Fiscal and Macroprudential Policies During an Energy Crisis

Romanos Priftis[1] Raphael Schoenle[2]

[1]European Central Bank [2]Brandeis University, CEPR

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C.R.E.T.E. Tinos

Motivation

- Soaring fossil fuel prices in early 2022: triggered by Russia's invasion of Ukraine, and exacerbated by pressures from COVID-19 (e.g., rising food prices, supply chain bottlenecks)
- Inflation exceeded 10% in many EU countries
- Fiscal policy responses aimed at mitigating the impact of higher energy costs on households and firms
- Relief measures present conflict with long-term environmental goals (EU Commission's Green Deal)

What we do

- Develop medium-scale E-DSGE model with disaggregated energy and financial sector
- Study transmission of fossil fuel price shock, and its propagation through financial sector
- Assess effects of **fiscal** policies motivated by reaction to EU energy crisis
- Explore parallel **macroprudential** policies to buffer increase in emissions

- **We contribute to**:
  - DiLuiso et al. (2021), Coenen et al. (2023), Auclert et al. (2022), Erceg et al. (2023), among others
  - By including financial frictions, fiscal + macroprudential policy coordination

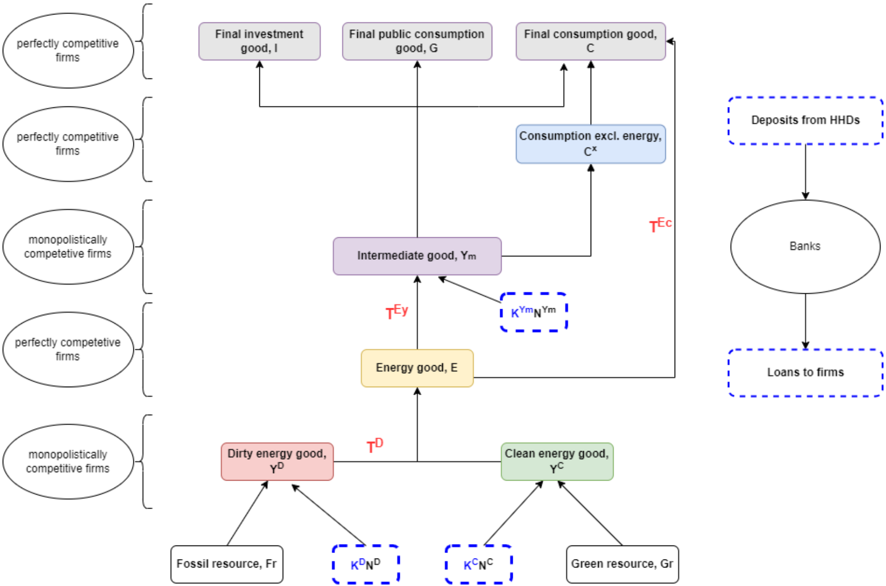
What we find

- A fossil price shock is stagflationary. Occasionally-binding leverage constraints amplify the effects
- Energy subsidies operate through marginal costs and impact on pre-subsidy price of energy
  - Subsidies to firms lower CPI and core inflation and are expansionary
  - Subsidies to households (HHDs) only lower CPI inflation and are contractionary
- Both subsidies temporarily increase emissions
- Parallel macroprudential policy that taxes dirty energy assets tilts bank portfolios to promote "green" investment

Model overview

- Non-linear, environmental NK DSGE model calibrated to EA (small open economy)
- **Disaggregated energy production and use**:
  - 2 separate energy-producing sectors: "clean" (solar/wind, etc.) and "dirty" (oil/coal, etc.)
  - Utilized by firms for production of intermediate good; by HHDs for consumption
- **Banking sector**
  - All firms require bank financing for acquiring capital. Banks are leverage-constrained

Model structure



Use of energy in consumption

- Production of final consumption good:

$$C_t = \left[\omega_c^{\frac{1}{\epsilon_c}} \left(E_t^C \right)^{\frac{\epsilon_c - 1}{\epsilon_c}} + (1 - \omega_c)^{\frac{1}{\epsilon_c}} \left(C_t^X \right)^{\frac{\epsilon_c - 1}{\epsilon_c}} \right]^{\frac{\epsilon_c}{\epsilon_c - 1}} \tag{1}$$

where E_t^C denotes energy used for consumption purposes, and C_t^X is the consumption good excluding energy

- Demand for energy by HHDs is given by

$$E_t^C = \omega_c \left(\frac{\left(1 + \tau_t^{Ec}\right) P_{E,t}}{P_{C,t}} \right)^{-\epsilon_c} C_t \tag{2}$$

Use of energy in production

- Production of intermediate good:

$$Y_{m,t} = \left[\omega_m^{\frac{1}{\epsilon_m}} \left(KL_{m,t}\right)^{\frac{\epsilon_m - 1}{\epsilon_m}} + \left(1 - \omega_m\right)^{\frac{1}{\epsilon_m}} \left(E_t^Y\right)^{\frac{\epsilon_m - 1}{\epsilon_m}}\right]^{\frac{\epsilon_m}{\epsilon_m - 1}} \tag{3}$$

where E_t^Y denotes energy used for the production of the intermediate good and $KL_{m,t}$ is the capital-labour bundle used

- Demand for the energy good by intermediate good producers is given by

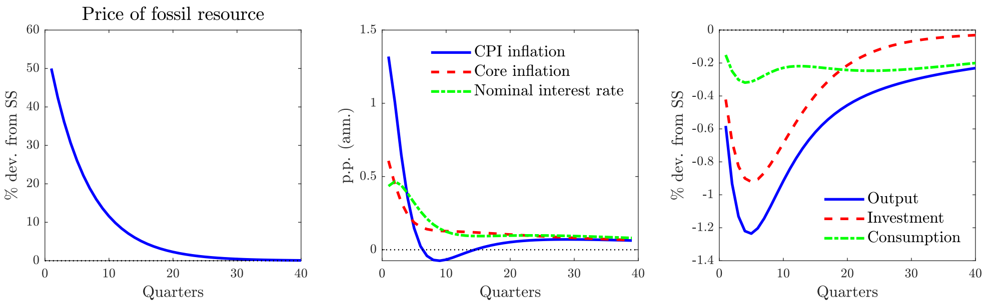
$$E_t^Y = P_{m,t}^{\epsilon_m} \left(1 - \omega_m\right) Y_{m,t} \left(\left(1 + \tau_t^{Ey}\right) P_{E,t}\right)^{-\epsilon_m} \tag{4}$$

Calibration of energy shares and parameters

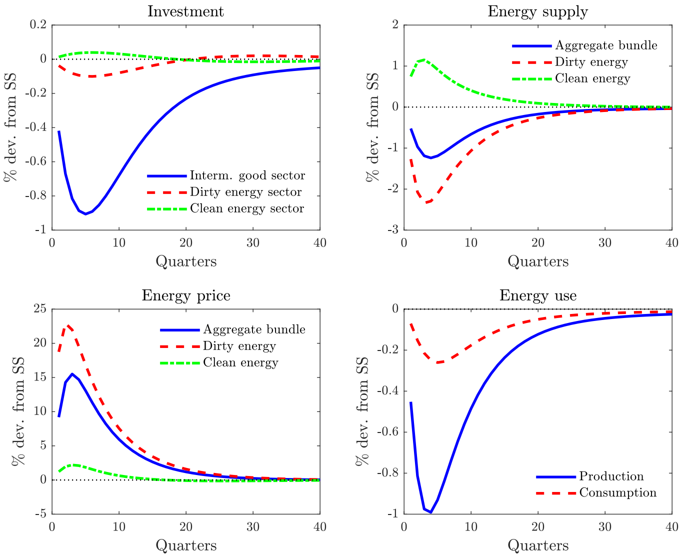
Empirical share	Value	Source
Energy share in final consumption	5.5%	OECD TiVA
Energy share in intermediate goods	7.2%	OECD TiVA
Dirty energy share in energy bundle	71.7%	Eurostat, energy balances

Parameter	Value	Elasticity of substitution	Source
ϵ_C	0.4	Energy and consumption ex energy	Bodenstein et al. (2011)
ϵ_m	0.4	Energy and capital-labour bundle	Bodenstein et al. (2011)
ϵ_e	1.8	Dirty and clean energy	Papageorghiou et al. (2017)

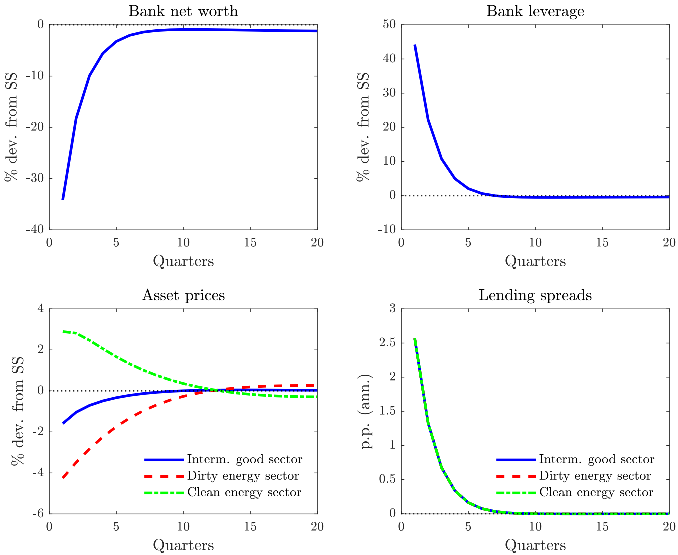
Aggregate effects of a fossil fuel price shock



Sectoral effects of a fossil fuel price shock



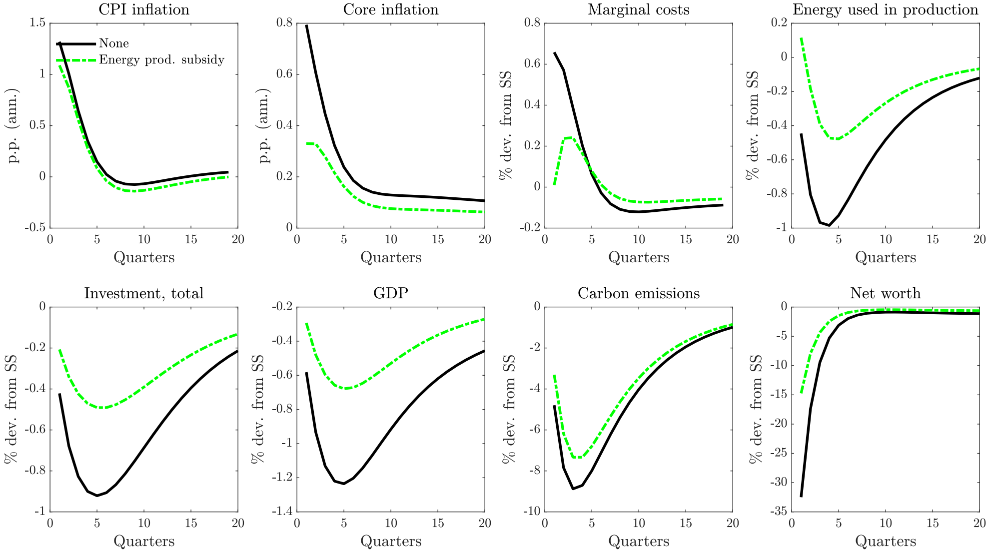
Financial sector effects of a fossil fuel price shock



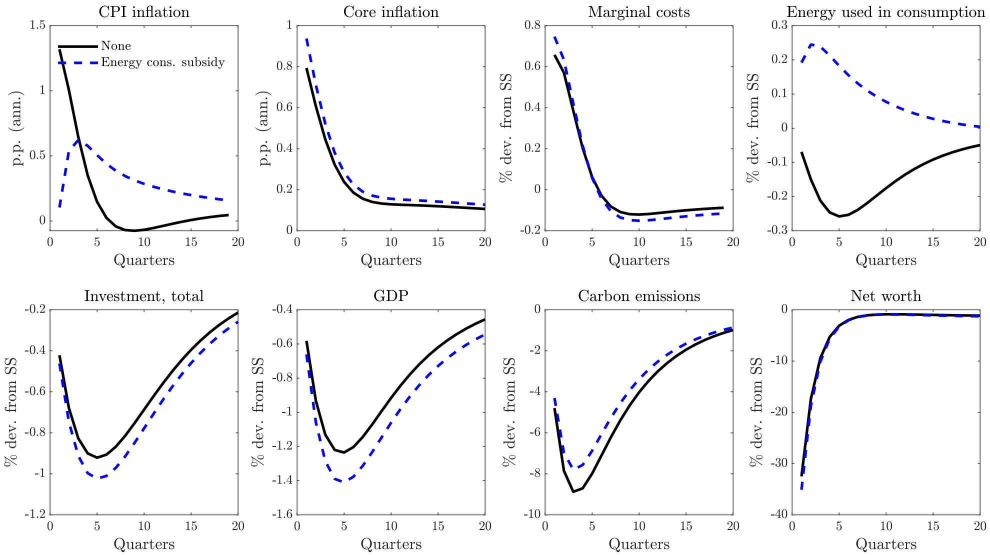
Energy-related fiscal policy

- **Subsidies**:
  - Energy bundle utilized by intermediate-good firms (τ_t^{Ey})
  - Energy bundle consumed by HHDs (τ_t^{Ec})
- **Fiscal cost** = 1% (of GDP) decline in revenues financed with lump-sum tax

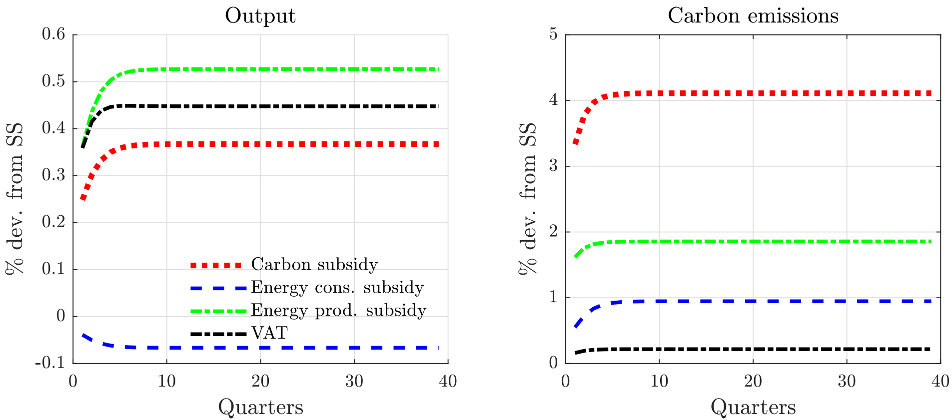
Energy production subsidy



Energy consumption subsidy



Present value fiscal multipliers



$$M_t^{PV} = \frac{\sum_{h=0}^{t} \overline{R}^{-h} \left(\hat{X}_h - \overline{X} \right)}{\sum_{h=0}^{t} \overline{R}^{-h} \left(\hat{Rev}_h - \overline{Rev} \right)} \tag{5}$$

Macroprudential policy to offset temporary transition risks

- Energy price subsidies can mitigate inflationary effects.
- But they contribute towards temporarily slowing down the "green transition"
- **Sectoral macroprudential taxes/subsidies** on bank assets can compensate for the slow-down

Banking sector

- Financial intermediary balance sheet

$$Q_{m,t}S^b_{m,t} + Q_{f,t}S^b_{f,t} + Q_{g,t}S^b_{g,t} = N_t + B^b_t \tag{6}$$

LHS: quantity of financial claims on non-financial firms; RHS: net worth/equity capital, N_t, and deposits from HHDs, B^b_t

- Constraint on bank's leverage ratio:

$$\phi_t = \frac{Q_{m,t}S^b_{m,t} + (1+\tau_{\Psi,f})Q_{f,t}S^b_{f,t} + (1+\tau_{\Psi,g})Q_{g,t}S^b_{g,t}}{N_t} \tag{7}$$

- $\tau_{\Psi f}$: "Brown" Macroprudential policy - reduces share of dirty energy assets
- $\tau_{\Psi g}$: "Green" Macroprudential policy - increases share of clean energy assets

Stabilization effects of policy packages - inflation and carbon emissions

	CPI inflation			Carbon emissions		
	Baseline	Brown Mpru	Green Mpru	Baseline	Brown Mpru	Green Mpru
No subsidy	0.059	0.067	0.059	0.080	0.092	0.080
τ^{E^y}	0.061	0.033	0.026	0.052	0.065	0.056
τ^{E^c}	0.022	0.011	0.009	0.056	0.062	0.054

Notes: Variance of different macroeconomic variables following a fossil price shock, and when accompanied with different fiscal and macroprudential configurations. The variance is calculated over the percentage point (for CPI inflation) and % deviation (for carbon emissions) from their steady state value over 40 quarters

Conclusion

- Developed medium-scale E-DSGE model with disaggregated energy and financial sector to explore policies during the EU energy crisis
- Following a fossil price shock, targetting subsidies to energy producers is favorable to lower both CPI and core inflation
- Parallel "Brown" and "Green" macroprudential policies can buffer the temporary increase in emissions

Background slides

Role of financial frictions