The Heterogeneous Impact of Inflation on Households' Balance Sheets *

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Abstract

We identify and study analytically three key channels that shape how inflation affects households' wealth: (i) the traditional wealth (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 price 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 and high-frequency client-level data from one of the main commercial banks. The unexpected nature and temporary perception of the inflation shock in this particular period closely maps on to the assumptions behind our theoretical decomposition. Results show that the wealth and income channels are one order of magnitude larger than the consumption channel. Middle-aged individuals were largely unaffected by inflation, while older ones suffered the most. We find similar results when using representative surveys on households' wealth, income, and consumption.

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

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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 households' wealth.

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 characterize 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, Rios-Rull, and Terajima (2010) Adam and Zhu (2016), Auclert (2019), Cao, Meh, Rios-Rull, and Terajima (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

[1] See Ross Sorkin (2022).

[2] This is in line with the evidence presented by Bihan, Montornès, and Heckel (2012) and Barattieri, Basu, and Gottschalk (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.

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 (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 the second largest Spanish bank by total assets, and third by number of clients. 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, García, Hansen, Ortiz, Rodrigo, Rodriguez Mora, and Ruiz (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]

[3]See, for example, Reis (2006).

[4]The 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

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 the 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 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 with strong empirical backing. A couple of recent works directly use our decomposition to carry out an extended cross-country analysis. First, using survey data for six countries within the euro area (France, Germany, Greece, Italy, Portugal and Spain), Chafwehé, Ricci, and Stoehlker (2024) find similar relative magnitudes for the different channels across age and income groups as the ones we uncover for Spanish individuals. Second,

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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.

[5]The 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.

[6]We 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.

the International Monetary Fund (IMF, 2023) has applied our decomposition to an even wider sample of countries, including Kenya, Mexico, Senegal, Colombia, Finland, and France. Both of these papers show how the estimates of the different channels, and their relative importance, are contingent on the economic structure of each country. Note, however, that the accuracy of these quantifications crucially depend on how well the assumptions underlying our theoretical decomposition capture the particular situation of each country in 2020-2021. We emphasize this point in Sections 2 and 3.

While this framework is appealing as a first answer to an important question, two recent works go beyond our simple decomposition in some important dimensions. First, Del Canto, Grigsby, Qian, and Walsh (2023) study money-metric welfare movements as in Fagereng, Gomez, Émilien Gouin-Bonenfant, Holm, Moll, and Natvik (2024) and combine cross-sectional and time series data to estimate the response to identified shocks, which allows them to assess whether different origins of shocks to inflation carry different impacts. Second, starting from a similar framework as ours, Pallotti, Paz-Pardo, Slacalek, Tristani, and Violante (2023) impose further reasonable assumptions to characterize the effect on money-metric welfare of three additional channels related to (i) (unconventional) fiscal responses, (ii) equilibrium response of prices, and (iii) long-run effects. They implement this extended decomposition with data from four European countries during 2021 and 2022. Interestingly, they find that the key *direct channels* through which the inflation shock affected welfare are the same we quantify for Spain in 2021, namely the change in the net nominal position as well as in wages and pensions. Fiscal policy responses, the effect of heterogeneous consumption baskets, and general equilibrium (*indirect*) effects, while non-trivial, are significantly smaller. Additionally, and in line with what we uncover here, they find age to be the main dimension of heterogeneity.

We view our paper as a building block to Del Canto, Grigsby, Qian, and Walsh (2023) and Pallotti, Paz-Pardo, Slacalek, Tristani, and Violante (2023) in the following sense. We impose a minimum set of assumptions which we carefully map to a particular event, i.e. Spain in 2021, with features that make it an almost ideal set-up to quantify our analytical decomposition. Although the channels we characterize are a sub-set of those presented in Pallotti, Paz-Pardo, Slacalek, Tristani, and Violante (2023), this is precisely a consequence of our choice to exploit the 2021 event to measure, as cleanly as possible, the effect of the inflation shock *on impact*.[7] Our analysis abstracts from the more complex (albeit very interesting and

[7]Our decomposition can be seen as capturing the direct component in the welfare analysis of Pallotti, Paz-Pardo, Slacalek, Tristani, and Violante (2023). We note that, while our focus is on changes in real wealth, this coincides with money-metric welfare, so our results can be directly reinterpreted in

relevant) problem that arises when agents realize the shock is more persistent (and potentially larger) than what was expected. In that scenario, expectations start to adjust and therefore to shape behavioral responses of households and rms (in terms of consumption baskets, portfolio composition, pricing decisions, etc.), as well as of the scal and monetary authorities. Tracing out the dynamic impact of a sizeable in ationary shock once these adjustments start to take place, requires imposing more structure in order to characterize how equilibrium prices are determined, as well as the role of policy instruments in shaping the distributional impact of in ation.

This paper contributes to the emerging literature analyzing the heterogeneous consequences of in ation across the population. In addition to the empirical references already cited, a number of recent papers have analyzed the re-distributive e ects 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, Luo, Manovskii, and Mitman (2019), Auclert, Bardóczy, and Rognlie (2023)) and the relative consumption channel (Cravino, Lan, and Levchenko (2020); Olivi, Sterk, and Xhani (2023)). We contribute to this literature by presenting a theoretical framework that allows us to quantify the relative importance of the di erent 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 in ation in 2021

In this section, we analyze the surge in in ation observed in the year 2021. We focus on this year for three reasons. First, in ation 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, nancial 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 in ation levels in 2022. These three reasons make the episode in 2021 ideal to study the impact of large, temporary in ation shocks on household balance sheets.

In ation surged in 2021 . Figure 1 presents the evolution of the Harmonized Index of Consumer Prices (HICP), together with broad categories, in Spain since January 2020.

welfare terms.

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

The gure presents Spanish HICP general in ation, as well as the in ation 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)

In ation surged in 2021, with energy and food items experiencing a larger increase than services or manufactured (industrial) goods. This in ation rate is much larger than that in December 2020 (-0.6%) or even in June 2021 (2.5%), re ecting the surge in in ation experienced over the year 2021. We then collect price indices and in ation gures for di erent spending categories directly from the National Statistical Institute in Spain (INE). Focusing on 2021, Column (a) of Table 1 shows the annual growth rate of the 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%, re ecting 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 in ation, 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.

Table 1: Annual in ation and weights by ECOICOP group - December 2021

	(a) In ation		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 in ation (a) is computed using the in aiton rates for each COICOP group (common to INE and BBVA) and the spending weights (columns (b) and (c)).

The surge in in ation was largely unanticipated. Table 2 displays di erent indicators of in ation expectations for Spain. These include the Survey of Professional Forecasters (SPF), the ECB Macroeconomic Projections, the ECB Consumer Expectations Survey (CES) and the instantaneous forward rates derived from in ation-linked swaps (ILS). The rst two indicators, the SPF and ECB projections, forecast Spanish in ation. The SPF is a survey of banks and economic institutions. The ECB projections are based on di erent 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 in ation forecast. The ILS are market instruments. They re ect the compensation for in ation risks demanded by market participants. They do not re ect genuine in ation expectations, as they may include a certain term premium if market participants are risk averse. Figure 2 presents 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 2 as well as their evolution during 2020 and 2021 in Figure 2, suggest that the increase in in ation in 2021 was largely unanticipated. The expectations in December 2020 (rst column in Table 2) were relatively low, all

Figure 2: Evolution of alternative in ation 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 in ation expectations constructed using the answers of households from Spain as reported in the CES since April 2020.

Table 2: In ation 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
In ation-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 in ation in Dec. 21 / 22
Median response about which 12-month ahead Euro area do you expect?

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

The surge in in ation was expected to be temporary. Finally, we argue that in- ation was expected to be a temporary phenomenon. In ation expectations for 2022 hardly changed from December 2020 to June 2021 (second and fourth columns in Table 2), despite the fact that expected in ation in 2021 was much larger by June of that year than previously expected (third column). Though in ation expectations for 2022 adjusted progressively towards the end of 2021, this evidence suggests that markets and people alike interpreted the rise in in ation 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 in ation 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 2. 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

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

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

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

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,

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

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

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

$$P_{t+1} a_{j;t+1} + \sum_{k=1}^{K} p_{kt+1} c_{j;kt+1} = m_{j;t} + Q_{t+1} d_{j;t} + P_{t+1} q_{t+1} s_{j;t} \quad Q^b_{t+1} b_{j;t} + i_t Q_t d_{j;t} + r^s_{t+1} P_{t+1} q_t s_{j;t} \quad i^b_t Q^b_t b_{j;t} + w_{j;t+1};$$

which reflects that the nominal value of wealth plus expenses in $t+1$ (on the left hand side) have to be equal to the total value of wealth in period t, valued at prices in $t+1$, plus the asset payments and income (on the right hand side).[10] The budget constraint can then be expressed as

$$P_{t+1} a_{j;t+1} = m_{j;t} + \left(1 + \frac{Q_{t+1}}{Q_t} + i_t\right) Q_t d_{j;t} + \left(1 + \frac{q_{t+1}}{q_t} + r^s_{t+1}\right) P_{t+1} q_t s_{j;t} \left(1 + \frac{Q^b_{t+1}}{Q^b_t} + i^b_t\right) Q^b_t b_{j;t} + w_{j;t+1} \sum_{k=1}^{K} p_{kt+1} c_{j;kt+1};$$

where $\frac{Q_{t+1}}{Q_t} \quad \frac{Q_{t+1} \quad Q_t}{Q_t}$; $\frac{q_{t+1}}{q_t} \quad \frac{q_{t+1} \quad q_t}{q_t}$ and $\frac{Q^b_{t+1}}{Q^b_t} \quad \frac{Q^b_{t+1} \quad Q^b_t}{Q^b_t}$ 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

$$P_t a_{j;t+1} = \frac{1}{1 + \quad_{t+1}} m_{j;t} + \frac{1 + \frac{Q_{t+1}}{Q_t} + i_t}{1 + \quad_{t+1}} Q_t d_{j;t} + \left(1 + \frac{q_{t+1}}{q_t} + r^s_{t+1}\right) P_t q_t s_{j;t} \quad (2)$$
$$\frac{1 + i^b_t + \frac{Q^b_{t+1}}{Q^b_t}}{1 + \quad_{t+1}} Q^b_t b_t + \frac{w_{j;t+1}}{1 + \quad_{t+1}} \sum_{k=1}^{K} \frac{1 + \quad_{kt+1}}{1 + \quad_{t+1}} p_{kt} c_{j;kt+1};$$

where we have applied the definition of inflation (1). We can define the individual weights $!_{j;kt+1} \quad \frac{p_{kt} c_{j;kt+1}}{P_t C_{j;t+1}}$ as the ratio between the expenditure in good k and total expenditure $C_{j;t+1}$, evaluated at time-t prices. The last term in equation (2) can thus be expressed as

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instead.

[10] Notice that while the nominal interest rates on nominal assets and liabilities are predetermined at time t, those on real assets are determined at time $t+1$. The real return on nominal assets and liabilities will be determined at time $t+1$ as it depends on inflation.

$P_t C_{j;t+1}$ $\sum_{k=1}^{K} \frac{1+\ _{kt+1}}{1+\ _{t+1}}!\ _{j;kt+1}$.

For low in ation levels, we can approximate $\frac{1}{1+\ _{t+1}}$ t 1 $_{t+1}$, $\frac{1+\frac{Q_{t+1}}{Q_t}+i_t}{1+\ _{t+1}}$ t $1+\frac{Q_{t+1}}{Q_t}+i_t$ $_{t+1}$, and $\frac{1+\ _{kt+1}}{1+\ _{t+1}}$ t $1+\ _{kt+1}$ $_{t+1}$. Equation (2) then simpli es to

$$P_t a_{j;t+1} \quad t \quad _{t+1} \quad NNP_{j;t} + w_{j;t+1} + P_t C_{j;t+1} \left(\sum_{k=1}^{K} \frac{j;kt+1}{t+1}!\ _{j;kt+1} \quad 1 \right) \tag{3}$$
$$+ m_{j;t} + \quad 1 + \frac{Q_{t+1}}{Q_t} + i_t \quad d_{j;t} + \quad 1 + \frac{q_{t+1}}{q_t} + r^s_{t+1} \quad s_{j;t} \quad 1 + \frac{Q^b_{t+1}}{Q^b_t} + i^b_t \quad b_{j;t}$$
$$+ w_{j;t+1} \quad P_t C_{j;t+1}$$

where

$$NNP_{j;t} \quad m_{j;t} + Q_t d_{j;t} + P_t q_t s_{j;t} \quad Q^b_t b_{j;t}$$

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 assumetemporary surprise in ation . It is de ned as an unexpected in ation rise at time $t+1$ that is expected to disappear at time$t+2$, that is,

$$_{t+1} > \ ; \ E_{t+1}[\ _{t'}] = \ ; \text{ for } t' > t+1;$$

where is the expected constant in ation rate. The fact that in ation is unexpectedimplies that nominal returns at time $t+1$, i_t, i^b_t, which are determined at the end of period$t$, do not incorporate the surge in in ation. The fact that in ation is expected to be temporary implies that the capital gains/losses at time $t+1$ are independent of in ation at time $t+1$. This is because asset prices at time$t+1$ only depend on future payments, which are una ected as in ation is expected to revert back to its trend. This assumption is consistent with the evidence on in ation expectations presented in Section 2. As in ation is expected to revert to the constant value , the in ationary episode introduces persistent di erences in individual prices. We do not analyze the impact in posterior periods.

Second, we also assume that nominal income is sticky , de ned as the fact that income at time $t+1$ doesnot depend on in ation in that period. This implies that wages or bene ts are set in period t and then kept constant for a period. They can include the expected in ation at time t, , but not the realized in ation $_{t+1}$. 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 signi cant share of contracts updated every two years. The

upper panel in Figure 3 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 signi cant share of contracts that are updated every two years.

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

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

$$\underbrace{NNP_{j;t}}_{\text{Wealth channel}} + \underbrace{w_{j;t+1}}_{\text{Income channel}} + \underbrace{P_t C_{j;t+1}}_{\text{Consumption channel}} \overbrace{\left(\frac{_{j;t+1}}{_{t+1}} - 1 \right)}^{\text{Individual in ation}} ; \qquad (4)$$

where $_{j;t+1} = \sum_{k=1}^{K} {}_{j;kt+1} \, ! \, {}_{j;kt+1}$; is the individual in ation rate.

Equation (4) captures the three main channels through which surprise in ation a ects the wealth of an individual.

First, there is the standard wealth (Fisher) channel by which in ation redistributes wealth from creditors of nominal assets to debtors.[11]

Second, there is an income channel as in ation reduces the real value of nominal income ows. 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 6.6% in ation (see the lower panel in Figure 3 for details on this). Something similar happens with unemployment bene ts and pensions. This implies that in ation made a dent in workers' and pensioners' purchasing power. While the Fisher channel favors debtors and harms creditors, the income channel negatively a ects 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 di erent individuals can di er from the average basket, which is the one employed to compute aggregate in ation. If the prices of all goods grew at the same rate, this fact would be inconsequential. However, if in ation is asymmetric, that is, if in ation is higher for some goods than for

[11] In our case, as in Auclert (2019), given the temporary expected nature of in ation, this channel only operates through the product of the NNP at the end of period t times in ation 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 in ation a ect the NNP through asset prices.

Figure 3: Frequency of wage changes in labor contracts and wage re-negotiations in Spain

(a) Extensive margin: proportion of contracts changing each month

(b) Intensive margin: nominal wage changes

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.

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 in ation rates compared to the average, $_{t+1} < _{j;t+1}$, will have to devote more resources to maintain their consumption patterns, whereas those with individual in ation below average, $_{t+1} > _{j;t+1}$, will devote less resources. This mechanism will be proportional to the total consumption expenditure $C_{j;t+1}$ of the individual.[12]

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

Why not de ating using the individual price level? One may wonder why we are de ating 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 di erent 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 in ation matters independently of your individual in ation. We assume, for instance, that real assets pay a nominal return which equals the real return plus average in ation, independently of your particular consumption basket. Furthermore, de ating by di erent price indices makes comparison between individuals, as well as aggregation, unfeasible. As discussed next, our approach yields a direct welfare comparison. These arguments convince us that our approach is the most sensible one.

Measuring impacts on real wealth vs. welfare. While we originally decided to analyze the impact of in ation on wealth, in line with the Fisherian analysis of Doepke and Schneider (2006), recent analysis by Del Canto, Grigsby, Qian, and Walsh (2023) or Pallotti, Paz-Pardo, Slacalek, Tristani, and Violante (2023) focus instead on money-metric welfare. Both approaches yield similar results in this context, as the welfare change depends exclusively on the change in real wealth. In particular, equation (3) is equivalent to the direct welfare decomposition in Pallotti, Paz-Pardo, Slacalek, Tristani, and Violante (2023), taking into account that we do not analyze changes in dividends or capital gains under our assumptions.

[12] Although here we are considering heterogeneous price increases across goods / sectors, heterogeneity could also arise in the increase of the price of a given good across regions. Similar individuals consuming a similar basket in di erent regions could then, in principle, experience di erent in ation rates. For this feature to impact our results, it should be the case that such regional heterogeneity in price increases is correlated with socio-economic and demographic characteristics of these regions.

Our results, therefore, can be reinterpreted as a welfare analysis.[13]

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 repeatedly surprised by in ation increases. In this case, we can express the impact of in ation wealth at time $t+T$ in time-t prices, proceeding as above, as

$$\underbrace{NNP_{j;t+T}}_{\text{Wealth channel}} + \underbrace{\sum_{=1}^{T} w_{j;t+}}_{\text{Income channel}} + \underbrace{\sum_{=1}^{T} P_t C_{j;t+} \left(\frac{P_{s=1} {}_{j;t+s}}{P_{s=1} {}_{t+s}} 1 \right)}_{\text{Consumption channel}}; \qquad (5)$$

Equation (5) implies that, in this case, the relevant NNP is that at the end of the period, $NNP_{j;t+T} = NNP_{j;t} + \sum_{=1}^{T} {}^{1} m_{j;t+} + Q_{t+} d_{j;t+} Q^{b}_{t+} b_{j;t+}$, 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 in ation.

Real assets. Finally, our decomposition distinguishes between nominal and real assets and assumes that real returns from real assets are una ected by the in ation surprise. For the vast majority of Spanish households, housing is the only real asset.[14] Pallotti, Paz-Pardo, Slacalek, Tristani, and Violante (2023) analyze the impact of in ation on housing prices and nd that is very low, so this assumption seems reasonable.

4 Description of the data

BBVA data. In order to implement equation (5) 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; we compute a client's net balance at the end of each month in their current

[13] Our measure can also be interpreted within the "equivalence approach" as described and analysed in Fleurbaey (2009).

[14] Only 12.5 percent of Spanish households own stocks at the end of 2022, according to the Encuesta Financiera de las Familias, and these households are concentrated in the upper decile of wealth and age older than 65 years.

accounts and savings accounts, reinvestment dividends accounts and deposit accounts. Thus, it comprises brokerage services from investing in stocks, bonds, mutual funds and ETFs, as well as individual retirement accounts and other employer-sponsored retirement accounts that include dividend reinvestment options. Mutual funds and certi cate of deposit accounts are also included. On the liability side, we consider the outstanding amount of consumer credit each month, including revolving credit coming from credit cards and lines of credit and installment credit. Thus, we include personal loans, home equity lines of credit, as well as the pending debt of auto loans, student loans, or mortgages (disentangling between those at xed and variable interest rates).

In terms of identi ed 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, García, Hansen, Ortiz, Rodrigo, Rodriguez Mora, and Ruiz (2021) and Buda, Carvalho, Hansen, Ortiz, Rodrigo, and Rodriguez Mora (2022), and map transactions to particular consumption goods and services, grouping them according to the 12 European Classi cation of Individual Consumption by Purpose (ECOICOP) categories.[15][16]

Importantly, we also observe labour-related income received by each client in those cases in which the said client has her BBVA account de ned as a salary/pension account . We consider as income nal payment (after taxes) that a client received in his bank account as the concept of salary, pension payment and unemployment bene t each month, where we identify the payer (disentangling if it is a private entity or a public one).

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 ows 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 nal sample of around 1.8 million clients observed since 2016. Restrictions (i) and (iii) are

[15] Each of these transactions has associated to it either a Merchant Client Code (MCC), a BBVA label (ca. 100), or an IBAN / bene ciary name, together with an ID for the counterparty rm. Although we also observe cash withdrawals, we cannot map them one-to-one 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, García, Hansen, Ortiz, Rodrigo, Rodriguez Mora, and Ruiz (2021).

[16] In 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.

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 nancial products, in a di erent nancial intermediary which we cannot observe. This could introduce biases in our calculations.

Representative surveys. For robustness, we redo our analysis employing data from two representative surveys publicly available 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 o cial in ation gures. 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 signi cant (rotating) panel component.

Comparing the client sample with the Spanish population. The nal sample of BBVA clients that emerges after imposing the restrictions described above, is re-weighted in two ways. We rst adjust client-level spending to account for possible intra-household relationships between clients. We then construct frequency weights in order to get closer to the Spanish population along gender, age, and regional dimensions, which are used in the computation of moments below. Appendix C provides a more detailed discussion on the implemented re-weighting scheme and on the di erences between the re-weighted BBVA and survey data.

5 Impact of in ation on households' balance sheets

Estimating the channels. The top panel in Figure 4 displays the mean value of the key objects characterizing the three channels (wealth, income and relative consumption) computed for di erent age and income groups.

Several interesting results emerge. First, the mean NNP is negative for all groups below

Figure 4: Components and total e ect of unexpected in ation on individual wealth

The top panel presents, for each age-income group, the means of the three components in eq. (6), while the bottom panel presents the total e ect of unexpected in ation 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 in ation levels are the average in ation rate e ectively experienced by each age-income group in December 2021, computed using average in ation 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.

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. 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.[17]

Second, the income channel is of a similar magnitude to the wealth channel, but its sign is always positive. As wages and benefits are sticky at frequencies higher than annual, the erosion in real income due to surprise inflation affects all agents.[18] 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 $P_t C_{j;t+1} \left(\frac{\pi_{j;t+1}}{\pi_{t+1}} - 1 \right)$, 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 groups.[19] Notice that the relative consumption channel is negative for

[17] Balance 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.

[18] Following the assumptions in Section 3, labor income is assumed to be nominally fixed.

[19] In 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.

all individuals younger than 55 years and positive for most older people. This re ects 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 e ect of in ation in 2021. The bottom panel in Figure (4) reports the total e ect of in ation as of December 2021, computed as the sum of the three channels multiplied by (minus) the annual in ation rate, according to equation (6).[20] The impact of in ation is quite heterogeneous across households. Whereas people aged 36-45 bene ted from it in 2021, especially those in the lowest quartile of income, due to a reduction in their real debt burden, older individuals experienced a signi cant fall in their wealth due to the combination of the three channels. In order to frame total e ects in terms of a variable closer to standard welfare measures, Figure 7 in the appendix displays total e ects 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 5 displays how the di erent elements of the decomposition in equation (6) 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 rst three panels display the evolution of the NNP, income, and consumption expenditures for di erent 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 di erent components of the NNP (assets and liabilities) and the ECOICOP categories of consumption spending. The same message emerges: the main di erences across individuals are along the life cycle dimension, and these have been quite stable during 2021. Individual in ation (lower right panel), however, clearly trends upward in 2021 and 2022, with a widening gap between old and young clients. This re ects 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 signi cant in 2022.

[20] In order to obtain the total e ect as a % of annual income, we rst compute the ratio for each individual, and then obtain the mean within the corresponding age-income group.

Figure 5: Dynamics of NNP, income, consumption, and individual in ation

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

Estimation with representative surveys . Finally, we redo our analysis employing data from the EFF and the EPF. Results, reported in Figure 6, roughly coincide with those described above using BBVA data. There are two main di erences, 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 di erence in terms of consumption baskets. The sign of the relative consumption channel reverses for several age groups, as older households now bene t from in ation. 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 in ation rates across age and income groups.

Figure 6: Components and total e ect of unexpected in ation on individual wealth: surveys

The top panel presents, for each age-income group, the means of the three components in eq. (6), while the bottom panel presents the total e ect of unexpected in ation on saving capacity, relative to annual income. Net nominal positions (NNP) and nominal income are computed from the survey of consumer nance (Encuesta Financiera de las Familias, or EFF) for 2017 and 2020. Nominal income and consumption are measured at an annual frequency.Individual in ation levels are the average in ation rate e ectively experienced by each age-income group in December 2021, computed using average in ation 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.

6 Conclusions

In this paper, we explore the redistributive consequences of in ation. We put forward a novel decomposition of the impact of surprise in ation on agents' real wealth and then quantify them in the year 2021 using a new granular dataset that contains detailed information about consumption patterns, income sources, and nominal assets and liabilities. We nd that the wealth and income channels are the largest, while the relative consumption channel is much less signi cant. In ation hurts all households through the income channel, but middle-aged households bene t through the wealth one as they are typically large nominal debtors in mortgages.

Our research highlights the di erent channels through which in ation a ects households. We hope that this will spur further theoretical analysis on the implications of in ation for the design of monetary and scal policies, along the lines of the recent work by Cravino et al. (2020) and Yang (2023).

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Online Appendix

A Additional tables and gures

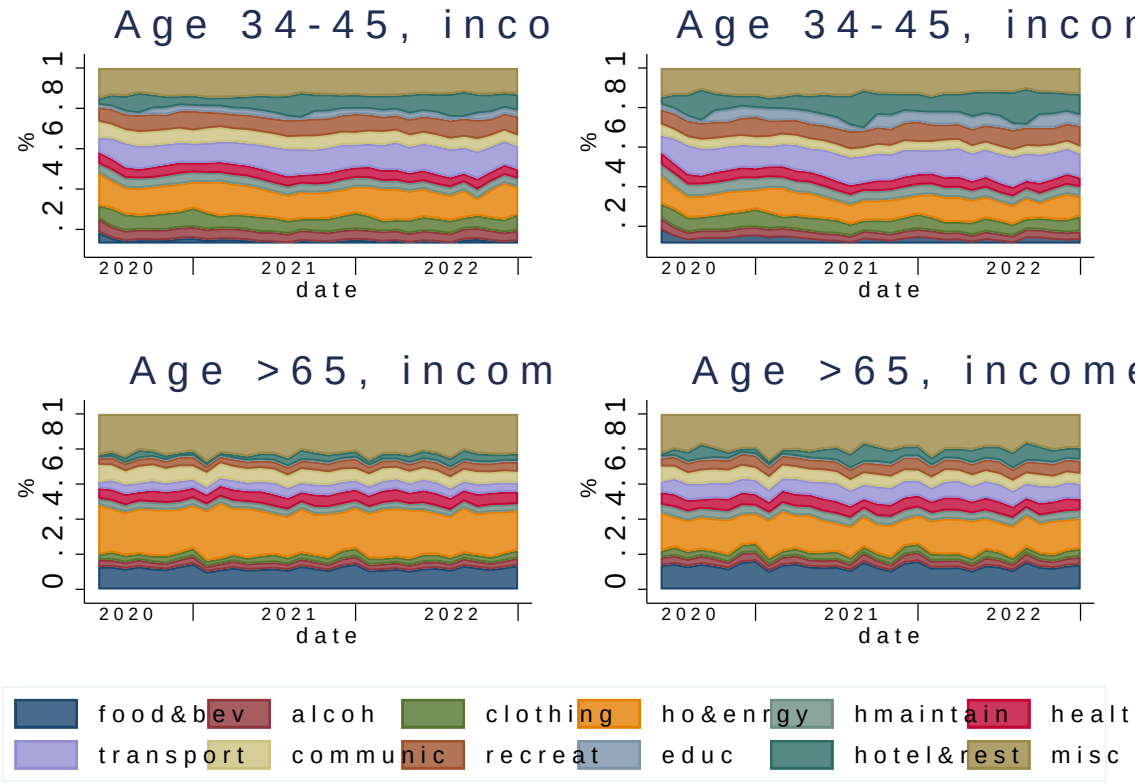
Figure 7: Total e ect of unexpected in ation on individual wealth: BBVA vs surveys

The gure presents the total e ect of unexpected in ation 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

$$\begin{aligned}
P_{t+T}a_{j;t+T} &= m_{j;t} + \sum_{\tau=1}^{T-1} m_{j;t+\tau} + \left(1 + \frac{Q_{t+1}}{Q_t} + i_t\right) Q_t d_{j;t} \\
&+ \sum_{\tau=1}^{T-1} \left(1 + \frac{Q_{t+\tau+1}}{Q_{t+\tau}} + i_{t+\tau}\right) Q_{t+\tau} d_{j;t+\tau} \\
&+ \left(1 + \frac{q_{t+1}}{q_t} + r^s_{t+1}\right) P_{t+1} q_t s_{j;t} \\
&+ \sum_{\tau=1}^{T-1} \left(1 + \frac{q_{t+\tau+1}}{q_{t+\tau}} + r^s_{t+\tau}\right) P_{t+\tau+1} q_{t+\tau} s_{j;t+\tau} \\
&+ \left(1 + \frac{Q^b_{t+1}}{Q^b_t} + i^b_t\right) Q^b_t b_{j;t} + \sum_{\tau=1}^{T-1} \left(1 + \frac{Q^b_{t+\tau+1}}{Q^b_{t+\tau}} + i^b_{t+\tau}\right) Q^b_{t+\tau} b_{j;t+\tau} \\
&+ \sum_{\tau=1}^{T} w_{j;t+\tau} - \sum_{\tau=1}^{T} \sum_{k=1}^{K} p_{kt+\tau} c_{j;kt+\tau};
\end{aligned}$$

where Δx_t is the 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 on wealth at time $t+T$ in time-t prices, proceeding as above, as

$$\underbrace{NNP_{j;t+T}}_{\text{Wealth channel}} + \underbrace{\sum_{\tau=1}^{T} w_{j;t+\tau}}_{\text{Income channel}} + \underbrace{\sum_{\tau=1}^{T} P_t C_{j;t+\tau} \left[\frac{\prod_{s=1}^{\tau} \pi_{j;t+s}}{\prod_{s=1}^{\tau} \pi_{t+s}} - 1\right]}_{\text{Consumption channel}}; \tag{6}$$

where we have applied the fact that

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

Equation (6) implies that, in this case, the relevant NNP is that at the end of the period, $NNP_{j;t+T} = NNP_{j;t} + \sum_{\tau=1}^{T} \left[m_{j;t+\tau} + Q_{t+\tau} \Delta d_{j;t+\tau} - Q^b_{t+\tau} \Delta b_{j;t+\tau}\right]$, 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

In this appendix, we describe the adjustments we implement on the BBVA client sample in order to better capture household composition and the distribution of the Spanish population along certain demographic and geographic characteristics.

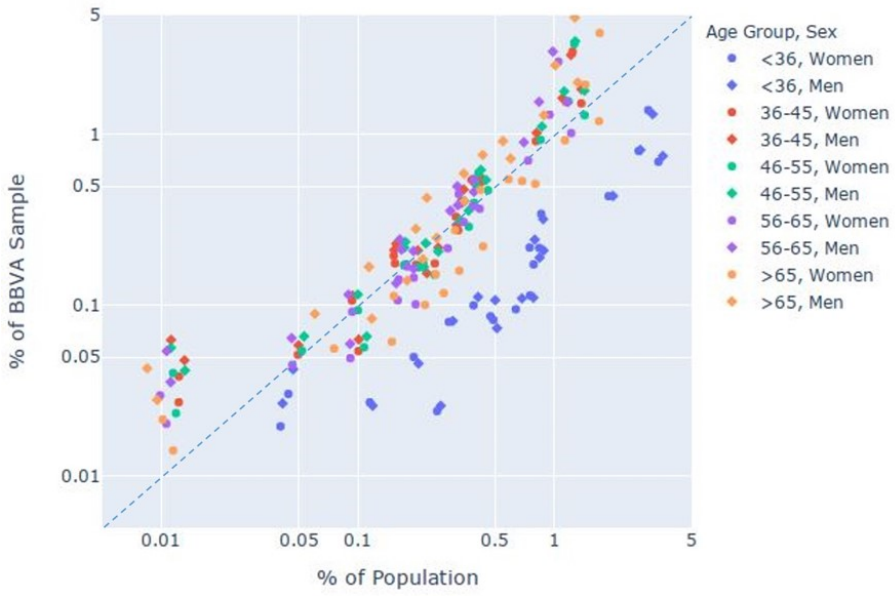
Potential intra-household relationships. One of the main obstacles when comparing results from client data and representative surveys is that the former, in its raw form, refers to individual information (spending, assets, liabilities, etc) without accounting for possible intra-household decisions and spending splits. In the first step, therefore, we impute relationships between clients based on certain observable spending items, and we adjust client i's consumption according to:

$$c_{i;t} = \frac{\sum_{j \in A(i)} c^{NH}_{j;t} + c^{H}_{h(i);t}}{A(i) + 0.5O(i)} \tag{7}$$

where $h(i)$ is the household identifier to which client i has been assigned, $A(i)$ is the number of BBVA clients whom have been assigned to that same household unit, $O(i)$ are other members of household $h(i)$ for whom we don't have spending data, $c^{NH}_{j;t}$ is non-housing spending by client j who has been identified to be a member of household $h(i)$ (and for whom we observe spending data); and $c^{H}_{h(i);t}$ is common spending on housing services (i.e. utility bills, etc) for the household $h(i)$ to which client i belongs. Expression (7) is an approximation to the *true* average *per-capita* spending of all clients belonging to an identified household in a given period t. This adjustment allows us to better compare per-capita spending from BBVA and the representative surveys.

Frequency differences between samples. Figure 10 presents a scatter plot were each data point measures the percentage of the total population represented by different age and gender groups in BBVA client sample and the Spanish population. Points closer to the 45^o line imply that the BBVA and representative sample are more alike along the dimension captured by those points. The observed pattern hints that the BBVA clients might present certain systematic *frequency* differences with respect to the overall Spanish population. In particular, older groups are in general over-represented in the BBVA sample, while younger groups are under-represented. This translates to differences in moments for consumption baskets (see columns (a) and (c) of Table 1).

Figure 10: Comparison between the BBVA client sample and the Spanish population



The figure presents the percentage of the total BBVA sample in the y-axis (before re-weighting) and the 2018 Spanish census in the x-axis, that falls within different age and gender groups. Points closer to the 45^o line imply a higher degree of similarity between the BBVA sample and Spanish population along those particular dimensions.

In order to bring the BBVA sample closer to the 2018 Census (reported by the National Statistical Institute INE), we perform a post-stratification exercise following the methodology described in Buda, Carvalho, Hansen, Ortiz, Rodrigo, and Rodriguez Mora (2022). In particular, we compute *frequency* weights as a factor that captures frequency differences between BBVA clients and the Spanish population at each point in time along age, gender and region characteristics:

$$w_{i(g;a;r);t} = \frac{x^{INE}_{g;a;r;t}}{x^{BBVA}_{g;a;r;t}} \tag{8}$$

where $x^{INE}_{g;a;r;t}$ is the total count of Spanish adults in gender-age-region cell $fg;a;rg$ according to census data, $x^{BBVA}_{g;a;r;t}$ is the total count of *active* customers in the same cell $fg;a;rg$. Note that all clients within a cell $fg;a;rg$, who we denote $i(g;a;r)$, will receive the *same* weight. These weights are then used to compute weighted means and medians for all the variables considered in the main text.

Figure 11 presents a comparison between our final BBVA client sample, re-weighted, and the Spanish population captured by the representative surveys. The comparison is made along