Climate Policies and Monetary Policies in the Euro Area

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29 September 2021

Presentation to Sintra Forum, 29 September 2021

Summary

- Overview of the paper
- Empirical results on Carbon taxes and inflation in Europe
- A global model for climate policy and monetary policy interactions
- Model Simulations of climate issue
  - Global climate shocks (physical risk)
  - Climate policy changes in the Euro Area (transition risk)
  - Global climate policy changes transition risk)

- Conclusion

Overview of the paper

- Use two different approaches to explore the impact of climate change on monetary policy in Europe

  - Historical exploration of the impact of carbon taxes on inflation and growth in European economies from 1985 to 2020

  - Apply a global model to explore physical climate risk (both underlying climate change and extreme climate events), transitional climate risk (through changes in climate policies), and climate policies applied only in the Euro area compared to a global policy response.

  - Explore the interaction of the climate shocks and the ECB monetary policy rule, focusing on the degree of forward-lookingness of the monetary policy rule.

Table 1. Carbon taxes in the Euro area

Jurisdiction	Date	Initial rate (EUR/DM)	2020 rate (EUR)	Coverage
Finland	1990	2.01	56.71	0.36
Slovenia	1996	7.56	15.82	0.24
Estonia	2000	0.42	1.83	0.03
Latvia	2004	0.50	8.23	0.15
Ireland	2010	17.13	23.78	0.49
Spain	2014	24.16	13.72	0.03
France	2014	8.46	5.48	0.35
Portugal	2015	5.25	21.60	0.29

Notes: This table summarizes the carbon taxes used for the empirical analysis All rates are expressed in 2018 EUR per ton of carbon dioxide (CO2) equivalent (e) emissions, using the German GDP deflator and exchange rate to convert nominal USD rates from the Carbon Pricing Dashboard of the World Bank. Coverage is the share of total greenhouse gas (GHG) emissions covered by the tax in 2019. Source: https://carbonpricingdashboard.worldbank.org/, Accessed 15.02.2021.

Econometrics

- Following Metcalf and Stock (2020) we estimate

$$\Delta CPI_{i,t+h} = \alpha_i + \Theta_h \tau_{i,t} + \beta(L)\tau_{i,t-1} + \delta(L)\Delta CPI_{i,t-1} + \gamma_t + \epsilon_{i,t}$$

- where $\tau_{i,t}$ is the real carbon tax rate in country i in year t.
- Θ_h is the effect of an unexpected change in the carbon tax at year t on CPI, h years ahead.
- α_i and γ_t absorbs unobserved heterogeneity specific to each country or year.
- $\epsilon_{i,t}$ is an error term

	Impact in year					
Sample	0	1–2	3–5	Controls	N	R2
a) GDP	−0.68***	−0.21	0.09	Country FE	497	0.05
	(0.23)	(0.38)	(0.38)			
	−0.75***	−0.21	0.31	Economic	276	0.34
	(0.18)	(0.17)	(0.56)			
	0.18*	0.13	0.15	Country & Time FE	497	0.87
	(0.10)	(0.09)	(0.31)			
b) Headline CPI	−0.06	0.07	−0.89	Country FE	454	0.11
	(0.29)	(0.32)	(0.56)			
	−0.01	0.19	−0.67*	Economic	247	0.40
	(0.38)	(0.32)	(0.37)			
	0.26	1.03***	0.28	Country & Time FE	454	0.52
	(0.33)	(0.40)	(0.64)			
c) Core CPI	−0.53***	−0.16	−0.87***	Country FE	367	0.10
	(0.20)	(0.31)	(0.26)			
	−0.42*	−0.04	−0.29	Economic	246	0.20
	(0.24)	(0.28)	(0.38)			
	−0.37	0.34	−0.32	Country & Time FE	367	0.31
	(0.27)	(0.35)	(0.28)			

Figure 1. Cumulative Impulse Response for GDP

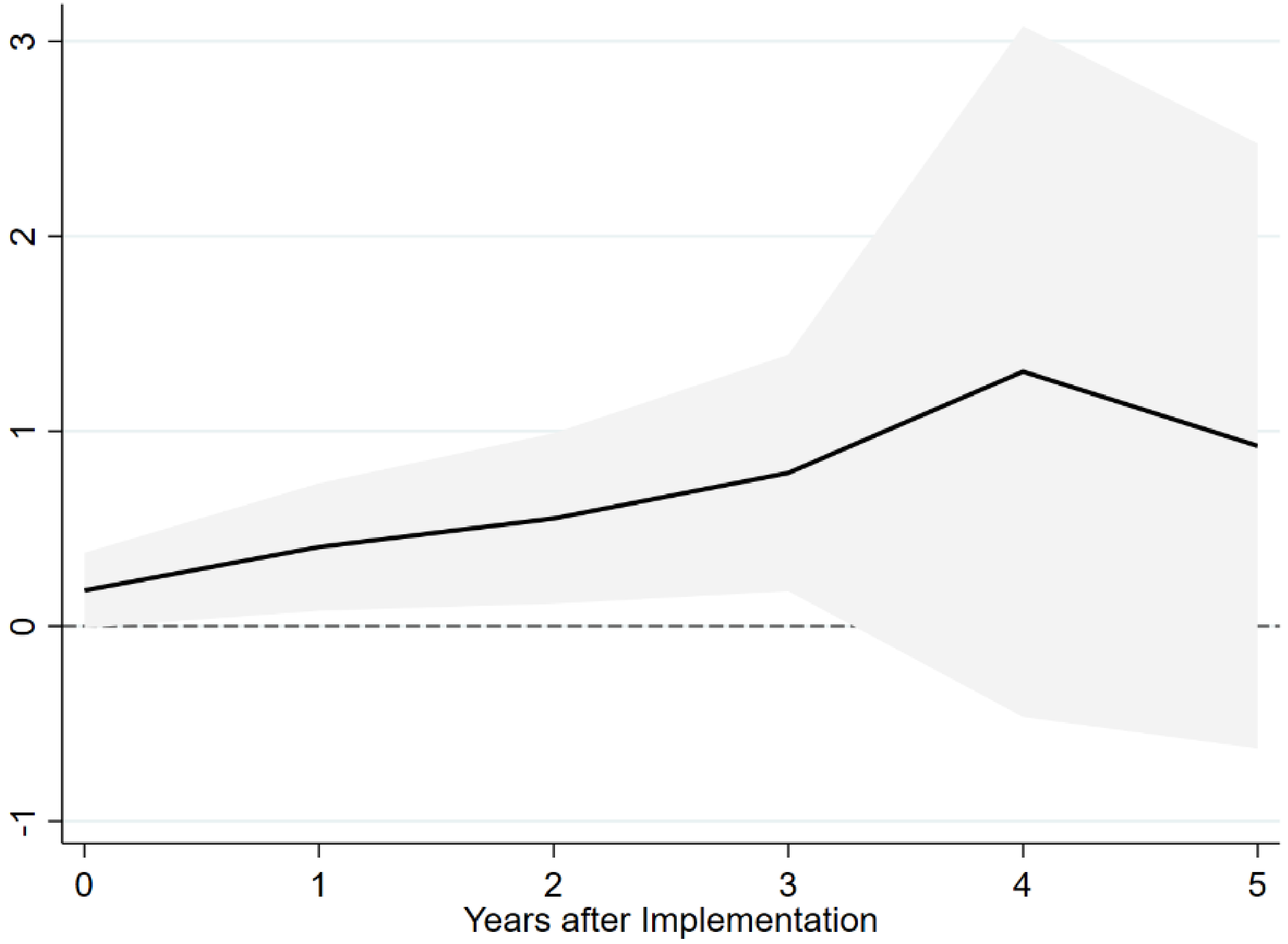
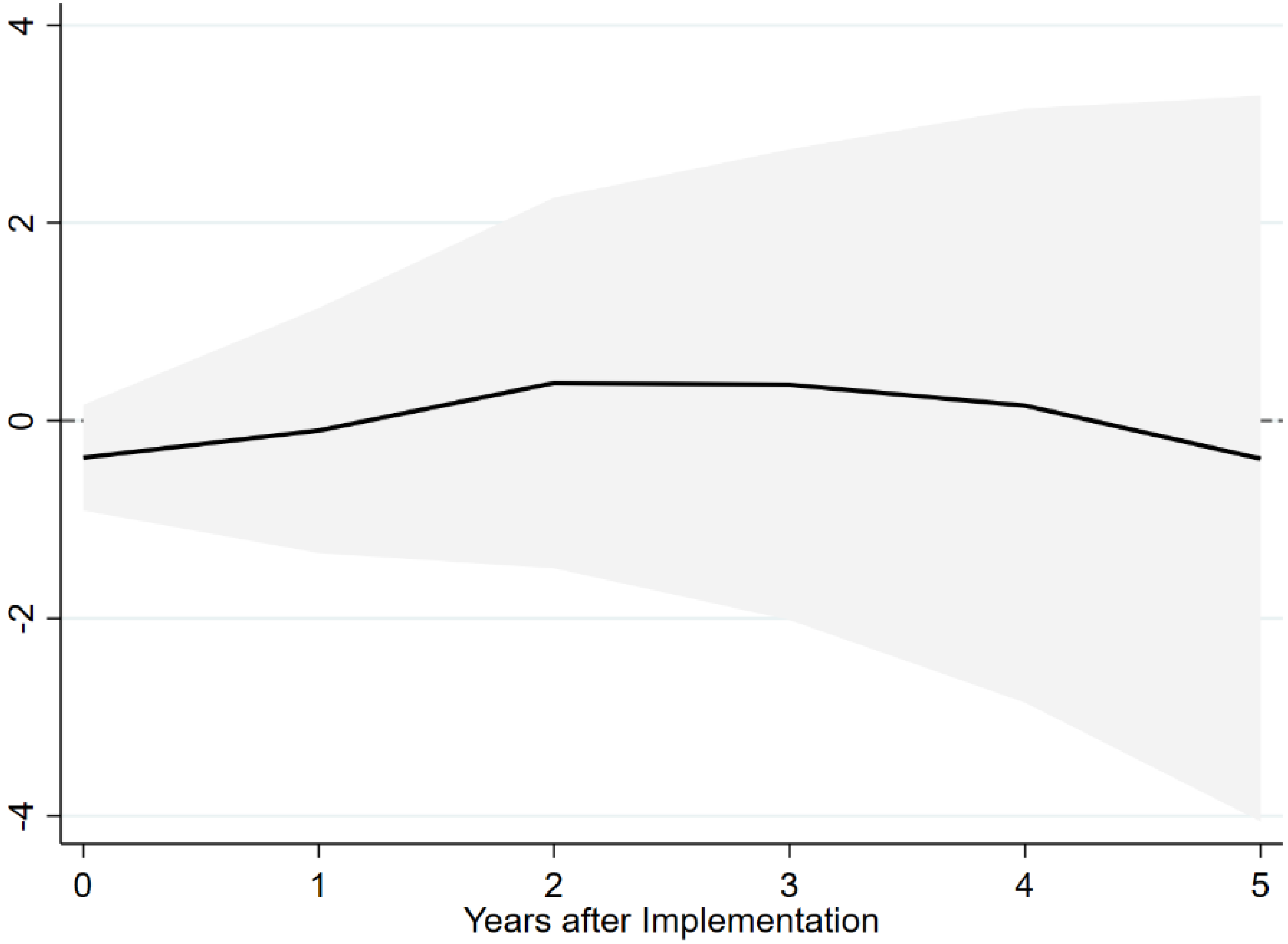


Figure 3. Cumulative Impulse Response for Core CPI



G-Cubed Model

G-Cubed Model

- Hybrid of a dynamic stochastic general equilibrium (DSGE) models (used by central banks) and a computable general equilibrium (CGE) model.

- Models Inter-industry linkages, international trade, capital flows, consumption, and investment.

- Annual macroeconomic and sectoral dynamics

- Captures frictions in labor market and capital accumulation
  - Full employment in the long run but unemployment in the short run
  - Labor mobile across sectors but not regions
  - Sector specific quadratic adjustment cost to physical capital

G-Cubed Model

- Each country has a fiscal rule for government spending and taxation policy

- Each country has a monetary rule which shows how interest rates are adjusted to trade off various policy target (inflation, output, exchange rates, nominal income)

Version 20N

10 countries/regions

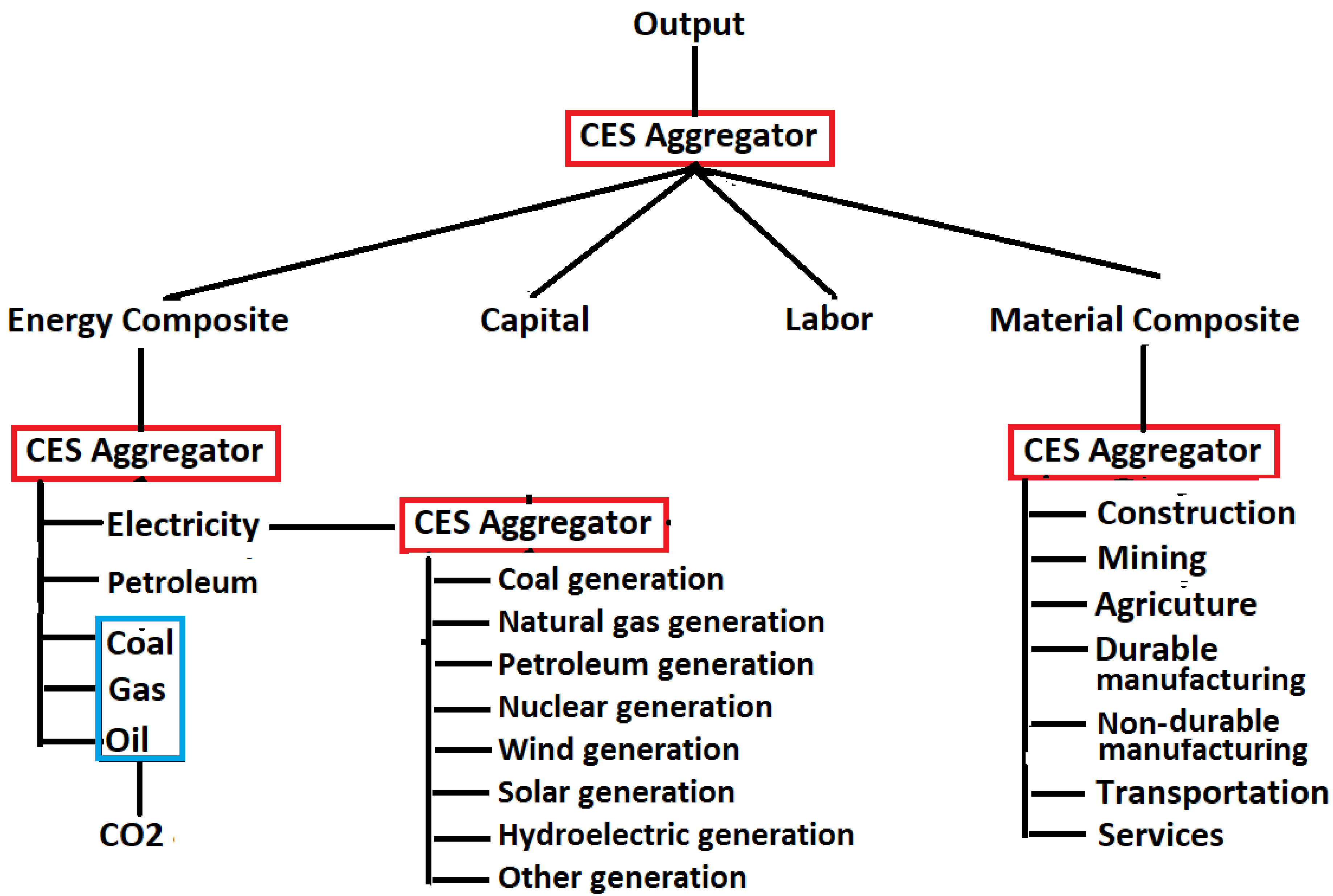
- United States
- Japan
- Australia
- Euro Area
- Rest of Advanced Economies
- China
- India
- Russian Federation
- Oil-exporting and the Middle East
- Rest of World

20 Sectors in each region

Number	Description	Code
1	Electricity delivery	ElecU
2	Gas Extraction and utilities	GasU
3	Petroleum refining	Ref
4	Coal mining	CoalEx
5	Crude oil extraction	CrOil
6	Construction	Const
7	Other mining	Mine
8	Agriculture and forestry	Ag
9	Durable goods	Dur
10	Nondurables	NonD
11	Transportation	Trans
12	Services	Serv
13	Coal generation	Coal
14	Natural gas generation	Gas
15	Petroleum generation	Oil
16	Nuclear generation	Nuclear
17	Wind generation	Wind
18	Solar generation	Solar
19	Hydroelectric generation	Hydro
20	Other generation	Other

Electricity Sector

Figure 1 Production structure in G-Cubed model



Baseline without significant climate policy or climate shocks

- Solve the model from 2019 to 2100 under assumptions about
  - population growth by country;
  - productivity growth by sector and country;
  - technological assumptions,
  - policy rules etc

Implementation of climate shocks & policies

- Climate shocks expected from 2021 onwards
- Surprise climate agreement in 2021
- Agents know the future path of the climate policies in 2021.
- 30% of firms and households have rational expectations
- 70% follow a rule of thumb

Two Alternative ECB policy Rules

$$i_t = i_{t-1} + 0.34 * (\pi_{t,t+1} - \bar{\pi}_{t+1}) + 0.4 * (g_{t,t+1} - \bar{g}_{t+1}) \qquad \text{HS} \qquad (1)$$

$$i_t = i_{t-1} + 0.5 * (0.34 * (\pi_t - \bar{\pi}_t) + 0.4 * (g_t - \bar{g}_t))$$

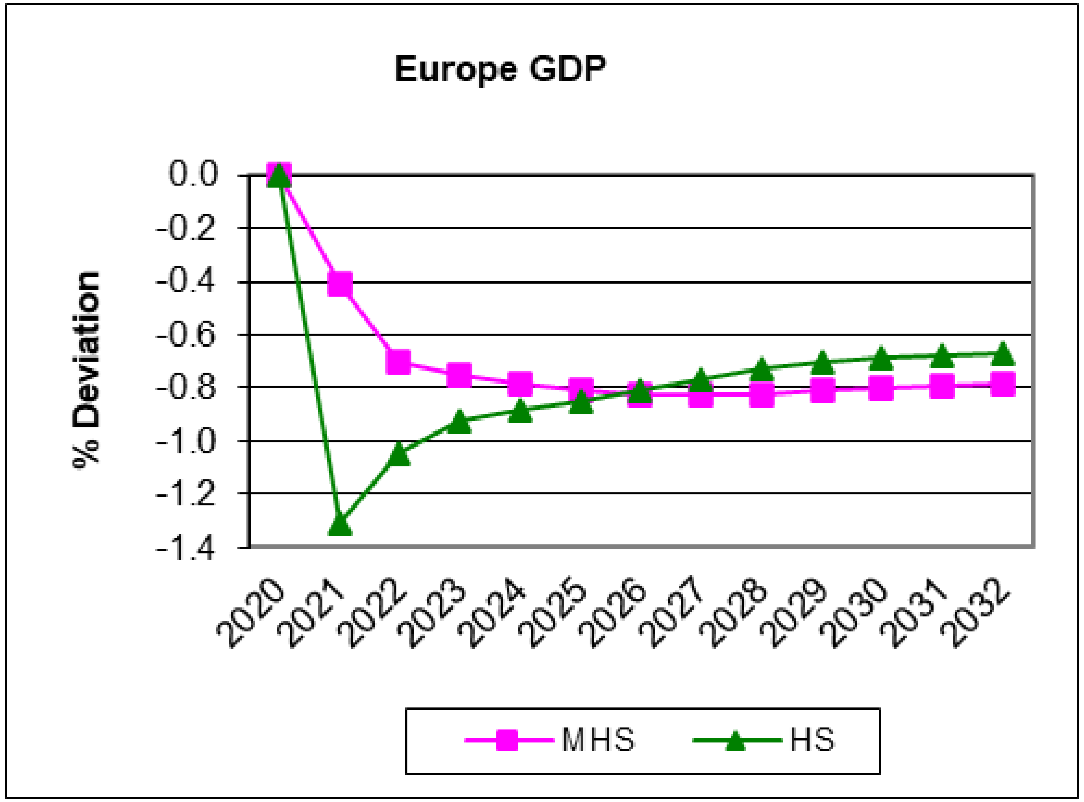
$$+0.5 * (0.34 * (\pi_{t,t+1} - \bar{\pi}_{t+1}) + 0.4 * (g_{t,t+1} - \bar{g}_{t+1}) \qquad \text{MHS} \qquad (2)$$

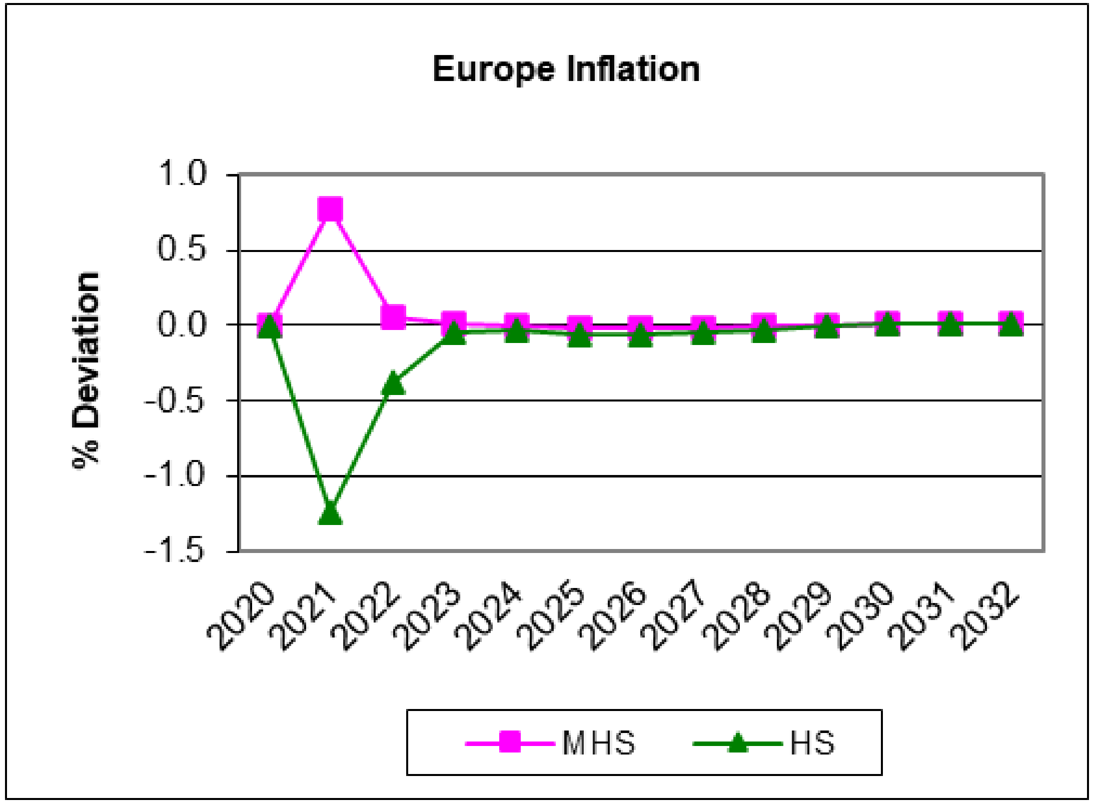
Where i_t is the policy interest rate, $\pi_{t,t+1}$ is the expectation in period t of inflation in period t+1 (rationally expected from the model) and $g_{t,t+1}$ is the growth rate in output in period t+1 expected in period

Climate Shocks

- Following Fernando, Liu, and McKibbin (2021) we consider a physical climate risk scenario that incorporates both
  - Chronic climate change
  - Extreme climate Events
- Based on (Representative Concentration Pathway) RCP 4.5
  - CO_2 Concentrations stabilize at 650ppm by 2100

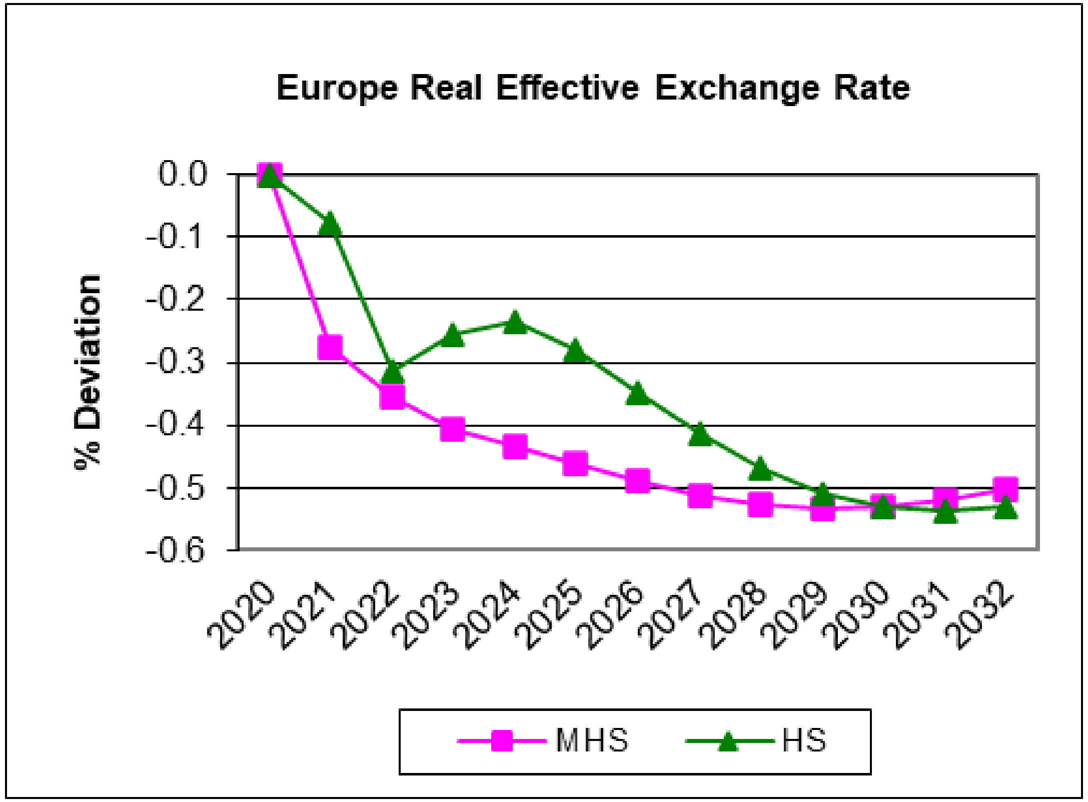
Climate Shocks

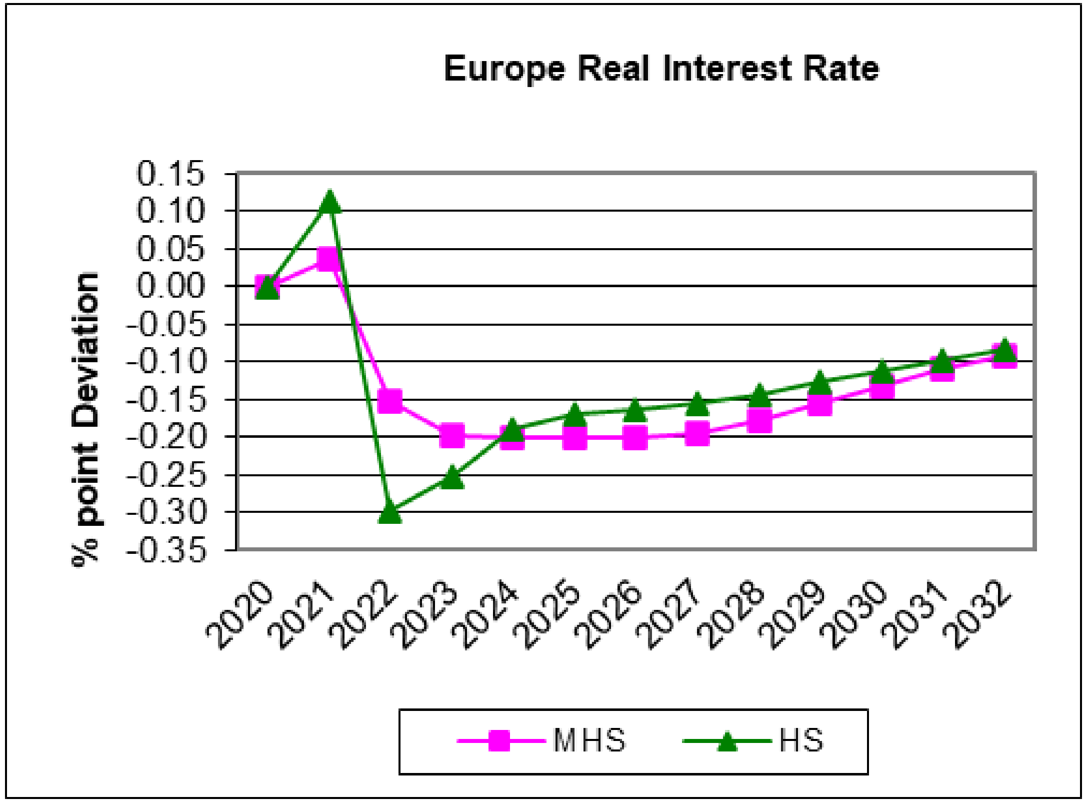




Source G-Cubed Model Version GGG20N_v161

Climate Shocks



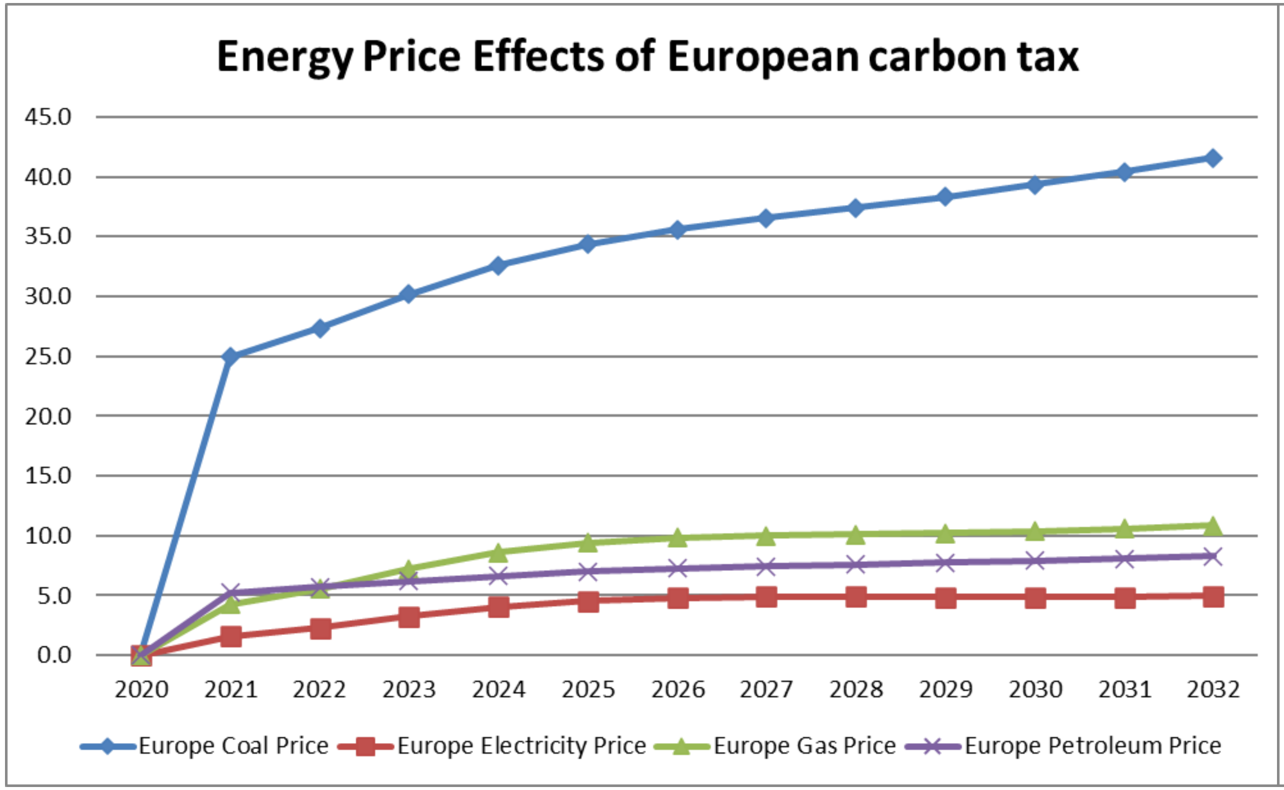


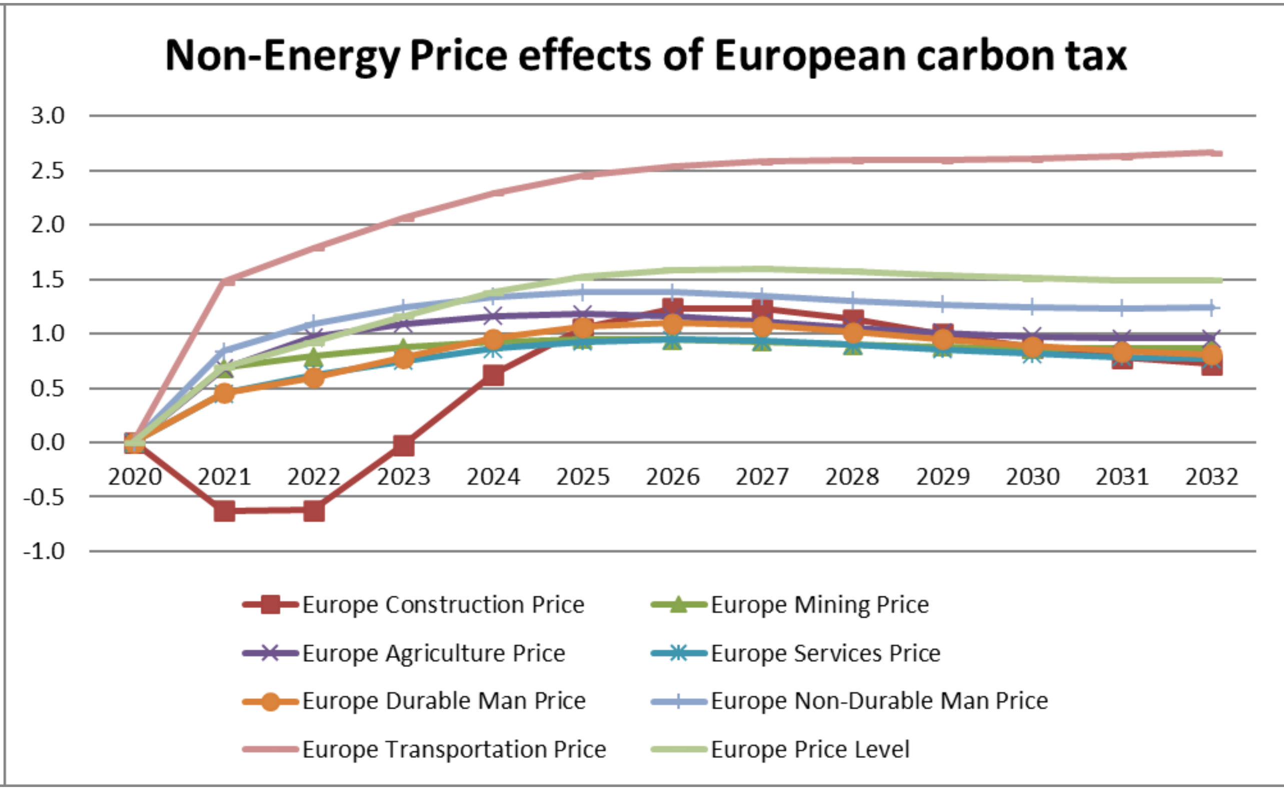
Source G-Cubed Model Version GGG20N_v161

Climate Policy in Europe

- Euro countries implement a carbon tax in 2021 that starts at $50 euro per ton of CO2 and rising by 3% per year

Climate Policy in Euro Area (under MHS)





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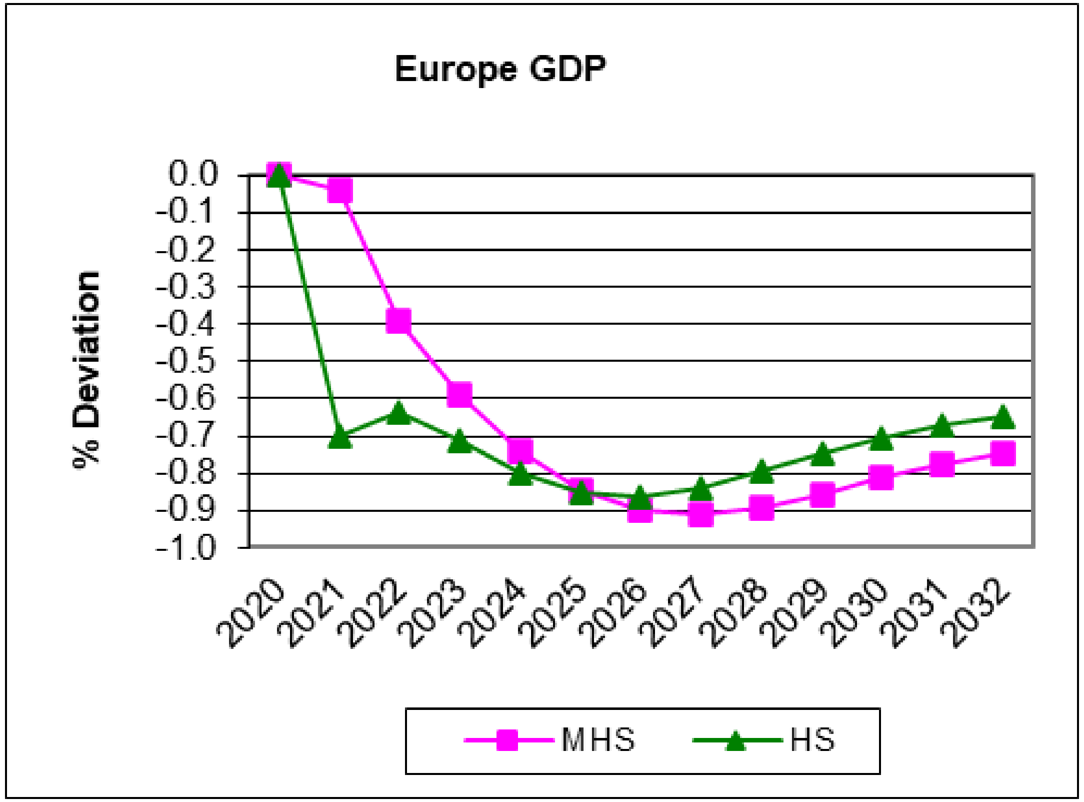
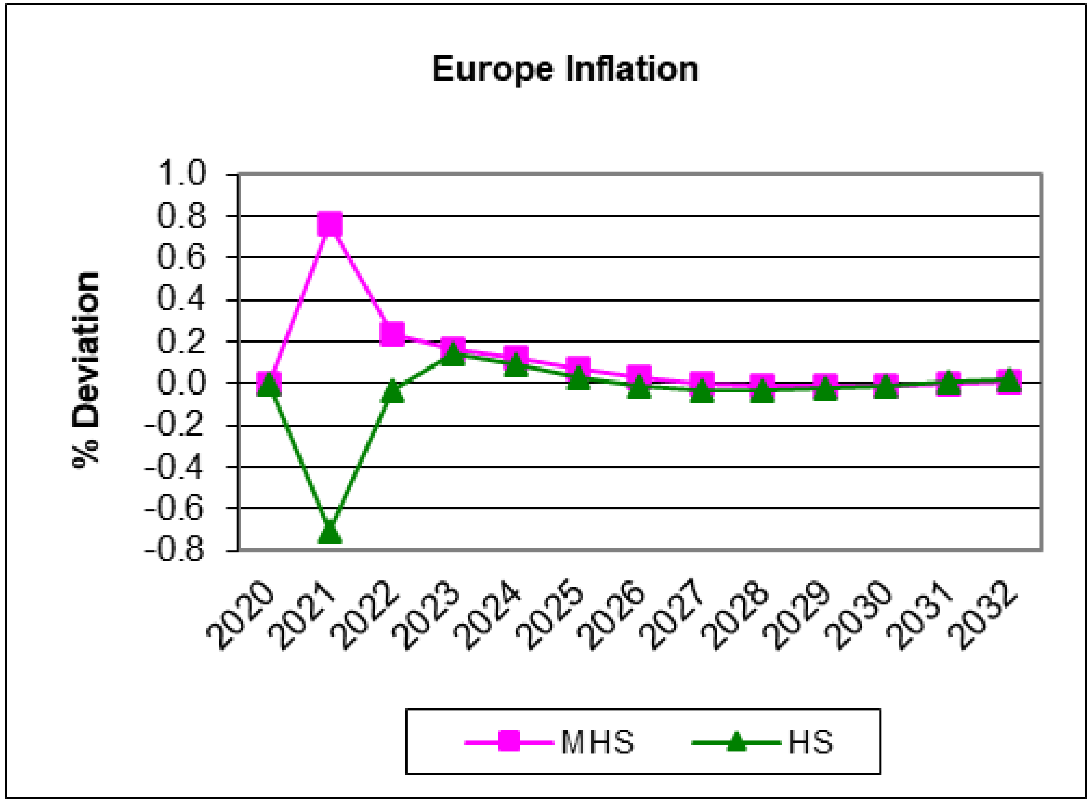
Climate Policy in Euro Area





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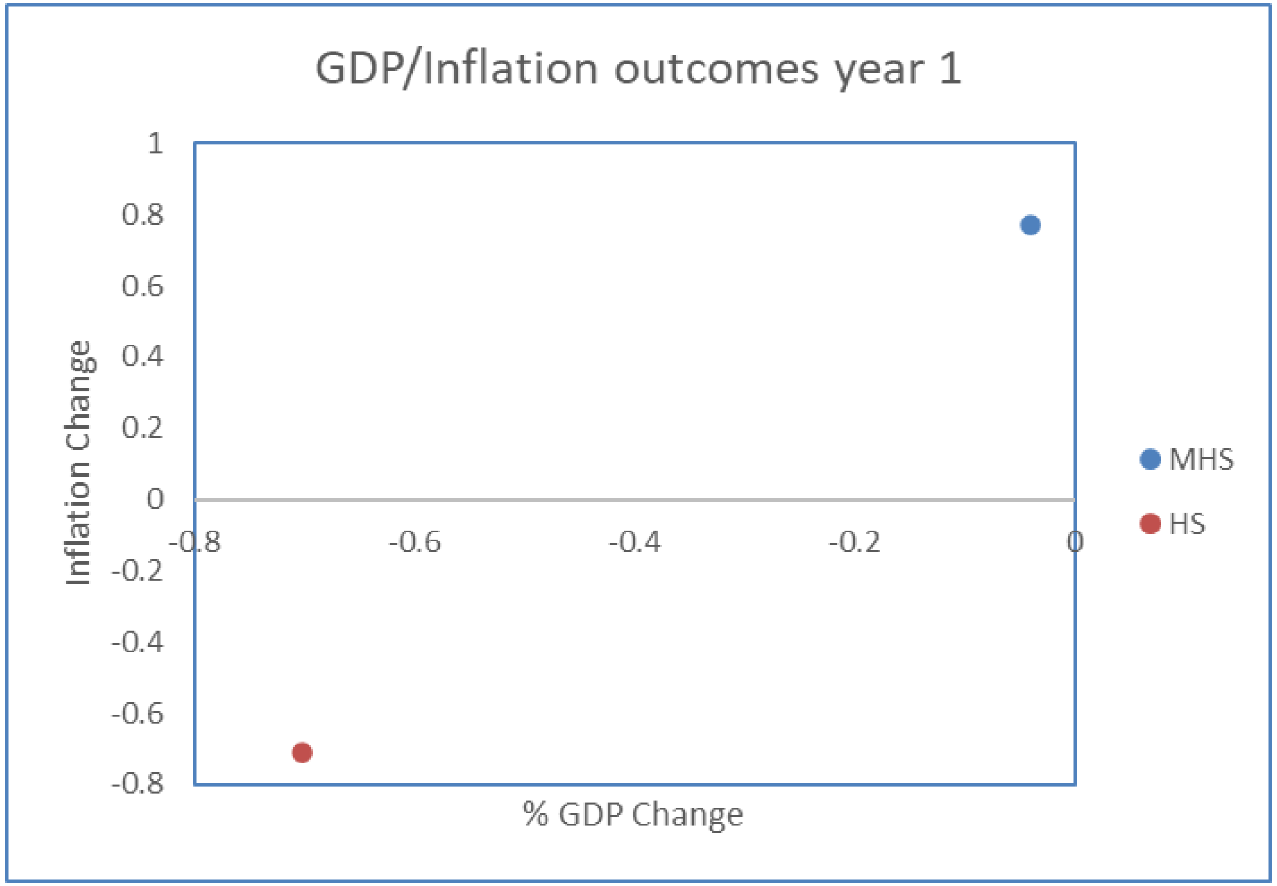
Climate Policy in Euro Area



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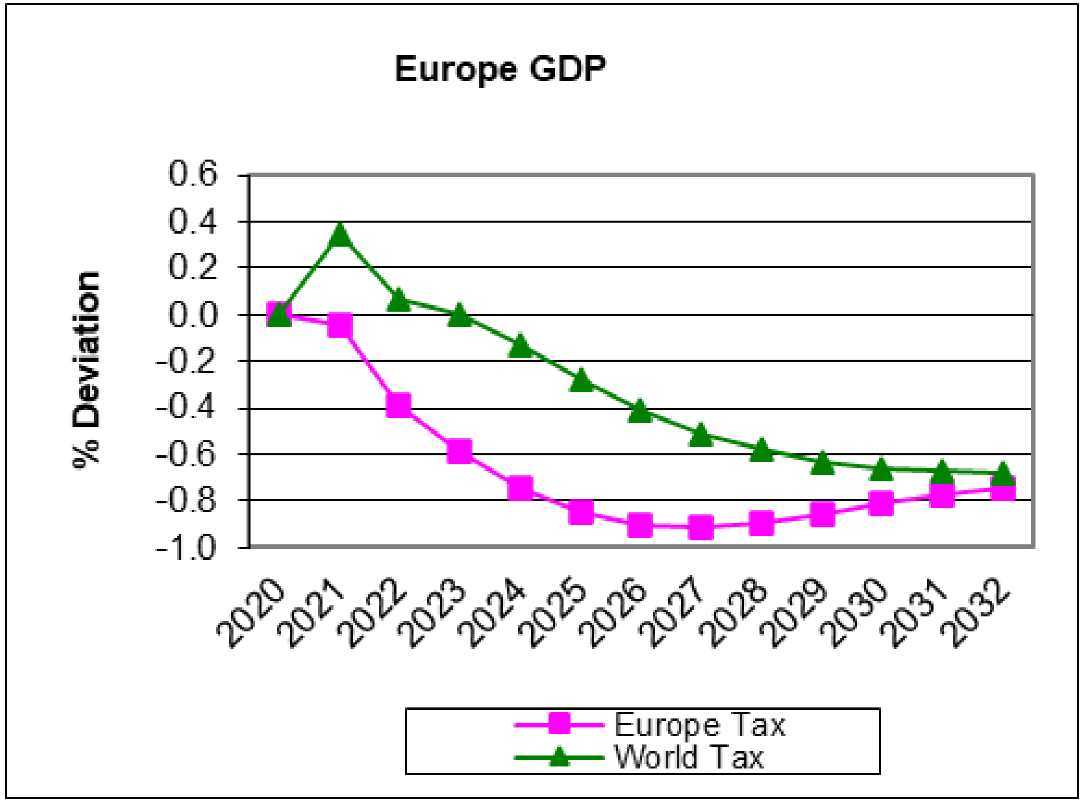
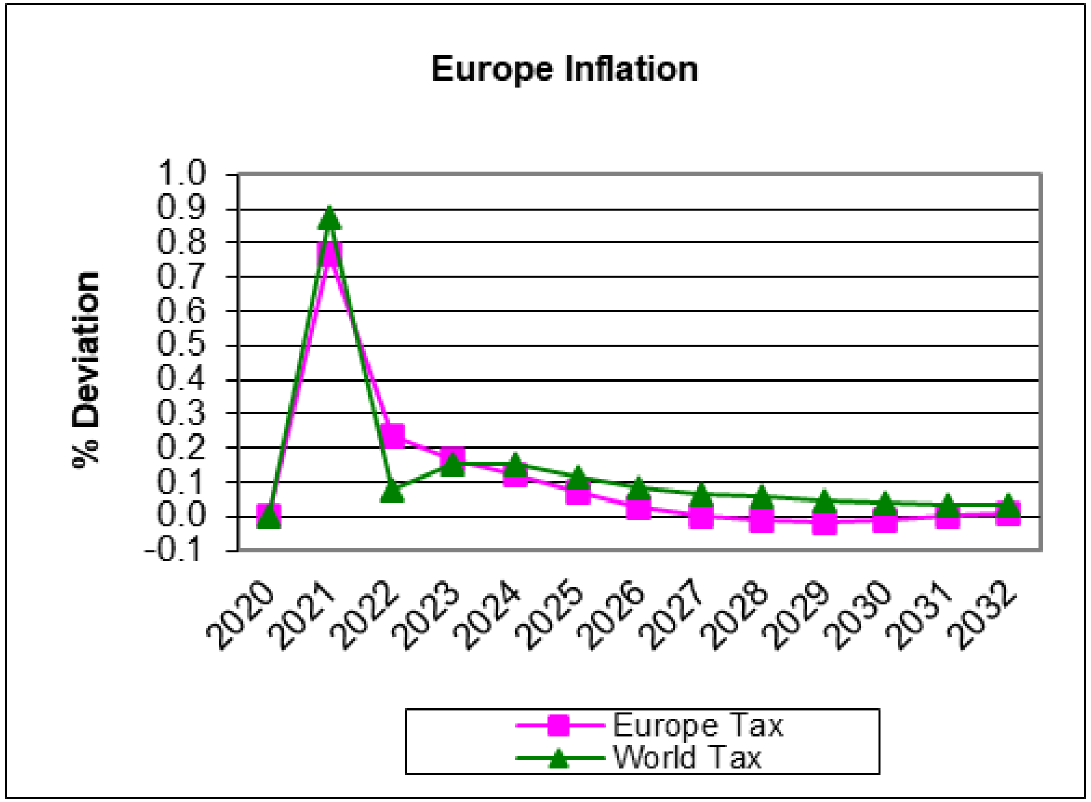
Climate Policy Globally

- All countries (except oil exporting Middle East) implement a carbon tax in 2021 that starts at $50euro per ton of CO2 and rising by 3% per year

Global Climate Policy





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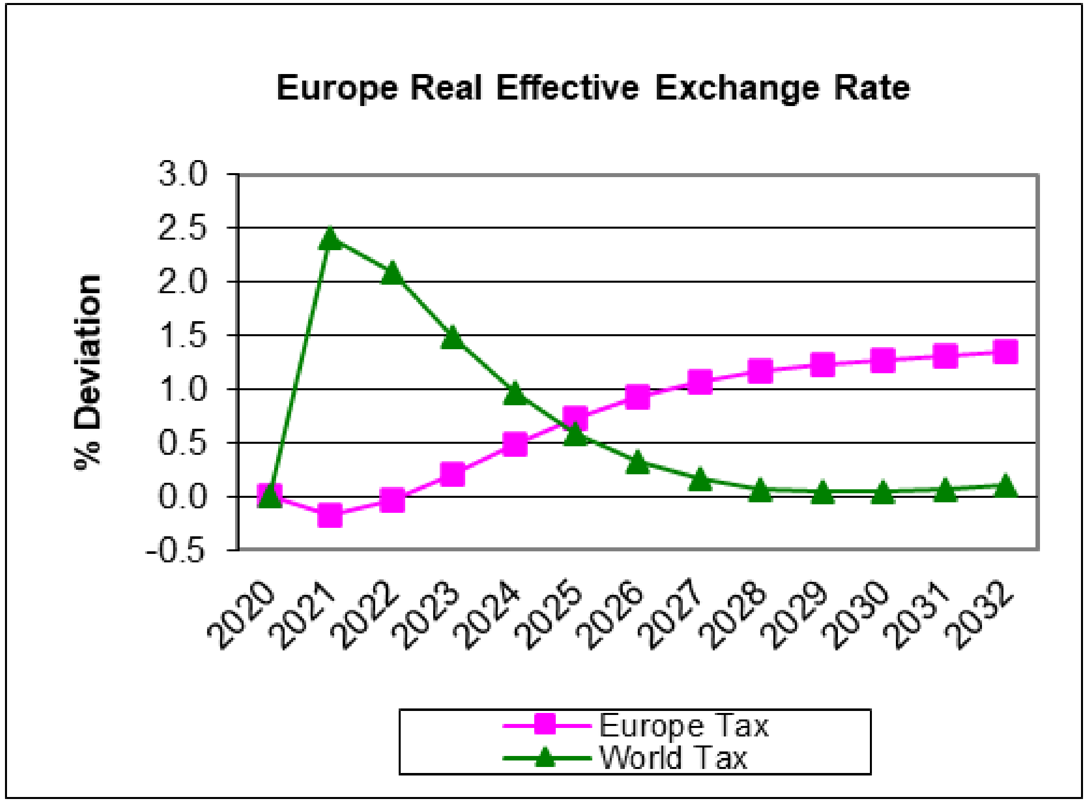
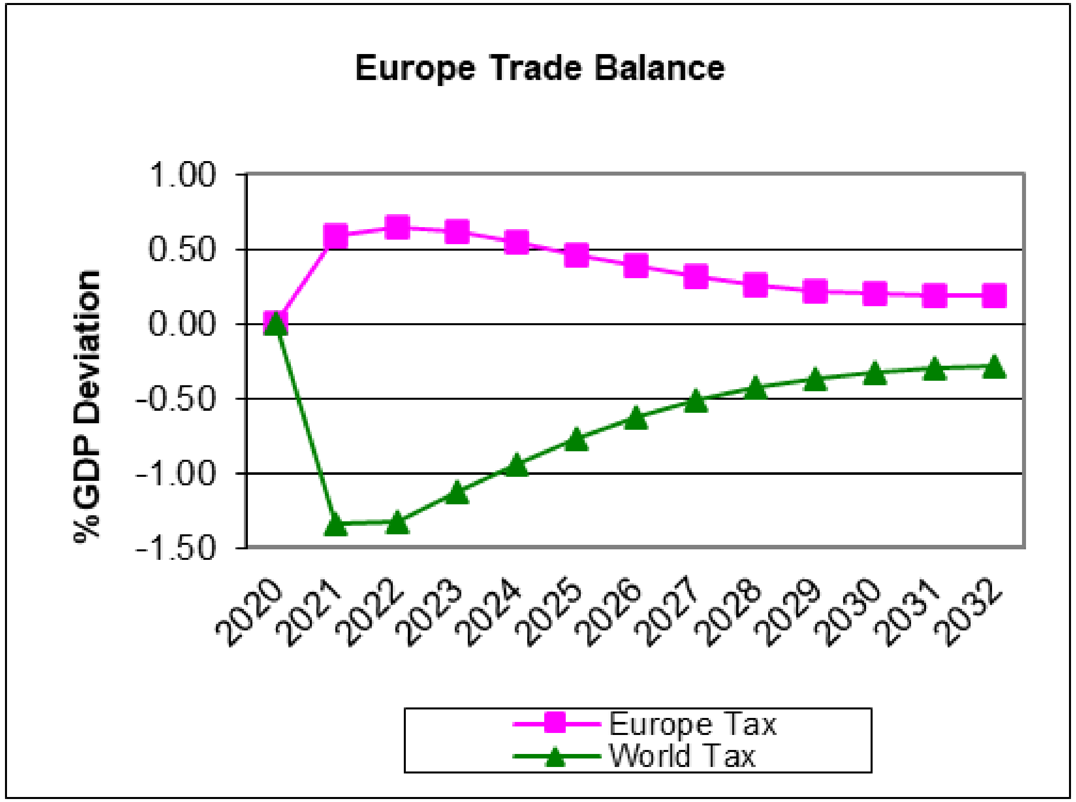
Global Climate Policy





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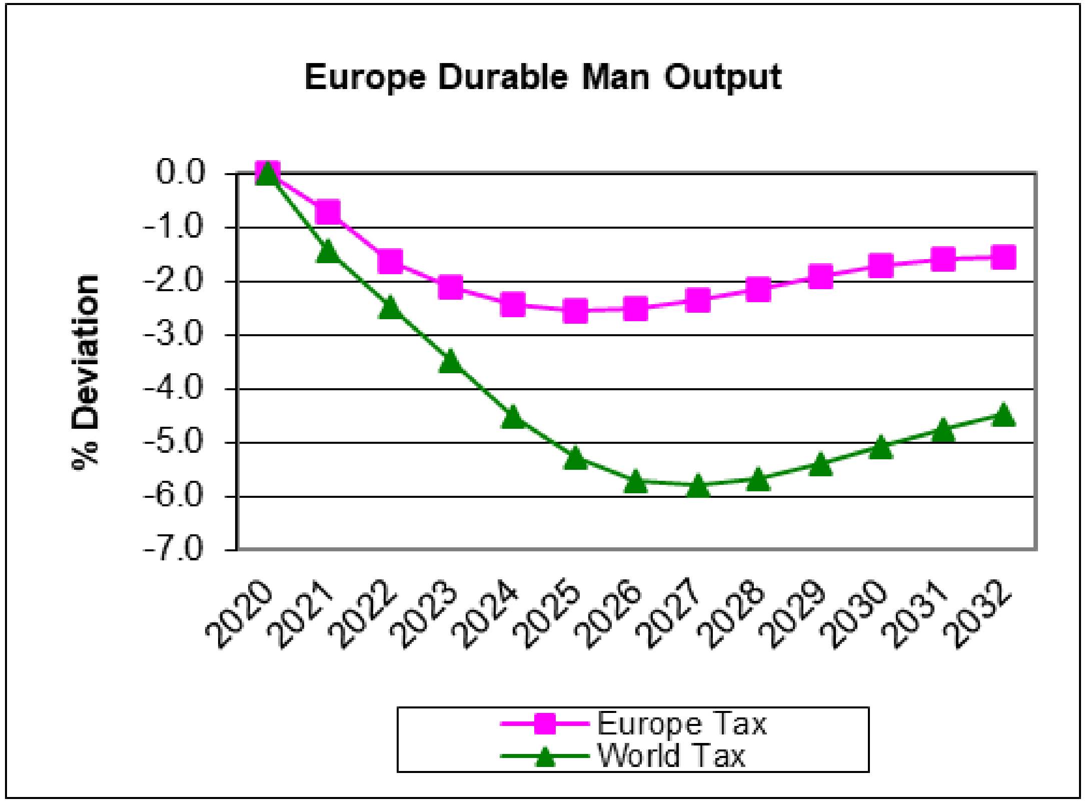
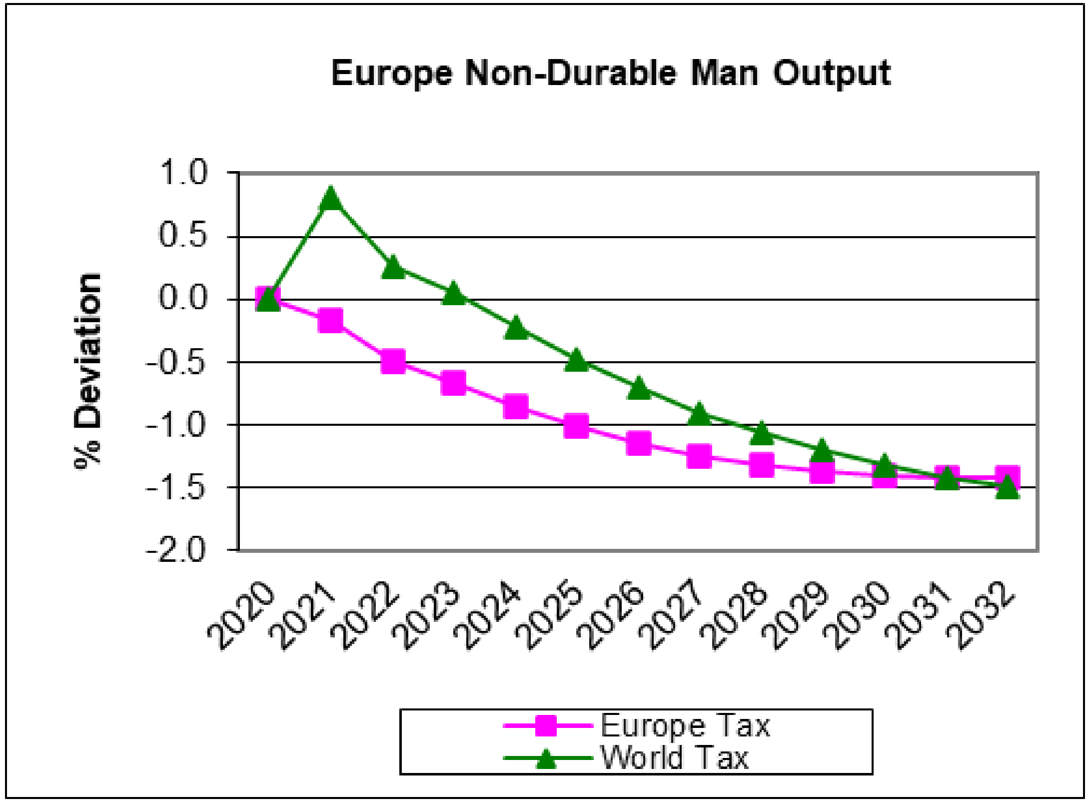
Global Climate Policy





Source G-Cubed Model Version GGG20N_v161

Comparison accross types of climate shocks under the MHS monetary policy, 10 years

	b) Effect after 10 years		
Variable	(1) Climate shock	(2) Euro area carbon tax	(3) Global carbon tax
GDP	−7.45	−6.99	−2.76
Inflation	0.78	1.34	1.67
Price level	8.17	13.49	13.61
Trade balance	0.31	4.25	−7.74
Real exchange rate	−4.52	6.90	8.20
Durable goods output	−18.35	−20.17	−44.94

Conclusion 1/

- **Historicaly, carbon taxes in Euro area** have tended to have a short positive effect headline inflation, which is contained after 3 years.
- The impact on core inflation tended to be negative indicating that carbon taxes operated mostly by changing relative prices rather than affecting the overall price level, **for a given monetary policy**

Conclusion 2/

- The short run outcome from the various climate shocks depend significantly on the **policy rule followed by the ECB**.
- Depending on the monetary policy response implementing a **carbon tax could result in inflation or deflation**.
- Incorporating current and future information into the policy rule leads to better inflation and output outcomes than a purely forward-looking rule.
- Inflation in the Euro area is contained in all shocks and the magnitude of the inflationary response is in line with our finding of the historical responses in the Euro area.

Conclusions 3/

- The largest cumulative negative impact on GDP is due to **physical climate risks, not transition risks** from carbon taxation.
- Climate shocks and climate policies tend to reduce the level of GDP relative to baseline and significantly reduce global investment with negative effects on durable goods manufacturing**.**
- For a **Euro area carbon tax**, capital flows out of the euro area, the exchange rate depreciates and the trade balance improves. The opposite is true in case of a global carbon tax.
- The **fiscal response** particularly in terms of infrastrucuture investment can change this outcome.

Future Research

- The importance of coordinating monetary, fiscal and climate policies within countries and globally.
- **The interactions between monetary, fiscal and climate policies matter. They will have to be taken into account by all actors.**

Further information on G-Cubed

www.gcubed.com