

Who Bears the Costs of Inflation?

Euro Area Households and the 2021–2022 Shock

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Heterogeneous Agents in Macroeconomic Models, ČNB, May 2024

The views expressed in this paper solely reflect those of the authors and do not necessarily represent those of the European Central Bank

What are the distributional effects of the recent inflation shock?

- ▶ Large shocks to headline inflation in euro area, 2021–22 [Data](#)
- ▶ Key drivers: energy and food prices [Data](#)
- ▶ **Public debate: contrasting arguments**
 - ▶ Poorer and younger households spend more on energy and food
 - ▶ But, wealthier and older households own more nominal wealth
- ▶ **Our contribution:**
 1. **Conceptual:** Simple framework that illustrates various channels of inflation shocks
 2. **Empirical:** Quantify size of various channels across households in four EA countries

What the paper does

- ▶ **Develops a model** to illustrate distributional effects of inflation through:
 1. Heterogeneous consumption bundles
 2. Unconventional fiscal policy through energy subsidies and direct transfers
 3. Devaluation / revaluation of nominal net positions
 4. Response of real asset (housing, stocks) prices to the inflation shock
 5. Heterogeneous nominal wage rigidity
- ▶ **Combines various data sources** to measure each channel in DE, FR, IT, ES
- ▶ **Quantifies welfare cost** of each component across the age/consumption distribution

Empirical results

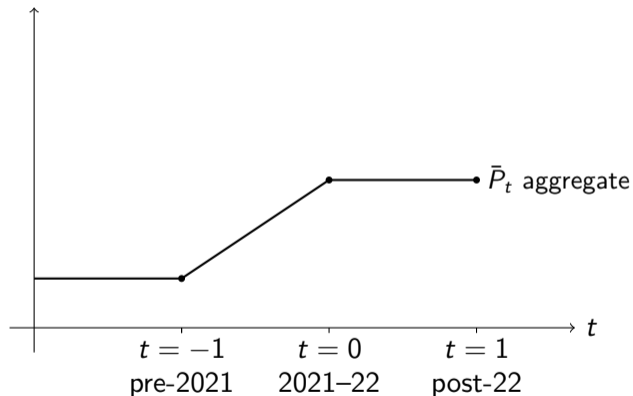
- ▶ Real wages of most households declined (wage stickiness)
- ▶ Net nominal positions: retirees lost, while indebted younger benefited
- ▶ Low-consumption Hhs: a bit higher inflation rates, but hedged by low rent inflation
- ▶ 'Unconventional' fiscal policy: shielded vulnerable Hhs (especially in Spain)
- ▶ Housing and stocks: not good inflation hedges in short run
- ▶ Overall:
 - ▶ losses are large: 70% of households lost about up to 15% of income;
 - ▶ older households lost the most as a fraction of income;
 - ▶ within age brackets, lower-consumption households often experienced larger losses;
 - ▶ 30% of households experienced gains, especially in France and Spain—indebted

Recent related contributions

- ▶ Fagereng, Gomez, Gouin-Bonenfant, Holm, Moll, Natvik (2022)
 - ▶ Framework to study impact of capital gain shocks on household welfare
- ▶ Del Canto, Grigsby, Qian, Walsh (2023)
 - ▶ Builds on Fagereng et al. (2022) to study IRFs to structural inflationary shocks
- ▶ Cardoso, Ferreira, Leiva, Nuño, Ortiz, Rodrigo, Vazquez (2022)
 - ▶ Distributional impact for Spain using BBVA data
- ▶ Many [other empirical studies](#), mostly focusing on heterogeneous consumption baskets
 - ▶ Battistini, Di Nino, Dossche, Kolndrekaj (2022)
 - ▶ Charalampakis, Fagandini, Henkel, Osbat (2022)
 - ▶ Curci, Savegnago, Zevi, Zizza (2023)
 - ▶ Menyhert (2022)

Our experiment: one-off increase in infl 2021–22 (MIT shock)

P_t price level



Assumptions

Before $t = 0$ (pre-2021), aggr price level constant (zero infl in steady state)

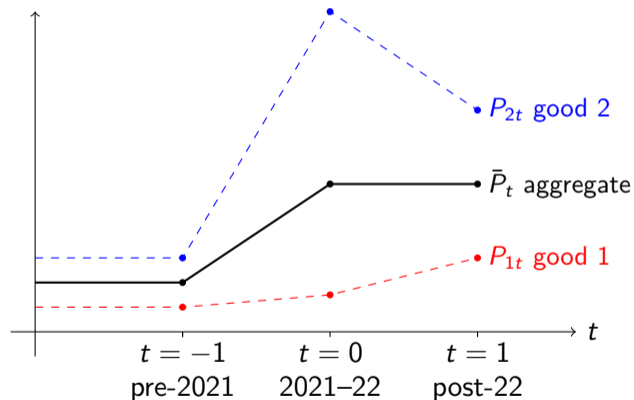
[A1] At $t = 0$ (short run; years 2021–22), unanticipated inflation shock $dz_0 \Rightarrow$ permanent jump in aggr price level

Relative goods prices left unrestricted

[A2] At $t = 1$ (long run; after 2022), price stability restored

Our experiment: one-off increase in infl 2021–22 (MIT shock)

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Relative goods prices left unrestricted

[A2] At $t = 1$ (long run; after 2022), price stability restored

Relative prices back to pre-shock

[A3] The shock is neutral in the long run (real values of wages, asset prices, taxes, dividends do not change)

[A4] Long-run adjustment of the govt budget constraint through price level or future real surpluses

Households

- ▶ Overlapping generations living for two periods $t = 0, 1$ (short-run & long-run)
- ▶ No uncertainty (aggregate or idiosyncratic), and no binding liquidity constraints
- ▶ Problem of individual i belonging to the cohort born at $t = 0$:

$$V_i = \max_{c_{it}, a_{i,kt+1}, B_{St+1}, B_{Lt+1}} u_i(c_{i0}) + \beta_i u_i(c_{i1})$$

s.t.

$$c_{it} P_{it} = W_{it} - T_{it} + B_{i,St} + (1 + Q_{Lt} \delta) B_{i,Lt} + \sum_k (Q_{kt} + D_{kt}) a_{i,kt} \\ - Q_{St} B_{i,St+1} - Q_{Lt} B_{i,Lt+1} - \sum_k Q_{kt} a_{i,kt+1}.$$

W nominal wages, T nominal government taxes net of transfers, B_S short-term bonds, B_L long-term bonds, a_k real assets, Q_k asset/bond prices, D_k dividends, δ coupon decay rate

Households

- ▶ Problem of individual i belonging to the cohort born at $t = 0$:

$$\begin{aligned} V_i &= \max_{c_{it}, a_{i,kt+1}, B_{St+1}, B_{Lt+1}} u_i(c_{i0}) + \beta_i u_i(c_{i1}) \\ &\text{s.t.} \\ \underbrace{c_{it} P_{it}^* (1 - \tau_{it})}_{P_{it}} &= W_{it} - T_{it} + B_{i,St} + (1 + Q_{Lt}\delta)B_{i,Lt} + \sum_k (Q_{kt} + D_{kt}) a_{i,kt} \\ &\quad - Q_{St}B_{i,St+1} - Q_{Lt}B_{i,Lt+1} - \sum_k Q_{kt} a_{i,kt+1}. \end{aligned}$$

W nominal wages, T nominal government taxes net of transfers, B_S short-term bonds, B_L long-term bonds, a_k real assets, Q_k asset/bond prices, D_k dividends, δ coupon decay rate, τ combined price subsidy

Households

- Problem of individual i belonging to the cohort born at $t = 0$:

$$V_i = \max_{c_{it}, a_{i,kt+1}, B_{St+1}, B_{Lt+1}} u_i(c_{i0}) + \beta_i u_i(c_{i1})$$

s.t.

$$c_{it} [\bar{P}_t^* + (P_{it}^* - \bar{P}_t^*)] (1 - \tau_{it}) = W_{it} - T_{it} + B_{i,St} + (1 + Q_{Lt}\delta)B_{i,Lt} + \sum_k (Q_{kt} + D_{kt}) \\ - Q_{St}B_{i,St+1} - Q_{Lt}B_{i,Lt+1} - \sum_k Q_{kt}a_{i,kt+1}.$$

W nominal wages, T nominal government taxes net of transfers, B_S short-term bonds, B_L long-term bonds, a_k real assets, Q_k asset/bond prices, D_k dividends, δ coupon decay rate, τ combined price subsidy, \bar{P}^* aggregate price level

Price indexes: actual and counterfactual [starred]

'Unconventional' fiscal policy—interventions in energy markets

- ▶ Quantify inflation of individual price deflators P_{it} for household i
- ▶ Estimate counterfactual/raw 'starred' deflators for good j which would prevail in absence of good-specific government subsidies (or taxes)

$$\mathcal{P}_{jt} = \mathcal{P}_{jt}^* \times (1 + \tau_{jt})$$

'Unconventional' fiscal policy dampens energy price shock: $\tau_{jt} \ll 0$; $\mathcal{P}_{jt} \ll \mathcal{P}_{jt}^*$

- ▶ At household level (in logs):

$$\underbrace{d \log P_{i0}}_{\text{Effect of } \pi \text{ shock on consumer price}} \simeq \underbrace{d \log \mathcal{P}_{i0}^*}_{\text{Counterfactual price}} + \underbrace{d \log \mathcal{T}_{i0}}_{\text{Govt interventions in energy mkts, } \ll 0}$$

Money metric welfare

- ▶ Object of interest: impact of inflation shock dz_0 on welfare of each household
- ▶ Invoke the **envelope theorem** (dz_0 'small'), and ignore changes in choice variables
- ▶ Money metric welfare change:

$$d\mathcal{W}_i = \frac{dV_i/u'_i(c_{i0})}{dz_0} P_{i0}$$

'How much EUR would you be willing to give up to avoid the inflation shock?'

Welfare decomposition: four components

- ▶ Differentiate Lagrangean with respect to (inflation) shock z_0
- ▶ Decompose welfare change as: $dW_i = dW_i^{DIR} + dW_i^{UFP} + dW_i^{IND} + dW_i^{LR}$
 1. **Direct:** impact of the raw inflation shock, using **Hh-level raw inflation shock** P_{i0}^*
 2. **Unconventional fiscal policy:** impact of govt interventions, gap between P_{i0}^* and P_{i0}
 3. **Indirect:** equilibrium response of labor and capital income, taxes, and asset prices to z_0
 4. **Long-run:** residual long-run effects (relative price re-alignment)
- ▶ These components consist of terms related to parts of budget constraint (income, NNP, ...)

Measurement

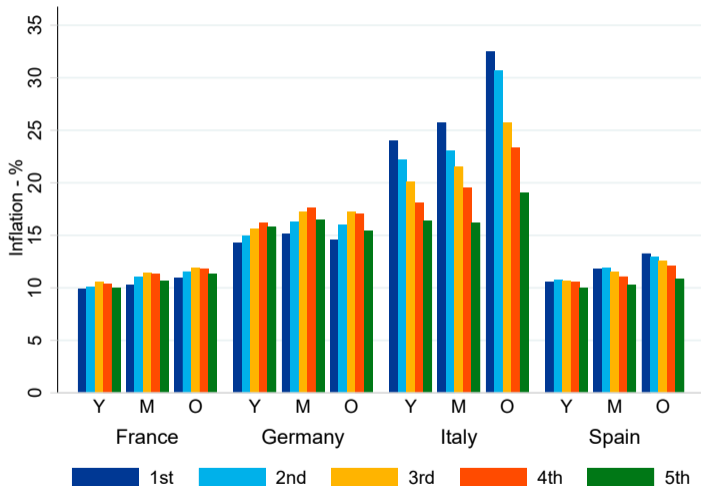
Countries and demographic groups

- ▶ Focus on the big-4 economies in euro area: [Germany](#), [France](#), [Italy](#), [Spain](#)
- ▶ Breakdown of households by:
 - ▶ 3 age groups: 25–44, 45–64, 65+ years
 - ▶ 5 consumption quintiles (proxy for permanent income)
- ▶ We express welfare change as a [share of household total disposable income](#)

Individual price indexes

- ▶ Initial expenditure shares: 20 categories, Household Budget Survey (2015) [Categories](#)
- ▶ Good-level prices: Harmonized Index of Consumer Prices (HICP)
- ▶ We measure [surprise inflation](#): deviation from expected inflation (Consensus Economics)

2021–22 cumulative household-level inflation: 11–20 percent



Cumulative inflation shock

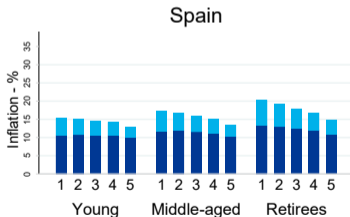
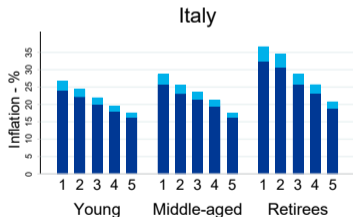
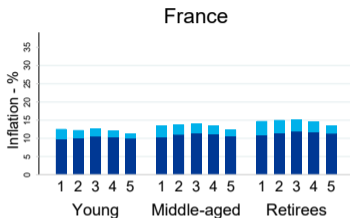
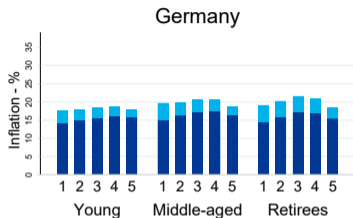
- ▶ FR: 11%
- ▶ DE: 16%
- ▶ IT: 20%
- ▶ ES: 11%

Without rents

Unconventional fiscal policy

- ▶ [Bruegel dataset](#) on national fiscal policy responses to the energy crisis
- ▶ Two parts: 1. Energy market interventions
2. Direct transfers to households
- ▶ 1. [Energy market interventions](#): include both subsidies and outright regulation
 - ▶ Calculate [counterfactual retail price indices](#) for:
 - ▶ Electricity; gas used for heating and liquid fuels (petrol and diesel)
 - ▶ Regress retail prices on wholesale prices
 - ▶ Then aggregate (Dao et al., 2023)
- ▶ 2. [Direct transfers](#): ad-hoc income support to low-income households, etc.

Unconventional fiscal policy reduced inflation by 2–5 pp



Actual Inflation Difference to Counterfactual Inflation

Inflation reduction

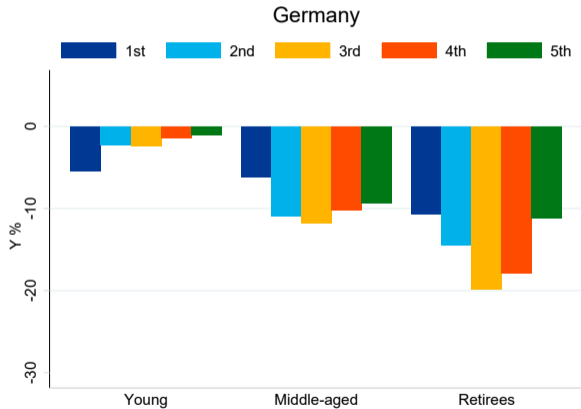
- ▶ DE: -2.3%
- ▶ FR: -1.9%
- ▶ IT: -2.0%
- ▶ ES: -4.9%

Direct component—measurement

Parts of budget constraint (for individual households)

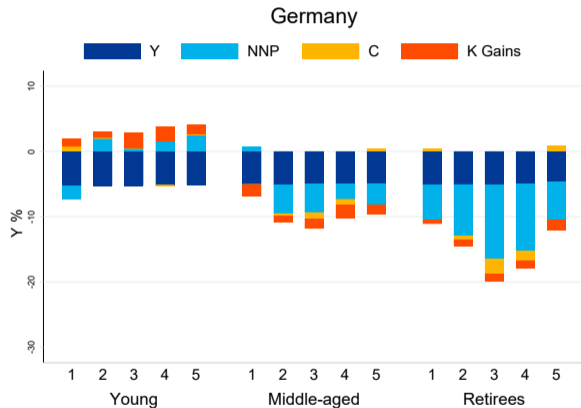
- ▶ **Income distribution:** Household Finance and Consumption Survey 2017
- ▶ **Taxes and transfers:** OECD Tax Database
- ▶ **Interest, dividends, etc.:** Household Finance and Consumption Survey 2017
- ▶ **Balance sheets:** Household Finance and Consumption Survey 2017

Direct component: Germany



- ▶ Retirees and middle-aged lose
- ▶ Young nearly break even

Breakdown of direct component: Germany



▶ **Net income:** loss of 5%, even across groups

▶ **Net nominal positions:** positive impact for the young, negative for the retirees

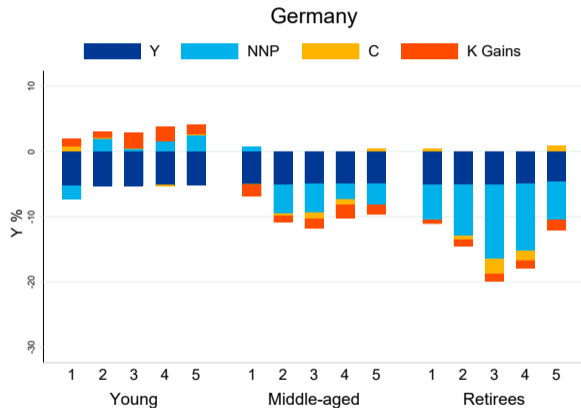
▶ **π differences:** in general, quite small

▶ **K gains:** gains for young (net asset buyers)
Welfare only affected when trading

Overall:

Losses of 5–20% of income, bigger for retirees

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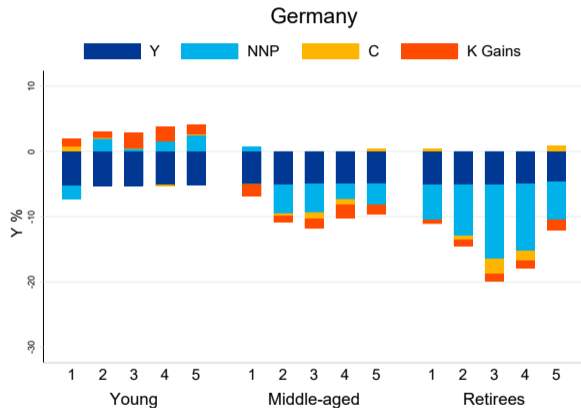


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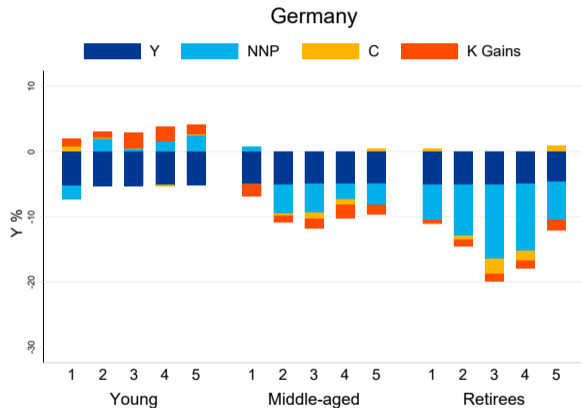


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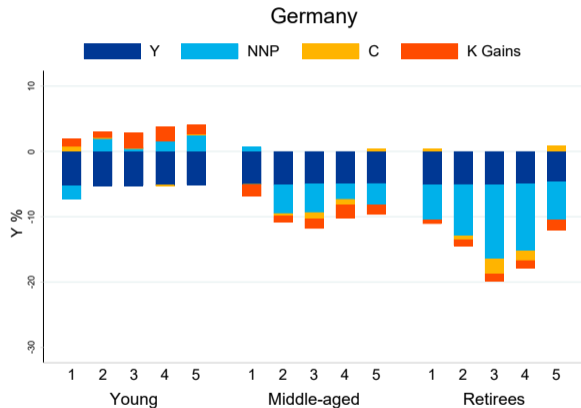


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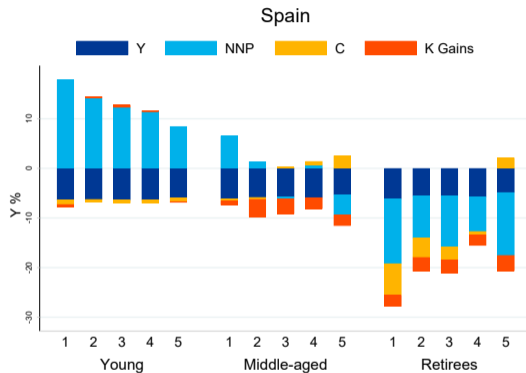
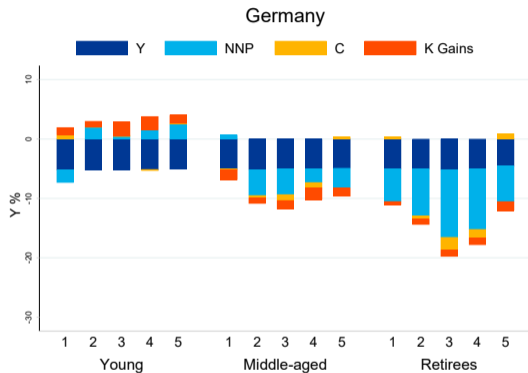


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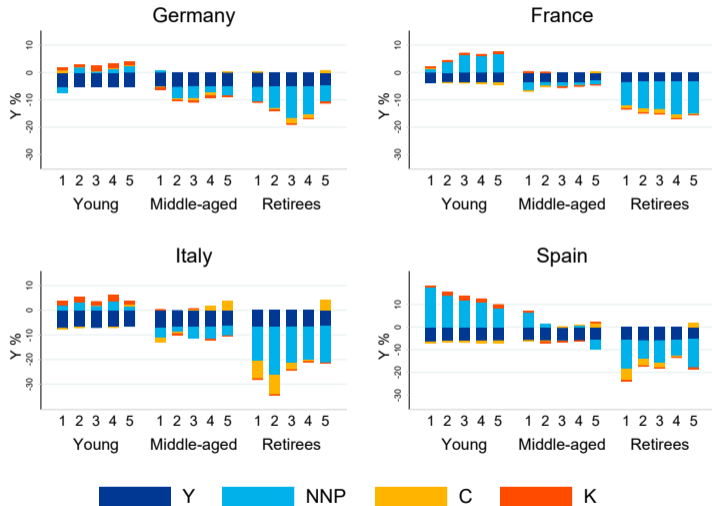
Direct component: Germany vs Spain



Y: Net income; **NNP: Net nominal positions;** **C: π differences;** **K gains**

More heterogeneity in Spain, despite lower inflation, because of larger NNP and π diff's

Direct component: cross-country comparison



Y: Net income

NNP: Net nominal positions

C: π differences

K: Capital gains

Indirect effect—measurement

Equilibrium response of parts of budget constraint to π shock (income, asset prices)

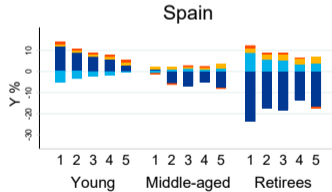
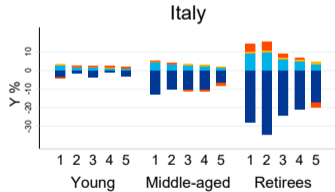
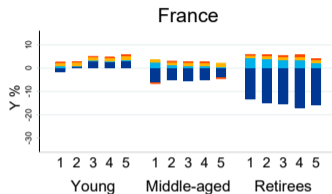
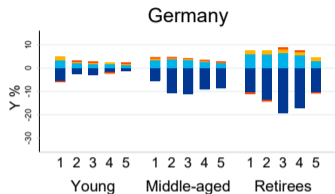
Income components

- ▶ **Wages:** data on negotiated wage agreements (growth rates) from national stat agencies
- ▶ **Minimum wage; Pensions:** national official sources

Asset prices

- ▶ **House prices:** reaction of REIT on the day of release of German HICP as instrument for country-level quarterly house price indexes → small effect
- ▶ **Stock prices:** reaction of daily stock price to release of German HICP → large effect
- ▶ **Long-term bond prices:** same strategy → small effect

Putting together the four components of the effect on welfare

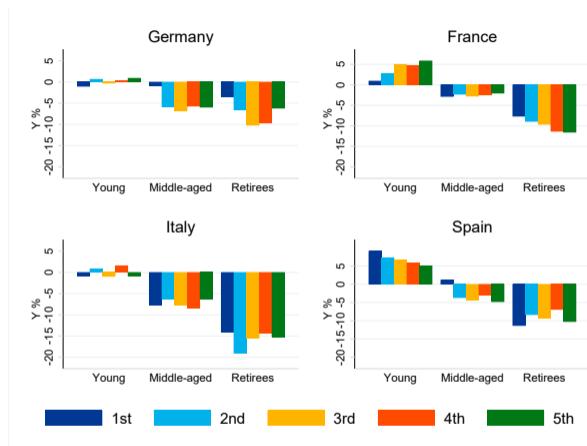


- ▶ Direct component dominates
- ▶ Fiscal response is nontrivial
- ▶ Indirect and long-run limited

Average total effect:

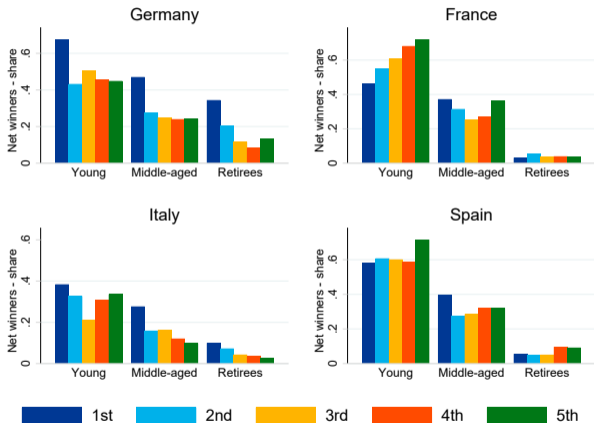
- ▶ DE: -4.3%
- ▶ FR: -2.8%
- ▶ IT: -8.4%
- ▶ ES: -3.0%

Total effect on welfare across households (all four components)



- ▶ Inflation is an **age-dependent tax**, but there is no clear pattern across quantiles with age
- ▶ **Heterogeneity**: 5% gains among young in ES, and 15% losses among retirees in Italy

Share of winners within household groups



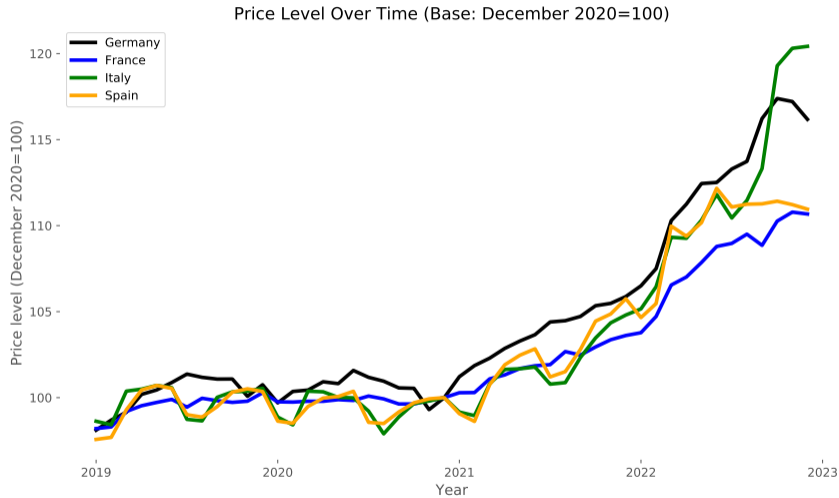
- ▶ On average, 30% of net winners
- ▶ In DE, FR, ES half of 25–44 gain
- ▶ Young win because of NNP gains
- ▶ More winners in FR and ES because of negative NNPs
- ▶ Almost every retiree is a net loser

Summary: who bore the costs of inflation in euro area?

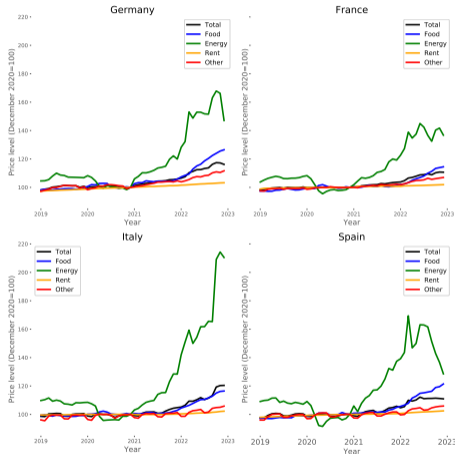
- ▶ Inflation shock was an **age-dependent tax** that hit hard older households
- ▶ **Uniform incidence within age**: higher inflation rate for poor offsets higher NNP for rich
- ▶ Nominal wages are quite **rigid** in the short run
- ▶ **Unconventional fiscal policy** played a significant role, especially in Spain
- ▶ Housing and stocks are **not good inflation hedges** in the short run
- ▶ Italy has recorded the largest welfare losses among the big four
- ▶ Spain has the largest share of winners

Thanks!

Headline inflation



Key drivers: energy and food prices



Back

Expenditure Categories

Consumption Categories			
Class	Label	Class	Label
01	Food	07.21	Spare parts
02	Alcohol and tobacco	07.22	Fuels
03	Clothing	07.23	Vehicle maintenance
04.1	Actual rent	07.24	Other services for transport equipment
04.3	Dwelling maintenance	07.3	Transport services
04.4	Water supply	08	Communication
04.5	Electricity and gas	09	Recreation
05	Furnishings	10	Education
06	Health	11	Restaurants and Hotels
07.1	Vehicles	12	Miscellaneous

Source: Household Budget Survey (2015)

Price indexes: Actual and counterfactual [starred]

- ▶ Individual price deflators P_{it} satisfy the relation $c_{it}P_{it} = \sum_{j=1}^J c_{i,jt}\mathcal{P}_{jt}$
- ▶ Aggregate price deflator \bar{P}_t satisfies same relation for nationwide expenditure shares
- ▶ Goods prices \mathcal{P}_{jt} paid by consumers include of good-specific taxes and subsidies (energy)

$$\mathcal{P}_{jt} = \mathcal{P}_{jt}^* (1 + \tau_{jt})$$

- ▶ Change in household specific price indexes at $t = 0$ induced by the shock:

$$\begin{aligned} d \log P_{i0} &\simeq \sum_{j=1}^J xsh_{ij,ss} \cdot d \log \mathcal{P}_{j0} \simeq \sum_{j=1}^J xsh_{ij,ss} \cdot (d \log \mathcal{P}_{j0}^* + d\tau_{jt}) \\ &= \underbrace{\log P_{i0}^*}_{\text{counterfactual price}} + \underbrace{d \log \mathcal{T}_{i0}}_{\text{govt interventions in energy mkt}} \end{aligned}$$

Effect of infl shock consists of: effect on “raw” price and govt interv in energy mkt \mathcal{T}_{i0}

Our experiment: One-off increase in infl 2021–22 (MIT shock)

Before $t = 0$ (pre-2021), aggr price level \bar{P}_{ss} constant (zero inflation in steady state)

[A1] At $t = 0$ (short run; years 2021–22),

unanticipated inflation shock $dz_0 \Rightarrow$ permanent jump in aggregate price level

$$\frac{d \log \bar{P}_0}{dz_0} > 0$$

Relative good prices, wages, taxes, dividends, and asset prices left unrestricted at $t = 0$

[A2] At $t = 1$ (long run; after 2022),

price stab restored $d \log \bar{P}_1 = d \log \bar{P}_0$, rel prices back to pre-shock $d \log P_{i1} = d \log \bar{P}_{i0}$

[A3] The shock is neutral in the long run, i.e. at $t = 1$:

$$\frac{d \log W_{i1}}{dz_0} = \frac{d \log T_{i1}}{dz_0} = \frac{d \log D_{i,k1}}{dz_0} = \frac{d \log Q_{k1}}{dz_0} = \frac{d \log P_1}{dz_0}$$

[A4] Long-run adjustment of the govt budget constraint through price level or future real surpluses

Direct component: four sources of heterogeneity

Impact of the **raw inflation shock** P_{i0}^*

$$dW_i^{DIR} = \left[\underbrace{\frac{d \log \bar{P}_0^*}{dz_0}}_{\text{average } \pi} - \underbrace{\left(\frac{d \log P_{i0}^*}{dz_0} - \frac{d \log \bar{P}_0^*}{dz_0} \right)}_{\text{1. } \pi \text{ gap raw}} \right] \times$$

$$\left[\underbrace{W_{i0} - T_{i0}}_{\text{2. net income}} + \underbrace{B_{i,S0} + (1 + Q_{L0}\delta) B_{i,L0}}_{\text{3. net nominal position (NNP)}} + \underbrace{\sum_{k=1}^K D_{k0} a_{i,k0} + \sum_{k=1}^K Q_{0k} (a_{i,0k} - a_{i,1k})}_{\text{4. dividends + capital gains (K)}} \right]$$

Note that the change in prices is the **raw one**, P^* , i.e., before fiscal interventions

'Unconventional' fiscal policy: energy market interventions & ad hoc transfers

$$dW_i^{UFP} = \underbrace{\left(\frac{d \log P_{i0}^*}{dz_0} - \frac{d \log P_{i0}}{dz_0} \right)}_{\text{1. } \pi \text{ gap fiscal: energy market interventions}} \times \left[W_{i0} - T_{i0} + B_{i,S0} + (1 + Q_{L0}\delta) B_{i,L0} + \sum_{k=1}^K D_{k0} a_{i,k0} + \sum_{k=1}^K Q_{0k} (a_{i,0k} - a_{i,1k}) \right] - \underbrace{\frac{dT_{i0}^{HOC}}{dz_0}}_{\text{2. ad-hoc transfers}}$$

Recall that:

$$\frac{d \log P_{i0}}{dz_0} - \frac{d \log P_{i0}^*}{dz_0} = \frac{d \log \mathcal{T}_{i0}}{dz_0}$$

Indirect component: four sources of heterogeneity

$$dW_i^{IND} = \underbrace{\frac{d \log W_0}{dz_0} W_0}_{1. \Delta \text{ wages}} - \underbrace{\frac{d \log T_{i0}^{AUT}}{dz_0} T_{i0}^{AUT}}_{2. \Delta \text{ net taxes}} - \underbrace{\frac{d \log Q_{S0}}{dz_0} Q_{S0} B_{S0} - \frac{d \log Q_{L0}}{dz_0} Q_{L0} (B_{i,L1} - \delta B_{i,L0})}_{3. \Delta \text{ nominal interest rates}}$$
$$+ \underbrace{\sum_{k=1}^K \frac{d \log D_{k0}}{dz_0} D_{k0} a_{i,k0} + \sum_{k=1}^K \frac{d \log Q_{k0}}{dz_0} Q_{k0} (a_{i,k0} - a_{i,k1})}_{4. \Delta \text{ dividends + stock and house prices}}$$

The inflationary shock affects all prices entering the household budget constraint

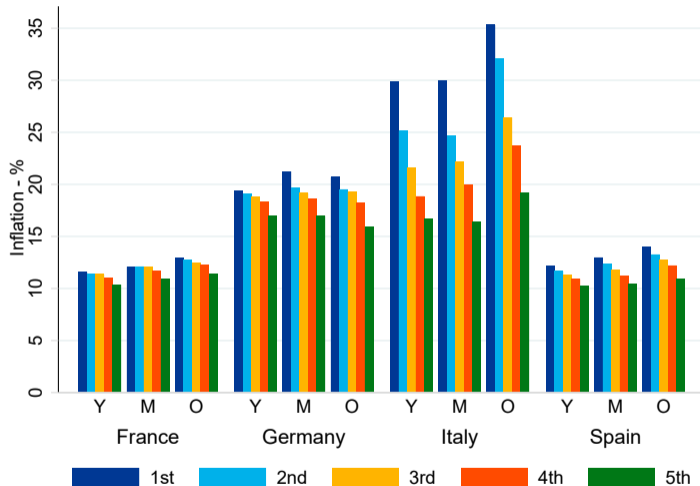
Long-run component

$$dW_i^{LR} = -R_{S1}^{-1} \cdot \left(\frac{d \log \bar{P}_1}{dz_0} - \frac{d \log P_{i0}}{dz_0} \right) [B_{i,S1} + (1 + Q_{L1}\delta) B_{i,L1}].$$

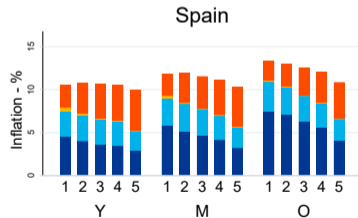
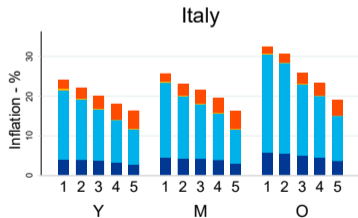
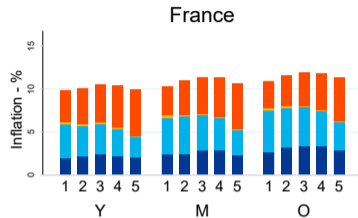
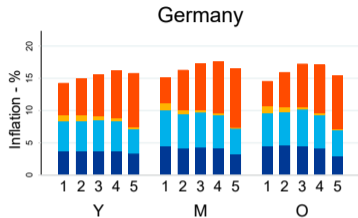
- ▶ Revaluation of NNP at $t = 1$ due to long-run **realignment in relative prices**
- ▶ This component is **zero** only if the shock does not affect relative prices at $t = 0$. Then:

$$d \log P_{i0} = d \log \bar{P}_0 = d \log \bar{P}_1$$

Cumulative inflation without rents



Inflation decomposition



Food Energy Rent Other

Labor income

- ▶ **Income distribution:** Household Finance and Consumption Survey 2017
- ▶ **Wages:** data on negotiated wage agreements from national statistical agencies
- ▶ **Minimum wage:** national official sources
- ▶ **Pensions:** national data transmitted to the ECB

Subtract expected inflation from the nominal growth rates

Measurement

Taxes and transfers

- ▶ OECD Tax database

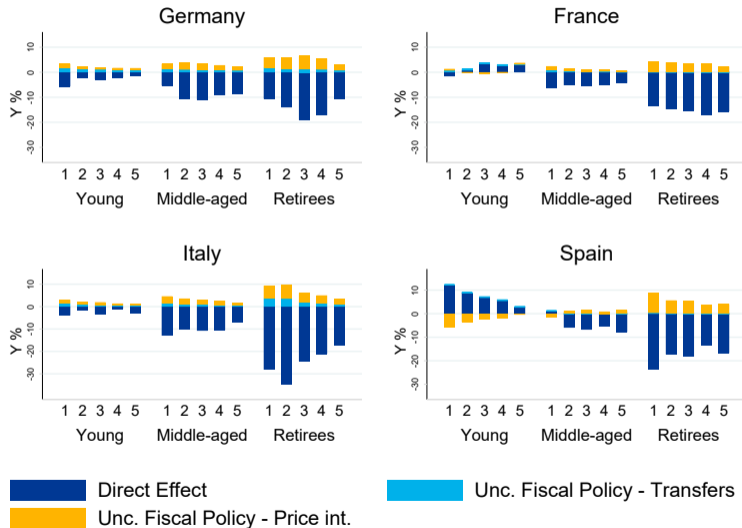
Other sources of income

- ▶ Interest, dividends, etc.: Household Finance and Consumption Survey 2017

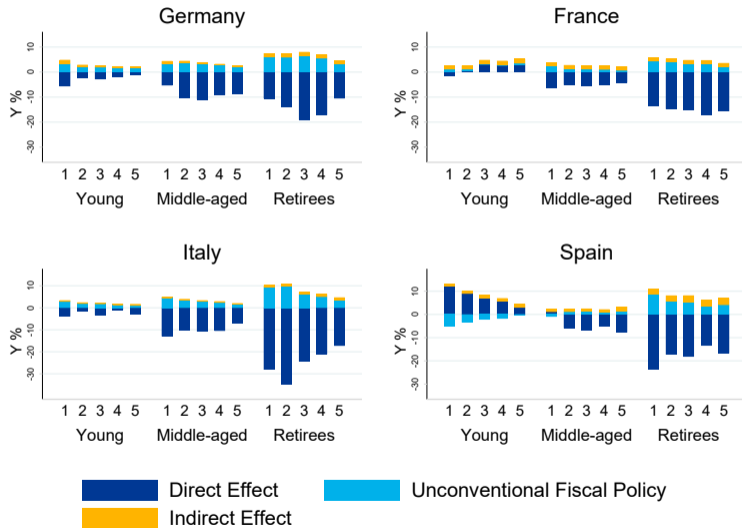
Asset prices

- ▶ Balance sheets: Household Finance and Consumption Survey 2017
- ▶ House prices: Reaction of REIT on the day of release of German HICP as instrument for country-level quarterly house price indexes → small effect
- ▶ Stock prices: Reaction of daily stock price to release of German HICP → large effect
- ▶ Long-term bond prices: Same strategy → small effect

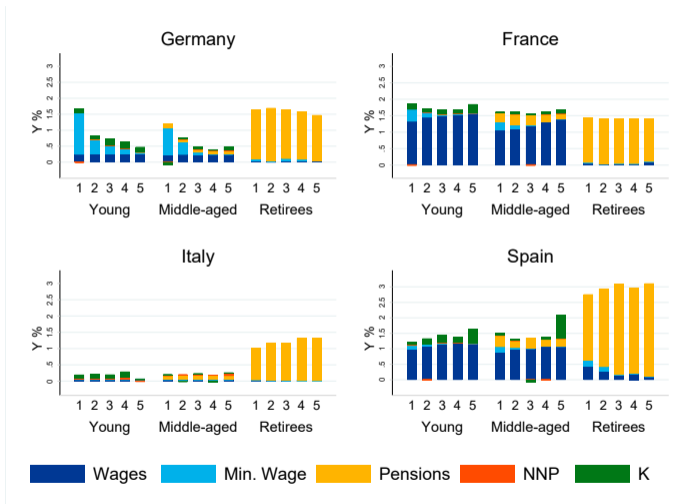
2. Unconventional fiscal policy component



3. Indirect component



3. Breakdown of indirect component



Y: Net labor income

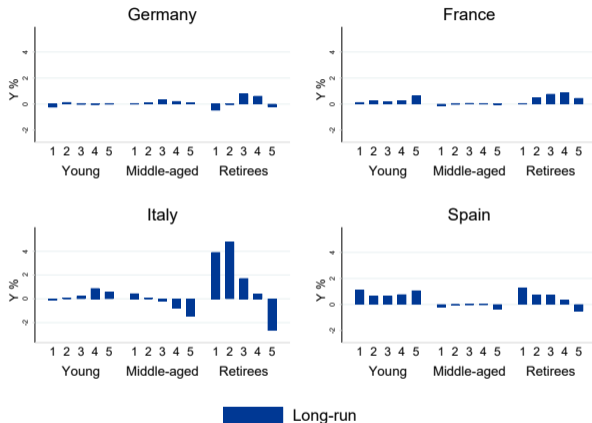
Minimum wage

Pensions

NNP: Bond prices

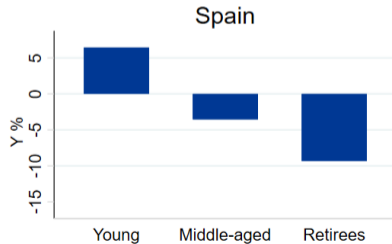
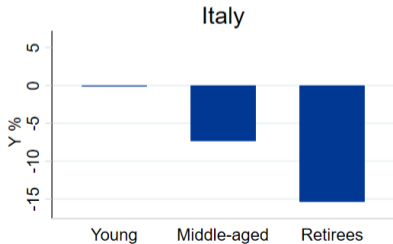
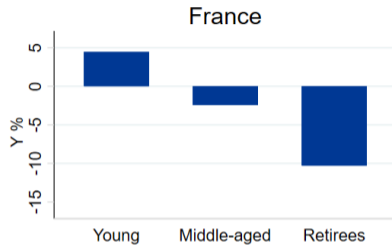
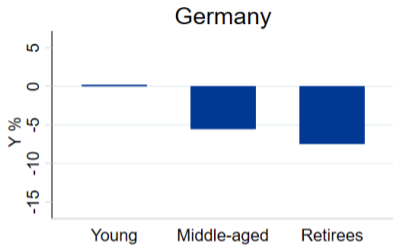
K: House and stock prices

4. Long run component

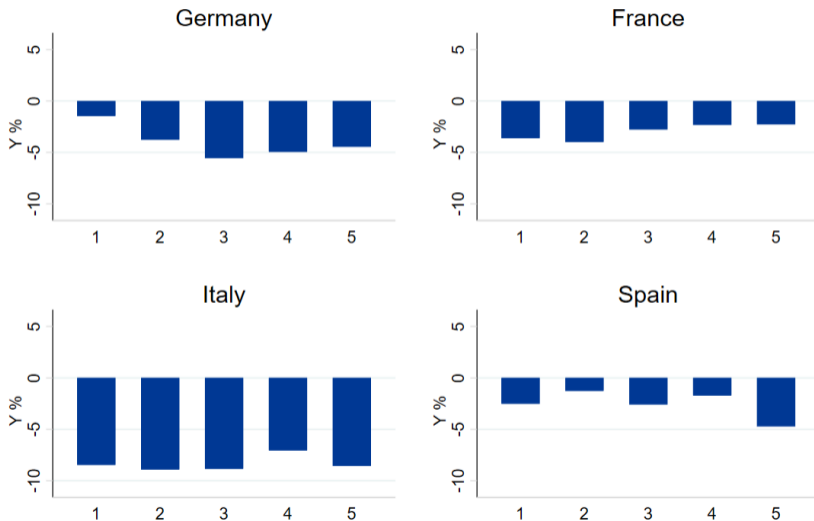


- ▶ Small, except for **poor retirees in Italy** whose budget share in energy is large

Total welfare change: clear gradient by age



Total welfare change: no clear gradient by income



Beyond the household sector

- ▶ **Household sector** is a net loser from episode—but who's on other side?
- ▶ Compute aggregate gains by broad sector (households, government, foreign)
 - ▶ Attributing firm holdings to their owners **Foreign sector**
- ▶ **Government gains** because it is a net borrower, but it loses through:
 1. Ad-hoc fiscal measures to protect households from inflation
 2. Higher costs of its purchases

	Household		Government		
	Net Gain	NNP	Fiscal Support	Higher Costs	Net Gain
France	-4.3	4.2	-2.0	-1.2	0.8
Germany	-2.8	5.4	-1.9	-0.7	2.8
Italy	-8.4	13.6	-2.4	-1.3	9.9
Spain	-3.0	5.3	-2.0	-0.7	2.6

Percentages of biannual income / GDP