Who Bears the Costs of Inflation?

Euro Area Households and the 2021–2023 Shock

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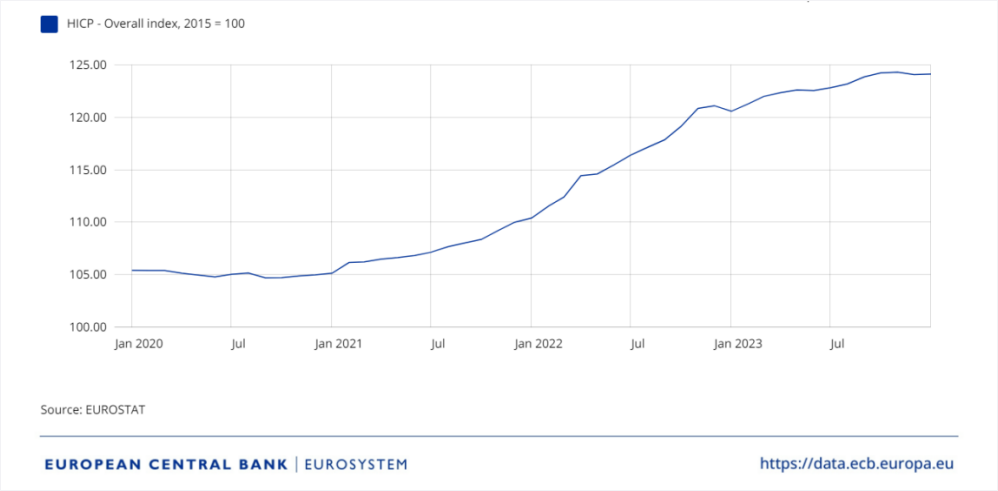
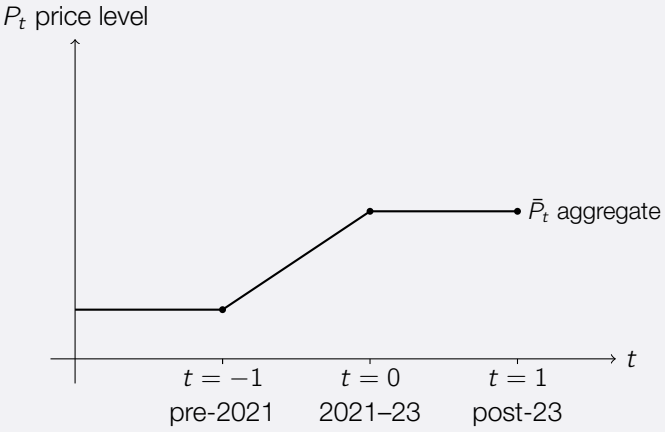
Event study: recent Euro Area inflation episode



What are the distributional effects of recent inflation shock?

- Large shock in Euro Area during 2021–23: 18% cumulative price increase
- Key drivers: energy and food prices Data
- Public debate: contrasting arguments, as in the literature
  - Poorer and younger households spend more on energy and food
  - But wealthier and older households own more nominal wealth
- Our contribution:
  1. Conceptual: Organizing framework to illustrate transmission channels of inflation shock
  2. Empirical: Quantify size of various channels across income/age in the 4 main EA countries

Thought experiment



Assumptions

Before $t = 0$ (pre-2021), price level constant

[A1] At $t = 0$ (short run; years 2021–23), unanticipated inflation shock dz_0

[A2] At $t = 1$ (long run; after 2023), price stability restored

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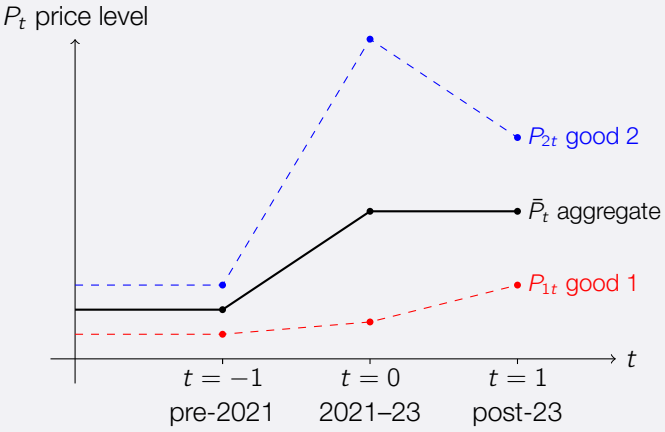

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Relative prices back to pre-shock

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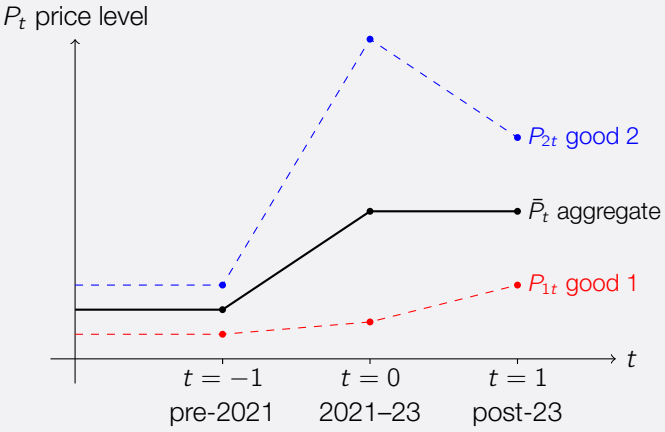

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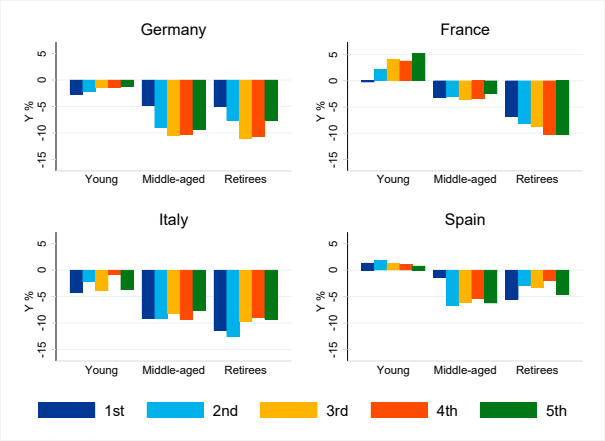
Relative prices back to pre-shock

[A3] Neutral shock in long-run (real wages, asset prices, taxes, dividends do not change)

Welfare analysis

- **Sources of heterogeneity in welfare change**:
  1. Heterogeneous consumption baskets $\Rightarrow$ different inflation rates across households
  2. Heterogeneous net nominal positions (e.g., borrowers vs savers)
  3. Heterogeneous "stickiness" of nominal income (e.g., workers vs pensioners)
  4. Heterogeneous holdings of real assets (e.g., housing and stocks)

Total welfare change



- Inflation surge hit hard older households
- No clear gradient by income
- Some households (debtors) gained

Household Problem

- Overlapping generations living for two periods $t = 0, 1$ (short-run & long-run)
- No aggregate or idiosyncratic uncertainty, and no binding liquidity constraints
- Problem of the household at $t = 0$

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

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\end{aligned}
$$

- $P_{it} = P^*_{it}(1 - \mathcal{T}_{it})$, effective prices = raw prices - government subsidy

Welfare analysis

- **Object of interest**: impact of inflation shock dz_0 on each household welfare
- **Methodology**: envelope theorem (first-order perturbation)
- **Welfare criterion**: money metric welfare change, i.e. share of income individual i would have been willing to pay (in 2020 Euros) in order to avoid the 2021-23 inflation shock

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

Welfare analysis

- **Welfare decomposition**:

$$\mathbf{d}\mathcal{W}_i = d\mathcal{W}_i^{DIR} + d\mathcal{W}_i^{UFP} + d\mathcal{W}_i^{IND} + d\mathcal{W}_i^{LR}$$

1. Direct: impact of the raw inflation shock on nominal income and wealth
   - On: (1) labor market income, (2) net nominal positions, (3) dividends and capital gains
   - Heterogeneous because of π heterogeneity
2. Unconventional Fiscal Policy: impact of targeted government interventions
3. Indirect: adjustment of labor and capital income, taxes, and asset prices
   - Through (1) equilibrium responses, (2) indexation, (3) tax bracket creep
4. Long-Run: residual long-run effects (i.e., relative price re-alignment)

Components

Measurement

Countries and demographic groups

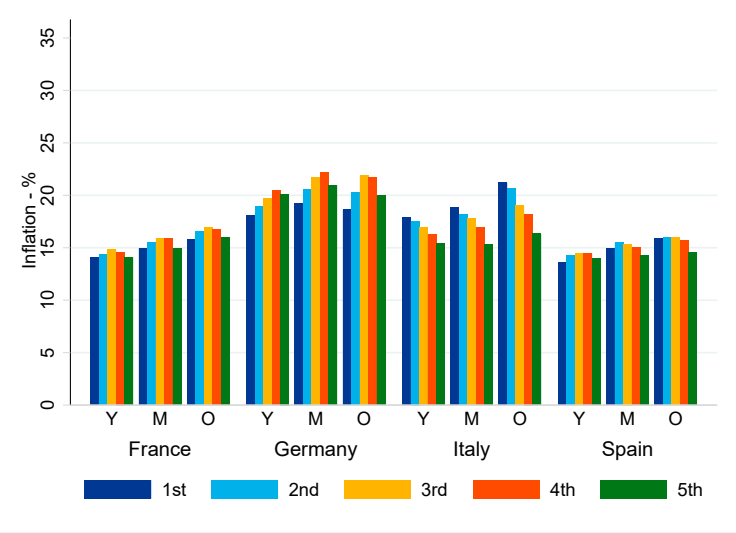
- Big-4 economies in Euro Area: Germany, France, Italy, Spain
- Breakdown of households by age (25–44, 45–64, 65+) and consumption quintiles

Data sources

- Direct component
  - Prices and consumption baskets: Household Budget Survey (2015), Harmonized Index of Consumer Prices (HICP), expected inflation (Consensus Economics)
  - Income, wealth and portfolios: Household Finance and Consumption Survey (2017)
- Unconventional Fiscal Policy: Bruegel dataset
- Indirect component
  - Wages from collective agreements and official minimum wage data; pension data
  - House prices, REIT returns, stock market data

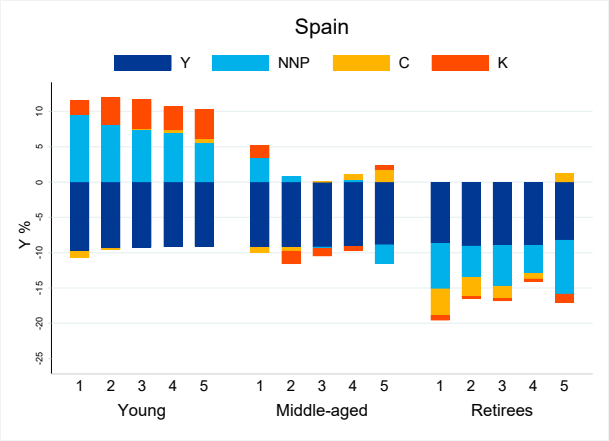
Details

2021–23 cumulative household-level inflation: 14–23%



Without rents | Decomposition

1. Breakdown of direct component: Spain



- **Net income:** loss of 9%, even across groups

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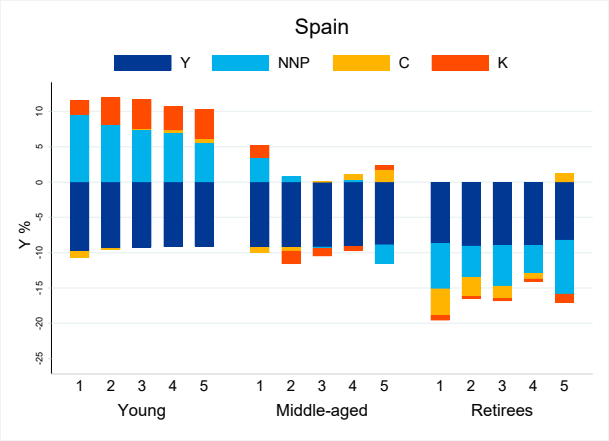

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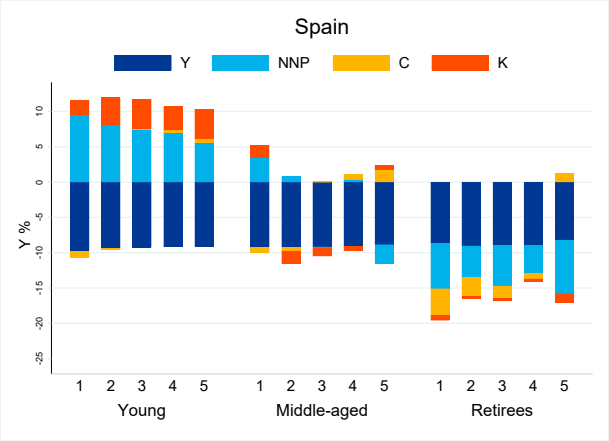

- **Net income:** loss of 9%, even across groups
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- π **differences:** some heterogeneity
- **K gains:** gains for prospective buyers (young)

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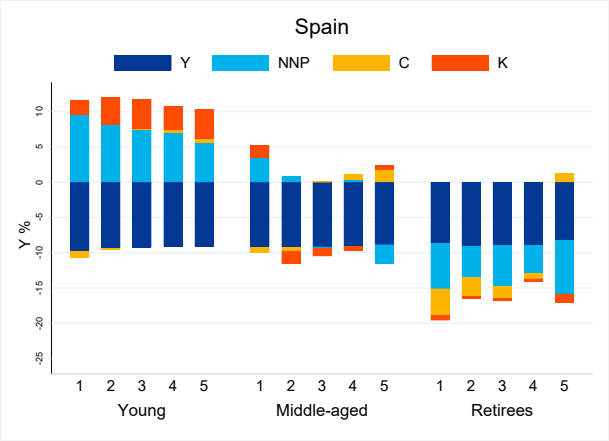

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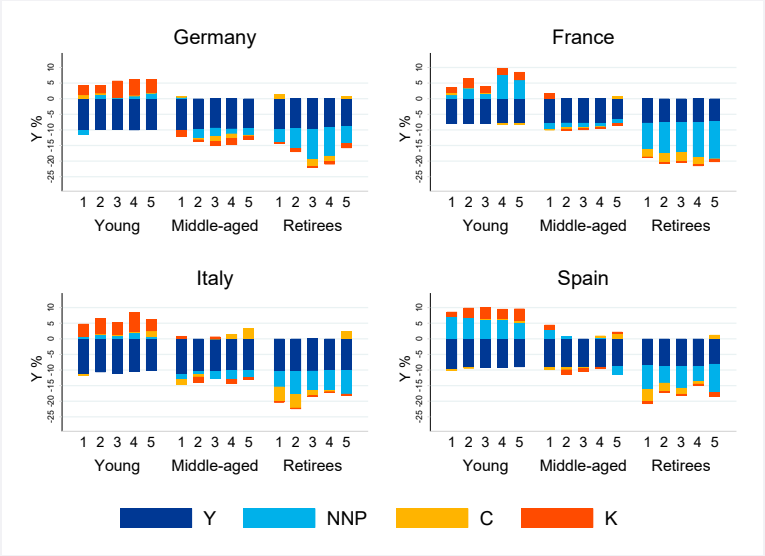
Overall:
Old lose 15%, young break even or gain slightly

1. Direct component: cross-country comparison



Y: Net income

NNP: Net nominal positions

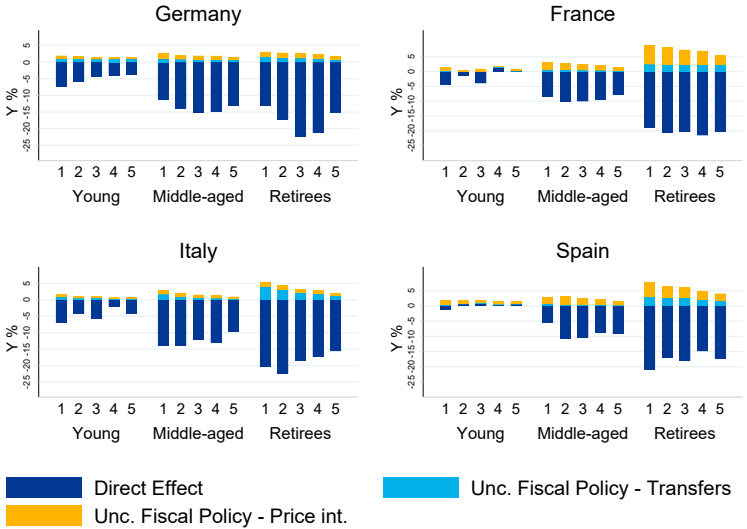
C: π differences

K: Capital gains

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

Totals

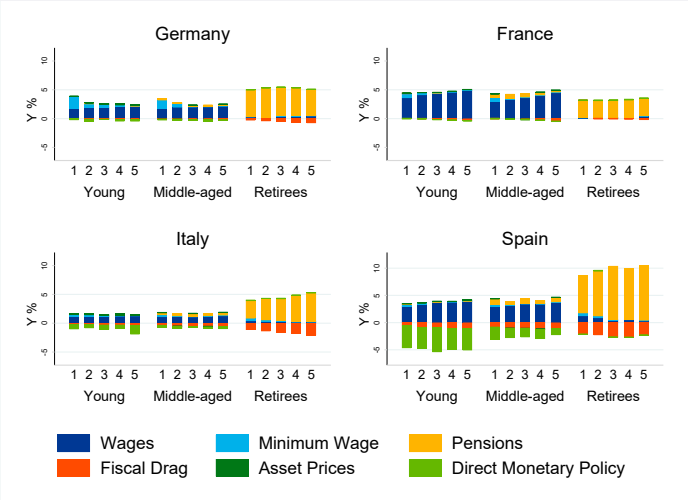
2. Unconventional fiscal policy component



Mitigation of welfare loss, particularly through price interventions

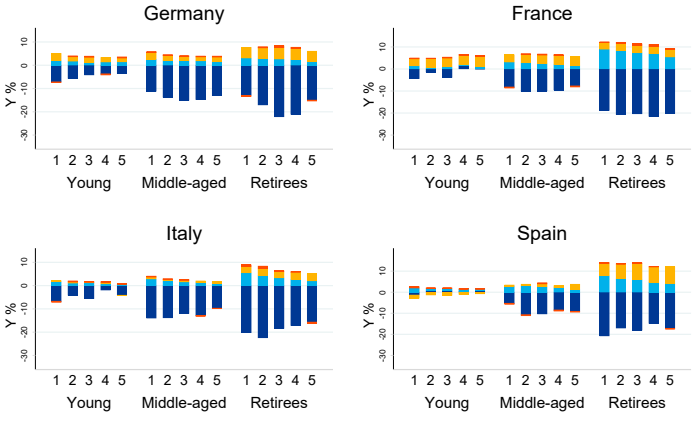
Reduction in inflation

3. Breakdown of indirect component



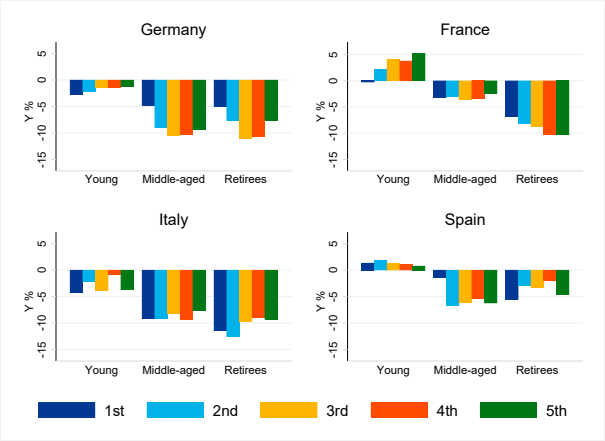
- **Y: Net labor income**: large real purchasing power loss, sizeable recovery only in France
- **Minimum wage**: partially compensates low-income workers in Germany/France
- **Pensions**: mostly indexed, large adjustments, particularly in Spain
- **Monetary policy**: affects negatively the Spanish young (adjustable-rate mortgages)
- **House and stock prices**: small effects

Putting together the four components of the effect on welfare



- Direct component dominates
- Fiscal response is nontrivial More
- Indirect relevant for some More
- Long-run limited effect

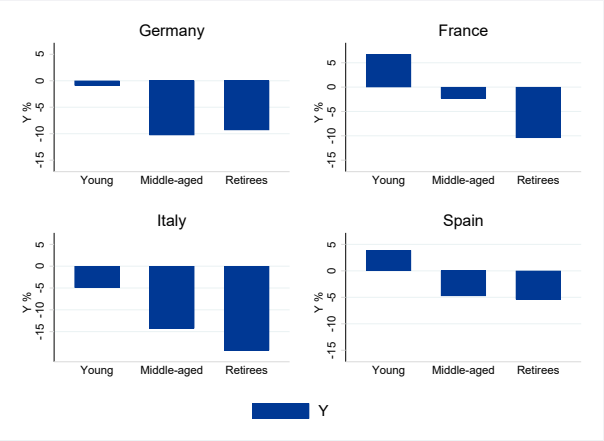
Total welfare change



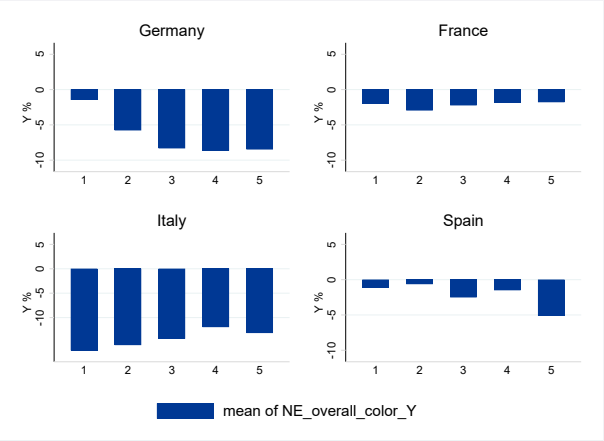
Average total effect:

- DE: –7.0%
- FR: –2.5%
- IT: –9.0%
- ES: –3.5%

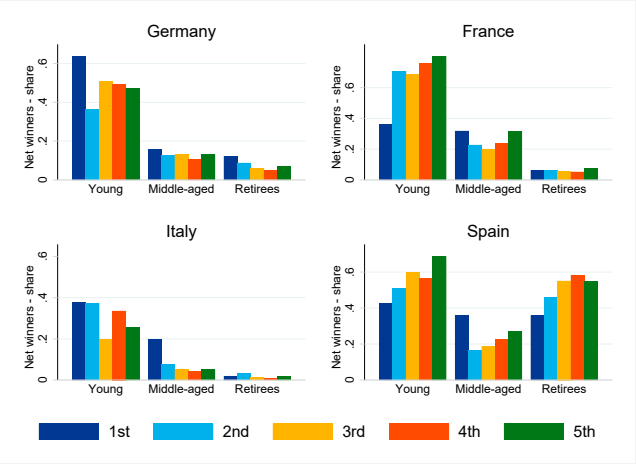
Total welfare change: clear gradient by age



Total welfare change: no clear gradient by income



Share of winners



- On average, 25% of net winners
- But there are many young that lose, even in ES/FR
- Most retirees are net losers, except for ES

Beyond the household sector

- Household sector is a net loser from the episode - but who is on the other side of NNP losses?
- 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 and because of the fiscal drag, but it loses through financing of ad-hoc fiscal measures and higher costs of its purchases.

Country	NNP	Fiscal drag	Fiscal support	Pensions	Government consumption		**Total**
					Lower bound	Upper bound	
Germany	3.5	0.2	-1.6	-1.1	-0.5	-1.6	−0.6 to 0.5
France	4.8	0.1	-1.3	-0.6	-0.8	-1.6	1.3 to 2.1
Italy	7.5	0.6	-1.8	-0.9	-0.3	-0.9	4.5 to 5.1
Spain	4.5	1.0	-1.2	-1.7	-0.4	-1.0	1.6 to 2.2

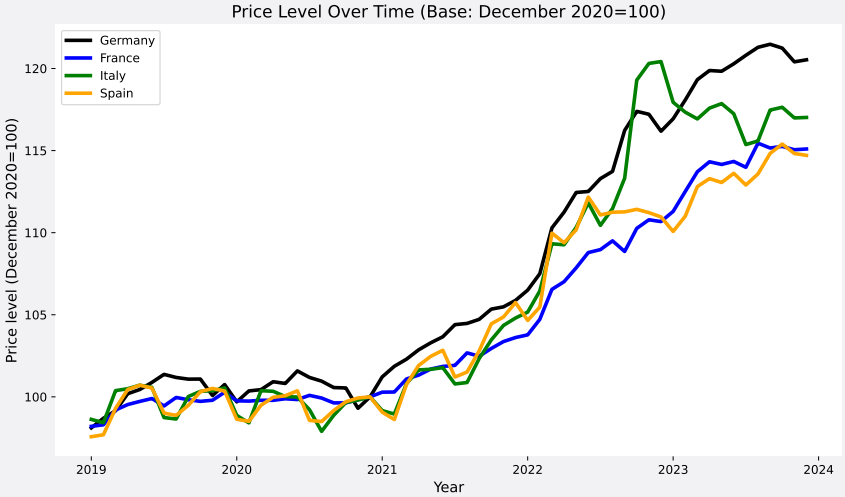
Table: Sources of gains and losses for the government sector, % of triennial GDP

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 the poor, larger NNP for the rich
- Nominal wages are quite rigid in the short run
- Unconventional fiscal policy played a significant role
- Most households lost, but around 30% (debtors) gain
- Governments were mostly net winners

Thanks!

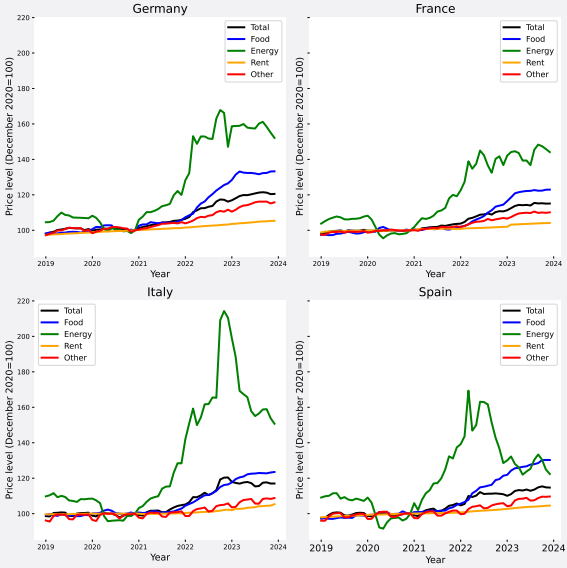
Headline inflation



Back

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)

Back

Price indexes: actual and counterfactual

'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: $\tau_{jt} < 0 \Rightarrow \mathcal{P}_{jt} < \mathcal{P}^*_{jt}$

- At household level (in logs):

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

Back

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)

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

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

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

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

1. Direct component

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

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

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

2. Unconventional fiscal policy component

$$dW_i^{UFP} = \underbrace{\left(\frac{d\log P_{i0}^*}{dz_0} - \frac{d\log P_{i0}}{dz_0}\right)}_{\text{1. } \pi \text{ gap fiscal}} \times$$

$$\left[W_{i0} - T_{i0} + B_{i,S0} + (1 + Q_{L0}\delta)B_{i,L0} + \sum_{k=1}^{K} D_{k0}a_{i,k0} + \sum_{k=1}^{K} Q_{0k}\left(a_{i,0k} - a_{i,1k}\right)\right]$$

$$- \underbrace{\frac{dT_{i0}^{HOC}}{dz_0}}_{\text{2. ad-hoc transfers}}$$

3. Indirect component

$$d\mathcal{W}_i^{IND} = \underbrace{\frac{d\log W_0}{dz_0}W_0}_{\text{1. Δ labor income}} - \underbrace{\frac{d\log T_{i0}^{AUT}}{dz_0}T_{i0}^{AUT}}_{\text{2. Δ net taxes}} - \underbrace{\frac{d\log Q_{S0}}{dz_0}Q_{S0}B_{S1} - \frac{d\log Q_{L0}}{dz_0}Q_{L0}\left(B_{L1} - \delta B_{L0}\right)}_{\text{3. Δ price of nominal assets}}$$

$$+ \underbrace{\sum_{k=1}^{K}\frac{d\log D_{k0}}{dz_0}D_{k0}a_{i,k0} + \sum_{k=1}^{K}\frac{d\log Q_{k0}}{dz_0}Q_{k0}\left(a_{i,k0} - a_{i,k1}\right)}_{\text{4. Δ dividends + stock and house prices}}$$

- Prices in household budget constraint can change because of GE forces of indexation
- Taxes rise through fiscal drag

4. Long-run component

Back

$$d\mathcal{W}_i^{LR} = Q_{S0} \cdot \left(\frac{d \log P_{i0}}{dz_0} - \frac{d \log \bar{P}_1}{dz_0} \right) [B_{i,S1} + (1 + Q_{L1}\delta) B_{i,L1}] .$$

- Revaluation of NNP at $t = 1$ due to long-run realignment in relative prices

Measurement 1

Countries

- Big 4 economies in Euro Area: France, Germany, Italy, Spain

Demographic groups

- 3 age groups: 25-44, 45-64, 65+
- 5 consumption expenditure quintiles (proxy for permanent 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)

Measurement 2

Unconventional fiscal policy

Bruegel dataset on national fiscal policy responses to the energy crisis

Split interventions in two groups:

1. Energy market interventions: include both subsidies and outright regulation
    - Calculate counterfactual price indices separately for gas used for heating, electricity and liquid fuels (petrol and diesel), and then aggregate
2. Direct transfers: ad-hoc income support to low-income households, etc...

Measurement 3 Back

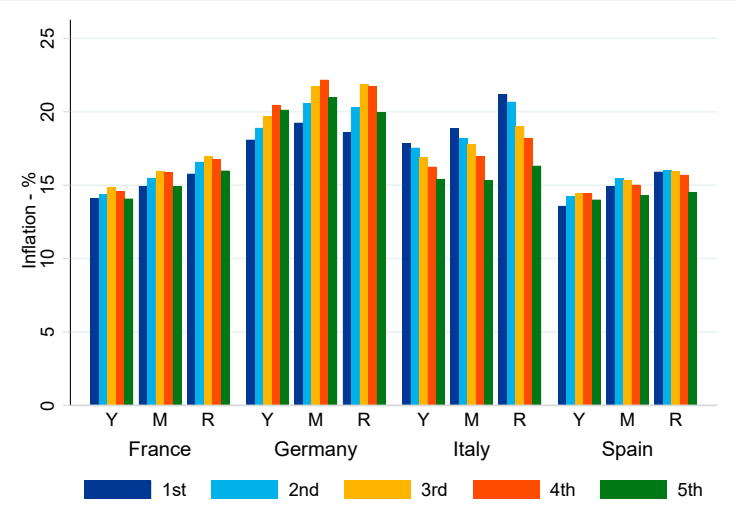
Distribution of household income and balance sheet

- 2017 Household Finance and Consumption Survey

Prices

- Wages: official data on negotiated wage agreements and minimum wages
- 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

Cumulative inflation without rents



Inflation decomposition

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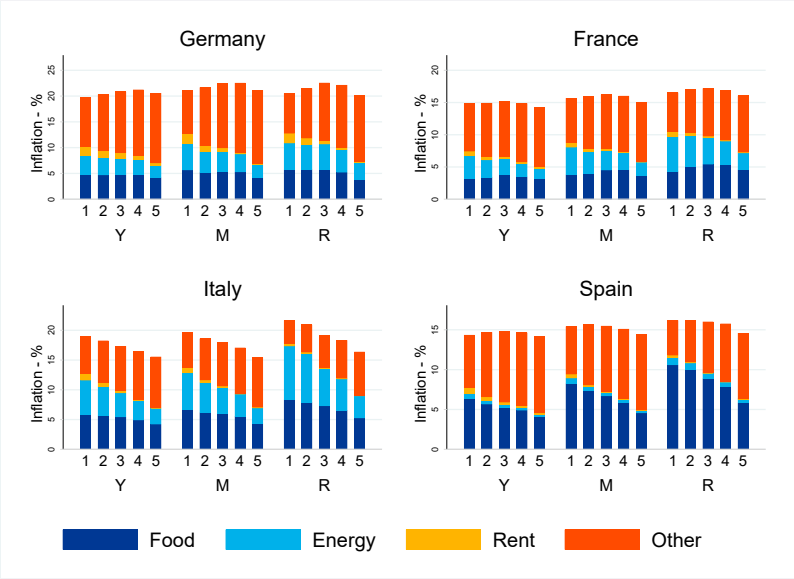
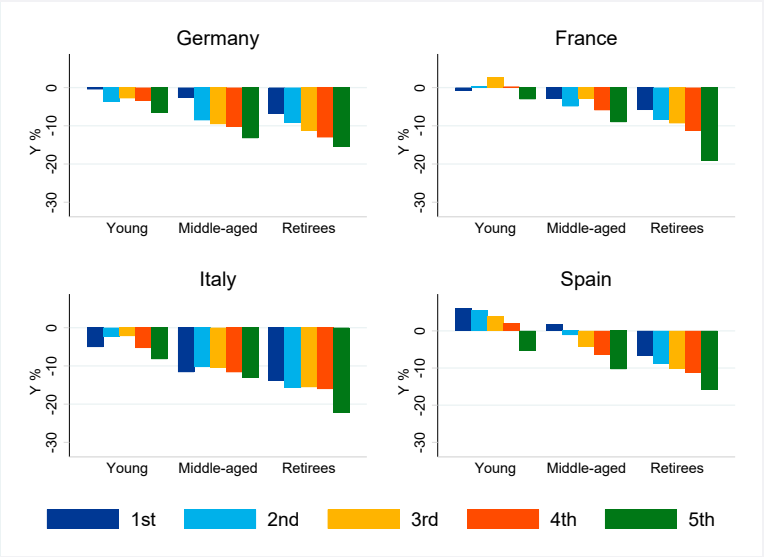


1. Direct component: cross-country comparison

Back



Y: Net income

NNP: Net nominal positions

C: π differences

K: Capital gains

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

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

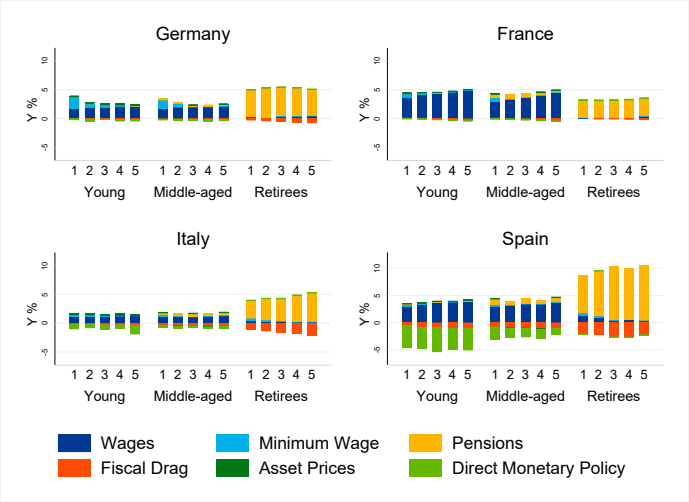
- Interest, dividends, etc.: Household Finance and Consumption Survey 2017

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 $\rightarrow$ small effect
- Stock prices: Reaction of daily stock price to release of German HICP $\rightarrow$ large effect
- Long-term bond prices: Same strategy $\rightarrow$ small effect

3. Breakdown of indirect component

Back



Y: Net labor income

Minimum wage

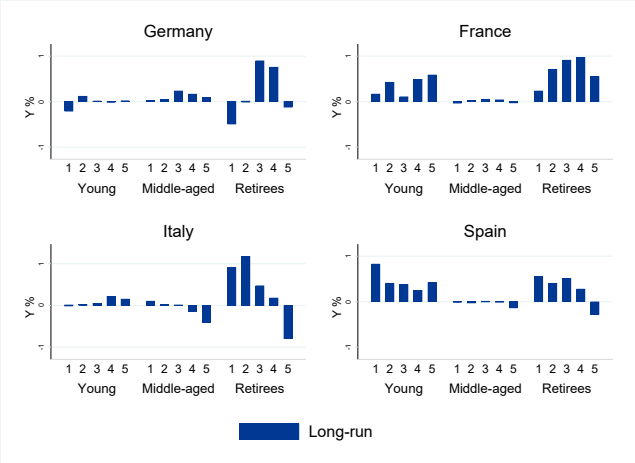
Pensions

NNP: Bond prices

K: House and stock prices

4. Long run component

Back



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

More

Gains and losses for government and foreigners: NNPs

Net Nominal Positions (share of biennial GDP)

Country	Households		Government	Foreign
	NNP_0^h	$DNNP_0^h$	NNP_0^g	NNP_0^x
Germany	0.37	0.45	-0.26	-0.11
France	0.40	0.48	-0.50	0.10
Italy	0.40	0.54	-0.67	0.27
Spain	0.09	0.22	-0.48	0.39

Gains/losses from NNP channel

Country	Households	Government	Foreign
Germany	-6.0	4.2	1.8
France	-4.3	5.4	-1.1
Italy	-8.2	13.6	-5.4
Spain	-1.0	5.3	-4.3

The government

Back

Country	Fiscal support			Increased costs of government consumption	
	Total	Households	Firms	Lower bound	Upper bound
Germany	-2.0	-1.7	-0.3	-0.6	-1.8
France	-1.9	-1.8	-0.1	-0.3	-1.0
Italy	-2.4	-1.5	-0.9	-0.8	-1.7
Spain	-2.0	-1.1	-0.9	-0.4	-1.0

Table: Cost of government interventions and increased expenditure, % of biennial GDP

Country	Upper bound	Lower bound
Germany	1.6	0.4
France	3.2	2.5
Italy	10.4	9.5
Spain	2.9	2.3

Table: Total government gains, % of biennial GDP

The foreign sector

Back

Country	Gain/loss through terms of trade 2020–2022	Total gain/loss for foreign sector
Germany	3.4	5.2
France	1.0	-0.1
Italy	3.4	-2.0
Spain	2.5	-1.8

Table: Gains of the foreign sector: through the terms of trade and total, % of biennial GDP