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Abstract

We identify and study analytically three key channels that shape how inflation affects wealth inequality: (i) the traditional wealth (or Fisher) channel through which inflation redistributes from lenders to borrowers; (ii) an income channel through which inflation reduces the real value of sticky wages and benefits; and (iii) a relative consumption channel through which heterogeneous increases in the prices of different goods affect people differently depending on their consumption baskets. We then quantify these channels during the 2021 inflation surge in Spain using detailed, high-frequency customer-level data from one of the main commercial banks. The unexpected nature of the inflation shock and its perception as temporary in this period in particular closely fit the assumptions behind our theoretical decomposition. Results show that the wealth and income channels are an order of magnitude larger than the consumption channel. Middle-aged individuals were, in net terms, largely unaffected by inflation, while the elderly suffered the most. We find similar results when using representative surveys on households' wealth, income, and consumption.

Keywords: uneven inflation, net nominal positions, nominal wage rigidities.

JEL classification: G51, D31, E31.

Resumen

Identificamos y estudiamos analíticamente tres canales clave que configuran cómo la inflación afecta a la desigualdad de la riqueza: i) el canal tradicional de la riqueza (canal de Fisher), a través del cual la inflación redistribuye la riqueza de los prestamistas a los prestatarios; ii) un canal de ingresos, mediante el cual la inflación reduce el valor real de salarios y beneficios sociales que se caractericen por tener cierta rigidez nominal, y iii) un canal de consumo relativo, a través del cual aumentos heterogéneos en el precio de diferentes bienes afectan a las personas de manera diferente según sus cestas de consumo. Cuantificamos estos canales durante el aumento de la inflación de 2021 en España utilizando datos detallados y de alta frecuencia a nivel de cliente de uno de los principales bancos comerciales. La naturaleza inesperada y la percepción temporal del *shock* inflacionario en este período en particular se ajustan estrechamente a las suposiciones que hay detrás de nuestra descomposición teórica. Los resultados muestran que los canales de riqueza e ingresos son un orden de magnitud mayor que el canal de consumo. En neto, las personas de mediana edad se vieron poco afectadas por la inflación, mientras que las personas mayores fueron las más perjudicadas. Encontramos resultados similares al utilizar encuestas representativas sobre la riqueza, los ingresos y el consumo de los hogares.

Palabras clave: inflación desigual, posición nominal neta, rigideces en salarios nominales.

Códigos JEL: G51, D31, E31.

1 Introduction

Ben Bernanke, former Chairman of Federal Reserve, stated that “The difference between inflation and unemployment is that inflation affects just everybody.[...] Inflation has a social-wide kind of impact.”¹ While inflation may affect everyone, it does not affect everyone in the same way. Differences in wealth composition, salary or consumption patterns may lead to quite different outcomes for different individuals. The aim of this paper is to cast some light on the different channels through which inflation affects wealth inequality.

The paper leverages the unexpected nature of the 2021 surge in aggregate inflation in Spain (and the Euro-Area more broadly), as well as the broad perception of its short-lived dynamics, in order to analytically characterizes how a shock to inflation impacts a person’s wealth in the short run. We derive an analytical expression decomposing the impact of inflation on individual wealth into three different channels, in the spirit of the sufficient statistics approach of Auclert (2019). To this end, we consider a surprise one-off increase in goods and services’ prices, which is heterogeneous across sectors but does not trigger a response of asset prices or interest rates on impact.

First, the “wealth (Fisher) channel” captures how inflation redistributes real wealth from lenders to borrowers by changing the value of nominal assets and liabilities. This channel has already been studied by Doepke and Schneider (2006), Meh et al. (2010) Adam and Zhu (2016), Auclert (2019), Cao et al. (2021) or Pallotti (2022). The impact of inflation on wealth is fully captured by the net nominal position (NNP), defined as the difference between nominal assets and nominal liabilities.

Second, inflation reduces the real value of nominal income, in what we call the “income channel”. Nominal income sources such as wages, pensions, or unemployment benefits are often sticky. Wages in Spain, for instance, are typically updated at annual frequency or even lower than that.² While inflation reduces the real income and wealth of all agents in the same proportion *relative* to their pre-shock levels, the *absolute* impact will naturally be higher the higher the nominal income is.

Third, inflation does not typically affect all prices homogeneously. The prices of some goods or services rise more than those of others. Given that individuals consume different baskets of goods and services, an increase in prices that is heterogeneously distributed across these goods will impact agents differently. We demonstrate how this “relative consumption channel” is proportional to a person’s consumption expenditure multiplied by the ratio between the *individual inflation rate*, computed using the basket of each particular individual, and the *economy-wide inflation rate*, computed using the basket of the average consumer. This connects this channel to the emerging literature on “inflation inequality” (Hobijn and Lagakos,

¹See Ross Sorkin (2022).

²This is in line with the evidence presented by Bihan et al. (2012) and Barattieri et al. (2014), who find that the pattern of nominal wage changes appears to be in line with the staggered contracting model of Taylor (1980), with the hazard for wage contracts peaking at 12 months both in France and the US.

2005; Kaplan and Schulhofer-Wohl, 2017; Argente and Lee, 2021; Jaravel, 2018; Jaravel, 2021), which analyzes how different individuals experience different inflation rates. For those agents who consume more of the goods and services that experience the largest price increases, that is those agents with higher individual inflation rates, this channel will lead to a reduction in their wealth, as they need to devote a larger share of resources to pay for their consumption basket. Conversely, those agents experiencing lower individual inflation rates will enjoy an increase in their wealth, as they need to devote less resources to pay for their consumption.

Next, we turn to the empirical quantification of these three channels within the context of the 2021 inflation surge in Spain. Three features of this particular episode render it an almost ideal event for our estimation exercise. First, the surge was completely unexpected as evident from different measures of inflation expectations at the end of 2020. Second, even when the sharp increase in inflation was well underway, it was (incorrectly) perceived to be very short-lived. Third, the surge arrived after a long period of very low inflation rates, making it more likely that households, firms, unions, and other agents were, at least during the first phase, still *inattentive* and facing significant costs and inertia to adjust their behavior.³ For our quantification, we employ a novel proprietary dataset from Banco Bilbao Vizcaya Argentaria SA (BBVA). BBVA is a large global bank with a strong presence in Spain. The dataset includes the universe of bank accounts, with information about deposits and current accounts, as well as mortgages, consumer loans, credit and pre-paid cards. It also includes the universe of card transactions collected from BBVA cardholders and BBVA-operated point-of-sale in Spain, originally collected in Carvalho et al. (2021) (and further expanded in Buda et al., 2022), together with other means of payment such as cash, direct debit and transfers, which allows us to account for monthly payments to utilities (i.e. electricity, water, gas, and telecommunication...⁴

Three main results emerge. First, both the wealth and the income channels are, on average, one order of magnitude larger than the relative consumption channel. This implies that heterogeneity in consumption baskets plays a smaller role than these two 'traditional' channels. The reason is that the dispersion in *individual* inflation rates across the population in 2021 was not large enough to generate significant losses or gains.

Second, the magnitudes of the income and wealth channels are equivalent in absolute value, though the income channel leads to inflation reducing real wealth of all households, whereas the wealth channel increases the real wealth of debtors while reducing that of creditors. The result is that middle-aged individuals, who have large negative NNPs due to mortgages, were

³See, for example, Reis (2006).

⁴The advantages of using actual transaction and accounts data instead of representative surveys in our setting are threefold: first, and as discussed in Kaplan and Schulhofer-Wohl (2017), actual transactions and income do not suffer from a problem of miss-reporting, or lack of memory. Second, unlike both representative surveys available for the purpose of comparison, our client data contains *both* transaction (i.e. consumption spending) as well as income and detailed balance sheet information for the *same individual*. Third, client transactions and balance sheet positions can be observed at a weekly frequency, while the relevant surveys are released with an annual or lower frequency.

roughly unaffected, or even benefited, by the 2021 inflation, while old people experienced the largest decline in real wealth, as they have large positive NNPs.

Reassuringly, these two results are confirmed if we use data from two representative surveys, publicly available, that have been extensively employed both in the policy and research domains: the consumer expenditure survey (the *Encuesta de Presupuestos Familiares* (EPF)), and the representative consumer finance survey (the *Encuesta Financiera de las Familias* (EFF)).⁵

Third, despite the increase in inflation, we observe no significant change in either NNP or income for different age groups from end-2020 to end-2022. Individual inflation, however, displayed higher variability across age groups in 2022, which suggests that the relative consumption channel may have played a larger role in that year.⁶

The approach we follow in our paper is quite straightforward: it is based on a very general set of assumptions. While this is appealing as a first answer to this important question, a number of recent works go beyond our simple framework in a number of important dimensions.⁷ First, Canto et al. (2023) study money-metric welfare movements, rather than wealth inequality, and combine cross-sectional and time series data to estimate the response to identified shocks, which allows them to assess whether different shocks to inflation carry different impacts. Second, Pallotti et al. (2023) measure welfare effects for several countries in the Euro-area, while also considering rents, dividends, and capital gains. On top of partial equilibrium effects, they impose further assumptions which allow them to analyze general equilibrium effects. They find that general equilibrium effects are an order of magnitude smaller than partial equilibrium ones.

We view our paper as a building block to Canto et al. (2023) and Pallotti et al. (2023). We impose a minimum set of assumptions, carefully mapped to a particular event, in order to quantify the contemporaneous effect of unexpected inflation on individuals' real wealth. Importantly, given the empirically sound assumptions, our estimated effects can be interpreted as emerging from general equilibrium. The length of the period for which this is a valid approximation depends, crucially, on the dynamics of expectations and how these shape behavioral responses of households and firms (in terms of consumption baskets, portfolio composition, etc.), as well as of the fiscal and monetary authorities. Tracing out the dynamic impact of different (and sizeable) inflationary shocks once these adjustments start to take place, is outside the scope of this paper. Doing so requires imposing more structure in order to characterize

⁵The EPF is a comprehensive household expenditure survey carried out with an annual frequency by the Spanish National Statistical Institute (INE). The EFF instead is a representative household survey collecting detailed information on household's balance sheets.

⁶We do not recompute aggregate results for 2022 as the conditions for the decomposition are not satisfied in 2022, with inflation being now both expected and perceived to be more persistent.

⁷Within the policy domain, the International Monetary Fund (IMF (2023)) has recently applied our framework to a wide sample of countries, including Kenya, Mexico, Senegal, Colombia, Finland, and France, showing how the estimates of the different channels, and their relative importance, are contingent to the economic structure of each country.

how equilibrium prices are determined, as well as the role of policy instruments in shaping the distributional impact of inflation.

This paper contributes to the emerging literature analyzing the heterogeneous consequences of inflation across the population. In addition to the empirical references already cited, a number of recent papers have analyzed the re-distributive effects of monetary policy in general-equilibrium models with heterogeneous agents through the Fisher channel (see Nuño and Thomas, 2022 or Ferrante and Paustian, 2019, among others), wage stickiness (Hagedorn et al., 2019, Auclert et al., 2020) and the relative consumption channel (Cravino et al., 2020; Olivi et al., 2023). We contribute to this literature by presenting a theoretical framework that allows us to quantify the relative importance of the different channels in the data. In a recent paper, Yang (2023) combines these three channels in a heterogeneous-agent New Keynesian model and analyzes optimal monetary policy.

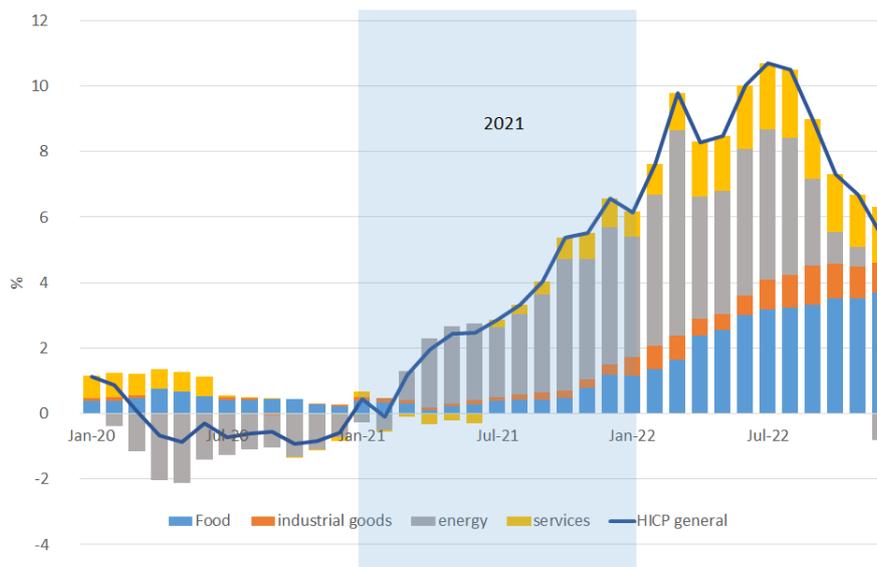
2 The unexpected increase of inflation in 2021

In this section, we analyze the surge in inflation observed in the year 2021. We focus on this year for three reasons. First, inflation experienced a large increase, quite heterogeneous across goods and services: it was concentrated on food and energy items. Second, this increase was, to a large extent, unexpected: neither households, financial markets nor professional forecasters had anticipated it by the end of 2020, or even the middle of 2021. Third, the increase was (wrongly) perceived to be short-lived, quickly reverting to relatively low inflation levels in 2022. These three reasons make the episode in 2021 ideal to study the impact of large, temporary inflation shocks on household balance sheets.

Inflation surged in 2021. Figure 1 presents the evolution of the HICP general inflation, together with broad categories, in Spain since January 2020. Inflation surged in 2021, with energy and food items experiencing a larger increase than services or manufactured (industrial) goods. This inflation rate is much larger than that in December 2020 (-0.6%) or even in June 2021 (2.5%), reflecting the surge in inflation experienced over the year 2021. We then collect price indices and inflation figures for different spending categories directly from the National Statistical Institute in Spain (INE). Focusing on 2021, Column (a) of Table 2 in appendix A shows the annual growth rate of the Harmonized Index of Consumer Prices (HICP) in Spain in December 2021, which was 6.6%. The increase in prices was strongly asymmetric. On the one hand, housing, water, electricity gas and other fuels increase more than 20% and transportation more than 10%, reflecting the large rise in the price of oil and gas after the Covid crisis. On the other hand, communications declined by -0.3% and clothing and footwear increased only 0.7%. Column (b) displays the weights in 2021 employed to compute aggregate inflation, which INE computes using EPF responses. Food and non-alcoholic beverages, housing and transport represent almost half of the consumption expenditures of the average individual.

The surge in inflation was largely unanticipated. Table 1 displays different indicators of inflation expectations for Spain. These include the Survey of Professional Forecasters (SPF), the ECB Macroeconomic Projections, the ECB Consumer Expectations Survey (CES)

Figure 1: Evolution of HICP inflation in Spain: general and main components



The figure presents Spanish HICP general inflation, as well as the inflation of its main components, from January 2020 up to December 2022. The shaded area corresponds to the period January - December 2021. Source: Spanish National Statistics Institute (INE, www.ine.es)

Table 1: Inflation expectation indicators in 2021 and 2022

	Dec. 2020		Jun. 2021	
	2021	2022	2021	2022
Survey of Professional Forecasters*	0.6	1.2	1.7	1.2
ECB projections	0.6	1.2	1.9	1.2
Inflation-linked swaps (ILS)**	1.0	0.9	1.8	1.3
Consumer Expectations Survey***	2.0	-	2.0	

Source: Survey of Professional Forecasters, ECB, Bloomberg. Note: in pp.

* For 2022 we employ the January 2021 survey.

**ILS instantaneous forward rates for Euro area inflation in Dec. 21 / 22

*** Median response about “which 12-month ahead Euro area do you expect?”

and the instantaneous forward rates derived from inflation-linked swaps (ILS). The first two indicators, the SPF and ECB projections, forecast Spanish inflation. The SPF is a survey of banks and economic institutions. The ECB projections are based on different econometric models. The CES is a survey of households from the six main European countries; it includes, among other several expectational questions, one about their 12-month ahead inflation forecast. The ILS are market indicators. They reflect the compensation for inflation risks demanded by market participants. They do not reflect genuine inflation expectations, as they may include a certain term-premium if market participants are risk averse. Figure 5 in appendix A present the evolution of expectations from two of the above measures, throughout the relevant period of analysis.

All these measures, both the point forecasts in Table 1 as well as their evolution during 2020 and 2021 in figure 5, suggest that the increase in inflation in 2021 was largely unanticipated. The expectations in December 2020 (first column in Table 2) were relatively low, all below the ECB target of 2%. The average inflation rate in 2021 was 3.1%, much higher than inflation expectations. The comparison between these numbers and the 6.6% inflation rate discussed above is not straightforward, as some of them reflect point estimates of inter-annual inflation (ILS and CES), which can be compared to 6.6%, whereas other reflect the average yearly inflation rate (SPF and ECB projections). Notwithstanding, all these numbers support the idea that economic agents were not expecting in 2020 a surge in inflation such as the one observed in 2021. The evolution of expectations displayed in figure 5 emphasizes this conclusion. Projections made by the ECB during 2020 (top panel) forecasted inflation rates for 2021 that were well below 2%. It was not until mid-2021 that inflation by the end of 2021 was forecasted above 2%. Household expectations from the CES show a similar scenario; the median 1-year ahead inflation expectation in Spain was 2% even by August 2021 (i.e. inflation between July 2021 and July 2022 was expected, in August 2021, to be around 2%).

The surge in inflation was expected to be temporary. Finally, we argue that inflation was expected to be a temporary phenomenon. Inflation expectations for 2022 hardly changed from December 2020 to June 2021 (second and fourth columns in Table 1), despite the fact that expected inflation in 2021 was much larger by June of that year than previously expected (third column). Though inflation expectations for 2022 adjusted progressively towards the end of 2021, this evidence suggests that markets and people alike interpreted the rise in inflation as temporary. For instance, in the Monetary Policy Statement following the ECB Governing Council meeting on 9 September 2021, President Lagarde stated that “*The current increase in inflation is expected to be largely temporary and underlying price pressures are building up only slowly.*”⁸ This was systematically reflected in the ECB projections, as seen in the top panel of figure 5. Inflation projections carried out during all of 2021 forecasted inflation rates which were back to 2% (or below) by mid-2022.

3 A theoretical framework to quantify the impact of surprise inflation on individual wealth

In this section, we introduce a theoretical framework to analyze the impact of surprise inflation on agents’ wealth. Time t is discrete.

Price indices. Agents can consume goods or services from K different sectors. The aggregate price level P_t is constructed as

$$P_t = \sum_{k=1}^K p_{kt} \omega_{kt},$$

⁸See <https://www.ecb.europa.eu/press/pressconf/2021/html/ecb.is210909~b2d882f724.en.html>

where p_{kt} is the price of good $k \in K$, and ω_{kt} are the weights at time t of the different goods in the basket of the average consumer, $\sum_{k=1}^K \omega_k = 1$. We define aggregate and sectoral inflation as

$$\pi_{t+1} = \frac{P_{t+1}}{P_t} - 1, \quad \pi_{kt+1} = \frac{p_{kt+1}}{p_{kt}} - 1, \quad (1)$$

respectively.

Wealth. The net wealth of an individual j at time t , $P_t a_t$, is the sum of cash, $m_{j,t}$, deposits and bonds, $d_{j,t}$, real assets (such as stocks or housing), $s_{j,t}$, and (minus) consumer debt and mortgages, $b_{j,t}$:

$$P_t a_{j,t} = m_{j,t} + Q_t d_{j,t} + P_t q_t s_{j,t} - Q_t^b b_{j,t},$$

where a_t is the wealth expressed in real terms, Q_t and Q_t^b are the prices of nominal assets and liabilities, respectively, and q_t is the price of real assets. Each period, the individual receives (i) a nominal labour income $w_{j,t}$ due to wages, unemployment benefits or pension payments; (ii) nominal interest payments i_t, i_t^b on nominal assets (bonds and deposits) and liabilities (loans and mortgages)⁹; and (iii) real interest payments r_{t+1}^s on real assets (rents, capital gains, dividends). Each period the agent also spends a nominal amount $P_{t+1} C_{j,t+1} = \sum_{k=1}^K p_{kt+1} c_{j,kt+1}$ on consumption, where $c_{j,kt}$ is the consumption of good/service k .

The budget constraint of an individual is then

$$\begin{aligned} P_{t+1} a_{j,t+1} &= m_{j,t} + \left(1 + \frac{\Delta Q_{t+1}}{Q_t} + i_t\right) Q_t d_{j,t} + \left(1 + \frac{\Delta q_{t+1}}{q_t} + r_{t+1}^s + \pi_{t+1}\right) P_t q_t s_{j,t} \\ &\quad - \left(1 + \frac{\Delta Q_{t+1}^b}{Q_t^b} + i_t^b\right) Q_t^b b_{j,t} + w_{j,t+1} - \sum_{k=1}^K p_{kt+1} c_{j,kt+1}, \end{aligned}$$

where $\frac{\Delta Q_{t+1}}{Q_t} \equiv \frac{Q_{t+1} - Q_t}{Q_t}$, $\frac{\Delta q_{t+1}}{q_t} \equiv \frac{q_{t+1} - q_t}{q_t}$ and $\frac{\Delta Q_{t+1}^b}{Q_t^b} \equiv \frac{Q_{t+1}^b - Q_t^b}{Q_t^b}$ are the capital gains/losses on deposits, real assets, and debts, respectively. The budget constraint reflects how the nominal wealth in the next period is the result of the gains/losses on current assets, including interest payments, plus nominal income, and minus consumption expenditures.

We can express the wealth at time $t + 1$ in the price level of time t . This is

$$\begin{aligned} P_t a_{j,t+1} &= \frac{1}{1 + \pi_{t+1}} m_{j,t} + \frac{1 + \frac{\Delta Q_{t+1}}{Q_t} + i_t}{1 + \pi_{t+1}} Q_t d_{j,t} + \frac{\frac{\Delta q_{t+1}}{q_t} + r_{t+1}^s + \pi_{t+1}}{1 + \pi_{t+1}} P_t q_t s_{j,t} - \quad (2) \\ &\quad - \frac{1 + i_t^b + \frac{\Delta Q_{t+1}^b}{Q_t^b}}{1 + \pi_{t+1}} Q_t^b b_{j,t} + \frac{w_{j,t+1}}{1 + \pi_{t+1}} - \sum_{k=1}^K \frac{1 + \pi_{kt+1}}{1 + \pi_{t+1}} p_{kt} c_{j,kt+1}, \end{aligned}$$

where we have applied the definition of inflation (1). We can define the individual weights $\omega_{j,kt+1} \equiv \frac{p_{kt} c_{j,kt+1}}{P_t C_{j,t+1}}$ as the ratio between the expenditure in good k and total expenditure

⁹In the case of liabilities, the agent does not receive any payment, but should pay to her creditors instead.

$C_{j,t+1}$, evaluated at time- t prices. The last term in equation (2) can thus be expressed as $P_t C_{j,t+1} \sum_{k=1}^K \frac{1+\pi_{kt+1}}{1+\pi_{t+1}} \omega_{j,kt+1}$.

For low inflation levels, we can approximate $\frac{1}{1+\pi_{t+1}} \approx 1 - \pi_{t+1}$, $\frac{1+\frac{\Delta Q_{t+1}}{Q_t}+i_t}{1+\pi_{t+1}} \approx 1 + \frac{\Delta Q_{t+1}}{Q_t} +$

$i_t - \pi_{t+1}$, and $\frac{1+\pi_{kt+1}}{1+\pi_{t+1}} \approx 1 + \pi_{kt+1} - \pi_{t+1}$. Equation (2) then simplifies to

$$P_t a_{j,t+1} \approx -\pi_{t+1} \left[NNP_{j,t} + w_{j,t+1} + P_t C_{j,t+1} \left(\sum_{k=1}^K \frac{\pi_{j,kt+1}}{\pi_{t+1}} \omega_{j,kt+1} - 1 \right) \right] \quad (3)$$

$$+ m_{j,t} + \left(1 + \frac{\Delta Q_{t+1}}{Q_t} + i_t \right) d_{j,t} + \left(1 + \frac{\Delta q_{t+1}}{q_t} + r_{t+1}^s \right) s_{j,t} - \left(1 + i_t^b \right) b_t +$$

$$+ w_{j,t+1} - P_t C_{j,t+1}$$

where

$$NNP_{j,t} \equiv m_{j,t} + Q_t d_{j,t} + P_t q_t s_{j,t} - Q_t^b b_{j,t}$$

is the *net nominal position* (NNP) at the end of period t , that is, it is the share of wealth invested in nominal instruments.

Assumptions. First, we assume *temporary surprise inflation*. It is defined as an unexpected inflation rise at time $t + 1$ that is expected to disappear at time $t + 2$, that is,

$$\pi_{t+1} > \bar{\pi}, \mathbb{E}_{t+1}[\pi_{t'}] = \bar{\pi}, \text{ for } t' > t + 1,$$

where $\bar{\pi}$ is the expected constant inflation rate. The fact that inflation is *unexpected* implies that nominal returns at time $t + 1$ i_t, i_t^b , which are determined at the end of period t , do not incorporate the surge in inflation. The fact that inflation is expected to be temporary implies that the capital gains/losses at time $t + 1$ are independent of inflation at time $t + 1$. This is because asset prices at time $t + 1$ only depend on future payments, which are unaffected as inflation is expected to revert back to its trend. This assumption is consistent with the evidence on inflation expectations presented in section 2.

Second, we also assume that nominal income is “sticky”, defined as the fact that income at time $t + 1$ does *not* depend on inflation in that period. This implies that wages or benefits are set in period t and then kept constant for a period. They can include the expected inflation at time t , $\bar{\pi}$, but not the realized inflation π_{t+1} . The evidence, again, strongly supports this (relatively standard) assumption. Most wage changes in Spain above a small threshold happen at an annual frequency, with a significant share of contracts updated every two years. Figure 6 in appendix A presents evidence that strongly supports this (relatively standard) assumption for Spain. Most wage changes above a small threshold happen at an annual frequency. There is also a significant share of contracts that are updated every two years.

Third, we abstract from general equilibrium effects through contemporaneous changes in taxation or public spending, real wages, real returns, dividends, or capital gains, that could be related to contemporaneous inflation.

Channels. Under these assumptions, the impact of inflation on an individual's wealth is fully captured by the first line of equation (3). That is, the impact of inflation is negatively proportional to

$$\underbrace{NNP_{j,t}}_{\text{Wealth channel}} + \underbrace{w_{j,t+1}}_{\text{Income channel}} + \underbrace{P_t C_{j,t+1} \left(\overbrace{\pi_{j,t+1} / \pi_{t+1}}^{\text{Individual inflation}} - 1 \right)}_{\text{Consumption channel}}, \quad (4)$$

where $\pi_{j,t+1} = \sum_{k=1}^K \pi_{j,kt+1} \omega_{j,kt+1}$, is the *individual inflation rate*.

Equation (4) captures the three main channels through which surprise inflation affects the wealth of an individual.

First, there is the standard *wealth (Fisher) channel*, by which inflation redistributes wealth from creditors of nominal assets to debtors.¹⁰

Second, there is an *income channel* as inflation reduces the real value of nominal income flows. The average increase in agreed nominal wages in Spain, both for newly signed and revised contracts, was around 1.5% in 2021, compared to a 3.1% average inflation (see the lower panel in Figure 6 in the appendix for details on this). Something similar happens with unemployment benefits and pensions. This implies that inflation made a dent in workers' and pensioners' purchasing power. While the Fisher channel favors debtors and harms creditors, the income channel negatively affects all households, as long as they enjoy labour incomes, though its impact will be larger the larger their incomes are.

Third, there is a *relative consumption channel*. The basket of goods consumed by different individuals can differ from the average basket, which is the one employed to compute aggregate inflation. If the prices of all goods grew at the same rate, this fact would be inconsequential. However, if inflation is asymmetric, that is, if inflation is higher for some goods than for others, those individuals who consume more of the goods experiencing higher price increases will have to devote proportionally more resources to maintain the same consumption basket. The result is that those individuals experiencing higher individual inflation rates compared to the average, $\pi_{t+1} < \pi_{j,t+1}$, will have to devote more resources to maintain their consumption patterns, whereas those with individual inflation below average, $\pi_{t+1} > \pi_{j,t+1}$, will devote less resources. This mechanism will be proportional to the total consumption expenditure $C_{j,t+1}$ of the individual.

The combination of these three channels, namely wealth, income and consumption will determine the total impact of surprise inflation on a person's wealth.

¹⁰In our case, as in Auclert (2019), given the temporary expected nature of inflation, this channel only operates through the product of the NNP at the end of period t times inflation at $t + 1$. This contrasts with the analysis carried out by Doepke and Schneider (2006), for instance, who consider how changes in the future path of inflation affect the NNP through asset prices.

Why not deflating using the individual price level? One may wonder why we are deflating wealth using the aggregate price level P_t and not the individual price level $P_{j,t}$ that can be constructed using individual weights. In this case the relative consumption channel would disappear, being embedded into the different magnitudes of the Fisher and income channels. There are pros and cons of this approach. On the one hand, that would solve the potential criticism that an individual cares about how the prices of the goods that she consumes change, and not those of the average consumer. On the other hand, average inflation matters independently of your individual inflation. We assume, for instance, that real assets pay a nominal return which equals the real return plus average inflation, independently of your particular consumption basket. Furthermore, deflating by different price indices makes comparison between individuals, as well as aggregation, unfeasible. These arguments convince us that our approach is the most sensible one.

Extension to multi-period shocks. In appendix B we show how the framework can be extended to a multi-period setting, in which people are systematically surprised by inflation increases.

4 Description of the data

BBVA data. In order to implement equation (4) we need individual-level data on assets, liabilities, labour income, and detailed consumption expenditures, potentially at a high frequency. To this end, we consider a proprietary dataset from Banco Bilbao Vizcaya Argentaria (BBVA). BBVA is the second largest Spanish bank by total assets, and third by number of clients. This dataset includes detailed granular information for BBVA clients' asset/liabilities positions as well as transactions.

For constructing net nominal positions, we consider: (i) on the asset side, current accounts and deposits; (ii) on the liability side, consumer loans, mortgages, and credit card balances. In terms of identified transactions needed to construct reliable consumption baskets, we consider three types of payments: (i) credit and debit card payments, (ii) direct debit payments, and (iii) 'irregular' transfers. We then follow Carvalho et al. (2021) and Buda et al. (2022), and map transactions to particular consumption goods and services, grouping them according to the 12 European Classification of Individual Consumption by Purpose (ECOICOP) categories.¹¹¹² Importantly, we also observe labour-related income (wages, pension payments and

¹¹Each of these transactions has associated to it either a Merchant Client Code (MCC), a BBVA label (ca. 100), or an IBAN / beneficiary name, together with an ID for the counterparty firm. Although we also observe cash withdrawals, we cannot map these 1-to-1 into particular transactions, so we are currently not including them in our calculations. For further details on the construction and grouping of consumption-related transactions, we refer the reader to the methodology described in Carvalho et al. (2021).

¹²In ECOICOP category 4, we do not include imputed rents. The reason for this is that the National Statistical Institute does not include them in the construction of the Harmonized Index of Consumer Prices (HICP) in Spain.

unemployment benefits) received by each client in those cases in which the said client has her BBVA account defined as a “salary/pension account”.

Our initial sample includes more than 4 million bank accounts. We then keep (i) those non-commercial clients for which we observe non-zero labour-related income in 2021, in particular, we keep clients for whom we observe monthly income flows higher than 100 euros during the previous 12 months; (ii) who have been BBVA clients for at least one year; and (iii) for whom we observe at least 10 transactions per quarter in the period 2015-2021. This leaves us with a final sample of around 1.8 million clients observed since 2016. Restrictions (i) and (iii) are the most relevant, and standard, in this context. They are imposed in order to minimize the probability that a particular client, while having an open account with BBVA, has her main account, labour payments, and financial products, in a different financial intermediary which we cannot observe. This could introduce biases in our calculations.

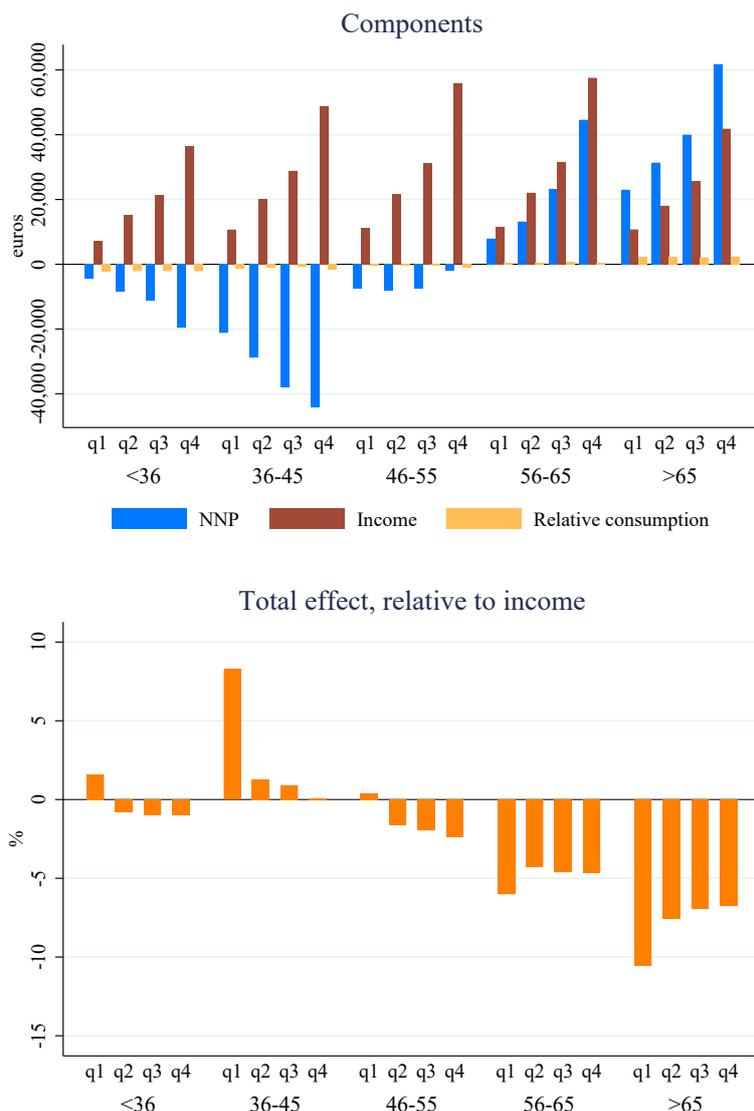
Survey data. For robustness, we redo our analysis employing data from two public surveys that have been extensively used both in the policy and research domains: the *Encuesta de Presupuestos Familiares* (EPF), and the *Encuesta Financiera de las Familias* (EFF). The EPF is a comprehensive expenditure survey carried out with annual frequency by the National Statistical Institute (INE) since 1958, with a sample size of around 20,000 households. Its main goal, similar to the U.S. Consumer Expenditure Survey (CES), is to collect detailed information on household consumption expenditures and their evolution over time. This is the main input into the calculations of weights used to construct price indices and official inflation figures. The EFF instead is a representative survey collecting detailed information on household’s balance sheets. It is conducted by Banco de España, the national central bank. It started in 2002, it runs every three years and it samples around 6,000 households per wave. It is the Spanish counterpart to the Survey of Consumer Finance (SCF) in the U.S., with the advantage of having a significant (rotating) panel component. In the next section, we discuss the differences between BBVA and survey data, especially in terms of the NNP, and we provide a more detailed discussion in appendix C.

5 Impact of inflation on households’ balance sheets

Estimating the channels. The top panel in figure (2) displays the mean value of the key objects characterizing the three channels (wealth, income and relative consumption) computed for different age and income groups.

Several interesting results emerge. First, the mean NNP is negative for all groups below 56 years, irrespective of their income. This reflects the life-cycle dynamics by which young people borrow to finance the purchase of a house, repaying it before retirement. Old people instead enjoy positive NNP in the form of cash and deposits. The most negative NNP, -48,051 eur, is that of individuals aged 36-45 years in the upper quartile of income, whereas the most positive, 61,539 eur is that of individuals older than 65 also in the upper-income quartile.

Figure 2: Components and total effect of unexpected inflation on individual wealth



The top panel presents, for each age-income group, the means of the three components in eq. (5), while the bottom panel presents the total effect of unexpected inflation on saving capacity, relative to annual income. These objects are computed as of December 2021. Nominal income and consumption are measured at an annual frequency. *Individual* inflation levels are the average inflation rate effectively experienced by each age-income group in December 2021, computed using average inflation indices for each ECOICOP category in that month and *predetermined* consumption baskets as constructed from clients' transactions in 2021. All quantities in the top panel are in euros, except indicated otherwise.

These patterns are similar to what has been found by Doepke and Schneider (2006) for the U.S. using aggregate data. Surprise inflation thus redistributes wealth from older to younger people through the wealth channel, the more so for individuals in higher income quartiles, as their NNPs are larger in absolute values.¹³

¹³Balance sheet and demographic characteristics of winners through this channel can be mapped to the wealthy hand-to-mouth" identified in Kaplan and Violante (2014), while characteristics of losers resemble those of *Ricardian* individuals at the latter part of the life-cycle. As documented by Slacalek et al. (2020), the share of wealthy hand-to-mouth households in Spain is above that of other large European countries.

Second, the income channel is of a similar magnitude to the wealth channel, but its sign is always negative. As wages and benefits are sticky at frequencies higher than annual, the erosion in real income due to surprise inflation affects all agents. This channel is naturally higher the higher income is, peaking for households before retirement age, namely those aged 56-65 years in the upper quartile.

Third, the relative consumption channel, which in our derivations above is defined as the cumulative mean of $C_{j,t+1} \left(\frac{\pi_{j,t+1}}{\pi_{t+1}} - 1 \right)$, is one order of magnitude lower than the wealth and income channels. This is not due to lower consumption (in fact, consumption is of the same order of magnitude as income), but to the size of the dispersion of *individual* inflation across age and income group.¹⁴

Notice that the relative consumption channel is negative for all individuals younger than 55 years and positive for most older people. This reflects the fact that old people, especially low-income ones, devote a larger share of their consumption to food and energy, which in 2021 experienced the largest increases. The asymmetric increase in prices across sectors thus redistributes wealth from poor old people to rich young ones. The most negative relative consumption is -439 eur for people below 36 years in the upper income quartile whereas the most positive is 449 eur for individuals older than 65 in the lower income quartile.

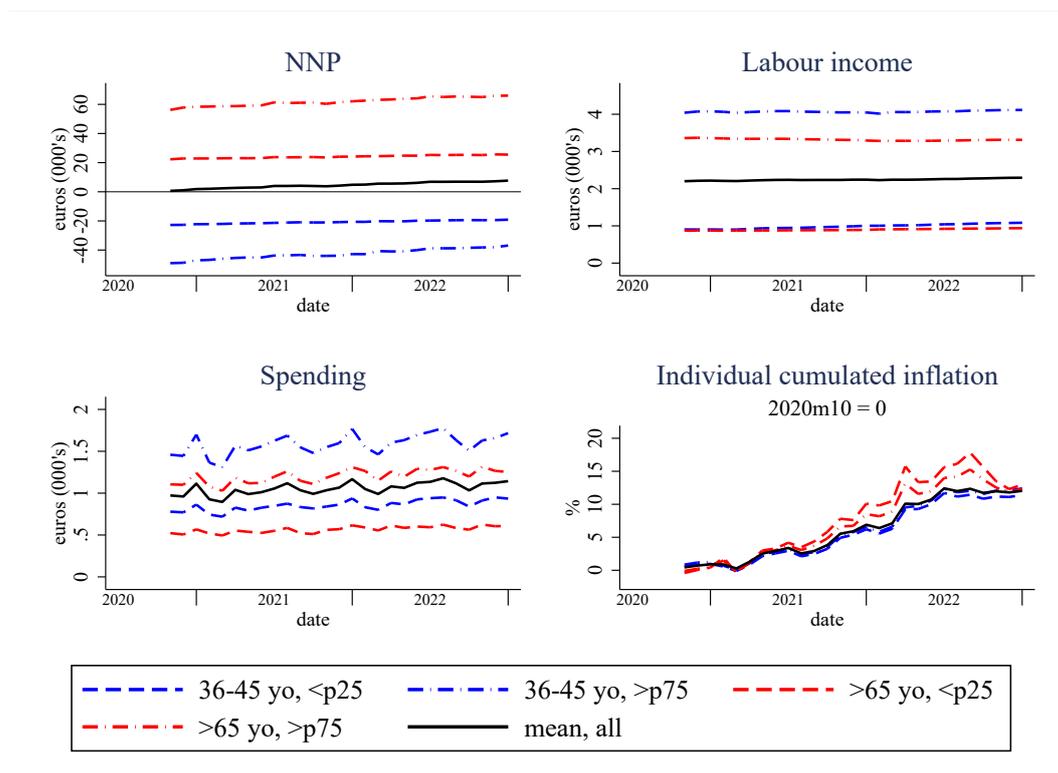
Total effect of inflation in 2021. The bottom panel in figure (2) reports the *total effect* of inflation as of December 2021, computed as the sum of the three channels multiplied by the annual inflation rate, according to equation (5).¹⁵ The impact of inflation is quite heterogeneous across households. Whereas people aged 36-45 benefited from it in 2021, especially those

¹⁴In this respect, it is worth analyzing whether our result on the magnitude of the relative consumption channel is a consequence of the aggregation of spending into broad 12 ECOICOP categories. This is the main argument in Jaravel (2018). Using U.S. scanner and survey data, he argues that, in order to properly capture inflation inequality across income brackets, one needs to analyze price and quantity /quality changes *within* detailed product categories. Using representative expenditure data from the EPF in Spain, we find a similar *attenuation from aggregation* effect. In particular, we compute average inflation rates by income quartiles (in order to match our exercise) for two different aggregations of the E-COICOP categories: our benchmark at 2-digits (constrained by the BBVA client spending information), and a finer one at the 4-digit level. Average annual inflation rates in 2021 for the bottom and top 25% of the income distribution were 3.84% and 3.06%, respectively, when using 2-digit aggregation, while the price increases implied by aggregating at the 4-digit level were 4.11% and 3.13%. This is a 25% increase in inflation differences. Although this underestimation of inflation inequality as a result of using 2-digit aggregation is non-trivial, the *missed* dispersion cannot account for the order of magnitude difference between the channels that we uncover.

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¹⁵In order to obtain the total effect as a % of annual income, we first compute the ratio for each individual, and then obtain the mean within the corresponding age-income group.

Figure 3: Dynamics of NNP, income, consumption, and individual inflation

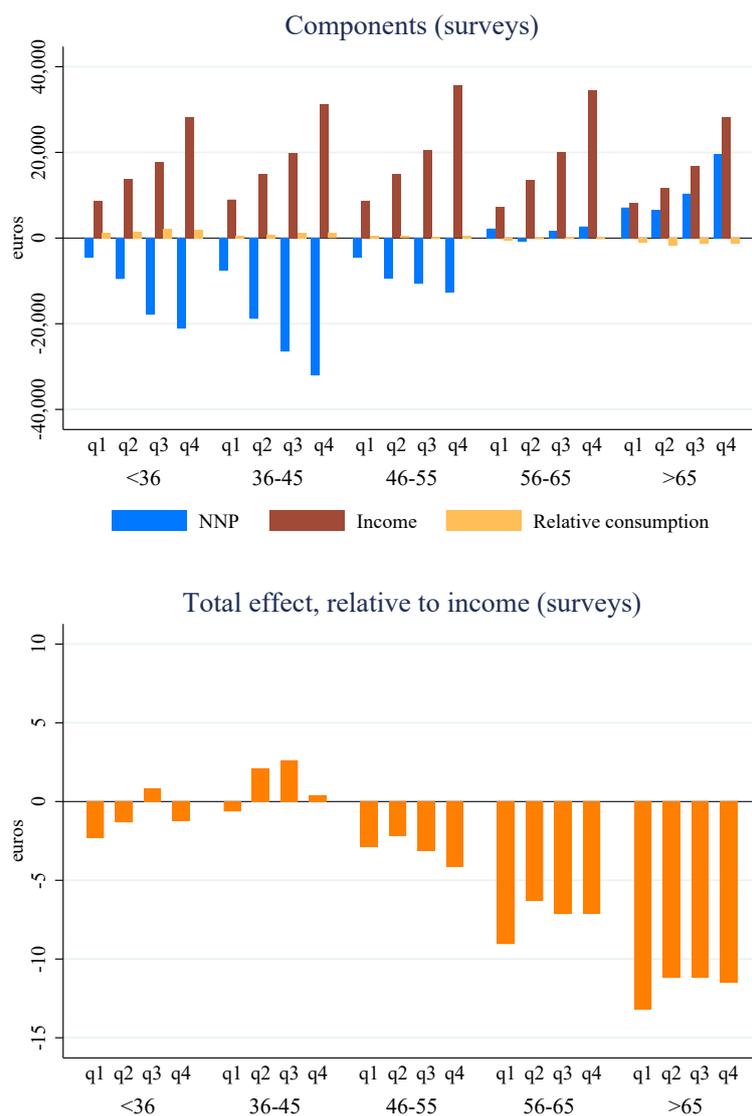


NNP, income and consumption are reported in thousands of euros. Individual inflation is the average inflation rate effectively experienced by each age-income group in each month, computed using average inflation indices for each ECOICOP category and consumption baskets constructed from clients' transactions in that month

in the lowest quartile of income, due to a reduction in their real debt burden, older individuals experienced a significant fall in their wealth due to the combination of the three channels. In order to frame total effects in terms of a variable closer to standard welfare measures, figure 7 in the appendix displays total effects relative to spending. As one would expect given standard consumption-saving behavior, magnitudes are larger than when computed relative to income; life-cycle patterns, however, are similar across the two measures.

Dynamics. Figure 3 displays how the different elements of the decomposition in equation (5) evolved before and after the year 2021. This information is useful to reject the possibility that the year 2021 was peculiar in some particular way. We can compute them at monthly frequency due to the time granularity of the BBVA sample. The first three panels display the evolution of the NNP, income, and consumption expenditures for different age groups. In the case of NNP and income, they display very little variation from 2020 to 2022. In the case of consumption, there is certain seasonality, but no trend seems to emerge. Figures 8 and 9 in appendix A present the evolution of the different components of the NNP (assets and liabilities) and the ECOICOP categories of consumption spending. The same message emerges: the main differences across individuals are along the life cycle dimension, and these have been quite stable during 2021. Individual inflation (lower right panel), however, clearly trends upward in 2021 and 2022, with a widening gap between old and young clients. This

Figure 4: Components and total effect of unexpected inflation on individual wealth: surveys



The top panel presents, for each age-income group, the means of the three components in eq. (5), while the bottom panel presents the total effect of unexpected inflation on saving capacity, relative to annual income. Net nominal positions (NNP) and nominal income are computed from the survey of consumer finance (Encuesta Financiera de las Familias, or EFF) for 2017 and 2020. Nominal income and consumption are measured at an annual frequency. *Individual* inflation levels are the average inflation rate effectively experienced by each age-income group in December 2021, computed using average inflation indices for each ECOICOP category in that month and *predetermined* consumption baskets as constructed from the survey of consumer spending (Encuesta de Presupuestos Familiares, or EPF) in 2020. All quantities in the top panel are in euros, except indicated otherwise.

reflects the larger increase in energy and food prices in 2022 after the invasion of Ukraine by Russia. The conclusion of this analysis is that the contribution of the relative consumption channel would probably have been more significant in 2022.

Estimation with representative surveys. Finally, we redo our analysis employing data from the EFF and the EPF. Results, reported in figure 4, roughly coincide with those described above using BBVA data. There are two main differences, however. First, BBVA clients aged

36-45 have more negative NNPs and clients older than 65 have more positive NNPs than the representative Spanish household in the corresponding age group reported in the EFF. Second, there is a difference in terms of consumption baskets. The sign of the relative consumption channel reverses for several age groups, as older households now benefit from inflation. This result, however, is inconsequential for the overall result, as the relative consumption channel is even more negligible in the BBVA data, given the even smaller dispersion in individual inflation rates across age and income groups.

References

- Adam, Klaus, y Junyi Zhu. (2016). “Price-Level Changes And The Redistribution Of Nominal Wealth Across The Euro Area”. *Journal of the European Economic Association*, 14(4), pp. 871-906. <https://doi.org/10.2139/ssrn.2666983>
- Argente, David, y Munseob Lee. (2021). “Cost of Living Inequality During the Great Recession”. *Journal of the European Economic Association*, 19(2), pp. 913-952. <https://doi.org/https://doi.org/10.1093/jeea/jvaa018>
- Auclert, Adrien. (2019). “Monetary Policy and the Redistribution Channel”. *American Economic Review*, 109(6), pp. 2333-2367. <https://doi.org/10.1257/aer.20160137>
- Auclert, Adrien, Bence Bardóczy y Matthew Rognlie. (2023). “MPCs, MPEs, and Multipliers: A Trilemma for New Keynesian Models”. *The Review of Economics and Statistics*, 105(3), pp. 700-712. https://doi.org/10.1162/rest_a_01072
- Barattieri, Alessandro, Susanto Basu y Peter Gottschalk. (2014). “Some Evidence on the Importance of Sticky Wages”. *American Economic Journal: Macroeconomics*, 6(1), pp. 70-101. <https://doi.org/10.1257/mac.6.1.70>
- Bihan, Hervé Le, Jérémie Montornès y Thomas Heckel. (2012). “Sticky Wages: Evidence from Quarterly Microeconomic Data”. *American Economic Journal: Macroeconomics*, 4(3), pp. 1-32. <https://doi.org/10.1257/mac.4.3.1>
- Buda, Gergely, Vasco M. Carvalho, Stephen Hansen, Álvaro Ortiz, Tomasa Rodrigo y Sevi Rodriguez Mora. (2022). “National Accounts in a World of Naturally Occurring Data: A Proof of Concept for Consumption”. Mimeo, BBVA.
- Canto, Felipe N. Del, John R. Grigsby, Eric Qian y Conor Walsh. (2023). “Are Inflationary Shocks Regressive? A Feasible Set Approach”. NBER Working Papers, 31124, National Bureau of Economic Research, Inc. <https://doi.org/https://doi.org/10.3386/w31124>
- Cao, Shutao, Cesaire A. Meh, José-Víctor Rios-Rull y Yaz Terajima. (2021). “The welfare cost of inflation revisited: The role of financial innovation and household heterogeneity”. *Journal of Monetary Economics*, 118(C), pp. 366-380. <https://doi.org/10.1016/j.jmoneco.2020.11>
- Carvalho, Vasco M., Juan Ramón García, Stephen Hansen, Álvaro Ortiz, Tomasa Rodrigo, Sevi Rodriguez Mora y José Ruiz. (2021). “Tracking the COVID-19 Crisis with High-Resolution Transaction Data”. *Royal Society Open Science*, (8). <https://doi.org/10.1098/rsos.210218>
- Cravino, Javier, Ting Lan y Andrei A. Levchenko. (2020). “Price stickiness along the income distribution and the effects of monetary policy”. *Journal of Monetary Economics*, 110(C), pp. 19-32. <https://doi.org/10.1016/j.jmoneco.2018.12.001>
- Doepke, Matthias, y Martin Schneider. (2006). “Inflation and the Redistribution of Nominal Wealth”. *Journal of Political Economy*, 114(6), pp. 1069-1097. <https://doi.org/10.1086/508379>

- Ferrante, Francesco, y Matthias Paustian. (2019). “Household Debt and the Heterogeneous Effects of Forward Guidance”. *International Finance Discussion Papers*, 1267, Board of Governors of the Federal Reserve System (U.S.). <https://doi.org/10.17016/ifdp.2019.1267>
- Hagedorn, Marcus, Jinfeng Luo, Iourii Manovskii y Kurt Mitman. (2019). “Forward guidance”. *Journal of Monetary Economics*, 102(C), pp. 1-23. <https://doi.org/10.3386/w24521>
- Hobijn, Bart, y David Lagakos. (2005). “Inflation Inequality In The United States”. *Review of Income and Wealth*, 51(4), pp. 581-606. <https://doi.org/10.1111/j.1475-4991.2005>
- IMF. (2023). “Chapter 2: Inflation and Disinflation: What Role for Fiscal Policy?”. *Fiscal Monitor*. <https://doi.org/https://doi.org/10.5089/9798400234026.089>
- Jaravel, Xavier. (2018). “The unequal gains from product innovations: Evidence from the U.S. retail sector”. *The Quarterly Journal of Economics*, 134(2), pp. 715-783. <https://doi.org/10.1093/qje/qjy031>
- Jaravel, Xavier. (2021). “Inflation Inequality: Measurement, Causes, and Policy Implications”. *Annual Review of Economics*, 13(1), pp. 599-629. <https://doi.org/10.1146/annurev-economics-091520-082042>
- Kaplan, Greg, y Sam Schulhofer-Wohl. (2017). “Inflation at the household level”. *Journal of Monetary Economics*, 91(C), pp. 19-38. <https://doi.org/10.3386/w22331>
- Kaplan, Greg, y Giovanni L. Violante. (2014). “A model of the consumption response to fiscal stimulus payments”. *Econometrica*, 82(4), pp. 1199-1239. <https://doi.org/10.3982/ECTA10528>
- Meh, Cesaire A., José-Víctor Rios-Rull y Yaz Terajima. (2010). “Aggregate and welfare effects of redistribution of wealth under inflation and price-level targeting”. *Journal of Monetary Economics*, 57(6), pp. 637-652. <https://doi.org/https://doi.org/10.1016/j.jmoneco.2010.05.001>
- Nuño, Galo, y Carlos Thomas. (2022). “Optimal Redistributive Inflation”. *Annals of Economics and Statistics*, (146), pp. 3-63. <https://doi.org/10.2307/4>
- Olivi, Alan, Vincent Sterk y Dajana Xhani. (2023). “Optimal Monetary Policy during a Cost of Living Crisis”. Mimeo, UCL.
- Pallotti, Filippo. (2022). “Winners and losers from unexpected inflation”. Working paper, UCL.
- Pallotti, Filippo, Gonzalo Paz-Pardo, Jirka Slacalek, Oreste Tristani y Gianluca Violante. (2023). “Who bears the costs of inflation? Euro area households and the 2021-2022 shock”. Working Paper Series, 31896, NBER. <https://doi.org/https://doi.org/10.3386/w31896>
- Reis, Ricardo. (2006). “Inattentive consumers”. *Journal of Monetary Economics*, 53(8), pp. 1761-1800. <https://doi.org/10.1016/j.jmoneco.2006.03.001>
- Ross Sorkin, Andrew. (2022). *Ben Bernanke Sees Stagflation Ahead*.

- Slacalek, Jiri, Oreste Tristani y Giovanni L. Violante. (2020). “Household balance sheet channels of monetary policy: A back of the envelope calculation for the euro area”. *Journal of Economic Dynamics and Control*, 115. <https://doi.org/https://doi.org/10.1016/j.jedc.2020.103879>
- Taylor, John B. (1980). “Aggregate Dynamics and Staggered Contracts”. *Journal of Political Economy*, 88(1), pp. 1-23. <https://doi.org/10.1086/260845>
- Yang, Yucheng. (2023). “Redistributive Inflation and Optimal Monetary Policy”. Mimeo, Princeton. <https://doi.org/https://doi.org/10.2139/ssrn.4275770>

Online Appendix

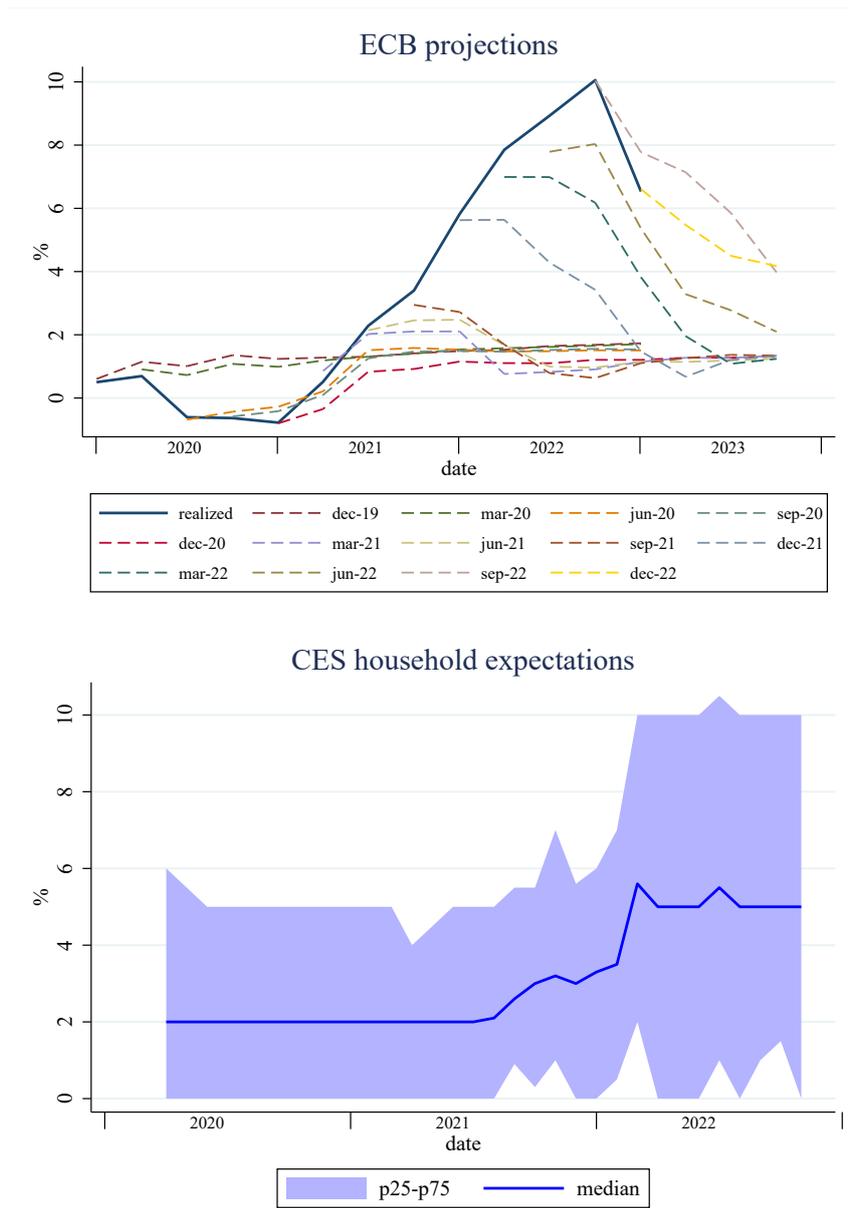
A Additional tables and figures

Table 2: Annual inflation and weights by ECOICOP group - December 2021

	(a) Inflation		Weights	
	INE	BBVA	(b) INE	(c) BBVA
General	6.6	3.9		
1. Food and non-alcoholic beverages	4.9		22.8	15.6
2. Alcoholic beverages and tobacco	1.6		3.1	5.3
3. Clothing and footwear	0.7		6.3	7.2
4. Housing and energy	22.9		13.2	5.5
5. Furniture and household equipment	2.1		5.9	5.6
6. Health	0.8		3.8	7.7
7. Transport	10.7		12.9	15.6
8. Communications	-0.3		3.6	2.7
9. Recreation and culture	2.3		5.5	9.1
10. Education	1.2		1.6	1.3
11. Hotels, cafes and restaurants	4.0		13.1	10.1
12. Others	1.6		8.1	14.2

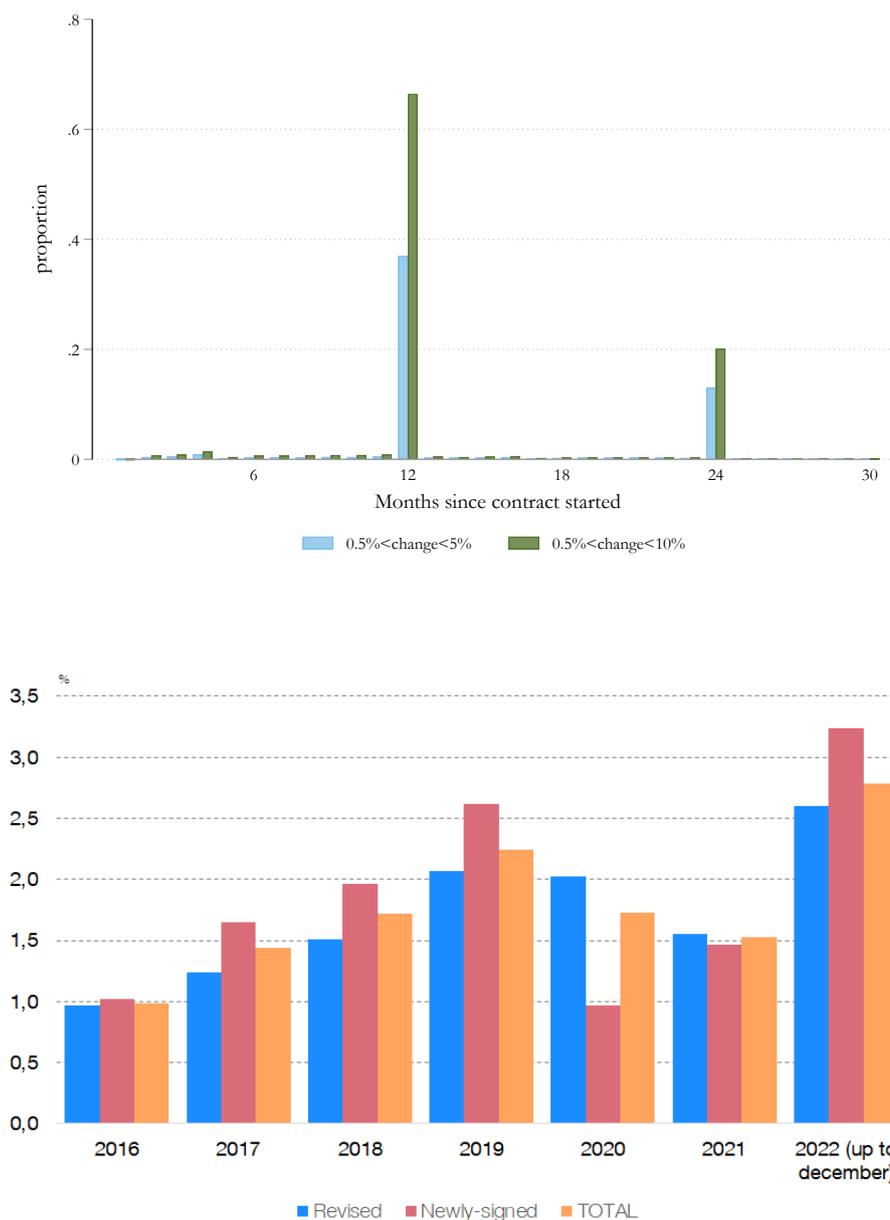
Values are in pp. Source: Spanish National Statistics Institute (INE, www.ine.es) and BBVA proprietary data. General inflation (a) is computed using the inflation rates for each COICOP group (common to INE and BBVA) and the spending weights (columns (b) and (c)).

Figure 5: Evolution of alternative inflation expectations measures for Spain



The top panel presents 2-years ahead forecasts emerging from the Broad Macroeconomic Projection Exercise (BMPE) carried out at a quarterly frequency by the ECB. The bottom panel presents the distribution (median and inter-quartile range) of households' 1-year ahead inflation expectations constructed using the answers of households from Spain as reported in the CES since April 2020.

Figure 6: Frequency of wage changes in labor contracts and wage re-negotiations in Spain



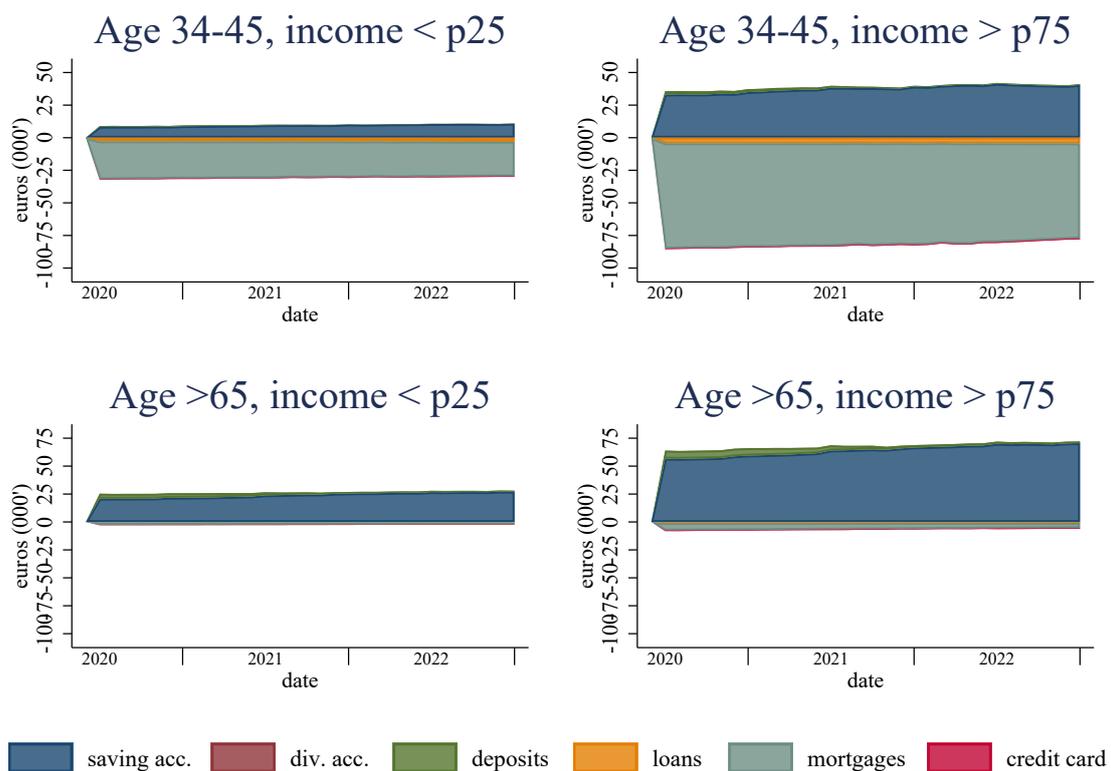
The top panel presents, for contracts that last at least 1 year, the proportion of which change by a certain magnitude (between 0.5% and 5%, or between 0.5% and 10%) in each of the 30 months after a contract is signed. The bottom panel reports nominal wage increases for existing contracts that are revised (blue bars) and newly signed contracts, as compared to existing contracts for the same position (red bars). Data source: the top panel is constructed from a random sample of administrative wage records of 1940 to 2004 cohorts in Spain, the *Muestra Continua de Vidas Laborales (MCVL)*, whereas the bottom panel is based on data from the Spanish Labour Ministry.

Figure 7: Total effect of unexpected inflation on individual wealth: BBVA vs surveys



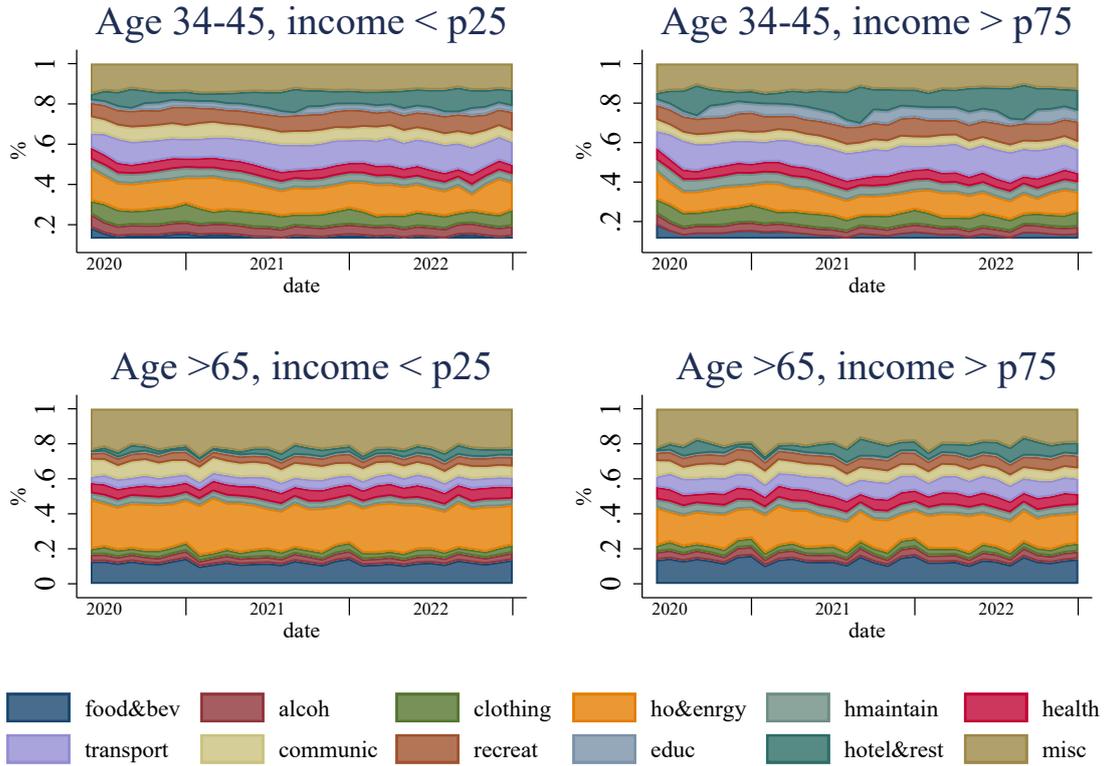
The figure presents the total effect of unexpected inflation on saving capacity, relative to annual income and annual spending, for the BBVA client sample (top panel) and from surveys (bottom panel).

Figure 8: Evolution of assets and liabilities that make up the NNP, by age and income groups



Each panel presents the evolution of average values (in thousand of euros) for each age-income group in the BBVA client sample.

Figure 9: Evolution of the share of spending on each ECOICOP category, by age and income groups



Each panel presents the evolution of the average share of total spending dedicated to the 12 main ECOICOP categories, by the corresponding age-income group in the BBVA client sample.

B Extension to multi-period shocks

The decomposition of the impact of inflation above can be extended to the case in which agents are systematically surprised by above-expectations inflation that they expect to be short-lived.

Assume that the episode lasts for $T > 1$ periods, wealth after T periods is

$$\begin{aligned}
 P_{t+T}a_{j,t+T} &= m_{j,t} + \sum_{\tau=1}^{T-1} \Delta m_{j,t+\tau} + \left(1 + \frac{\Delta Q_{t+1}}{Q_t} + i_t\right) Q_t d_{j,t} \\
 &+ \sum_{\tau=1}^{T-1} \left(1 + \frac{\Delta Q_{t+\tau+1}}{Q_{t+\tau}} + i_{t+\tau}\right) Q_{t+\tau} \Delta d_{j,t+\tau} \\
 &+ \left(1 + \frac{\Delta q_{t+1}}{q_t} + r_{t+1}^s + \pi_{t+1}\right) P_t q_t s_{j,t} \\
 &+ \sum_{\tau=1}^{T-1} \left(1 + \frac{\Delta q_{t+\tau+1}}{q_{t+\tau}} + r_{t+\tau}^s + \pi_{t+\tau}\right) P_{t+\tau} q_{t+\tau} \Delta s_{j,t+\tau}
 \end{aligned}$$

$$\begin{aligned}
& - \left(1 + \frac{\Delta Q_{t+1}^b}{Q_t^b} + i_t^b \right) Q_t^b b_{j,t} - \sum_{\tau=1}^{T-1} \left(1 + \frac{\Delta Q_{t+\tau+1}^b}{Q_{t+\tau}^b} + i_{t+\tau}^b \right) Q_{t+\tau}^b \Delta b_{j,t+\tau} \\
& + \sum_{\tau=1}^T w_{j,t+\tau} - \sum_{\tau=1}^T \sum_{k=1}^K p_{kt+\tau} c_{j,kt+\tau},
\end{aligned}$$

where Δx_t is the monthly change in the balance of variable $x_t = \{m_{j,t}, d_{j,t}, s_{j,t}, b_{j,t}\}$. In this case, we can express the impact of inflation wealth at time $t + T$ in time- t prices, proceeding as above, as

$$\underbrace{NNP_{j,t+T}}_{\text{Wealth channel}} + \underbrace{\sum_{\tau=1}^T w_{j,t+\tau}}_{\text{Income channel}} + \underbrace{\sum_{\tau=1}^T P_t C_{j,t+\tau} \left(\frac{\sum_{s=1}^{\tau} \pi_{j,t+s}}{\sum_{s=1}^{\tau} \pi_{t+s}} - 1 \right)}_{\text{Consumption channel}}, \quad (5)$$

where we have applied the fact that

$$\begin{aligned}
\frac{P_t}{P_{t+T}} \sum_{\tau=1}^T \sum_{k=1}^K p_{kt+\tau} c_{j,kt+\tau} &= \sum_{\tau=1}^T P_t C_{j,t+\tau} \sum_{k=1}^K \frac{\prod_{s=1}^{\tau} (1 + \pi_{kt+s})}{\prod_{s=1}^{\tau} (1 + \pi_{t+s})} \frac{p_{kt+\tau} c_{j,kt+\tau}}{P_t C_{j,t+\tau}} \approx \\
&\approx \sum_{\tau=1}^T P_t C_{j,t+\tau} \left(\frac{\sum_{s=1}^{\tau} \pi_{j,t+s}}{\sum_{s=1}^{\tau} \pi_{t+s}} - 1 \right)
\end{aligned}$$

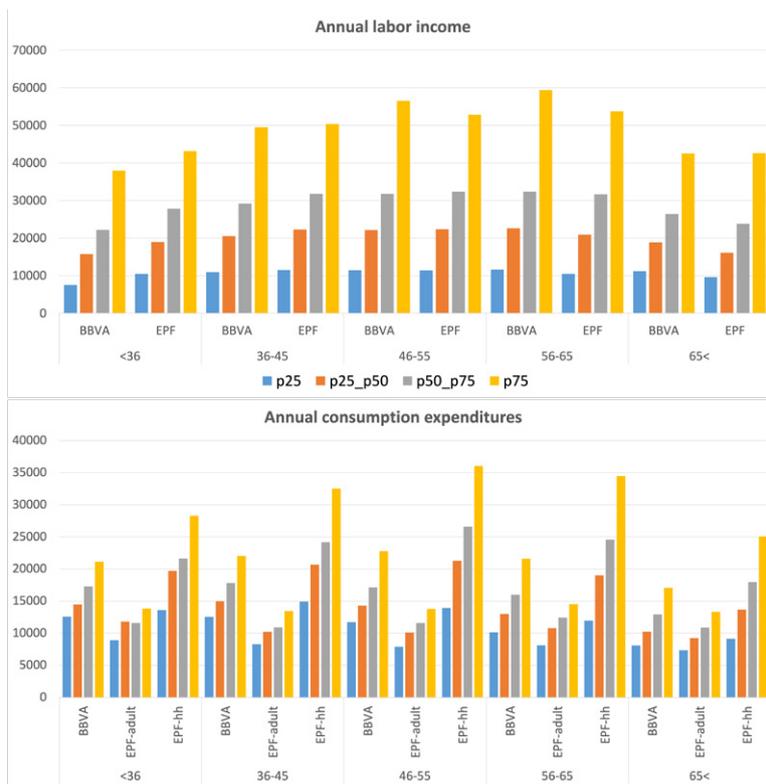
Equation (5) implies that, in this case, the relevant NNP is that at the end of the period, $NNP_{j,t+T} = NNP_{j,t} + \sum_{\tau=1}^{T-1} (\Delta m_{j,t+\tau} + Q_{t+\tau} \Delta d_{j,t+\tau} - Q_{t+\tau}^b \Delta b_{j,t+\tau})$, while the income is the total accumulated income over the period. Regarding the consumption inequality channel, it depends on the period-by-period ratio between individual and aggregate inflation.

C Comparison between BBVA data and representative surveys

Figure 10 presents a comparison between our final BBVA client sample and the Spanish population captured by the representative surveys. Both datasets deliver roughly similar results for consumption expenditures and income. Notwithstanding, two features are worth noting. First, while clients below 36 years tend to have lower labour income than the average Spanish individual, the opposite is true for older clients on the top quartile of the conditional income distribution. Middle-aged clients seem to be representative of the Spanish population. Second, client-level consumption expenditures in the BBVA sample are lower than the expenditures that emerge from the EPF, for all age-income groups.

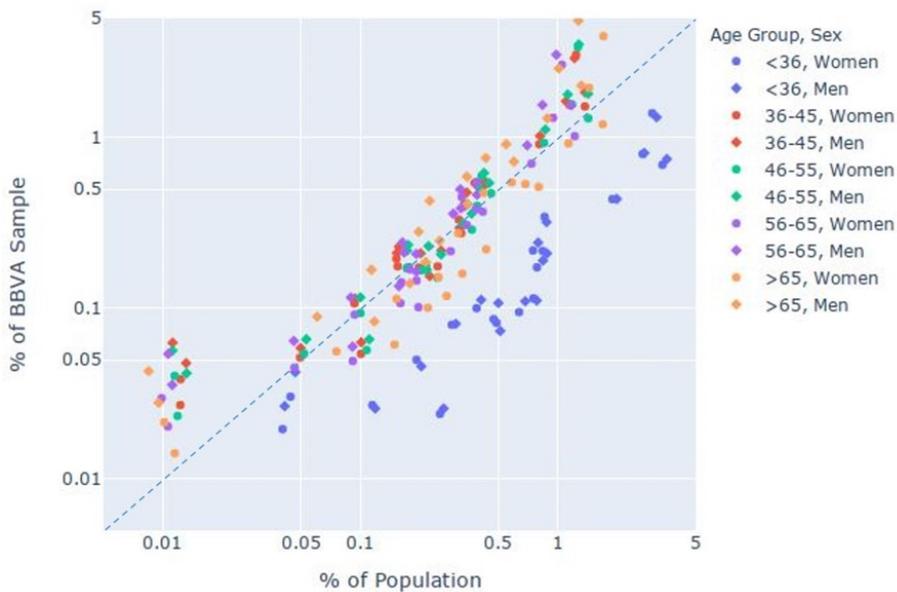
Column (c) in table 2 presents the consumption category weights in order to construct price indices computed using the BBVA client sample. The main differences that emerge with respect

Figure 10: Descriptive statistics: income and consumption. BBVA clients vs EPF (adult and household)



The figure presents mean annual labour income (top panel) and mean annual consumption expenditures (bottom panel) for each age-income quartile group in our benchmark BBVA client sample, as well as in the EPF. Variables are constructed as described in the main text.

Figure 11: Comparison between the BBVA client sample and the Spanish population



to INE is the smaller weight in housing and energy prices (item 4) and the larger increase in health (item 6) and recreation and culture (item 9). This reflects the client characteristics outlined in the main text: despite the correction, there is a higher proportion of richer and older individuals compared to the Spanish population. This leads to a lower inflation in the BBVA sample, that is, if we compute the average increase in prices in the consumption basket of BBVA clients it yields 3.9% instead of 6.6%, as shown in Table 2.

Figure 11 hints that the BBVA client sample might present certain systematic differences with respect to the overall Spanish population. In particular, older groups are in general over-represented in the sample, while younger groups are under-represented. Although this translates to differences in consumption baskets (see columns (a) and (c) of table 2) figure 10 shows, however, that the overall mapping on income and consumption is surprisingly good. In order to bring the two closer together, we perform a post-stratification exercise to account for such differences across age, gender, and region.¹⁶

¹⁶In particular, we account for demographic imbalances between the active customer sample and Spanish census data from 2018 using the methodology described in Buda et al. (2022).

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