We refer to this channel as *the wealth channel*. For households that can move resources freely across time, the change in lifetime wealth from this channel correctly summarizes the welfare effects of unexpected inflation. However, for households who are liquidity-constrained, losses in some periods may have severe consequences that are not offset by gains in other periods—even when the net present value of gains and losses is zero or positive. We refer to this intertemporal mismatch of gains and losses as *the liquidity channel* of unexpected inflation. In this paper, we argue that the liquidity channel accounts for a significant proportion of the welfare effects of inflation.

We formalize the liquidity channel in a standard consumption-saving model with convex borrowing costs and borrowing constraints. A household optimally chooses consumption, labor, and its holdings of assets and liabilities. It receives streams of payments over time from income and assets, and makes payments on its liabilities. Parts of these payment streams are nominal and are affected by unexpected changes in the price level—an *inflation shock*. We provide a formula to decompose the welfare effect of an inflation shock into two terms: (1) the wealth channel: absent illiquidity, the welfare effect is proportional to the change in a household's lifetime wealth; and (2) the liquidity channel: due to the existence of borrowing costs and constraints, the welfare effect contains an interaction term that captures the misalignment across time between the household's gains (and losses) and how much the household values these gains (and losses).

Following a sufficient statistics approach, we construct the empirical counterparts of the terms in our formula to quantify welfare effects for individual U.S. households. We estimate nominal streams of payments for each household using balance sheet information from the Survey of Consumer Finances (SCF). To identify illiquidity, we use transaction-level household bank account data (Facteus) to estimate consumption responses from unexpected transfers, and we map these responses into estimates of the "wedges" in each household's Euler Equation. We then combine these household-specific wedges with SCF balance sheet data to compute welfare effects. Our welfare calculation is driven by two main empirical findings.

Our first empirical finding is that household balance sheets display a large *nominal maturity*

mismatch: the average household holds nominal liabilities with significantly longer duration than its nominal assets, where duration measures the weighted average timing of cash flows. We construct the complete stream of nominal flows that each household expects to pay and receive over different time horizons, using granular items on households' balance sheets. For example, many U.S. households hold large nominal liabilities in fixed-rate mortgages, spread out over 30 years. On the other hand, nominal assets, such as deposits, have a short horizon. Future labor income is also partially nominal—wages adjust to inflation over a few years, not immediately—making it an asset with short nominal duration. Because of this maturity mismatch of nominal assets and liabilities, a typical U.S. household suffers losses in the short run and gains in the long run as a result of unexpected inflation.

Our second empirical finding concerns household illiquidity. We measure the level of illiquidity faced by households from two sources: borrowing costs and borrowing constraints. To calculate borrowing costs, we use information from the SCF about whether households have revolving credit and, if so, the interest rate they pay on that credit. To estimate the level of illiquidity due to borrowing constraints, we compute a *shadow rate*: how much a household would have been willing to pay had it been able to borrow more. Our key methodological innovation is to recover these shadow rates using data on households' high-frequency consumption responses to quasi-experimental income shocks: government stimulus payments during 2020-2021 that we identify and measure in transaction-level bank data. We measure shadow rates for U.S. households and show how the total level of illiquidity—combining the spread and the shadow rate—varies across the wealth distribution. The poor (bottom wealth decile households) are willing to borrow at a marginal rate up to 14 percentage points above the Treasury rate. The rich (top wealth decile households), on the other hand, are only willing to borrow with a 3% spread. Moreover, the source of illiquidity differs for the poor and rich: poor households are illiquid mostly due to borrowing constraints, while illiquidity for wealthier households is mostly reflected in their borrowing costs.

Combining these two findings with our welfare formula, we quantify the effects of unexpected inflation shocks on welfare. First, as a case study, we examine the 2021–2022 inflation episode to quantify the relative welfare effects of the wealth and liquidity channels. For a large majority of U.S. households, the liquidity channel causes welfare losses significantly larger in magnitude than welfare losses from the wealth channel. For households in the bottom half of the wealth distribution, the unexpected increase in inflation during this period leads to a welfare loss equivalent to an average of 1.1% of lifetime wealth, which is equal (in dollar terms) to 47% of annual non-durable consumption. The effects of the liquidity channel are particularly stark for poor households: more than 90% of the welfare loss for the bottom

wealth decile is due to illiquidity.

To extend these results beyond the 2021–2022 inflation episode, we calculate households' welfare exposure to inflation shocks over arbitrary time horizons. Wealthy households are negatively exposed to inflation at all horizons primarily through the wealth channel, while poor and middle-class households are most vulnerable to inflation at short horizons due to the liquidity channel, reflecting how borrowing frictions interact with the nominal maturity mismatch of household balance sheets.

Our work builds on Doepke and Schneider (2006), who provided the first empirical analysis of how inflation affects households' lifetime wealth by changing the net present value of their nominal assets and liabilities. Recent work by Cardoso et al. (2022) and Pallotti et al. (2024) evaluates the 2021-2022 inflation episode through a similar lens. We identify a novel liquidity channel: inflation not only transfers wealth from net nominal lenders to net nominal borrowers, but also creates a mismatch in the timing of real gains and losses for households with different mixes of asset and liability durations. This liquidity channel, which is absent in prior work, is quantitatively more important for the majority of U.S. households than the wealth channel that has been the focus of previous research. The quantitative importance of the liquidity channel offers a new perspective on why people dislike inflation, complementing work by Shiller (1997), Stantcheva (2024), and Guerreiro et al. (2024).

Our paper relates to research that quantifies the heterogeneous effects of aggregate shocks on households, particularly those where inflation is central to the analysis (Auclert, 2019; Pugsley and Rubinton, 2023; Del Canto et al., 2023). While such shocks affect households through various channels—including output, real interest rates, and asset prices—inflation is important in these studies because it affects lifetime wealth by changing the real value of net nominal positions. For example, Del Canto, Grigsby, Qian and Walsh (2023) argue that the inflationary effects of monetary and oil shocks are well captured by their effects on households' lifetime budgets, with a limited role for borrowing constraints. Our paper delivers a distinct message: when gains and losses materialize over different horizons due to the nominal maturity structure of household balance sheets, liquidity-constrained households suffer significant welfare losses from the resulting temporal mismatch. Since this channel is quantitatively important for a significant fraction of households, it is of first-order concern when studying any macroeconomic shocks that affect inflation.

The key to this difference lies in how we measure household illiquidity. Our measurement builds on a large literature emphasizing the importance of heterogeneous consumption responses to transitory income shocks (Parker et al., 2013; Jappelli and Pistaferri, 2014; Kaplan

et al., 2014; Fagereng et al., 2021; Aguiar et al., 2020). While Del Canto et al. (2023) argue that borrowing constraints play a limited role, their calculation uses an aggregate Euler equation at the age-education group level, which yields average wedges around 2% among constrained households. By contrast, we estimate these wedges from consumption responses to quasi-experimental income shocks in transaction-level data and find substantially larger illiquidity: our estimated wedges reach 8–14% for the bottom half of the wealth distribution. This order-of-magnitude difference in measured illiquidity, combined with the nominal maturity mismatch we document, explains why inflation generates significant welfare losses for many households through the liquidity channel.

More broadly, our measurement approach has implications for other applications of the sufficient statistics approach. For example, Fagereng et al. (2022) study the redistributive effects of asset price changes due to variations in real returns and conclude that borrowing frictions play a minor role. Our findings suggest that directly quantifying borrowing frictions through consumption responses may reveal larger effects than alternative measurement approaches.

2 Framework

To analyze the liquidity channel of unexpected inflation and guide our empirical measurement, we consider a standard consumption-saving model with an arbitrary maturity structure, similar to Auclert (2019), extended to allow for borrowing frictions and adjustment costs over the maturity structure. The household has perfect foresight over macroeconomic variables except for an unanticipated inflation shock to the path of price levels.

We first establish a benchmark result: without borrowing frictions, the welfare effects of unexpected inflation shocks are proportional to changes in households' lifetime wealth—the well-known wealth channel. We then demonstrate that when households face illiquidity due to convex borrowing costs or binding borrowing constraints, welfare effects depend on an additional statistic that captures the intertemporal misalignment between when inflation-induced gains and losses occur and when households most value additional resources. These results, while derived in a standard framework, highlight the unique interaction between households' nominal maturity structure and liquidity needs for understanding the welfare effects of inflation.

2.1 Household Problem

A household derives utility from consumption of a final good c_t and disutility from labor h_t, and can trade nominal and real assets indexed by maturity $j = 0, 1, 2, \ldots$. Each unit of nominal asset j pays one unit of currency in period j, while each unit of real asset j pays P_j units of currency—the nominal value of a unit of the final good. The wage W_t is partially nominal, with a fraction $1 - \theta_t^W$ indexed to inflation.

Let $n_{j,t}$ and $y_{j,t}$ denote the household's nominal and real holdings with maturity j in period t, which can be either positive or negative, representing assets or liabilities. The prices of these assets are $Q_{j,t}^n$ and $Q_{j,t}^y$ respectively. Making adjustments to holdings is costly: the household must pay a real adjustment cost $\phi_t(\cdot)$ that depends on the value of adjustments. These holdings over different horizons represent long-term cash flow arrangements, such as mortgages or retirement plans, that allow the household to tailor payment streams to its life cycle but are costly to adjust. Let $n_{j,-1} = \bar{n}_j$ and $y_{j,-1} = \bar{y}_j$ denote the household's initial holdings of nominal and real assets at the beginning of period 0.

In addition to the illiquid holdings, the household can save and borrow using a liquid nominal asset B_t without adjustment costs. However, liquid saving and borrowing are limited by two frictions. First, the household faces a real interest rate schedule $\tilde{R}_{t+1}^B(B_t/P_t)$ that depends on the real value of borrowing (or saving), inducing a convex borrowing cost. Second, a borrowing constraint χ_t limits the real value that the household can borrow: $B_t/P_t \geq -\chi_t$. Without loss of generality, we normalize initial liquid holdings to zero, $B_{-1} = 0$, subsuming any initial position into $y_{0,-1}$.

Given $\{P_t, Q_{j,t}^n, Q_{j,t}^y, W_t\}$ and the initial conditions, the household solves:

$$\max_{\{c_t, h_t, n_{j,t}, y_{j,t}, B_t\}_{t\geq 0}} \sum_{t=0}^{\infty} \beta^t \big[u_t(c_t) - \nu_t(h_t)\big]$$

subject to the nominal budget constraint

$$\begin{aligned} &P_t c_t + B_t + \sum_{j>t}^{\infty} \big[Q_{j,t}^n (n_{j,t} - n_{j,t-1}) + Q_{j,t}^y (y_{j,t} - y_{j,t-1})\big] + P_t \phi_t(\cdot) \\ &= W_t h_t + P_t/P_{t-1} \tilde{R}_t^B(\cdot) B_{t-1} + n_{t,t-1} + P_t y_{t,t-1}, \end{aligned}$$

the borrowing constraint $B_t/P_t \geq -\chi_t$, and the adjustment cost $\phi_t(\cdot) \coloneqq \phi_t(\{\frac{Q_{j,t}^n}{P_t}(n_{j,t} - n_{j,t-1}), \frac{Q_{j,t}^y}{P_t}(y_{j,t} - y_{j,t-1})\}_{j>t})$. Due to the presence of borrowing frictions and the adjustment cost, the household's consumption-saving behavior deviates from that of a permanent income

household.

In each period t, $n_{t,t-1}$ and $P_t y_{t,t-1}$ represent the nominal payments from maturing nominal and real assets. The real values of these holdings in terms of final goods in period t are $n_{t,t-1}/P_t$ and $y_{t,t-1}$, respectively. The real returns from holding nominal and real assets that mature in period j are given by

$$\tilde{R}^n_{j,t} \coloneqq \frac{Q^n_{j,t}}{Q^n_{j,t-1}} \frac{P_{t-1}}{P_t}, \quad \tilde{R}^y_{j,t} \coloneqq \frac{Q^y_{j,t}}{Q^y_{j,t-1}} \frac{P_{t-1}}{P_t},$$

with $Q^n_{t,t} = 1$ and $Q^y_{t,t} = P_t$.

While we suppress household indices for notational simplicity, preferences, adjustment costs, and borrowing frictions can vary across households in our empirical implementation, and time subscripts allow for life-cycle changes.

Inflation Shock

We now analyze the welfare effect of unexpected changes in the path of price levels. Initially, households expect prices to follow a sequence $\{\bar{P}_t\}$, but an unexpected inflation shock causes actual prices to evolve according to $\{P_t\}$:

$$\log P_t = \log \bar{P}_t + \hat{\pi}^t_0.$$

The sequence $\{\hat{\pi}^t_0\}$ is revealed to the household at the beginning of period $t = 0$ and represents the effects of the unexpected inflation shock over different time horizons, where $\hat{\pi}^t_0$ denotes the change in cumulative inflation from the beginning of period 0 to the end of period t.

To isolate the effects of inflation on cash flows over different horizons, we assume that the real returns $\tilde{R}^n_{j,t+1}, \tilde{R}^y_{j,t+1}$ and interest rate schedule $\tilde{R}^B_{t+1}(\cdot)$ are unaffected by price level changes for all periods $t \geq 0$. This assumption differentiates our channel from those working through changes in real returns—for example, the "interest rate exposure channel" in Auclert (2019), where households' welfare is affected by real interest rate changes, or Fagereng et al. (2022), which focuses on the distributional effects of asset price changes due to variation in real rates of return while holding real cash flows constant. In a more general framework, aggregate shocks or policies would simultaneously affect both inflation and real returns. Our analysis focuses on the inflation component of such shocks, examining how it affects households through their holdings of nominal assets and liabilities.

By isolating this inflation component, we provide a clear benchmark for understanding how households are affected by inflation, placing the nominal features of the economy at the center of the analysis. This contrasts with work such as Del Canto et al. (2023), where the effects of monetary and oil shocks operate through multiple channels simultaneously, changing not only inflation but also real variables such as output and real interest rates. Many of these real effects would occur even in an economy where households can sign nominal contracts that are perfectly indexed to inflation. By holding real rates constant, our analysis identifies the welfare effects of inflation that arise specifically from households' nominal balance sheet positions.

Welfare Effects

The inflation shock affects the real value of the household's nominal holdings and partially indexed wages. When the price level changes from $\bar{P}_t$ to P_t, the real value of a unit of nominal payment in period t changes from $1/\bar{P}_t$ to $1/P_t$, and the real wage changes from $\bar{w}_t$ to $w_t = [\frac{\bar{P}_t}{P_t}\theta_t^W + (1-\theta_t^W)]\bar{w}_t$.[1] Nominal assets pay a fixed amount of currency and lose real value under inflation, while the non-indexed portion of wages similarly decreases in real terms.

Let $\bar{c}_t, \bar{h}_t$ denote the optimal consumption and labor choices of the household, given the original sequence of price levels $\bar{P}_t$ and wages $\bar{W}_t$. The following lemma characterizes the welfare effect of the unexpected inflation shock $\{\hat{\pi}_0^t\}$:

Lemma 1 *The first-order effect of the inflation shock on the household's welfare is given by:*

$$dU = \sum_{t=0}^{\infty} \beta^t u_t'(\bar{c}_t)\Delta z_t,$$

where

$$\Delta z_t := -z_t \times \hat{\pi}_0^t, \quad z_t := \frac{1}{\bar{P}_t}\left[\bar{n}_t + \theta_t^W \bar{W}_t \bar{h}_t\right]$$

Proof. See Appendix A.1. □

Intuitively, z_t captures the real value of the nominal payments, coming from the household's initial nominal holdings, $\bar{n}_t$, and the portion of labor income exposed to inflation, $\theta_t^W \bar{W}_t \bar{h}_t$; Δz_t captures the gains and losses due to the initial nominal exposure to the inflation shock. If the household has net nominal liabilities in a period, then a positive inflation shock reduces

[1] In our empirical implementation, we assume that changes in the real value of wages paid to households correspond to equal changes in the real wage costs for the corporate sector, which are then allocated back to households based on their ownerships.

the real cost of paying off those liabilities, thereby increasing Δz_t; the effect is reversed for net nominal assets. In response to the shock, the household adjusts consumption, labor, and asset holdings. However, because these choices were made optimally before the shock, the envelope theorem implies that the welfare effect depends only on the direct impact on the initial cash flows, eliminating the effects from all endogenous portfolio adjustments. The total welfare effect is the sum of these period-by-period effects, weighted by the household's marginal utility of consumption in each period.[2]

We now consider two cases: (1) a frictionless benchmark, where the household can borrow and save across time at the market rate, and (2) a case in which the household faces illiquidity due to convex borrowing costs and constraints that hinder their ability to borrow and save across time.

Frictionless Benchmark

Consider the case in which there is no borrowing constraints, $\chi_t = \infty$, and the household faces linear borrowing costs, $\tilde{R}^B_{t+1}(\cdot) \equiv R_{t+1}$, where R_{t+1} denote a benchmark *market rate* for short-term borrowing and saving (e.g., the Treasury rate). In this "frictionless" scenario, the household's consumption satisfies the standard Euler equation:

$$u'_t(\bar{c}_t) = \beta u'_{t+1}(\bar{c}_{t+1}) R_{t+1}. \tag{1}$$

The welfare effect in Lemma 1 simplifies as follows:

Lemma 2 *If $\chi_t = \infty$ and $\tilde{R}^B_{t+1}(\cdot) \equiv R_{t+1}$, then*

$$dU = u'_0(\bar{c}_0) \times \Delta NPV, \quad \textit{where} \quad \Delta NPV := \sum_{t=0}^{\infty} \frac{\Delta z_t}{R^t_0}$$

and $R^t_0 := \prod_{s=1}^{t} R_s$ denotes the cumulative return at the market rate.

Proof. See Appendix A.1. □

Without any frictions in borrowing and saving, the welfare effects of unexpected inflation are summarized by ΔNPV, the real present discounted value of changes in nominal cash flows, with $u'_0(\bar{c}_0)$ mapping this change in life-time wealth into welfare. When households can freely borrow and save at the market rate, the marginal utility of consumption is equalized across

[2]Our formula differs from Fagereng et al. (2022): their welfare effects depend on planned asset transactions, while ours depend on the initial nominal payment streams. This distinction reflects different underlying thought experiments: they study changes in real asset prices holding real cash flows constant, while we study inflation as it changes the real value of nominal cash flows, holding real returns constant.

all periods. The timing of gains and losses does not matter—only their net present value matters. Households can always borrow and save to smooth consumption optimally.

This is a standard result that motivates the typical calculation of redistributive effects of inflation in the literature: the welfare effect of an unexpected inflation shock is proportional to the change in net present value of wealth, discounted at the market rate. For example, Doepke and Schneider (2006) and the Fisher channel in Auclert (2019) use this baseline to calculate the redistributive effects of inflation across household types due to their nominal balance sheets. However, when households are illiquid and cannot freely move resources across time, welfare effects can no longer be summarized by changes in wealth discounted at a single market rate. Relaxing the assumption that households can easily move resources across time leads to our key mechanism.

Household Illiquidity

When the household cannot freely borrow and save with the liquid asset at the market rate R_{t+1}, the Euler equation in Equation (1) does not hold. Yet, there exists a sequence of "wedges" $\{\tau_t\}$ such that the sequence of consumption $\{\bar{c}_t\}$ solves a modified Euler equation:

$$u'_t(\bar{c}_t) = \beta u'_{t+1}(\bar{c}_{t+1}) R_{t+1}(1 + \tau_{t+1}), \tag{2}$$

where τ_{t+1} depends on the shape of the borrowing cost $\tilde{R}^B(\cdot)$ and the size of the Lagrange multiplier on the borrowing constraint; $\tau_{t+1} > 0$ if either the borrowing constraint binds or if the marginal cost of borrowing is above R_{t+1}. If $\tau_{t+1} > 0$, the household would like to move resources from period $t+1$ to period t under the market rate R_{t+1}, thereby increasing c_t and decreasing c_{t+1}. However, due to the borrowing cost and constraint, they settle on the consumption path $\{\bar{c}_t\}$. The size of the wedges represents how far the household is from being able to equalize its marginal utility across time relative to the market rates.

While we focus on borrowing frictions for liquid assets, the wedges τ_t also incorporate information about adjustment costs $\phi_t(\cdot)$ as the household chooses $\{n_{j,t}, y_{j,t}\}$ to optimize across different margins. The adjustment costs are crucial because they affect the household's liquid borrowing and the severity of its borrowing constraints. The adjustment costs on long-term positions and frictions on liquid borrowing together create the wedges that prevent households from perfectly smoothing consumption.

Denote the cumulative wedge from period 0 to period t as:

$$1 + \tau_0^t \coloneqq \prod_{s=1}^{t}(1+\tau_s). \tag{3}$$

To incorporate the role of illiquidity, we need to characterize how the timing of gains and losses, Δz_t, aligns with the household's need for liquidity. For liquidity-constrained households, gains in periods where consumption is already high provide less value than gains in periods of low consumption. To formalize this intuition, we use a perpetuity that pays one unit of real good in every period as a benchmark for evaluating the timing of cash flows.

Let $\Omega \coloneqq \sum_{t=0}^{\infty} \frac{1}{R_0^t}$ be the price of this perpetuity. The weight $\omega_t \coloneqq \Omega^{-1}\frac{1}{R_0^t}$ represents the fraction of the perpetuity's value attributable to the payment in period t, where $\sum_{t=0}^{\infty}\omega_t = 1$. These weights allow us to compare any stream of gains and losses to an equivalent-value stream of payments with the perpetuity's smooth profile.

The following lemma characterizes the first-order welfare effects of unexpected inflation with household illiquidity:

Lemma 3

$$dU = u_0'(\bar{c}_0) \times avg\big[(1+\tau_0^t)^{-1}\big]\Big(\underbrace{\Delta NPV}_{\textit{(1) wealth channel}} + \underbrace{\Omega \times \Big\langle \Delta z_t, \frac{(1+\tau_0^t)^{-1}}{avg[(1+\tau_0^t)^{-1}]} - 1 \Big\rangle}_{\textit{(2) liquidity channel}} \Big), \tag{4}$$

where

$$avg[x_t] \coloneqq \sum_{t=0}^{\infty}\omega_t \times x_t, \quad \langle x_t, y_t\rangle \coloneqq \sum_{t=0}^{\infty}\omega_t \times x_t y_t.$$

Proof. See Appendix A.1. □

Due to illiquidity, the welfare effect differs from the frictionless benchmark in important ways. The term $u_0'(\bar{c}_0) \times avg[(1+\tau_0^t)^{-1}]$ measures the marginal utility of an extra unit of wealth delivered as a perpetuity, and reduces to $u_0'(\bar{c}_0)$ when $\tau_t = 0$ (no borrowing frictions). This average marginal utility multiplies the sum of two components: (1) The wealth channel (ΔNPV), corresponding to the direct effect of the inflation shock on the net present value of lifetime wealth in Lemma 2. (2) The liquidity channel, an additional term proportional to $\langle \Delta z_t, \frac{(1+\tau_0^t)^{-1}}{avg[(1+\tau_0^t)^{-1}]} - 1\rangle$, capturing how the inflation-induced gains and losses align with the household's need for liquidity over time.

The liquidity channel captures whether inflation redistributes resources toward periods when

the household values them more or less. When the household's marginal utility is high in periods when it receives nominal payments and low in periods when it makes nominal payments, this interaction term becomes negative. Inflation is particularly hurtful in this case, eroding the value of payments from nominal assets precisely when additional income would be most valuable, while reducing debt burdens when resources are already plentiful. By shifting resources away from high marginal utility periods toward low marginal utility periods, inflation exacerbates the household's liquidity problem.

The liquidity channel vanishes under two benchmark scenarios: (i) if Δz_t remains constant across time horizons, or (ii) if $\tau_0^t = 0$ for all t.[3] Empirically, neither condition holds for most U.S. households. Sections 3 and 4 document substantial variation in Δz_t across horizons due to nominal maturity mismatches on household balance sheets. Section 5 shows that borrowing frictions generate substantial wedges τ_t.

To implement this framework empirically, we need to measure not only the wealth channel ΔNPV, but also (1) how gains and losses Δz_t distribute across time horizons, and (2) the size of borrowing wedges τ_t. The following sections measure these objects for U.S. households to study how they are affected by unexpected inflation. We focus on the 2021–2022 inflation episode as our primary application, but also examine welfare exposure to inflation shocks at arbitrary horizons to demonstrate the broader implications of the liquidity channel.

3 Household Nominal Balance Sheet

We calculate streams of nominal payments $\{z_t\}$ that each household expects to receive in future years based on their current holdings of assets and liabilities and their characteristics. Our data for this calculation comes from the 2019 Survey of Consumer Finances, which contains household balance sheet information in detailed asset and liability categories. Since the SCF is triennial and the 2021–2022 inflation episode is our main focus, we use the last SCF release immediately preceding the inflation shock, assuming that these balance sheet data represent an accurate pre-shock image of household wealth, income, and characteristics.

We use granular observations of each household's holdings to construct payment streams based on the characteristics of each asset and liability category. We first consolidate balance sheet items that represent claims with heterogeneous characteristics; for example, a household's equity holdings may contain both claims on commercial real estate (real asset) and corporate deposits (nominal asset). We deconstruct these balance sheet items and convert

[3]The definition of τ_0^t in Equation (3) implies that $\tau_0^0 = 0$. Thus, $(1 + \tau_0^t)^{-1}$ can remain constant over time only if $\tau_0^t = 0,\ \forall t \geq 0$.

household balance sheets from the SCF into consolidated balance sheets that tell us their claims on assets and liabilities with relatively homogeneous properties. We then use information about each category, with some necessary assumptions, regarding nominality (whether payments track the price index or not) and maturity structure (the time horizons over which payments are expected) to construct plausible estimates of $\{z_t\}$.

We adjust the data so that (1) household-level data in the SCF are consistent with national aggregate statistics, and (2) all nominal assets and liabilities at each horizon sum to zero when the government and the rest of the world are included.[4] We describe our empirical procedure and results in this section, and provide details in Appendix C.

3.1 Direct and Indirect Holdings

We begin by separating all assets and liabilities on households' balance sheets in the SCF into two categories: *final* and *intermediate*. Final assets and liabilities include vehicles, homes, cash, the franchise value of a business, or a well-defined stream of nominal payments such as Treasury debt or fixed-rate mortgages. Intermediate assets are those that define ownership stakes in final assets and liabilities or other intermediate assets. These intermediate assets include shares of stocks and mutual funds or claims to investment in retirement accounts.

Final assets and liabilities are either directly held by households or indirectly held through intermediate assets. For final assets and liabilities that a household reports to hold directly in the SCF, we refer to them as the household's *direct holdings*. For final assets that households claim through intermediate assets, we refer to them as their *indirect holdings*. Below, we describe households' direct and indirect holdings and how we deconstruct intermediate assets into households' indirect holdings of final assets and liabilities.

Direct Holdings

Households' direct holdings of final assets include items such as cash, certificates of deposit, and vehicles, as well as liabilities such as mortgages, credit card debts, and student loans. In addition to these typical assets and liabilities, we also include households' expected future labor income ($\bar{W}_t\bar{h}_t$) as a final asset (and liability for the corporate sector). Following our framework in Section 2, we assume that a fraction of labor income in each future period is fixed nominally and exposed to unexpected inflation shocks. Since expected labor income

[4] For instance, household mortgages are liabilities to households but assets to the financial sector. Similarly, the nominal component of future labor income is an asset to households but a liability to the corporate sector.

is one of the largest sources of wealth for many households, its response to inflation shocks will be crucial. This extends the work of Doepke and Schneider (2006), who do not consider labor income in their calculation of household wealth.

Indirect Holdings

Households hold assets and liabilities indirectly through intermediate assets such as pension funds, mutual funds, and corporate equity. As an example, consider a household that owns $100,000 of shares in a mutual fund. If the mutual fund holds 10% of its value in Treasury debt, then the household indirectly holds $10,000 of Treasury debt. Moreover, if the mutual fund holds 50% of its value in the general stock market, and the corporate sector together invests 10% of its value in Treasury debt, then the household holds another $5,000 of Treasury debt through this second-level linkage. We rely on national financial accounts (the Flow of Funds, or FOF) to trace the indirect holdings of various asset classes. The FoF reports the cross-holdings of assets and liabilities of financial and corporate entities at the aggregate level, such as holdings of pension funds, mutual funds, etc.[5] We consolidate the balance sheets of these entities to calculate each household's final asset holdings. Details of the consolidation procedure and the consolidated results are provided in Appendix C.1. In particular, Table C.2 shows that our consolidated balance sheets satisfy the accounting identity that each liability corresponds to an asset owned by another sector in the economy, up to minor data discrepancies.

Consolidated Household Balance Sheet: Descriptive Statistics

Figure 1 shows the consolidated balance sheet of U.S. households in each wealth decile. The X-axis represents the household decile in the wealth distribution, and the Y-axis shows gross assets and liabilities held by each decile. The left panel summarizes holdings in 2021 dollars, while the right panel describes holdings as a fraction of net worth. As we can see, assets and liabilities are held in strikingly large quantities by the top decile of the wealth distribution, and a large component of assets and liabilities is indirectly held, which means that those asset holders are indirect holders of debt through these indirect assets. With the consolidated household balance sheet, we observe the outstanding amount of each final asset eventually owned by or owed to a household.

[5]Because our calculation of indirect holdings relies on aggregate data, we cannot account for portfolio heterogeneity across households within each intermediate asset category.

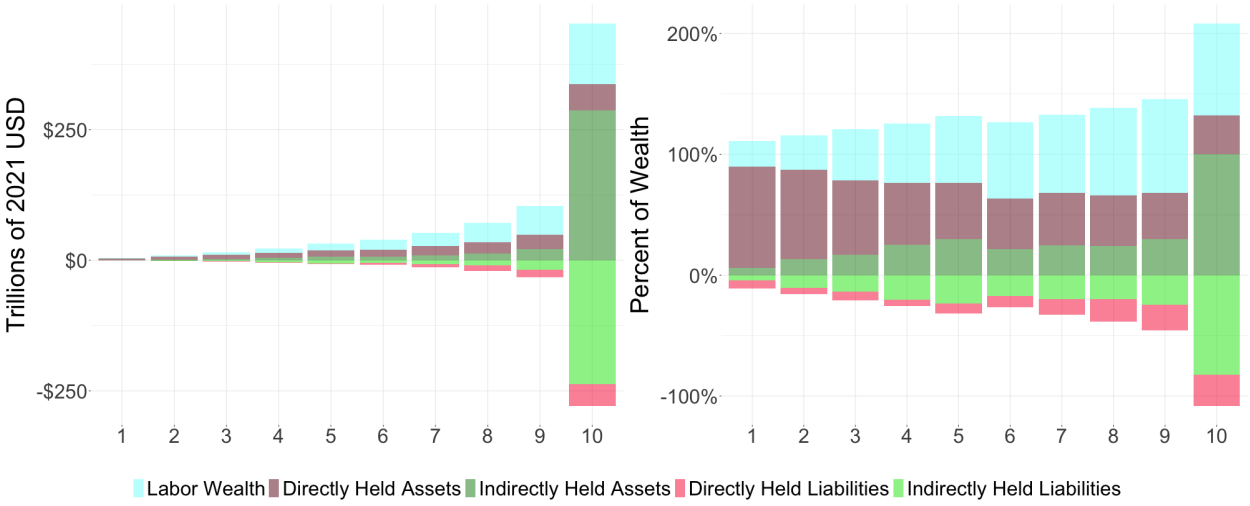


Figure 1: Consolidated balance sheet of U.S. households by wealth decile: dollars and percent of net wealth.

In Figure 2, we show the assets and liabilities held by households in the SCF, broken down by the highest-value holdings. The vast majority of wealth for households outside the top wealth decile comes from expected labor income — a channel we discuss further below. In contrast, the highest wealth decile holds a significant fraction of wealth in corporate business value (accounted as "Goodwill") and other business interests. As a fraction of net worth, we also see large differences between the poor and the rich. For the poorest decile, expected future labor income and housing make up a significant fraction of total net worth, while for the richest decile, business interests are relatively more important.

These differences between the rich and the poor also correlate with other household characteristics. In Appendix Table B.1, we summarize the demographic composition of households by decile of wealth. Here, we see that the low-wealth households are less educated, less likely to be white, and older. Since we account for future labor income in our calculation of wealth, many of these low-wealth households contain retirees without significant sources of income beyond social security. In comparison, the highest-wealth households are younger and are significantly more likely to be white and to have attended college.

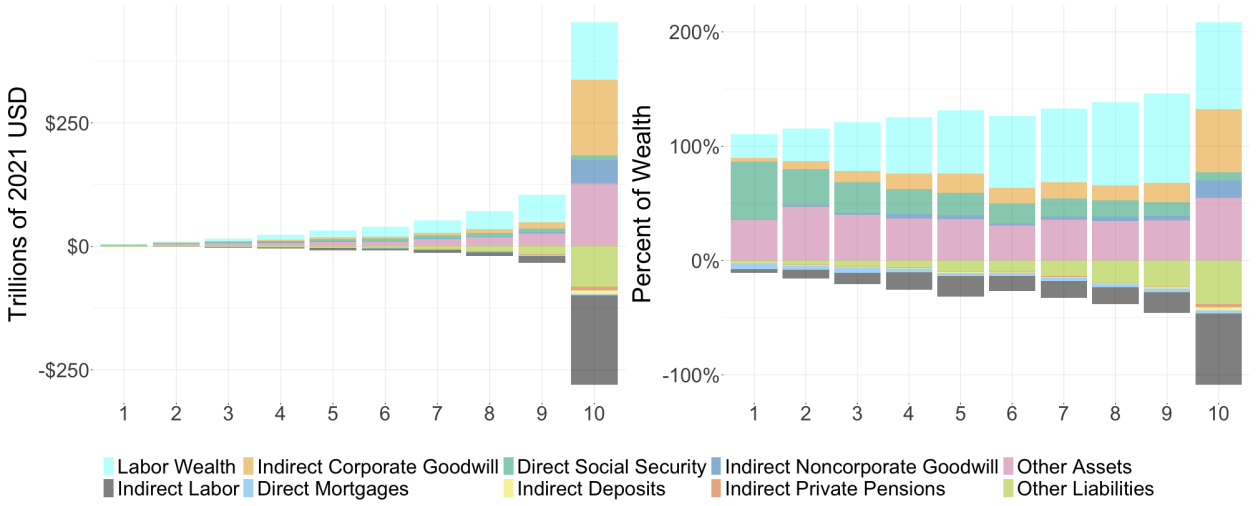


Figure 2: Consolidated balance sheet of U.S. households by wealth decile: dollars and percent of net wealth (top holdings).

3.2 Nominality and Maturity Structure

Given the consolidated balance sheets of final assets and liabilities for each household, we use information about each asset/liability category to specify two of their characteristics: (1) the level of *nominality* over different time horizons, denoted by θ_t, and (2) the timing of payments. With these two characteristics, we construct the stream of nominal payments z_t for each household.

The nominality of assets and liabilities describes how much their real value changes with the general price level. A checking deposit of one dollar is a simple example of a nominal asset with nominality $\theta_t = 1$ that pays one dollar in period 0 and nothing thereafter: A household with such deposit holdings loses purchasing power dollar-for-dollar with a positive realized inflation. However, it can be freely adjusted after the shock, as only the initial holding is pre-committed. Certificates of deposit and some nominal bonds have similar characteristics, although they have a longer maturity. Now consider what we treat as a real asset with nominality $\theta_t = 0$: the value of a homeowner's home. As most households directly consume the service flows from their houses, these service flows are not affected by changes in the price level. Therefore, we regard the home value reported as a real asset, whose value adjusts one-to-one with inflation.

Many assets and liabilities—like treasuries and mortgages—can be either nominal or real assets depending on the household's holdings. For example, if a mortgage has a fixed rate, then it is nominal because the interest rate is prespecified and unchanging. If a mortgage

has an adjustable rate, then it is real because the rate is often pegged to real-time interest rates. Similarly, a Treasury security can be nominal or real depending on whether it is inflation-protected or not.

Below, we discuss a selection of important asset and liability categories, and we detail assumptions underlying the rest of the assets and liabilities in Appendix C.2.

Treasury Securities

Most treasuries held directly and indirectly by households are nominal assets that lose value (in real terms) when there is a positive inflation shock. Only a small minority (roughly 9%, according to the Congressional Budget Office) of treasuries are TIPS: Treasury Inflation-Protected Securities. We do not observe which households hold typical or inflation-protected treasuries; so for every household in the SCF that directly or indirectly holds treasuries, we assume that 9% of their holdings are adjustable-rate (real) and 91% are fixed-rate (nominal). We also use annual issuances of treasuries of different maturities to construct the stream of nominal payments from outstanding treasuries, and we assume that all households holding treasuries receive streams of nominal payments that are proportional to the aggregate stream of nominal payments from Treasury securities.

Mortgages

Mortgages can be adjustable or fixed-rate. For each household with a mortgage, SCF reports whether the interest rate adjusts, the number of years remaining, the prevailing interest rate, and the remaining principal. We use this detailed information in the SCF to identify households with fixed-rate mortgages. We assume all fixed-rate mortgages are nominal and all adjustable-rate mortgages are real. For fixed-rate mortgages, we use the constant mortgage rate for that loan. For adjustable-rate mortgages, we calculate a forward mortgage rate using the forward treasury rate plus the mortgage spread, making further adjustments to account for the initial period with fixed rates and contractual caps on the frequency and size of rate changes. Using this data, we construct a stream of nominal mortgage payments which the household is expected to pay over the remaining years of the mortgage.

Labor Income

We estimate the expected stream of labor income for each household by regressing logged labor income on demographic fixed effects (sex, age, race, and college) and year fixed effects, interacting age and year separately with the other demographic variables, using pooled 2010–2019 SCF microdata. Prior to estimation, we replace zeros with the 5th percentile of

non-zero income for each demographic group. We then apply the resulting estimated life-cycle income growth rates to each individual's reported income. We also adjust expected labor income for mortality rates and calculate federal and local tax liabilities separately.[6]

We allow households' expected labor income to contain a nominal component that varies by income level. We incorporate the nominality of labor income using estimates from Hajdini et al. (2023), who survey respondents surrounding the 2021 inflation shock and find that for households earning less than \$50k, \$50-100k, or more than \$100k, only 13%, 31%, or 34% of expected income growth adjusts with inflation expectations. This implies nominality θ_0^W are 0.87, 0.69, and 0.66, respectively, depending on household income. For labor income after the initial year, we assume a gradual adjustment, where $\theta_1^W = 0.6 \times \theta_0^W$ and $\theta_2^W = 0.15 \times \theta_0^W$; wages in years afterwards are assumed to have completely adjusted to inflation. We test the robustness of these assumptions in Appendix F.

Other Assets/Liabilities

We assemble data describing each of our 20 main asset and liability classes to characterize their nominality and the timing of payments. This involves a series of imputations and assumptions about liability types like car loans (with three years remaining) and credit card loans (with an assumed maturity of one year). We describe these assumptions in more detail in Appendix C, with Figure C.3 showing the assumptions about the nominality and maturity structure of each asset and liability.

3.3 Nominal Balance Sheet and Maturity Mismatch

In Figure 3, we show the nominal holdings of households, breaking the holdings into specific assets and liabilities held by households in each wealth decile. Panel A shows the net present values of holdings, while Panel B is normalized by the total net worth of each wealth decile. Among poor households, most nominal wealth is held in the form of expected labor income, with holdings of fixed-rate mortgages on the liability side partially offsetting those nominal assets. For wealthy households, labor income plays a much smaller role in nominal asset holdings, and households instead hold significant nominal assets and liabilities of other types, which together form a larger fraction of net worth.

[6] In the calculation of household wealth decile, we include the net present value of future labor income discounted with Treasury rates as part of their "wealth."

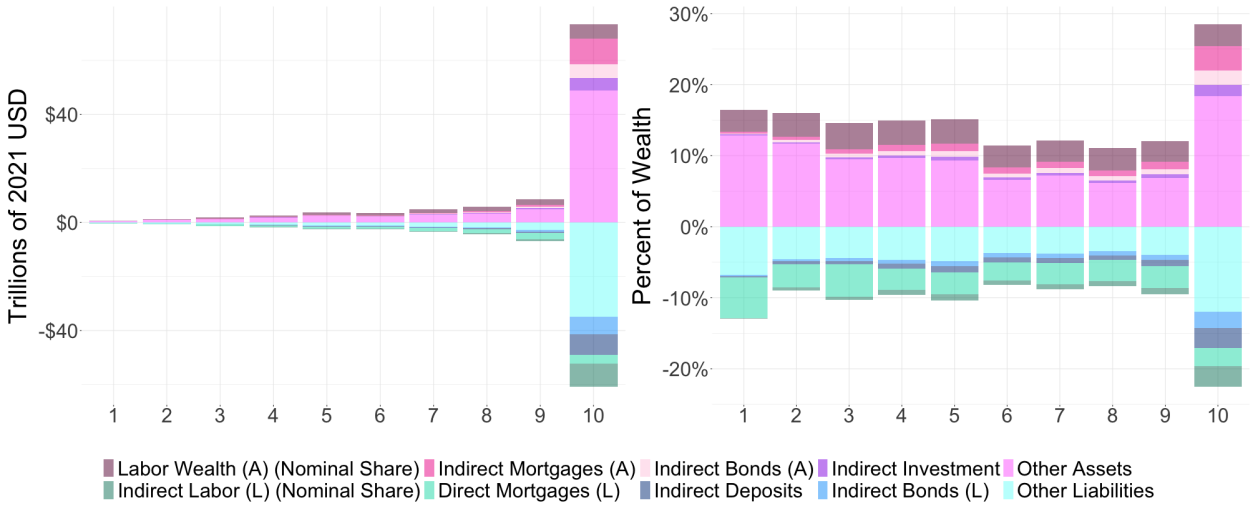


Figure 3: Consolidated nominal balance sheet of U.S. households by wealth decile: holdings in dollars (left) and percent of net wealth (right). Appendix Figure B.1 shows versions of this figure conditional on household age groups.

Table 1 shows the present values and average duration of nominal assets and liabilities for households in the 1st, 5th, and 10th wealth deciles, where present values are discounted using Treasury yields. Except for the 10th decile, the duration of liabilities substantially exceeds that of assets. This phenomenon is what we refer to as a "nominal maturity mismatch." In fact, nominal maturity mismatch is not only a key feature for the 1st and 5th deciles but a common phenomenon for all deciles besides the 10th. We show the prevalence of this phenomenon across wealth deciles in Appendix Table B.2, which contains the same calculation of nominal durations for each wealth decile, and Appendix Table B.3, which shows the share of nominal maturity mismatched households. We will show later on that this nominal maturity mismatch has important implications for the effects of an unexpected inflation shock on illiquid households.

Table 1: Nominal Balance Sheet across Wealth Decile

Household Decile	1	5	10
Assets	45	286	5,695
Liabilities	33	199	4,708
Assets Duration	1.8	2.9	3.9
Liabilities Duration	6.5	5.5	3.8

Note: Levels are in thousands, 2021 USD. Duration is calculated as the average time of payments (in years), weighted by net present values.

4 Timing of Gains and Losses from Inflation

With the nominal payment stream for each household, we can calculate how each household was affected by the 2021–2022 inflation episode. We use data on realized inflation and inflation expectations to construct a path of inflation shocks $\hat{\pi}_0^t$ over different time horizons. Combining these shocks with the nominal payment streams for each household, we compute their gains and losses over different horizons.

4.1 Inflation Shocks

We construct our measure of inflation shocks $\hat{\pi}_0^t$ for horizon t as:

$$\hat{\pi}_0^t \coloneqq E_1[\pi_0^t] - E_0[\pi_0^t],$$

where $E_0[\pi_0^t]$ and $E_1[\pi_0^t]$ are, respectively, the (log) inflation expectations of cumulative inflation from the beginning of period 0 to the end of period t, based on information available at the beginning of period 0 and 1. For example, for the initial inflation shock, $\hat{\pi}_0^0$, we take the difference between the realized inflation during period 0 and the inflation expectation at the beginning of that period. Similarly, $\hat{\pi}_0^t$ represents the updates in inflation expectations about period 0 through t, with $E_1[\pi_0^t]$ incorporating the realization of the initial shock and updates of expectations over future periods in the initial period:

$$E_1[\pi_0^t] = \pi_0^0 + E_1[\pi_1^t].$$

We construct our measure of realized inflation using the CPI. For inflation expectations, we use data from the Federal Reserve Bank of Cleveland, which combines information about Treasury yields, inflation swaps, and survey-based measures into one comprehensive measure of inflation expectations.

Figure 4 shows the inflation shock for the 2021–2022 inflation episode (January 2021 to January 2022, dark blue line) and contrasts it with the corresponding measure from the year before (January 2020 to January 2021, gray line). The X-axis represents the horizon of expectations, and the Y-axis represents the initial inflation shock (squares) and inflation expectation updates for longer horizons (circles), annualized for ease of comparison. We can clearly see that over the year 2021, U.S. households experienced a large increase in realized inflation and a significant increase in their inflation expectations over longer horizons. These unexpected changes in inflation and inflation expectations alter the real value of nominal assets and liabilities for each household.

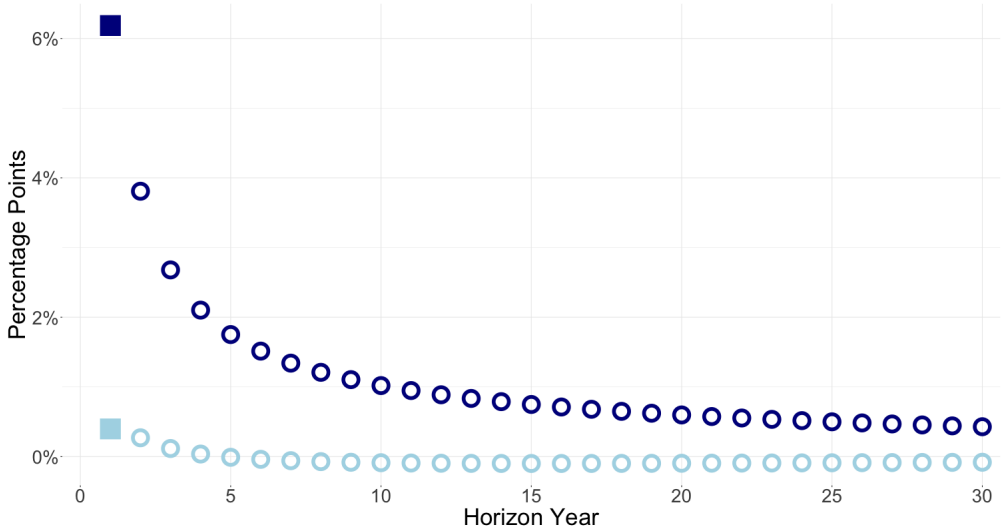


Figure 4: Realized inflation shock (squares), $\hat{\pi}_0^0 = \pi_0^0 - E_0[\pi_0^0]$, and annualized expectation updates (circles) over different horizons, $\frac{1}{t+1}\hat{\pi}_0^t = \frac{1}{t+1}(E_1[\pi_0^t] - E_0[\pi_0^t])$. Dark blue dots represent the 2021-2022 inflation shock we study; light blue dots represent the same calculation for the period 2020-2021 for comparison.

4.2 Gains and Losses

We now combine our measure of households' nominal positions with the inflation shocks from Figure 4 to calculate changes in the real value of households' payment streams over different horizons. For each horizon t, we calculate the change in the real value of nominal payments as:

$$\Delta z_t = -z_t \times \hat{\pi}_0^t,$$

where z_t represents the real value of a household's net nominal position at horizon t and $\hat{\pi}_0^t$ is the cumulative inflation shock. To compute the net present values of the effects, we use real Treasury rates R_0^t for the corresponding horizons to discount Δz_t.[7]

Table 2 illustrates this calculation for a typical household: the average household in the 5th wealth decile.

[7]We use Treasury yields for 1-, 3-, 5-, 10-, 20- and 30-year maturities observed in Dec 2019, linearly interpolating horizons in between. Nominal yields are converted to real yields using inflation expectations from the Cleveland Fed.

Table 2: Nominal Position of the Average Household in the 5^{th} Wealth Decile

horizon	1 year	2-5 year	6+ year
assets	133	120	33
liabilities	62	75	63
net position	71	46	-30
cumulative inflation shock (avg.)	6%	8%	11%
gains and losses	-4.4	-3.5	3.3
effects on networth	-0.23%	-0.18%	0.17%

Note: Levels are rounded to thousands, 2021 USD.

The top panel shows the household's nominal assets and liabilities at different horizons. Comparing assets and liabilities, the average household has a net positive nominal position for the 1-year horizon, a small positive position in the medium run (2–5-year), and a net negative nominal position for the longer horizon (6+ years). This feature of their balance sheet is the nominal maturity mismatch that we document in Section 3.3. A positive nominal position in the short run means that the average household experiences losses from positive inflation shocks as their nominal assets lose more in value than they gain from nominal liabilities. On the contrary, the average household holds more nominal liabilities than assets in the long run, so they expect a gain in the long run as the real value of debt reduces with unexpected increases in inflation and inflation expectations.

The bottom panel of Table 2 shows the resulting gains and losses, reported in both thousands of 2021 USD and as a percentage of the household's wealth. A net positive nominal position in the short run means the household experiences losses from positive inflation shocks. Conversely, the net negative nominal position in the long run generates gains as the real value of debt declines with higher inflation expectations. Across time horizons, the net effect on lifetime wealth is small: losses in the short run (0.23% and 0.18%) are largely offset by gains in the long run (0.17%).

While Table 2 focuses on households in the 5th wealth decile, the same pattern is representative of a large majority of U.S. households. Figure 5 shows the effects of the 2021–2022 inflation shock for each household, averaged within each wealth decile. Gains and losses are separately shown, with gains above the X-axis and losses below the X-axis. Effects of the inflation shock due to assets and liabilities held over different time horizons are presented in different colors. The red dashed lines represent the net effect of the inflation shock on households' wealth, which corresponds to the commonly studied wealth channel.

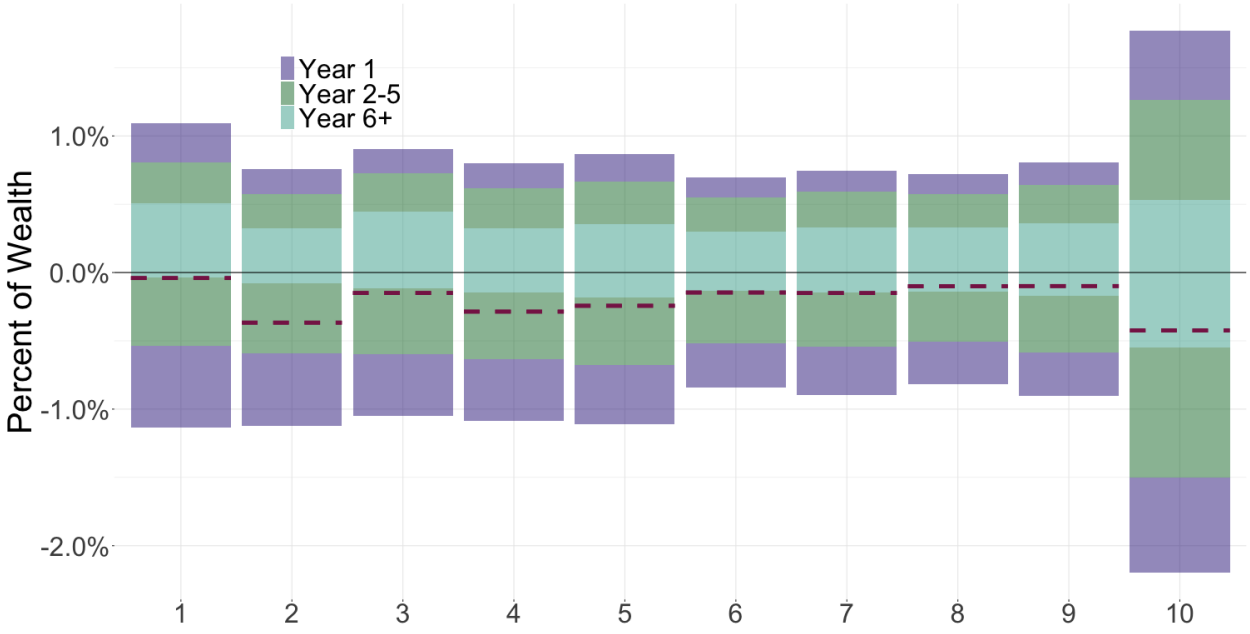


Figure 5: Gains and losses due to nominal exposure across the wealth distribution. X-axis: wealth by net worth; Y-axis: gains and losses as a percentage of wealth. Dashed lines indicate net change. Appendix Figure B.4 shows versions of the figure conditional on household age groups.

Overall, for wealth deciles 1–9, the pattern is roughly the same as for the 5th wealth decile (as shown in Table 2). This majority of households experience larger short-run losses (the purple bars) and longer-run gains (green and blue bars, representing years 2+). On the other hand, households in the top wealth decile hold different types of assets and liabilities and do not experience the same pattern of losses and gains.

While some households gain and others lose from inflation, the aggregate impact on the household sector's lifetime wealth is negative but represents a very small fraction of total wealth. In Appendix B, Figure B.5 shows that the offsetting gains are captured by the government through reduced real debt burden. Still, these gains from the household sector are modest when compared to those from the rest of the world.[8]

The literature on the effects of inflation has focused on the *net* effects on each household's lifetime wealth, identifying and quantifying the effects of inflation shocks on net nominal holders of assets and liabilities across the wealth distribution (e.g., Doepke and Schneider

[8]Our framework is partial equilibrium in nature and does not model what the government does with these gains. We maintain this agnosticism deliberately, as the welfare implications depend on fiscal policy choices beyond the scope of our paper. However, our analysis of how households are affected by inflation provides useful information for evaluating how the government might best deploy these resources.

(2006), Auclert (2019), Cardoso et al. (2022), and Del Canto et al. (2023)). However, the total wealth effect misses that many households may value these gains and losses differently because they occur over different time horizons: the interaction term in Section 2 between the gain and loss across time horizons and the wedges due to household illiquidity. In the next section, we construct measures of each household's illiquidity — the τ_t term in our model, and we use these measures to incorporate the welfare loss of unexpected inflation shocks due to illiquidity.

5 Measuring Household Illiquidity

We measure the frictions households face when transferring resources across time, represented by the wedge τ_t between their marginal utility of consumption over time.

5.1 Measuring Wedges

To measure these frictions, we focus on the household's Euler equation for liquid assets—the primary margin through which households adjust their intertemporal allocation. The optimality of the household's savings decisions implies:

$$u_t'(\bar{c}_t) = \beta u_{t+1}'(\bar{c}_{t+1}) R_{t+1}(1+\tau_{t+1}).$$

As we show in Appendix A, the wedge τ_{t+1} has two components:

$$1+\tau_{t+1} = (1+s_{t+1})(1+\zeta_{t+1}),$$

where s_{t+1} denotes the *spread* due to convex borrowing costs and ζ_{t+1} denotes the *shadow rate* from borrowing constraints:

$$1+s_{t+1} \coloneqq \frac{\tilde{R}^B_{t+1}(\bar{b}_t) + \bar{b}_t \tilde{R}^B_{t+1}{}'(\bar{b}_t)}{R_{t+1}}, \quad 1+\zeta_{t+1} \coloneqq \frac{1}{1-\bar{\mu}_t}. \tag{5}$$

The spread s_{t+1} captures how much more expensive borrowing is relative to the market rate R_{t+1}, with $\tilde{R}^B_{t+1}(\bar{b}_t)+\bar{b}_t\tilde{R}^B_{t+1}{}'(\bar{b}_t)$ corresponds to the marginal cost of borrowing, given the real value of borrowing, $b_t \coloneqq B_t/P_t$. The shadow ζ_{t+1}, on the other hand, represents how much a household would have been willing to pay to borrow, with $\bar{\mu}_t$ representing the Lagrange multiplier associated with the borrowing constraint at time t.[9]

[9]The Lagrangian is defined in Equation (6) in Appendix A.

We measure these two components of the wedges from two sources. To measure the spreads, we rely on detailed questions in the SCF to infer households' marginal cost of borrowing. To measure the shadow rates, we use households' consumption responses to one-time unexpected transfers of liquid assets to bound the additional gap between their marginal utility of consumption.

Spreads

Because many households rely on credit cards to fulfill unexpected spending needs and to maintain revolving credit card balances (unpaid balances that carry over month-to-month and accrue interest), we measure households' marginal borrowing costs by tracking the credit card interest rate for each household that has a revolving balance. To determine which households carry balances and the interest rates they pay, we use the following two detailed SCF questions about credit card usage:

1. *After the last payment was made, what was the total balance still owed?*
2. *What interest rate do you pay on the card where you have the largest balance?*

We use the first question to identify households carrying revolving balances. For households that report having less than \$100 in remaining balance, we assign a spread of zero. Conditional on the household carrying a remaining balance of at least \$100, we then calculate the household's marginal cost of borrowing as the reported interest rate from the second question. In Appendix D.1, we describe details of the calculation and report summary statistics.

Shadow Rates: A New Method

When households face a binding borrowing constraint, the Euler equation does not hold with equality even after correcting for the marginal cost of borrowing:

$$u'_t(\bar{c}_t) > \beta u'_{t+1}(\bar{c}_{t+1}) R_{t+1}(1 + s_{t+1}).$$

To measure the size of this additional wedge, we propose a new method that exploits households' consumption responses to unexpected lump-sum transfers. The key idea is that when the borrowing constraint binds for a household, a lump-sum transfer at time t allows it to increase consumption c_t to reduce the gap between its marginal utility in the two periods until the Euler equation holds with equality. Therefore, the size of the consumption response between periods t and $t+1$ reveals the severity of the borrowing constraint.

Specifically, consider a one-time lump-sum transfer of value $\check{T}$ at period t, and let $\check{c}_t$ denote

the log deviation of consumption in period t in response to the transfer from its original level. The optimality of the household's consumption-saving problem implies the following inequality:

Lemma 4 *Suppose that* $\frac{-u_t''(c)c}{u_t'(c)} = \sigma$ *and* s_{t+1} *is unaffected by the transfer.*[10] *Then*

$$\sigma \times (\check{c}_t - \check{c}_{t+1}) \leq \log\left(\frac{1}{1-\bar{\mu}_t}\right) = \log(1+\zeta_{t+1}).$$

Proof. See Appendix A.2. □

Intuitively, if the constraint is not binding, the household's Euler equation holds with equality ($\check{c}_t = \check{c}_{t+1}$), and the multiplier $\bar{\mu}_t$ is zero. If the constraint binds, the transfer allows the household to increase consumption, and the multiplier decreases accordingly. The larger the change in consumption in one period relative to the next, the more the multiplier must decrease. Since the multiplier is bounded below by zero, a large decrease implies a large multiplier $\bar{\mu}_t$ originally, and thus we can infer that the household faces a higher shadow rate. Measuring households' consumption responses therefore provides lower bounds for their shadow rates, given the intertemporal elasticity of substitution $1/\sigma$. We build on this insight to measure shadow rates for U.S. households using transaction-level data to identify consumption responses to unexpected lump-sum transfers.

5.2 Shadow Rates and Consumption Response

We estimate shadow rates by measuring household consumption responses to the 2020–2021 stimulus checks in high-frequency transaction data from Facteus. The Facteus panel contains transaction-level spending and income data for tens of thousands of consumers, sourced from administrative bank records, allowing us to estimate precise responses to income shocks at a daily frequency. Following Karger and Rajan (2023), we identify sharp changes in spending around several rounds of stimulus payments during 2020-2021, then map these consumption responses to SCF households as a function of age and income. We provide an overview of how we construct the measure and refer to Appendix D.2 for details.

[10] For example, if the household is at the borrowing constraint and stays constrained after the transfer, then the liquid holding response is zero: $\check{b}_t = 0$. Since $\tilde{R}^B_{t+1}(\cdot)$ is a function of b_t, $\check{b}_t = 0$ implies s_{t+1} is unaffected. Alternatively, the condition also holds if $\tilde{R}^B_{t+1}(\cdot)$ is a step function and $\tilde{R}^B_{t+1}{}'(\cdot) = 0$ locally.

Background and Identification

The 2020–2021 federal stimulus checks provided households earning under $150,000 in household income (or less than $75,000 in individual income) with up to three rounds of lump-sum payments. Households with different family compositions received different stimulus amounts: for example, single filers with no children received $1,200 in the first round of stimulus checks in April 2020, while single filers with two children received $2,200.[11]

In each bank account in Facteus, we observe income and detailed spending for each account holder. We measure daily consumption as the sum of typical card spending transactions, account fees, and ATM cash withdrawals. This measure primarily captures non-durable goods and services (e.g., groceries, general merchandise, restaurants) and, by construction, excludes mortgage payments, rent, and utilities.

In our sample, average spending is $1,561 per month ($18,740 annually) and average after-tax annual income is $28,214. The sample skews toward middle- and low-income households, which is well-suited for our purposes: these households are most likely to face binding borrowing constraints, and therefore, measuring the shadow rates is particularly essential for assessing how inflation affects their welfare.

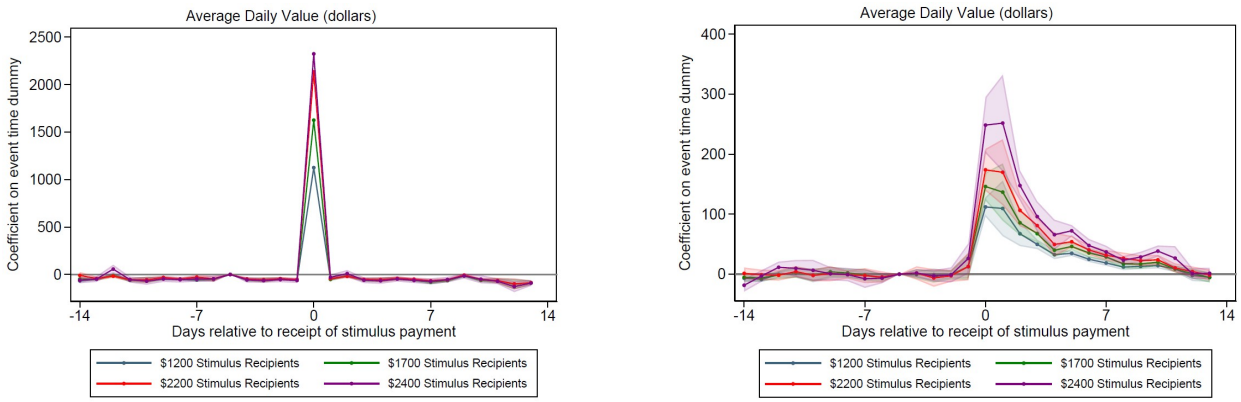
Using this data, we identify consumption responses to the stimulus checks through an event-study design that exploits the sharp timing of stimulus receipt. This approach addresses two key identification concerns. First, we verify that there are no anticipatory consumption changes before the transfer, which would indicate that households adjusted spending in advance of receiving the payment. Second, by comparing spending around the exact receipt date at the individual level, which varies across three weeks, we can confidently rule out confounding effects from aggregate shocks, such as COVID-19-related consumption shifts, which affected all households similarly regardless of their stimulus timing. We focus on the first round of stimulus to alleviate concerns that subsequent rounds might be affected by the effects of previous transfers.

To illustrate the event, Figure 6 shows the consumption response to stimulus receipt for the first round of payments, broken down by households receiving different check sizes. There is no anticipatory change in spending in the weeks leading up to payment. On the day the stimulus check is deposited, we observe a sharp increase in spending that remains elevated for two weeks before returning to pre-shock levels. This clean pattern with no anticipation, a sharp response, and a gradual decay, validates our identification strategy and motivates

[11] There were smaller checks given to individuals and households with larger incomes, but the checks phased out quickly as a function of income.

our approach to measuring consumption responses over a two-week window.

Figure 6: Consumption Response to Stimulus Payments



(a) Transfer (b) Spending

Notes: Event study of daily spending around stimulus check receipt in April 2020, broken down into households receiving different check amounts. The figure plots coefficients from a regression of daily spending on event-time dummies (relative to the deposit date), controlling for account fixed effects and state-by-date fixed effects. Coefficients are normalized to zero five days before receipt. Standard errors are clustered by state and calendar date.

Measuring Consumption Responses

We construct household-specific consumption responses by measuring how much each household increases spending following the first round of stimulus receipt. For each individual i in the Facteus data, we calculate their consumption response as the change in spending in the two weeks following stimulus receipt relative to the two weeks before, normalized by annual consumption to express the change at an annual frequency:

$$\Delta c_i = \frac{c_{i,post} - c_{i,pre}}{c_i}$$

where $c_{i,post}$ and $c_{i,pre}$ are two weeks post- and pre-receipt spending, and c_i is household i's annual non-durable consumption.

To apply these consumption responses to the broader U.S. population in the SCF, we estimate how responses vary systematically with age and income. We regress consumption responses on flexible splines in age and income:

$$\Delta c_i = f(age_i; \beta_a) + g(income_i; \beta_y) + \varepsilon_i$$

and use the estimated coefficients $\hat{\beta}_a$ and $\hat{\beta}_y$ to predict responses for each SCF house-

hold:

$$\widehat{\Delta c_i} = f(age_i; \hat{\beta}_a) + g(income_i; \hat{\beta}_y).$$

Table 3 shows how estimated consumption responses vary across the wealth distribution in the SCF. The first row shows the responses relative to annual consumption, while the second row normalizes the responses by the amount of transfer received. The poorest wealth decile spends almost half of the transfer in the two weeks following receipt, while the richest decile spends little. This substantial heterogeneity is consistent with a large literature on the marginal propensity to consumption out of income shocks (R. Baker et al., 2023; Fagereng et al., 2021; Crawley and Kuchler, 2023).

Table 3: Two-Week Consumption Response by Wealth Decile

Decile	1	2	3	4	5	6	7	8	9	10
Spending/Annual Cons.	0.06	0.04	0.03	0.03	0.02	0.02	0.02	0.01	0	0
Spending/Check Size	0.47	0.39	0.35	0.33	0.3	0.3	0.29	0.28	0.06	0

Notes: Two-week consumption responses by wealth decile in the SCF: spending increase divided by annual consumption (first row) and transfer amount (second row). Consumption responses are predicted for each SCF household based on age and income using flexible splines estimated in the Facteus data. Wealth deciles are based on household net worth as described in Section 3.1.

Computing Shadow Rates

We use the consumption responses to the stimulus to calculate shadow rates for each household. To calculate $\check{c}_{i,0}$ in Lemma 4, we use each household's consumption response $\widehat{\Delta c_i}$:

$$\check{c}_{i,0} = \log(1 + \widehat{\Delta c_i^0}).$$

To apply the formula, we also need each household's response in the subsequent year, $\check{c}_{i,1}$. Our high-frequency identification strategy precisely estimates the two-week response but cannot reliably identify effects one year later. We therefore calibrate the longer-run response using estimates from Auclert et al. (2024), who show that consumption responses to unexpected income shocks decay to approximately 30% of the initial response by the second year. Accordingly, we set $\check{c}_{i,1} = 0.3 \times \check{c}_{i,0}$ for each household.

Given $\check{c}_{i,0}$ and $\check{c}_{i,1}$, we compute the lower bound for each household's shadow rate $\zeta_{i,0}$ from Lemma 4, setting the intertemporal elasticity of substitution to one-half ($\sigma = 2$). We assume that the shadow rates are equal to their lower bounds. This assumption is conservative: since most households experience short-run losses and long-run gains from inflation (Section 4),

and higher shadow rates amplify the welfare cost of this timing mismatch. Therefore, using the lower bounds for the shadow rates provides a lower bound on the strength of the liquidity channel. In Appendix F, we vary σ to test the robustness of our result.

5.3 Estimating Wedges over Time

To calculate how the measures of illiquidity evolve over different time horizons, we project shadow rates and spread for each household based on their projected age and income in t periods, using expected labor income estimated in Section 3.

For the shadow rates, we use the spline coefficients $\hat{\beta}_a$ and $\hat{\beta}_y$, estimated from the Facteus data, and apply them to SCF households for future horizons. For spreads, we project cross-sectional observations from the SCF directly onto the age-income spline and compute the expected spread for future horizons based on projected age and income. This approach allows us to track how household-level illiquidity measures evolve as their age and income change over the life cycle. Details of the projection methodology are provided in Appendix D.3.

5.4 Illiquidity Across the Wealth Distribution

Figure 7 quantifies the level of household illiquidity across the wealth distribution, showing the two key components of wedges τ_t: the average size of spreads s_{t+1} and shadow rates ζ_{t+1}.

The figure highlights two key facts. First, the level of wedges decreases with wealth, from around 14% at the bottom wealth decile to 3% at the top decile. Second, the composition of the wedge—the part due to spreads versus shadow rates—changes across the wealth distribution. These facts demonstrate the importance of borrowing constraints in understanding household illiquidity: if we relied only on spreads as our illiquidity measure, we might conclude that poor households have lower borrowing costs than middle-income households, since the average spread increases from lower to middle wealth deciles. However, this pattern is driven by the fact that many poor households lack access to credit cards and cannot easily borrow through standard financial services. This inability to borrow is captured by the binding borrowing constraints these households face, which we quantify through shadow rates. Once we account for shadow rates, the total illiquidity measure τ_t exhibits a monotonically decreasing pattern across the wealth distribution, with borrowing constraints representing a relatively important source of illiquidity for poor households.

The magnitude of wedges τ_t (8%–14%) for the bottom half of the wealth distribution under-

scores the importance of measuring illiquidity based on consumption responses from a quasi-experimental design. Our measurement, consistent with patterns documented by Parker et al. (2013); Jappelli and Pistaferri (2014); Fagereng et al. (2021); Aguiar et al. (2020), leads to a crucial difference from Del Canto et al. (2023), who report an average wedge between 1–2% (even for household groups among whom half are constrained) and conclude that borrowing constraints are not essential for the welfare effects of inflationary shocks. Their calculation uses an aggregate Euler equation at the age-education group level, using average consumption growth from the CEX, and assumes log-utility with a constant discount factor. By contrast, our approach reveals substantially larger wedges—an order of magnitude higher for poor households. As we demonstrate in Section 6, this difference in the measurement approach leads to a drastically different conclusion about the importance of borrowing constraints in understanding the welfare effects of inflation.

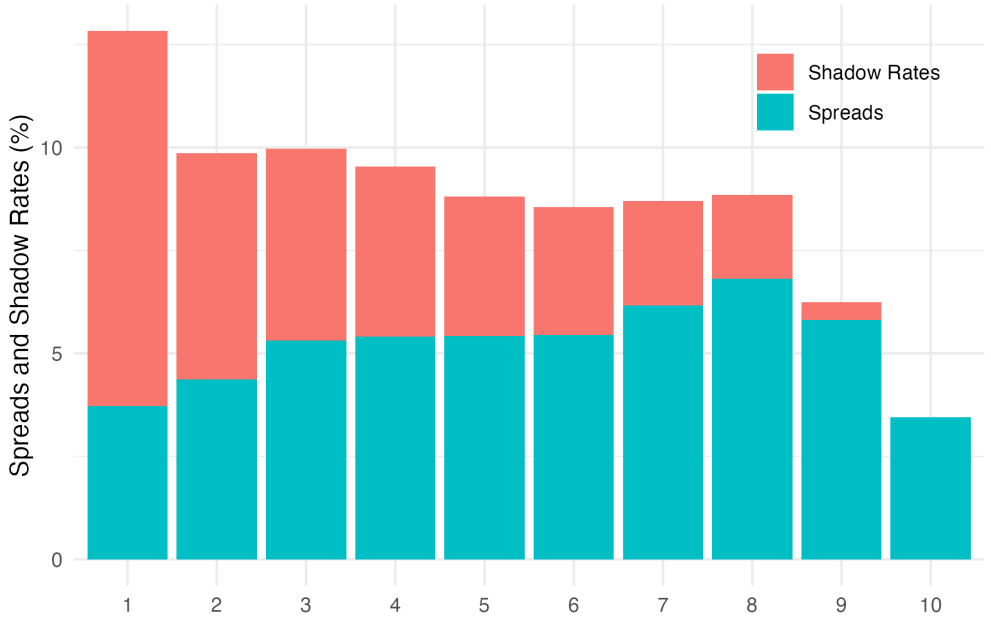


Figure 7: Average Spreads and Shadow Rates by Wealth Decile.

6 Welfare Effects of Inflation Shocks

We now combine components to estimate the welfare effects of the inflation shock, taking into account the differences in household balance sheets and their liquidity concerns. We first focus on the 2021–2022 inflation episode, using the inflation shock $\hat{\pi}_0^t$ from Figure 4. We then expand the analysis to provide households' welfare exposure to inflation at different horizons, which can be used to calculate the welfare effects of an arbitrary inflation shock.

Recall that Equation (4) in Lemma 3 decomposes the welfare effect as:

$$dU = u_0'(\bar{c}_0) \times avg\big[(1+\tau_0^t)^{-1}\big]\Big(\underbrace{\Delta NPV}_{\text{(1) wealth channel}} + \underbrace{\Omega \times \Big\langle \Delta z_t, \frac{(1+\tau_0^t)^{-1}}{avg[(1+\tau_0^t)^{-1}]} - 1 \Big\rangle}_{\text{(2) liquidity channel}} \Big).$$

From Sections 3 and 5, we can calculate:

1. the gain (or loss) in each period (Δz_t), using the nominal payment streams (z_t) from the SCF and FOF, together with a given inflation shock sequence ($\hat{\pi}_0^t$);
2. the level of illiquidity for each household (τ_{t+1}), using interest rate spreads (s_{t+1}) from the SCF, and shadow rates (ζ_{t+1}) from consumption responses estimated in Facteus.

6.1 Wealth vs. Liquidity Channels

Figure 8 shows the welfare effects for U.S. households across the wealth distribution, decomposed into different channels using Equation (4). To understand how the liquidity channel depends on different sources of illiquidity, we include two counterfactual calculations that isolate the roles of borrowing costs and borrowing constraints. We calculate welfare effects in the following four scenarios:

1. the wealth channel alone: term (1),
2. the wealth channel plus illiquidity due to spreads: τ_{t+1} replaced by s_{t+1} in term (2),
3. the wealth channel plus illiquidity due to shadow rates: τ_{t+1} replaced by ζ_{t+1} in term (2),
4. the overall effects, including both the wealth and liquidity channel: terms (1) and (2).

Scenarios (2) and (3) are counterfactuals that shut down one component of the wedges while holding the other at the observed level. Because the welfare formula is nonlinear in s_{t+1} and ζ_{t+1}, these counterfactual effects do not sum to the total liquidity channel in scenario (4); the difference reflects the interaction between spreads and shadow rates.

For each household, we convert these effects into equivalent gains and losses relative to their lifetime wealth (top panel) and in dollar terms relative to annual non-durable consumption at $t = 0$ (bottom panel). We present the averages for each wealth decile, with calculation details provided in Appendix E.

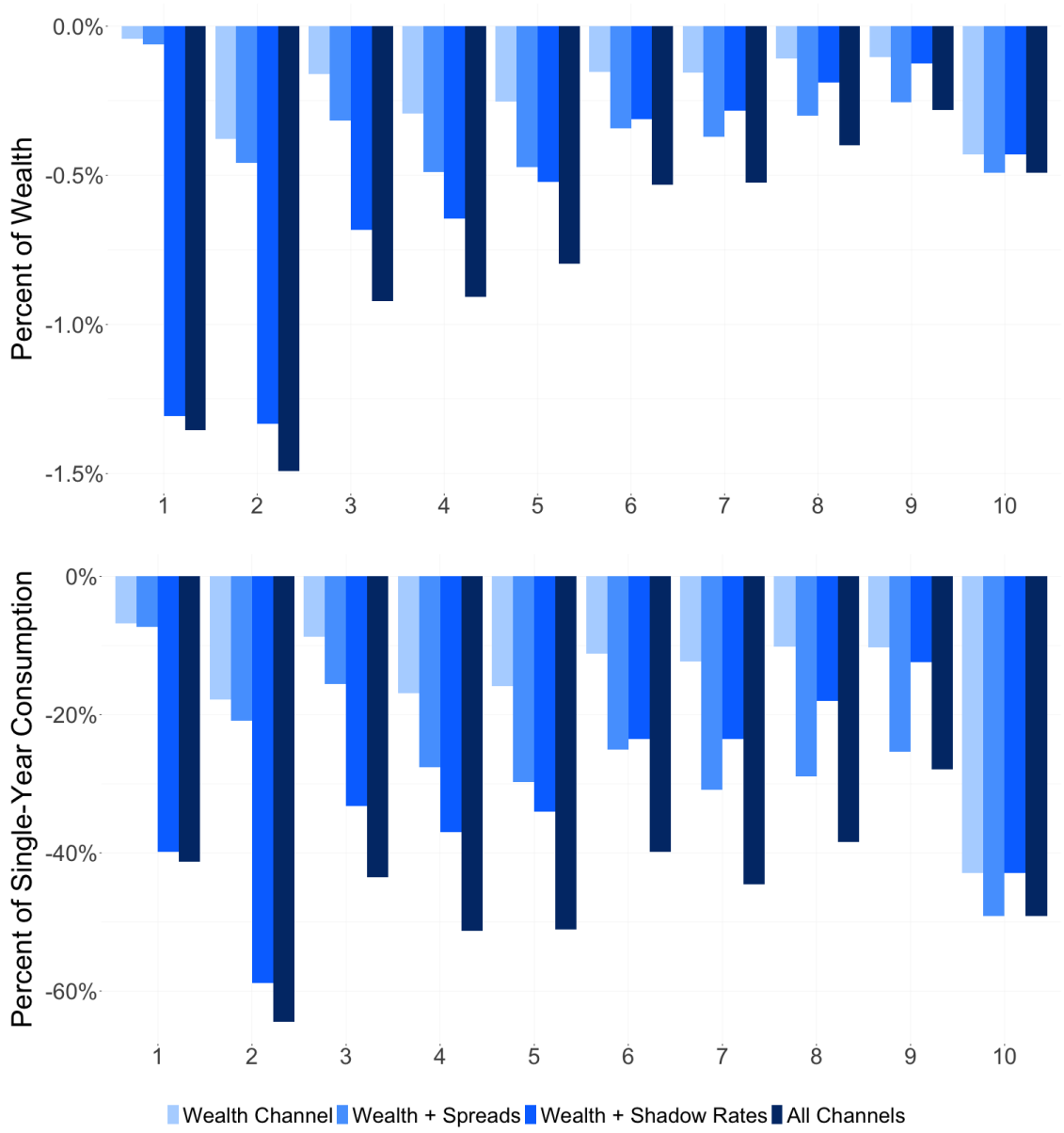


Figure 8: Effects of different channels in wealth equivalence as a percentage of lifetime wealth and annual non-durable consumption, averaged within each wealth decile.

Households in the bottom half of the wealth distribution suffer a welfare loss equivalent to around 1% of their lifetime wealth (top panel), or in dollar terms, around 50% of their annual non-durable consumption (bottom panel). Households in the top wealth decile suffer smaller welfare losses, equivalent to around 0.6% of their lifetime wealth (top panel). Still, because their annual non-durable consumption accounts for a relatively small fraction of their wealth, the loss is equivalent in dollar terms to around 50% of their annual consumption level (bottom panel).

While the level of losses varies across the wealth distribution, the sources of those losses vary as well. For households in the top decile, the losses mainly come from the wealth channel, reflecting that these households are relatively unconstrained. However, for households in the bottom half of the wealth distribution, the liquidity channel is particularly important, accounting for most of the losses. The detailed decomposition of the liquidity channel into two sources—borrowing costs and borrowing constraints—further highlights the nature of the liquidity problem: for households in the bottom half of the wealth distribution, a significant source of illiquidity comes from the presence of borrowing constraints, a direct consequence of our measurement of the two different sources of illiquidity shown in Figure 7.

In Appendix B, we provide additional figures to show a comprehensive picture of how the liquidity channel alters the welfare effects of inflation. Figure B.6 and B.7 compare the two channels at the individual level for each survey correspondent. Figure B.8 shows the proportion of households in each wealth decile for whom accounting for the liquidity channel changes whether they gain or lose from inflation. Figures B.9 show versions of Figure 8 conditional on different age groups. Older households experience larger welfare losses than younger households (relative to their wealth), yet the importance of the liquidity channel is common across all age groups.

6.2 Robustness under Alternative Specifications

We emphasize the effects on the poor as our main result and caveat conclusions about the wealthy—because the rich hold more complex balance sheets with significant indirect holdings, making our estimates for them more sensitive to modeling assumptions.

Figure 9 shows the range of estimates for the overall welfare effects under different specifications of our empirical analysis. These specifications include whether we adjust the SCF to match aggregate data from the FoF (or vice versa), the level of nominal rigidities we assume for labor income, and alternative assumptions for our estimates of consumption responses. We describe details about these assumptions in Appendix F. As the figure shows, our baseline specification (red dots) yields conservative estimates for the poor, while for wealthier households our estimates tend to be at the more negative end of the range, suggesting our main results may represent an upper bound on welfare losses for the rich.

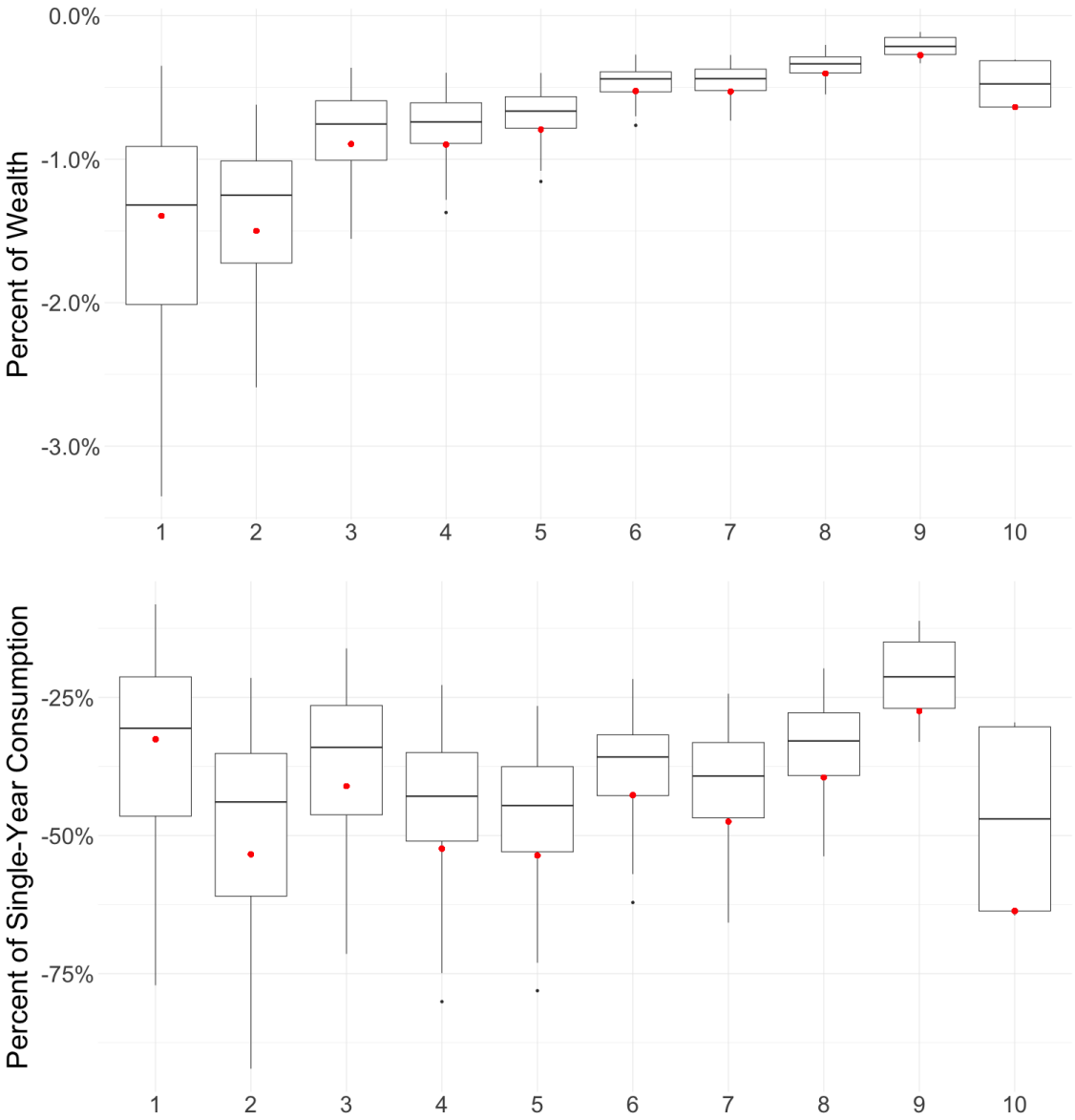


Figure 9: Effects of parameter adjustment on different channels, averaged within each wealth decile as a percentage of lifetime wealth and annual consumption. Boxes represent interquartile ranges, whiskers represent minimum/maximum values, and individual points represent outliers. Red dots represent the specification used in the main results.

In Appendix F, we provide additional robustness checks of our results. From Figures F.1 through F.8, we compare the welfare effects through wealth and liquidity channels for households in the lowest and highest wealth deciles under all permutations of the alternative specifications. While there are some differences in the effects of these two channels across specifications, the liquidity channel we document remains a crucial factor in understanding how households are affected by inflation under all alternative specifications.

6.3 Welfare Exposure to Inflation at Different Horizons

Our analysis above focuses on the 2021–2022 inflation episode. We now expand our analysis to compute the welfare exposure to inflation at an arbitrary time horizon and perform the same decomposition into wealth and liquidity channels to understand why households' welfare is affected by inflation.

To compute the exposure to inflation at horizon h, we construct a shock to cumulative inflation as:

$$\hat{\pi}_0^t(h) = 1\% \times \mathbf{1}_{\{t \geq h\}}.$$

This represents a scenario where inflation between the beginning of period 0 and the beginning of period h is zero, there is 1% inflation during period h, and there is no inflation afterwards.

Figure 10 reveals distinct patterns of inflation exposure across the wealth distribution. Households in the 1^{st} and 5^{th} wealth deciles are negatively exposed to inflation at short horizons, primarily due to the liquidity channel. This is evident from the large gap between the total welfare effects and those operating through the wealth channel alone. At longer horizons, these households become positively exposed to inflation, with the wealth channel accounting for most of these gains. In contrast, households in the 10^{th} decile are negatively exposed to inflation at all horizons, with losses primarily attributable to the wealth channel.

These patterns reflect the nominal maturity mismatch documented earlier. Poor and middle-class households hold nominal assets concentrated at shorter horizons, while their nominal liabilities extend over longer horizons. When inflation occurs at short horizons, these households lose on their nominal assets while gains from their nominal liabilities are spread out, generating welfare losses due to the liquidity channel. At longer horizons, the real value of their liabilities declines while the real value of their nominal assets remains relatively unaffected, generating gains through the wealth channel. Wealthy households, by contrast, have positive net nominal positions across all horizons, leading to consistent losses from inflation regardless of timing. Together, these patterns demonstrate that the liquidity channel is not only crucial for understanding the 2021–2022 inflation episode, but is key to understanding how a large majority of households are affected by inflation more generally.

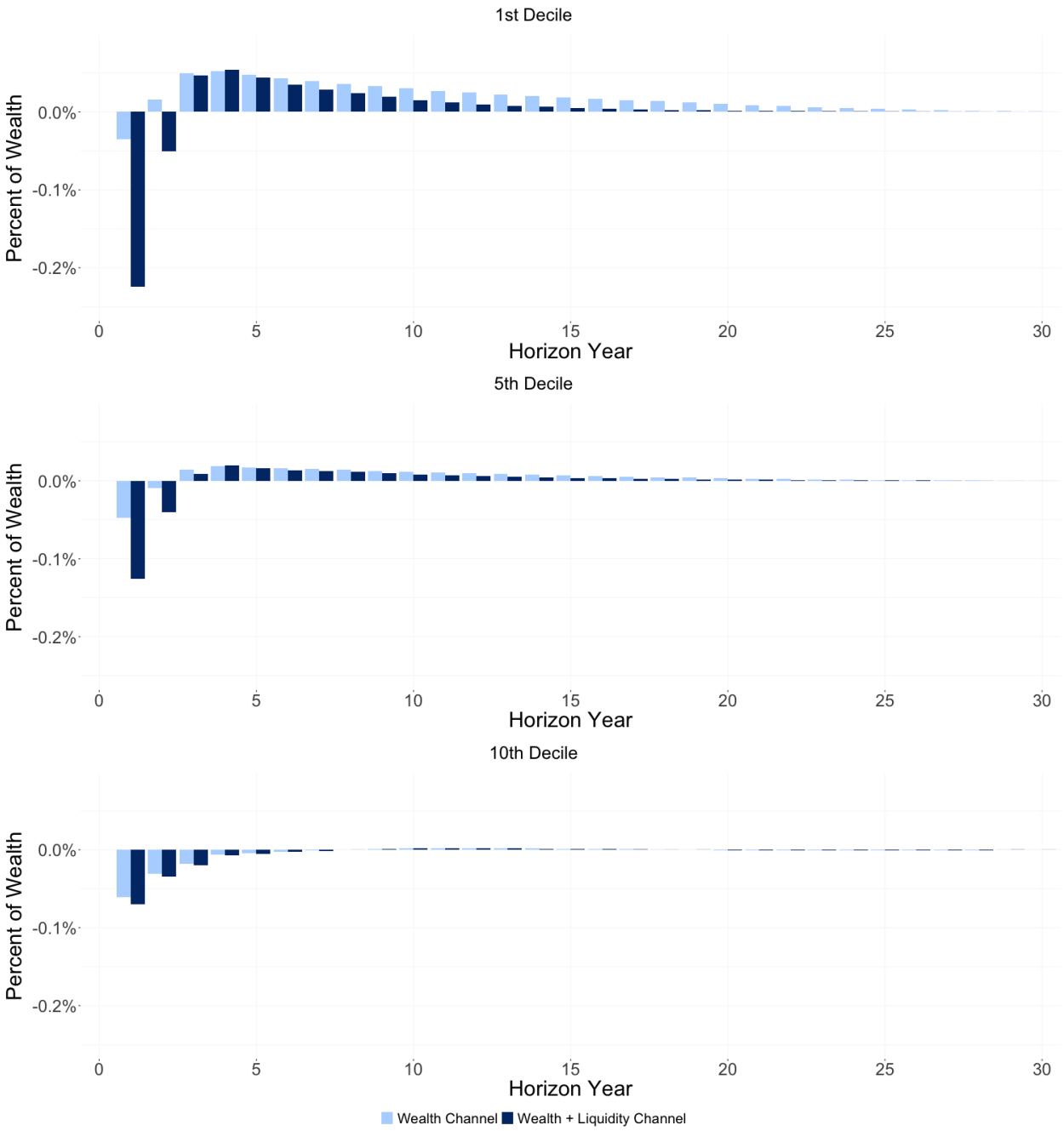


Figure 10: Welfare exposure through wealth and liquidity channels to a 1% inflation at different horizons, computed for the 1^{st}, 5^{th}, and 10^{th} wealth deciles and averaged within each decile as a percentage of lifetime wealth.

7 Conclusion

We show that households' balance sheets feature a nominal maturity mismatch: the average household holds nominal liabilities with a significantly longer duration than their nominal

assets. This mismatch has important effects on welfare: unexpected inflation not only transfers wealth between borrowers and lenders but also misaligns the timing of gains and losses. Even when inflation does not affect the net present value of lifetime wealth, short-run losses harm households who cannot borrow against future gains. During the 2021–2022 inflation episode, this liquidity channel generated welfare losses equivalent to 1.1% of lifetime wealth for the bottom half of the wealth distribution. These losses are substantially larger than the traditional wealth channel.

More broadly, this liquidity channel has implications for how policy should respond to inflation. If welfare costs are driven primarily by short-run liquidity constraints rather than changes in lifetime wealth, policies that prioritize liquidity provision, such as facilitating short-term borrowing or timely transfers to constrained households, may be particularly effective.

Finally, our approach of using quasi-experimental shocks to measure illiquidity wedges is widely applicable in other contexts. Welfare evaluation using a sufficient statistics approach often requires estimates of how households value resources at different points in time. We show how to recover these values directly from well-studied consumption responses to plausibly exogenous shocks.

References

Aguiar, Mark A, Mark Bils, and Corina Boar, "Who are the Hand-to-Mouth?," Technical Report, National Bureau of Economic Research 2020.

Auclert, Adrien, "Monetary policy and the redistribution channel," *American Economic Review*, 2019, *109* (6), 2333–67.

_ , Matthew Rognlie, and Ludwig Straub, "The intertemporal keynesian cross," *Journal of Political Economy*, 2024, *132* (12), 4068–4121.

Baker, Scott R., Robert A Farrokhnia, Steffen Meyer, Michaela Pagel, and Constantine Yannelis, "Income, liquidity, and the consumption response to the 2020 economic stimulus payments," *Review of Finance*, 2023, *27* (6), 2271–2304.

Canto, Felipe N Del, John R Grigsby, Eric Qian, and Conor Walsh, "Are Inflationary Shocks Regressive? A Feasible Set Approach," Technical Report, National Bureau of Economic Research 2023.

Cardoso, Miguel, Clodomiro Ferreira, José Miguel Leiva, Galo Nuño, Álvaro Ortiz, Tomasa Rodrigo, and Sirenia Vazquez, "The heterogeneous impact of inflation on households' balance sheets," *Red Nacional de Investigadores en Economıa Working Paper*, 2022, *176*.

Crawley, Edmund and Andreas Kuchler, "Consumption heterogeneity: Micro drivers and macro implications," *American Economic Journal: Macroeconomics*, 2023, *15* (1), 314–341.

Doepke, Matthias and Martin Schneider, "Inflation and the redistribution of nominal wealth," *Journal of Political Economy*, 2006, *114* (6), 1069–1097.

Fagereng, Andreas, Martin B Holm, and Gisle J Natvik, "MPC heterogeneity and household balance sheets," *American Economic Journal: Macroeconomics*, 2021, *13* (4), 1–54.

_ , Matthieu Gomez, Emilien Gouin-Bonenfant, Martin Holm, Benjamin Moll, and Gisle Natvik, "Asset-price redistribution," Technical Report, Working Paper 2022.

Guerreiro, Joao, Jonathon Hazell, Chen Lian, and Christina Patterson, "Why Do Workers Dislike Inflation?: Wage Erosion and Conflict Costs," 2024.

Hajdini, Ina, Edward S Knotek, John Leer, Mathieu Pedemonte, Robert W Rich, and Raphael Schoenle, "Low passthrough from inflation expectations to income growth expectations: why people dislike inflation," 2023.

Jappelli, Tullio and Luigi Pistaferri, "Fiscal policy and MPC heterogeneity," *American Economic Journal: Macroeconomics*, 2014, *6* (4), 107–136.

Kaplan, Greg, Giovanni L Violante, and Justin Weidner, "The wealthy hand-to-mouth," Technical Report, Brookings Papers on Economic Activity 2014.

Karger, Ezra and Aastha Rajan, "Heterogeneity in the Marginal Propensity to Consume: Evidence from Covid-19 Stimulus Payments," *Working Paper*, 2023.

Pallotti, Filippo, Gonzalo Paz-Pardo, Jiri Slacalek, Oreste Tristani, and Giovanni L Violante, "Who bears the costs of inflation? Euro area households and the 2021–2023 shock," *Journal of Monetary Economics*, 2024, p. 103671.

Parker, Jonathan A, Nicholas S Souleles, David S Johnson, and Robert McClelland, "Consumer spending and the economic stimulus payments of 2008," *American economic review*, 2013, *103* (6), 2530–2553.

Pugsley, Benjamin and Hannah Rubinton, "The Uneven Welfare Costs of the Volcker Disinflation," 2023.

Shiller, Robert J, "Why do people dislike inflation?," in "Reducing inflation: Motivation and strategy," University of Chicago Press, 1997, pp. 13–70.

Stantcheva, Stefanie, "Why do we dislike inflation?," Technical Report, National Bureau of Economic Research 2024.

A Derivations and Proofs

A.1 Welfare Effects

To better isolate the channels through which inflation affects the household, we reformulate the problem to a mathematically equivalent setup in which the household chooses how much it would adjust the value of its holdings for each asset, relative to the initial holdings.

We first rewrite the nominal budget constraint as a real budget constraint with the following definition:

$$b_t = \frac{B_t}{P_t}, \quad q^n_{j,t} = \frac{Q^n_t}{P_t}, \quad q^y_{j,t} = \frac{Q^y_t}{P_t}, \quad w_t = \frac{W_t}{P_t}.$$

Dividing both sides of the nominal budget constraint by P_t, we have

$$c_t + b_t + \sum_{j>t}^{\infty} q^n_{j,t}(n_{j,t} - n_{j,t-1}) + q^y_{j,t}(y_{j,t} - y_{j,t-1}) + \phi_t(\cdot) = w_t h_t + \tilde{R}^B_t(\cdot) b_{t-1} + \frac{n_{t,t-1}}{P_t} + y_{t,t-1},$$

where $b_t \geq -\chi_t$ and $\phi_t(\cdot) = \phi_t(\{q^n_{j,t}(n_{j,t} - n_{j,t-1}), q^y_{j,t}(y_{j,t} - y_{j,t-1})\}_{j>t})$.

For each horizon j, define the household's asset holding adjustments, $\tilde{a}^n_{j,t}$ and $\tilde{a}^y_{j,t}$, as the value of holdings in period t relative to the value of initial holdings:

$$\tilde{a}^n_{j,t} = q^n_{j,t} n_{j,t} - q^n_{j,t} \bar{n}_j, \quad \tilde{a}^y_{j,t} = q^y_{j,t} y_{j,t} - q^y_{j,t} \bar{y}_j.$$

The household's problem becomes:

$$U \coloneqq \max_{\{c_t, \tilde{a}^n_{j,t}, \tilde{a}^y_{j,t}, h_t\}_{t\geq 0}} \sum_{t=0}^{\infty} \beta^t \big[u_t(c_t) - \nu_t(h_t)\big]$$

such that

$$\begin{aligned} & c_t + b_t + \sum_{j>t}^{\infty} (\tilde{a}^n_{j,t} - \tilde{R}^n_{j,t}\tilde{a}^n_{j,t-1}) + (\tilde{a}^y_{j,t} - \tilde{R}^y_{j,t}\tilde{a}^y_{j,t-1}) + \phi_t(\cdot) \\ & = w_t h_t + \tilde{R}^B_t(\cdot) b_{t-1} + \tilde{R}^n_{t,t}\tilde{a}^n_{t,t-1} + \tilde{R}^y_{t,t}\tilde{a}^y_{t,t-1} + q^n_{t,t}\bar{n}_t + q^y_{t,t}\bar{y}_t. \end{aligned}$$

where $b_t \geq -\chi_t$ and $\phi_t(\cdot) = \phi_t(\{\tilde{a}^n_{j,t} - \tilde{R}^n_{j,t}\tilde{a}^n_{j,t-1}, \tilde{a}^y_{j,t} - \tilde{R}^y_{j,t}\tilde{a}^y_{j,t-1}\})$, and $\tilde{a}^n_{j,-1} = \tilde{a}^y_{j,-1} = b_{-1} = 0$.

The Lagrangian associated with the problem is:

$$\begin{aligned} \mathcal{L} \coloneqq & \sum_{t=0}^{\infty} \beta^t \big[u_t(c_t) - \nu_t(h_t)\big] \\ & + \lambda_t \Big\{ w_t h_t + \tilde{R}^B_t(\cdot) b_{t-1} + \tilde{R}^n_{t,t}\tilde{a}^n_{t,t-1} + \tilde{R}^y_{t,t}\tilde{a}^y_{t,t-1} + q^n_{t,t}\bar{n}_t + q^y_{t,t}\bar{y}_t \\ & \quad - \big(c_t + b_t + \sum_{j>t}^{\infty} (\tilde{a}^n_{j,t} - \tilde{R}^n_{j,t}\tilde{a}^n_{j,t-1}) + (\tilde{a}^y_{j,t} - \tilde{R}^y_{j,t}\tilde{a}^y_{j,t-1}) + \phi_t\big) \\ & \quad + \mu_t\big(b_t + \chi_t\big)\big] \Big\}, \end{aligned} \tag{6}$$

where $\lambda_t \geq 0$ and $\lambda_t \times \mu_t \geq 0$ are present value multipliers associated with the budget and borrowing constraints: λ_t represents the marginal value of resources at time t; μ_t represents the shadow value of relaxing the borrowing constraint by one unit of goods, scaling by λ_t to express it in terms of resources at time t.

We consider the first-order effects of a change in the path of the price levels from $\bar{P}_t$ to P_t that occurs at $t = 0$. We parameterize the change by a scalar δ:

$$\log P_t(\delta) - \log \bar{P}_t = \hat{\pi}^t_0 \times \delta.$$

At the same time, we keep real returns $\tilde{R}^n_{j,t+1}$, $\tilde{R}^y_{j,t+1}$, and $\tilde{R}^B_{t+1}(\cdot)$ constant for all $t \geq 0$ to isolate the effects of changes in price level.

Proof of Lemma 1. Envelope theorem implies that

$$\frac{d}{d\delta} U(\delta)\big|_{\delta=0} = \sum_{t=0}^{\infty} \bar{\lambda}_t \Big[\frac{d}{d\delta} q^n_{t,t}(\delta)\big|_{\delta=0} \times \bar{n}_t + \frac{d}{d\delta} w_t(\delta)\big|_{\delta=0} \times \bar{h}_t \Big],$$

where $\bar{\lambda}_t$ and $\bar{h}_t$ are associated with the solution at $\delta = 0$.

The impact of inflation on the real value of nominal holdings in period t is given:

$$\frac{d}{d\delta} q^n_{t,t}(\delta)\big|_{\delta=0} = \frac{d}{d\delta}\frac{1}{P_t(\delta)}\big|_{\delta=0} = \frac{-1}{\bar{P}_t} \times \hat{\pi}^t_0.$$

The nominal wage adjusts to inflation according to:

$$W_t(\delta) = \Big[\theta^W_t + \frac{P_t(\delta)}{\bar{P}_t}(1-\theta^W_t)\Big]\bar{W}_t.$$

Therefore, the impact of inflation on the real wage is:

$$\frac{d}{d\delta} w_t(\delta)\big|_{\delta=0} = \frac{-1}{\bar{P}_t}\theta^W_t \bar{W}_t \times \hat{\pi}^t_0.$$

Together, we have

$$\frac{d}{d\delta} U(\delta)\big|_{\delta=0} = \sum_{t=0}^{\infty} \bar{\lambda}_t \Delta z_t,$$

where

$$\Delta z_t = -z_t \times \hat{\pi}^t_0, \quad z_t \coloneqq \frac{1}{\bar{P}_t}\Big[\bar{n}_t + \theta^W_t \bar{W}_t \bar{h}_t\Big],$$

and the first-order condition with respect to c_t implies $\bar{\lambda}_t = \beta u'_t(\bar{c}_t)$. □

To decompose the welfare effects into different channels, note that at $\delta = 0$, the first-order conditions of c_t and b_{t+1} together give us:

$$u'_t(\bar{c}_t)(1-\bar{\mu}_t) = \beta u'_{t+1}(\bar{c}_{t+1})\big(\tilde{R}^B_{t+1}(\bar{b}_t) + \bar{b}_t \tilde{R}^{B\,\prime}_{t+1}(\bar{b}_t)\big). \tag{7}$$

Define wedges τ_t as

$$1 + \tau_{t+1} \coloneqq \frac{\tilde{R}^B_{t+1}(\bar{b}_t) + \bar{b}_t \tilde{R}^{B\,\prime}_{t+1}(\bar{b}_t)}{(1-\bar{\mu}_t)R_{t+1}}, \tag{8}$$

then we have

$$u'_t(\bar{c}_t) = \beta u'_{t+1}(\bar{c}_{t+1}) R_{t+1}(1+\tau_{t+1}).$$

Recall that $R^t_0 \coloneqq \prod_{s=1}^t R_s$ and $1 + \tau^t_0 \coloneqq \prod_{s=1}^t (1+\tau_s)$, then Equation (7) and Lemma 1

imply

$$dU = u_0'(\bar{c}_0) \sum_{t=0}^{\infty} \frac{\Delta z_t}{R_0^t(1+\tau_0^t)}. \tag{9}$$

The formula in Lemma 2 is a special case:

Proof of Lemma 2. If $\chi_t = \infty$, then $\bar{\mu}_t \equiv 0$. Together with $\tilde{R}_{t+1}^B(\cdot) \equiv R_{t+1}$, we have $\tau_t = 0,\ \forall t$. Therefore, the welfare effect in Equation (9) reduces to

$$dU = u_0'(\bar{c}_0)\Delta NPV,$$

where $\Delta NPV \coloneqq \sum_{t=0}^{\infty} \frac{\Delta z_t}{R_0^t}$. □

Our goal now is to decompose the welfare effects into the portion due to a change in wealth and the portion due to the misalignment of gains and losses over different horizons. To this end, we compare the total welfare effect to a change in wealth in the form of a perpetuity that pays one unit of a real good in each period until $t = \infty$.

Proof of Lemma 3. Recall that we define $\Omega \coloneqq \sum_{t=0}^{\infty} \frac{1}{R_0^t}$ and $\omega_t \coloneqq \Omega^{-1}\frac{1}{R_0^t}$, and use notation $avg[\cdot]$ and $\langle \cdot, \cdot \rangle$ defined in Lemma 3. From Equation (9),

$$dU = u_0'(\bar{c}_0) \times \sum_{t=0}^{\infty} \frac{\Delta z_t}{R_0^t(1+\tau_0^t)}.$$

Using the notation defined, we have

$$\begin{aligned}
dU &= u_0'(\bar{c}_0) \times \Omega \times \left\langle \Delta z_t, (1+\tau_0^t)^{-1} \right\rangle \\
&= u_0'(\bar{c}_0) \times \Omega \times \Big(avg[\Delta z_t] avg[(1+\tau_0^t)^{-1}] + \left\langle \Delta z_t - avg[\Delta z_t], (1+\tau_0^t)^{-1} \right\rangle \Big) \\
&= u_0'(\bar{c}_0) \times \Omega \times avg[(1+\tau_0^t)^{-1}] \Big(avg[\Delta z_t] + \left\langle \Delta z_t - avg[\Delta z_t], \frac{(1+\tau_0^t)^{-1}}{avg[(1+\tau_0^t)^{-1}]} \right\rangle \Big).
\end{aligned}$$

Because $\Omega \times avg[\Delta z_t] = \Delta NPV$ and

$$\left\langle \Delta z_t - avg[\Delta z_t], \frac{(1+\tau_0^t)^{-1}}{avg[(1+\tau_0^t)^{-1}]} \right\rangle = \left\langle \Delta z_t, \frac{(1+\tau_0^t)^{-1}}{avg[(1+\tau_0^t)^{-1}]} - 1 \right\rangle,$$

we have

$$dU = u_0'(\bar{c}_0) \times avg[(1+\tau_0^t)^{-1}]\Big(\Delta NPV + \Omega \times \Big\langle \Delta z_t, \frac{(1+\tau_0^t)^{-1}}{avg[(1+\tau_0^t)^{-1}]} - 1 \Big\rangle\Big).$$

□

A.2 Bounds for Shadow Rates

By the definition of s_{t+1} and ζ_{t+1} in Equation (5), Equation (8) implies

$$1 + \tau_{t+1} = (1 + s_{t+1})(1 + \zeta_{t+1}).$$

Proof of Lemma 4. From the assumption that $\frac{-u_t''(c)c}{u_t'(c)} = \sigma$, the general solution of the ordinary differential equation is

$$u_t(c) = \frac{c^{1-\sigma}}{1-\sigma} \times \xi_t$$

for some shifter ξ_t, where we drop an additive term without loss of generality.

The household's optimality condition is given by:

$$-\sigma \log \bar{c}_t = -\sigma \log \bar{c}_{t+1} + \log \beta \xi_{t+1}/\xi_t R_{t+1} + \log(1 + s_{t+1}) - \log(1 - \bar{\mu}_t) \tag{10}$$

Let $\tilde{c}_t$, and $\tilde{c}_{t+1}$ be the consumption response when the household receives the one-time unexpected transfer $\check{T}$, and $\tilde{\mu}_t$ be the corresponding multiplier. If s_{t+1} remains constant under the transfer, then:

$$-\sigma \log \tilde{c}_t = -\sigma \log \tilde{c}_{t+1} + \log \xi_{t+1}/\xi_t R_{t+1} + \log(1 + s_{t+1}) - \log(1 - \tilde{\mu}_t). \tag{11}$$

Let $\check{c}_t \coloneqq \log \tilde{c}_t - \log \bar{c}_t$. Taking the difference between Equation (10) and (11), we have

$$\sigma \times (\check{c}_t - \check{c}_{t+1}) = \log \frac{1 - \tilde{\mu}_t}{1 - \bar{\mu}_t}.$$

Because the Lagrangian $\tilde{\mu}_t \geq 0$, we have

$$\sigma \times (\check{c}_t - \check{c}_{t+1}) \leq \log \Big(\frac{1}{1 - \bar{\mu}_t}\Big).$$

□

B Additional Tables and Figures

B.1 Summary Statistics

Demographics across the Wealth Distribution

Table B.1: Demographic Characteristics by Decile

Decile	1	2	3	4	5	6	7	8	9	10
Networth	279	645	1014	1422	1888	2422	3104	4045	5521	13544
Income	22	35	46	53	67	72	90	115	150	423
Income 0-50k	0.98	0.84	0.63	0.52	0.43	0.36	0.20	0.07	0.02	0.00
Income 50-200k	0.02	0.16	0.37	0.47	0.57	0.63	0.75	0.84	0.79	0.39
Income 200k+	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.09	0.19	0.61
Wage Income	0.08	0.28	0.49	0.58	0.69	0.72	0.76	0.85	0.85	0.73
Business Income	0.01	0.04	0.07	0.09	0.07	0.07	0.08	0.07	0.07	0.22
Dividend/Interest	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.09
Capital Gain Income	0.00	0.00	0.00	0.05	0.01	0.01	0.01	0.01	-0.00	0.06
Social Security/Pension	0.68	0.53	0.35	0.25	0.21	0.13	0.11	0.06	0.04	0.05
Transfer Income	0.13	0.10	0.07	0.07	0.05	0.05	0.02	0.02	0.01	0.02
Home Owner	0.48	0.63	0.63	0.59	0.61	0.57	0.66	0.71	0.76	0.86
Mortgage	0.11	0.16	0.30	0.29	0.34	0.35	0.47	0.55	0.65	0.63
Working	0.16	0.38	0.56	0.65	0.76	0.79	0.83	0.91	0.93	0.89
College	0.11	0.16	0.25	0.24	0.30	0.35	0.38	0.45	0.60	0.79
Male	0.44	0.55	0.63	0.65	0.74	0.74	0.80	0.88	0.92	0.95
White	0.64	0.66	0.63	0.64	0.66	0.63	0.66	0.73	0.74	0.81
Black	0.26	0.21	0.21	0.16	0.15	0.18	0.16	0.11	0.11	0.04
Other Races	0.11	0.13	0.16	0.19	0.19	0.20	0.18	0.16	0.16	0.16
Age	71.47	65.67	57.50	52.76	50.07	45.14	44.61	43.14	41.11	45.76
Age 18-44	0.02	0.05	0.18	0.28	0.38	0.53	0.54	0.56	0.67	0.54
Age 45-64	0.20	0.40	0.46	0.49	0.41	0.33	0.35	0.36	0.26	0.33
Age 65+	0.78	0.55	0.35	0.23	0.21	0.14	0.11	0.08	0.07	0.13

Net Worth and Income are in thousands of 2021 USD. Age is in years. Income is bottom-coded at the 5th percentile. Other variables are shares.

Table B.1 shows the demographic characteristics of each wealth decile. Both net worth and income increase with wealth decile, as does home ownership. Wage income and business income shares peak for the 8th and 10th deciles, respectively, consistent with these deciles being wealthy and active in the labor force. In contrast, the 10th decile is the only decile with significant shares of income coming from interest/dividends and capital gains. This is likely due to the high number of retirees in the 10th decile relative to other higher-wealth deciles. Social security, pension, and transfer income generally make up high shares of total income for lower wealth deciles. The fraction of households with mortgages and with a working head of household also increases with deciles, though the 10th decile has slightly

smaller shares, again due to retirees. Overall, the old are concentrated in the bottom and top deciles. Wealthier households are also more likely to be college-educated and white.

Features of Nominal Balance Sheets

Table B.2 shows a version of Table 1 for all deciles. All but the top decile experience nominal maturity mismatch.

Table B.2: Nominal balance sheet across wealth decile

Decile	1	2	3	4	5	6	7	8	9	10
Assets	45	103	146	210	286	277	376	450	672	5695
Liabilities	33	57	105	136	199	202	272	342	531	4708
Assets Duration	1.8	2.1	2.4	2.6	2.9	2.9	2.9	3	3.2	3.9
Liabilities Duration	6.5	5.7	6.7	5.3	5.5	5.7	6	6.2	6	3.8

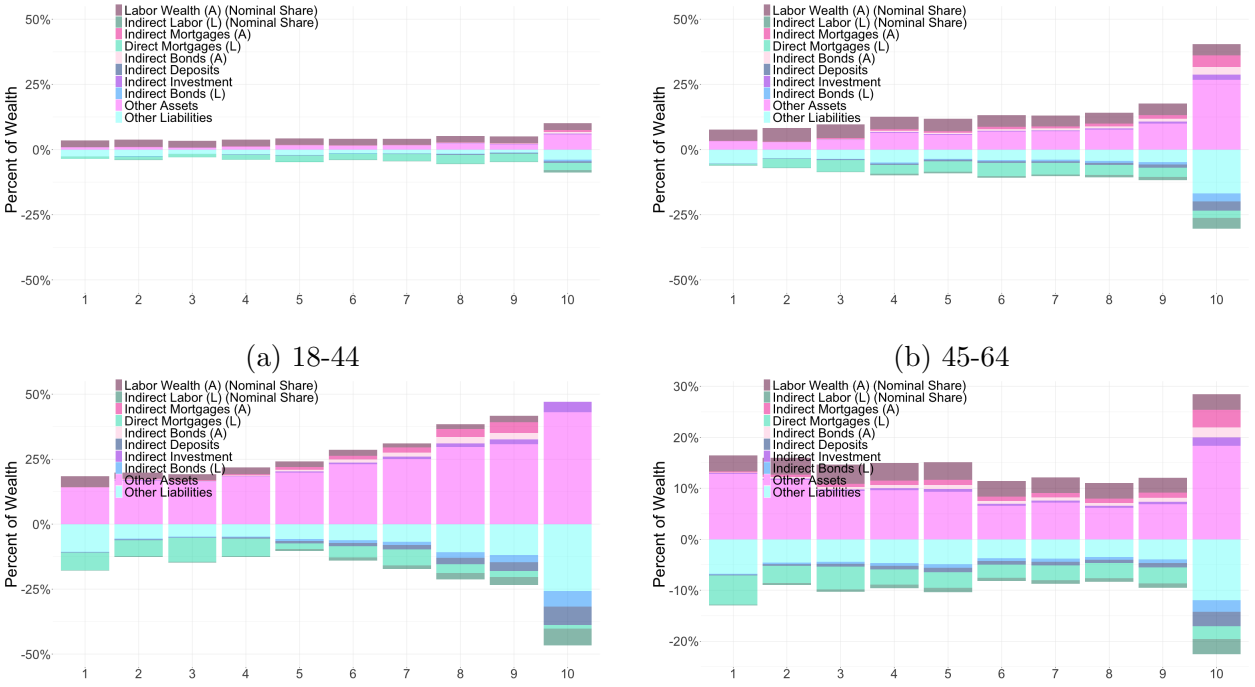
Note: : Levels are in thousands, 2021 USD; duration in years.

Table B.3 shows that more than half of households in all wealth deciles are nominally maturity mismatched, with the gap between average duration largest for the 1st decile and smallest (and almost negligible) for the 10th decile.

Table B.3: Share of Nominal Maturity Mismatched Households across Wealth Deciles

Decile	1	2	3	4	5	6	7	8	9	10
Share NMM	0.63	0.65	0.69	0.72	0.75	0.77	0.84	0.88	0.87	0.73

Figure B.1 splits Figure 3 into different age groups. It shows that most of the holdings are concentrated in the higher age groups.



(a) 18-44

(b) 45-64

(c) 65+

(d) Full Sample

Figure B.1: Decomposition of Top Nominal Holdings by Age Group

Government and the Rest of the World

Figure B.2 shows the consolidated balance sheets for the U.S. government and the rest of the world. Government liabilities outweigh assets, with both mostly held directly. For the rest of the world, assets exceed liabilities, and both are held mostly indirectly.

Table B.4 shows the present values and average duration of nominal assets and liabilities for the government and the rest of the world. Again, we see that the government has more liabilities than assets, while the rest of the world has more assets than liabilities. While asset maturities are similar for both owners, government liabilities are of much longer duration than those held by the rest of the world.

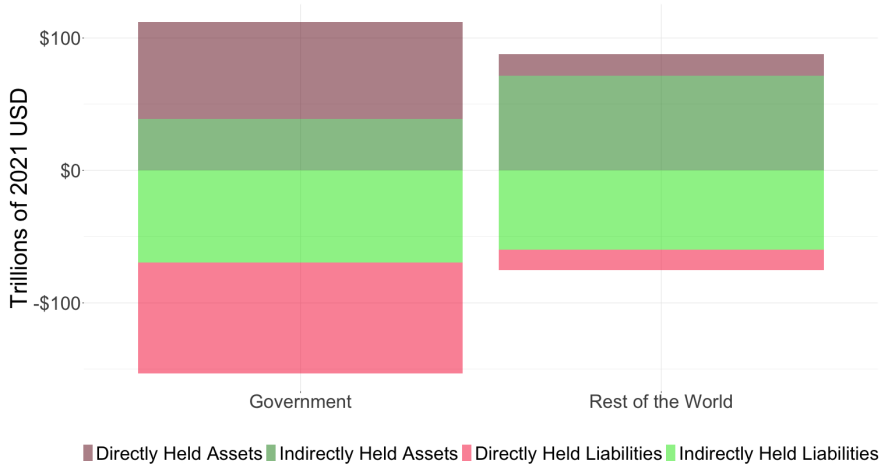


Figure B.2: Consolidated balance sheet of Government and Rest of the World.

Table B.4: Nominal balance sheet for Government and Rest of the World

	Government	Rest of the World
assets	26	39
liabilities	43	29
assets duration	4.2	3.8
liabilities duration	4.2	2.4

Note: Levels are in trillions, 2021 USD; duration in years.

B.2 Gains and Losses

Figure B.3 shows the effect of the 2021–2022 inflation shock on the average household in each wealth decile relative to annual consumption. The effects are most prominent for the 10th decile because its consumption is relatively small compared to the size of its balance sheet.

Figure B.4 splits the results of Figure 5 by age group, where wealth deciles are resorted within age groups. The size of the effects tends to increase with age. For households in the 18-44 age range, most deciles gain, while for households in the 65+ range, most deciles lose.

Figure B.5 shows the effects of the 2021–2022 inflation shock on the government and the rest of the world. Due to the government's large holding of treasury securities as a liability, it gains overall from the inflation shock, particularly in the long run; the rest of the world loses, primarily due to nominal payments from 6+ years.

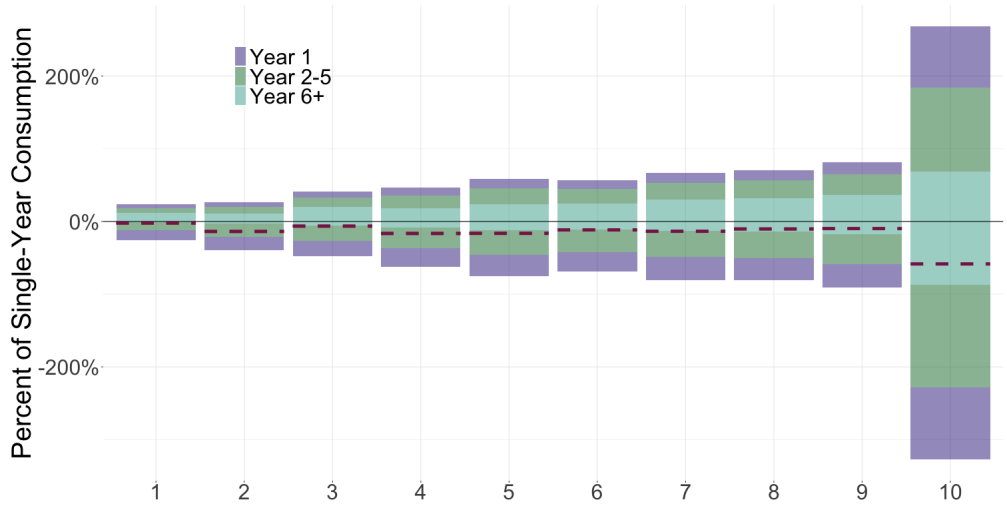
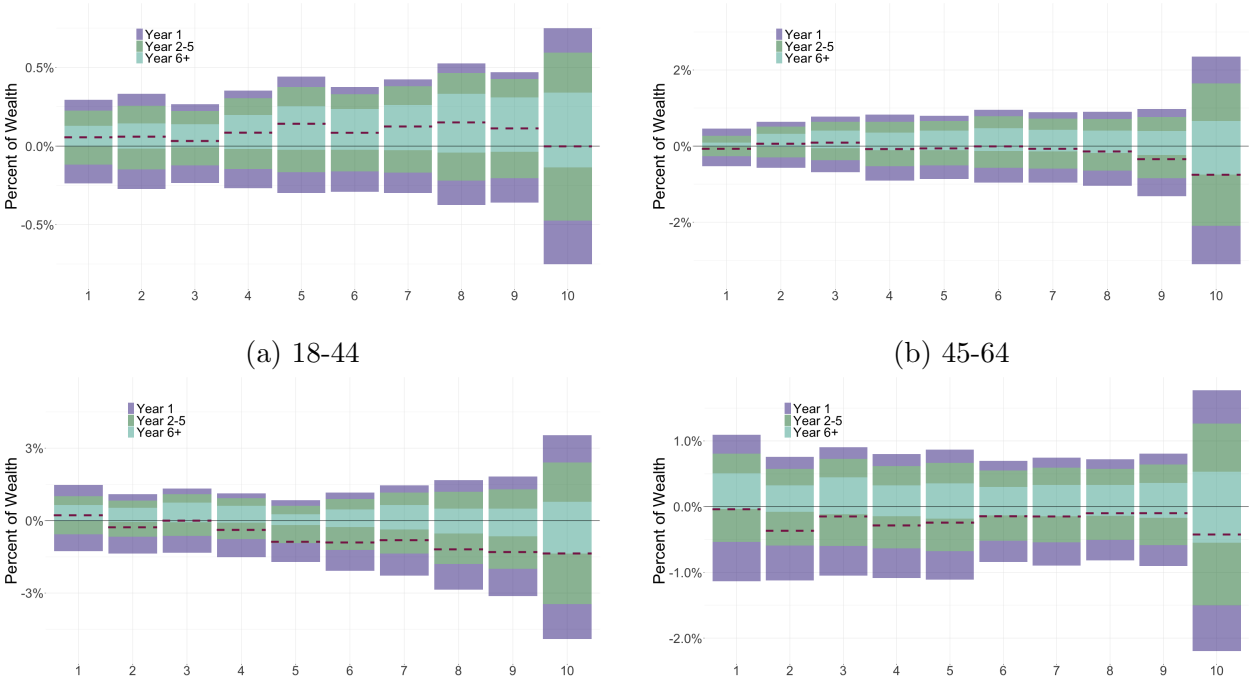


Figure B.3: Gains and losses due to nominal exposure across the wealth distribution. X-axis: wealth by net worth; Y-axis: gains and losses relative to annual consumption. Dashed lines indicate the net change.



(a) 18-44

(b) 45-64

(c) 65+

(d) Full Sample

Figure B.4: Gains and losses due to nominal exposure by lifetime wealth deciles for different age groups. Wealth deciles are resorted within age groups.

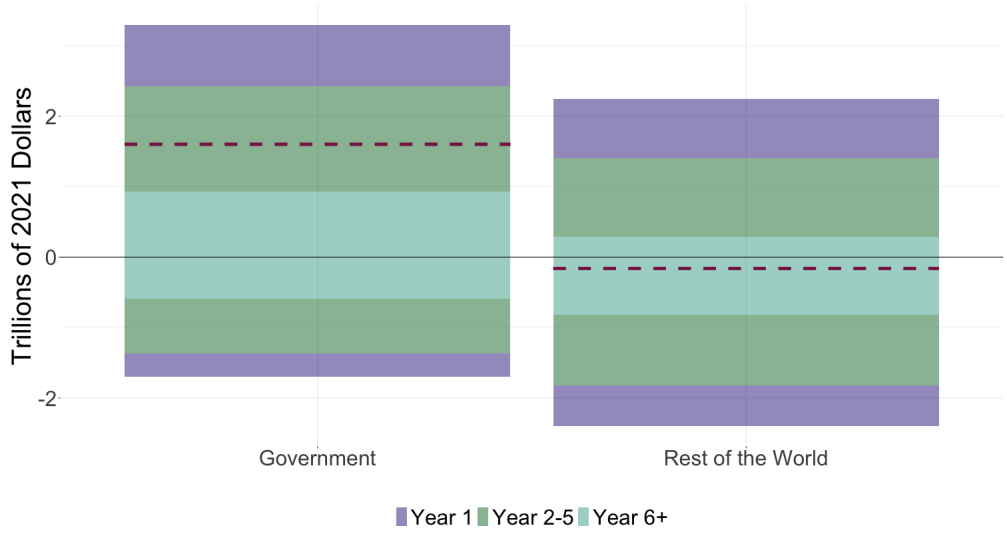


Figure B.5: Gains and losses due to nominal exposure for the government and the rest of the world. X-axis: wealth; Y-axis: gains and losses in trillions of dollars. Dashed lines indicate the net change.

B.3 Wealth and Liquidity Channel

Wealth and Liquidity Channel at the Individual Level

Figure B.6 shows the relative size of the traditional wealth channel (X-axis) and the combined effects of the wealth and liquidity channel (Y-axis). Each blue dot is an observation from the SCF. The axes measure the effects of the 2021–2022 unexpected inflation shock in terms of wealth. If the liquidity channel did not matter, we would see all individuals lying on the 45% line. Instead, we see that many blue dots lie below the 45%. This means that the liquidity channel is generating a loss for many individuals. Figure B.7 shows the same results in terms of annual consumption.

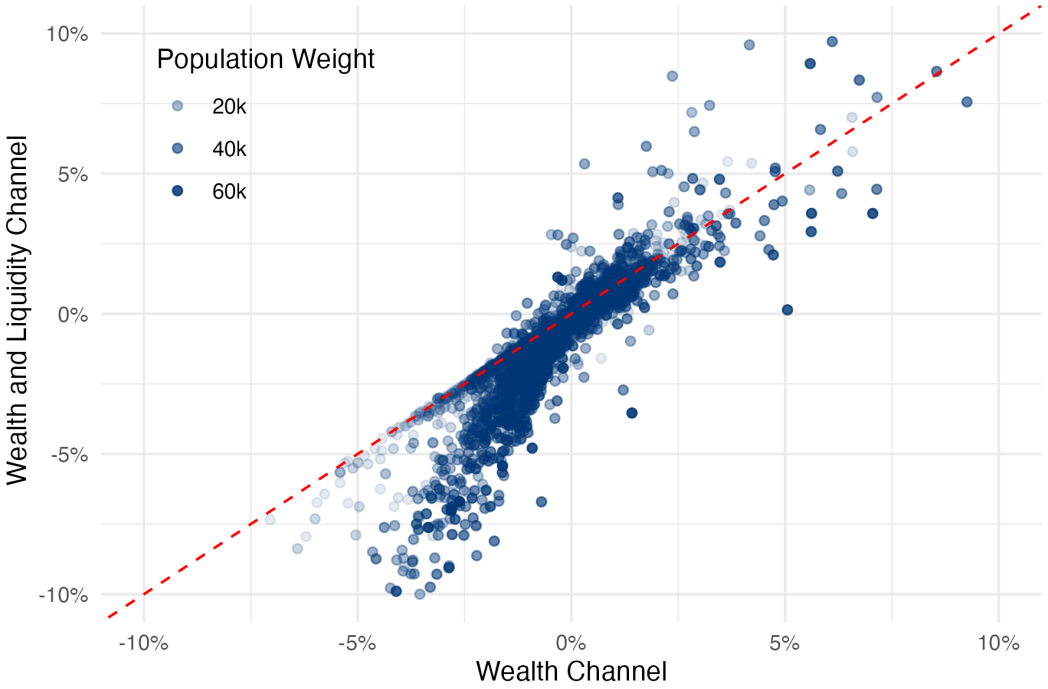


Figure B.6: Welfare effects of unexpected inflation. X-axis: the wealth channel; Y-axis: the wealth and liquidity channels. Units: percentage of lifetime wealth.

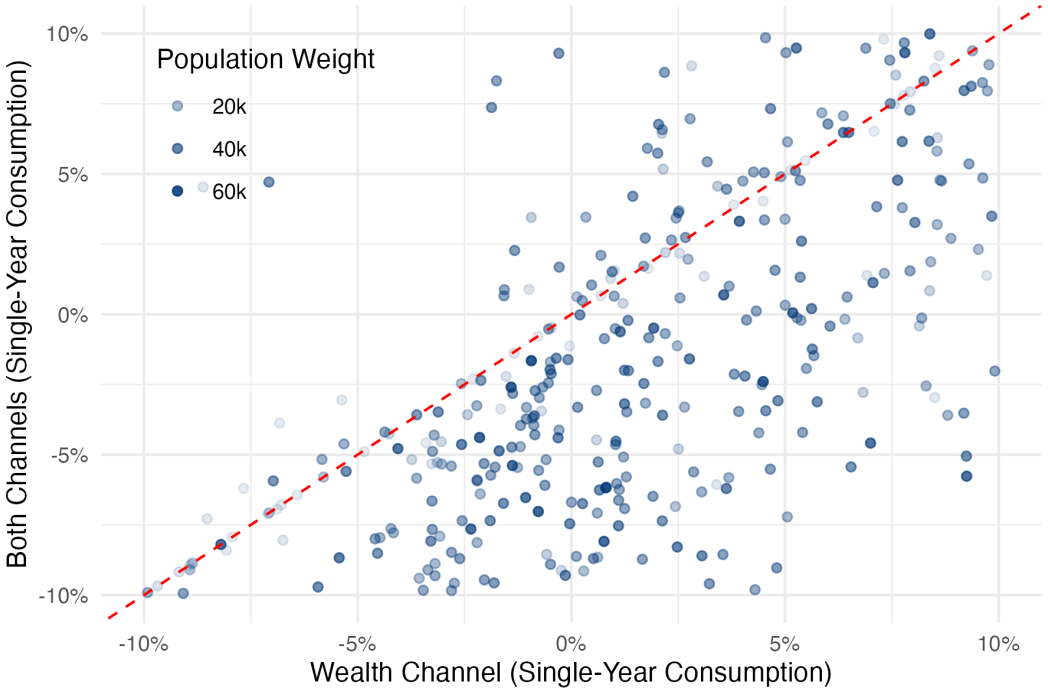


Figure B.7: Welfare effects of unexpected inflation. X-axis: the wealth channel; Y-axis: the wealth and liquidity channels. Units: percentage of annual consumption.

Winners and Losers with the Wealth and Liquidity Channels

Figure B.8 shows the percentage of households that gain and lose through the wealth channel vs the liquidity + wealth channel in each decile. The majority of households lose through both combinations of channels, particularly for the lower deciles. The ninth decile sees the most households gain through both or at least one of the two channels. The fewest households lose through the wealth channel while gaining through the liquidity + wealth channel.

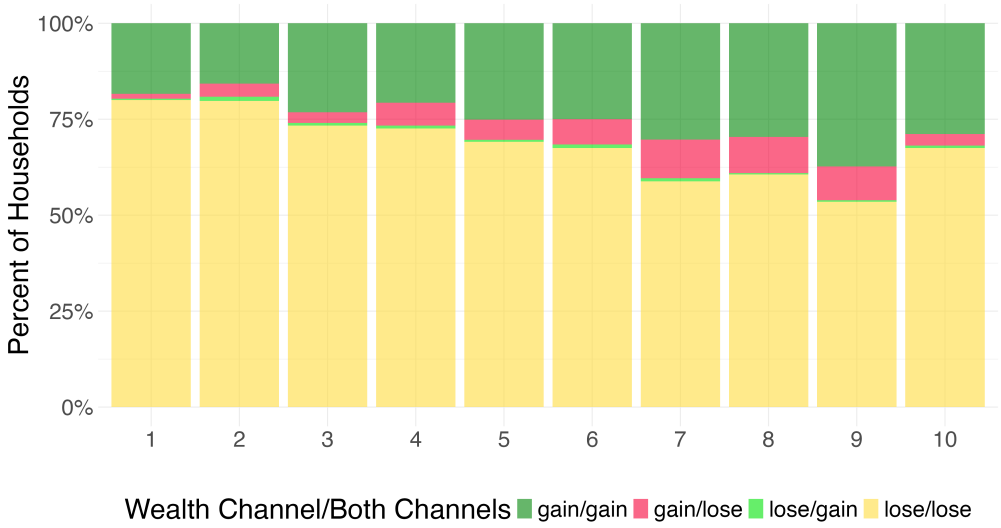


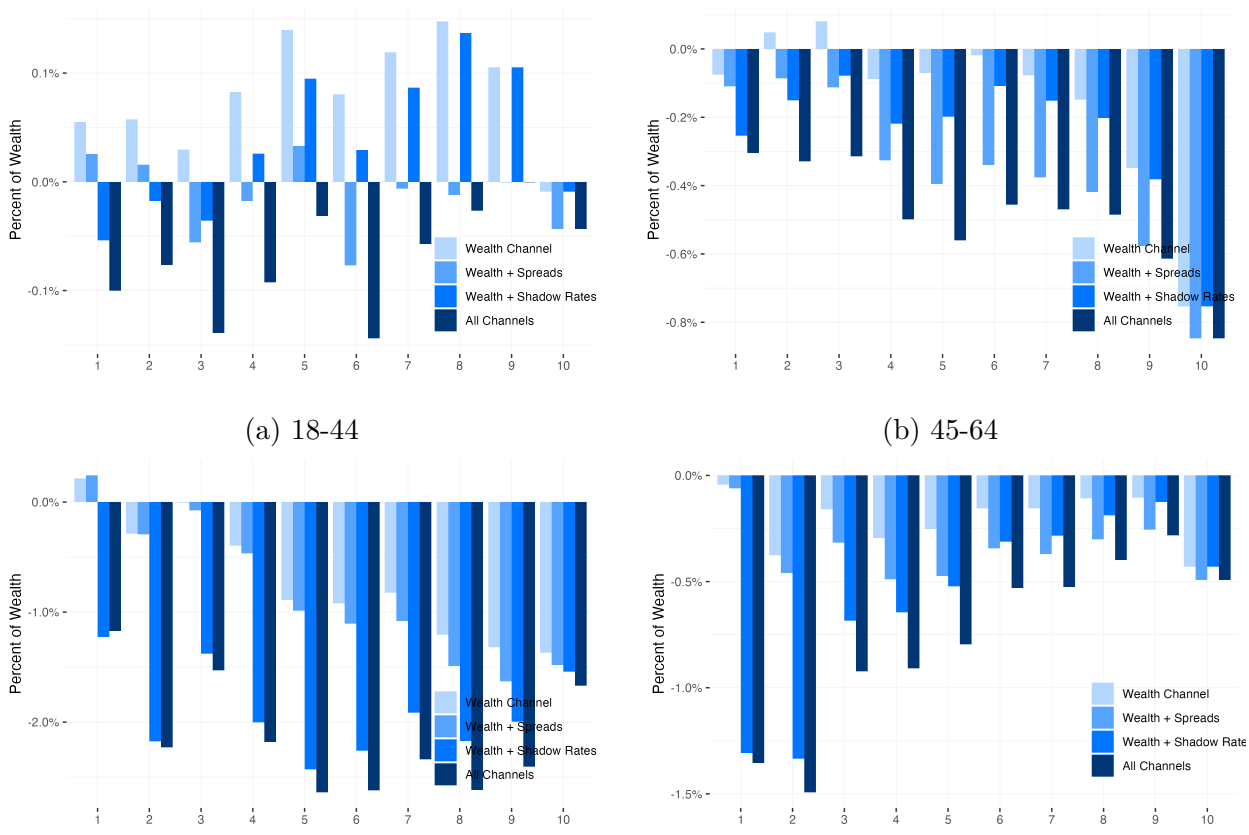
Figure B.8: Percent of households that gain and lose through the wealth channel and liquidity+wealth channel for each wealth decile

Wealth vs. Liquidity Channel by Age Groups

Figure B.9 shows versions of Figure 8 in Section 6, split by age group. For each age group, we resort the households based on their wealth decile within the age group.

For households in the 18-44 age range, many deciles experience net gains from the wealth channel. This age group tends to hold more debt, especially in the form of mortgages, and thus gains when the value of their liabilities decreases with inflation. However, these gains are significantly reduced due to the liquidity channel.

In contrast, almost all households in older age groups lose, regardless of decile. The losses are the largest for the 65+ group, reflecting the fact that older households have lower lifetime wealth as their expected income streams are lower due to mortality. These households are concentrated in the bottom deciles in the full sample. However, one feature consistent across all age groups is the importance of the liquidity channel for households outside the top wealth decile.



(a) 18-44

(b) 45-64

(c) 65+

(d) Full Sample

Figure B.9: Effects of Different Channels as Percentage of Lifetime Wealth by Age Group. Wealth deciles are resorted within each age group.

C Data Appendix: Household Balance Sheets

Our household balance sheet data come from two primary sources, the Survey of Consumer Finances (SCF) and the Flow of Funds (FoF), both of which are produced and maintained by the Federal Reserve System. The SCF is a detailed survey of household finances that includes questions related to household income, asset holdings, mortgages, credit usage, and demographic characteristics. The FoF includes balance sheets for entities at the aggregate level, including the household sector, the federal government, businesses, and groups in the financial sector. We rely on the FoF for information about intermediate holdings and the holdings of assets and liabilities of each entity (in aggregate) that are reflected on other entities' balance sheets. We also use auxiliary data from other sources, including treasury yields and inflation from FRED, inflation expectation data from the Cleveland Fed, and consumption data from Facteus.

In this appendix, we describe in detail how we construct nominal payment streams for each household in the SCF (Section 3), and how we construct the inflation shocks that we present in Section 4. We refer readers to Karger and Rajan (2023) for additional details about the Facteus data.

C.1 A Method of Consolidating Indirect Holdings

Before we describe how we construct households' nominal balance sheets, we first present our method for disentangling cross-holdings between entities, which arise because each entity controls some assets and liabilities that are themselves intermediaries on the balance sheet. For example, if households own mutual funds, the mutual funds in turn often control other corporate equities and more straightforward holdings like cash and treasury bills. We need a method to disentangle these intermediaries, calculating the consolidated balance sheet for households' indirect holdings.

We categorize all *Sectors* in the Flow of Funds into "end owners" $l = 1, \ldots, L$ and "intermediaries" $i = 1, \ldots, I$. End owners include the household sector, the government, and the rest of the world; intermediaries include all other sectors (e.g., Nonfinancial Business and Mutual Funds). We separate all "Instruments" in the FoF into claims on intermediaries (e.g., Corporate Equities and Mutual Fund Shares) and "final assets" (and liabilities) indexed by $k = 1, \ldots, K$. Final assets do not represent ownership stakes in other assets or liabilities. These final assets include corporate bonds, bank loans, mortgage-backed securities, treasury bills, real estate holdings, and goodwill.

Let

- $b_{i,l}$ denote the share of intermediary i owned by end owner l;
- $\xi_{i,j}$ denote the share of intermediary i owned by intermediary j;
- $a_{k,i}$ denote the share of final asset (liability) k that shows up in intermediary i's balance sheet.

Our goal is to assign all final assets $a_{k,i}$ owned by the intermediaries to end-owners. The indirect holding of asset k by end owner l is given by the (k, l) element of matrix $\boldsymbol{a}^{ID}$ s.t.

$$\boldsymbol{a}^{ID} = \boldsymbol{a}(\boldsymbol{I}_{I\times I} - \boldsymbol{\Xi})^{-1}\boldsymbol{b},$$

where $\boldsymbol{a} = [a_{k,i}], \boldsymbol{\Xi} = [\xi_{i,j}], \boldsymbol{b} = [b_{i,l}]$.

Note that with this allocation, we should have the total (direct and indirect) ownership

of end owners over intermediaries sum to one, and all final assets eventually held by end owners:

$$\boldsymbol{\Xi}\mathbf{1}_I + \boldsymbol{b}\,\mathbf{1}_L = \mathbf{1}_I, \quad \sum_l \boldsymbol{a}_l^{ID} + \boldsymbol{a}_l^D = \mathbf{1}_K$$

where $\boldsymbol{a}_l^D$ denotes end owner l's direct share of final asset $k = 1, \ldots, K$.

C.2 Household Balance Sheet Construction

This section proceeds in three parts. First, we describe how we take microdata from the SCF to calculate households' most important direct holdings: mortgage payments and expected future labor income. We add to this dataset information regarding rent payments, social security, and taxes.

After we describe the creation of this dataset containing detailed information about SCF households' direct holdings of assets and liabilities, we then discuss our consolidation of indirect holdings into the final ownership of each asset and liability by each household. At this stage, we adjust the SCF data to match Flow-of-Funds (FoF) totals for the U.S. economy, accounting for under- and over-reporting of the average household in the SCF of certain assets and liabilities in their self-reported holdings data. This minimizes the chance that our results in this paper are distorted by reporting bias in the SCF, although we explore the importance of that assumption in later robustness checks.

We then describe how we rely on the full data on household-level holdings of assets and liabilities to construct measures of the welfare effect of inflation shocks. We do this by (1) calculating each household's exposure to inflation by transforming the household-level dataset into separately measured holdings of nominal and real assets and liabilities of differing duration; and (2) calculating the size of inflation shock for the 2021–2022 inflation episode, for which we evaluate the welfare effects in this paper.

For all discounting to calculate present values, we use the Treasury yield curve over a thirty-year time horizon.

C.2.1 Payment Streams and Income

Our main data for household balance sheets come from the 2019 SCF, adjusted to be in 2021 dollars, as our welfare calculation focuses on the 2021–2022 inflation episode. We clean the raw SCF data to obtain household-level demographic data on age, sex, race, and college education of the household head, as well as income and household weights.

Mortgage payment streams. We use an SCF extract with detailed variables on household mortgages. We use the mortgage principal, current interest rate, payment frequency, and years remaining to calculate streams of annual mortgage payments for each household. For adjustable-rate mortgages, we make further adjustments to account for the initial period with fixed rates and contractual caps on the frequency and size of rate changes. When the expected repayment year is not reported, we impute the years remaining based on the outstanding balance and the calculated annual payment. Instead of using the current mortgage rate that each household pays, we calculate a forward mortgage rate using the forward treasury rate plus the mortgage spread. This gives us a vector of mortgage payments from the current year extending into the future for each household with a mortgage.

Rent. For households paying rent, we add 6 months of rent reported in the SCF as a liability.

Income streams. We use pooled 2010–2019 SCF microdata to estimate future income streams, relying on demographic information to predict life-cycle income growth rates for each household. We separate income into three components: labor income, social security payments, and defined benefit income, and calculate federal and local tax liabilities separately based on these incomes.

We define labor income as total annual income minus interest and dividend income, capital gains, and retirement income. To estimate expected labor income streams, we regress logged labor income on demographic fixed effects (sex, age, race, and college) and year fixed effects, interacting age and year separately with the other demographic variables. Prior to estimation, we replace zeros with the 5th percentile of non-zero income for each demographic group. We apply the resulting estimated life-cycle income growth rates to each individual's reported current labor income.

Retirement income. We distinguish social security from defined benefit income, although the SCF does not report each category separately. First, we calculate the average level observed among retirees who receive only Social Security income. Then, for retirees with both sources of income, we cap the social security component at the average level of those with only social security. For non-retirees, we project future Social Security payments from their estimated labor income streams according to the SSA rules on Average Indexed Monthly Earnings and Primary Insurance Amount. For non-retirees who indicate that they expect to receive defined benefit income, we project it based on the average ratio of defined benefit and social security income.

Tax liabilities. We use the TAXSIM calculator provided by the National Bureau of Economic Research. TAXSIM uses variables such as marital status, age, number of dependents, rent paid, labor income, and social security income to compute taxes owed by households. We obtain these variables from the SCF. Because taxes vary by state and the SCF does not provide geographic information, we randomly assign households to states such that the distribution of weights across states closely matches the distribution of population across states from the Census. We calculate each household's tax liabilities on labor and retirement income for the current and future years.

Adjustments and counterparties. We adjust expected income streams and taxes by conditional survival probabilities and scale future payments by the average annual nominal wage growth rate from 2010 to 2020, compounded to each payment's horizon, to account for inflation and long-run real wage growth.

We account for the counterparties of these income and liability streams as follows: (1) Mortgage holdings are allocated according to the FoF. (2) Labor income, private defined benefit, and rent are split between corporate and non-corporate businesses based on their asset shares. (3) Social security, public pension, and taxes are owned by the government as liabilities and assets.

C.2.2 Matching SCF to Flow of Funds

We construct the "longdata" dataset by combining SCF household data with FoF aggregate ownership information using the method described in Section C.1.

FoF consolidation. We use Q4 2019 FoF data to consolidate indirect holdings for the three end owners. We identify agents using four-character codes in the FoF tables (e.g., "FL15" for households, "FL63" for money market funds) and compute ownership shares by dividing balance sheet items by their totals. We calculate goodwill for the corporate and non-corporate sectors as the difference between the sectors' market valuations and their accounting net worth (financial assets minus liabilities). Since market valuations already reflect expected future labor costs and DB pension obligations, but we account for these separately as standalone liabilities for firms, we add them back to goodwill to avoid double-counting. We split pension holdings into defined benefit (DB) and defined contribution (DC) components; DC holdings are consolidated into indirect holdings, while DB entitlements are treated as a separate asset. When FoF asset and liability totals differ, we scale assets proportionally to match liabilities.

Variable mapping. We match SCF variables to FoF intermediaries and holdings (see Table C.1). The mapping involves: (1) combining multiple SCF variables for single FoF categories (e.g., `checking`+`prepaid` for Checkable Deposits); (2) splitting SCF variables across FoF categories (e.g., trust funds allocated across equities, treasuries, municipal and corporate bonds; retirement accounts allocated across DC pension fund types); and (3) using the separately computed NPVs for capitalized income streams.

Adjustment factors. To reconcile SCF and FoF totals, we compute adjustment factors:

$$\text{Adjustment Factor} = \frac{\text{SCF Total/FoF Total}}{\text{HH Direct Share}} \tag{12}$$

where HH Direct Share is the fraction held directly by households. We prioritize liability-based ratios when available; otherwise, we use asset-based ratios; if neither is available, the factor defaults to 1. For categories with poor SCF-FoF matches—variables marked with (*) in Table C.1—we skip adjustment to prevent extreme scaling.

Variables without SCF equivalents. Some FoF categories lack corresponding SCF variables. Rather than leaving these unallocated, we reassign household shares to the non-corporate business sector. Asset-side reassignments include consumer loans held as assets, U.S. Deposits in Foreign Countries, seller-financed mortgages, Trade Credit, and Agency/GSE Securities. Liability-side reassignments include Municipal Securities and Trade Credit. This treats these holdings as ownership stakes in non-corporate entities, preserving consistency with FoF totals.

Allocation to individual households. To allocate the aggregate household sector's holdings to individual households, we use each household's share of SCF totals for each intermediary (e.g., mutual funds, DC pensions). We scale these shares so that the weighted sum across all households matches the aggregate household sector's share from the FoF. We then apply the Leontief inverse from Appendix C.1 to trace each household's indirect ownership of final assets through chains of intermediaries. Direct holdings equal the SCF value divided by the adjustment factor.

FoF vs. SCF adjustment. Our main specification adjusts household balance sheets to match FoF totals, which provide a more complete view of the economy. Adjusting to FoF increases totals for holdings like Treasury Securities, which are predominantly government liabilities and indirect household assets. Consequently, the government gains more and

wealthy households lose more from unexpected inflation compared to using unadjusted SCF values.

C.2.3 Summary Tables

Table C.1 shows matches between FoF and SCF variables. The columns include: FoF variable names, FoF totals (trillions of 2021 USD), household direct shares, corresponding SCF variable names, SCF totals, and adjustment factors. Categories marked "N/A" lack SCF equivalents and are reassigned to the non-corporate business sector.

Several variables use computed values rather than raw SCF variables: (1) `npv_mtg` is the nominal present value of mortgage payment streams; (2) `rent*6` annualizes monthly rent to a semi-annual basis; (3) `labor_inc_npv` is the nominal present value of labor income streams; (4) `db_inc_npv` is the nominal present value of defined benefit pension entitlements; (5) `ss_inc_npv` is the nominal present value of social security income streams; and (6) `tax` is the computed tax liability based on income.

Table C.1: FoF to SCF Matching

FoF Names	FoF Totals	HH Shares	SCF Names	SCF Totals	Adjustment
Non-Corporations	14.08	1.00	bus	22.27	1.58
Credit Card Loans	1.14	1.00	ccbal	0.38	0.33
Auto Loans	1.24	1.00	veh_inst	0.87	0.7
Student Loans	1.71	1.00	edn_inst	1.16	0.68
Other Consumer Credit	0.27	1.00	oth_inst	0.29	1.1
Real Estate	34.22	1.00	(houses+oresre)	36.97	1.08
Durable Goods	5.98	1.00	vehic	3.03	0.51
S&L DC Funds	0.60	0.99	s_l_dc_share_of_total*retqliq	0.35	0.59
Private DC Funds	8.92	0.99	priv_dc_share_of_total*retqliq	5.26	0.59
Federal DC Funds	0.79	0.99	fed_dc_share_of_total*retqliq	0.46	0.59
Time and Savings Deposits	13.40	0.79	(saving+cds+call)	3.35	0.32
Life Insurance Reserves	2.38	0.77	(cashli+annuit)	1.94	1.06
Money Market Funds	3.78	0.59	mma	1.74	0.78
Mutual Funds	18.36	0.55	nmmf	10.29	1.02
Municipal Securities	4.01	0.46	(notxbnd + trust_split_muni)	0.82	0.45
Corporations	57.10	0.38	(stocks + trust_split_stocks)	9.55	0.44
Checkable Deposits and Currency	4.99	0.26	(checking+prepaid)	1.43	1.09
Treasury Securities	19.78	0.10	(savbnd + govtbnd + trust_split_treas)	0.48	0.24
Corporate and Foreign Bonds	14.59	0.07	(obnd + trust_split_corpbnd)	0.27	0.28
Total Misc Fin Claims	25.20	0.05	othfin	0.79	0.69
Other Loans and Advances	4.21	0.24	odebt (*)	0.17	1
Other Depository Inst Loans	3.97	0.09	othloc (*)	0.08	1
Total Mortgages	16.65	0.68	npv_mtg (1)	11.94	1.05
Rent	0.27	1.00	rent*6 (2)	0.27	1
Labor Income	285.29	1.00	labor_inc_npv (3)	285.29	1
DB Entitlements	51.52	1.00	db_inc_npv (4)	51.52	1
Social Security	52.83	1.00	ss_inc_npv (5)	52.83	1
Taxes	63.15	1.00	tax (6)	63.15	1

FoF and SCF Totals are in trillions of 2021 USD. Shares denote the fraction of the FoF Total held directly by households. The adjustment factor equals (SCF Total / FoF Total) / HH Share.

Table C.2 shows all holdings across the three end owners: households, U.S. government, and

the rest of the world. Columns two through four show liability totals, while columns five through seven show asset totals. Column eight shows the asset-to-liability ratio.

For all financial assets, the ratio equals 1, meaning total assets exactly match total liabilities. Real assets show "N/A" ratios since they have no corresponding liability holdings.

Table C.2: Consolidated Holdings Across All End Owners

	Liabilities			Assets			
FoF Names	Households	Government	Rest of World	Households	Government	Rest of World	Ratio A/L
Credit Card Loans	1.14	0.00	0.00	0.56	0.42	0.15	1
Auto Loans	1.24	0.00	0.00	0.61	0.46	0.17	1
Student Loans	1.71	0.00	0.00	0.84	0.64	0.23	1
Other Consumer Credit	0.27	0.00	0.00	0.13	0.10	0.04	1
Time and Savings Deposits	9.63	1.12	2.65	12.23	0.48	0.70	1
Life Insurance Reserves	1.62	0.24	0.52	2.23	0.05	0.11	1
Municipal Securities	0.65	3.24	0.12	3.45	0.16	0.40	1
Checkable Deposits and Currency	1.97	2.48	0.54	2.93	0.73	1.33	1
Treasury Securities	0.00	19.78	0.00	6.38	5.91	7.49	1
Corporate and Foreign Bonds	8.06	0.92	5.61	7.92	1.24	5.43	1
U.S. Reserves and SDR Allocations	0.00	0.05	0.12	0.00	0.17	0.00	1
SDRs and Treasury Currency	0.00	0.06	0.00	0.00	0.06	0.00	1
U.S. Deposits in Foreign Countries	0.00	0.00	0.79	0.63	0.05	0.11	1
Net Interbank Transactions	0.06	1.70	0.02	1.19	0.14	0.45	1
Federal Funds and SRPA	2.67	0.45	1.43	2.86	0.49	1.20	1
Open Market Paper	0.47	0.05	0.56	0.66	0.18	0.25	1
Agency and GSEs	7.01	0.84	1.93	5.15	2.51	2.12	1
Other Depository Inst Loans	2.93	0.11	0.92	2.85	0.33	0.78	1
Other Loans and Advances	2.82	0.19	1.21	2.60	0.40	1.21	1
Trade Credit	3.41	1.69	0.65	4.00	0.65	1.11	1
Taxes Payable by Businesses	0.47	0.03	0.08	0.00	0.59	0.00	1
Direct Investment	0.00	0.00	7.55	5.51	0.61	1.43	1
Total Misc Fin Claims	14.23	7.47	3.50	16.28	6.49	2.43	1
Total Mortgages	16.41	0.07	0.17	11.74	1.72	3.19	1
Rent	0.27	0.00	0.00	0.21	0.02	0.04	1
Labor Income	220.89	19.20	45.20	285.29	0.00	0.00	1
DB Entitlements	8.77	40.96	1.79	51.52	0.00	0.00	1
Social Security	0.00	52.83	0.00	52.83	0.00	0.00	1
Taxes	63.15	0.00	0.00	0.00	63.15	0.00	1
Corporate Goodwill	0.00	0.00	0.00	191.24	22.33	52.56	N/A
Durable Goods	0.00	0.00	0.00	5.98	0.00	0.00	N/A
Equipment	0.00	0.00	0.00	4.92	0.46	1.08	N/A
Inventories	0.00	0.00	0.00	2.02	0.21	0.48	N/A
IP	0.00	0.00	0.00	2.50	0.26	0.60	N/A
Non-Corporate Goodwill	0.00	0.00	0.00	56.71	0.00	0.00	N/A
Other Real Estate	0.00	0.00	0.00	27.62	1.23	2.89	N/A
Real Estate	0.00	0.00	0.00	34.22	0.00	0.00	N/A

Columns show holdings of liabilities and assets by each end owner. All totals are in trillions of 2021 USD.

Figures B.2 and B.5, along with Table B.4, present the main results for the U.S. government and rest of the world. While households across the wealth distribution tend to lose from unexpected inflation, Figure B.5 shows that the government has corresponding gains.

C.2.4 Household Nominal Payment Streams

Our second main dataset is called "payment streams." For this dataset, we construct nominal payment streams for all holdings of assets and liabilities with non-zero nominality (excluding, for example, real estate and equipment) based on our assumptions about their nominality and duration. Table C.3 shows the assumptions we made about the nominality and maturity of holdings. Holdings with a maturity of N/A are not considered nominal. Several of the cells contain notes concerning their values for holdings, which are partially real and partially nominal:

(1) We assume that for every household, 9% of their Treasury holdings are inflation-protected TIPS (real) and 91% are fixed-rate (nominal).

(2) For fixed-rate mortgages, we assume the mortgage payments are nominal; for adjustable-rate mortgages, we assume the payments adjust one-to-one with the price level, consistent with constant real interest rates.

(3) For households paying rent for housing, we assume half a year of the rent liability is nominal.

(4) For labor income, we incorporate the nominality of labor income using estimates from Hajdini et al. (2023), who survey respondents surrounding the 2021 inflation shock and find that for households earning less than \$50k, \$50–100k, or more than \$100k, only 13%, 31%, or 34% of expected income growth adjusts with inflation expectations. This implies nominality θ_0^W of 0.87, 0.69, and 0.66, respectively, depending on household income. For labor income after the initial year, we assume a gradual adjustment, where $\theta_1^W = 0.6 \times \theta_0^W$ and $\theta_2^W = 0.15 \times \theta_0^W$; wages in years afterwards are assumed to have completely adjusted to inflation. We apply the same nominality pattern to Defined Benefit and Social Security income.[12]

(5) We treat taxes on the nominal fractions of households' labor and social security income as nominal assets for the government and liabilities of the households.

For direct holdings of assets and liabilities such as mortgages and labor income, we use the detailed information in SCF to construct the nominal payment streams based on the procedure described in Appendix C.2 and the assumptions about their nominality as shown in Table C.3. For rent, we take the next six months of rent from the SCF as nominal liability

[12] While Social Security benefits are subject to annual cost-of-living adjustments, these adjustments occur with a one-year lag, and the actual adjustment may differ from realized inflation due to the timing of the measurement period. Our assumed decay pattern approximates this delayed adjustment, with substantial nominality in the initial year and gradual indexation thereafter.

for households who are paying rent.

For payments to be received from holdings of Treasury debt, we use data from the CRSP US Treasury Database. In that dataset, we observe the outstanding value of each Treasury security with information regarding its face value, coupon rate, and maturity date. We take all Treasury securities outstanding at the beginning of 2019 and calculate the aggregate Treasury nominal payment streams for all Treasury securities. We assume that, for each household in the SCF, the nominal payment streams from their holdings of Treasury securities are proportional to the aggregate Treasury streams, with the present value matching each household's total Treasury holdings (direct and indirect) after the adjustments described in Appendix C.2.

For other holdings for which we do not have detailed information, we calculate the maturity structure of the outstanding assets (or liabilities) in each category as follows: (1) For each category, we assume that assets and liabilities are issued with a constant maturity as summarized by Table C.3. (2) We use changes in the outstanding values for each category in the FoF since 2010 to calculate the maturity structure of the outstanding stock in 2019. This procedure is similar to the approach taken by Doepke and Schneider (2006). Dividing these maturity totals by the nominal present value gives us the value in future payments of $1 today. We then use the values we obtained in longdata to calculate the values in future payments of each holding owned by households.

This gives us payment_streams.csv, which contains streams of payments of each holding held by each household in the SCF for thirty periods: from year 0 (the current year) to year 29. Now that we have created longdata and payment streams for households, we create three more datasets. The first of these is a nominal version of longdata, which is calculated by taking the net present value of all payment streams that exist only for nominal holdings. The second two datasets are versions of longdata and payment streams created for the U.S. government and the rest of the world. These are constructed in the same manner as we did for households, but instead using FoF data for the remaining two end owners: the U.S. government and the rest of the world. This step allows us to verify that totals of assets and liabilities across all end owners (households, the U.S. government, and the rest of the world) match up,[13] and also that each gain has a corresponding loss and vice versa.

[13]The ratio of aggregate assets to liabilities is 0.996, as shown in Table C.2. For most individual holdings, the ratio equals 1. Discrepancies arise when the FoF indicates direct household holdings but no corresponding SCF variable exists (e.g., U.S. deposits in foreign countries). We estimate the effects of these discrepancies to be minor.

Table C.3: Maturity and Nominality

Holding	Maturity	Nominal
U.S. Reserves and SDR Allocations	1	Yes
SDRs and Treasury Currency	1	Yes
US Deposits in Foreign Countries	1	Yes
Net Interbank Transactions	1	Yes
Checkable Deposits and Currency	1	Yes
Time and Savings Deposits	2	Yes
Federal Funds and SRPA	1	Yes
Open Market Paper	1	Yes
Agency and GSEs	20	Yes
Municipal Securities	10	Yes
Corporate and Foreign Bonds	7	Yes
Other Depository Inst Loans	3	Yes
Other Loans and Advances	3	Yes
Credit Card Loans	1	Yes
Auto Loans	5	Yes
Student Loans	10	Yes
Other Consumer Credit	3	Yes
Trade Credit	1	Yes
Life Insurance Reserves	1	Yes
Taxes Payable by Businesses	1	Yes
Direct Investment	3	Yes
Total Misc Fin Claims	3	Yes
Real Estate	N/A	No
Equipment	N/A	No
IP	N/A	No
Inventories	N/A	No
Durable Goods	N/A	No
Corporate Goodwill	N/A	No
Non-Corporate Goodwill	N/A	No
Other Real Estate	N/A	No
Treasury Securities	NA	(1)
Total Mortgages	NA	(2)
Rent	1	(3)
Labor Income	NA	(4)
DB Entitlements	NA	(4)
Social Security	NA	(4)
Taxes	NA	(5)

Notes: (1) 9% of each household's Treasury holdings are inflation-protected TIPS (real), and 91% are fixed-rate (nominal). (2) Fixed-rate mortgages are nominal, and adjustable-rate mortgages are real. (3) Half a year of rent liability is nominal. (4) Nominality decays over the first three years based on income group; see text for details. Social Security and DB entitlements follow the same adjustment. (5) Taxes associated with the nominal fractions of labor and social security income are treated as nominal assets for the government and liabilities for households.

C.2.5 Inflation Shocks

We use the monthly inflation expectations data from the Cleveland Fed, which provides expectations for average inflation over the $1, \ldots, 30$ year horizons. We combine it with realized inflation calculated from monthly CPI data from FRED (CPIAUCSL). We construct the inflation shock for a year 0 as follows: For the initial inflation surprise, $\hat{\pi}_0^0$, we take the log

difference between realized inflation π_0^0 and over year 0 and the one-year inflation expectation at the beginning of the year $\mathbb{E}_0[\pi_0^0]$. For the expectation updates $\hat{\pi}_0^t$ for $t > 0$, we first compute the updated expectation at the end of the year, $\mathbb{E}_1[\pi_0^t]$, as the sum of realized inflation π_0^0 and the expectation on cumulative inflation, $\mathbb{E}_1[\pi_1^t]$, calculated as t times the expectation of average inflation from the beginning of period 1 to the end of t. To compute $\hat{\pi}_0^t$, we then take the difference between $\mathbb{E}_1[\pi_0^t]$ and the cumulative inflation expectation $\mathbb{E}_0[\pi_0^t]$, calculated as $t+1$ times the expectation of average inflation from the beginning of period 0 to the end of t.

D Data Appendix: Household Illiquidity

This appendix provides additional details on the measurement of household illiquidity discussed in Section 5.

D.1 Credit Card Spreads

We measure households' marginal cost of borrowing as the interest rate paid on credit card balances, as reported in the 2019 Survey of Consumer Finances (SCF). We construct spreads as follows:

1. Sum balances across bank-type cards (Visa, MasterCard), store-branded cards, and charge cards.
2. Restrict to households with revolving balances exceeding $500.
3. Use the reported interest rate (X7132) as the marginal borrowing cost.
4. For households with balances but missing interest rates, impute the population-weighted mean rate.
5. Calculate spreads as:

$$s_0 = 100 \times \left[\frac{1 + \text{credit card rate}}{1 + \text{1-year treasury rate}} - 1 \right].$$

6. Assign zero spreads to households with no credit card debt or balances below the threshold.

Table D.1 presents summary statistics on credit card debt by wealth decile.

Table D.1: Credit Card Debt: Summary Statistics by Wealth Decile

Wealth Decile	1	2	3	4	5	6	7	8	9	10
All Households										
Prop. with Balance	0.22	0.27	0.33	0.32	0.36	0.36	0.36	0.42	0.38	0.23
Avg. Balance ($k)	1.6	2	2.7	2.8	2.8	2.9	2.9	4.1	3.7	2.8
Avg. Spread (%)	3.73	4.37	5.31	5.41	5.42	5.44	6.17	6.81	5.81	3.45
Conditional on Having Balance										
Avg. Balance ($k)	6.8	6.9	7.4	8.5	7.1	6.5	7.5	8	7.8	10.8
Avg. Spread (%)	17.05	16.28	16.32	17.12	15.24	15.02	17.13	16.04	15.22	15

Notes: The top panel shows statistics for all households. The bottom panel shows statistics conditional on having a revolving credit card balance of at least $500 with a positive interest rate. "Avg. Balance" is in thousands of dollars. "Avg. Spread" is the credit card spread (in percentage points) relative to the 1-year Treasury rate.

D.2 Shadow Rates from Consumption Responses

Shadow rates capture the implicit cost of borrowing constraints that prevent households from smoothing consumption. We estimate shadow rates using households' marginal propensity to consume (MPC) out of transitory income shocks, as revealed by responses to COVID-19 stimulus payments.

D.2.1 Facteus Transaction Data

Our data comes from Karger and Rajan (2023), who use anonymized transaction-level bank account data from Facteus covering tens of thousands of primary bank accounts. Transaction amounts and demographic information are perturbed to preserve anonymity.

The sample includes accounts that received IRS stimulus payments in April 2020, with minimum annual consumption of $5,000. Treatment groups are defined by check size: $1,200 (single adults), $1,700 (one dependent), $2,200 (two dependents), or $2,400 (married filers).

Income Matching. Income in Facteus is measured as annualized bank deposits. To match this concept in the SCF, we construct "deposit-equivalent" income as the sum of labor income, defined benefit pension income, and Social Security income, net of estimated tax withholding. We apply type-specific withholding rates (30% for labor income, 15% for DB pensions, 10% for Social Security) to approximate the income that actually arrives in households' bank accounts. Both Facteus and SCF incomes are expressed in January 2021 dollars.

Table D.2 compares summary statistics between the Facteus sample and SCF households by income bracket.

Table D.2: Sample Comparison: Facteus vs. SCF by Income Bracket

	<$25k		$25–50k		$50–75k		>$75k	
	Facteus	SCF	Facteus	SCF	Facteus	SCF	Facteus	SCF
Share (%)	46	23	42	32	11	18	1	27
Mean Age	36.1	51.6	37.3	51.5	37.1	50.8	39.7	52.7
Consump/Income	0.81	—	0.68	—	0.59	—	0.45	—
Spending/Check Size	0.47	—	0.38	—	0.28	—	0.22	—
Spending/Annual Cons.	0.06	—	0.03	—	0.02	—	0.01	—

Notes: Share shows the percentage of each sample in each bracket. Income in Facteus is annualized bank deposits; in the SCF, it is deposit-equivalent income (labor + DB pension + Social Security, net of withholding). Consump/Income is the mean consumption-to-income ratio. Spending/Check Size is the MPC out of stimulus payments. Spending/Annual Cons. is the ratio of stimulus spending to annual consumption. All amounts are in January 2021 dollars.

D.2.2 Event Study Specification

The event study in Figure 6 estimates the following specification for each check-size group:

$$y_{i,t} = \sum_{s=-14}^{13} \beta_s \cdot \mathbf{1}(\text{stimulus received})_{i,t-s} + \varepsilon_{i,t} \tag{13}$$

where $y_{i,t}$ is individual i's income or spending on day t. Standard errors are two-way clustered at the state and date level. All specifications yield an average spending-to-transfer ratio of 0.46 in the two weeks following the first stimulus payment.

D.2.3 Projection to SCF Households

We project consumption responses to SCF households using natural splines for age and income:

$$\Delta c_i = f(\text{age}_i) + g(\text{income}_i) + \varepsilon_i \tag{14}$$

where Δc_i is the consumption response relative to annual consumption, and $f(\cdot)$ and $g(\cdot)$ are natural spline functions with knots at incomes $\{5k, 10k, 30k, 50k, 70k, 90k, 150k\}$ dollars and ages $\{25, 35, 45, 55, 65\}$.

Bounds on Consumption Response. We apply the following restrictions:

- Households with income $\geq$ \$150,000 are assigned zero consumption responses.

- Households with net worth $>$ \$5 million are assigned zero consumption responses.
- Age is capped at 85 for prediction, as the Facteus sample has limited observations above this age.
- Income is floored at the minimum knot value (\$5,000) to prevent extrapolation below the observed range.

Figure D.1 shows consumption responses by income and age group.

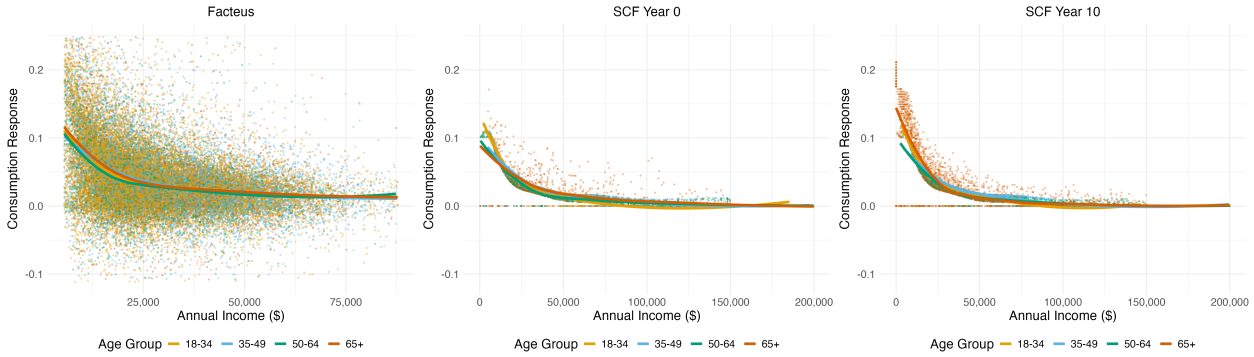


Figure D.1: Consumption responses relative to annual consumption, by income and age group. Left: Facteus data. Middle: SCF households, year 0. Right: SCF households, year 10.

D.3 Projection of Illiquidity Measures Over Time

Both shadow rates and credit card spreads are projected over 30 years to match the horizon of household nominal payment streams. We describe the projection methodology for each component.

D.3.1 Shadow Rate Projection

Shadow rates are derived from consumption responses, which depend on household age and income. We project consumption responses forward as follows:

1. **Income projection:** We use 30-year projections of deposit-equivalent income (labor + DB pension + Social Security, net of withholding) for each SCF household.
2. **Age projection:** Household age increases by one year in each period.
3. **Spline prediction:** For each future year t, we predict the consumption response $\Delta c_{i,t}/c_{i,t}$ using the same natural spline model fitted on Facteus data, evaluated at the household's projected age and income.

4. **Shadow rate calculation:** The annual shadow rate $\zeta_{i,t}$ is computed from the consumption response using the formula in Section 5. We then compute the geometric mean shadow rate up to horizon t.

The same bounds apply in all years: households with income $\geq$ \$150,000 or net worth $>$ \$5 million receive zero consumption responses.

D.3.2 Credit Card Spread Projection

Credit card spreads are projected using a similar spline-based approach:

1. **Initial spread estimation:** For year 0, we observe credit card interest rates directly from SCF variable X7132 and compute spreads relative to the 1-year Treasury yield.
2. **Spline regression:** We fit a weighted regression of observed spreads on natural splines of age and income, using the same knot specification as for consumption responses.
3. **Forward projection:** For years 1–29, we predict spreads using the fitted spline model evaluated at each household's projected age and income.
4. **Product spread calculation:** We compute the geometric mean spread up to each horizon t for use in the welfare calculation.

Households with income $\geq$ \$150,000 are assigned zero spreads in all years. Income is floored at \$5,000 to prevent extrapolation below the observed range.

E Welfare Effects Calculation

To calculate the welfare effects in Figure 8, we use the formula in Lemma 3:

$$dU = u_0'(\bar{c}_0) \times avg\big[(1+\tau_0^t)^{-1}\big]\Big(\underbrace{\Delta NPV}_{\text{wealth channel}} + \underbrace{\Omega \times \Big\langle \Delta z_t, \frac{(1+\tau_0^t)^{-1}}{avg[(1+\tau_0^t)^{-1}]} - 1 \Big\rangle}_{\text{liquidity channel}} \Big),$$

We define effects for the four decompositions in Figure 8 as Υ_j for $j \in \{1, \cdots, 4\}$, where Ω and Δz_t are as defined in Lemma 3:

1. the wealth channel:

$$\Upsilon_1 \coloneqq \Delta NPV;$$

2. the wealth channel plus the effect of illiquidity due to spreads s_{t+1}:

$$\Upsilon_2 \coloneqq \Delta NPV + \Omega \times \left\langle \Delta z_t, \frac{(1+s_0^t)^{-1}}{avg[(1+s_0^t)^{-1}]} - 1 \right\rangle;$$

3. the wealth channel plus the effect of shadow rates:

$$\Upsilon_3 \coloneqq \Delta NPV + \Omega \times \left\langle \Delta z_t, \frac{(1+\zeta_0^t)^{-1}}{avg[(1+\zeta_0^t)^{-1}]} - 1 \right\rangle;$$

4. the wealth channel plus the liquidity channel:

$$\Upsilon_4 \coloneqq \Delta NPV + \Omega \times \left\langle \Delta z_t, \frac{(1+\tau_0^t)^{-1}}{avg[(1+\tau_0^t)^{-1}]} - 1 \right\rangle.$$

To express these welfare effects in economically interpretable units, we normalize them in two ways:

- as a fraction of lifetime wealth:

$$\Upsilon_j^{wealth} \coloneqq \frac{\Upsilon_j}{NPV},$$

  where NPV denotes the household's lifetime wealth, constructed as described in Appendix C.2;

- as a fraction of annual consumption:

$$\Upsilon_j^{consump} \coloneqq \frac{\Upsilon_j}{\bar{c}_0},$$

  where $\bar{c}_0$ is the household's annual consumption level projected from Facteus data using a natural spline regression on age and income. For households with positive net worth, predicted consumption is bounded between 1% and 20% of net worth to ensure reasonable consumption-to-wealth ratios.

The first normalization expresses welfare effects as equivalent changes in the household's lifetime wealth, in the form of a perpetuity with constant payments. The second normalization similarly expresses the welfare effect as a perpetuity, but denominated in units of annual consumption rather than lifetime wealth: a welfare loss of $x\%$ means the household loses resources equivalent to paying a perpetuity whose net present value equals $x\%$ of their

annual consumption.[14]

We use the same calculation for Figure 9 and the additional figures in Appendix B.

F Robustness

Our results depend on a variety of parameters and assumptions. In this section, we test how alternative assumptions and values of parameters affect our result.

- The first assumption we test is how adjusting the SCF balance sheet totals to match the FoF total affects our result. As described in Section C.2, we chose to adjust the SCF to match the FoF for our main results. Due to the discrepancy between the two data sets that we see in Section C.2, we expect our result to depend on this adjustment. Here, we show how the results change if we instead adjust to match SCF totals.
- The second important parameter is the share of labor income that is nominal. In our main results, we assume this to be 0.87, 0.69, 0.66 in the first year if the respondent's post-tax income is <50k, 50k-100k, or >100k, respectively. We then assume second-year nominality is 0.6 and third-year is 0.15 of the first-year nominality. All income starting in the 4th year is real. Here, we show how multiplying all of the values of nominality by a scalar of 1.1, 1.0, or 0.9 affects the results.
- The third specification we test for robustness is our estimate of household consumption responses to stimulus checks, which determined their shadow rate. We take our estimates of $\check{c}_0$ for each household from the Facteus data and multiply these estimates by a scalar $\varsigma = 1.5$, 1.0, or 0.5.
- Finally, we test how much our result depends on our assumption of households' intertemporal elasticities of substitution. In our baseline specification, we assume $\sigma = \frac{-u_t''(c)c}{u_t'(c)} = 2$ to calculate the shadow rates. Here, we show how assigning σ with values of 3, 2, or 1 impacts our result.

Table F.1 summarizes these alternative specifications.

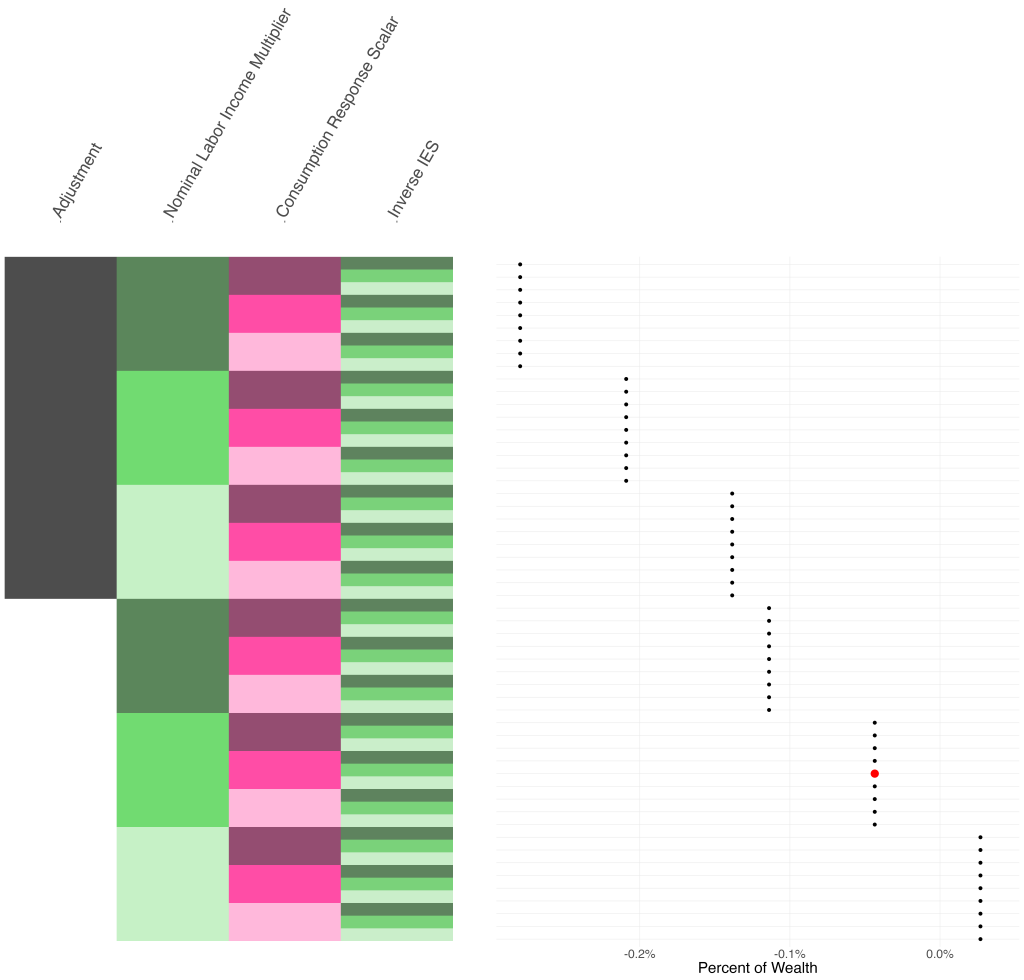
[14] Because a perpetuity's present value equals many years of annual payments, x% of annual consumption represents a substantial lifetime welfare effect. For example, if a household's lifetime wealth is 50 times their annual consumption, then a 1% loss in lifetime wealth corresponds to roughly 50% of annual consumption under this normalization.

Table F.1: Parameter Values in Robustness Checks

Parameters	Values
Adjustment	SCF, FoF
Labor Income Nominality Scalar	1.1, 1.0, 0.9
Consumption Response Scalar	1.5, 1.0, 0.5
Inverse IES	3, 2, 1

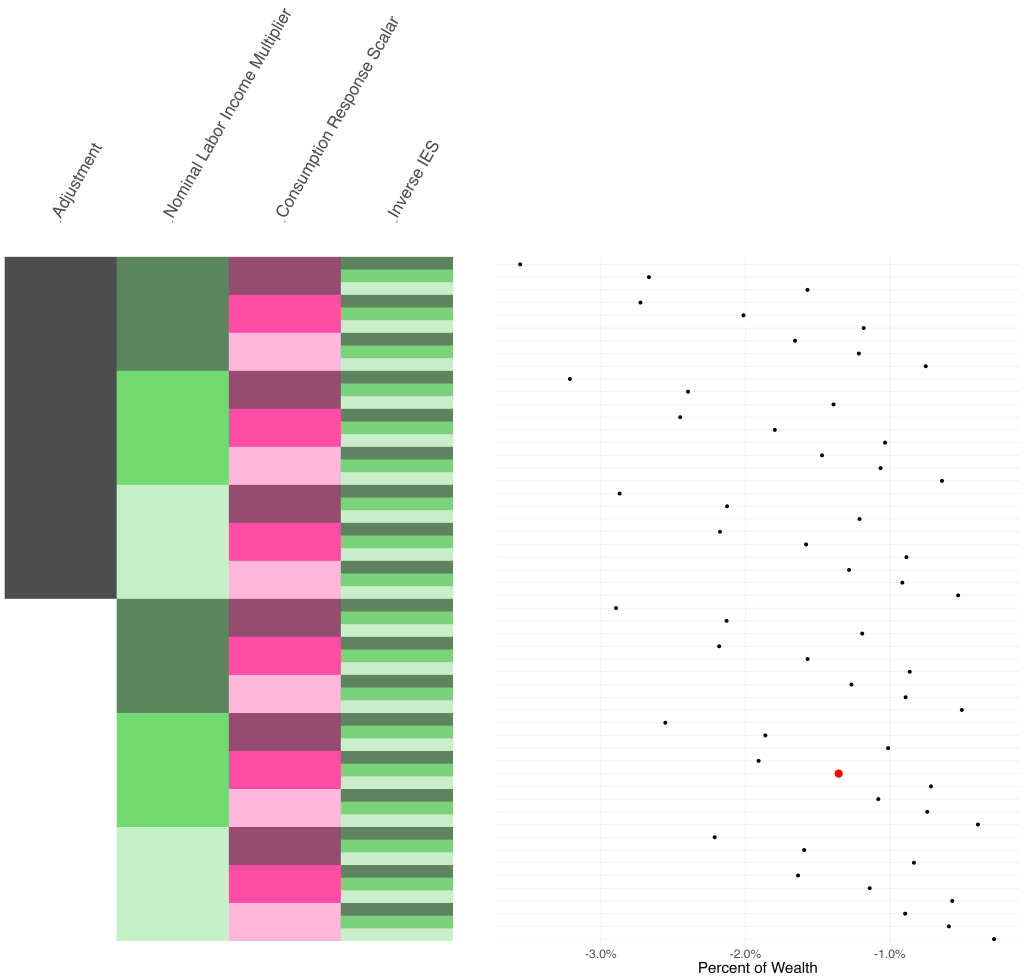
Note: Values in red correspond to our baseline specification.

In Figure F.1 through F.8, we consider all possible permutations of the assumptions in Table F.1, and we show the effects of the unexpected inflation shock for the wealth and liquidity channels for the 1st and 10th wealth deciles, with the effects represented in either lifetime wealth or annual consumption. In Panel (a), the legend uses darker colors to represent higher values and lighter colors to represent lower values. Each column corresponds to a particular parameter, and each row represents a unique combination of parameter values. For example, in the first column, black represents results adjusted to the SCF total, while white represents adjustments to the FoF total. In the second column, dark green represents a labor income nominality scalar of 1.1, medium green 1.0, and light green 0.9. In Panel (b), the Y-axis shows unique combinations of parameter values, and the X-axis shows the resulting welfare effect. The point highlighted in red represents the specification used in the main results. As we can see, adjusting to the FoF generally reduces the size of welfare losses. Similarly, lower nominal shares of labor income also yield more moderate estimates for welfare losses. In Figure F.1, F.3, F.5, and F.7, the wealth channel relative to lifetime wealth does not depend on consumption response scalars or the inverse IES; hence, we see only 6 unique values on the x-axis.



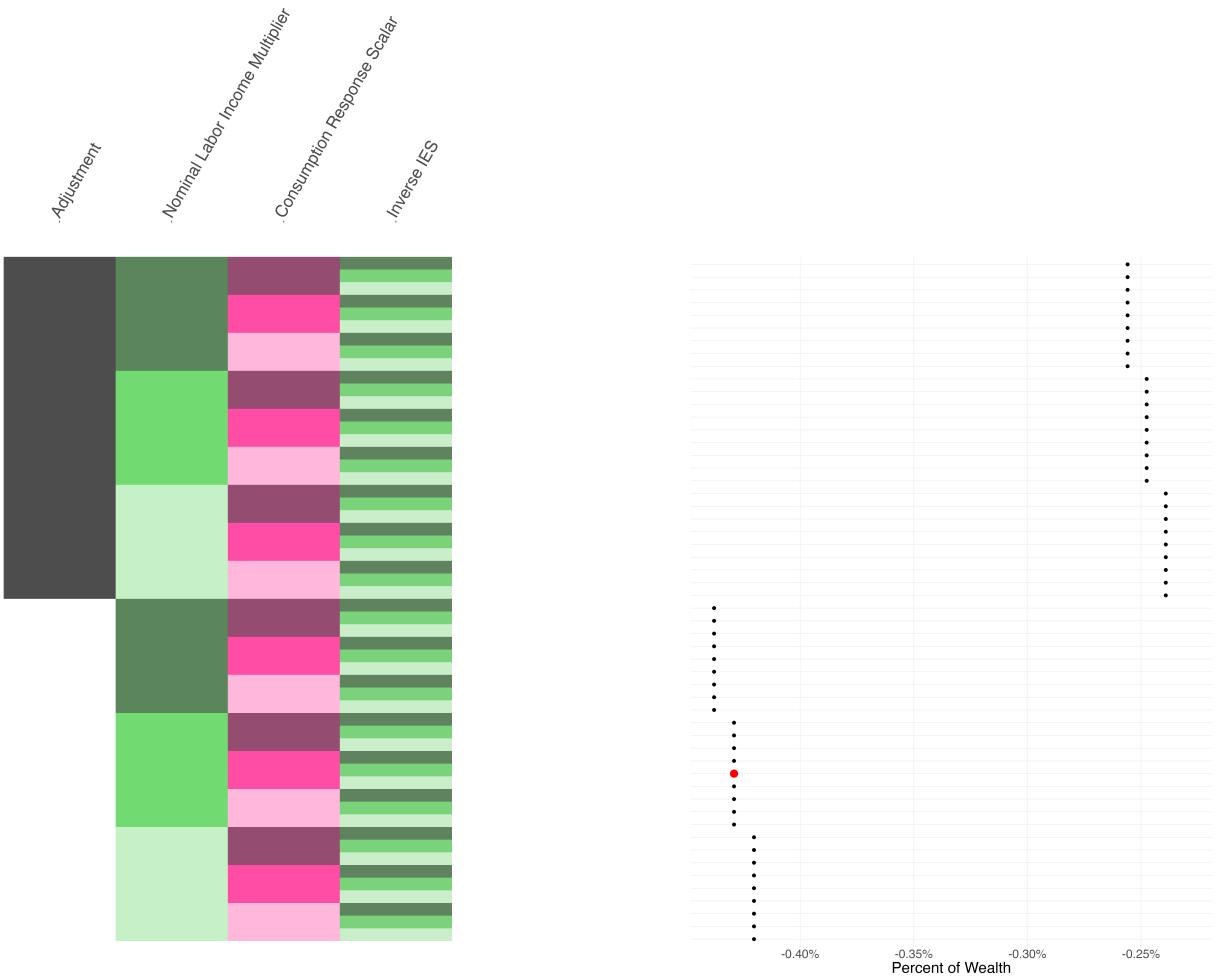
(a) Legend (b) Wealth Channel

Figure F.1: Robustness: Welfare effects for the wealth channel alone in percent of wealth for the 1st decile. For (a), for Adjustment, black values represent SCF and white values represent FoF. For other parameters, dark to light values are: Labor Income Nominality Scalar: 1.1, 1.0, 0.9. Consumption Response Scalar: 1.5, 1.0, 0.5. Inverse IES: 3, 2, 1. For (b), each point represents a parameter combination. The red point highlights the specification in the main results.



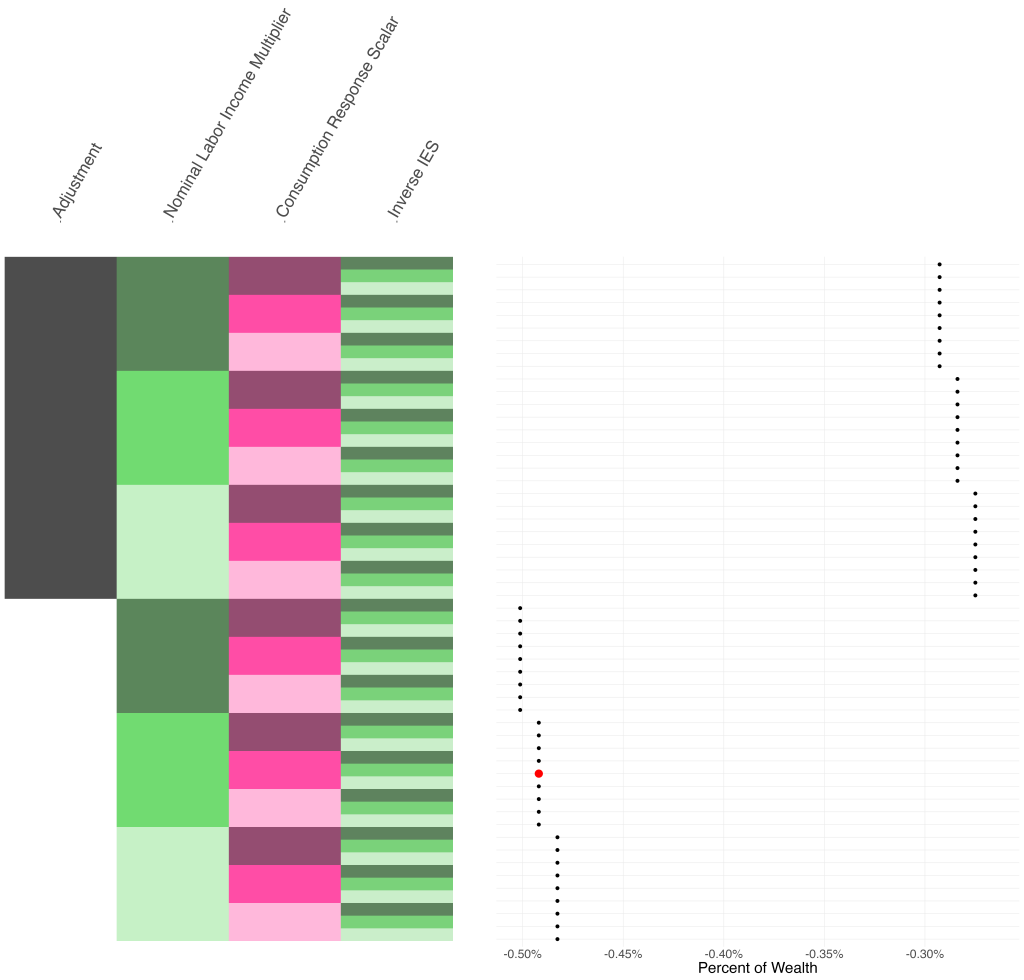
(a) Legend (b) Wealth + Liquidity Channel

Figure F.2: Robustness: Welfare effects for the wealth and liquidity channels in percent of wealth for the 1st decile. For (a), for Adjustment, black values represent SCF and white values represent FoF. For other parameters, dark to light values are: Labor Income Nominality Scalar: 1.1, 1.0, 0.9. Consumption Response Scalar: 1.5, 1.0, 0.5. Inverse IES: 3, 2, 1. For (b), each point represents a parameter combination. The red point highlights the specification in the main results.



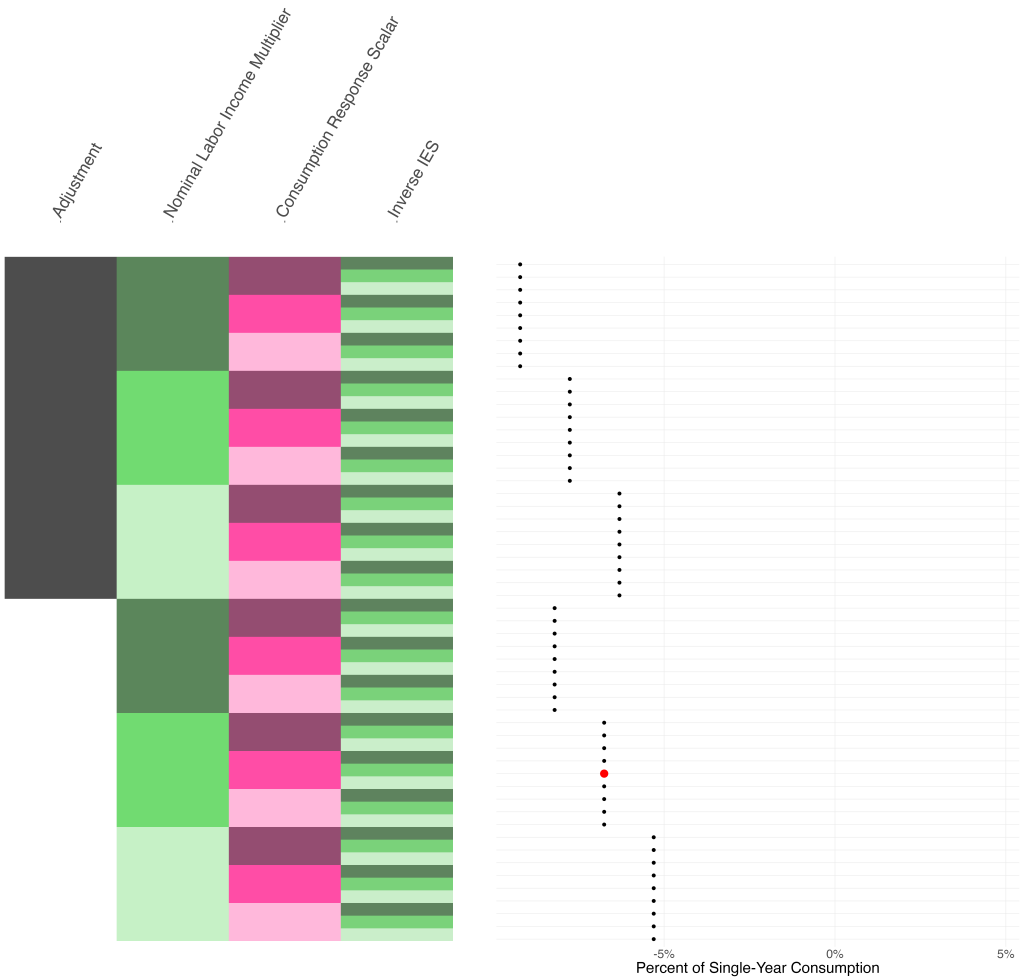
(a) Legend (b) Wealth Channel

Figure F.3: Robustness: Welfare effects for the wealth channel alone in percent of wealth for the 10th decile. For (a), for Adjustment, black values represent SCF and white values represent FoF. For other parameters, dark to light values are: Labor Income Nominality Scalar: 1.1, 1.0, 0.9. Consumption Response Scalar: 1.5, 1.0, 0.5. Inverse IES: 3, 2, 1. For (b), each point represents a parameter combination. The red point highlights the specification in the main results.



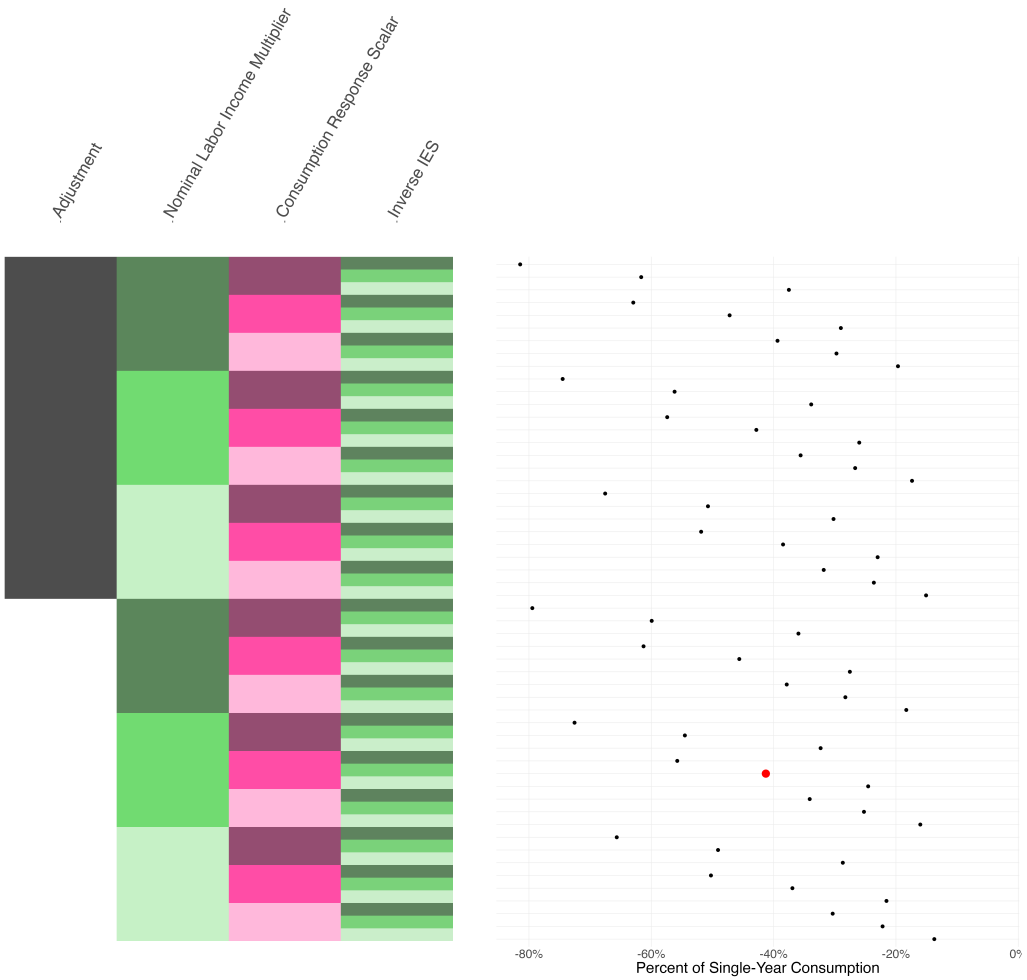
(a) Legend (b) Wealth + Liquidity Channel

Figure F.4: Robustness: Welfare effects for the wealth and liquidity channels in percent of wealth for the 10th decile. For (a), for Adjustment, black values represent SCF and white values represent FoF. For other parameters, dark to light values are: Labor Income Nominality Scalar: 1.1, 1.0, 0.9. Consumption Response Scalar: 1.5, 1.0, 0.5. Inverse IES: 3, 2, 1. For (b), each point represents a parameter combination. The red point highlights the specification in the main results.



(a) Legend (b) Wealth Channel

Figure F.5: Robustness: Welfare effects for the wealth channel alone in percent of annual consumption for the 1st decile. For (a), for Adjustment, black values represent SCF and white values represent FoF. For other parameters, dark to light values are: Labor Income Nominality Scalar: 1.1, 1.0, 0.9. Consumption Response Scalar: 1.5, 1.0, 0.5. Inverse IES: 3, 2, 1. For (b), each point represents a parameter combination. The red point highlights the specification in the main results.

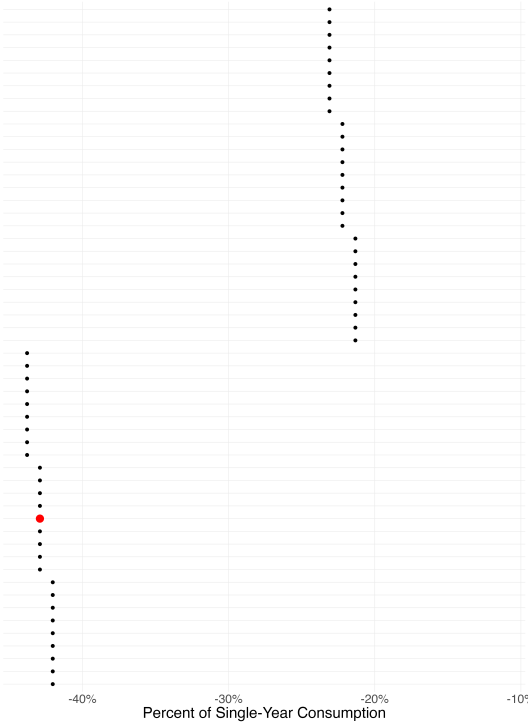


(a) Legend (b) Wealth + Liquidity Channel

Figure F.6: Robustness: Welfare effects for the wealth and liquidity channels in percent of annual consumption for the 1st decile. For (a), for Adjustment, black values represent SCF and white values represent FoF. For other parameters, dark to light values are: Labor Income Nominality Scalar: 1.1, 1.0, 0.9. Consumption Response Scalar: 1.5, 1.0, 0.5. Inverse IES: 3, 2, 1. For (b), each point represents a parameter combination. The red point highlights the specification in the main results.

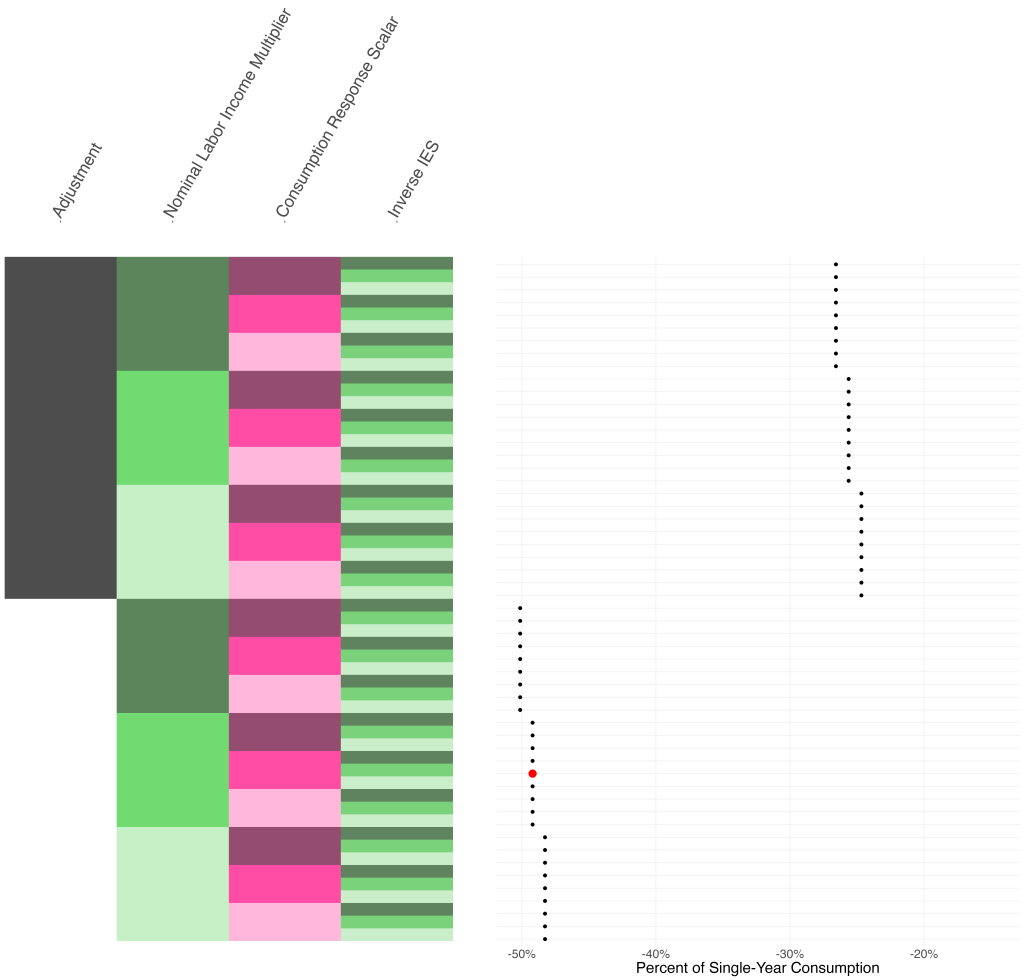


(a) Legend



(b) Wealth Channel

Figure F.7: Robustness: Welfare effects for the wealth channel alone in percent of annual consumption for the 10th decile. For (a), for Adjustment, black values represent SCF and white values represent FoF. For other parameters, dark to light values are: Labor Income Nominality Scalar: 1.1, 1.0, 0.9. Consumption Response Scalar: 1.5, 1.0, 0.5. Inverse IES: 3, 2, 1. For (b), each point represents a parameter combination. The red point highlights the specification in the main results.



(a) Legend (b) Wealth + Liquidity Channel

Figure F.8: Robustness: Welfare effects for the wealth and liquidity channels in percent of annual consumption for the 10th decile. For (a), for Adjustment, black values represent SCF and white values represent FoF. For other parameters, dark to light values are: Labor Income Nominality Scalar: 1.1, 1.0, 0.9. Consumption Response Scalar: 1.5, 1.0, 0.5. Inverse IES: 3, 2, 1. For (b), each point represents a parameter combination. The red point highlights the specification in the main results.