Energy Cost Pass-through in Production Networks

9th WS2 ChaMP Workshop

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Motivation

- Price setting has important implications for a wide range of issues in both macro and micro
  - i.e. recent energy-driven inflation wave, business cycles dynamism, reallocation, etc.
- In a production network, the ripple effects of microeconomic shocks can drive aggregate economic fluctuations and their persistency (Acemoglu, 2012; Pasten, Schoenle, and Weber, 2018)
- What matters is to what degree / speed shocks are pass-through to prices (Alvarez et al, 2016), which depend on the characteristics of the firms and sectors in the network
- Monetary policy response might differ based on the underlying drivers of inflation and price adjustments
- How do firms in a production network update output prices in response to energy shocks?

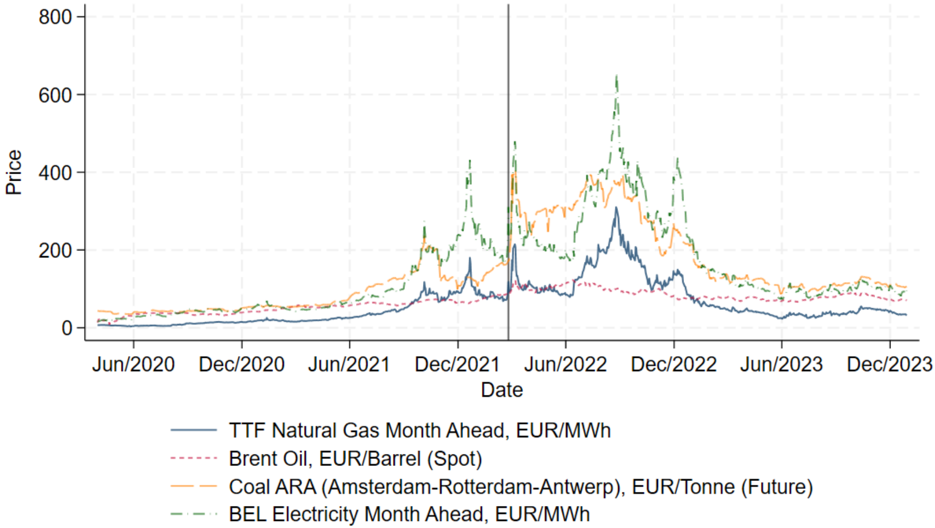
This Paper

- We leverage the recent surge in price of different energy commodities for identification
- We construct monthly energy price shocks using a common factor model
- Apply local projections for identification to evaluate:
    1. the direct impact of the energy-cost shock on price adjustment
    2. the role played by the network
    3. the characteristics of shocks and the environment

Data

- Energy price data
  - Daily energy market data (LSEG Eikon): Coal, Natural Gas, Oil, and Electricity
- Firm-level data
  - (Manufacturing) Producer Price Index (Statbel): firm-product-level prices, monthly
  - Services Price Index (Statbel): firm-product-level prices, quarterly
  - Construction Price Index (Statbel): firm-product-level prices, quarterly
  - Sectoral frequency of price adjustment, quarterly
- Network data
  - VAT listings (Dhyne, Duprez and Komatsu, 2023): sales firm-to-firm within Belgium, yearly

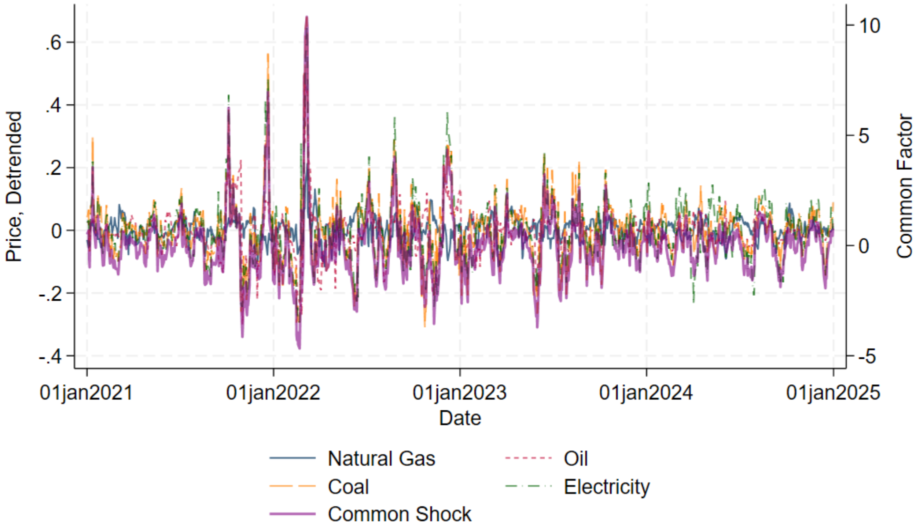
Energy Price Series



Identifying the Energy Price Shock

- We apply HP filtering on each commodity (log) price time series
- We apply common factor model on the four de-trended series
- We aggregate identified daily shocks to the monthly / quarterly level

Identifying the Energy Price Shock



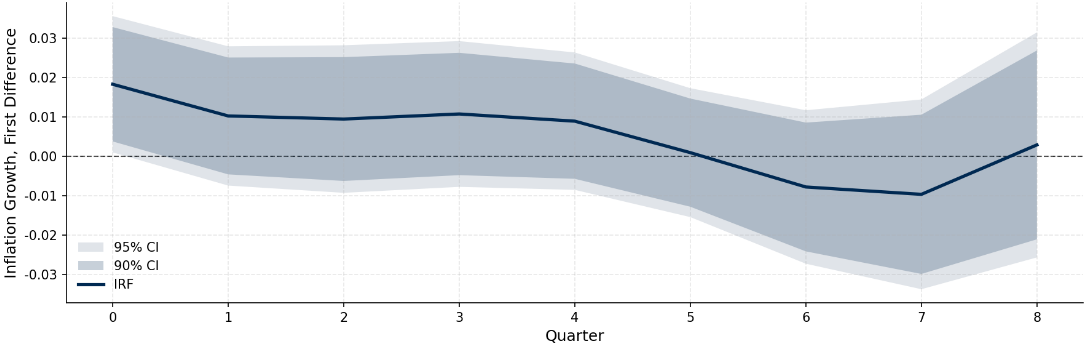
Local Projections: Total Effect

- Smoothed local projections (Jorda, 2005; Barnichon & Brownlees, 2019):

$$\Delta^h \mathrm{Log}(Y_{i,t+h}) \equiv \mathrm{Log}(Y_{i,t+h}) - \mathrm{Log}(Y_{i,t-1})$$
$$= \alpha_i + \beta_h \, \mathrm{Energy\_Shock}_t + \gamma_h X_{i,t} + \varepsilon_{i,t+h},$$

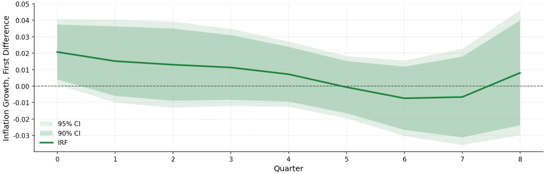
  - Outcome $Y_{i,t+h}$: price of firm-product i at horizon h
  - $\mathrm{Energy\_Shock}_t$: energy shock at time t
  - Controls $X_{i,t}$: 2-lag $\Delta \, \mathrm{Log}(Y_i)$ and $\mathrm{Energy\_Shock}_t$ + sectoral frequency of price changes in t
  - α_i : firm-product-level fixed effect
  - Driscoll-Kraay SEs: robust to heterosc. and auto-correlation

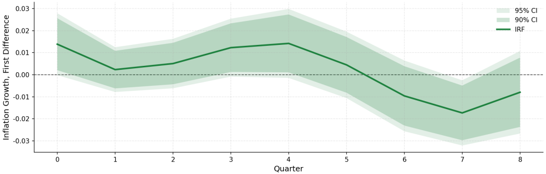
IRF: Total Effect

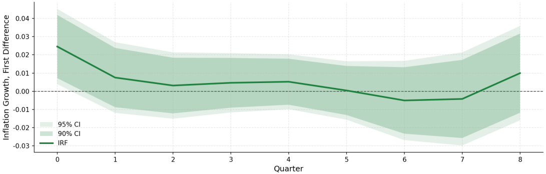


- 1sd energy price shock increase $\rightarrow$ $+2\%$ within the first quarter
- No delay in the effect and dissipation after first year

IRF: Total Effect, by Sector







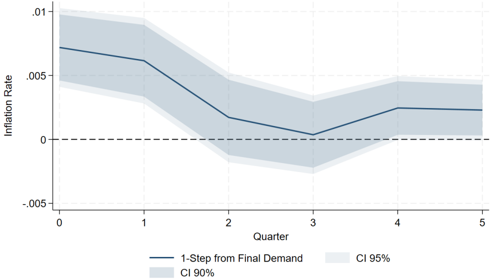
Local Projections: Upstreamness

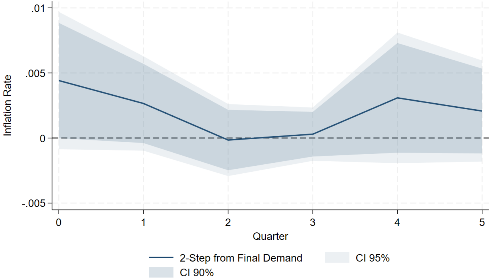
- Smoothed local projections (Jorda, 2005; Barnichon & Brownlees, 2019):

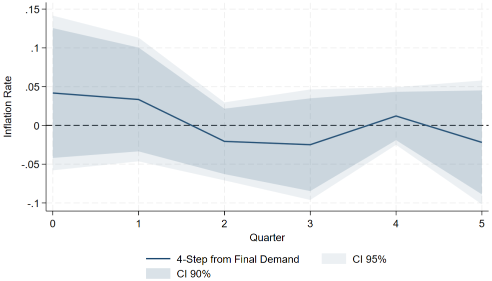
$$\Delta^h \, \text{Log}(Y_{i,t+h}) = \alpha_i + \beta_h \, \text{Energy\_Shock}_t + \delta_h \, \text{Upstream}_{i,t-1} + \\ + \lambda_h \, (\text{Upstream}_{i,t-1} \times \text{Energy\_Shock}_t) + \gamma_h \, X_{i,t} + \varepsilon_{i,t+h},$$

  - Outcome $Y_{i,t+h}$: price of firm-product i at horizon h
  - Energy_Shock_t : energy shock at time t
  - Upstream_{t-1} : distance from final demand (in previous period)
  - Controls $X_{i,t}$: 2-lag $\Delta \, \text{Log}(Y_i)$ and Energy_Shock_t + sectoral frequency of price changes in t
  - α_i : firm-product-level fixed effect
  - Driscoll-Kraay SEs: robust to heterosc. and auto-correlation

IRF: Total Effect, by Upstreamness







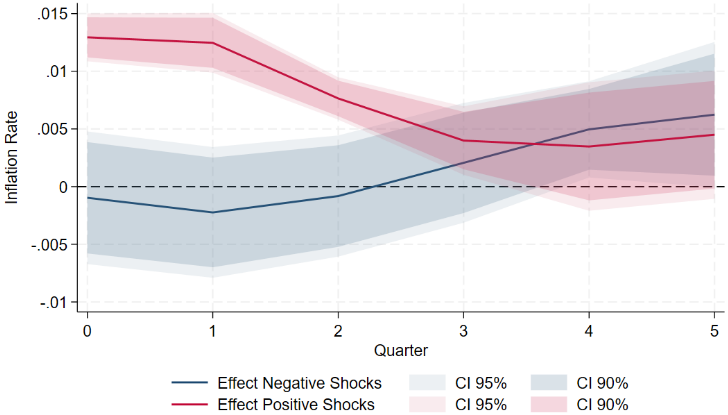
Local Projections: Asymmetric Effect

- Smoothed local projections (Jorda, 2005; Barnichon & Brownlees, 2019):

$$\Delta^h \text{Log}(Y_{i,t+h}) = \alpha_i + \beta_h \text{Energy\_Shock}_t + \delta_h \text{Dummy\_Pos\_Shock}_t + \\ + \lambda_h \left(\text{Dummy\_Pos\_Shock}_t \times \text{Energy\_Shock}_t\right) + \gamma_h X_{i,t} + \varepsilon_{i,t+h},$$

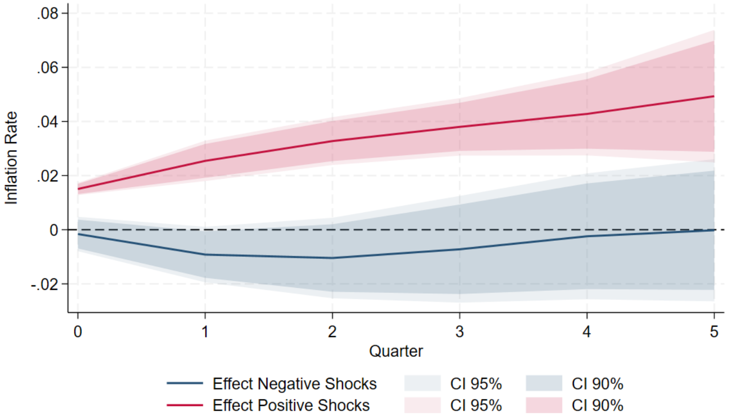
  - Outcome $Y_{i,t+h}$: price of firm-product i at horizon h
  - Energy_Shock_t : energy shock at time t
  - Dummy_Pos_Shock_t : dummy for positive energy shocks
  - Controls $X_{i,t}$: 2-lag $\Delta \text{Log}(Y_i)$ and Energy_Shock_t + sectoral frequency of price changes in t
  - α_i : firm-product-level fixed effect
  - Driscoll-Kraay SEs: robust to heterosc. and auto-correlation

IRF: Asymmetric Effect



- 1sd positive energy price shock $\rightarrow$ $+1.5\%$ in first quarter

IRF: Asymmetric Effect, Cumulative

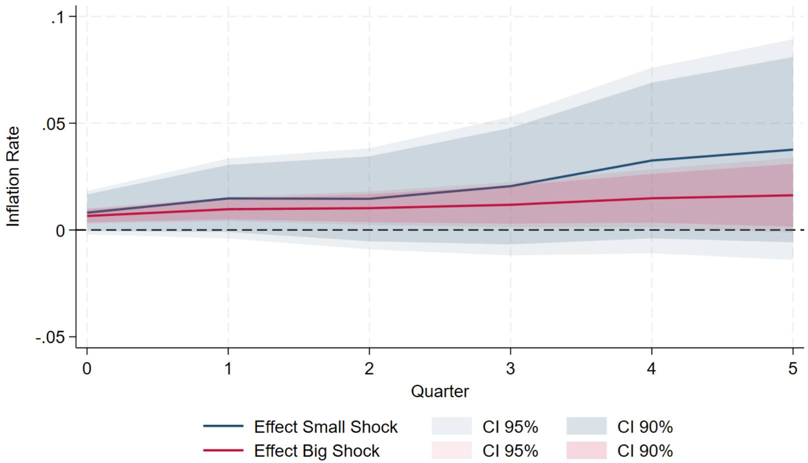


- Strong asymmetric effect: $\rightarrow$ +4% within first year due to positive shocks

Drivers?

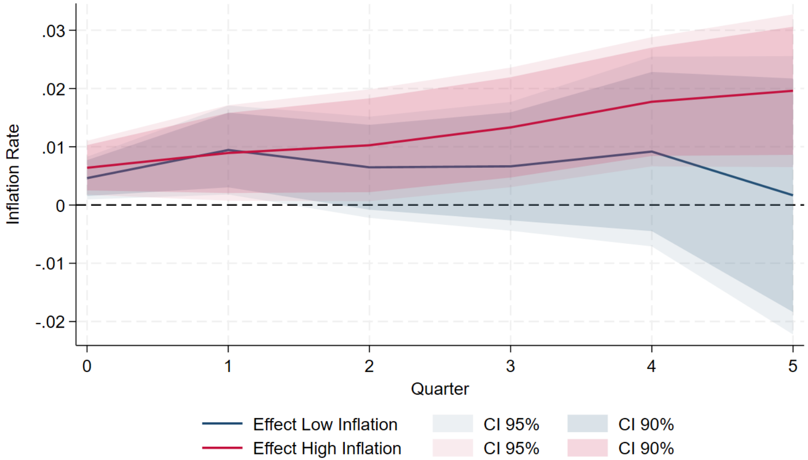
- What could drive this strong asymmetric effect?
- Potentially, we are picking large positive shocks in our sample period...
- ... hence, we test for heterogeneity of energy shocks: 1st vs 4th quartile
- Additionally, firms might react strategically when expecting all competitors to increase prices...
- ... hence, we test price responses occurring in high inflation periods (above vs below median)

IRF: Large Energy Shocks, Cumulative



- Not so clear this is what drive the result

IRF: High Inflation Period, Cumulative



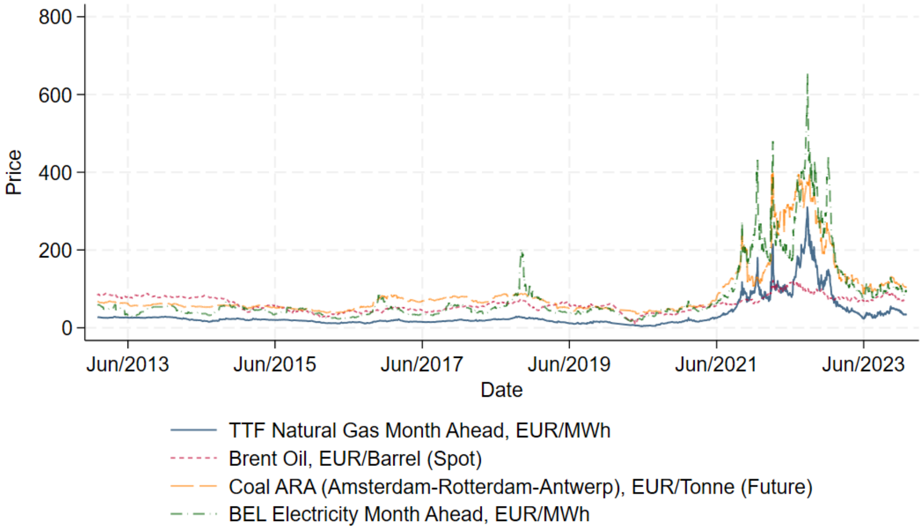
- During periods of high inflation, firms are able to permanently raise prices

Conclusions

- We study how firms pass costs shocks to output prices
- We find firms to adjust prices with no delay
- Asymmetric effects hide much of the adjustment, in particular:
  - Firms react more to positive shocks...
  - ... especially, when they expect other firms to adjust as well
- Downstream firms react more strongly. Why?
  - idiosyncratic shocks are harder to pass-through (Magermann and Duprez, 2018)
  - for aggregate shocks, firms anticipate they will adjust prices
  - the incentive is to respond immediately $\rightarrow$ no need to justify it to customers
  - final consumers cannot adjust much if everyone is updating prices simultaneously

Thank You

Energy Prices, Long Time Series



IRF: Total Effect, Cumulative