The Fisher Channel According to HANK: Unexpected Inflation and the Missing Recession*

Filippo Pallotti†

30th November, 2024
WORK IN PROGRESS
Link to the latest version

Abstract

I show that the wealth redistribution from savers to borrowers, triggered by the recent inflationary episode, has been one of the reasons for the remarkable strength of the U.S. economy after the pandemic. Unexpected inflation reduced the real value of households' debts. Using a Heterogeneous Agent New Keynesian (HANK) model calibrated to match to match the empirical distribution of nominal exposures and their covariance with marginal propensities to consume (MPCs), I find that this wealth transfer increased aggregate consumption and contributed to inflation persistence. I support these findings with empirical evidence from billions of household-level transactions obtained from a U.S. fintech company, as well as county-level data on consumption and nominal debt. Finally, I demonstrate that the Fisher channel significantly amplifies the effectiveness of monetary policy in HANK and revisit the "paradox of flexibility," highlighting how wealth redistribution from unexpected inflation influences the interaction between nominal rigidity and monetary policy transmission.

Keywords: Inflation, Redistribution, Household Heterogeneity, Net Nominal Positions, Consumption, HANK, Monetary Policy, Alternative Data, Fintech.

JEL Codes: D12, D14, D31, E21, E52, E58

*This draft: 30th November, 2024. First version: December 2023.

†University College London and Lombard Odier, filippo.pallotti@ucl.ac.uk and f.pallotti@lombardodier.com. The views expressed in this paper are my own and do not necessarily reflects those of my employers.

I am deeply thankful to Morten Ravn and Adrien Auclert for invaluable guidance and support throughout this project. I am also extremely grateful to Oreste Tristani, Gianluca Violante, Samy Chaar, Stephen Hansen, Lukasz Rachel, Marcel Peruffo, Ralph Luetticke, Albert Marcet, seminar participants at the Paris School of Economics, Bank of England, Queen Mary University of London, EEA Congress in Rotterdam, the UCL Macro Group and the ECB Task Force on Heterogeneity in Macroeconomics. Financial support from the Stone Centre at UCL is gratefully acknowledged.

1 Introduction

Over the course of 2022, as the Federal Reserve began raising rates aggressively, a recession in the US started to become widely anticipated by many economists in the financial sector, in central banks, as well as in academia.[1] During the press conference following the last FOMC meeting in 2023, Fed Chair Jay Powell reflected on these predictions.[2] Contrary to these forecasts, not only was a recession averted, but the US also witnessed robust economic growth, with real personal consumption expenditures rising by 3.3% in 2023 and showing resilient readings in the first half of 2024.

In this paper, I propose that the wealth transfer from nominal creditors to debtors induced by unexpected inflation in the US has moderately increased aggregate demand post-pandemic. This concept goes back to Fisher (1933), hence the name of the channel: unexpected inflation reduces the real value of nominal claims. If debtors possess a higher marginal propensity to consume (MPC) than creditors (Tobin (1982)), such a shift would increase aggregate demand. The seminal work by Auclert (2019) integrated this insight into an Heterogeneous Agents New Keynesian (HANK) model, in the context of the broader distributional impacts of monetary policy. In the following, I build a HANK model specifically designed to shed further light on the Fisher channel, and apply it to the context of the latest inflationary shock in the US.

In a companion paper (Pallotti (2022)), I showed that US households have accumulated substantial nominal assets and liabilities in the past four decades. As uncovered first by Doepke and Schneider (2006), these nominal assets and liabilities are concentrated within very different household groups. Wealthier, middle-aged, and elderly households hold most of nominal assets, like bonds and deposits, whereas nominal liabilities are typically held by the young middle-class, especially through fixed-rate mortgages.[3] The former group stand to lose from unexpected inflation, while the latter stand to gain.

[1]For example, a Bloomberg article predicted a 100% likelihood of a recession in 2023 (link). A survey of academics of the Initiative on Global Markets and showed that as of June 2022, 70% of respondents believed a recession would start before the end of 2023, with an additional 10% before the 2024Q2 Link.

[2]"So I think forecasters generally, if you go back a year, were very broadly forecasting a recession for this year (...) that includes Fed forecasters and really essentially all forecasters (...) ."

[3]In the US, unlike in other countries like the UK or Spain, more than 90% of outstanding mortgages in 2021 were fixed rate for the whole duration of the loan.

In this paper I construct a HANK model, deviating from its canonical form to accurately match some moments of the empirical distribution of net nominal positions (NNP) across households.[4] Crucially, my model also matches perfectly the empirical covariance between the NNP and MPC - a sufficient statistic in Auclert (2019) within a broad class of environments, which a baseline HANK model has trouble capturing.

I use my model to study the propagation to the broader economy of the wealth redistribution generated by the "inflation shock" which started in 2021. According to the model, this redistribution of wealth from low to high MPC households raised aggregate consumption by around 0.5 percentage point in the first year following the shock. Similarly, thorough a standard New Keynesian Phillips Curve, inflation increased endogenously by around 0.3 percentage points on impact. In other words, in a HANK model that matches some key moments for the Fisher channel, unexpected inflation tends to "feed-on-itself", despite monetary policy following a standard Taylor rule.

Empirical evidence seem to support the consumption implications of the model. I leverage big data from a fintech company in the US covering all the flows in and out of the bank accounts of more than 4 millions US households, amounting to almost 2 billions of transactions in the period of interest (from the start of the inflation episode in March 2021 to September 2023, where my data currently stop). I show these data are well representative of the US population, with some official statistics tracked to virtual perfection. During this inflationary period, I find that mortgagors have grown their consumption by 2% more than the rest of the US population, with extremely tight confidence intervals, in line with the predictions of the model.

As complementary evidence using publicly available data, I perform a cross-county regression a la Mian et al. (2013). In particular, I leverage high-frequency data on spending at the county level from Chetty et al. (2020), as well as county-level data on nominal assets and liabilities from the New York Fed and the IRS Statistics of Income. Once again, I find that the counties with a more negative net nominal position, and especially those with more nominal debt, have been the ones where consumption expenditures grew relatively more in the two years following the onset of the inflation shock - although results are not

[4]NNP is defined as the market value of nominal assets less the one of nominal liabilities.

statistically significant.

I close the paper moving beyond the current inflationary episode and looking at the monetary policy implications of the Fisher channel in my HANK model. I uncover two main results: First, the presence of an active Fisher channel significantly amplifies the effectiveness of monetary policy. Specifically, it makes a persistent monetary policy shock almost 50% more powerful in influencing aggregate consumption on impact, due to the redistributive effects of unexpected inflation which move wealth from wealthier households to indebted ones with higher marginal propensities to consume. Second, the degree of nominal rigidities interacts with the Fisher channel in a way that can lead to a 'paradox of flexibility'. In standard models, greater nominal rigidity enhances the impact of monetary policy, through a higher impact on real interest rates. However, the Fisher channel introduces an opposing effect: with less nominal rigidity, unexpected inflation responds more strongly to monetary policy shocks, leading to greater wealth redistribution toward (or from) indebted households with high marginal propensities to consume. In calibrations of the Fisher channel that match key empirical moments - as in my model - the first effect on the real rate quantitatively dominates, therefore conventional wisdom still holds; greater nominal rigidity does enhance the effectiveness of monetary policy. However, the Fisher channel plays a quantitatively significant role in reducing the differences in monetary policy impacts across varying levels of nominal rigidity, effectively mitigating the expected differences. At the zero lower bound (ZLB), in response to a demand shock both channels work in the same direction, and 'paradox of flexibility' by Eggertsson and Krugman (2012) is greatly enhanced.

My model builds on the standard HANK framework whereby households are subject to idiosyncratic risk. In my baseline specification, they save and borrow in one account which is made of long-term nominal claims, matching the average duration of nominal positions in the economy. I follow an emerging convention in the HANK literature adopting a sticky-wages flexible prices specification, as in Auclert et al. (2024). This implies that the real wage simply follows productivity and allows me to abstract away from the effect of inflation on the distribution between labor and capital income Lorenzoni and Werning (2023) - focusing only on the redistribution of nominal wealth. As I show in the paper, this modeling choice is also broadly consistent with the US experience, where nominal wages have been largely following the increase in the price level during the inflationary episode, unlike in other countries.[5]

Of course, inflation is an endogenous variable in the model. Many different structural shocks have been deemed responsible for the surge in the price level after the pandemic, both from the supply and demand side (Bernanke and Blanchard (2023), Dao et al. (2024), Giannone and Primiceri (2024)). Since my focus is on how the wealth redistribution caused by unexpected inflation affects aggregate demand, I do not model the exact combination of these primitive shocks. Instead, I directly simulate a shock to the unit of account that mirrors the unexpected surge in the price level over 2021 and 2022. This approach effectively shocks the wealth distribution by reducing the real value of nominal wealth holdings, redistributing resources from asset-rich households to indebted ones. By examining the impulse response functions of consumption and inflation to this wealth redistribution shock, I isolate and analyze the propagation of unexpected inflation to aggregate consumption - relative to a counterfactual where households hold only real assets and no wealth redistribution occurs. This method allows me to concentrate on the redistributive effects of inflation due to nominal assets and liabilities, without taking a stance on the specific structural shocks that generated the inflation surge.

Motivated by recent work by Schnorpfeil et al. (2023), which shows households may not be fully aware of the devaluation of their nominal debt implied by the Fisher channel, I also extend the benchmark version of my HANK model to include a form of cognitive discounting on the gains or losses on households' long-term nominal claims, such as fixed-rate mortgages. This behaviourial friction implies a smaller response of aggregate consumption on impact, but a more persistent tailwind going forward.

Literature Review This paper builds on some of the very first Heterogeneous Agent New Keynesian (HANK) models that included nominal assets, such as Auclert (2019) and Luetticke (2021). Compared to these studies, I match the empirical distribution of net

[5] In some cases nominal wage growth has also exceeded the rise in the price level, especially for the lowest income brackets, as documented also by e.g. Autor et al. (2023).

nominal positions (NNPs) and their covariance with the marginal propensity to consume (MPC), enhancing the realism of the impulse response functions (IRFs). Most of the subsequent HANK literature features one-period real assets or is formulated in continuous time, where inflation plays no role, following Kaplan et al. (2018). Recent exceptions include Yang (2022), Kaplan et al. (2023), and Angeletos et al. (2024), which incorporate the redistributive effects of unexpected inflation among households. Relative to these papers, I provide a quantitative model of the Fisher channel disciplined by empirical evidence on NNP distribution and their covariance of MPC, as well as test its predictions for consumption in the data. To this end, I build on the literature that utilizes alternative data from fintech companies to study consumption patterns, as in e.g. Diamond and Moretti (2021) and Buda et al. (2023), demonstrating their usefulness to inform macro models and monetary policy.

Structure of the paper Section 2 describes the HANK model. Section 3 studies the propagation of the wealth distribution to aggregate consumption and inflation in the model. Section 4 evaluates the strength of the Fisher channel in this particular inflation episode, using household level data from a fintech and county-level data from Chetty et al. (2020). Section 5 analyzes the broader implications for the Fisher Channel regarding monetary policy within the model. Section 6 concludes.

2 The Model

Households face idiosyncratic risk and are constrained in their borrowing capacity, deriving utility from consumption and leisure. They save and borrow into a long-term nominal assets modeled as in Hatchondo and Martinez (2009): at price Q_t, the asset provides a stream of nominal payments $1, \delta, \delta^2, \ldots$. Setting δ to 0 (as in section A.4.3) recovers the usual case of a one-period bond.

The household's problem is given by:

$$
\begin{aligned}
&\max_{\{c_{it}\}_{t=0}^{\infty}} \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t \left(u(c_{it}) - v(N_t) \right) \right] \\
&\text{subject to} \quad P_t c_{it} + Q_t \Lambda_{it} = (1+\delta) Q_t \Lambda_{i,t-1} + z_{it}, \quad \forall t \qquad (1) \\
&\qquad\qquad\quad Q_t \Lambda_t \geqslant \underline{a} P_t, \quad \forall t \qquad (2)
\end{aligned}
$$

where c_t is consumption, Λ_t is the amount of nominal claims and Q_t their price. Net labor income $z_{i,t}$ is given by:

$$
z_{i,t} = \tau_t (W_t e_{i,t} N_t)^{1-\theta} \qquad (3)
$$

Where τ_t is the intercept of the retention function, W_t is the nominal wage, $e_{i,t}$ is household-level productivity and θ is the progressivity parameter. As shown by Heathcote et al. (2017), this rule can approximate particularly well the existing tax structure in the US. Following an emerging convention in the HANK literature, hours worked N_t are chosen by unions and taken by the household as given, as described below.

The borrowing limit $\underline{a}$ in equation 2 is defined in real terms, so that unexpected inflation effectively relaxes the borrowing constraint. This as a natural starting point, as any more elaborate borrowing constrained defined e.g. in terms of debt-to-income ratio (as in e.g. Paz-Pardo (2021)), or collateral value (as in e.g. Iacoviello (2005)) will also relax when nominal incomes and/or house prices approximately follow the price level (see section A.2 for a discussion in the context of the latest inflationary episode in the US). Moreover, in my calibration discussed below I will have virtually no households at the borrowing constraint.

Given the expected path of nominal interest rate i_t, the price of the long-term bond Q_t is pinned down by a no-arbitrage condition:

$$
Q_t = \frac{1 + \delta \mathbb{E}_t[Q_{t+1}]}{(1+i_t)}
$$

The ex-post real interest rate r_t faced by households is then simply given by the Fisher equation $r_t = \frac{(1+i_{t-1})}{(1+\pi_t)} = \frac{(1+\delta Q_t)}{Q_{t-1}} \frac{1}{1+\pi_t}$. Finally, the utility function belongs to the constant elasticity of substitution (CES) family with intertemporal elasticity σ, i.e. $u(c) = \frac{c^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}$, while the disutility function from work has a Frisch elasticity of labor supply ϕ, i.e. $v(N) = N^{1+\frac{1}{\phi}}$.

Supply On the supply side, I follow an emerging convention in the HANK literature by adopting sticky wages and flexible prices. As emphasized by Auclert et al. (2023) and Broer et al. (2020), this combination of sticky wages and flexible prices avoids countercyclical profits and large income effects on labor supply, which are both in contrast with empirical evidence. Specifically, there is a representative firm that produces output with a technology which is linear in labor N_t and productivity A_t

$$Y_t = A_t N_t$$

Solving the firm problem yields $\frac{W_t}{P_t} = A_t$, i.e. the real wage follows productivity, which is constant in the rest of the paper (a productivity shock is analyzed separately in section A.5.3).[6] A constant real wage and no profits are conceptually appealing for my purpose as they allow the model to abstract away from any redistributional effect of inflation stemming from differential impacts on profits versus labor income (see, e.g. Lorenzoni and Werning (2023)). As discussed in section A.2, the real wage has indeed remained approximately constant in the US during the inflation shock, and it actually increased for the bottom half of the distribution (Autor et al. (2023)). Section A.4.5 extends the baseline model featuring both sticky wages and sticky prices.

Sticky wages Wages are set by unions subject to a quadratic costs a la Rotemberg (1982). Appendix A.1 describes the union problem following Auclert et al. (2018), which extends to the heterogeneous agent setting the standard microfoundation of sticky wages from Erceg et al. (2000), showing that it leads in equilibrium to the New Keynesian Wage Phillips Curve for wage inflation π_t^w:

[6] The firm problem here is simply given by $\max_{N_t} P_t A_t N_t - W_t N_t$. Wage inflation and price inflation are thus the same at all times: as way to see it, $\frac{W_t(1+\pi_t^w)}{P_t(1+\pi_t)} = A_t(1+g_{At})$, take logs and obtain $\pi_t^w - \pi_t = g_{At} = 0$.

$$\pi_t^w(1+\pi_t^w) = \kappa^w\left(\mu^w \frac{\gamma N_t^{1/\phi}}{(C_t^*)^{-\sigma}(1-\theta)(Y_t-T_t)/N_t} - 1\right) + \beta\pi_{t+1}^w(1+\pi_{t+1}^w) \tag{4}$$

Where κ^w denotes its slope and is a function of the elasticity of substitution across different union tasks and the costs of adjusting wages, as documented in section A.1, μ^w is the mark-up applied by unions, $T_t = w_t N_t - \int z_{it} di$ are total taxes collected by the government, and C_t^* is a virtual consumption aggregator that captures the aggregate wealth effect on labor supply, defined as:

$$C_t^* = \left(\int \frac{e_{it}^{1-\theta}}{\int e_{it}^{1-\theta} di} c_{it}^{-\sigma} di\right)^{-\frac{1}{\sigma}}$$

Monetary Policy The monetary authority follows a standard Taylor rule for setting the nominal interest rate i_t:

$$i_t = r^* + \phi \mathbb{E}\pi_t + \epsilon_t \tag{5}$$

Where r^* is the natural interest rate, ϕ is the coefficient on inflation, and ϵ_t a monetary policy shock.

Government The government issues long-term nominal debt B_t held by the household sector, which also earns an ex-post return r_t defined above. In the benchmark version of the model, I assume that government adjust government spending G_t in response to shocks that move its debt level away from the steady state, with a coefficient γ_G, in order to satisfy the standard government budget constraint, $T_t + B_{t+1} = G_t + (1+r_t)B_t$:

$$G_t = G_{ss} - \gamma_G(B_t - B_{ss}) \tag{6}$$

With γ_G=1 in equation 6, we have balance budget, while for $r < \gamma_G < 1$ debt gradually converges back to its steady state. Appendix A.4.4 treats the case of adjusting taxes rather than government spending as in 6 to satisfy the government budget constraint.

Equilibrium Given initial values for government debt B_{t-1}, nominal wage W_{t-1}, price level P_{t-1}, a distribution of households over skills e and assets Λ such that the economy starts from its steady state, a general equilibrium is a path for prices $\{P_t,\ W_t,\ \pi_t,\ \pi_t^w,\ r_t,\ i_t\}$ and aggregates $\{Y_t,\ N_t,\ C_t,\ B_t,\ G_t,\ T_t\}$ such that households optimize, unions optimize, the representative firm optimizes, monetary policy follows the Taylor rule 5, the government satisties its budget constraint and 6, and markets clear:

$$Y_t = \int c_{it} di + G_t \tag{7}$$

$$B_t = \int \Lambda_{it} di \tag{8}$$

2.1 Calibration

I calibrate the model at a yearly frequency, following conventions in the literature for most of the parameters. The main deviation consist in relaxing the borrowing constraint to account for mortgage debt. Table 1 reports all the values, while appendix A.4 explores alternative calibrations.

Households Both the intertemporal elasticity of substitution σ and the Frisch elasticity of labor supply θ have values well within the ranges of empirical estimates at 0.5 (see also Auclert et al. (2021)). The income process faced by households is also standard and follows an AR(1) process with persistence ρ_e of 0.91 and a standard deviation of the earnings σ_e at 0.92, as in e.g. Auclert and Rognlie (2018). I discretize this process using Rouwenhorst method on a grid of 11 points for e_{it}.

In order to match the empirical distribution of net nominal positions, I set the borrowing limit $\underline{a}$ to 1, which is the average yearly income in the economy. This is a deviation from the literature, as $\underline{a}$ is typically calibrated to zero or to the average quarterly income (see e.g. Kaplan et al. (2018)). The standard calibration is motivated by a focus of HANK models on consumer credit: here, my emphasis in on matching the empirical distribution of NNP, which include also mortgages. The real return is 5% per year as in Auclert and Rognlie (2018). While high, this allows me to match the distribution of the NNP better as well as hit perfectly the covariance between MPC and NNP, having virtually no households clustered at the borrowing limit. The discount factor β clears the asset market at 0.85. Finally, the bond decay parameter δ is set at 0.8 to match the average duration of nominal positions at the end of 2020, which was approximately 4.5 years (Pallotti (2022)).

Supply I set wage markup to 1.1 and the coefficient for wage rigidity to 0.05 following standard values in the literature based on Grigsby et al. (2021).

Policy The coefficient for tax progressivity is 0.18, as in Heathcote et al. (2017). Government spending represents 20% of GDP. The level of government debt in the steady state is also at 20% of GDP, as it acts as a counterpart to the aggregate Net Nominal Position of the household sector, which was 20% of GDP at the start of the inflation episode (as in Pallotti (2022)). As my focus here is on the redistribution within the household sector, I prefer to capture the distribution of NNP across households and their aggregate position well, rather the actual NNP of the government. Appendix A.4 provides the alternative calibration with a higher value of government debt.[7] The responsiveness of government spending to deviation of its debt level from the steady state γ_G is set conservatively at 0.1, implying a small but quite persistent response. The coefficient on expected inflation in the Taylor rule is set to 1.25.

Solution method I use 500 points on a grid for assets, solving the household problem through the endogenous grid method. The model is solved using the Sequence Space Jacobian method from Auclert et al. (2021).

[7] As shown in Pallotti (2022), the rest of the world plays a significant role in financing the large NNP of the government in the US. As the model is a closed economy, I currently abstract from the redistribution from the rest of the world to the US from unexpected inflation.

Table 1: Calibration parameters for the model.

Parameter	Description	Value	Parameter	Description	Value
σ	IES	0.5	κ_w	Slope of wage Phillips curve	0.05
v	Frisch	0.5	μ_w	Wage markup	1.1
$\underline{a}$	Borrowing constraint	-1	ϕ	Taylor Rule coefficient	1.25
θ	Tax progressivity	0.18	B	B/Y	0.2
ρ_e	Autocorrelation of earnings	0.91	G	Government spending	0.2
σ_e	Std of log earnings	0.92	γ_G	G response	0.1
β	Discount Factor	0.85	$r*$	Eq. real rate	0.05
δ	Bond decay	0.80	π_{ss}	Steady-state inflation	0

2.1.1 Results

Table 2 reports percentiles of the distribution of the net nominal position over labor market income in the model against the ones from the 2019 Survey of Consumer Finances (SCF), following the methodology in Pallotti (2022) in order to compute both the direct and indirect nominal positions in the SCF.[8] Overall, the matching is quite accurate. Both distributions switch from negative to positive NNP between the 50th and the 75th percentiles, and have similar value in the left tail as well as to some extent in the right tail, despite the well known difficulty for the one-account HANK model to capture the very wealthy (e.g. Castaneda et al. (2003)). [9]

Most importantly, the model is able to perfectly match the empirical covariance between NNP and MPC at -0.072, which is the most precise estimate among the ones in Auclert (2019). As shown in Auclert (2019), within a very general class of models, this covariance is a sufficient statistics to predict the impact on aggregate consumption of a wealth redistribution stemming from a transitory shock to the price level.

Matching well the distribution of NNP as well as the covariance between NNP and MPC comes at the cost of having virtually no people at the borrowing constraint, and thus a lower average MPC in the model, which is 21% per year - in the low range of the

[8]As in Doepke and Schneider (2006), besides nominal positions that are directly held in household portfolios or that sits in investments intermediaries such as mutual funds, I also take into account indirect nominal positions arising from the households' ownership of equity in firms that have nominal assets or liabilities on their balance sheets (typically, the former).

[9]This relatively good performance in the right tail is driven by the fact that the NNP distribution is not as skewed as the one for overall wealth, which includes also housing, stocks and other real assets.

Table 2: Net nominal positions in the data and in the model

NNP Quantiles			Consumption CDF
Pct	Data	Model	Model
0.01	-6.8	-7.2	0.0%
0.05	-3.6	-4.8	0.8%
0.1	-2.5	-3.5	2.3%
0.25	-1.1	-2.3	8.7%
0.5	-0.1	-0.9	25.3%
0.75	0.4	0.5	51.3%
0.9	2.2	2.0	74.3%
0.95	4.1	2.9	84.7%
0.99	10	4.6	95.7%

Net nominal position over household annual labor income in the 2019 SCF vs. in the model. Cumulative distribution function of consumption in the model.

empirical estimates. The Intertemporal Keynesian Cross Auclert et al. (2018) is thus less powerful in this model relative to a baseline HANK, and the propagation to the broader economy of any initial impulse to aggregate demand can be interpreted as a lower bound.[10]

3 Wealth Redistribution and its Propagation

First, I use the model to examine how wealth redistribution resulting from an inflation shock propagates to aggregate variables in the economy. Specifically, I trace out the impulse response functions (IRFs) of consumption and inflation. Compared to the expected path for the price level implied by the Survey of Professional Forecasters at the end of 2020, the actual price level was 10% higher by the end of 2022.[11]

This shock to the price level has been arguably due to several factors: supply chain disruptions, generous transfers from the government to households, and monetary policy remaining accommodative even after inflation started to exceed 2% year-on-year in April

[10]Appendix A.4.1 present the results for a standard HANK model featuring more agents a higher average MPC, but also an implausibly large covariance between MPC and NNP.

[11]Figure 11 shows the actual and expected paths for the price level as of December 2020.

2021 (e.g. Giannone and Primiceri (2024), Bernanke and Blanchard (2023), Dao et al. (2024). Since my interest lies solely in how the redistributive effects from this inflation shock—arising from the presence of nominal assets and liabilities—propagated to the rest of the economy, it is not necessary within the model to specify the exact combination of underlying structural shocks that caused this spike in the price level.

Instead, in the model, I directly shock the wealth distribution by simulating a change in the unit of account equal in magnitude to the surprise inflation observed over 2021 and 2022. Through the lens of the model, the only effect comes from Λ becoming less valuable in terms of real consumption c, which redistributes resources away from asset-rich households and towards indebted ones. Another equivalent interpretation to the change in the unit-of-account is that of a one-off wealth tax, θ_π, on wealth holdings Λ, which results in negative outlays for creditors and a positive subsidy to debtors and to the government, which has a negative net nominal position. One way to interpret the IRFs of consumption and inflation to this wealth tax θ_π is by comparing a real-asset economy, hit by the same combination of primitive structural shocks that moved inflation initially, to a nominal-asset economy where these primitive shocks also had redistributive effects.

Of course, it is entirely feasible within the model to generate inflation (and thus wealth redistribution) through primitive structural shocks. We will look at several examples of these in Section 5.

3.1 Impact on aggregates

The right panel of Figure 1 depicts the response of aggregate consumption to the price level shock described above. Consumption rises by 0.5% in the first year and then begins to slowly decline back toward the steady state, ultimately undershooting it. Figure 2 sheds light on the various channels within the model behind the aggregate increase in consumption. The direct impact of the shock (blue dotted line) is initially expansionary, as it redistributes resources from households with low MPC to those with high MPC. This initial positive effect raises output in the economy (the blue line in the left panel of figure 2), which further boosts consumption through the intertemporal Keynesian cross (Auclert

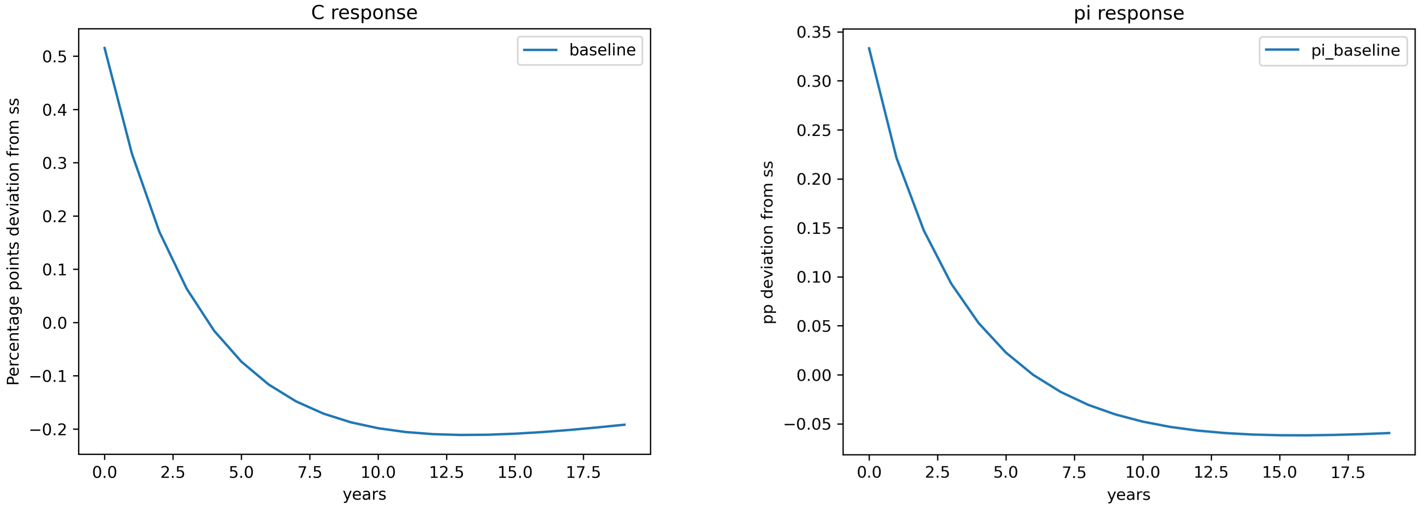


Figure 1: Impulse response functions (IRFs) of consumption and inflation to the wealth redistribution generated by the 2021 inflation shock.

et al., 2018), as shown by the dotted orange line in the right panel of figure 2. Output also increases due to a small but persistent rise in government spending as in equation 6 - due to the devaluation of its nominal debt -, as shown by the green line in the left panel of Figure 2.

The increase in output from both consumption and government spending pushes up inflation as in the New Keynesian Wage Phillips Curve (Equation 4). The relative IRF reported in the right panel of Figure 1. Inflation rises on impact and then slowly decays, with the price level being 0.3 percentage points higher in the first year after the shock compared to a counterfactual with no redistribution. This rise in inflation triggers a monetary policy response, raising nominal interest rates according to the Taylor rule (Equation 5), also reported in the left panel of Figure 2. The ex-post real interest rate is negative in the first period, both because of the unexpected inflation and because the price of the long-term bond unexpectedly falls due to discounting the higher future path of nominal interest rates.

After a few years, the direct response of consumption to the shock turns negative, as shown in the right panel of Figure 2. This occurs because, while households close to the borrowing constraint have a higher MPC and initially raise their consumption substan-

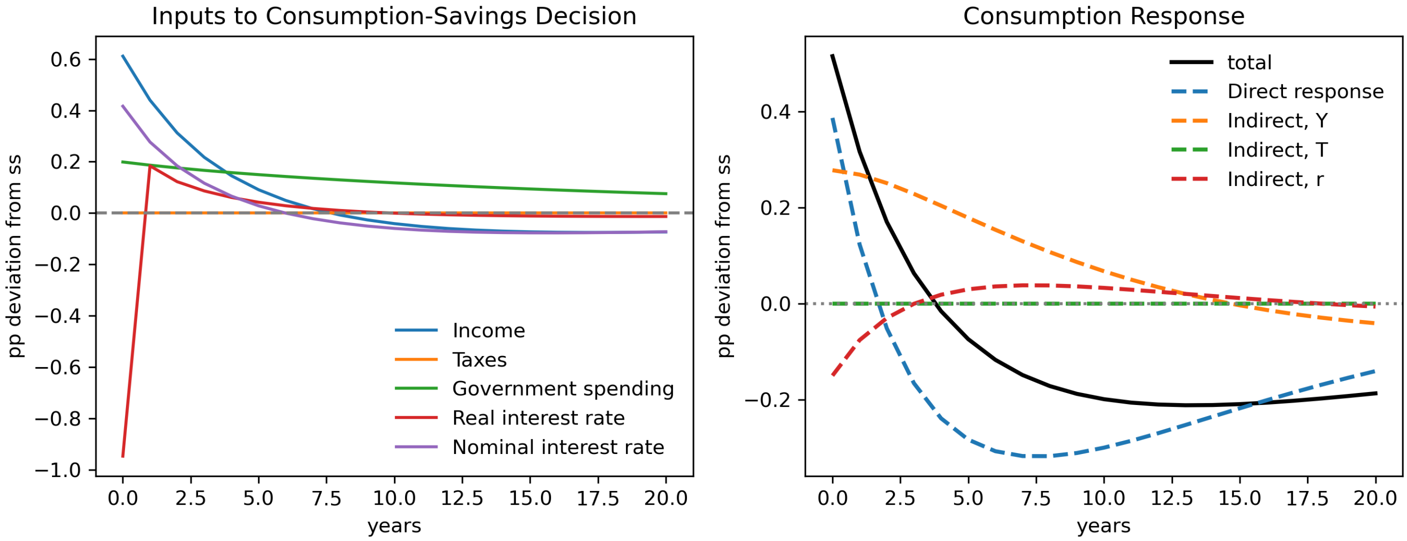


Figure 2: Decomposition of the effect on consumption among the direct impact of the shock, the feedback from income through the intertemporal Keynesian cross, and the reactions of taxes and the real interest rate.

tially, wealthier households behave more in line with the Permanent Income Hypothesis (Friedman, 1957), cutting their consumption permanently by an amount close to the annuity value of the negative wealth shock. Over time, the consumption behavior of the rich dominates the initial spending spree of indebted households, also because the household sector as a whole has a positive net nominal position.

As the negative direct effects begin to dominate the positive general equilibrium impulse from the intertemporal Keynesian cross, consumption and inflation undershoot their steady-state values. Consequently, monetary policy starts cutting interest rates marginally after a few years, and consumption converges back to its equilibrium level from below. The model suggests that while the effects of wealth redistribution on aggregate quantities are quite small after a few years, they are very long-lasting, as it takes a long time for the wealth distribution to return to its ergodic state.

Appendix A.4 conducts a sensitivity analysis around the main parameters of the model and its specification. Results are qualitatively and, in most cases, quantitatively unchanged for any reasonable range of parameter values, or for alternative specifications of the policy block of the model.

3.1.1 Behavioural frictions

Using data for Germany, Schnorpfeil et al. (2023) show that households are often unaware of the debt reduction induced by the Fisher effect. This is particularly relevant for long-term nominal positions like Treasuries or mortgages, where the reduction in the real value of cash flows from these instruments occurs over long time horizons. To capture this potential friction in the model, I shift from simulating a one-off wealth redistribution to introducing an inflation tax $\theta_{\pi,t}$ on nominal assets and liabilities that phases off after d years.

$$\theta_{\pi,t} = \begin{cases} \frac{\gamma_\pi}{d} & \text{for } t < d \\ 0 & \text{for } t \geqslant d \end{cases}$$

Here, γ_π represents the overall inflation shock described above, and d is the average duration of net nominal positions as of the end of 2020 (five years, as in Pallotti (2022)). Households with negative net nominal positions Λ receive a subsidy equal to $\theta_{\pi,t}\Lambda$, while households with positive net nominal positions will have to pay the equivalent tax. This subsidy-tax lasts only d periods, and households form their expectations about its future values according to cognitive discounting, following Gabaix (2020):

$$E_t^{BR}[\theta_{\pi,t+1}] = \theta_{\pi,ss} + \tilde{m}E_t[\theta_{\pi,t+1}] \tag{9}$$

Here, $\theta_{\pi,ss}$ is the steady-state value of this tax, which is zero. The parameter $\tilde{m}$ governs the degree of cognitive discounting regarding the future values of this inflationary tax.

Figure 3 reports the impulse response functions (IRFs) for consumption and inflation in the model for varying degrees of $\tilde{m}$. For $\tilde{m}$ close to one, the effect is similar to the rational expectations case. As we decrease $\tilde{m}$ towards zero, the response of consumption becomes less pronounced on impact but more persistent over time. This occurs because indebted households do not anticipate the subsequent reduction in the real value of their liabilities and adjust their consumption positively when they realize their liabilities have a lower value than expected. The response of inflation for lower $\tilde{m}$ is more persistent, though broadly similar on impact, since the unions are fully rational and forecast the cumulative deviation of consumption from its steady state when setting wages.

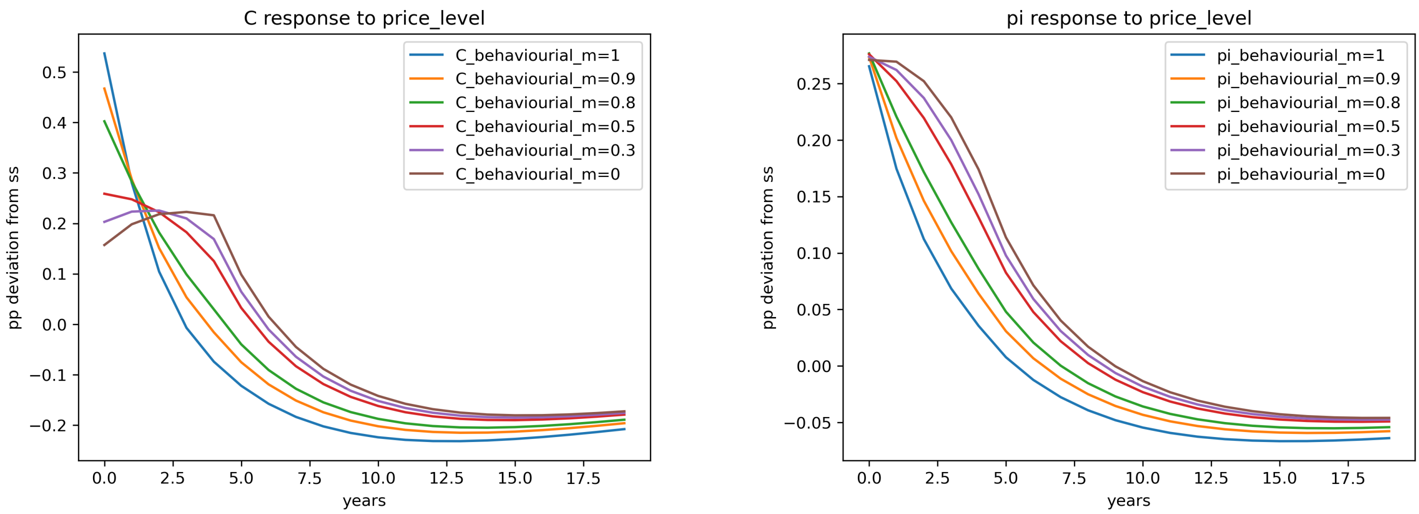


Figure 3: Impulse response functions (IRFs) of consumption and inflation to the wealth redistribution generated by the inflation shock when households exhibit cognitive discounting regarding the reduction in the real value of their assets and liabilities. A lower $\tilde{m}$ implies more cognitive discounting in Equation 9.

4 Empirical Evidence

A key prediction of the model is that households with nominal debt should increase their consumption. I test this empirically using data from a fintech company in the US where I can identify households who have been paying down a mortgage througout the inflationary shock. I then move to publicly available data, leveraging variation at the county level.

4.1 Fintech data

The dataset covers almost 100 billion transactions for more than 45 million unique account holders.[12] The company from which I sourced the data provides a financial platform to US banks which helps the banks' users to gain a broad overview of their financial situation. Therefore, a unique account holder is typically associated with a household.

[12]The exact numbers for the whole sample are 97,869,791,714 transactions and 45,302,620 unique account holders.

Each account holder can have multiple bank accounts. For any bank account in the sample, the data contain all the outflows (including direct debit expenditures, credit card payments, cash withdrawals, transfers to other accounts) as well as inflows (for example salaries, transfers, refunds).

Sample selection In order to abstract from households entering and exiting the sample at any point in time, I focus on a consistent cohort of unique account holders that performed at least ten consumption transactions every month from January 1st 2019 to the end of my sample on October 30th 2023.[13] I also remove outliers (following the fintech algorithm to identify them) and include only transactions in US dollars.[14] This leaves me with 12 billions of transactions over four years made by 4.5 million households.[15]

Tracking US Aggregates The data closely align with the official statistics for the US economy. Figure 4 below compares the official monthly retail sales data from the US Census with an aggregate constructed using expenditures from both credit and debit card transactions post-sample selection.[16]

Figure 15 and figure 16 in the appendix report the comparison with Personal Consumption Expenditures and with Personal Consumption Expenditure on Goods, both produced by the BEA. These official measures contain consumption categories such as owners' equivalent rent or purchases directly financed by government (e.g. Medicaid) which by construction are not captured in the fintech data, as they don't entail monetary transactions. Nevertheless, the fintech data seem to capture the underlying trends for both official series quite well.

Data on income appear somewhat less accurate, as reported in figure 17 which compares offical US Personal Income per household from the BEA to the average inflows in the accounts categorized as 'Salary/Regular Income' by internal algorithm of the fintech.

[13] Results are robust to this number as reported in section B.3

[14] I follow the fintech own algorithm to identify outliers and duplicates.

[15] The exact numbers are 12,049,599,781 transactions for 4,475,198 unique account holders.

[16] In particular, to conform as much as possible to the goods and services contained in US Retail Sales, I include expenditures in the following categories: 'Restaurants', 'Entertainment/Recreation', 'Groceries', 'Electronics/General Merchandise', 'Automotive/Fuel', 'Utilities', 'Cable/Satellite/Telecom', 'Education', 'Rent', 'Travel', 'Healthcare/Medical', 'Postage/Shipping', 'Gifts', 'Pets/Pet Care'

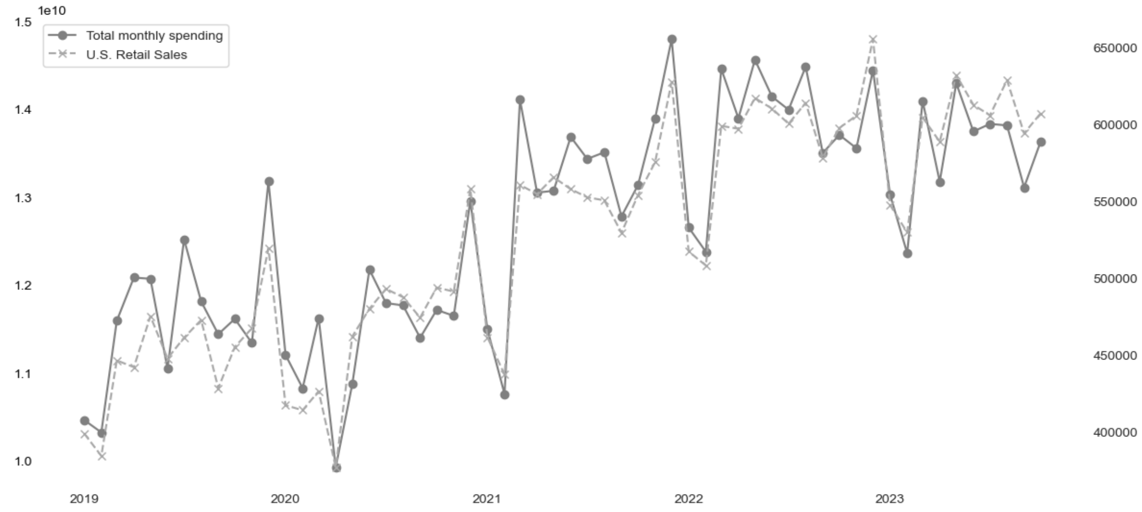


Figure 4: Comparison of official US retail sales data with fintech-based aggregate expenditures, January 2019 to October 2023.

Mortgagors Crucially for my analysis, I am also able to identify households who are paying down a mortgage as part of their outflows throughout the period. Transactions involving mortgages are identified through the fintech internal algorithm based on information including the transaction description and the recipient. I further filter the mortgage transactions by including only those above 200 USD.

4.1.1 Empirical evidence

My empirical strategy begins with a simple regression of household i spending growth on an indicator function M for households that have been paying down a mortgage throughout the period, controlling for a number of confounding factors X_i:

$$\Delta \log(C)_i = \alpha + \beta_1 \times M + \boldsymbol{\beta_2} \times \mathbf{X}_i + \epsilon_i \tag{10}$$

In particular, given the inherent volatility of daily data, I measure consumption growth as $\Delta \log(C)_i = \log(\overline{C_{i,t}}) - \log(\overline{C_{i,s}})$, where $\overline{C_{i,t}}$ represents the average consumption of household i during period t. Confounding factors X_i include income growth at the household level, state fixed effects based on the residence of the household, and a measure their employment status.

As reported in figure 21, inflation started exceeding 2% YoY in March 2021. By June

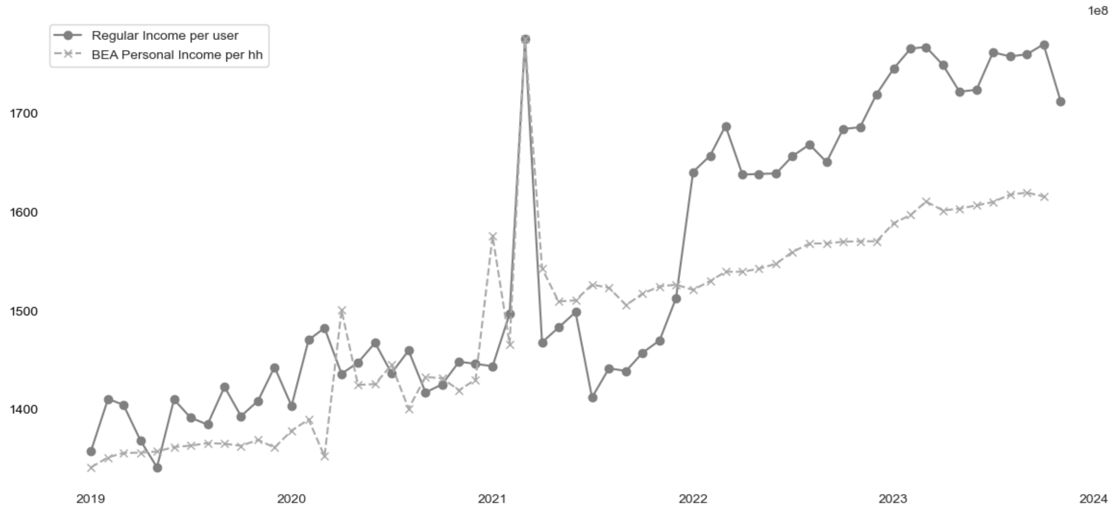


Figure 5: Comparison of official US Personal Income per Household with fintech-based regular income per user, January 2019 to October 2023.

2021 inflation reached 5% and it was widely reported in the media, capturing people's attention (figure 22 reports statistics from Google trends). In my benchmark regression to measure consumption growth, I therefore define t as June-July 2021 and s as September-October 2023, the latest period available in my sample.[17]

Results Table 3 reports the results across different t without any controls X_i. Consumption growth of mortgage holders has been on average 2% larger than non-mortgage holders. The coefficient is precisely estimated, also thanks to the sample size - more than 4 million households.

4.2 Cross-county evidence

Credit/debit card spending Moving to cross-county evidence, I leverage variation in the net nominal positions and test its relationship with county-level spending, using real-time credit and debit card expenditures made publicly available by Chetty et al. (2020). The dataset contains credit and debit card spending provided by Affinity Solutions. Figure 19 in the appendix presents the time series for the US and compares it with aggregate

[17] I choose June-July 2021 also in order to abstract from any differential impact driven by the Covid-related stimulus checks, the last of which was distributed in March 2021.

Spending Growth and Mortgagors

	Jun-Jul 2021	Mar-Apr 2021
Aug-Sept 2023	2.1%	2.0%
	[2.0%, 2.2%]	[1.9%, 2.1%]
N	4,237,632	4,228,147
R^2	0.0	0.0

Table 3: Coefficient β_1 in regression 10 on consumption growth for mortgagors from June-July 2021 or March-April 2021 to the end of my sample (August-September 2023).

expenditures from BEA data. Figure 18 contains an example of the data for the county of Dutchess, NY.

Net Nominal Position I follow a separate procedure for assets and liabilities when constructing the Net Nominal Position at the county level. For nominal assets, I start from the total nominal assets (NA) held by US domestic households as computed in Pallotti (2022), and then assign it proportionally across counties based on each county j fraction of yearly interest income over national interest income (I_j/I) reported by the IRS Statistics of Income.[18] For nominal liabilities, I use the debt to income ratio for county j (DTI_j) reported by the NY FED, and scale it by income at the county level (Y_j) reported by the IRS Statistics of Income. Figure 20 in the appendix illustrates the variation in debt to income ratios at the county level.

The net nominal position of county j is therefore simply:

$$NNP_j = \frac{I_j}{I} \times NA - DTI_j \times Y_j \tag{11}$$

Regression I follow the same approach as in section 4.1.1, regressing the change in consumption at the county level during the inflationary shock on a measure of the county-level NNPs at the start of the period. I scale county-level NNP by its income Y_j. As the

[18] I thus abstract away from differences in maturity structure of nominal positions at the county level and adopt a risk-neutral approach with respect to differential exposure to bond defaults, assuming they are fully reflected in interest income.

daily or weekly values are extremely volatile, I take an average of June and July 2021 as a starting point of the inflation episode and of August and September 2023 as the endpoint. [19] The results are robust to alternative specifications for the time interval, including extending the sample to the latest available data (June 2024 at the time of writing), as reported in appendix B.4. Equation 10 below describes my empirical strategy:

$$\Delta \log(C)_j = \alpha + \beta_1 \times \frac{\text{NNP}_j}{Y_j} + \boldsymbol{\beta_2} \times \mathbf{X}_j + \epsilon_j \tag{12}$$

I control for a number of confounding factors X_j which may have been relevant to determine the county-level spending growth over the inflationary shock. These include state-level fixed effect, industry composition at the county level (defined as the share in employment for each NAICS 2-digit sectors) and the level of employment in each county at the start of the inflation episode (an average over the first two months, as above). Appendix B.1 contains all the details about data sources.

Results Table 4 reports the result. Consistently with the theory, counties with a more negative NNP tended to exhibit higher spending growth following the onset of the inflationary trend. The first uses all controls: as we move to the right side of the table, these controls are progressively excluded. The magnitude of the coefficient shrinks, and the sign flips once we do not limit ourselves to within-State variation and do not control for industry composition.

Table 5 decomposes the NNP/Y at the county level into nominal assets and liabilities, again gradually excluding controls as we move to the right side of the table. Consistently with the theory, counties with more nominal debt have seen a larger consumption response, which is close to being statistically significant. The effect of asset to income is much less precisely estimated, and the point estimate is slightly above zero, in contrast with the theory.

[19] Data are seasonally adjusted as in Chetty et al. (2020).

Table 4: NNP and Spending Growth

	(1)	(2)	(3)	(4)
NNP/Y	-0.2866	-0.1018	0.1476	0.6640
	(0.459)	(0.385)	(0.295)	(0.300)
State FE	✓	✓	✓	
Industry Comp.	✓	✓		
Employment	✓			
N	952	1607	1607	1607
R^2	0.447	0.394	0.371	0.007

Results of regression 12 of consumption growth from June-July 2021 to August-September 2023 on NNP/Y (net nominal position relative to income) plus controls, all at the county level.

Table 5: Separating nominal assets and nominal liabilities

	(1)	(2)	(3)	(4)
NL/Y	0.7193	0.4640	0.0683	-0.1168
	(0.691)	(0.574)	(0.351)	(0.678)
NA/Y	0.1300	0.277	0.4600	-1.2669
	(0.736)	(0.679)	(0.795)	(0.525)
State FE	✓	✓	✓	
Industry Comp.	✓	✓		
Employment	✓			
N	952	1607	1607	1607
R^2	0.448	0.394	0.372	0.011

Results of regression 12 of consumption growth from June-July 2021 to August-September 2023 on NL/Y and NA/Y (respectively, nominal liabilities and nominal assets relative to income) plus controls, all at the county level.

5 Implications for Monetary Policy

The previous two sections focused on the importance of the Fisher channel in the context of the surprising strength of aggregate demand in the US post-pandemic. In this section, I move beyond the current inflationary episode and study monetary policy in my HANK model with a quantitatively disciplined Fisher channel.

Monetary policy shocks I start by simulating a standard 25 bps expansionary shock with persistence $\rho = 0.7$ as in Kaplan et al. (2018).[20] I trace out the IRFs of consumption and inflation when households and the government have nominal assets, as in my benchmark model, and then contrast those IRFs with the case in which all assets are real - as in baseline HANK models, where inflation has no redistributive impacts.

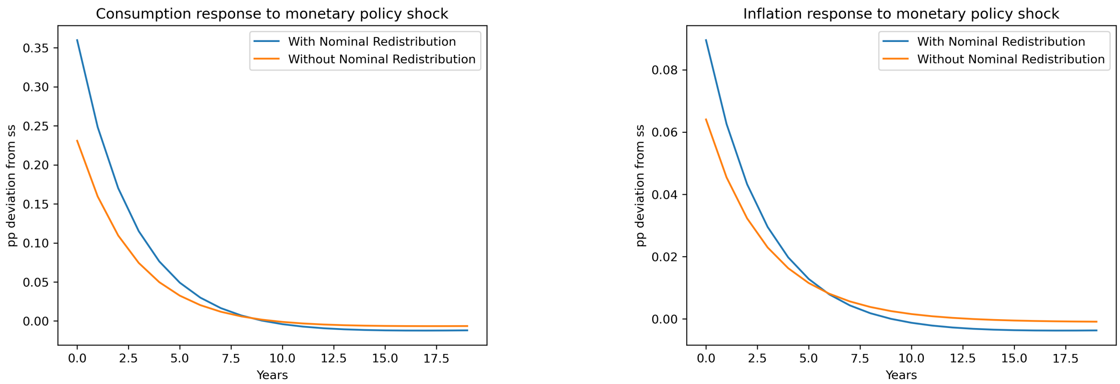


Figure 6: Impulse response functions of consumption and inflation to a standard monetary policy shock with and without an active Fisher channel in the model.

Figure 6 reports the results. The left panel shows that an active Fisher channel makes monetary policy almost 50% more powerful on impact in its transmission to consumption. The intuition is the same as in the previous section: a persistent monetary policy shock generates some unexpected inflation (reported in the right panel of figure 6) which redistributes resources from wealthy households towards indebted ones with a higher MPC. In turn, this also generates more inflation thorough the standard New Keynesian Wage Phillips Curve 4.[21]

[20]The path for the monetary policy shock is reported in figure 13 in the appendix.

[21]As reported in the previous section, over time, the smaller but more persistent cut to consumption by wealthy households - who behave more according to the permanent income hypothesis (Friedman

Increasing the degree of activeness of monetary policy through a higher coefficient on inflation in the Taylor rule 5 reduces the differences across models with nominal and real assets. Indeed, in the case of an expansionary monetary shock, the systematic component of monetary policy pulls up the nominal rate endogenously more to counteract any inflationary impact stemming from the Fisher channel. In turn, this limits the differences across the two models. Appendix A.6 reports the results for increasing the Taylor rule coefficient from 1.25 (benchmark) up to 2.5, when the difference between the two models disappear.

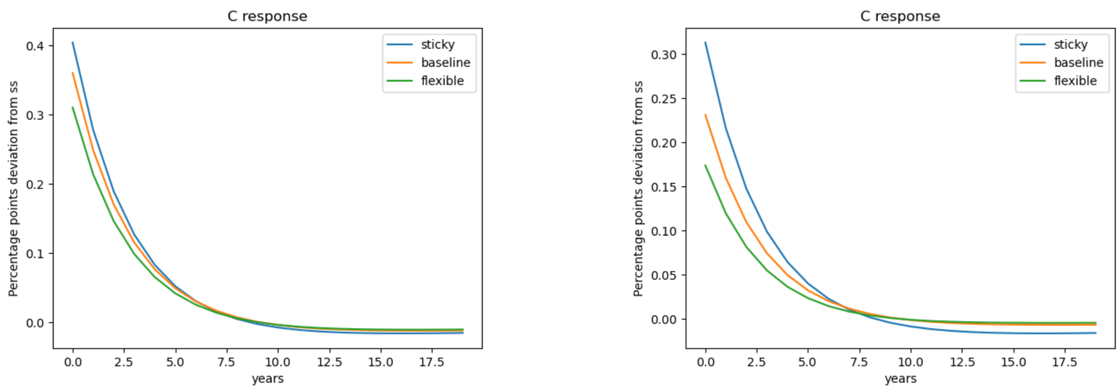
Nominal Rigidities and the Paradox of Flexibility In my model, varying the degree of nominal rigidity produces two opposing effects on the impact of monetary policy shocks on consumption. On the one hand, consistent with conventional wisdom, reducing nominal rigidities means that the real interest rate responds less to a monetary policy shock, decreasing the effectiveness of monetary policy. On the other hand, less nominal rigidity also leads to more wealth redistribution across households due to a stronger (unexpected) reaction of inflation, which increases the positive impact of an expansionary monetary policy shock on consumption (and symmetrically for contractionary shocks).

In the calibration of the Fisher channel used in my paper, which matches relevant sufficient statistics, the real-rate effect quantitatively dominates the opposing force arising from greater wealth redistribution under a more elastic inflation response. Therefore, consistent with conventional wisdom, monetary policy is still more effective the higher the degree of nominal rigidity in the model. The left panel of Figure 7 shows the IRF of consumption to the same monetary policy shock as in the previous section, for different calibrations of the slope of the New Keynesian Wage Phillips Curve (4), denoted by κ_w, in my benchmark model. Monetary policy is more effective the stickier nominal wages are, but the differences between IRFs are relatively small due to the counterbalancing effect of the Fisher channel. The right panel of Figure 7 shows the same IRFs of consumption across the same values of κ_w in a model with only real assets. The differences in consumption

(1957)) - dominates the increase in consumption of indebted households. The aggregate consumption IRFs to an expansionary monetary policy shocks therefore mildly undershoots its real-assets counterpart at long horizons.

IRFs across different values of κ_w are now much larger due to the absence of the Fisher channel - which, as discussed in the previous paragraph, also lowers the overall impact of monetary policy.

For some extreme parameterizations of the model that overstate the covariance between the marginal propensity to consume (MPC) and net nominal positions (NNP), the Fisher channel actually dominates the conventional impact of monetary policy on the real interest rate. This generates a "paradox of flexibility" whereby monetary policy has larger real effects the smaller the degree of nominal rigidity in the model. However, this paradox arises from a different mechanism than the one emphasized by Eggertsson and Krugman (2012), which operates through the effects of unexpected inflation in lowering the real interest rate when the nominal rate is stuck at the zero lower bound (ZLB). In my model, when monetary policy is stuck at the ZLB and the economy faces a demand shock, the Fisher channel will add to the real-rate channel, making the paradox of flexibility identified by Eggertsson and Krugman (2012) even more pronounced. Appendix A.6 documents this case.



Model with Fisher Channel **Model without Fisher Channel**

Figure 7: Impulse response functions of consumption to a standard monetary policy shock for different degrees of nominal rigidity in the model. Left panel: benchmark model with nominal assets; right panel: model with real assets, where there is no redistribution of wealth generated by inflation. Sticky: $\kappa_w = 0.05$; baseline: $\kappa_w = 0.10$; flexible: $\kappa_w = 0.15$.

6 Conclusions

Despite the seminal work by Auclert (2019), which emphasized the relevance of the Fisher channel in Heterogeneous Agent New Keynesian (HANK) models, much of the literature has continued to model assets in HANK frameworks as one-period real bonds or in continuous time, where inflation has no redistributive role by construction. In response to the current inflationary episode, recent studies such as Yang (2022), Kaplan et al. (2023), Angeletos et al. (2023), and Angeletos et al. (2024) have started to incorporate nominal assets. Relative to this emerging literature, I construct a HANK model that accurately matches key features of the empirical distribution of net nominal positions (NNP) and the covariance between marginal propensity to consume (MPC) and NNP â a sufficient statistic in a broad class of environments identified by Auclert (2019).

According to the model, the wealth redistribution generated by the unexpected inflation shock in the U.S. raised aggregate consumption by approximately 0.5% on impact, with the positive contribution persisting for several years. This finding is consistent with empirical evidence obtained from a fintech company's data covering expenditures of 4 million U.S. households. The data show that households with mortgages increased their consumption more than the rest of the population during the inflationary period, aligning with the model's predictions. Additionally, cross-county empirical analysis corroborates these findings, indicating that counties with higher levels of nominal debt experienced relatively stronger growth in consumption expenditures in the two years following the onset of the inflation shock â although these results are not statistically significant.

The policy implications are significant. The model shows that monetary policy becomes more effective in stimulating consumption when the Fisher channel is active, as unexpected inflation redistributes wealth toward indebted households with higher MPCs. While conventional wisdom holds that greater nominal rigidity enhances monetary policy effectiveness, the Fisher channel reduces differences in policy impacts across varying levels of nominal rigidity, and it enhances the 'paradox of flexibility' at the zero lower bound.

References

Angeletos, G.-M., Lian, C., and Wolf, C. K. (2023). Can deficits finance themselves? Technical report, National Bureau of Economic Research.

Angeletos, G.-M., Lian, C., and Wolf, C. K. (2024). Deficits and inflation: Hank meets ftpl.

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

Auclert, A., Bardóczy, B., and Rognlie, M. (2023). Mpcs, mpes, and multipliers: A trilemma for new keynesian models. *Review of Economics and Statistics*, 105(3):700–712.

Auclert, A., Bardóczy, B., Rognlie, M., and Straub, L. (2021). Using the sequence-space jacobian to solve and estimate heterogeneous-agent models. *Econometrica*, 89(5):2375–2408.

Auclert, A. and Rognlie, M. (2018). Inequality and aggregate demand. Technical report, National Bureau of Economic Research.

Auclert, A., Rognlie, M., and Straub, L. (2018). The intertemporal keynesian cross. Technical report, National Bureau of Economic Research.

Auclert, A., Rognlie, M., and Straub, L. (2024). forthcoming):âthe intertemporal keynesian cross,â. *Journal of Political Economy.*

Autor, D., Dube, A., and McGrew, A. (2023). The unexpected compression: Competition at work in the low wage labor market. Technical report, National Bureau of Economic Research.

Bernanke, B. and Blanchard, O. (2023). What caused the us pandemic-era inflation? *Peterson Institute for International Economics Working Paper*, (23-4).

Broer, T., Harbo Hansen, N.-J., Krusell, P., and Öberg, E. (2020). The new keynesian transmission mechanism: A heterogeneous-agent perspective. *The Review of Economic Studies*, 87(1):77–101.

Buda, G., Hansen, S., Rodrigo, T., Carvalho, V. M., Ortiz, Á., and Rodríguez Mora, J. V. (2023). National accounts in a world of naturally occurring data: a proof of concept for consumption.

Castaneda, A., Diaz-Gimenez, J., and Rios-Rull, J.-V. (2003). Accounting for the us earnings and wealth inequality. *Journal of political economy*, 111(4):818–857.

Chetty, R., Friedman, J. N., Hendren, N., Stepner, M., et al. (2020). The economic impacts of covid-19: Evidence from a new public database built using private sector data. Technical report, national Bureau of economic research.

Dao, M. C., Gourinchas, P.-O., Leigh, D., and Mishra, P. (2024). Understanding the international rise and fall of inflation since 2020. *Journal of Monetary Economics*, page 103658.

Diamond, R. and Moretti, E. (2021). Where is standard of living the highest? local prices and the geography of consumption. Technical report, National Bureau of Economic Research.

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

Eggertsson, G. B. and Krugman, P. (2012). Debt, deleveraging, and the liquidity trap: A fisher-minsky-koo approach. *The Quarterly Journal of Economics*, 127(3):1469–1513.

Erceg, C. J., Henderson, D. W., and Levin, A. T. (2000). Optimal monetary policy with staggered wage and price contracts. *Journal of monetary Economics*, 46(2):281–313.

Fisher, I. (1933). The debt-deflation theory of great depressions. *Econometrica: Journal of the Econometric Society*, pages 337–357.

Friedman, M. (1957). The permanent income hypothesis. In *A theory of the consumption function*, pages 20–37. Princeton University Press.

Gabaix, X. (2020). A behavioral new keynesian model. *American Economic Review*, 110(8):2271–2327.

Giannone, D. and Primiceri, G. (2024). The drivers of post-pandemic inflation. Technical report, National Bureau of Economic Research.

Grigsby, J., Hurst, E., and Yildirmaz, A. (2021). Aggregate nominal wage adjustments: New evidence from administrative payroll data. *American Economic Review*, 111(2):428–471.

Hatchondo, J. C. and Martinez, L. (2009). Long-duration bonds and sovereign defaults. *Journal of international Economics*, 79(1):117–125.

Heathcote, J., Storesletten, K., and Violante, G. L. (2017). Optimal tax progressivity: An analytical framework. *The Quarterly Journal of Economics*, 132(4):1693–1754.

Iacoviello, M. (2005). House prices, borrowing constraints, and monetary policy in the business cycle. *American economic review*, 95(3):739–764.

Kaplan, G., Moll, B., and Violante, G. L. (2018). Monetary policy according to hank. *American Economic Review*, 108(3):697–743.

Kaplan, G., Nikolakoudis, G., and Violante, G. L. (2023). Price level and inflation dynamics in heterogeneous agent economies. Technical report, National Bureau of Economic Research.

Lorenzoni, G. and Werning, I. (2023). Inflation is conflict. Technical report, National Bureau of Economic Research.

Luetticke, R. (2021). Transmission of monetary policy with heterogeneity in household portfolios. *American Economic Journal: Macroeconomics*, 13(2):1–25.

Mian, A., Rao, K., and Sufi, A. (2013). Household balance sheets, consumption, and the economic slump. *The Quarterly Journal of Economics*, 128(4):1687–1726.

Pallotti, F. (2022). Winners and losers from unexpected inflation. *Available at SSRN 4124693.*

Paz-Pardo, G. (2021). Homeownership and portfolio choice over the generations.

Rotemberg, J. J. (1982). Sticky prices in the united states. *Journal of political economy*, 90(6):1187–1211.

Schnorpfeil, P., Weber, M., and Hackethal, A. (2023). Households' response to the wealth effects of inflation. Technical report, National Bureau of Economic Research.

Tobin, J. (1982). Money and finance in the macroeconomic process. *Journal of money, credit and banking*, 14(2):171–204.

Yang, Y. (2022). Redistributive inflation and optimal monetary policy. *Available at SSRN 4275770*.

Appendix A Model

A.1 Unions

This sections describes the key steps behind the New Keynesian Wage Phillips Curve **??**. It recaps the crucial steps in Auclert et al. (2018), referring to that paper for further details. In the spirit of Erceg et al. (2000), each worker belongs to a union k, which employs a fully representative sample of the population. Each union aggregates individual tasks into $N_{kt} = \int e_{it} n_{ikt} di$. These tasks are combined by a competitive labor packer into aggregate employment according to

$$N_t = \int \left(N_{kt}^{\frac{\epsilon-1}{\epsilon}} dk \right)^{\frac{\epsilon}{\epsilon-1}}$$

and sold to firms at price W_t.

Adjusting wages has quadratic costs that feed in directly in the utility function. Each union sets a common wage W_{kt} for each efficient unit of labor provided by its members and (for simplicity) asks each member to work the same amount of hours, so $N_{kt} = n_{ikt}$.[22]

W_{kt} is set by each union in order to maximize the average utility of its members:

$$\max_{W_{k,t}} \sum_{\tau \geqslant 0} \beta^{\tau+T} \left(\int \{u(c_{i,t+\tau}) - v(m_{i,t+\tau})\} d\psi_{i,t+\tau} - \frac{\psi}{2} \left(\frac{W_{k,t+\tau}}{W_{k,t+\tau-1}} - 1 \right)^2 \right)$$

where $\psi_{i,t+\tau}$ is the density of households, $-\frac{\psi}{2} \int \left(\frac{W_{kt}}{W_{kt-1}} - 1 \right)^2 dk$ is the quadratic cost of adjusting wages, and the maximization is subject to the demand curve for labor:

$$N_{kt} = \left(\frac{W_{kt}}{W_t} \right)^{-\epsilon} N_t$$

Where $W_t = \left(\int W_{kt}^{1-\epsilon} dk \right)^{\frac{1}{1-\epsilon}}$ is the price index for aggregate employment services.

Taking the first-order condition wrt to $W_{k,t}$, applying the envelope theorem whereby $\frac{\partial c_{it}}{\partial W_{kt}} = \frac{\partial z_{it}}{\partial W_{kt}}$ (recalling the definition of z_{it} from 3), recognizing that all unions are identical and thus in equilibrium $W_{kt} = W_t$, defining wage inflation $\pi^w = \frac{W_t}{W_{t-1}} - 1$ and rearranging as in Auclert et al. (2018) we arrive at the New Keynesian Wage Phillips Curve:

$$\pi_t^w (1 + \pi_t^w) = \frac{\epsilon}{\psi} \int N_t \left(v'(n_{it}) - \frac{\epsilon - 1}{\epsilon} \frac{\partial z_{it}}{\partial n_{it}} u'(c_{it}) \right) di + \beta \pi_{t+1}^w (1 + \pi_{t+1}^w) \tag{13}$$

According to 13, the unions set higher wages whenever the marginal rate of substitution between hours and consumption is above the marginal income from extra hour (after tax), marked down by ϵ.

Which in unions set higher wages when the average of marginal rates of substitution between hours and consumption for households ($v'_{n_{it}}/u'_{c_{it}}$) exceeds a marked-down average of marginal after-tax income from extra hours.

Equation 13 can be rewritten in terms of aggregates by noticing that in equilibrium since $n_{it} = N_{kt} = N_t$ we have:

[22] As noted by Auclert et al. (2018), a more general rule $n_{it} = n(e_{it}) N_t =$ would be equivalent to redefine the e_{it} including the function n.

$$\frac{\partial z_{it}}{\partial n_{it}} = (1-\theta)\tau_{it} e_{it}^{1-\theta} \left(\frac{W_t}{P_t}\right)^{1-\theta} N_t^{-\theta} = (1-\theta)\frac{e_{it}^{1-\theta}}{\int e_{it} di}\frac{Z_t}{N_t}$$

And therefore:

$$\pi_t^w(1+\pi_t^w) = \frac{\epsilon}{\psi}\left(N_t v'(N_t) - \frac{\epsilon-1}{\epsilon}(1-\theta)Z_t u'(C_t^*)\right) + \beta\pi_{t+1}^w(1+\pi_{t+1}^w)$$

Where $u'(C_t^*)$ is defined as

$$u'(C_t^*) = \int \frac{e_{it}^{1-\theta} u'(c_{it})}{\int e_{it}^{1-\theta} di} di$$

Substituting in for the utility function, we get equation Finally, I specify the utility function from the constant elasticity of substitution (CES) family with intertemporal elasticity σ, $u(c) = \frac{c^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}$, and disutility from work with Frisch elasticity of labor supply ϕ as $v(N) = \gamma N^{1+\frac{1}{\phi}}$.

A.2 Inflation, nominal wages and house prices

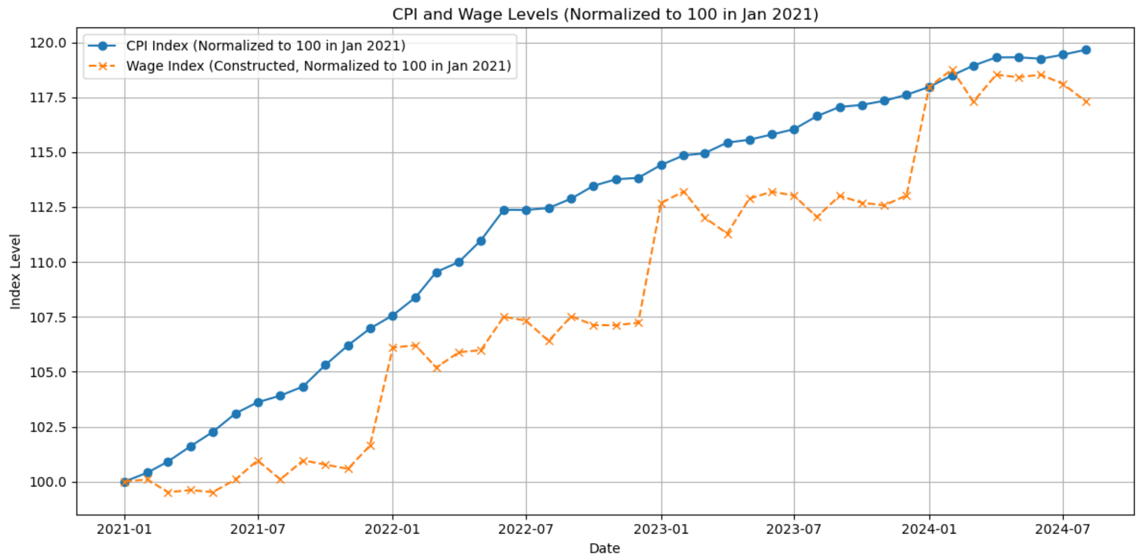


Figure 8: Price-level path for CPI and nominal wages from the Atlanta Fed Wage Tracker, normalized to 100 as of December 2020.

A.3 Inflation shock

The figure below report the difference in the expected path of inflation and its actual realization from December 2020. The cumulated difference until December 2022 (the devaluation used in the paper) has been 10%.

Of course, inflation expectations adjusted (gradually) upwards over the course of the episode. However, as most nominal assets and liabilites are long term claims, with an average duration of 4.5 years, any adjustment of inflation expectations after December 2020 - which reduces the

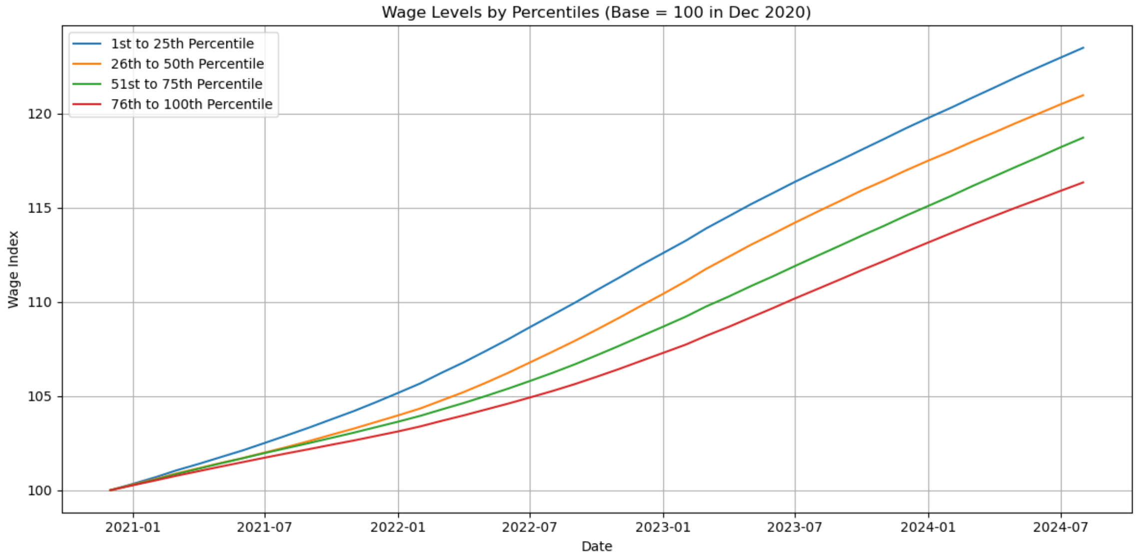


Figure 9: Path for nominal wages constructed from 12-Month Moving Averages Growth Rates from teh Atlanta Fed Wage Tracker for quartiles of the wage distribution, normalized to 100 as of December 2020.

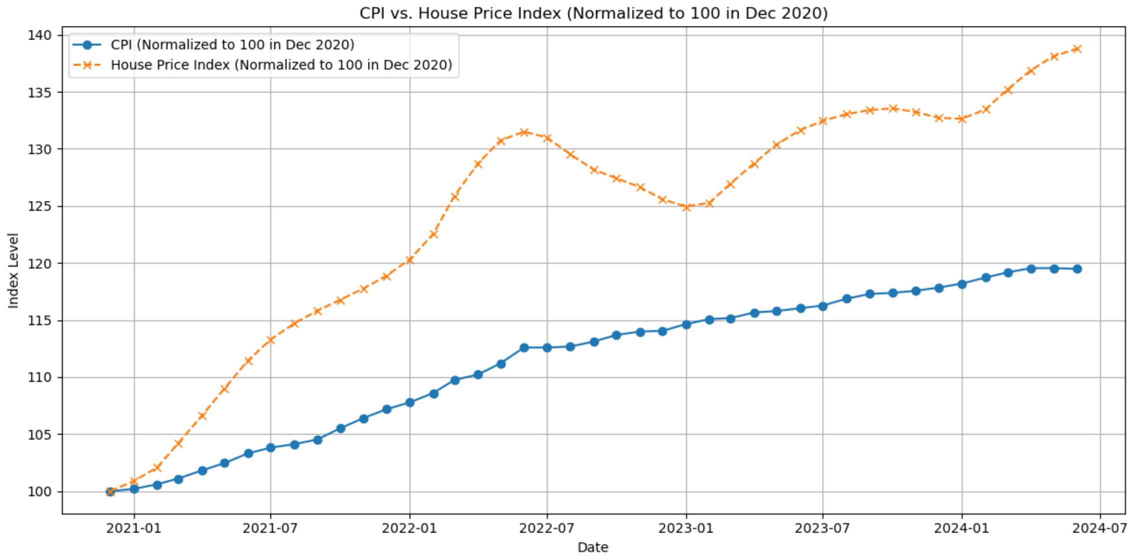


Figure 10: Price-level path for CPI and the Case-Shiller U.S. National Home Price Index from Standard & Poors, normalized to 100 as of December 2020.

extent of the actual surprise - does not really affect the devaluation of the stream of payments implied in long-term nominal assets or liabilities, such as Treasuries or fixed-rate mortgages. It does affect short-term ones, like deposits or consumer-credit, in case they are reinvested/refinanced at higher nominal rates.

As monetary policy started to gradually raise interest rates over the course of 2022, this could slightly overstate the actual devaluation faced by short-term nominal assets and liabilities over the period, reducing the actual amount of redistribution. However, this effect should be quantitatively small given the high average duration of nominal assets and liabilities and the fact that most of the rise in interest rates happened towards the end of 2022 and afterwards. Moreover, figure 12 shows that this gap between historically expected and actual evolution of inflation continued well into 2023-2024, adding (at the time of writing) an additional 2.5 pp, which then understate the actual amount of redistribution.

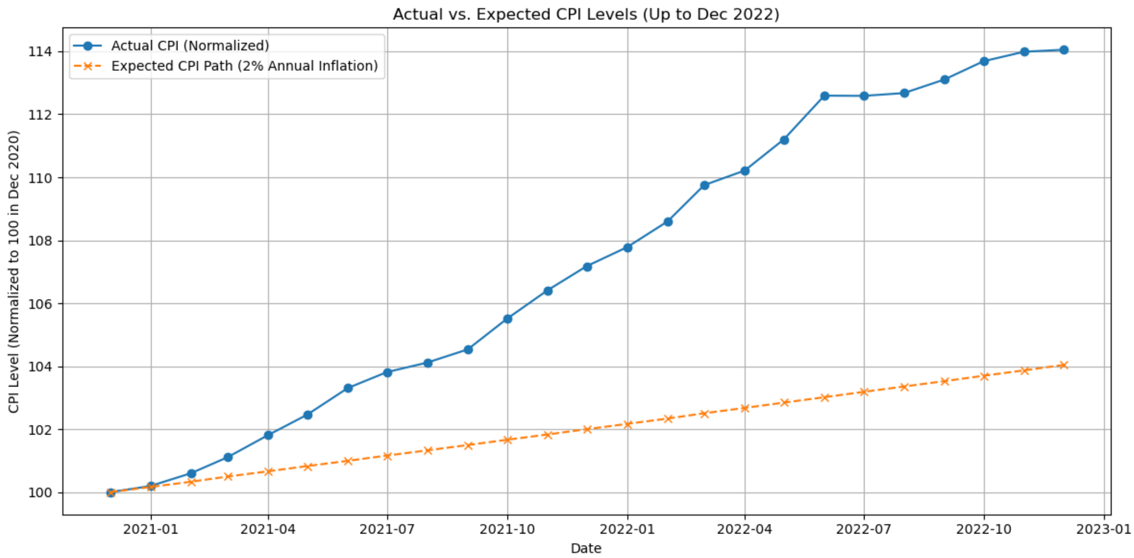


Figure 11: Actual and expected price-level path for CPI from December 2020 to December 2022. Expectations according to the Survey of Professional Forecasters as of December 2020.

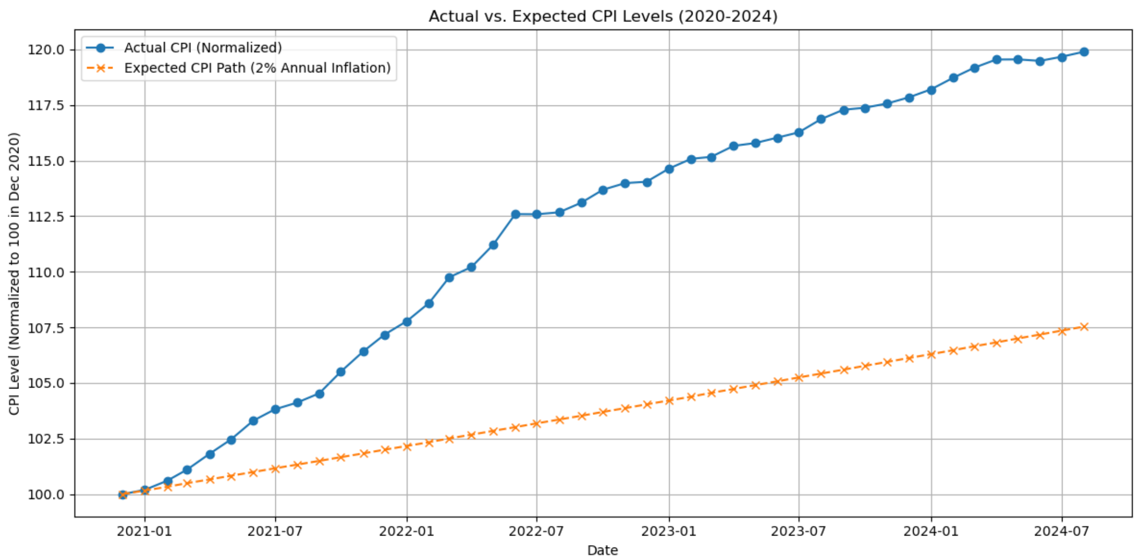


Figure 12: Actual and expected price-level path for CPI from December 2020 to August 2024. Expectations according to the Survey of Professional Forecasters as of December 2020.

A.4 Robustness to alternative specifications

A.4.1 Higher MPCs

A.4.2 Taylor rule coefficient

A.4.3 Maturity structure of long-term bonds

A.4.4 Adjusting taxes

A.4.5 Sticky prices and sticky wages

A.5 Structural shocks

A.5.1 A shock to the discount factor

A.5.2 A shock to government spending

A.5.3 Productivity shock

A.6 Policy implications and the paradox of flexibility

A.6.1 A shock to the discount factor

A.6.2 A shock to government spending

Appendix B Empirical Evidence

B.1 Data sources

B.2 Fintech data vs US official aggregates

B.3 Robustness

B.4 Alternative time intervals

B.5 Additional figures

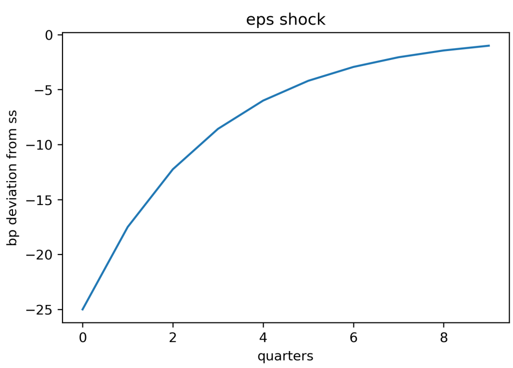


Figure 13: Monetary policy shock with persistence $\rho = 0.7$ as in Kaplan et al. (2018)

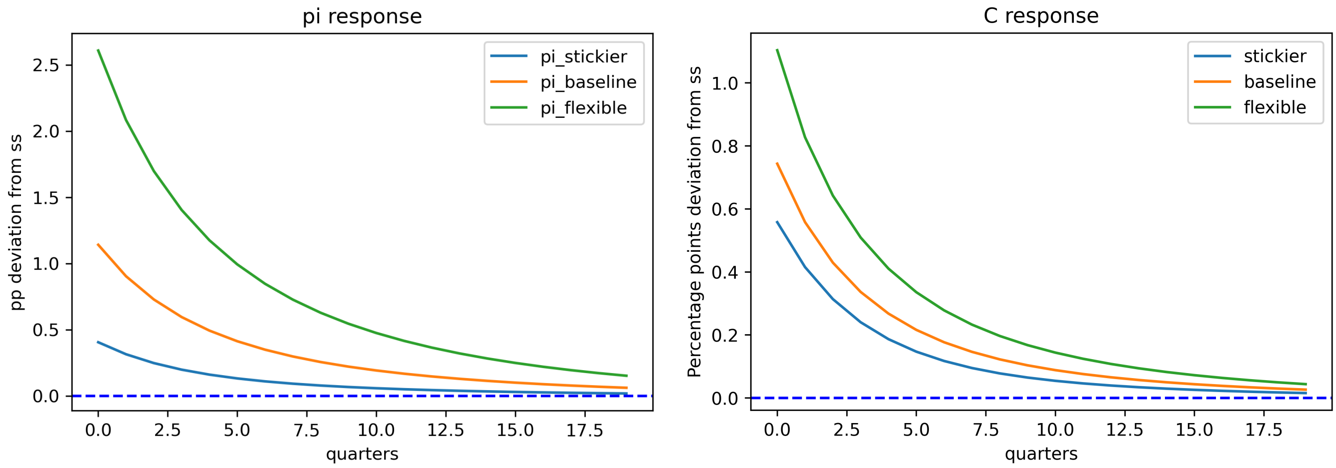


Figure 14: Monetary policy shock and the response of consummption and inflation in the model with extreme parameterization of the Fisher Channel. Stickier: $\kappa = 0.01$, baseline: $\kappa = 0.05$, flexible: $\kappa = 0.1$.

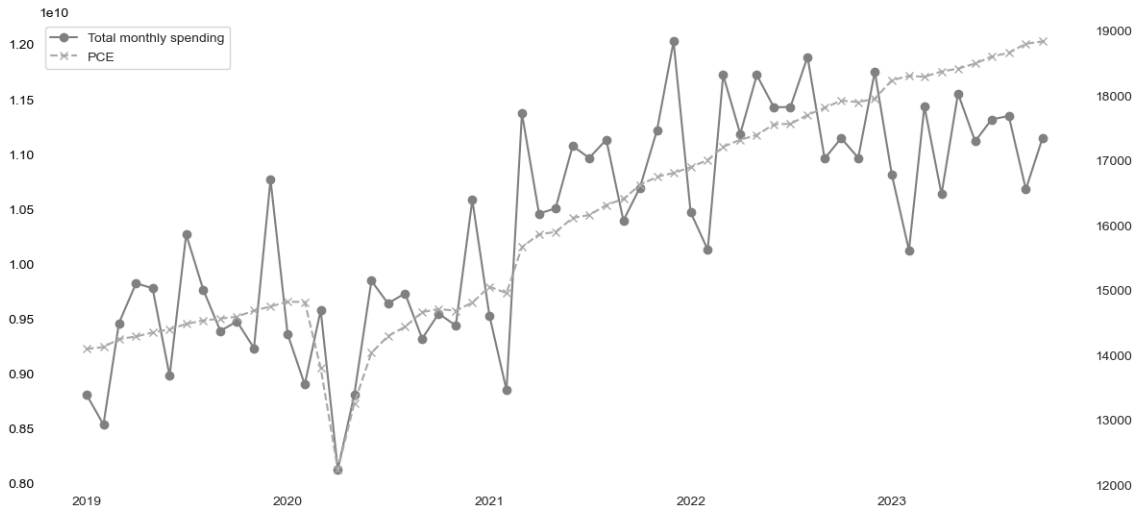


Figure 15: Comparison of official US Personal Consumption Expenditures data with fintech-based aggregate expenditures, January 2019 to October 2023. Note: data for US PCE are seasonally adjusted

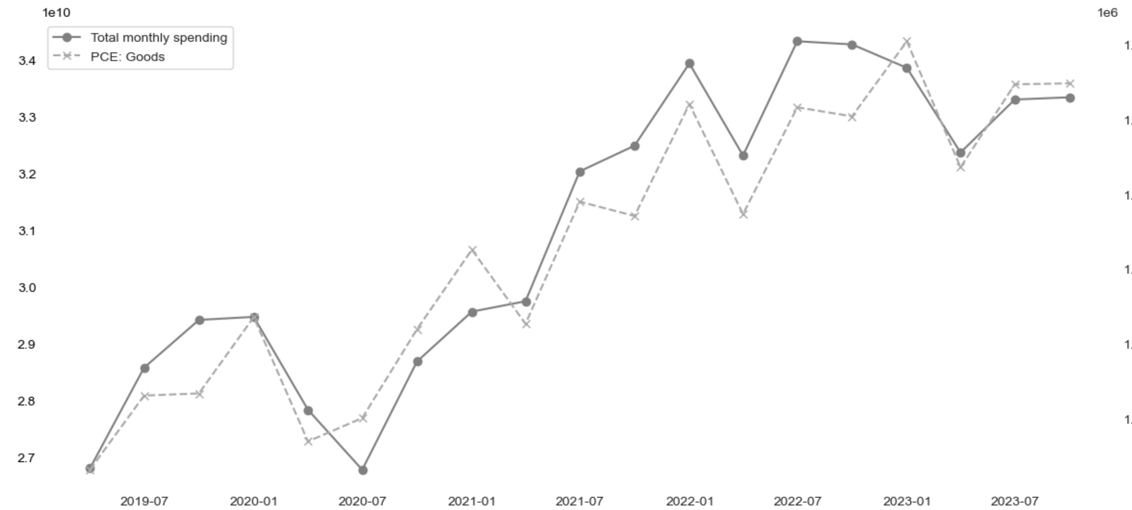


Figure 16: Comparison of official US Personal Consumption Expenditures on Goods with fintech-based aggregate expenditures, January 2019 to October 2023. Note: data for US PCE are seasonally adjusted and quarterly.

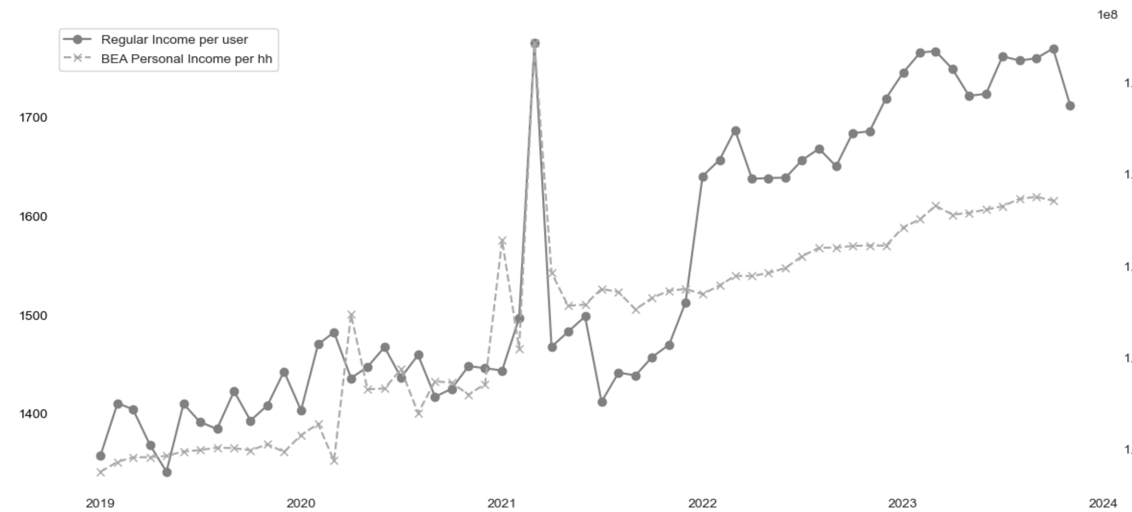


Figure 17: Comparison of official US Personal Income per Household with fintech-based regular income per user, January 2019 to October 2023. Note: there are time series data from BEA like salary income where the match could be better, currently not available on Fred

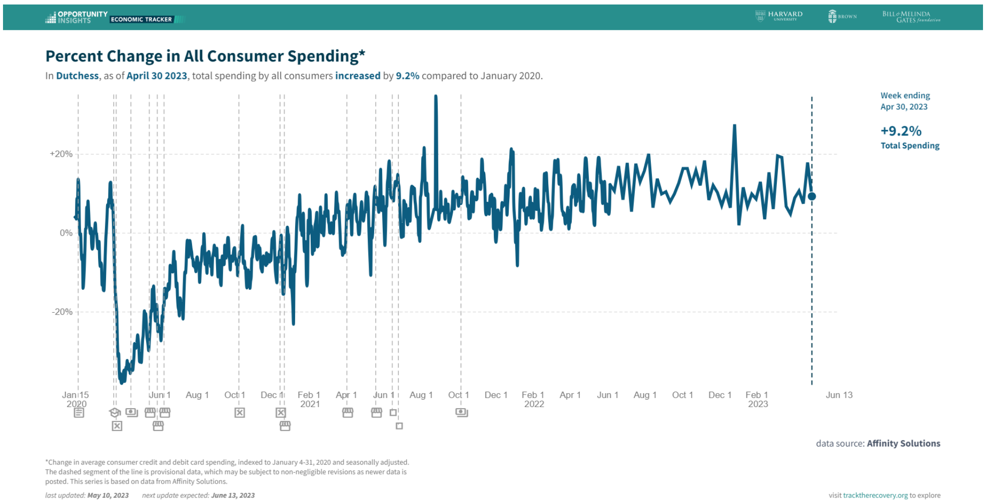


Figure 18: Example for the county of Dutchess of credit and debit card spending from January 1st 2020 to April 30th 2023. Source: https://tracktherecovery.org/.

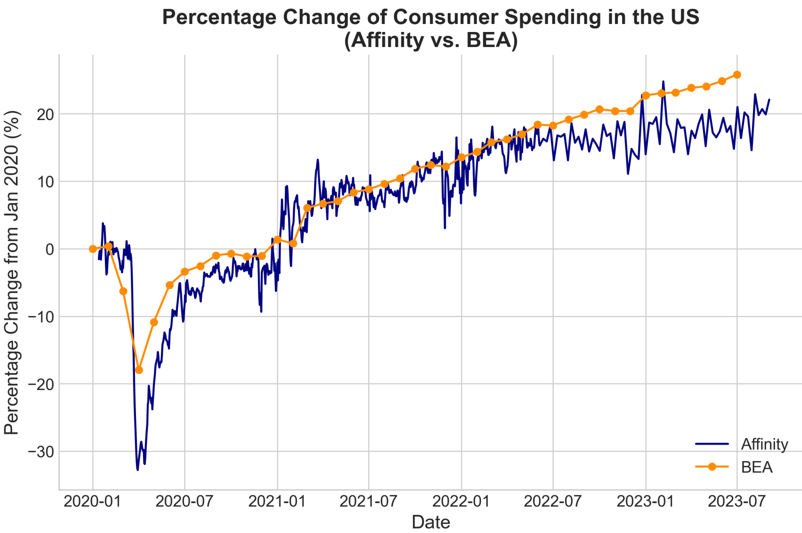


Figure 19: Total consumer spending in the US - Affinity versus BEA Personal Consumption Expenditures.

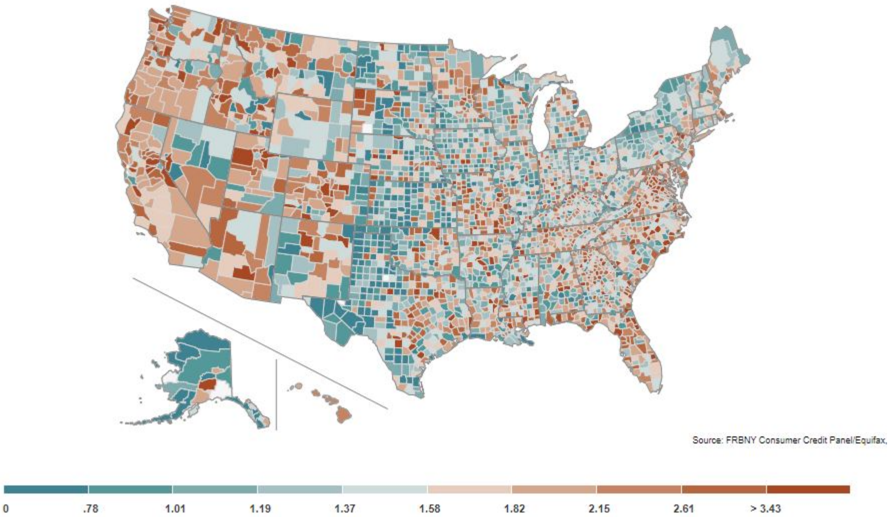


Figure 20: Debt to income ratio for US counties. Source: Federal Reserve of New York.

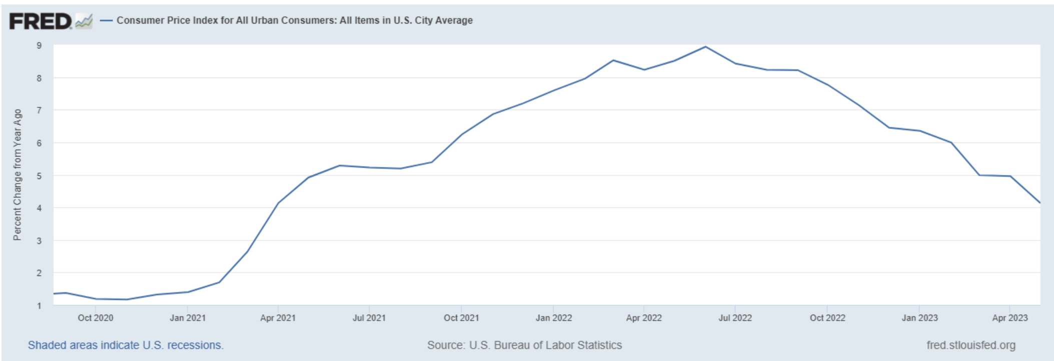


Figure 21: CPI for the US. Source: Fred.

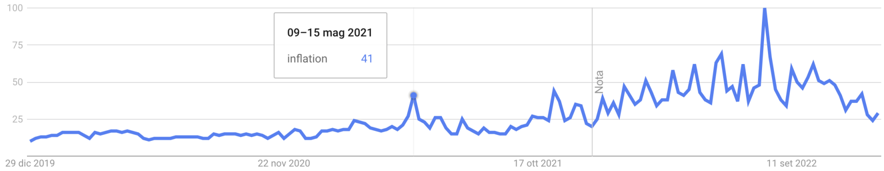


Figure 22: Google searches for inflation in the US. Source: Google Trends.