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Authors	Yu-Ting Chiang, and Ezra Karger
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Federal Reserve Bank of St. Louis, Research Division, P.O. Box 442, St. Louis, MO 63166

Nominal Maturity Mismatch and the Liquidity Cost of Inflation

Yu-Ting Chiang[†] Ezra Karger[‡]

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Abstract

We document a liquidity channel through which unexpected inflation generates substantial welfare losses. Household balance sheets are nominal maturity mismatched: nominal liabilities have a longer duration than nominal assets. Due to this mismatch, losses from unexpected inflation are concentrated over short time horizons, while gains are spread out over the longer run. This has negative effects on liquidity-constrained households, who cannot easily borrow against their future gains. We quantify the importance of the liquidity channel and show that, for households in the lower half of the wealth distribution, the recent 2021–2022 unexpected inflation shock caused welfare losses valued at 0.5% of lifetime wealth: a monetary loss equal in size to 15% of current-year consumption. More than 75% of that loss is due to the liquidity channel, with the remainder coming from the more commonly studied wealth channel.

JEL: E2,E3,G5

Keywords: inflation, household illiquidity, household balance sheet, nominal rigidity

[†]Federal Reserve Bank of St. Louis, contact email: yu-ting.chiang@stls.frb.org.

[‡]Federal Reserve Bank of Chicago, contact email: ezra.karger@chi.frb.org.

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1 Introduction

We measure how unexpected inflation affects households through their balance sheets. It is widely understood that inflation redistributes wealth from nominal lenders to nominal borrowers, with many papers documenting how much households gain or lose due to their net holdings of nominal assets and liabilities. We refer to this channel as *the wealth channel*. For households without borrowing constraints, the size of this wealth channel correctly summarizes the welfare effects of unexpected inflation. However, for liquidity-constrained households who cannot move resources freely across time, losses in some periods can have severe consequences that are not necessarily offset by gains in other periods. We refer to this intertemporal mismatch of gains and losses as *the liquidity channel* of unexpected inflation.

We illustrate this liquidity channel with a standard consumption-saving model, allowing for illiquidity from convex borrowing costs and fixed borrowing constraints. A household receives streams of payments over time from their assets, including human capital, stocks, and cash. They also make payments due to their liabilities, like mortgages. Part of each payment stream is nominal and is affected by unexpected changes in the price levels (e.g., an inflation shock). We express how the household's welfare is affected by an inflation shock with a formula containing two terms: (1) the wealth channel: absent illiquidity, the welfare effect is proportional to the change in their lifetime wealth; and (2) the liqudity channel: due to the existence of borrowing costs and constraints, the welfare effect contains an interaction term that captures the (mis)alignment across time between household's gains (and losses) and how much households value these gains and losses. We use this formula to guide our empirical measurement and quantify the effects of the two channels.

For each household in the U.S., we construct a nominal stream of payments using balance sheet information from the Survey of Consumer Finances (SCF). For asset and liability categories on household balance sheets that are relatively homogeneous, we assign nominality and duration based on available individual-level information. We deconstruct assets that represent claims on other assets and liabilities, such as equity and pension funds, into indirect holdings of homogeneous assets and liabilities with known nominality and duration. We use the granular items on households' consolidated balance sheets to estimate the complete stream of nominal payments that households expect to receive over different time horizons.

We show that households' nominal balance sheets display a large maturity mismatch, with the average household holding liabilities featuring significantly longer duration than their assets. As an example, many U.S. households hold large liabilities in the form of fixed-rate mortgages, spread out over time horizons of up to 30 years. On the other hand, nominal assets, such as deposits, have a short horizon. Another important type of "asset," future labor income, is also partially nominal due to nominal wage rigidities; while wages do not adjust immediately to inflation shocks, they do adjust over the course of a few years, making future labor income 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.

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 they been able to borrow more. We calculate this rate using a new method that maps high-frequency consumption responses from unexpected transfers to the shadow rate for each household. We show that the total level of illiquidity—combining the spread and the shadow rate—varies across the wealth distribution, with the lowest-wealth-decile households willing to borrow at a marginal rate up to 20 percentage points above the Treasury rate. The top wealth decile, on the other hand, is only willing to borrow with a 5% spread. Moreover, the source of illiquidity differs for the poor and rich: poor households are illiquid mostly due to borrowing constraints, while illiquidity for rich households is mostly reflected in their borrowing costs.

We use the 2021–2022 inflation episode as a case study to quantify the relative welfare effects of the wealth and liquidity channels in response to an unexpected inflation shock. For each household, we calculate these welfare effects by combining yearly gains and losses from inflation with our measures of illiquidity over different time horizons. For a large majority of U.S. households, the liquidity channel causes welfare losses almost three times the size of the standard 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 0.5% of lifetime wealth, which is equal (in dollar terms) to 15% of current year consumption. The effects are particularly stark for poor households due to the liquidity channel: more than three-quarters of the welfare loss for the bottom wealth decile is due to illiquidity.

Our work is related to a set of papers that quantify the effects of inflationary shocks on households, including Doepke and Schneider (2006), Auclert (2019), Cardoso et al. (2022), Pugsley and Rubinton (2023), Pallotti et al. (2024) and Del Canto et al. (2023). A common thread in these papers is the wealth channel through which inflation impacts households' lifetime wealth via households' net nominal positions. While some of these studies incorporate inflation-driven changes in asset prices and heterogeneity in consumption bundles, our contribution is to introduce a new 'liquidity' channel of unexpected inflation. This channel arises from the interaction between households' nominal maturity mismatch and illiquidity. We argue that this liquidity channel is more important for the majority of U.S. households than the wealth channel that has been a key focus of previous research; and the quantitative importance of the liquidity channel provides a new perspective on the question of why people dislike inflation (Shiller, 1997; Stantcheva, 2024).

Our focus on household illiquidity connects to a large literature emphasizing the importance of heterogeneous consumption responses to transitory income shocks, such as Jappelli and Pistaferri (2014), Kaplan et al. (2014) and Aguiar et al. (2020). We draw from this literature to construct measures of household illiquidity, linking household consumption responses to the extent to which they are borrowing constrained. We estimate household consumption responses using high-frequency consumption data from Karger and Rajan (2023), building on recent work by R. Baker et al. (2023) and Fagereng et al. (2021).

2 Framework

To precisely describe the liquidity channel of unexpected inflation and the related empirical objects we will measure in data, we use a standard consumption-saving model with borrowing frictions. We first derive a benchmark result where, without liquidity constraints, the welfare effects of unexpected inflation shocks are proportional to changes in households' lifetime wealth. We then show that when households face illiquidity in the form of convex borrowing costs or borrowing constraints, the welfare effects of inflation shocks are determined by an additional statistic that summarizes the intertemporal misalignment between liquidity and the redistribution of wealth caused by inflation.

2.1 Households' Problem

We are interested in the welfare effect of a one-time unexpected change in the path of price levels from $\{\bar{P}_t\}$ to $\{P_t\}$:

$$\log P_t = \log \bar{P}_t + (t+1) \times \hat{\pi}^t.$$

Changes in future price levels are given by a sequence of unexpected inflation shocks $\{\hat{\pi}^t\}$ over different time horizons. For each horizon t, $\hat{\pi}^t$ indicates the unexpected inflation (annualized) from period 0 to period t.

Consider a household solving a consumption-saving problem. The household derives utility from consumption and can hold various types of assets, denoted by a set $\mathcal{J}$. The household's initial positions in these assets are represented by a stream of nominal payments $\bar{Y}_t = \{\bar{Y}_{j,t}\}_{\{j\in\mathcal{J}\}}$ over different time horizons, t. Each asset j is characterized by its *nominality* for each horizons, $\{\theta_{j,t} \in [0,1]\}$, with fraction $1-\theta_{j,t}$ indexed to the price level. Given the inflation shocks, the household receives payment $Y_{j,t}$ from each asset type j:

$$Y_{j,t} = \Big(\theta_{j,t} + \frac{P_t}{\bar{P}_t}(1-\theta_{j,t})\Big)\bar{Y}_{j,t}.$$

After the unexpected inflation shocks $\{\hat{\pi}_0^t\}$ realize at time 0, the household can adjust their position in asset j through a sequence of holdings $\boldsymbol{a}_t = \{a_{j,t}\}_{\{j\in\mathcal{J}\}}$, where $\boldsymbol{a}_0 = \mathbf{0}$. Holding assets $\boldsymbol{a}_t$ over each period generates (gross) returns $\boldsymbol{R}_t^A$ and households pay adjustment cost $\Phi(\boldsymbol{a}_{t+1}, \boldsymbol{a}_t)$ to change their holdings. Besides assets in $\mathcal{J}$, the household can also save and borrow without adjustment costs using a liquid asset, b_t. However, the household faces a real interest rate schedule $R_t(b_t)$ for the asset and a fixed borrowing constraint, χ_t, that bounds the level b_t that the household can hold from one period to the next. Since these adjustments happen after the one-time inflation shock, without loss of generality, we assume $\{\boldsymbol{a}_t, \boldsymbol{R}^A, \Phi(\boldsymbol{a}_{t+1}, \boldsymbol{a}_t), b_t, R_t(b_t)\}$ are all real variables. Given any sequence of price level $\{P_t\}$, the household maximizes utility subject to real budget constraints and borrowing constraints:

$$U = \max_{c_t, b_t, \boldsymbol{a}_t} \sum_{t\geq 0} \beta_t u(c_t), \quad \text{s.t.}$$
$$\boldsymbol{a}_t^\intercal \mathbf{1} + b_t + c_t + \Phi(\boldsymbol{a}_t, \boldsymbol{a}_{t-1}) = z_t + \boldsymbol{a}_{t-1}^\intercal \boldsymbol{R}_{t-1}^A + b_{t-1}R^B(b_{t-1}),$$

where $z_t = \frac{1}{P_t}\sum_{j\in\mathcal{J}}(\theta_{j,t} + \frac{P_t}{\bar{P}_t}(1-\theta_{j,t}))\bar{Y}_{j,t}$ and $b_t \geq \chi_t$.

The stream of real income z_t comprises payments $\{Y_{j,t}\}$ and should be understood as the net resources available in period t based on to the household's already-committed contractual obligations. For example, the household might expect to receive labor income in period t, which will be a positive entry $Y_{j,t}$ for some j, but has a pre-committed fixed-rate mortgage to be paid off in future years, which will be a negative entry $Y_{j,t}$ for another j. How much the household's labor income versus mortgage adjusts with inflation depends are described by their nominality $\theta_{j,t}$. The income stream $\{z_t\}$ is the real positions the household expects at time 0 for each time horizon, absent any subsequent adjustments. The liquid asset b_t acts like a cash deposit if $b_t > 0$ or like credit card borrowing if $b_t < 0$; assets which are associated with different interest rates $R^B(b_t)$, depending on the level of saving or borrowing. After the inflation shock, the household can adjust their holdings of assets in $\mathcal{J}$ by paying an adjustment cost $\Phi(\boldsymbol{a}_t, \boldsymbol{a}_{t-1})$. Examples of these costly changes include paying down a mortgage early or withdrawing money early from a pension. To isolate our mechanism, we assume the returns $R^B(\cdot)$ and $\boldsymbol{R}_t^A$ are unaffected by changes in price levels. In a more general framework, there would be shocks or policies causing changes in these returns along with inflation. One can interpret our result as a detailed analysis of the channels through which households are affected by inflation through their balance sheets.

2.2 Welfare Effects

Let $\{\bar{c}_t\}$ denote the optimal consumption-saving plan of the household, given an initial sequence of price levels $\{\bar{P}_t\}$. The following lemma describes the welfare effects of an unexpected inflation shock $\{\hat{\pi}^t\}$:

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

$$dU = \sum_t \beta_t u'(\bar{c}_t)\Delta z_t$$

where $\Delta z_t := -\frac{1}{\bar{P}_t} Y_t^\theta \times (t+1) \times \hat{\pi}^t$, *and* $Y_t^\theta := \sum_{j\in\mathcal{J}} \theta_{j,t}\bar{Y}_{j,t}$.

Proof. See Appendix A.1. □

Intuitively, Δz_t captures how the inflation shock affects the real value of the nominal payment streams in each period. If the household has net nominal liabilities in a period, then a positive inflation shock will reduce the cost of paying off those liabilities, thereby increasing the size of Δz_t; the effect is reversed for net nominal assets. The total effect is a sum of these effects weighted by the household's marginal utility of consumption in each period

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 benchmark with no borrowing constraints, $\chi_t = -\infty$, and linear borrowing costs, $R^B(b) \equiv R_t$, where R_t is the market rate for short-term borrowing and saving (which we will assume is the treasury rate). The sequence of household consumption solves the standard Euler equation:

$$u'(\bar{c}_t) = R_t \beta_{t,t+1} u'(\bar{c}_{t+1}), \quad \beta_{t,t+1} \coloneqq \beta_{t+1}/\beta_t. \tag{1}$$

In this benchmark scenario, welfare effect in Lemma 1 reduces to:

Lemma 2 *If $\chi_t = -\infty$ and $R^B(b_t) \equiv R_t$,*

$$dU = u'(\bar{c}_0)\Delta w_0, \quad \Delta w_0 \coloneqq \sum_{t\geq 0} \frac{\Delta z_t}{R_0^t}.$$

where $R_0^t = \prod_{s=0}^t R_s$.

Proof. See Appendix A.1. □

In other words, without any frictions in borrowing and saving, the welfare effects of unexpected inflation from all periods are summarized by Δw_0, which is the total effect of inflation shocks on the household's lifetime budget, with $u'(\bar{c}_0)$ mapping that change in lifetime wealth into welfare through the marginal utility of consumption. When households can freely borrow and save across time at the market rate, it doesn't matter where in the time horizon a household gains or loses wealth, as long as it leads to the same net present value of wealth. Households can always borrow and save on their own to smooth their consumption.

This is a standard result that motivates the typical calculation of the redistributive effects of inflation in the literature: the effect of an unexpected inflation shock on welfare is proportional to the change in the net present value of wealth, discounted at the market rate. For example, Doepke and Schneider (2006) uses this baseline calculation to estimate the redistributive effects of inflation on households of different types due to their nominal balance sheet. Yet, when households face a liquidity constraint and cannot freely move resources across time, the welfare effects can no longer be summarized by the changes in the value of wealth. Relaxing the assumption that households can easily move resources across time leads us to our key mechanism.

Household Illiquidity

When the household cannot freely borrow and save at the market rate R_t, the Euler equation in 1 does not hold under the market rate R_t. Yet, there exists a sequence of "wedges" τ_t

such that the sequence of consumption $\{\bar{c}_t\}$ solves a modified Euler equation:

$$u'(\bar{c}_t) = R_t(1+\tau_t)\ \beta_{t,t+1} u'(\bar{c}_{t+1}),$$

where $\tau_t > 0$ if either the borrowing constraint binds (as there will be a Lagrange multiplier) or if the marginal cost of borrowing is above R_t. If $\tau_t > 0$, the household would like to move resources from period $t+1$ to period t under the market rate R^t (thereby increasing c_t and decreasing c_{t+1}). However, due to the borrowing cost and constraint, they settle on consumption path $\{\bar{c}_t\}$. The size of the wedges represents how far away the household is from being able to equalize its marginal utility across time.

To incorporate the consideration for illiquidity, we need to know how the effects of inflation in each period t (Δz_t) align (or not) with the household's need for liquidity. To capture this (mis)alignment over time, let $q_0 \coloneqq \sum_{t\geq 0} \frac{1}{R_0^t}$ be the price of a perpetuity that pays one unit of real good in each period (forever); let $\upsilon_t \coloneqq \frac{1}{q_0}\frac{1}{R_0^t}$ be the distribution of value of payments over time for the perpetuity such that $\sum_{t\geq 0} \upsilon_t = 1$. The following lemma characterized the welfare effects of unexpected inflation with household illiquidity:

Lemma 3

$$dU = avg\Big[\frac{u'(c_0)}{1+\tau_0^t}\Big]\Big(\underbrace{\Delta w_0}_{wealth\ channel} + \underbrace{q_0 \times \Big\langle \Delta z_t, \frac{(1+\tau_0^t)^{-1}}{avg[(1+\tau_0^t)^{-1}]} - 1 \Big\rangle}_{liquidity\ channel} \Big),$$

where $1+\tau_0^t = \prod_{s=0}^t (1+\tau_s)$, *and*

$$avg[x_t] \coloneqq \sum_{t\geq 0} \upsilon_t \times x_t, \quad \langle x_t, y_t\rangle \coloneqq \sum_{t\geq 0} \upsilon_t \times x_t y_t.$$

Proof. See Appendix A.1. □

Due to illiquidity, the welfare effect differs from the frictionless benchmark in a few important ways. The term $avg[\frac{u'(c_0)}{1+\tau_0^t}]$ measures the average marginal utility across periods. While marginal utilities are not generally equalized across time due to illiquidity, the term reduces to $u'(c_0)$ if τ_t are zeros for all periods. The average marginal utility multiplies the sum of two terms: (1) Δw_0, which captures the direct effect of the inflation shock on the net present value of lifetime wealth, which corresponds to the channel defined in Lemma 2; and (2) an additional term that depends on $\langle \Delta z_t, \frac{(1+\tau_t)^{-1}}{avg[(1+\tau_t)^{-1}]} - 1\rangle$. This term captures the interaction between the household's need for liquidity in period t, represented by $\frac{(1+\tau_t)^{-1}}{avg[(1+\tau_t)^{-1}]} - 1$, and the household's gain and loss due to inflation shocks, given by Δz_t.

To provide an intuition for this interaction term, it captures whether the inflation shock redistributes the household's wealth to time periods where they would value those dollars more or less relative to the market returns. For example, if the household's marginal utility of consumption is lower in periods where they are net nominal borrowers than in periods where they receive nominal payments, the covariance term will be negative: Following the inflation shock, the household gains income in periods where its marginal value is lower and they lose income in periods where they would benefit marginally more from additional income. As inflation shocks shift resources away from periods in which the household has high marginal utility to periods in which they have low marginal utility, these shocks exacerbate the household's liquidity problem.

Lemma 3 provides us a framework to understand how households are affected by unexpected inflation due to their balance sheets, allowing for the concerns for illiquidity. It shows that, to account for the effect of illiquidity, we not only need to know the total gain and loss in wealth, Δw_0, but also two new elements: (1) how these gain and loss Δz_t distribute over different time horizons, and (2) a measure of the wedges τ_t. In the following sections, we measure these two elements for U.S. households to document how they are affected by the unexpected inflation shock in the recent (2021–2022) inflation episode.

3 Household Nominal Balance Sheet

We calculate streams of nominal payments Y_t^θ that each household expects to receive in future years based on their current holdings and characteristics of their assets and liabilities. Our data for this calculation come from the 2019 Survey of Consumer Finances, which contains household balance sheet information in detailed asset and liability categories.

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 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 its nominality (whether payments track the price index or not) and duration (the time horizons over which payments are expected) to construct plausible estimates of $\{Y_t^\theta\}$ such that the present values are consistent with national aggregate statistics and household-level data from the SCF.

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

Household's 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, student loans, etc. In addition to these typical assets and liabilities, we also include a household's expected future labor income as a final asset. We assume each household holds a stock of human capital which pays dividends in the form of labor income. As we discuss below, we assume that a fraction of labor income in each future period is nominal and is exposed to unexpected inflation shocks. Since expected labor income is one of the largest sources of wealth for many households, its exposure to inflation shocks will turn out to be crucial.

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, then the household holds another $5,000 of Treasury 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.[1] We consolidate the balance sheets of these entities to calculate each household's final asset holdings of these entities. Details of the consolidation process are provided in Appendix A.3.

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 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 are 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.

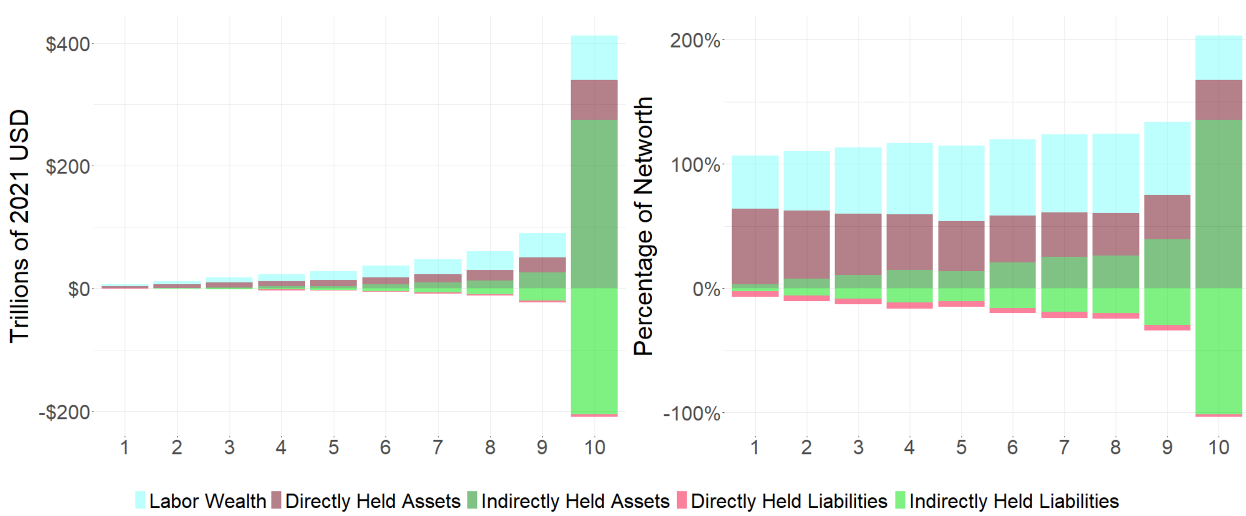


Figure 1: Consolidated balance sheet of U.S. households by wealth decile: dollars and percent of net wealth.

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

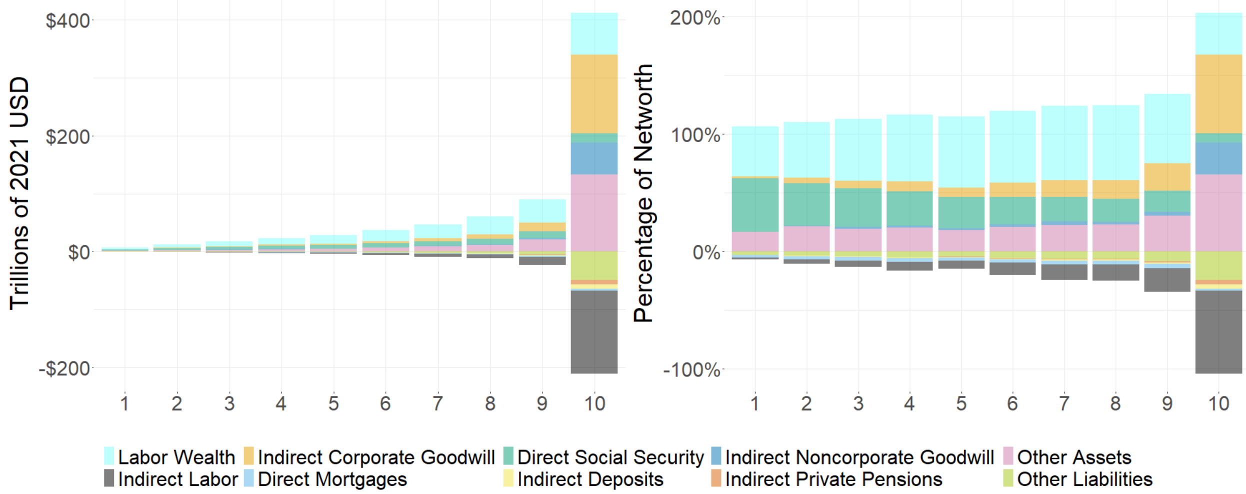


Figure 2: Consolidated balance sheet of U.S. households by wealth decile: dollars and percent of net wealth (top holdings).

In the Figure 2, we show the assets and liabilities held by households in the 2019 SCF, broken down by top 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 significant amounts of real estate, cash equivalents, 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, other business interests are (relatively) more important. While the lowest wealth households do hold mortgages and take out installment loans, the wealthiest households hold significantly larger mortgages (in levels).

These differences between the rich and the poor also correlate with other household characteristics. In the Figure A.3, we summarize the demographic composition of households in 2019 by decile of wealth. Here, we see that the lowest-wealth households are older, less educated, and less likely to be white than wealthier households. 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.

3.2 Nominality and Duration

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*, $\theta_{j,t}$, and (2) the *duration*. With these two characteristics, we construct the stream of nominal payments $\{Y_t^\theta\}$ 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 $\theta_{j,t} = 1$ and $Y_{j,0} = 1$ and $Y_{j,t} = 0$ for $t > 0$: 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 payment is pre-committed. Certificates of deposits and nominal bonds have similar characteristics. Now consider what we treat as a real asset with nominality $\theta_{j,t} = 0$: 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 value of homes reported in the SCF to be real assets 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. On the other hand, if a mortgage has an adjustable rate then it is real because the rate is often pegged to real-time interest rates. Similarly, treasuries 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 the Data Appendix A.4.

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%) 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 identify the weighted average duration of outstanding treasuries in 2019, and we assume that all households holding treasuries have a duration of those treasuries that matches the aggregate distribution of outstanding treasuries.

Mortgages

Mortgages can be adjustable- or fixed- rate. We use detailed information in the SCF about each household's holding of mortgages to identify the households with mortgages whose cost (the interest rate) adjusts with inflation. The SCF reports the duration of each household's mortgage, the prevailing interest rate, the remaining principal, and whether the interest rate adjusts. We assume all fixed-rate mortgages are nominal and all adjustable-rate mortgages are real.

Labor Income

We estimate the expected stream of labor income for each household using the income reported by households in the 2019 SCF. We regress logged labor income on fixed effects for age, race, college, allowing income to vary non-linearly with those demographic characteristics. We use the estimated regression to calculate expected income growth rates over the life-cycle for each demographic group. We then apply these expected growth rates to every individual's income in the SCF, replacing any zeros (unemployment and non-employment) with the 10th income percentile for a given person's race-by-college demographic group. We apply mortality rates (at the race-sex-age level) to future income to account for the age-varying probability of death, and apply federal and local tax rates to each projected income stream.[2]

We allow households' expected stream of future labor income to contain a nominal component. For example, for salary workers the contracts are often determined on a year-by-year basis. Moreover, for both salary and wage workers, their labor income could fail to keep up with the general price level due to contracting frictions. We incorporate the nominality of labor income at different time horizons using two different sources of information.

The first source comes from the estimates from Hajdini et al. (2023). The paper surveys respondents surrounding the 2021 inflation shock, and find that when respondents report a 1.0 percentage point increase in inflation expectation, other things equal, they expect their labor income to increase by only 0.2 percentage points. We interpret the result as saying that 80% of the labor income does not adjust with updates in inflation expectations; that is, the nominality of the first year of labor income after an increase in inflation is 0.8.

Our second source of information comes from the Atlanta Fed Wage Growth Tracker.[3] We show that relative to the 2017 through February 2021 trend in wages, the first quartile of the

[2] To include "labor wealth" in the calculation of household wealth decile, we use the net present value of future labor income calculated from each household's future income stream, discounted with a 10-year treasury rate.
[3] https://www.atlantafed.org/chcs/wage-growth-tracker

income distribution saw a 2.2 percentage point increase in wages by July 2022.[4] Because the one-year inflation shock during 2021 was on the order of 6 percentage points, that implies that labor income experienced an adjustment around 2.2/6=37% the size of the inflation shock. For the full sample of workers, the adjustment was smaller, and on the order of 1.6/6=27%.

Building on the two calculations above, in our main specifications, we assume that 30% of labor income is real in year 1 (and 70% is nominal); we then assume a gradual adjustment, where in year 2, 60% is real; in year 3, 90% is real, and by year 4, wages have completely adjusted with inflation. We test the robustness of these assumptions in the data appendix A.6.

Other Assets/Liabilities

We assemble data describing each of our 20 main asset and liability classes that allow us to characterize the nominal duration for each asset and liability in our data. 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 the data appendix, showing the wide range of assumptions about duration and nominality.

3.3 Nominal Balance Sheet and Maturity Mismatch

In Figure 3, we focus on the nominal holdings of each household, breaking wealth into specific assets and liabilities held by households in each wealth decile; panel A shows the level of these 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 smaller holdings of fixed-rate mortgages on the liability side 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.

[4]We calculate this change by regressing median wage growth for the first quartile of workers on a linear time trend from data at and after 2017. We then calculate the difference between realized wage growth and predicted wage growth in July, 2021.

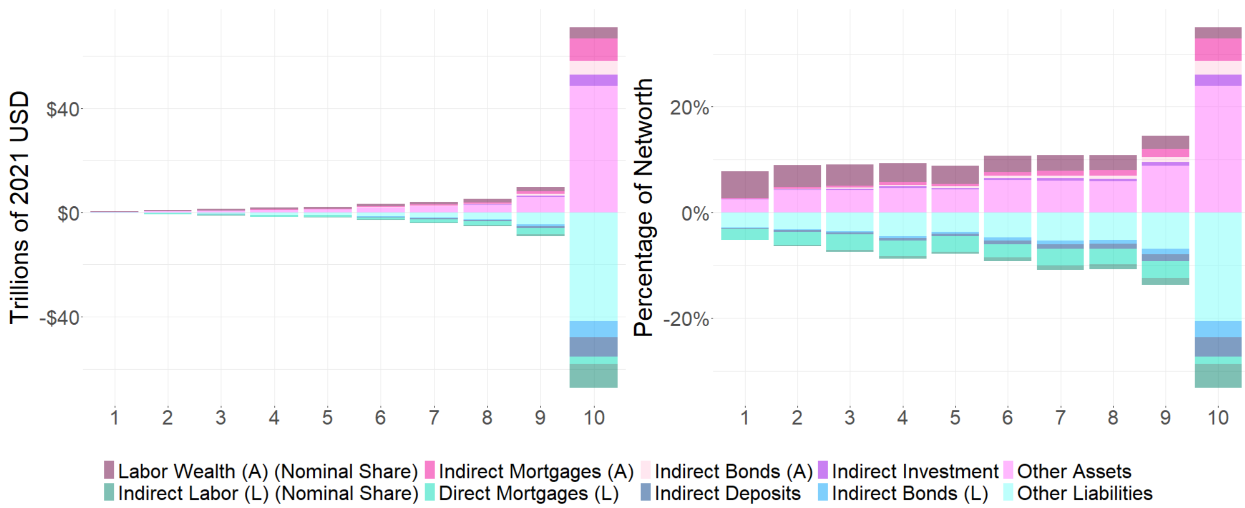


Figure 3: Consolidated nominal balance sheet of U.S. households by wealth decile: dollars and pct of net wealth

In Table 1, we show the present values and average duration of nominal assets and liabilities from the average household balance sheet in the first, fifth, and tenth decile, where present values are discounted using treasury yields. Comparing the duration of assets and liabilities, we can see that household assets and liabilities have quite different durations. Except for households in the 10th decile, the duration of liabilities is much longer than the duration of assets. This is further shown in Appendix Figure A.5, which breaks down the results for every decile. 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 decile, but a common phenomenon for all deciles but the 10th, with the gap is the largest for households in the poorest wealth decile. Table A.4, shows the prevalence of this phenomenon for each decile. We will show later on that this 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	36	168	5,519
liabilities	24	150	5,228
assets duration	1.7	2.9	4.1
liabilities duration	5.6	6.3	3.7

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

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 $\hat{\pi}^t$ 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 $\hat{\pi}^t$ for periods 0 to t as:

$$\hat{\pi}^t := E_1[\pi_0^t] - E_0[\pi_0^t],$$

where $E_0[\pi_0^t]$ and $E_1[\pi_0^t]$ are, respectively, the (log) inflation expectations of annualized inflation from time 0 to t, based on information available at time 0 and 1. For example, for the initial inflation shock, $\hat{\pi}^0$, we take the difference between realized inflation in period 0 and the inflation expectation at the beginning of that period. Similarly, $\hat{\pi}^t$ represents the updates in inflation expectations through period t, incorporating the initial shock and updates of expectations over future periods due to changes in policies or economic conditions in the initial period:

$$E_1[\pi_0^t] = \pi_0^1 + E_1[\pi_1^t].$$

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 complete measure of inflation expectations.

Figure 4 shows the inflation shocks 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). 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.

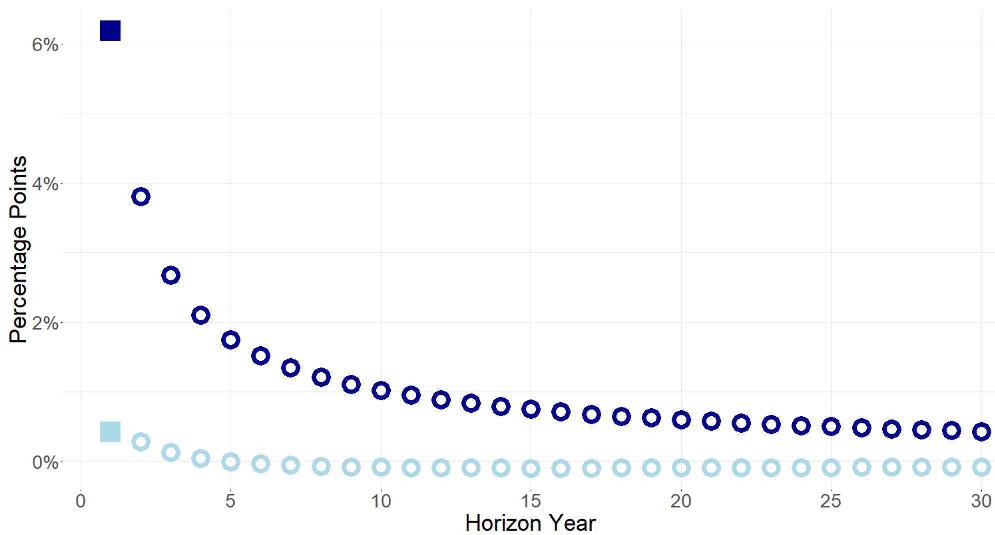


Figure 4: Inflation shocks (squares) and expectations updates (circles) over different horizons in 2021 (Dark) and 2020 (Light, for comparison).

4.2 Gains and Losses

We now combine our measure of households' nominal positions and the inflation shocks from Figure 4 to calculate changes in the real value of households' payment streams over different horizons. Table 2 provides an example of the effects of inflation on the nominal payment streams of a 'typical' household: the average household in the 5th wealth decile.

Table 2: Nominal position: the average household in the 5^{th} decile

horizon	1 year	2-5 year	6+ year
assets	94	57	18
liabilities	45	51	56
net position	49	6	-38
inflation shocks $\times(t+1)$	6%	8%	11%
redistribution	-3.1	-0.34	4.0
effects on networth	-0.16%	-0.02%	0.21%

Note: Levels are in thousands, 2021 USD.

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

To calculate the effects of inflation shocks over different time horizons, we directly calculate Δz_t for each horizon and discount it back at the Treasury rate R_0^t, leaving us with the net effect of the inflation shock on wealth:

$$\frac{\Delta z_t}{R_0^t} = \frac{1}{R_0^t} \times \frac{-Y_t^\theta}{\bar{P}_t} \times (t+1) \times \hat{\pi}^t.$$

We present the resulting gains and losses in the bottom row of Table 2, where we provide the value in both thousands of 2021 USD and as a percentage relative to the household's wealth. Summing the bottom row of Table 2, we see that the net effect is negative in the short-run (in years 1–5) but positive in the longer-run (years 6+).

This pattern is representative of most U.S. households. Figure 5 shows the effects from the 2021–2022 inflation shock for the average household in 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 line represents the net effect of the inflation shock on household's wealth, which correspondents to the commonly studied wealth channel.

Overall, for wealth deciles 1–9, the pattern is roughly the same as for the typical household in the fifth wealth decile (as shown in Table 2). Households experience large 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 short-run losses and long-run gains.

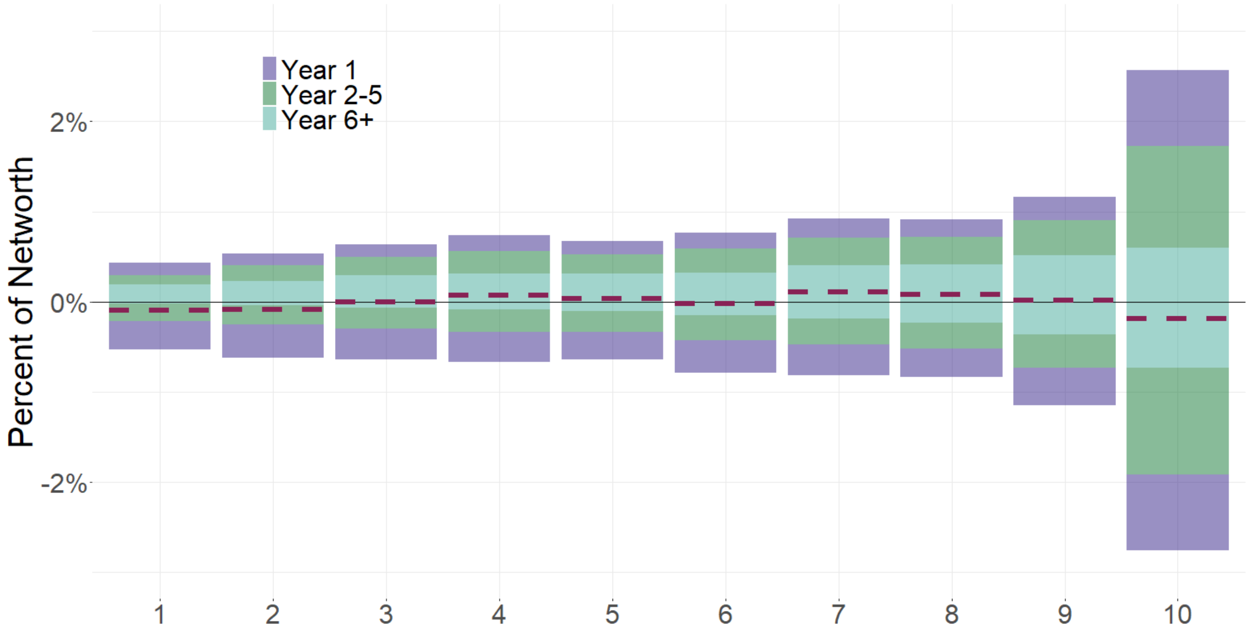


Figure 5: Redistribution due to nominal exposure across the wealth distribution. X-axis: wealth by net worth; y-axis: redistribution relative to net worth. Dashed lines indicate net redistribution. Appendix Figure A.8 shows these results for the government and rest of the world.

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 debts and assets across the wealth distribution (eg. Doepke and Schneider (2006), 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 very 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

In our framework, households can transfer resources across time using liquid assets (b_t), but are subject to frictions due to convex borrowing costs and borrowing constraints. Recall that the optimality of households' consumption and savings decisions implies that

$$u'(\bar{c}_t) = R_t(1+\tau_t)\ \beta_{t,t+1} u'(\bar{c}_{t+1}).$$

We separate the wedge τ_t into two parts: the part originating from the borrowing cost (*spreads*, s_t), and the part due to the borrowing constraints (*shadow rates*, ζ_t):

$$1+\tau_t = (1+s_t)(1+\zeta_t).$$

In Appendix A, we show that the spreads and shadow rates are respectively given by

$$1+s_t := \frac{R^B(b_t) + b_t R^{B'}(b_t)}{R_t}, \quad 1+\zeta_t := \frac{1}{1-\mu_t},$$

where $R^B(b_t) + b_t R^{B'}(b_t)$ corresponds to the marginal cost of borrowing, and μ_t represents the Lagrange multiplier associated with the borrowing constraint at time t.

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 transfers of liquid assets to bound the additional gap between their marginal utility of consumption.

Spreads

The SCF provides several pieces of information about the marginal costs of borrowing for each household. To calculate the interest rate faced by each household aiming to borrow an additional dollar this period, we rely on two questions in the SCF:

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

Because many households hold revolving credit card balances and rely on credit cards to fulfill unexpected spending needs, we calculate each household's marginal cost of borrowing as the reported interest rate paid on the card with the largest balance, conditional on households having remaining balances on a credit card.

Shadow Rates

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

$$u'(c_t) < (1 + s_t)R_t\beta_{t,t+1}u'(c_{t+1}).$$

As an immediate implication of such binding constraint, households increase consumption c_t upon receiving a one-time lump-sum transfer at time t without changing c_{t+1} until the equality holds. This means that when the borrowing constraint binds, we can measure how close it is to an unbinding constraint based on the size of the consumption response between period t and $t + 1$.

Specifically, consider a one-time lump-sum transfer of value $\check{T}$ at period t. Let $\check{c}_t$ denote the log deviation of consumption response in period t from its level without the transfer. The optimality of the household's consumption-saving problem implies:

Lemma 4 *Suppose that* $\frac{-u''(c)c}{u'(c)} \equiv \sigma$ *and* $\check{s}_t = 0$.[5] *Then*

$$\sigma(\hat{c}_t - \hat{c}_{t+1}) < \log\left(1 + \frac{\mu_t}{1 - \mu_t}\right).$$

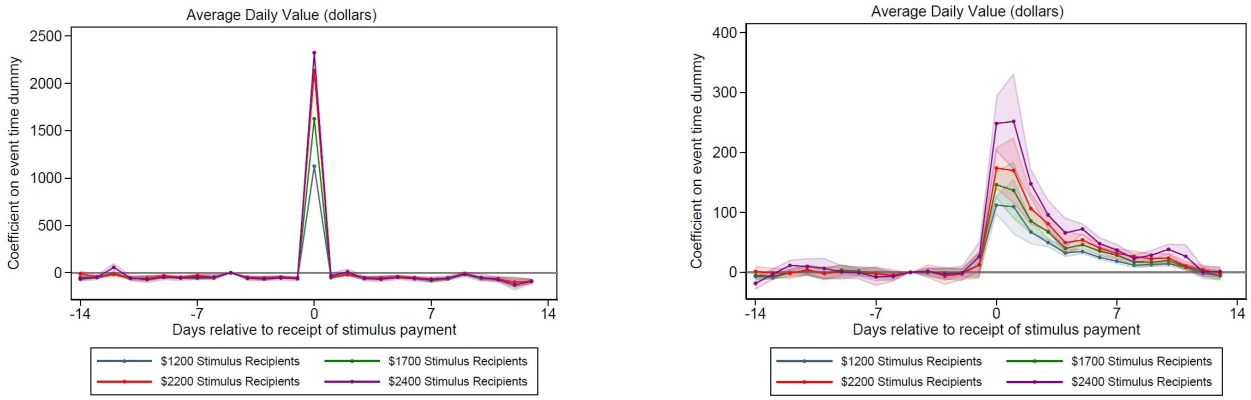
Proof. See Appendix A.2. □

Intuitively, if the constraint is not binding, the household's Euler equation holds, and $\sigma(\hat{c}_t - \hat{c}_{t+1}) = 0$. As households adjust consumption in response to the transfer, the larger the change in consumption growth, the larger the multiplier μ_t must be, and the higher the associated shadow rates. The mapping between consumption responses and the shadow rates is determined by the intertemporal elasticity of substitution $1/\sigma$. As a result, measuring households' consumption responses gives us lower bonds for their shadow rates. We build on this observation to measure the shadow rates for U.S. households, using high-frequency transaction-level data to identify households' consumption responses to one-time lump-sum transfers.

5.2 Shadow Rates and Consumption Response

We use data from Facteus to estimate household consumption responses to the 2020-2021 stimulus checks. The Facteus panel consists of high-frequency transaction-level data describ-

[5] For example, if the household is at the borrowing constraint, then $\check{b}_{t+1} = 0$ and implies $\check{s}_t = 0$. Alternatively, the condition can also hold locally if s_t is a step function.



(a) Transfer

(b) Spending

Figure 6: Consumption Responses to One-Time Lump-Sum Transfer

ing the spending and income of tens of thousands of consumers. We estimate sharp changes in spending surrounding stimulus checks during the Covid-19 pandemic, drawing on Karger and Rajan (2023), and then map the consumption responses to the SCF as a function of age and income. In each bank account in our data, we observe income and spending for each bank account holder. In the Facteus sample, we calculate daily consumption responses to 2020 and 2021 federal stimulus checks, which 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 size compositions received different stimulus amounts: for example, single-filers with no children received $1,200 in the first round of stimulus checks in Spring 2021, while single-filers with two children received $2,200.

As we can see in the event studies in Figure 6, there is no anticipatory change in spending for stimulus recipients in the weeks leading up to the stimulus payment. Then, on the day when each stimulus check is deposited into the recipient's bank account, we see a sharp increase in spending that declines (but remains at elevated levels) in the two weeks following the stimulus check receipt. After two weeks, spending declines to pre-shock level.

To estimate each household's consumption responses to the lump-sum transfers, we regress each individual recipient's change in consumption, relative to the size of checks, in the two weeks following the stimulus check receipt on age and income using flexible splines, and we project these predicted values onto households in the SCF.[6] After estimating household-level consumption responses for each household in the SCF using the Facteus data, Table 3 below shows the average first-year MPC as a function of the wealth distribution.

[6] We extrapolate our estimates of consumption responses to households with income over $150,000 who does not receive stimulus checks, and winsorize the spending relative to check size to be between 0 and 1.

Table 3: MPC across wealth deciles

Decile	1	2	3	4	5	6	7	8	9	10
MPC	0.43	0.41	0.37	0.35	0.32	0.29	0.24	0.18	0.12	0.07

Here, we see that the average short-run consumption response immediately following an unexpected income shock is strongly related to wealth, with the richest wealth decile spending very little of an unexpected income shock and the poorest wealth decile spending almost half of it in the period following the shock. The dramatic heterogeneity in the MPC and correlations with income (and wealth) are consistent with a large literature on MPC estimation (for example, see R. Baker et al. (2023), Fagereng et al. (2021), and Crawley and Kuchler (2023)).

We calculate $\hat{c}_t$ as the changes in consumption relative to the household's yearly consumption. We assume that consumption response in the subsequent year, $\hat{c}_{t+1}$ is roughly 30% of $\hat{c}_t$, consistent with evidence from Auclert et al. (2018). To calculate the shadow rate, we assume $\sigma = 2$, and use Lemma 4 to calculate the shadow rate ζ_t.

5.3 Illiquidity Across the Wealth Distribution

Figure 7 quantifies the level of household illiquidity across the wealth distribution as the average size of wedges τ_t. We break down the wedges into two components: spread s_t and shadow rate ζ_t.

The figure highlights two key facts. First, the level of wedges is decreasing in wealth, starting from around 20% at the bottom wealth decile to 5% at the top decile.

Second, the composition of the wedge—the part due to the spread vs. shadow rate—changes across the wealth distribution. If we just looked at spreads, we might conclude that poor households have low borrowing costs. However, this is likely to be driven by the fact that many poor households do not have credit cards and cannot easily borrow a marginal dollar using standard financial services. This inability to borrow is represented as the borrowing constraint faced by these households and their level of illiquidity is quantified by our measures of shadow rates. Finally, our measures only provide cross-sectional information. To calculate what households expect about their level of illiquidity, we assume that, for each household, s_t and ζ_t persist with probability .9 year-over-year for our baseline result. We discuss the empirical basis for this assumption and the robustness of our results in Appendix A.6.

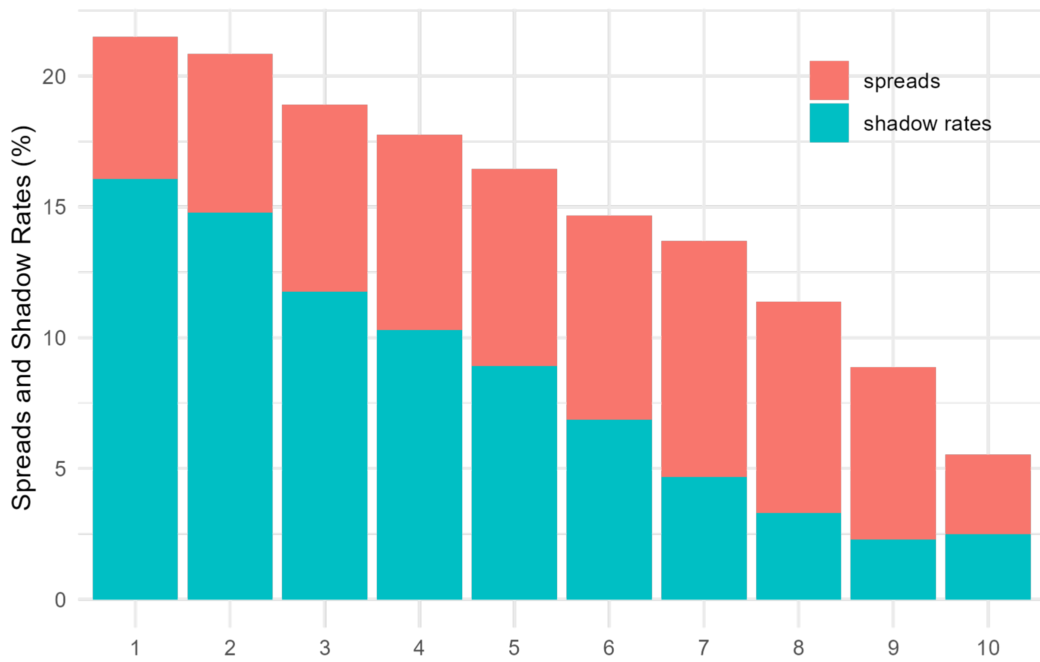


Figure 7: Average spreads and shadow rates by wealth decile.

6 Welfare Effects of Inflation Shocks

We now combine all of the information to estimate the welfare effects of an unexpected inflation shock, taking into account the differences in household balance sheets and their liquidity concerns:

$$dU = u'(c_0) \times avg\Big[(1+\tau_0^t)^{-1}\Big]\Big(\underbrace{\Delta w_0}_{\text{wealth channel}} + \underbrace{q_0 \times \Big\langle \Delta z_t, \frac{(1+\tau_0^t)^{-1}}{avg[(1+\tau_0^t)^{-1}]} - 1 \Big\rangle}_{\text{liquidity channel}} \Big),$$

where we have:

1. the gain (or loss) in each period t (Δz_t) from the nominal payment streams (Y_t^θ), estimated using the SCF and FOF, and inflation shocks (π_0^t) from the inflation expectation data;
2. the magnitude of illiquidity that households face (τ_t) from the SCF (spreads s_t) and the consumption response estimated using high-frequency transaction-level data from Facteus (shadow rates ζ_t).

Figure 8 further shows the decomposition of the welfare effects into detailed channels for U.S.

households across the wealth distribution. We separate out the effects operating through the wealth channel, adding the effects of illiquidity due to spreads and shadow rates, respectively, and finally, the overall effect, taking into account the liquidity channel.

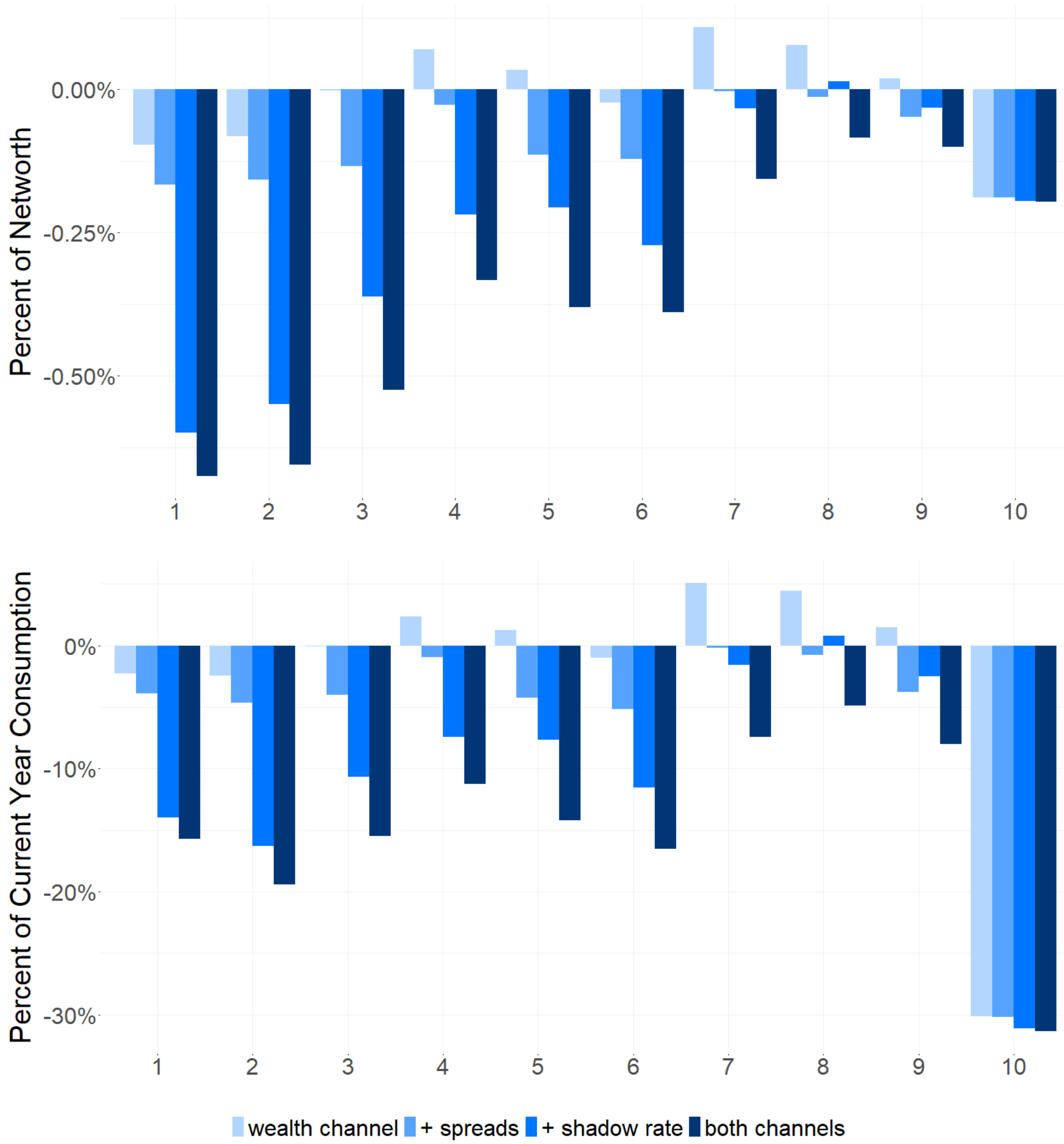


Figure 8: Effects of different channels in wealth equivalence as a percentage of current year consumption and net worth, averaged within each wealth decile.

Poor households suffer a welfare loss equivalent to 0.6% of their lifetime wealth (top panel). This is equivalent, in dollar terms, to around 15% of their current year consumption (bottom panel). Rich households suffer smaller welfare losses, equivalent to 0.15% of their lifetime wealth (top panel), but because they have larger wealth relative to annual consumption, this is equivlanet in dollar terms to around 30% of their current year consumption level (bottom panel). The level of losses varies across the wealth distribution, but the sources of those losses vary as well. For rich households, the losses mainly come from the wealth channel; for poor households, the liquidity channel is particularly important, accounting for most of the losses.

We focus on the effects on the poor and caveat conclusions about the wealthy because our estimates of the welfare effects for the poor rely less on the specific assumption we make about indirect assets, current year nominal labor share, and other parameters. In Figure 9, we show the different estimates one would get for the overall effect if we varied the key assumptions underlying our empirical analysis. These assumptions include adjusting the SCF to match aggregate data from the FOF (or vice versa), assuming different amounts of nominal wage rigidities, and varying assumptions about the persistence of illiquidity over time. In Appendix A.6 we describe these assumptions in more detail. As you can see, we can tightly estimate the welfare effects for the poor, while our estimates for the wealthy generally vary from -25% to +25% in terms of current year consumption. Lastly, in Appendix Figures A.13 through A.20, we show the importance of each of our assumptions to the estimates for the poor and the wealthy. Here, you can see that the assumptions regarding adjustments to match the FoF or SCF, as well as assumptions about nominal wage rigidities, are the key determinants of the magnitude of welfare effects.

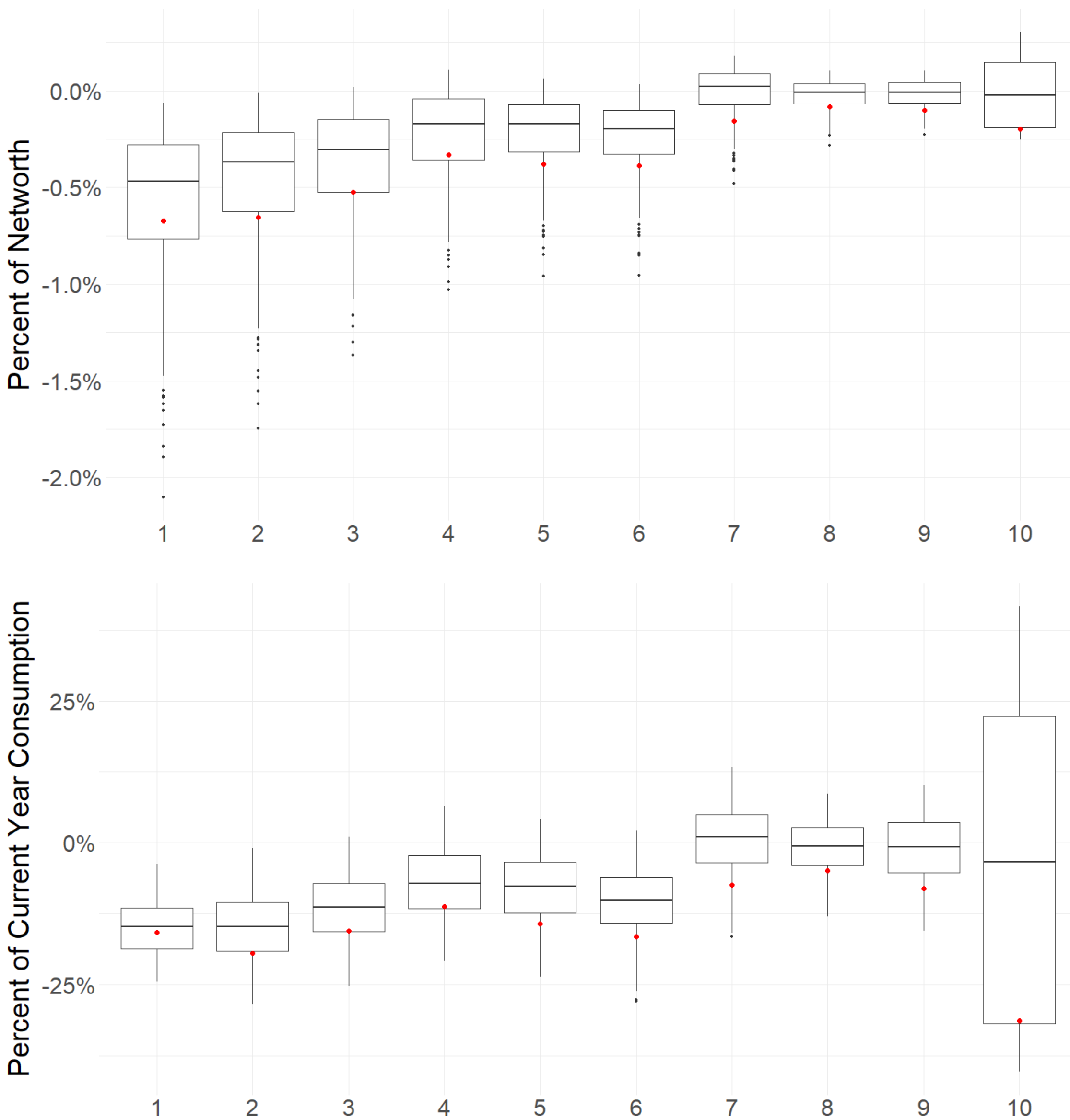


Figure 9: Effects of parameter adjustment on different channels, averaged within each wealth decile as a percentage of current year consumption and net worth. Boxes represent interquartile range, whiskers represent minimum/maximum values, individual points represent outliers. Red dots represent the specification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

7 Conclusion

We show that households' balance sheets feature a nominal maturity mismatch, with the average household holding nominal liabilities with a significantly longer duration than their nominal assets. This nominal maturity mismatch has important welfare consequences: unexpected inflation not only generates gains and losses in wealth but also creates a liquidity problem for a large majority of U.S. households. Using a standard consumption-saving model that features household illiquidity, we quantify the liquidity channel empirically. We show that during the 2021–2022 inflation episode, the liquidity channel caused welfare losses almost 3-times the size of the standard wealth channel. These effects are particularly stark for low-wealth households, as many of them face significantly higher levels of illiquidity.

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A Derivations and Proofs

A.1 Welfare Effects

Consider a change in the path of price level from $\bar{P}_t$ to $P_t(\delta)$, where

$$\log P_t(\delta) - \log \bar{P}_t = (t+1) \times \hat{\pi}^t,$$

and we consider the first-order effect of an increase in δ. Up to first-order approximation, the effect on z_t is given by

$$\Delta z_t = \frac{-Y_t^\theta}{\bar{P}_t} \times (t+1) \times \hat{\pi}^t.$$

The household's optimization problem gives the following Lagrangian:

$$\sum_{t \geq 0} \beta_t u(c_t) + \lambda_t \big(z_t + \boldsymbol{a}_t^\intercal \boldsymbol{R}_t^A + b_{t-1} R^B(b_{t-1}) - \boldsymbol{a}_t^\intercal \mathbf{1} - b_t - c_t - \Phi(\boldsymbol{a}_t, \boldsymbol{a}_{t-1}) \big)$$
$$+ \lambda_t \mu_t (b_{t+1} - \chi),$$

where λ_t and $\lambda_t \mu_t$ are the multipliers for the budget and borrowing constraints. Multiplier λ_t represents the value of a unit resource available in the budget constraint at time t; multiplier μ_t represents the value of relaxing the borrowing constraint by one unit of goods.

By the envelope theorem, the welfare effect is given by:

$$dU = \sum_{t \geq 0} \lambda_t \Delta z_t.$$

The first-order conditions with respect to c_t and b_{t+1} give us:

$$u'(\bar{c}_t)(1 - \mu_t) = \beta_{t,t+1} u'(\bar{c}_{t+1}) \big(R^B(\bar{b}_{t+1}) + \bar{b}_{t+1} R^{B\prime}(\bar{b}_{t+1}) \big).$$

Let

$$1 + \tau_t := \frac{R^B(\bar{b}_{t+1}) + \bar{b}_{t+1} R^{B\prime}(\bar{b}_{t+1})}{(1 - \mu_t) R_t},$$

then we have

$$u'(\bar{c}_t) = \beta_{t,t+1} u'(\bar{c}_{t+1}) R_t (1 + \tau_t).$$

Let $R_0^t \coloneqq \prod_{s=0}^t R_s$ and $1+\tau_0^t \coloneqq \prod_{s=0}^t 1+\tau_s$, then

$$dU = u'(c_0)\sum_{t\geq 0}\frac{\Delta z_t}{R_0^t(1+\tau_0^t)}.$$

Let $q_0 \coloneqq \sum_{t\geq 0}\frac{1}{1+r_0^t}$ and $\upsilon_t \coloneqq \frac{1}{q_0}\frac{1}{1+r_0^t}$, then $\sum_{t\geq 0}\upsilon_t = 1$, and define

$$avg[x_t] \coloneqq \sum_{t\geq 0}\upsilon_t \times x_t, \quad \langle x_t, y_t\rangle \coloneqq \sum_{t\geq 0}\upsilon_t \times x_t y_t,$$

then

$$dU = u'(c_0)\sum_{t\geq 0}\frac{\Delta z_t}{R_0^t(1+\tau_0^t)} = u'(c_0)\sum_{t\geq 0}\frac{\Delta z_t}{R_0^t} + \frac{\Delta z_t}{R_0^t}\frac{-\tau_0^t}{1+\tau_0^t}.$$

Note that

$$\begin{aligned}
&\sum_{t\geq 0}\frac{\Delta z_t}{R_0^t} + \frac{\Delta z_t}{R_0^t}\frac{-\tau_0^t}{1+\tau_0^t} \\
&= q_0\Big(avg[\Delta z_t] + \big\langle \Delta z_t - avg[\Delta z_t], \frac{-\tau_0^t}{1+\tau_0^t}\big\rangle + avg[\Delta z_t]avg[\frac{-\tau_0^t}{1+\tau_0^t}]\Big) \\
&= q_0\Big(avg[\Delta z_t]avg[(1+\tau_0^t)^{-1}] + \big\langle \Delta z_t - avg[\Delta z_t], (1+\tau_0^t)^{-1}\big\rangle\Big) \\
&= q_0 \times avg[(1+\tau_0^t)^{-1}]\Big(avg[\Delta z_t] + \big\langle \Delta z_t - avg[\Delta z_t], \frac{(1+\tau_0^t)^{-1}}{avg[(1+\tau_0^t)^{-1}]}\big\rangle\Big) \\
&= q_0 \times avg[(1+\tau_0^t)^{-1}]\Big(avg[\Delta z_t] + \big\langle \Delta z_t \frac{(1+\tau_0^t)^{-1}}{avg[(1+\tau_0^t)^{-1}]} - 1\big\rangle\Big).
\end{aligned}$$

Hence, we have

$$dU = u'(c_0) \times avg[(1+\tau_0^t)^{-1}]\Big(\Delta W_0 + q_0\ \Big\langle \Delta z_t, \frac{(1+\tau_0^t)^{-1}}{avg[(1+\tau_0^t)^{-1}]} - 1\Big\rangle\Big).$$

A.2 Calculating the wedges

Let

$$1+s_t \coloneqq \frac{R^B(\bar{b}_{t+1}) + \bar{b}_{t+1}R^{B\prime}(\bar{b}_{t+1})}{R_t}, \quad 1+\zeta_t \coloneqq \frac{1}{1-\mu_t}$$

Using the functional form $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$, the household's optimality condition is given by:

$$-\sigma \log \bar{c}_t = -\sigma \log \bar{c}_{t+1} + \log \beta_{t,t+1} R_t + \log(1 + s_t) - \log(1 - \mu_t).$$

Let $\check{c}_t$, and $\check{c}_{t+1}$ be the consumption response to a one-time unexpected transfer, and $\mu_t - \delta\mu_t$ be the corresponding multiplier. If s_t is constant, then:

$$-\sigma \log \check{c}_t = -\sigma \log \check{c}_{t+1} + \log \beta_{t,t+1} R_t + \log(1 + s_t) - \log(1 - (\mu_t - \delta\mu_t)).$$

Taking the difference gives:

$$\sigma(\delta c_t - \delta c_{t+1}) = \log \frac{1 - \mu_t + \delta\mu_t}{1 - \mu_t} = \log\left(1 + \frac{\delta\mu_t}{1 - \mu_t}\right)$$

where $\delta c_t \coloneqq \log \check{c}_t - \log \bar{c}_t$.

Because $\mu_t - \delta\mu_t > 0$, we have

$$\sigma(\delta c_t - \delta c_{t+1}) < \log\left(1 + \frac{\mu_t}{1 - \mu_t}\right).$$

Rearranging gives us a lower bound for μ_t:

$$\mu_t > \frac{\exp(\sigma(\delta c_t - \delta c_{t+1})) - 1}{\exp(\sigma(\delta c_t - \delta c_{t+1}))}.$$

A.3 Consolidation of indirect holdings

The FOF is produced by the Federal Reserve each year and tracks the relationship between assets and liabilities held by households, businesses, governments, and financial institutions. The FOF is unique in that it provides us with the network of assets and liabilities held by end-holders (like households) and intermediate holders (like banks) in the economy. We standardize the FOF so that we can match aggregate classes of assets and liabilities across the SCF and FOF. We then use these transactional relationships between households to identify the direct holdings of each household in the SCF.

In the previous subsection, we describe the SCF data. But the SCF data provides us with a superficial understanding of each households' exposure to inflation shocks because many of the holdings in the SCF are of the form of equity or pensions, which themselves hold underlying assets with different exposure to inflation.

We develop a new method for disentangling the direct holdings of each household using the Federal Flow of Funds data. To understand why this is important, consider a household where the head of the household is 50 years-old and sets aside $1,000$ per month into a defined contribution pension fund.

To understand how this logic works more generally, consider the following framework:

Suppose there are $k = 1, \dots, K$ final assets and liabilities, $i = 1, \dots, I$ intermediaries, and $l = 1, \dots, L$ end owners. Let

- $b_{i,l}$ denote the share of intermediary i owned by end owner l (l can be for example the x% income household, U.S. government, or ROW)
- $\omega_{i,j}$ 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 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.

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

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

Furthermore, 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:

$$(\boldsymbol{I}_{I\times I} - \boldsymbol{\Omega})^{-1} \times (\boldsymbol{1}_I - \boldsymbol{b}\ \boldsymbol{1}_L) = \boldsymbol{1}_I, \quad \sum_l \boldsymbol{a}_l^{ID} + \boldsymbol{a}_l^D = \boldsymbol{1}_K$$

where $\boldsymbol{a}_l^D$ denotes end owner l's direct share of final asset $k = 1, \dots, K$. The first restriction is equivalent to saying that all share of intermediaries by other intermediaries and end owners sums to one:

$$\boldsymbol{\Omega}\boldsymbol{1}_I + \boldsymbol{b}\ \boldsymbol{1}_L = \boldsymbol{1}_I.$$

In this framework, final assets and liabilities are those that do not have ownership stakes in other assets or liabilities. These include corporate bonds, bank loans, mortgage-backed securities, treasury bills (all of which are nominal); as well as real estate holdings, corporate valuations, and pension entitlements (all of which are real). Intermediaries are financial vehicles that hold ownership stakes in other intermediaries and/or final assets, and which are themselves owned by intermediaries or end-owners. These include pension funds and mutual funds. Finally, the end-owners are households, foreign investors, or the government.

A.4 Data Appendix

The data for this project comes 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. The SCF is a triennial survey of household finances, while the FoF includes balance sheets for various entities including households, the federal government, nonprofits, and businesses. 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.

We begin with data from the 2019 SCF. We use the years 2010–2019 to compute income growth rates, though every other SCF computation uses just the 2019 survey, adjusted to be in terms of 2021 dollars. We then clean the raw SCF data to obtain household-level demographic data on age, gender, race, and college education of the household head, as well as income and household weights.

We use constant maturities data and interpolate missing yields to construct a vector of yields for 2019, which we then use to calculate the nominal present value of payment streams.

We construct time series of inflation shocks. We use quarterly inflation expectations data from the Cleveland Fed to compute changes in long-term expectations at different horizons one year after initial expectations. We then use CPI data from FRED to obtain measures of 1-year-ahead and inflation realized over the past year. This allows us to compute inflation shocks as the "update" in inflation expectations. Finally, we annualize the data and output a 30-period vector of inflation shocks for the years 2020 and 2021.

We use the SCF data to construct payment streams of expected future labor income for households. We use the demographic data from 2010–2019 to predict growth rates, and then use bottom-coded income to impute future streams of income going to age 95 for each household. We further adjust these for expected future inflation and conditional mortality. Next, we use these labor income streams to calculated expected streams of social security payments. To account for taxes on income, 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 and social security income to compute taxes paid by households. We obtain these variables from the SCF. Notably, taxes can vary from state-to-state, though the SCF does not provide geographic information on households. Consequently, we randomly assign households to states based on the their relative weights in the SCF so that the distribution of weights across states closely matches the distribution of population across states, obtained from the Census. We then subtract the taxes to be paid from labor and social security income, implementing a zero lower bound so that income is never negative. We then use the difference between pre-tax and post-tax income to calculate taxes as an asset held by the government. This gives us vectors of post-tax labor and social security income from the current year (year0) extending into the future for each household.

We follow a similar process to create mortgage payment streams. We use an SCF extract with more detailed variables on household mortgages. We then use the mortgage principle, current interest rate and years remaining to calculate streams of yearly mortgage payments for each household. For adjustable rate mortgages, we make further adjustments for the initial fixed period and caps on frequency and size of rate changes. Finally, instead of using the current mortgage rate we calculate a forward mortgage rate using the forward treasury rate plus the mortgage spread. This outputs vectors of mortgage payments from the current year (year0) extending into the future for each household with a mortgage.

Next, we use the Q4 2019 FoF data to construct indirect holdings of various assets and liabilities from the FoF for three end owners: households, rest of world and government. We use the four-character codes at the beginning of each row in the FoF tables to assign balance sheet items to intermediaries and end owners. Some tables with non-standard organization required additional hardcoding to find all assets and liabilities and ensure the totals match. In the case of discrepancies, we assign them to make the asset and liability totals match. We divide all these balance sheet items by the holding's totals to obtain shares. This gives us matrices containing, for both assets and liabilities, the share of each holding held by intermediaries, the share of each intermediary held by intermediaries, the share of each intermediary held by end owners, and the share of each holding held by end owners. We can then use these matrices, along with the dollar values of each holding to calculate final ownership of holdings either directly, indirectly, or indirectly through defined contribution (DC) pensions. Finally, we add rent (taken from the SCF) as a liability held by households and as a corresponding asset held by corporations. Similarly, social security and labor income (from the payment streams we computed earlier) are assets held by households with a corresponding liability held by corporations and the government. Tax (from labor and social security income, computed above) is an asset held entirely by the government.

We then proceed to constructing the main datasets used in our analysis. The first of these is called longdata, and consists of household-level holdings of all the assets and liabilities we obtained from the FoF data held directly, indirectly and through DC pensions. This involves creating equivalent matrices to what we constructed using the FoF data, but instead at the individual household level using totals from the SCF. To calculate indirect holdings, we find SCF variables which correspond to FoF intermediaries, such as money market funds, mutual funds, and DC pensions. A full breakdown of the matches between SCF and FoF variables can be found in Figure A.1. We then divide by the dollar value of the holding held by all individuals in the SCF to obtain each household's share of that intermediary. We then combine these with the share of intermediaries held by intermediaries and the share of each holding held by intermediaries (computed from the FoF). Multiplying all these matrices by each other and then multiplying the share by the FOF dollar totals gives us the total of each asset and liability held indirectly or through DC pensions by each household. More details on this process can be found in Appendix A.3. For directly-held holdings, we find SCF variables which match the FoF holdings and use the totals held by each household. For the directly-held assets labor and social security income, we use the nominal present value of the payment streams we calculated. Similarly, the directly-held mortgage liability is the npv of the mortgage payment streams. This gives us longdata.csv, which contains demographic variables and all assets and liabilities held directly, indirectly or through DC pensions for each household in the SCF.

Importantly, we use FoF values to calculate the shares and dollar amounts of holdings held directly and indirectly by households. However, we use SCF values to calculate what share of overall household ownership is held by a particular household. This distinction is important, since the overall totals from the SCF and FoF are not always the same. For harmonizing variables across the two datasets, we often rely on imperfect matches. For example, we match "Real Estate" from the FoF to "Total value of primary residence of household, 2019 dollars" from the SCF. However, even when the variable definitions are fairly similar, the totals are occasionally significantly different. We make the decision to adjust all totals to match the FoF, since that dataset provides a more complete view of the entire economy.

To understand how this impacts our results, consider this example: Household A in the SCF holds \$1000 of Asset X. In total, all SCF households hold \$10 million of Asset X, which is thus the total held directly by households. [7] However, not all of Asset X is held directly by households. The FoF states that direct household holdings of Asset X constitute 50% of economy-wide holdings. Combining this fact with the SCF total implies that economy-wide holdings of Asset X constitute \$20 million. However, the FoF states that economy-wide holdings of Asset X are instead \$30 million. Thus, there is a discrepancy between the SCF and FoF totals. This leaves us with two options: 1) either increase all SCF values to match

[7] We rely on the assumption that SCF survey participants do not have detailed information on the indirect holdings of financial intermediaries, and their answers concern only direct holdings of assets and liabilities. Thus, when they denote their holdings of bonds, they are considering only direct holdings, and not calculating their holdings of mutual funds which in turn hold bonds on their balance sheets (which the household then holds indirectly).

the FoF total, or 2) decrease all FoF values to match the SCF total. Since we have chosen to adjust to the FoF total, this means inflating all SCF totals by a factor of 1.5, meaning that Household A is considered to hold $1500 dollars of Asset X, rather than the $1000 they originally stated.

Making this adjustment is necessary, since otherwise assets and liabilities across all end owners in the economy will not match. However, this adjustment has important implications. Adjusting to the FoF instead of to the SCF increases the totals of several important holdings, for example Treasury Securities. Since treasuries are overwhelmingly held as a direct liability by the government and an indirect asset by wealthy households, increasing this total total means that the government gains more and the wealthiest households lose more from unexpected inflation. Conversely, adjusting to the SCF will the government gain less and wealthy households lose less. Figures A.13-A.20 show the results when adjusting to the SCF instead of the FoF.

The second dataset is called payment streams. For all nominal holdings (excluding for example real estate, equipment, and some portion of labor income), we construct payment streams in a similar manner to what we did for labor income, social security income and mortgages. In order to create these payment streams, we use the maturities of each holding and FoF data on face values going back to 2006 to calculate the maturity composition of the face value of each holding in future periods. Dividing each of these 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. For mortgages and labor income, we use the payment streams computed separately. For the labor income payment streams we assume 70%, 40% and 10% of labor income in the first three years is nominal, and the rest is real. Finally, we assume that any holding held directly through a DC pension is not a stream of payments, but a single lump sum obtained when the household head turns 65 or in the current year, whichever is later. 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 year0 (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 npv of all payment streams, which exist only for nominal holdings. The second two datasets are versions of longdata and payment streams created for the rest of world and government. These are constructed in the same manner as we did for households, but instead using FoF data for the remaining two endowners, rest of world and government. This is an important step which allows us to verify that totals of assets and liabilities across all end owners (households, rest of world and government) match up, [8] and also that each gain has a corresponding loss and vice versa. While households across the wealth distribution tend to lose due to unexpected inflation, Figure A.8 shows that the government has corresponding gains.

Table A.1: FoF to SCF Matching

FoF Names	FoF Totals	Shares	SCF Names	SCF Totals	Adjustment
U.S. Reserves and SDR Allocations	0.17	0		0	N/A
SDRs and Treasury Currency	0.06	0		0	N/A
US Deposits in Foriegn Countries	0.8	0.3		0	1
Net Interbank Transactions	1.77	0		0	N/A
Checkable Deposits and Currency	4.44	0.33	(checking+prepaid)	1.38	0.93
Time and Savings Deposits	12.43	0.79	(saving+cds)	2.85	0.29
Federal Funds and SRPA	4.53	0		0	N/A
Open Market Paper	1.07	0		0	N/A
Treasury Securities	17.91	0.11	govtbnd	0.15	0.08
Agency and GSEs	9.18	0.07		0	1
Municipal Securities	4.04	0.47	notxbnd	0.58	0.31
Corporate and ForeignBonds	13.5	0.07	obnd	0.15	0.16
Other Depository Inst Loans	3.69	0.09		0	1
Other Loans and Advances	4.16	0.19		0	1
Total Mortgages	15.28	0.69	npv_mtg (1)	10.47	1
Credit Card Loans	1	1	lloan10	0.37	0.37
Auto Loans	1.16	1	veh_inst	0.83	0.72
Student Loans	1.6	1	edn_inst	1.11	0.7
Other Consumer Credit	0.24	1	oth_inst	0.28	1.2
Trade Credit	5.41	0.07		0	1
Life Insurance Reserves	2.19	0.77	cashli	1	0.59
Taxes Payable by Businesses	0.58	0		0	N/A
Direct Investment	15.44	0		0	N/A
Total Misc Fin Claims	27.77	0.04		0	1
Real Estate	32.42	1	houses	28.73	0.89
Equipment	6.5	0.07		0	1
IP	3.27	0.06		0	1
Inventories	2.55	0		0	N/A
Durable Goods	5.59	1	vehic	2.91	0.52
Corporate Goodwill	228.03	0		0	N/A
Non-Corporate Goodwill	57.68	0		0	N/A
Other Real Estate	26.36	0	nnresre	3.24	N/A
Private DB Pensions	11.84	1	priv_shareof_db*(retqliq*dbplancj) (2)	1.29	0.11
Federal DB Pensions	4.66	1	fed_shareof_db*(retqliq*dbplancj) (3)	1.28	0.27
State and Local DB Pensions	10.47	1	s_l_shareof_db*(retqliq*dbplancj) (4)	3.21	0.31
Labor Income	214.9	1	labor_inc (5)	214.9	1
Social Security	71.97	1	ss_inc (6)	71.97	1
Rent	0.26	1	rent*6	0.26	1
Tax	79.77	0	tax (7)	79.77	N/A

FoF and SCF Totals are in trillions of 2021 USD. Shares denotes the share of the FoF Total held directly by households. The adjustment factor is the SCF total divided by the FoF total multiplied by the share.

Table A.1 shows the matches between FoF and SCF variables. The first column shows the names of the FoF variables we use. The second column shows the FoF totals, in trillions of 2021 USD. The third column shows the share of the previous total held directly by

[8] The aggregate totals for the entire economy are within 1% of each other, though the totals for some individual holdings do not match. For example, the FoF denotes that a portion of US deposits in foreign countries are held directly by households, but there is no corresponding SCF variable to denote this. Consequently, that fraction of direct household ownership is missing from the aggregate asset total, which means that it is slightly smaller than the liability total. We estimate the effects of these disrepancies to be relatively minor.

households. The fourth and fifth columns gives the SCF names and totals, again in trillions of 2021 USD. Finally, the adjustment column is computed by taking the SCF total and dividing by the FoF total multiplied by the share held directly (computed from the FoF). In order to adjust to the SCF, we multiply FoF totals by the adjustment factor. In order to adjust to the FoF, we divide SCF totals by the adjustment factor. N/A denotes variables which are not held directly by households (for example Open Market Paper) and hence have no corresponding SCF variable. Additionally, several holdings, for example US Deposits in Foreign Countries, are partially held directly by households, but we have no corresponding SCF variable. Thus, this share of the holdings remains unallocated. Table A.2 shows that this has a relatively minor effect on results.

Several of the cells contain notes concerning their values. For (1), we use npv_mtg, the nominal present value of the mortgage payment streams. For (2), we multiply the privately-issued share of defined-benefit pensions (priv_shareof_db) by the pension value variable retqliq and dbplancj, an indicator which states whether a household holds a defined-benefit pension. (3) and (4) are identical to (2), but instead we multiply first by shares of defined benefit pensions issues by the federal government and state and local governments, respectively. (5) and (6) are the nominal present values of the labor (labor_inc) and social security (ss_inc) income streams. Finally, (7) is the total tax asset we calculated from labor and social security income.

Figure A.2 shows all holdings held across all end owners in the economy: Households, Government and Rest of World. Columns two through four show the liability totals for each, while five through seven show the asset totals. Column eight shows the ratio between the two. For most of the holdings, the ratio is 1, meaning that the total of assets perfectly matches the totals of liabilities. We outlined above that when the FoF indicates direct holdings by households (of either assets or liabilities), but then we are unable to find a SCF variable to account for this ownership, then that share of the holding is unallocated and the sum of assets and liabilities in the economy no longer matches. This explains why not all of the asset to liability ratios are exactly 1. However, the majority are extremely close, and those that are farther away represent a tiny portion of holdings in the economy. The ratio of all assets and liabilities together, shown in the "Total" row, is 0.996. This excludes real assets, which have ratios of N/A, since there are no corresponding liability holdings of, for example, real estate.

Table A.3 shows demographic characteristics of each wealth decile. Both networth and income increase with wealth decile, as does home ownership. Wage income and business income shares peak for the 8th and 7th deciles, respectively, consistent with these deciles

Table A.2: Consolidated Holdings Across all End Owners

	Liabilities			Assets			
FoF Names	Households	Government	Rest of World	Households	Government	Rest of World	Ratio A/L
U.S. Reserves and SDR Allocations	0	0.05	0.12	0	0.17	0	1
SDRs and Treasury Currency	0	0.06	0	0	0.06	0	1
US Deposits in Foriegn Countries	0	0	0.8	0.4	0.05	0.11	0.7
Net Interbank Transactions	0.07	1.68	0.02	1.18	0.14	0.45	1
Checkable Deposits and Currency	1.74	2.23	0.48	2.7	0.6	1.15	1
Time and Savings Deposits	8.92	1.06	2.44	11.32	0.44	0.67	1
Federal Funds and SRPA	2.7	0.38	1.45	2.93	0.28	1.32	1
Open Market Paper	0.49	0.06	0.52	0.65	0.18	0.24	1
Treasury Securities	0	17.91	0	5.69	5.2	7.02	1
Agency and GSEs	6.57	0.81	1.8	3.98	2.6	1.96	0.93
Municipal Securities	0.43	3.27	0.12	3.48	0.16	0.41	1.06
Corporate and ForeignBonds	7.55	0.88	5.07	7.24	1.18	5.08	1
Other Depository Inst Loans	2.45	0.11	0.8	2.65	0.32	0.73	1.1
Other Loans and Advances	2.94	0.38	0.38	1.73	0.54	1.12	0.91
Total Mortgages	15.06	0.07	0.15	10.68	1.62	2.91	1
Credit Card Loans	1	0	0	0.49	0.38	0.13	0.99
Auto Loans	1.16	0	0	0.56	0.44	0.15	0.99
Student Loans	1.6	0	0	0.78	0.6	0.21	0.99
Other Consumer Credit	0.24	0	0	0.11	0.09	0.03	0.99
Trade Credit	2.79	1.6	0.63	3.48	0.61	1.05	1.03
Life Insurance Reserves	1.49	0.23	0.47	2.04	0.04	0.11	1
Taxes Payable by Businesses	0.47	0.04	0.08	0	0.58	0	1
Direct Investment	6.07	0.7	8.67	5.15	0.58	9.71	1
Total Misc Fin Claims	15.06	8.88	3.79	16.4	7.48	2.64	0.96
Real Estate	0	0	0	32.42	0	0	N/A
Equipment	0	0	0	4.6	0.44	1.01	N/A
IP	0	0	0	2.28	0.24	0.55	N/A
Inventories	0	0	0	1.9	0.2	0.45	N/A
Durable Goods	0	0	0	5.59	0	0	N/A
Corporate Goodwill	0	0	0	163.67	19.52	44.84	N/A
Non-Corporate Goodwill	0	0	0	57.68	0	0	N/A
Other Real Estate	0	0	0	25.8	1.15	2.65	N/A
Private DB Pensions	0	4.66	0	4.66	0	0	1
Federal DB Pensions	166.87	14.57	33.46	214.9	0	0	1
State and Local DB Pensions	8.5	1.01	2.33	11.84	0	0	1
Labor Income	0.26	0	0	0.19	0.02	0.05	1
Social Security	0	71.97	0	71.97	0	0	1
Rent	0	10.47	0	10.47	0	0	1
Tax	0	0	0	0	79.77	0	N/A
Total	254.43	143.1	63.58	397.68	24.36	37.26	1

Columns show holdings of liabilities and assets by each endowner in the economy. All Totals are in Billions of 2021 USD.

Table A.3: Demographic Characteristics by Decile

Decile	1	2	3	4	5	6	7	8	9	10
Networth	438	788	1131	1448	1808	2236	2787	3572	4915	14851
Income	22	33	46	51	62	71	88	115	156	451
Income 0-50k	0.98	0.9	0.63	0.56	0.44	0.31	0.12	0.02	0	0.01
Income 50-200k	0.02	0.1	0.37	0.44	0.56	0.69	0.86	0.92	0.8	0.28
Income 200k+	0	0	0	0	0	0	0.02	0.07	0.19	0.71
Wage Income	0.1	0.32	0.54	0.61	0.67	0.73	0.77	0.81	0.79	0.67
Business Income	0	0.04	0.06	0.07	0.08	0.06	0.09	0.08	0.07	0.24
Dividend/Interest Income	0	0	0	0.01	0.01	0.01	0.01	0.01	0.02	0.1
Capital Gain Income	0	0	0	0.03	0.01	0	0	0.01	0.01	0.07
Social Security/Pension Income	0.66	0.48	0.31	0.24	0.16	0.15	0.13	0.09	0.09	0.1
Transfer Income	0.14	0.09	0.07	0.06	0.05	0.04	0.02	0.03	0.01	0.02
Home Owner	0.44	0.57	0.57	0.57	0.6	0.6	0.68	0.72	0.82	0.91
Mortgage	0.09	0.18	0.26	0.29	0.35	0.36	0.5	0.55	0.66	0.62
Working	0.17	0.42	0.61	0.68	0.76	0.8	0.85	0.87	0.89	0.84
College	0.08	0.15	0.21	0.22	0.29	0.33	0.41	0.48	0.63	0.83
Male	0.39	0.56	0.63	0.68	0.68	0.78	0.82	0.88	0.92	0.95
White	0.59	0.63	0.58	0.62	0.63	0.65	0.73	0.73	0.77	0.86
Black	0.28	0.23	0.23	0.17	0.17	0.17	0.11	0.12	0.08	0.03
Other Races	0.13	0.14	0.19	0.22	0.19	0.19	0.16	0.15	0.16	0.11
Age	69.75	62.26	56.76	51.43	47.42	46.17	44.58	43.18	44.25	51.42
Age 18-29	0.03	0.06	0.07	0.11	0.16	0.18	0.19	0.17	0.15	0.07
Age 30-49	0.02	0.1	0.23	0.35	0.35	0.42	0.45	0.54	0.54	0.39
Age 50-64	0.29	0.38	0.36	0.27	0.33	0.24	0.22	0.19	0.18	0.33
Age 65-95	0.67	0.47	0.34	0.27	0.15	0.17	0.13	0.11	0.14	0.21

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.

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 and pension income 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 increase 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.

Table A.4: Share of Nominal Maturity Mismatched Households across Wealth Deciles

Decile	1	2	3	4	5	6	7	8	9	10
Share NMM	0.25	0.44	0.53	0.61	0.64	0.71	0.75	0.73	0.69	0.51

Table A.4 Shows that more than half of households in deciles 3-10 experience nominal maturity mismatch, with the share peaking for the 7th decile. Interestingly, while the gap between average duration is actually largest for the 1st decile, only 25% of these households are actually nominal maturity mismatched. This result is driven by some households with high liability durations, largely driven by mortgages.

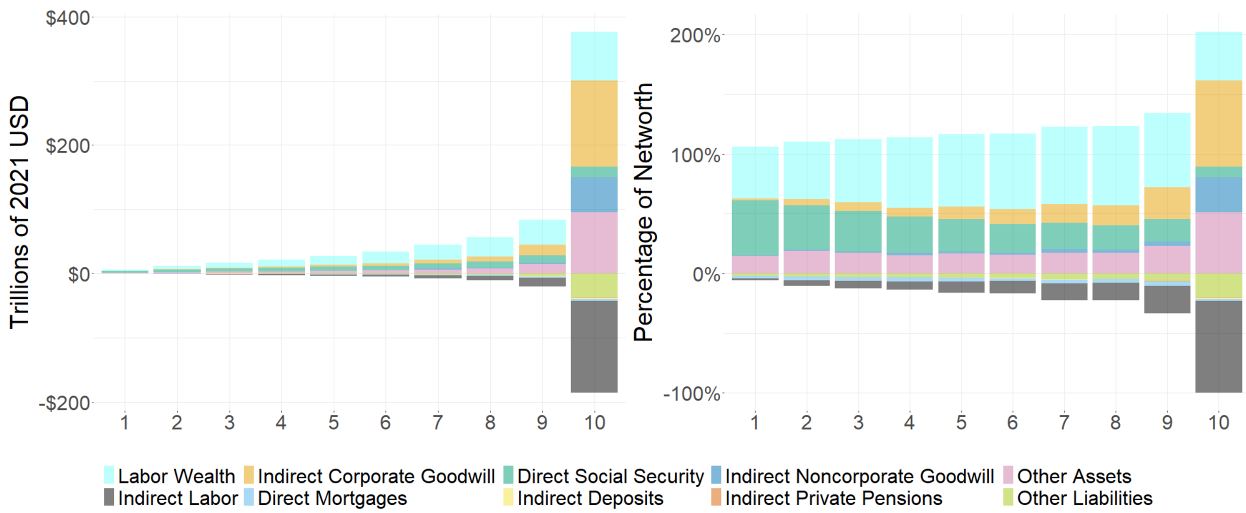


Figure A.1: Consolidated balance sheet of U.S. households by wealth decile (top holdings, adjusted to SCF).

Figure A.1 shows the results of Figure 2, but instead with holdings adjusted to match SCF totals. The overall level of holdings is slightly lower than it was when adjusting to the FoF, but otherwise results are similar. The vast majority of wealth for households outside the top wealth decile still comes from expected labor income. In contrast, the highest wealth decile holds significant amounts of corporate and noncorporate goodwill. 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, social security and housing make up a significant fraction of total net worth. While for the richest decile, other business interests are (relatively) more important. While the lowest wealth households do hold mortgages and take out installment loans, the wealthiest households hold significantly larger mortgages (in levels). Overall, the largest liability is indirect labor, held through intermediate assets such as mutual funds holding corporate equity.

Table A.5: Nominal balance sheet across wealth decile

Decile	1	2	3	4	5	6	7	8	9	10
assets	36	75	109	142	168	255	320	409	757	5519
liabilities	24	53	90	135	150	217	322	405	713	5228
assets duration	1.7	1.8	2.2	2.6	2.9	3.1	3.6	4.4	4.8	4.1
liabilities duration	5.6	5.9	6.2	5.7	6.3	5.6	6	6.4	6.4	3.7

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

Table A.5 shows the results of Table 1, but for all deciles. All but the top decile experience nominal maturity mismatch, with both assets and liabilities increasing with decile.

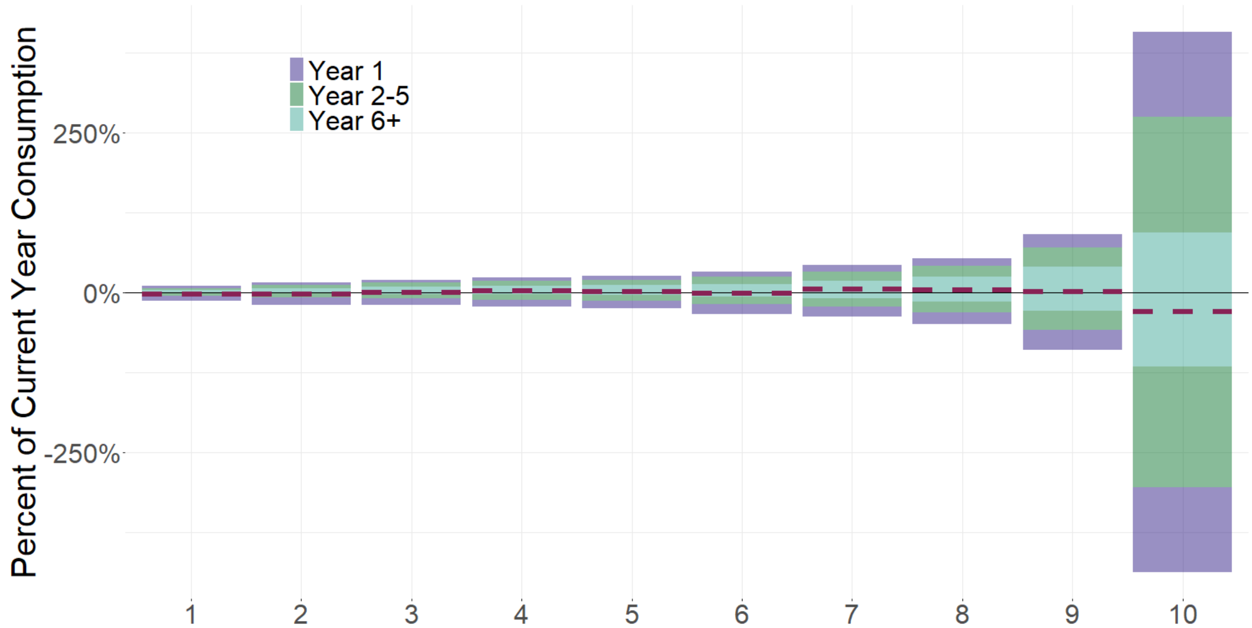


Figure A.2: Redistribution due to nominal exposure across the wealth distribution. X-axis: wealth by net worth; Y-axis: redistribution relative to current year consumption. Dashed lines indicated net redistribution.

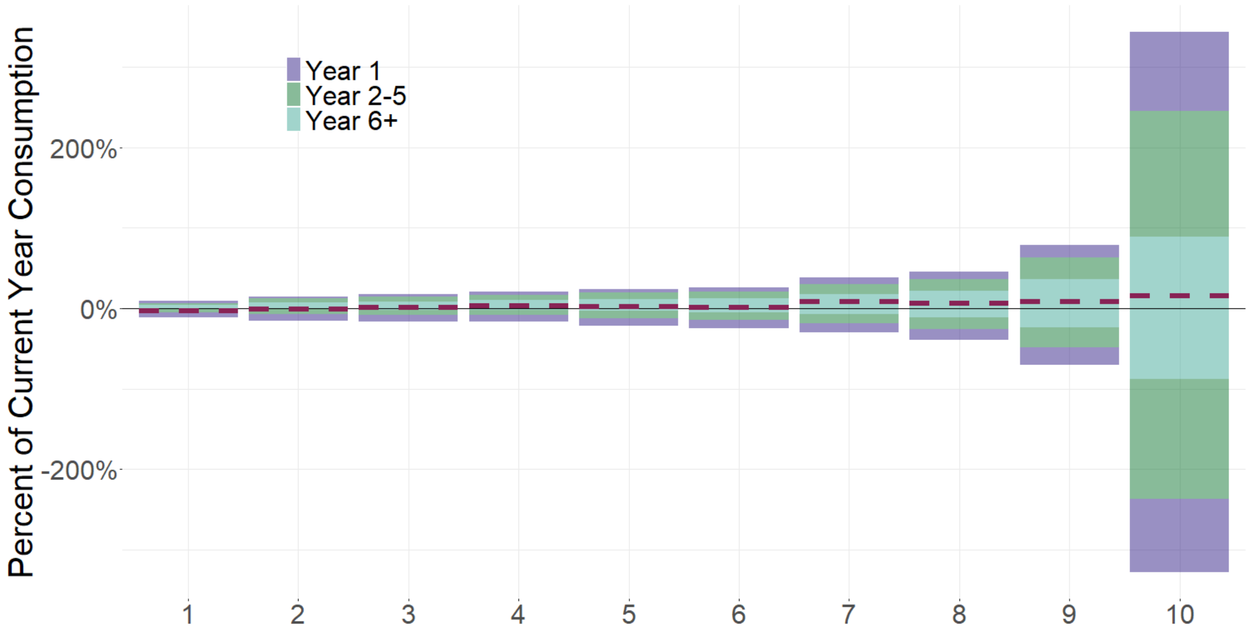


Figure A.3: Redistribution due to nominal exposure across the wealth distribution (adjusting to the SCF). X-axis: wealth by net worth; Y-axis: redistribution relative to current year consumption. Dashed lines indicated net redistribution.

Figure A.2 shows the net effect of the 2021–2022 inflation shock on the average household in each wealth decile relative to current year consumption. 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 black dashed line represents the total effect.

Overall, the results are relatively similar to what was seen in Figure 5. The welfare losses are most significant for the 10th decile, which consumes a relatively small share of it's net worth, making the effects relatively larger.

Figure A.3 shows the same results, but with all holdings adjusted to match the SCF totals. The primary difference is that the top deciles now gain. This is because adjusting to the SCF drastically decreases the holdings of bonds such as treasury securities, which are primarily held as assets by top deciles. This results in less aggregate losses, and thus a net welfare gain.

Figure A.4 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 individual from the SCF. The axes measure the effects of the 2021–2022 unexpected inflation shock in terms of current year consumption.

Figure A.4: Welfare effects of unexpected inflation. X-axis: the wealth channel; Y-axis: the wealth and liquidity channels. Units: percentage of current year consumption.

If the liquidity channel did not matter, we would see all individuals laying 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. Moreover, the blue dots line up on a steep line, with a slope more than three times large. This implies that many households who experience little gains and loss due to the wealth channel, in fact, bear a large welfare loss.

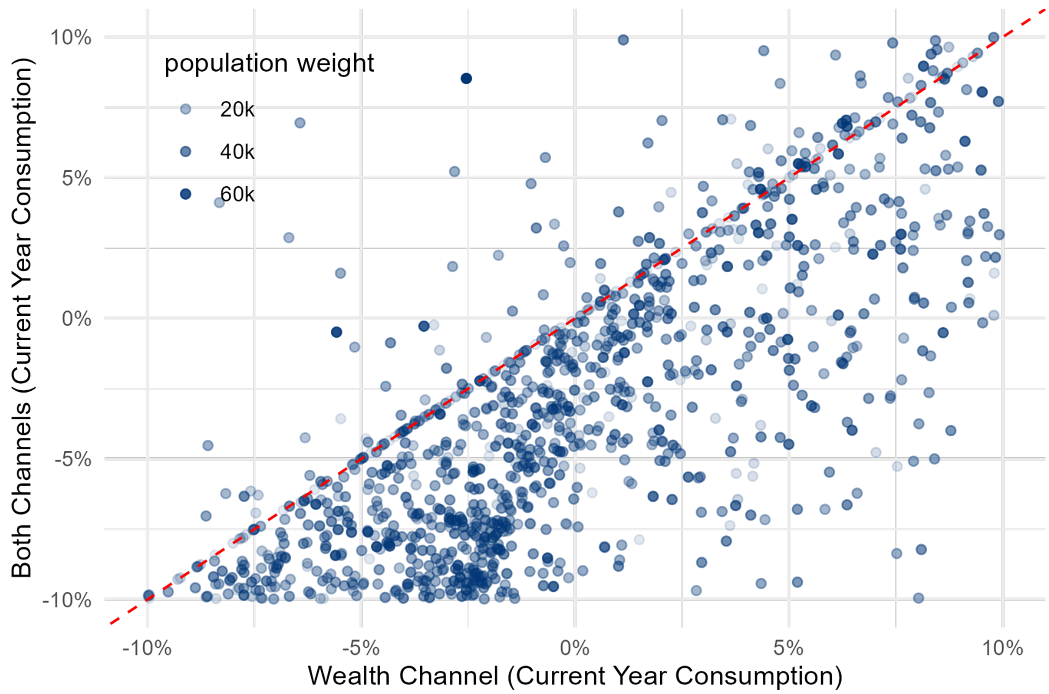


Figure A.5: Welfare effects of unexpected inflation (adjusting to the SCF). X-axis: the wealth channel; Y-axis: the wealth and liquidity channels. Units: percentage of current year consumption.

Figure A.4 shows the effects in terms of current year consumption. It 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 individual from the SCF. The axes measure the effects of the 2021–2022 unexpected inflation shock in terms of current year consumption (multiply $ change by the wedge and divide by current year consumption).

We see that most blue dots lie below the 45 degree line and the blue dots line up on a steep line, though the effects are more dispersed when put in terms of current year consumption. This implies that many households who experience little gain and loss due to the wealth channel in fact bear a large welfare loss.

Figure A.5 shows the same results, but with holdings adjusted to match SCF totals. The results are very similar, with slightly more concentration of points below the 45 degree line.

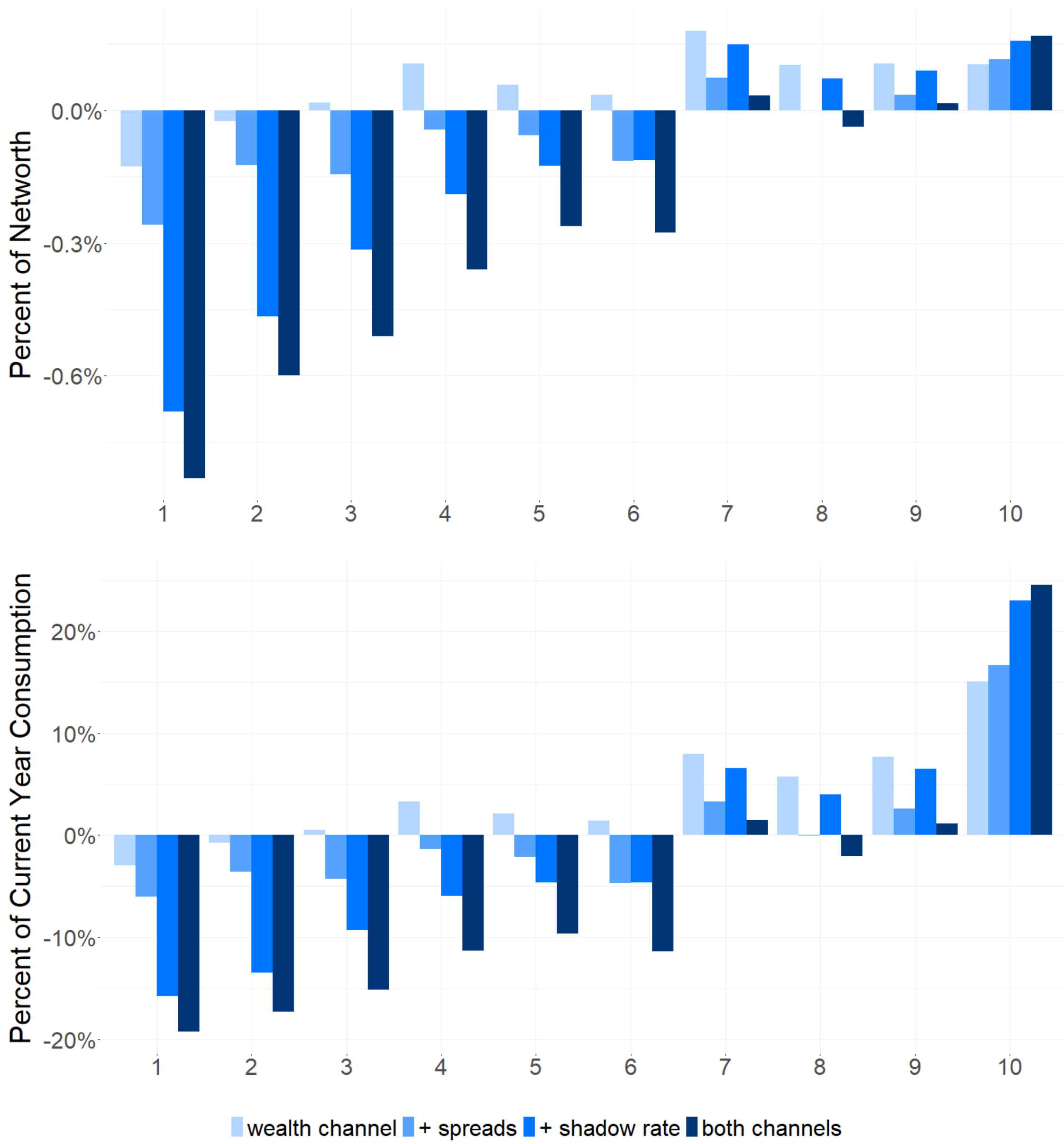


Figure A.6: Effects of different channels in wealth equivalence as a percentage of current year consumption and net worth, averaged within each wealth decile (adjusting to the SCF).

Figure A.6 shows the results of Figure 8, but instead adjusting holdings to match SCF totals. The top deciles now experience gains. Again, this is because adjusting to the SCF drastically decreases the holdings of bonds such as treasury securities, which are primarily held as assets by top deciles. This results in less aggregate losses, and thus a net welfare gain.

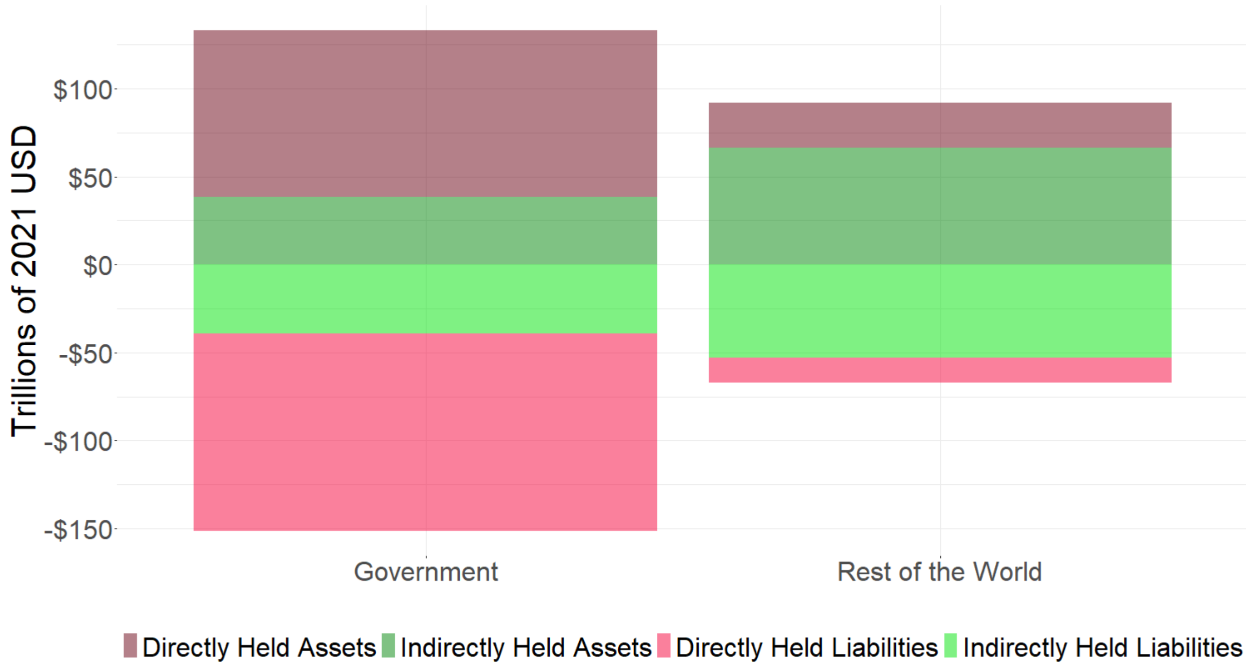


Figure A.7: Consolidated balance sheet of Government and Rest of the World.

Figure A.7 shows the consolidated balance sheets for the U.S. government and rest of the world. As can be seen 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 A.6: Nominal balance sheet for Government and Rest of the World

	Government	Rest of the World
assets	30	39
liabilities	43	29
assets duration	4.7	4.7
liabilities duration	6.4	2.3

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

Table A.6 shows the present values and average duration of nominal assets and liabilities for the government and rest of the world. Again, we see that the government have 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.

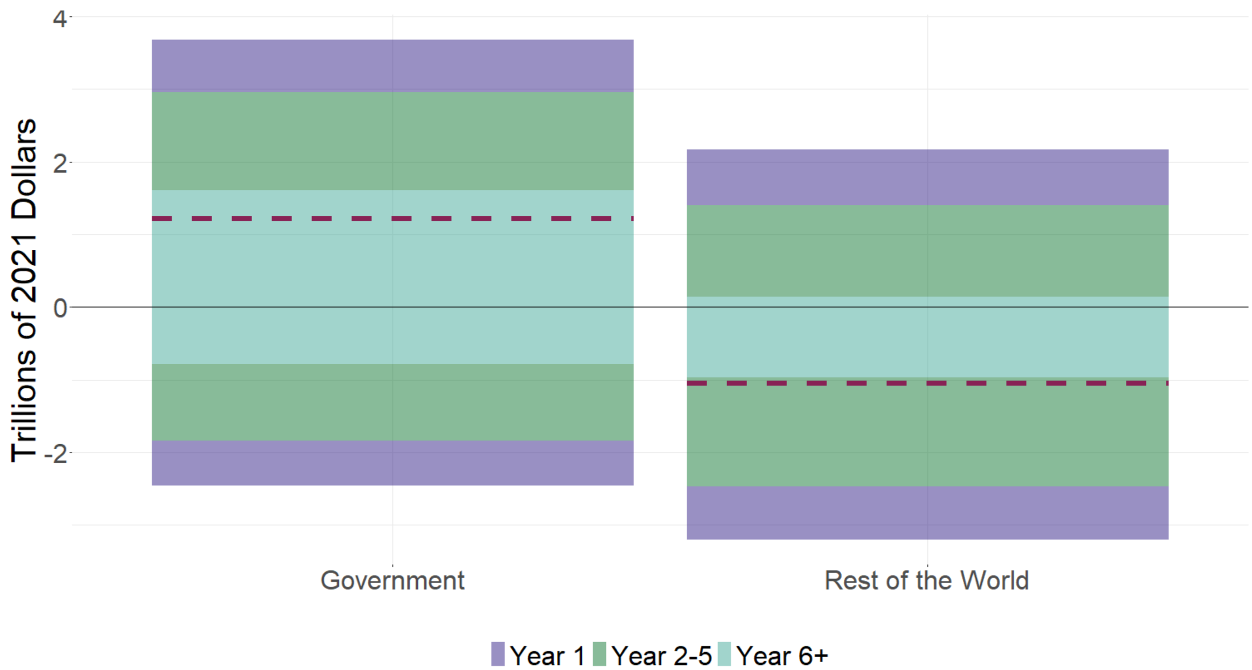


Figure A.8: Redistribution due to nominal exposure for government and rest of the world. X-axis: wealth; Y-axis: redistribution in trillions of dollars Dashed lines indicated net redistribution.

Figure A.8 shows the effects of the 2021–2022 inflation shock on the government and rest of the world. 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 line represents the total effect of the inflation shock. The government gains overall from the inflation shock, particularly in the long-term. This is due to the government's large holding of treasury securities as a liability. The rest of the world looses, again primarily through the 6+ year channel.

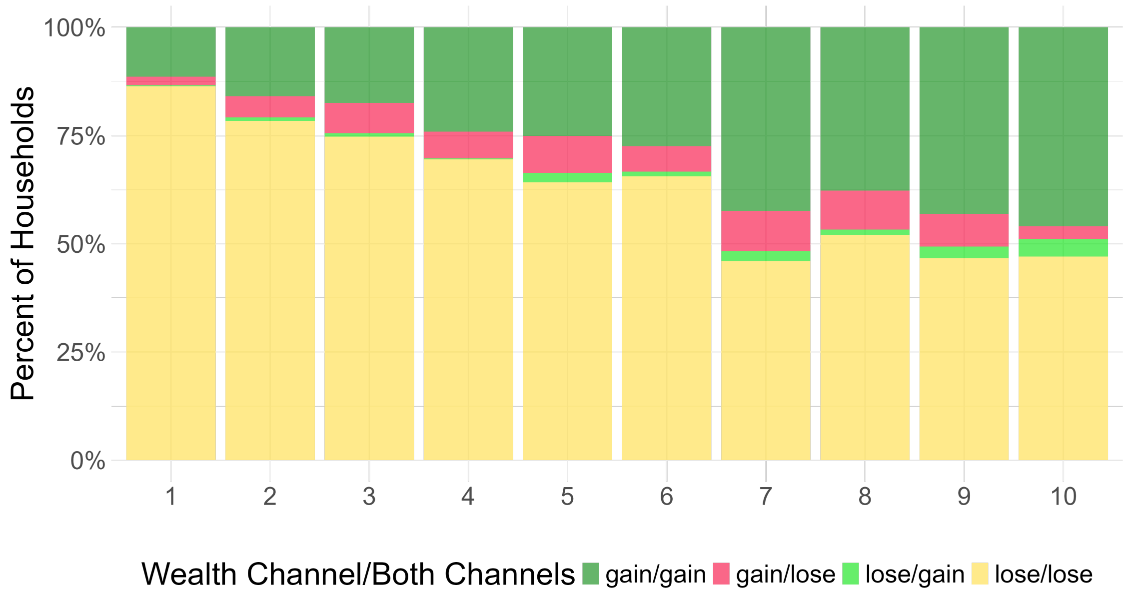


Figure A.9: Percent of households that gain and lose through the wealth channel and liquidity+wealth channel for each wealth decile

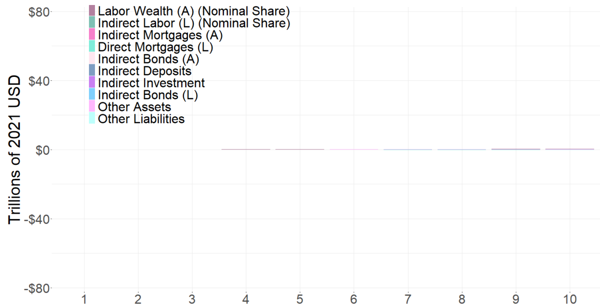
Figure A.9 shows the percentage of households that gain and lose through the wealth channel vs the liquidity + wealth channel in each decile. The majority of households lose through both combinations of channels, particularly for the lower deciles. The seventh decile sees the most households gain through both or at least one of the two channels. By far the fewest households lose through the wealth channel while gaining through the liquidity + wealth channel.

A.5 Decomposition of Results by Age Groups

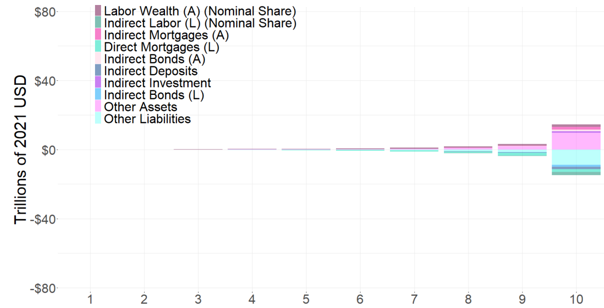
Figure A.10 shows the results of Figure 3, split by age group. Most of the holdings are concentrated in the higher age groups, with those in the 50-95 age range holding almost everything.

Figure A.11 shows the results of Figure 5, split by age group. As the age group increases, the size of the effects tend to increase. For households in the 30-49 age range, almost all deciles gain, while for households in the 50-95 range, almost all deciles lose.

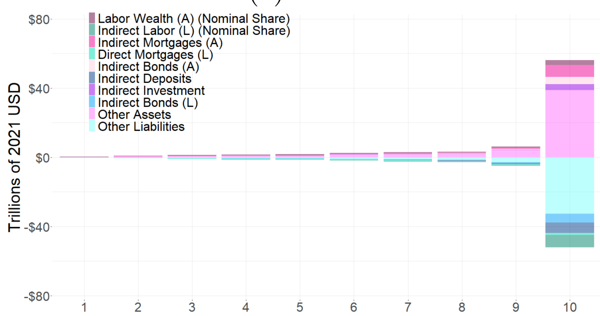
Figure A.12 shows the results of Figure 8, split by age group. Here, households in the 18-29 age range experience the biggest losses for 1st decile households. For households in the 30-49 age range, households in the top 4 deciles experience gains. This age group tends to hold more debt, especially in the form of mortgages, and thus gains when the value of their liabilities decreases with inflation. In contrast, almost all households in the 50-95 range



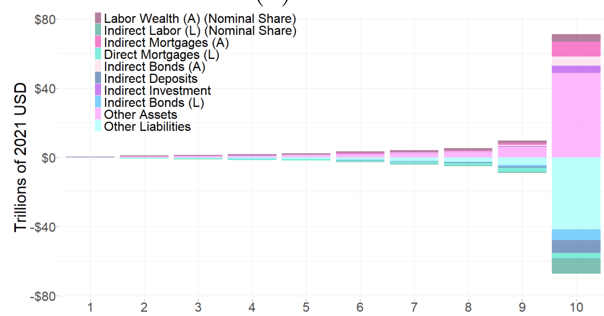
(a) 18-29



(b) 30-49

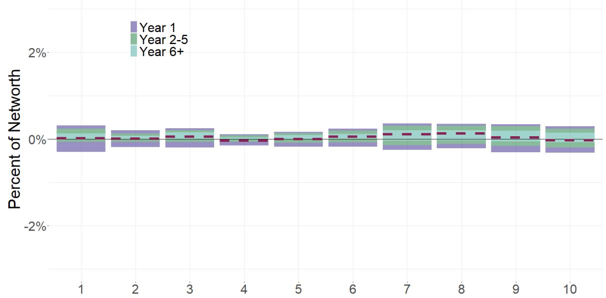


(c) 50-95

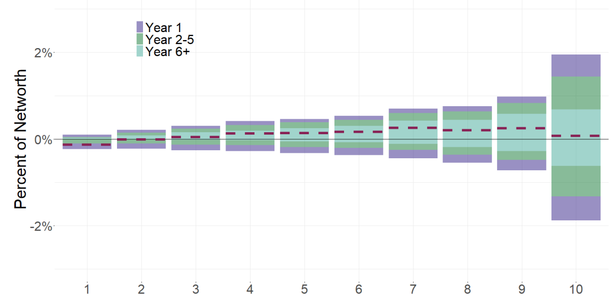


(d) Full Sample

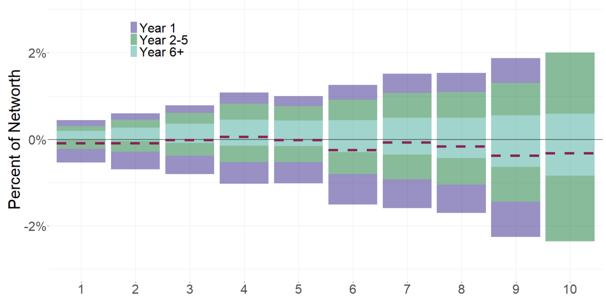
Figure A.10: Decomposition of Top Nominal Holdings by Age Group



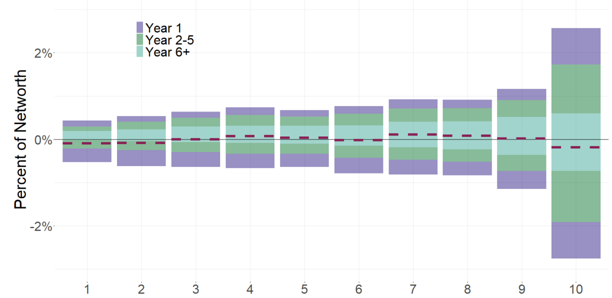
(a) 18-29



(b) 30-49

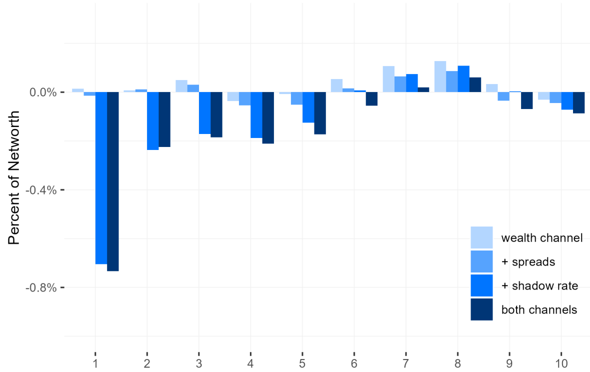


(c) 50-95

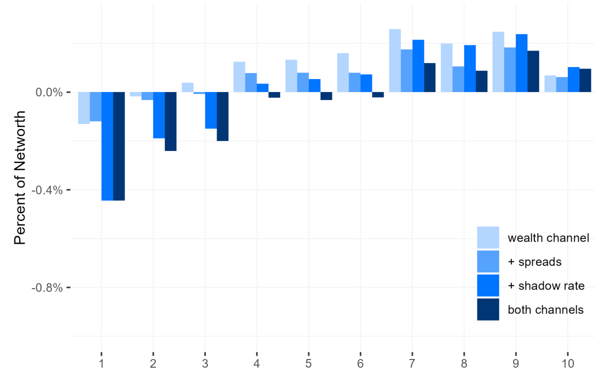


(d) Full Sample

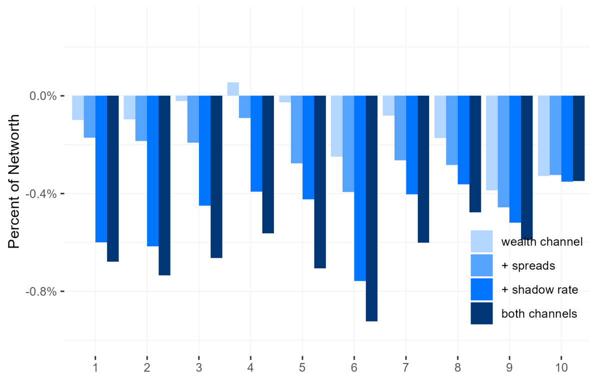
Figure A.11: Redistribution due to nominal exposure by age group



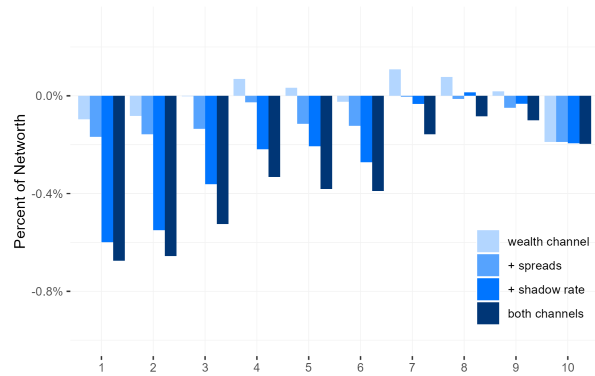
(a) 18-29



(b) 30-49



(c) 50-95



(d) Full Sample

Figure A.12: Effects of Different Channels as Percentage of Networth by Age Group

lose, regardless of decile, with 6th decile households seeing the largest lossess overall. These households are more likely to have paid off mortgages and accumulated assets, which now decline in value due to inflation.

A.6 Robustness

Our results depend on a variety of parameters and assumptions shown in Table A.7, particularly two parameters. The first is the adjustment to FoF or SCF, which describes whether we choose to adjust all dollar amounts to match the totals found in either dataset. In our main results, we chose to adjust to the FoF, but here we show how the results change if we instead adjust to match SCF totals. The second important parameter is the share of first-year labor income which is nominal. In our main results, we assume this to be 0.7 in the first year, 0.4 in the second and 0.1 in the third, with all income real after the 3rd year. Here, we show how varying the first-year share of nominal labor to be 0.9, 0.7 or 0.5 effects the results. Three other parameters have a smaller effect on results.

The first of these is the persistence of illiquidity. In the main results, we assume households that are liquidity-constrained have a probability of 0.9 of remaining so in future years. We calculate the persistence parameter by estimating MPCs for individuals in Facteus in response to two rounds of Covid-19 stimulus checks, the first in April, 2020, and the second in March, 2021. For each round, we estimate an individual's MPC by regression their change in consumption surrounding the receipt of the stimulus check on (as a fraction of the stimulus amount) on separate splines for age and income, allowing for knots at ages 20, 30, 40, 50, 60, and 70; and for knots at income values of $5,000, $10,000, $30,000, $50,000, and $70,000 annually, We then regress the estimated MPC value from round 1 and round 2 on one other, finding a raw correlation of 0.95 (and a rank-rank correlation of 0.94). These are high levels of persistence, and they may overstate the persistence of illiquidity because we do not account for individual-level changes in economic circumstances. To account for this, we show how our main results change if we instead use a persistence of 0.99, 0.95, 0.9, 0.8, or 0.6.

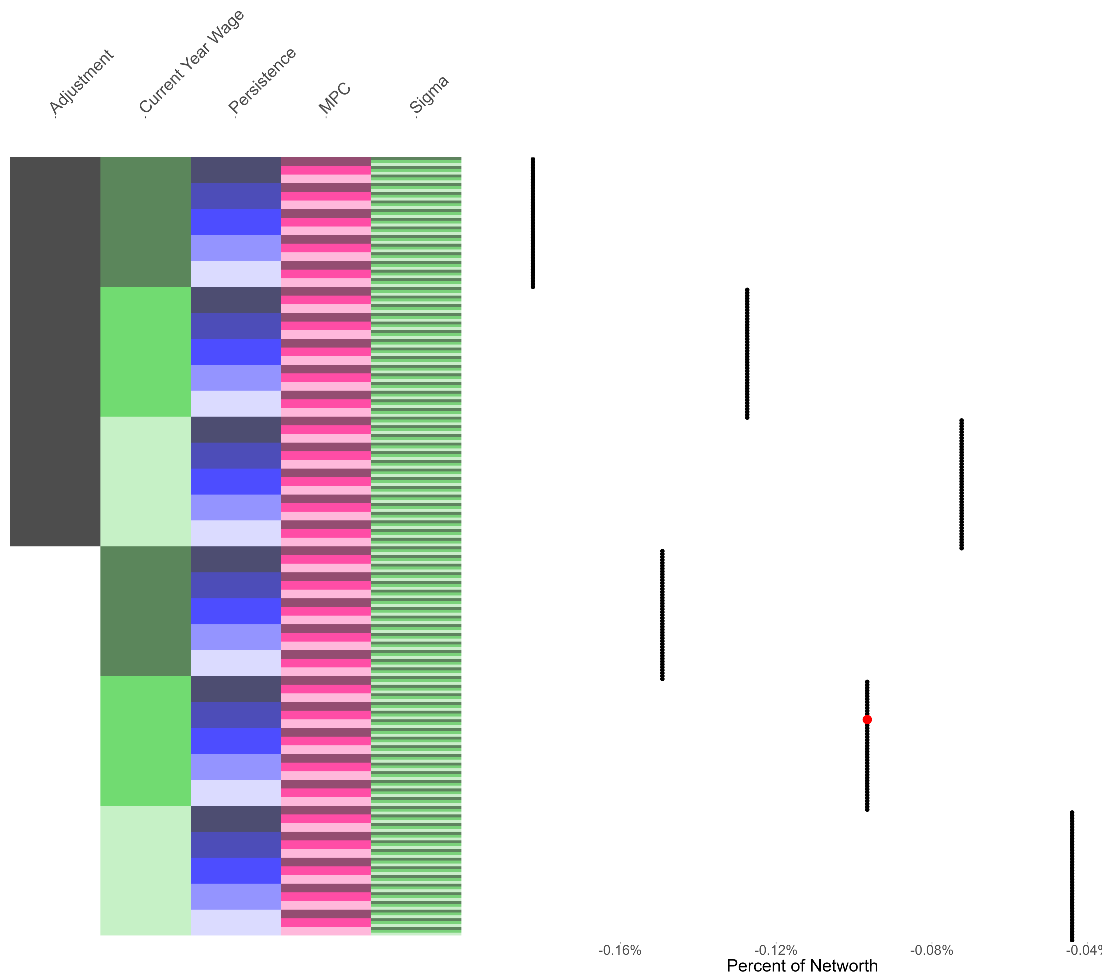
The second parameter is the marginal propensity to consume. We calculate these from the Facteus data and take them as calculated. Here, we test how the results are impacted by multiplying the mpcs by 1.5, 1.0 or 0.5. Finally, a sigma parameter of 2 is used to calculate the shadow rates. Here, we show how sigma values of 3, 2 or 1 impact the results.

Table A.7: Parameter Values in Robustness Checks

Parameters	Values
Adjustment	SCF, FoF
Year 1 Nominal Labor Income Share	0.9, 0.7, 0.5
Persistence	0.99, 0.95, 0.9, 0.8, 0.6
MPC	1.5, 1.0, 0.5
Sigma	3, 2, 1

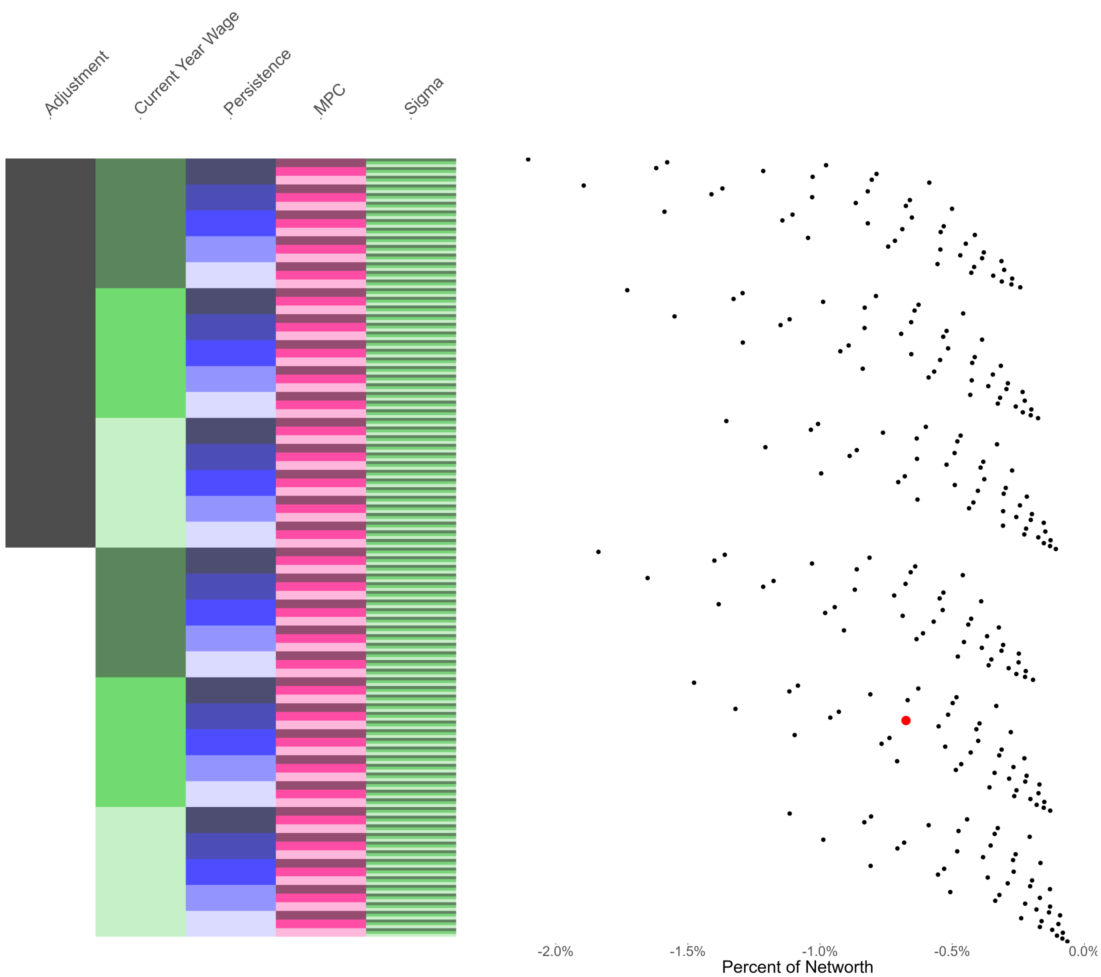
Note: Values in red are those used in the main results

Figure A.13 through A.20 shows the effects of the unexpected inflation shock for different channels and different wealth deciles when varying the parameters. 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 represent results adjusted the SCF total, while white represent adjustments to the FoF total. In the second column, dark green represents a first year nominal labor share of 0.9, medium green 0.7, and light green 0.5. Thus, 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. For Figure A.13, since the wealth channel does not depend on persistence, mpc or sigma, we see only 6 unique values on the x axis. As we can see, adjusting to the FoF yields more positive effects. Similarly, lower nominal shares of first year labor also yield more positive results.



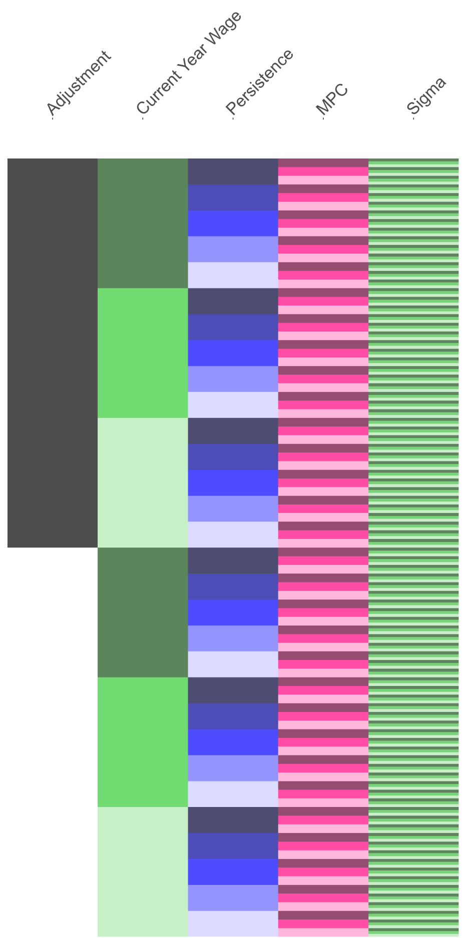
(a) Legend (b) Wealth Channel

Figure A.13: Robustness: Welfare effects in percent of net worth for 1st decile. For (a), for Adjustment, black values represent SCF and white values represent FoF. For other parameters, dark to light values are: Current Year Wage: 0.9, 0.7, 0.5. Persistence: 0.99, 0.95, 0.9, 0.8, 0.6. MPC: 1.5, 1.0, 0.5. Sigma: 3, 2, 1. For (b), each point represents a parameter combination. The red point highlights the specification in the main results.

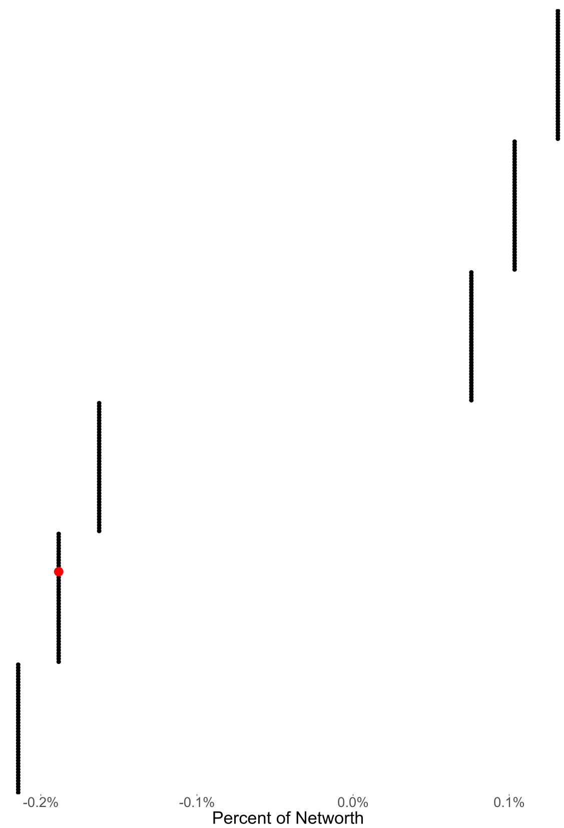


(a) Legend (b) Wealth + Liquidity Channel

Figure A.14: Robustness: Welfare effects in percent of net worth for 1st decile. For (a), for Adjustment, black values represent SCF and white values represent FoF. For other parameters, dark to light values are: Current Year Wage: 0.9, 0.7, 0.5. Persistence: 0.99, 0.95, 0.9, 0.8, 0.6. MPC: 1.5, 1.0, 0.5. Sigma: 3, 2, 1. For (b), each point represents a parameter combination. The red point highlights the specification in the main results.

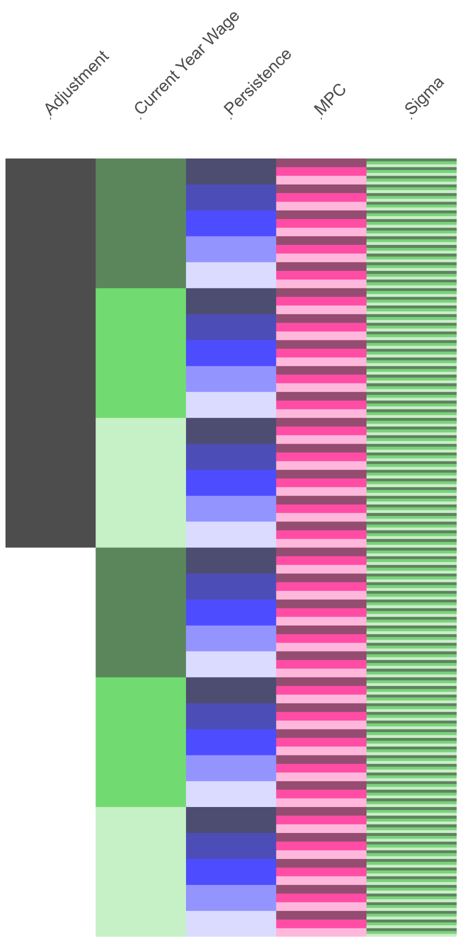


(a) Legend

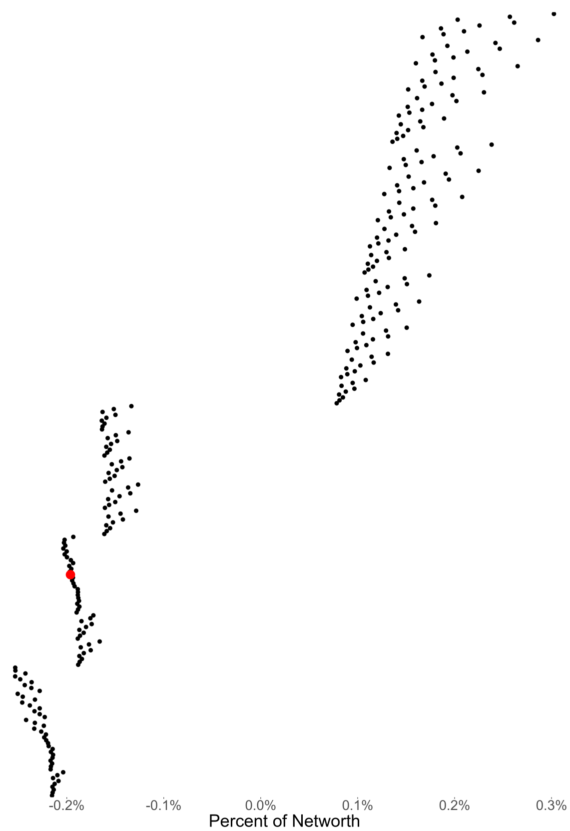


(b) Wealth Channel

Figure A.15: Robustness: Welfare effects in percent of net worth for 10th decile. For (a), for Adjustment, black values represent SCF and white values represent FoF. For other parameters, dark to light values are: Current Year Wage: 0.9, 0.7, 0.5. Persistence: 0.99, 0.95, 0.9, 0.8, 0.6. MPC: 1.5, 1.0, 0.5. Sigma: 3, 2, 1. For (b), each point represents a parameter combination. The red point highlights the specification in the main results.

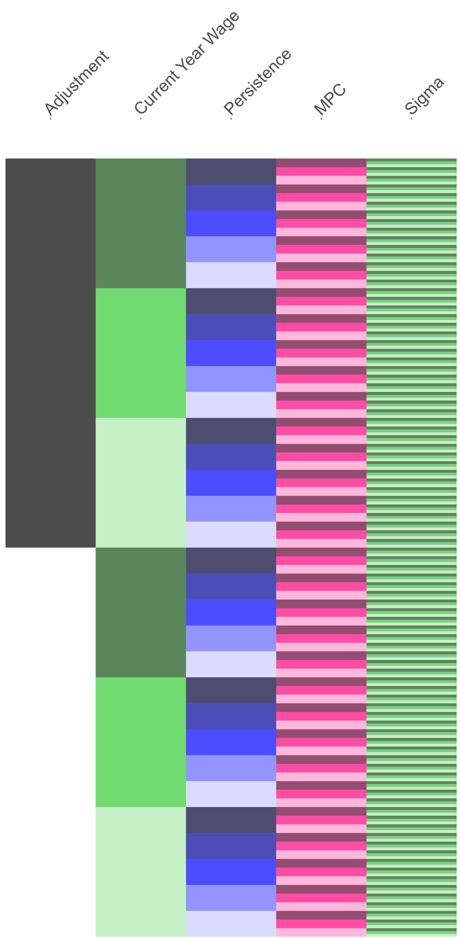


(a) Legend

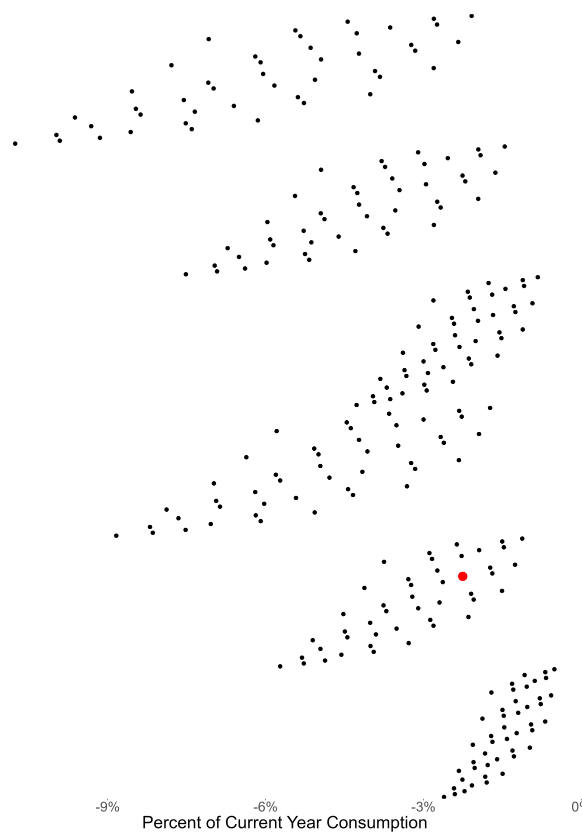


(b) Wealth + Liquidity Channel

Figure A.16: Robustness: Welfare effects in percent of net worth for 10th decile. For (a), for Adjustment, black values represent SCF and white values represent FoF. For other parameters, dark to light values are: Current Year Wage: 0.9, 0.7, 0.5. Persistence: 0.99, 0.95, 0.9, 0.8, 0.6. MPC: 1.5, 1.0, 0.5. Sigma: 3, 2, 1. For (b), each point represents a parameter combination. The red point highlights the specification in the main results.

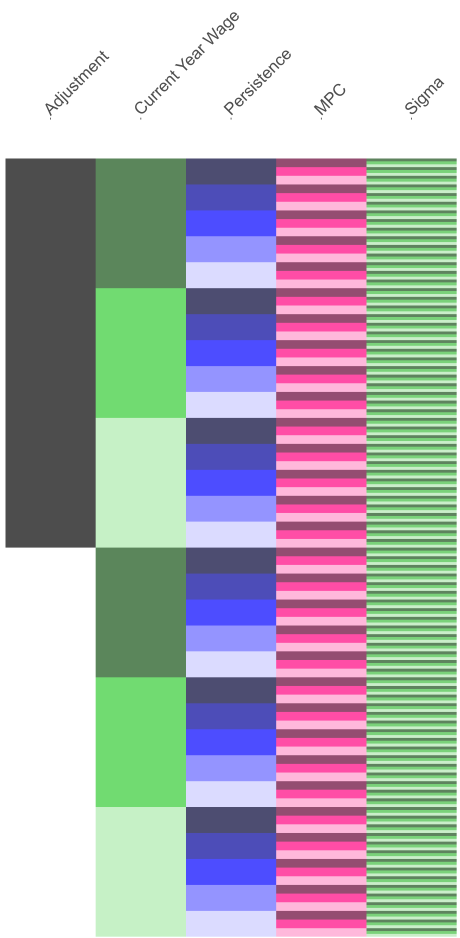


(a) Legend

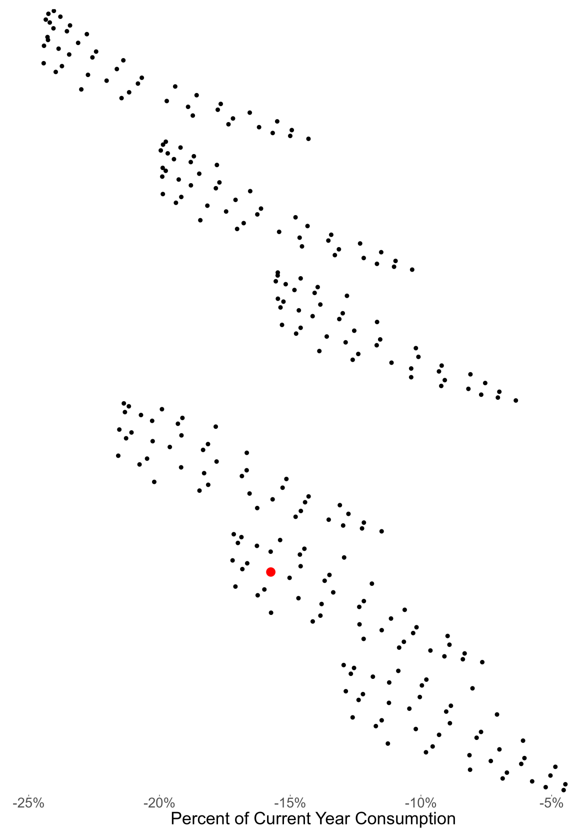


(b) Wealth Channel

Figure A.17: Robustness: Welfare effects in percent of current year consumption for 1st Decile. For (a), for Adjustment, black values represent SCF and white values represent FoF. For other parameters, dark to light values are: Current Year Wage: 0.9, 0.7, 0.5. Persistence: 0.99, 0.95, 0.9, 0.8, 0.6. MPC: 1.5, 1.0, 0.5. Sigma: 3, 2, 1. For (b), each point represents a parameter combination. The red point highlights the specification in the main results.

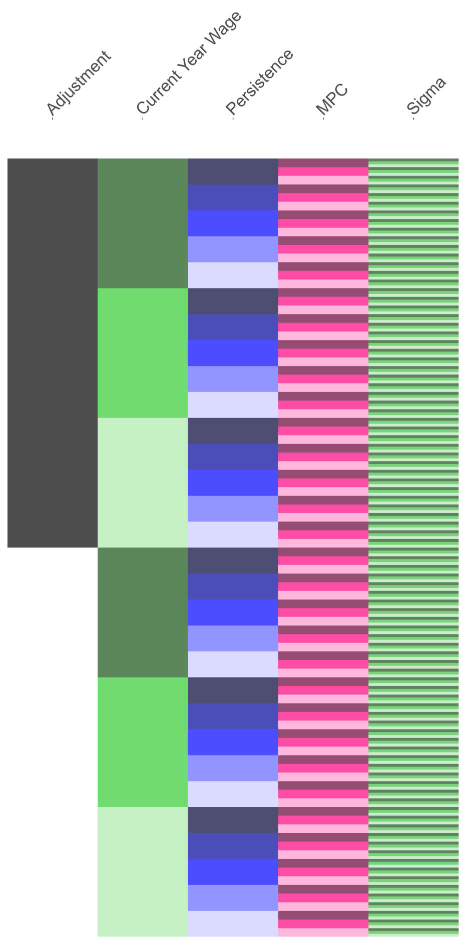


(a) Legend



(b) Wealth + Liquidity Channel

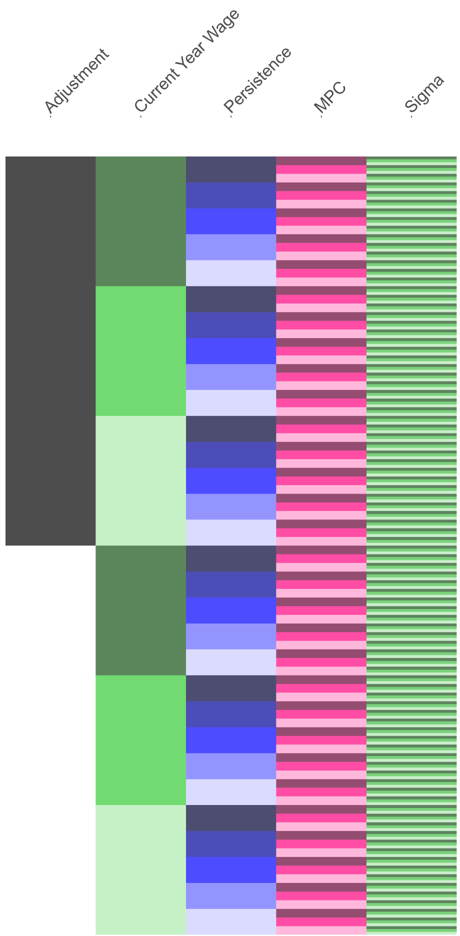
Figure A.18: Robustness: Welfare effects in percent of current year consumption for 1st Decile. For (a), for Adjustment, black values represent SCF and white values represent FoF. For other parameters, dark to light values are: Current Year Wage: 0.9, 0.7, 0.5. Persistence: 0.99, 0.95, 0.9, 0.8, 0.6. MPC: 1.5, 1.0, 0.5. Sigma: 3, 2, 1. For (b), each point represents a parameter combination. The red point highlights the specification in the main results.



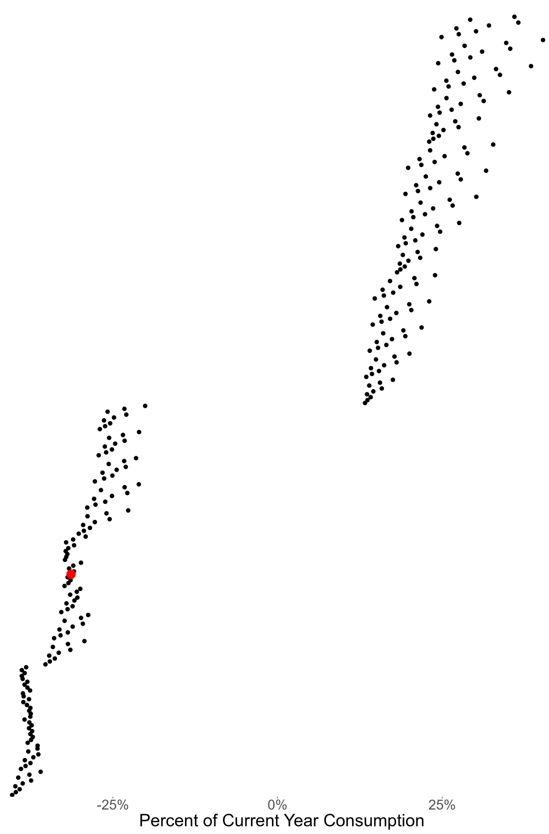
(a) Legend

(b) Wealth Channel

Figure A.19: Robustness: Welfare effects in percent of current year consumption for 10th decile. For (a), for Adjustment, black values represent SCF and white values represent FoF. For other parameters, dark to light values are: Current Year Wage: 0.9, 0.7, 0.5. Persistence: 0.99, 0.95, 0.9, 0.8, 0.6. MPC: 1.5, 1.0, 0.5. Sigma: 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 A.20: Robustness: Welfare effects in percent of current year consumption for 10th decile. For (a), for Adjustment, black values represent SCF and white values represent FoF. For other parameters, dark to light values are: Current Year Wage: 0.9, 0.7, 0.5. Persistence: 0.99, 0.95, 0.9, 0.8, 0.6. MPC: 1.5, 1.0, 0.5. Sigma: 3, 2, 1. For (b), each point represents a parameter combination. The red point highlights the specification in the main results.