Consumer Durables, Monetary Policy, and the Green Transition

Alexander Dietrich, Lukas Leitenbacher, Gernot Müller

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What role does monetary policy play for the green transition of households?

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Durable consumption

- Direct CO_2 emissions: large part of HH carbon footprint (transport & buildings)
- Covered by EU Emission Trading Scheme (ETS2) from 2027 onwards
- Pricing emissions shifts expenditure from brown to green durables

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Monetary policy

- Emission pricing pushes up inflation
- To keep inflation on target, monetary policy needs to raise interest rates
- Slows down green transition as durable purchases highly interest-rate sensitive

This paper

Institutional background & facts

- How households contribute to CO_2 emissions via durables consumption
- 2027: EU starts to price CO_2 emissions from transport and buildings (*ETS2*)

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Time-series evidence

- Revisit responsiveness of consumer durables to monetary policy in euro area

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Time-series evidence

- Revisit responsiveness of consumer durables to monetary policy in euro area

New Keynesian model with green and brown durables

- Calibrate to match time-series evidence
- Simulate phasing-in of price for household emissions: green transition
- Quantify tradeoff faced by monetary policy

Monetary policy tradeoffs during green transition

Green transition potentially inflationary

- "Fossilflation": Rising inflation due to carbon pricing (Schnabel 2023)
- Discussion focused on brown v green industries
- Tradeoff: Stabilizing CPI inflation v <u>supporting economic activity</u> (Del Negro et al. 2024, and quite a few others)

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This paper: two innovations

- Consumer durables: important for green transition & sensitive to monetary policy
- Tradeoff: Stabilizing CPI inflation v <u>supporting green transition</u>

Related literature

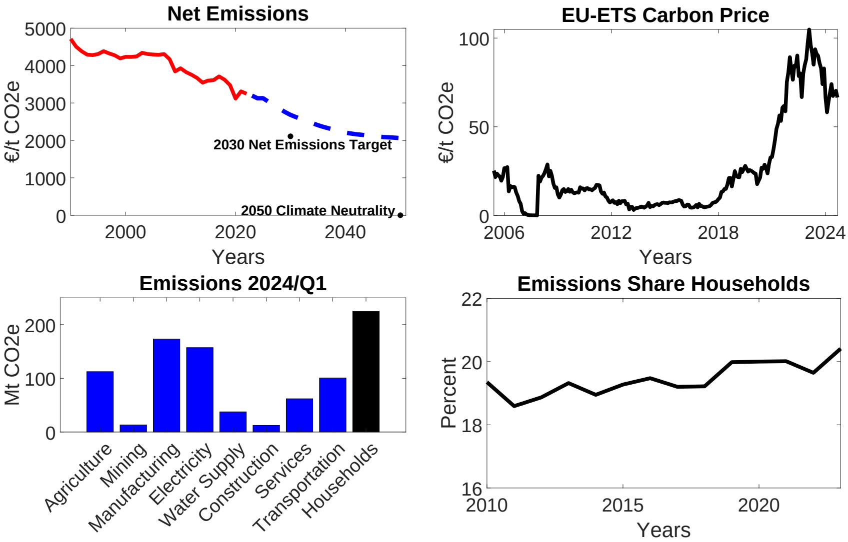
Green transition

- Inflationary impact: Känzig (2023), Konradt Weder di Mauro (2023)
- Monetary policy: Airaudo et al (2024), Coenen et al (2024), Ferrari Nispi-Landi (2024), Nakov Thomas (2024), Olovsson Vestin (2023)
- Optimal climate policy: Carratini et al (2023), Golosov et al (2014), Hassler et al (2021), Heutel (2012) van den Bremer van der Ploeg (2021)

Other

- Durables models and monetary policy: Barsky et al (2007), Di Pace Hertweck (2019), Erceg Levin (2006), Monacelli (2009), McKay Wieland (2021), Sterk Tenreyro (2018)
- Climate policy uncertainty: Dietrich et al (2024), Carattini et al (2023), Fried et al (2022), Lemoine (2017)

2. Preliminaries—institutional background



ETS2: Extension of EU-Emission Trading Scheme (EU-ETS) as of 2027

Covers CO_2 emissions in road transport and buildings

- Households are responsible for 60% of road transport emissions
- Durable consumption accounts for $\approx$ 50% of households' overall carbon footprint

Cap-and-trade market (just like EU-ETS)

- Anticipated price: at least 45€ (in 2020 prices) per allowance (1 ton CO_2)
- EU market stability reserve of 600 million allowances to manage prices
- Energy producers buy allowances and pass prices through to households

Expected costs for households $\approx$ 1.5 percent of consumption

- Direct emissions in residential buildings and road transport: 2t CO_2 per person
- Median ETS2 price forecast 2030: 140€ per allowance

Preliminaries—how monetary policy impacts durable purchases

New evidence for euro area

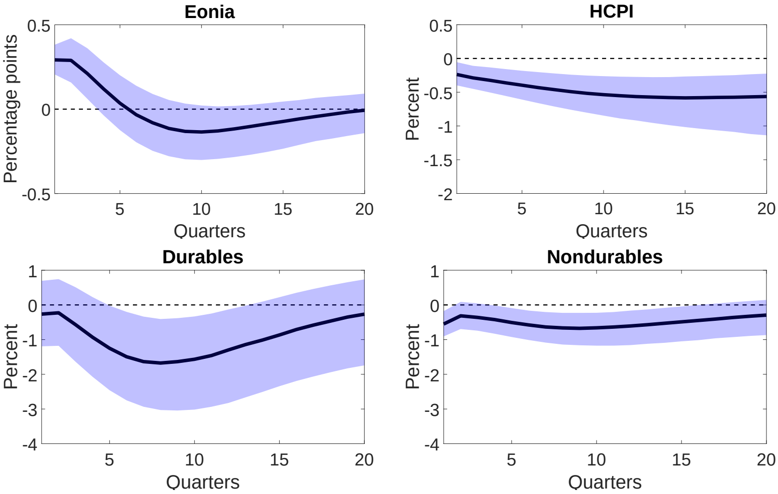
- Euro area BVAR 1999:1–2019:12, 6 lags
- 6 variables: EONIA, HCPI, durables, nondurables, M1 and industrial production

Identification (Badinger Schiman 2023)

- Narrative residual restrictions based on high-frequency monetary policy surprises
- Contractionary monetary policy shocks: Nov 2008, Oct 2011
- Expansionary: Oct 2008, Nov 2011
- One monetary policy shock via magnitude restriction in Nov 2011

How monetary policy impacts durable purchases: new time-series evidence

Median responses reported at quarterly frequency and 68% credible sets



3. New Keynesian model with green and brown durables

Households

- Purchase non-durable consumption goods and invest in durable stock
- Brown durables cause (potentially) costly emissions, green durables do not
- No feedback from emissions to economy

Firms

- Production uses labor input only, no capital, no emissions
- Monopolistic competition, infrequent price adjustment

Policy

- Monetary policy: interest rate rule
- Fiscal policy: sets emission price, rebates revenues lump sum

Household preferences

A representative, infinitely-lived household maximizes utility

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{(Z_t - hZ_{t-1})^{1-\sigma}}{1-\sigma} - \eta \frac{N_t^{1+\varphi}}{1+\varphi} \right],$$

with nested aggregates:

$$Z_t = C_{N,t}^{\psi_C} S_t^{1-\psi_C}, \text{ and } S_t = \left[\psi_B^{\frac{1}{\zeta}} D_{B,t}^{\frac{\zeta-1}{\zeta}} + (1-\psi_B)^{\frac{1}{\zeta}} D_{G,t}^{\frac{\zeta-1}{\zeta}} \right]^{\frac{\zeta}{\zeta-1}}$$

and law of motion for durable stock:

$$D_{k,t} = C_{k,t} + (1-\delta_k) D_{k,t-1} \quad \forall\, k \in \{G, B\}.$$

Household expenditure & adjustment costs

Non-durables and durables are CES-composites of varieties indexed $j \in [0, 1]$:

$$C_{N,t} + C_{G,t} + C_{B,t} = \left[\int_0^1 Y_t(j)^{\frac{\epsilon-1}{\epsilon}} \, dj \right]^{\frac{\epsilon}{\epsilon-1}}$$

With price of variety $P_t(j)$, $P_{y,t} = \left[\int_0^1 P_t(j)^{1-\epsilon} \, dj \right]^{\frac{1}{1-\epsilon}}$; period budget constraint:

$$\begin{aligned} W_t N_t + B_{t-1} + T_t \quad &= \quad P_{y,t} \sum_{k \in \{N,G,B\}} C_{k,t} + P_{CO_2,t} E_t + \mathcal{Q}_t B_t \\ &- \quad \underbrace{\frac{\Phi_1}{2} \left[\frac{C_{G,t} + C_{B,t}}{C_{G,t-1} + C_{B,t-1}} - 1 \right]^2}_{\text{CEE-type flow costs: aggregate}} - \underbrace{\frac{\Phi_2}{2} \left[\frac{C_{G,t} / C_{B,t}}{C_{G,t-1} / C_{B,t-1}} - 1 \right]^2}_{\text{CEE-type flow costs: composition}} \end{aligned}$$

Consumer prices and emission prices

Assumption

- Emissions proportional to brown stock of durables: $E_t = D_{B,t}$
- Implies for effective price of durable stock

$$P_{S,t} = \left[\psi_B (P_{y,t} + P_{CO2,t})^{1-\zeta} + (1-\psi_B)(P_{y,t})^{1-\zeta}\right]^{\frac{1}{1-\zeta}}$$

Consumer price index (CPI)

$$P_t = (P_{y,t})^{\psi_C} (P_{S,t})^{(1-\psi_C)}$$

Wedge between CPI and PPI

- Depends on $P_{CO2,t}$ and on weight of brown durable stock ψ_B

Firms

Production linear in labor:

$$Y_{i,t}(j) = N_{i,t}(j)$$

Monopolistic competition and Calvo friction:

$$\mathbb{E}_t \sum_{g=0}^{\infty} \theta^g \Lambda_{t,t+g} \left[P_t^* Y_{t+g|t} - \mathcal{C}_{t+g|t}(Y_{t+g|t}) \right]$$

Producer price index evolves as:

$$P_{y,t} = [(1-\theta)(P_t^*)^{1-\epsilon} + \theta(P_{y,t-1})^{1-\epsilon}]^{\frac{1}{1-\epsilon}}$$

Fiscal and monetary policy

Policy adjusts allowances to meet target for CO_2 price, given exogenously

$$P_{CO2,t} = P_{CO2,t-1} + \epsilon_{CO2,t},$$

Revenues rebated to household in lump-sum way

Monetary policy operates interest-rate feedback rule

$$\frac{i_t}{\bar{i}} = \left[\frac{i_{t-1}}{\bar{i}}\right]^{\rho} \left[\left(\frac{\Pi_t}{\bar{\Pi}}\right)^{\phi_\pi} \left(\frac{y_t}{\bar{y}}\right)^{\phi_y}\right]^{1-\rho} \epsilon_{i,t}$$

4. Calibration

	Parameter	Value	Target/Literature
Preferences and production			
Discount factor	β	0.9951	$r_t \approx 2\%$
Inverse Frisch elasticity	φ	1	Customary
Durables elast. of substitution	ζ	5	Strong substitutes
Relative labor disutility	η	2.2610	$N^{SS} = 1$
Variety substitution elasticity	ϵ	11	Markup 10%
Brown dur. depreciation rate	δ_B	0.054	20% ann. depreciation
Green dur. depreciation rate	δ_G	0.0127	5% ann. depreciation
$\rightarrow$ regulatory risk			
Sector sizes			
Nondurable CES share	ψ_C	0.8883	90% nondurable exp. share
Brown durable CES share	ψ_B	0.9982	85% brown durables exp. share

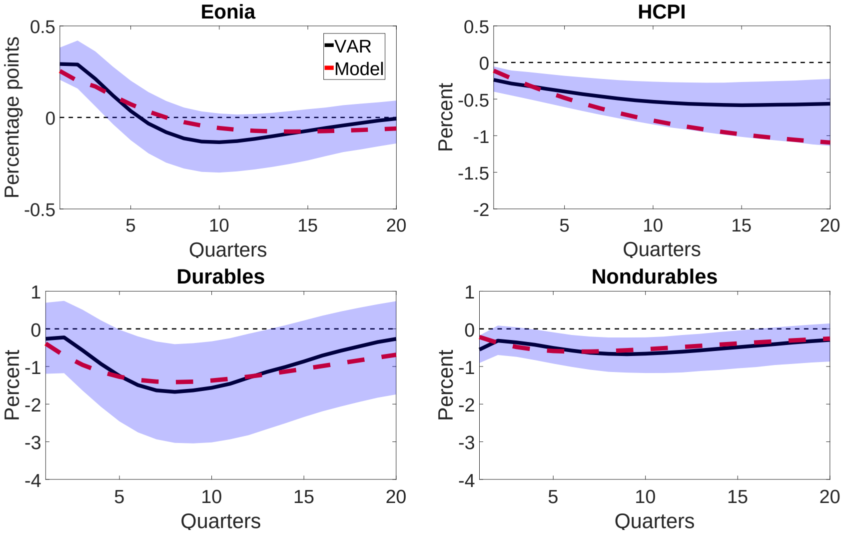
Bayesian IRF Matching

	Prior				Posterior			
	Distribution	Mean	Std.dev.	Bounds	Mode	Mean	5%	95%
θ	Beta	0.5	0.15	[0.01; 0.99]	0.9225	0.9216	0.9144	0.9301
Φ_1	Normal	4	1	[0.01; 10]	0.2224	0.2395	0.1681	0.3153
ϕ_π	Normal	1.5	0.15	[1.01; 5]	1.2111	1.2060	1.0121	1.3518
ρ	Beta	0.5	0.15	[0; 0.99]	0.5243	0.5266	0.4356	0.5981
h	Beta	0.5	0.15	[0; 1]	0.9277	0.9222	0.9013	0.9443
σ	Normal	1	0.2	[0.25; 4]	0.3554	0.3967	0.2594	0.5075

Note

- Output-response coefficient ϕ_y close to zero
- Adjustment costs of changing stock composition Φ_2 not identified

VAR v model


Eonia
Percentage points
0.5
0
-0.5
5
10
15
20
Quarters
VAR
Model
HCPI
Percent
0.5
0
-0.5
-1
-1.5
-2
5
10
15
20
Quarters
Durables
Percent
1
0
-1
-2
-3
-4
5
10
15
20
Quarters
Nondurables
Percent
1
0
-1
-2
-3
-4
5
10
15
20
Quarters

5. Green transition

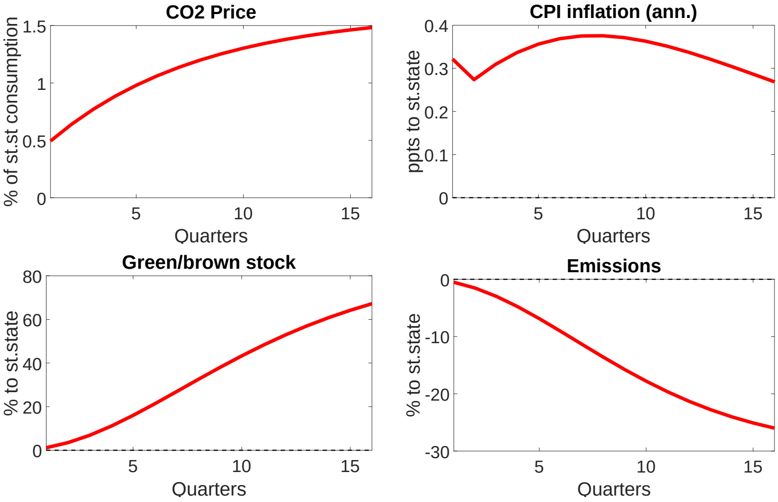
Shift expenditures from brown to green durable purchases

- Initial steady state: 85% brown v 15% green

Speed of transition depends on:

1. Price path of emissions: 45€ CO_2 price at the start in 2027, increases gradually to 140€ in 2030 (median forecast); baseline: unanticipated
2. Adjustment costs: set $\phi_2 = 0.00022$ to achieve emission reduction targeted under ETS2 by 26%

Green transition: 2027–2030



The role of monetary policy for the green transition

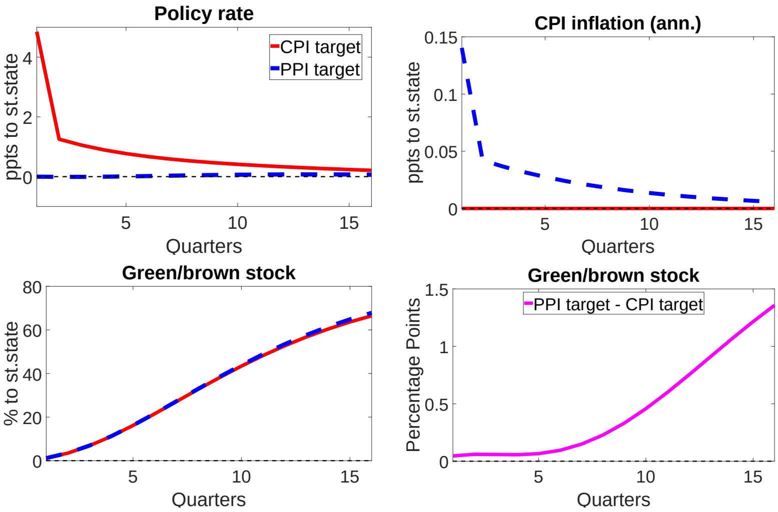
Assume strict inflation targeting (instead of Taylor rule) and two limiting cases

- Target CPI inflation: $\Pi_t = 1$
- Looking-through policy/PPI target: $\Pi_{y,t} = 1$

Intermediate cases: parameterize degree of looking through

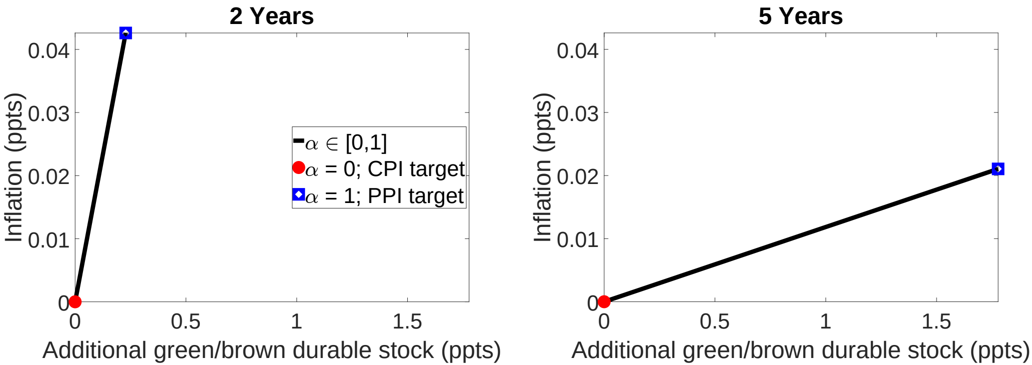
$$1 = \alpha \Pi_{y,t}^{T} + (1-\alpha)\Pi_t^{T}$$

Green transition: CPI targeting v PPI targeting



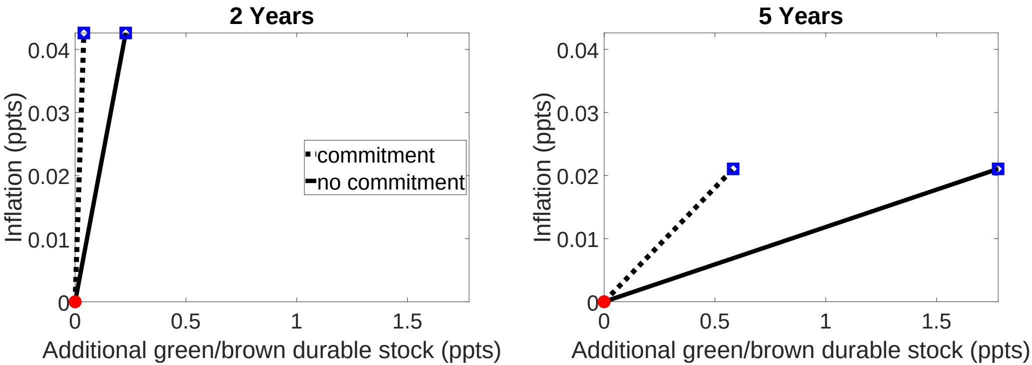
The tradeoff: price stability v supporting green transition

Varying degrees of looking through: $\alpha \in [0, 1]$

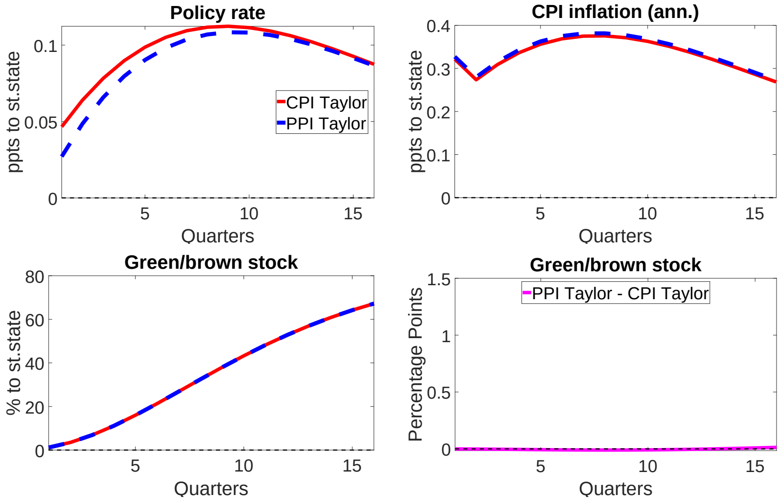


The tradeoff when price path fully anticipated “full commitment”

Varying degrees of looking through: $\alpha \in [0, 1]$



Green transition under **Taylor rule**: CPI v PPI target



6. Conclusion

Green transition of households

- Emission price goes up, shifting HH investment towards green durables
- Inflationary impact in EA $\approx$ 30 basis points during 2027–2030

Monetary policy tradeoff: price stability v supporting green transition

- Strict inflation targeting: looking through 5 basis points inflation yields additional 30 basis points in green/brown stock

Under Taylor rule monetary policy effectively supports green transition

- Why? Taylor rule provides lots of accommodation (compared to strict target)
- Inflationary impact almost the same for CPI or PPI target

Green transition under **Subsidy**: CPI v PPI target