Fuel price surges and rising inflation expectations in the Euro Area

A Bayesian structural VAR, 2005–2022

Hugo Morão

October 2026

ISEG – Lisbon School of Economics and Management
University of Lisbon

Fuel prices surged in 2021–22, and stagflation fears followed

- Oil prices soared above **$110 per barrel by June 2022**, and the paper describes a looming stagflation in the Eurozone
- **Unprecedented increases in retail fuel prices** in 2021–2022, attributed to oil and gas shortages
- Analysts and policymakers worried about the inflationary effects of persistent fuel price increases on **prices and wage decisions**
- The conflict in Ukraine intensifies these concerns: higher expected prices may feed more inflation through the **expectations channel**

Time series in the model

Research questions and approach

- **Q1.** How do rising fuel prices affect **short- and long-term inflation expectations**?
- **Q2.** How do these effects propagate to consumer prices, economic activity, the exchange rate and financial markets?
- **Q3.** How much of the variation in expectations around major economic and geopolitical events, such as the February–March 2022 burst of inflation, is due to fuel price shocks?
- **Approach**: Bayesian structural VAR on Euro Area monthly data, January 2005 to August 2022; fuel price shock identified with zero, sign and variance restrictions

Why it matters

The paper argues that rising fuel prices must enter policy discussions, given their impact on macroeconomic stability.

Preview of results

- **Expectations**: fuel price shocks raise both short- and long-term inflation expectations and contributed to their variation during key episodes. In the first month of the invasion of Ukraine, the rise in expectations is mostly driven by fuel prices
- **Prices**: higher retail fuel prices raise consumer prices, also excluding food and energy
- **Macroeconomy and finance**: lower industrial production and higher unemployment; real depreciation and a weaker trade balance; stock prices fall; credit and sovereign stress rise
- **After March 2022**: fuel shocks account for little of the movement in durable and non-durable goods prices, which the paper reads as pointing to demand factors
- Results are robust across the fuel type, taxes and the sample period

Related literature

1. **Oil/fuel shocks and inflation expectations, mostly U.S.**: Kilian (2022) and Kilian and Zhou (2022a); gasoline prices and expectations (Kilian and Zhou 2021; Kilian and Zhou 2022b); oil shocks and macro effects (Kilian 2009; Peersman and Van Robays 2009). Wong (2015): expectations are sensitive to real oil price shocks but do not contribute significantly to observed inflation
2. **Pass-through to inflation**: Conflitti and Luciani (2019) (U.S. and Euro Area): mainly through macroeconomic factors; Clark and Terry (2010): limited pass-through after 1980
3. **Euro Area**: industry-level effects (Scholtens and Yurtsever 2012), stock market volatility (Degiannakis et al. 2014), reduced-form models (Sussman and Zohar 2015; Conflitti and Cristadoro 2018), consumer sentiment (Clerides et al. 2022). According to the paper, none incorporate inflation expectations
4. **Russia–Ukraine war**: Boungou and Yatié (2022), Tosun and Eshraghi (2022), Huang and Lu (2022), and Deng et al. (2022)

Contribution

- **Euro Area evidence** on how fuel price shocks shape short- and long-term inflation expectations. The paper states that no earlier study shows this, while the U.S. is well covered
- **Identification**: Bayesian SVAR with sign, zero and variance restrictions (Baumeister and Peersman 2013; Kilian and Murphy 2014; Arias et al. 2018), covering consumer prices, economic activity and financial markets
- **Historical decomposition**: how much of the burst in inflation expectations, and of price dynamics after March 2022, can be attributed to fuel prices
- Real-time evidence from **Russia's invasion of Ukraine**, adding to that literature

Fuel price shocks, expectations and the wider macroeconomy in one Euro Area model.

Data and Method

Monthly Euro Area data, 2005m1–2022m8

- $y_t = [\zeta_t, \pi_t^{\text{e1y}}, \pi_t^{\text{5y5y}}, \pi_t, y_t^{\text{p}}, u_t, e_t, \text{nx}_t]'$
- **Fuel price** ζ_t: weighted average Euro Area price including taxes and duties. **Gasoil is the baseline**: typically less taxed, and the most consumed car fuel in many countries. Gasoline 95 and prices net of taxes are robustness checks
- **Expectations**: π^{e1y}, the European Commission survey of 1-year-ahead price expectations; π^{5y5y}, the market-based 5-year, 5-year forward rate implied by government bond yields
- **Macro**: headline HICP π, industrial production y^{p}, unemployment rate u, real broad effective exchange rate e, trade balance nx
- **Financial version** adds share prices, a high-yield bond rate, the sovereign systemic stress indicator (SovCISS), the 3-month interbank rate and the central bank balance sheet
- All series seasonally adjusted with X13

Data sources Time series

Bayesian structural VAR in levels, twelve lags

$$\mathcal{D}_0 y_t = \mathcal{D}_+ x_t + \eta_t, \qquad \eta_t \sim \mathcal{N}(0, I_n)$$

- x_t stacks a constant and ℓ lags of y_t; η_t are structural shocks; $\mathcal{D}_0$ is invertible
- **Prior**: independent normal-Wishart; Litterman-type shrinkage on the VAR coefficients (Litterman 1986); inverse Wishart for the residual covariance, scale from individual AR regressions (Karlsson 2013)
- Estimated in levels, so the autoregressive coefficient of the prior is set to $\rho = 1$
- **Gibbs sampler**: 10,000 iterations, 9,000 burn-in
- **Lag length of twelve**, following Kilian and Zhou (2022c); the robustness section tests this choice
- Hyperparameters from a grid search around common values (Dieppe et al. 2016)

Hyperparameters

Identifying an exogenous fuel price shock

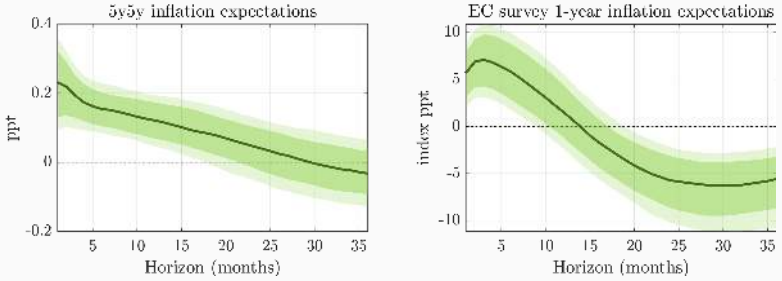
Shock \ variable	ζ	π^{e1y}	π^{5y5y}	π	y^{p}	u	e	nx
Fuel price	↑	↑	↑	↑	o	o	o	o

Notes: Sign and zero restrictions on the impact matrix, with the algorithm of Arias et al. (2018); financial variables are left unrestricted.

1. **Real fuel price up**: a nominal fuel price shock raises the real price, since HICP responds with a lag (Kilian and Zhou 2022a)
2. **Both expectations up**: household inflation expectations evidence (C. C. Binder 2018; C. Binder and Makridis 2022)
3. **Other macro variables do not react on impact**: higher fuel prices take time to reach economic activity
4. Sign restrictions on prices and expectations hold on impact and through the first month
5. The fuel price shock explains the largest share of the variation in real fuel prices from impact to three months (FEVD restriction, Weale and Wieladek 2016)

Results

Fuel price shocks raise short- and long-term inflation expectations

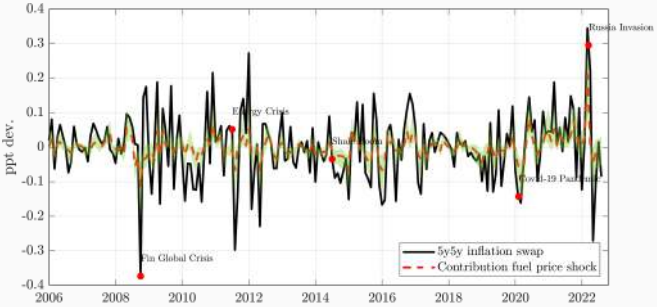


Notes: Shock normalized to raise fuel prices by 15%; median with 50% and 68% bands.

- **5y5y**: rises on impact by about 0.2 pp (read from the figure) and stays significant for around two years
- **1-year (EC survey)**: significant, but shorter-lived; the response turns negative after about a year. The paper links this fall largely to the Covid-19 pandemic
- No evidence of enduring effects on short-term expectations, which *might* suggest that monetary policy still anchors them

Without the pandemic

Fuel shocks drove expectations in several episodes, from the GFC on

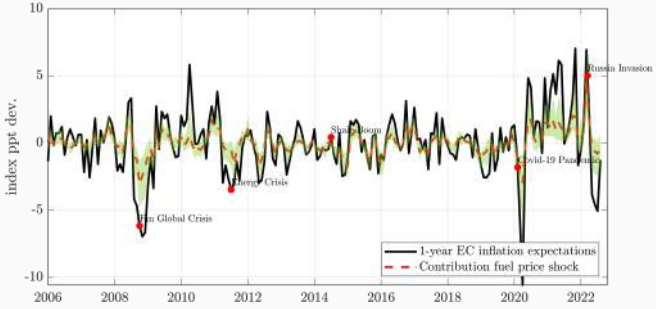


Notes: 5y5y expectations, first differences; solid: data, dashed: fuel price shock contribution, 68% band.

- **2005–mid-2008**: oil prices more than doubled, but fuel only matters for expectations around 2008; it drives the fall during the **Global Financial Crisis**
- After the crisis, only the price hikes around **early 2011** move expectations; the 2014 **shale boom** and the **pandemic** show falling fuel prices and falling expectations

Both measures

After the invasion, fuel explains the surge in expectations, not the later drop

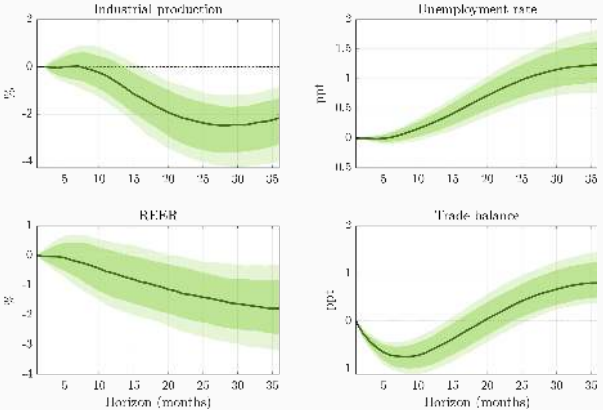


Notes: 1-year EC expectations, first differences; the 5y5y measure shows a similar pattern.

- Sanctions after Russia's invasion in February 2022 significantly affected global fuel supply; **fuel prices emerged as the major contributor** to the surge in expectations
- The **drop after March bears no relation to fuel prices**, unlike during the GFC; the paper suggests it could instead be linked to demand stimulated by Covid-related policies, but notes that a more comprehensive analysis needs additional data

Both measures

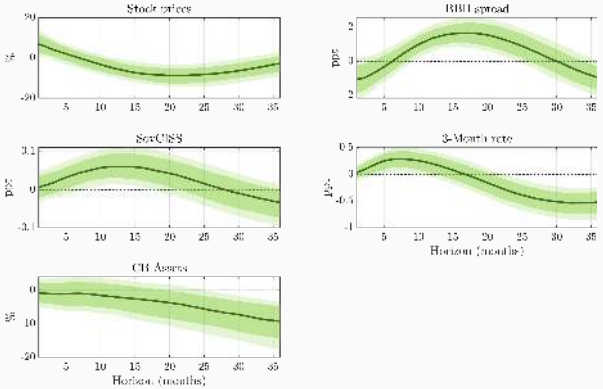
Real effects: output falls, unemployment rises, the trade balance weakens



Notes: Normalized to a 15% increase in the gasoil price, to match the March 2022 increase; median, 50% and 68% bands.

- **Industrial production**: flat for about 8 months, then a fall to roughly -2.5% around month 28
- **Unemployment** rises persistently, to about $+1.2$ pp at the end of the 36 months
- **REER** depreciates gradually, to about -1.8%
- **Trade balance** falls to about -0.75 pp within a year and returns to zero after about 20 months
- The paper reads the long fall in output as production-side rigidities, and the unemployment rise as reallocation frictions

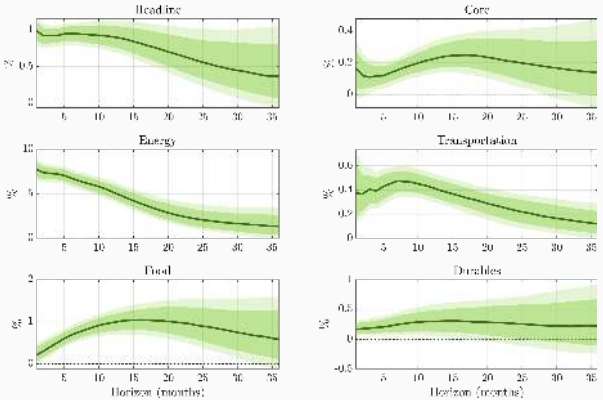
Financial markets: stocks fall, credit and sovereign stress rise



Notes: Same 15% fuel price shock; median, 50% and 68% bands. Values read from the figure.

- **Stock prices**: a brief rise (optimism), then a fall to about −9% around month 20; still below baseline at 36 months
- **Credit and sovereign stress** (BBB spread and SovCISS) rise, peaking roughly a year or more after the shock
- **Policy rate** (3-month): small rise early, below zero after about 1.5 years; **central bank assets** drift down
- The paper reads monetary policy as more reactive than proactive: it does not change on impact

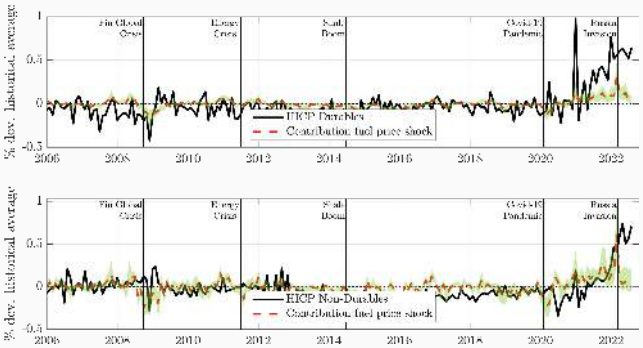
Consumer prices respond, but unevenly across categories



Notes: 15% fuel price shock; cubic trends as exogenous variables; median, 50% and 68% bands.

- **Headline**: about $+1\%$ on impact, fading to about 0.4% at 36 months; **core** rises less (roughly 0.1 to 0.25%), so retail fuel prices lift prices even excluding food and energy
- **Energy** responds most (about 7.7% on impact); **transportation** strongly
- **Food** builds up gradually, peaking after roughly 15 months
- **Durables**: the most muted response
- Ranking of pass-through: energy, then food, transportation and durables

Since March 2022, fuel shocks explain little of durable and non-durable prices



Notes: Historical decomposition of HICP durables and non-durables, first differences; solid: data, dashed: fuel shock contribution, 68% band.

- Fuel price shocks exert a **minimal impact** on durable and non-durable goods prices after March 2022
- Prices keep rising while the fuel contribution fades
- The paper suggests other factors play a larger role, such as demand supported by monetary and fiscal policy during and after the pandemic
- Inflationary pressure is **not only a supply-side fuel story**

Fuel shocks explain a large share of forecast error variance

h	5y5y	EC	HICP	IPI	Unemp.	REER	NXY
1	29.10	31.99	61.73	0.00	0.00	0.00	0.00
12	27.49	25.45	58.45	1.66	3.74	2.06	16.62
24	26.12	29.91	44.86	8.15	25.79	7.56	16.53
36	26.51	34.79	32.88	16.55	42.94	13.54	25.22

h	Shares	H.yield	SCISS	3M rate	Assets
1	12.26	9.93	5.82	7.04	5.51
12	13.49	13.81	13.21	13.69	7.04
24	22.04	20.25	15.06	15.74	9.79
36	24.83	19.97	18.01	25.25	15.57

Notes: Median share (%) of forecast error variance due to the fuel price shock at horizon h (months).

- **Expectations**: about 29% (5y5y) and 32% (EC) at one month; 27% and 35% at 36 months
- **Real variables**: small at short horizons, growing with the horizon; unemployment 3.7% at 12 months and 42.9% at 36
- **HICP**: 61.7% at one month, 32.9% at 36 months
- **Financial variables**: a growing share at longer horizons, including the policy rate

Robustness: the paper reads its conclusions as stable across specifications

- **Excluding Covid-19** (sample to December 2019): headline response more persistent, REER less significant; industrial production falls more, the trade balance less (figure); the later fall in 1-year expectations is smaller
- **Gasoline 95** instead of gasoil: estimates are similar
- **Fuel prices net of taxes**: REER effect weaker, industrial production and unemployment effects stronger; taxes affect the size, not the direction
- **ECB assets** added to the real model: main findings unchanged
- **Model specification**: lag length, S_0 as identity, diffuse prior, hyperparameters, block exogeneity, deterministic terms

Directions are stable; some magnitudes depend on sample, taxes and lags.

No pandemic | Gasoline | No taxes | Lags | ECB assets

Limits and caveats

- **Post-March 2022 dynamics**: the link to Covid-related demand is a suggestion; a more comprehensive analysis would need additional data (the sample ends in August 2022)
- The later fall in 1-year expectations is **sample-dependent**: the paper ties it largely to the pandemic, and it is smaller when the pandemic is excluded
- **Taxes matter for magnitudes**: including taxes in retail fuel prices may change the size of the effects, not their direction
- The study does not model high-frequency volatility, and leaves financial responses unrestricted in the identification
- The **effectiveness of national and EU measures** against soaring fuel prices is an open question, left to future research

Conclusion and policy implications

- Fuel price shocks **significantly raise short- and long-term inflation expectations** and contribute to their historical variation; they account for most of the February–March 2022 surge
- In the following months there is **no evidence that fuel prices are the main driver** of inflation, particularly in durable and non-durable goods
- Higher fuel prices slow economic activity and weigh on financial markets; at the macro level the paper points to energy costs as the main driver
- **Policy**: the paper argues significant actions are needed to limit the impact of fuel price hikes on economic activity, to avert a "lost decade" akin to the 1970s. It adds that gas price caps and windfall taxes might not suffice without demand-side management and could backfire

Thank you!

hmorao@phd.iseg.ulisboa.pt

Backup

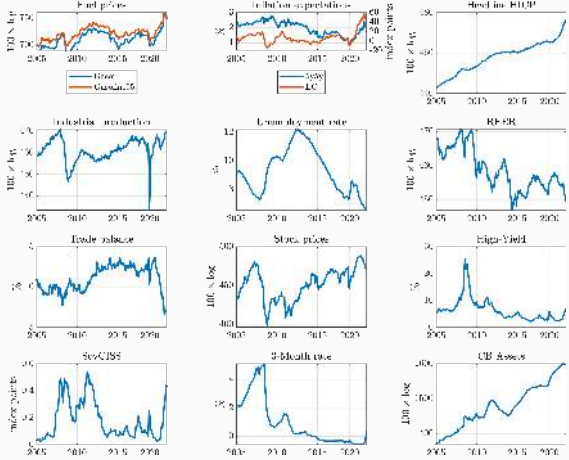
Data description and sources

Label	Description	Source
ζ_t	Fuel prices for the Euro Area	EC
π_t	HICP (headline, core, energy, transportation, food, durable)	Eurostat
π_t^{5y5y}	5y5y inflation expectations	Bloomberg
π_t^{e1y}	1-year inflation expectations	EC
y_t^p	Total industry excluding construction, Euro Area	FRED
e_t	Real broad effective exchange rate, Euro Area	FRED
u_t	Harmonized unemployment rate	Bloomberg
nx_t	Trade balance, Euro Area	FRED/Own
s_t	Total share prices, all shares, Euro Area	FRED
h_t	ICE BofA Euro High Yield Index	FRED
c_t	Composite indicator of sovereign systemic stress	ECBW
m_t	90-day interbank rates, Euro Area	FRED
a_t	Central bank assets, Euro Area	FRED

Notes: Monthly series covering 2005m1–2022m8.

‹ Back

Time series used in the model



Notes: The paper's figure "Time series in the model" (fuel prices, expectations, macro and financial variables).

Back

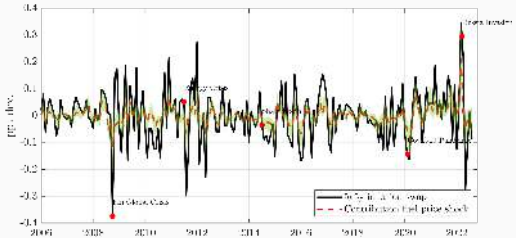
Prior hyperparameters

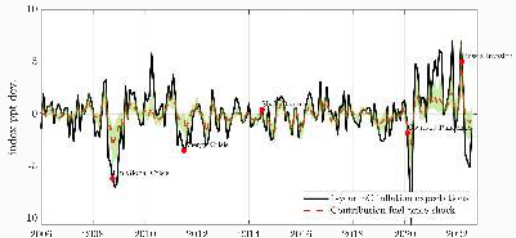
	Value	Description	Observation
ρ	1	autoregressive coefficients	used in all models
λ_1	0.1	overall tightness	$\lambda_1 = 1$ in the VAR robustness model
λ_2	0.5	cross-variable weighting	$\lambda_2 = 2$ in the VAR robustness model
λ_3	1	lag decay	$\lambda_3 = 2$ in the 1-lag model
λ_4	10^5	exogenous variable tightness	used in all models

Prior variances follow Litterman (1986), as in Dieppe et al. (2016); the residual covariance has an inverse Wishart prior (Karlsson 2013).

Back

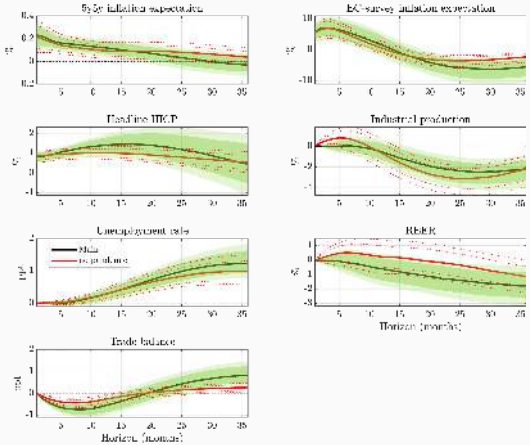
Historical decomposition of inflation expectations: both measures





Back

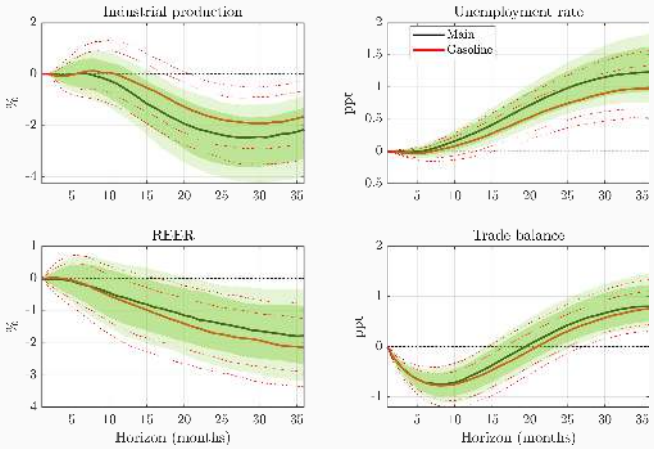
Robustness: excluding the pandemic



Notes: Main model against the model without the pandemic (red); panels as in the baseline: 5y5y, EC 1-year, headline HICP, industrial production, unemployment, REER, trade balance.

‹ Back

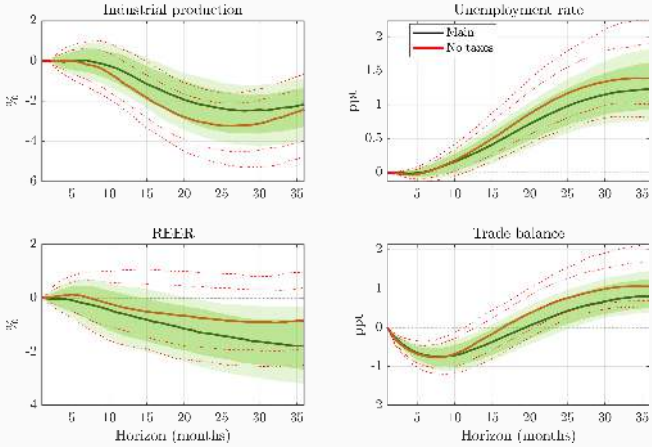
Robustness: gasoline 95 as the fuel price



Notes: Main model against the gasoline model (red); panels: industrial production, unemployment, REER, trade balance.

‹ Back

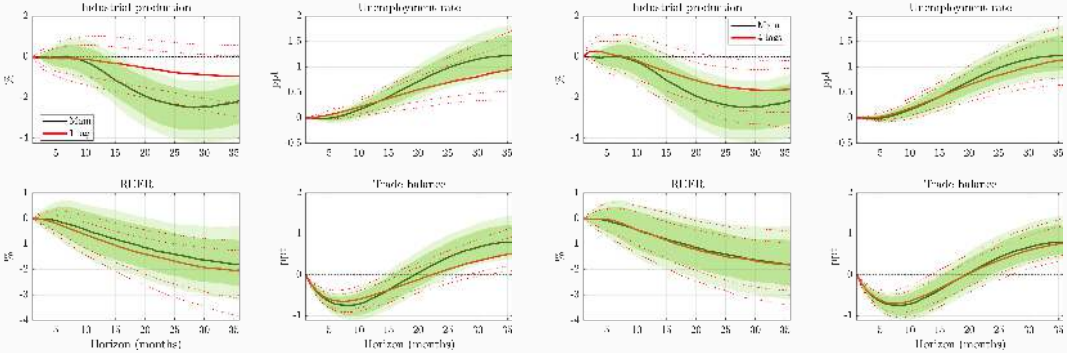
Robustness: fuel prices net of taxes



Notes: Main model against the model with retail fuel prices net of taxes and duties (red); panels: industrial production, unemployment, REER, trade balance.

‹ Back

Robustness: lag length



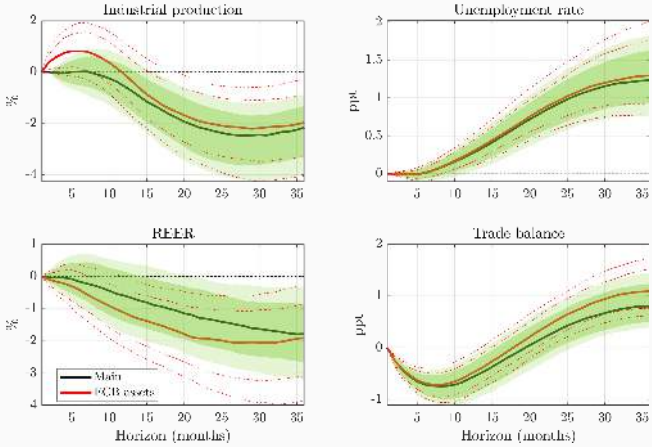
BVAR(1), selected by SC

BVAR(4), selected by AIC

Notes: Main model against the alternative lag length (red); panels: industrial production, unemployment, REER, trade balance. With one lag the industrial production decline is visibly smaller.

‹ Back

Robustness: ECB assets in the real model



Notes: Main model against the model with ECB assets in the main specification (red); panels: industrial production, unemployment, REER, trade balance.

Back

References i

Arias, Jonas E., Juan F. Rubio-Ramirez, and Daniel F. Waggoner (2018). **"Inference Based on Structural Vector Autoregressions Identified With Sign and Zero Restrictions: Theory and Applications".** In: *Econometrica* 86.2, pp. 685–720.

Baumeister, Christiane and Gert Peersman (2013). **"Time-varying effects of oil supply shocks on the US economy".** In: *American Economic Journal: Macroeconomics* 5.4, pp. 1–28.

Binder, Carola and Christos Makridis (2022). **"Stuck in the Seventies: Gas Prices and Consumer Sentiment".** In: *Review of Economics and Statistics* 104.2, pp. 293–305.

Binder, Carola Conces (2018). **"Inflation expectations and the price at the pump".** In: *Journal of Macroeconomics* 58, pp. 1–18.

Boungou, Whelsy and Alhonita Yatié (2022). **"The impact of the Ukraine–Russia war on world stock market returns".** In: *Economics Letters* 215.

Clark, Todd E. and Stephen J. Terry (2010). **"Time Variation in the Inflation Passthrough of Energy Prices".** In: *Journal of Money, Credit and Banking* 42.7, pp. 1419–1433.

Clerides, Sofronis et al. (2022). **"What matters for consumer sentiment in the euro area? World crude oil price or retail gasoline price?"** In: *Energy Economics* 105, p. 105743.

Conflitti, Cristina and Riccardo Cristadoro (2018). **"Oil Prices and Inflation Expectations".** In: *SSRN Electronic Journal*.

References ii

Conflitti, Cristina and Matteo Luciani (2019). **"Oil price pass-through into core inflation".** In: *Energy Journal* 40.6, pp. 221–247.

Degiannakis, Stavros, George Filis, and Renatas Kizys (2014). **"The effects of oil price shocks on stock market volatility: Evidence from European data".** In: *Energy Journal* 35.1, pp. 35–56.

Deng, Ming et al. (2022). **"Stock Prices and the Russia-Ukraine War: Sanctions, Energy and ESG".** In: *SSRN Electronic Journal*.

Dieppe, Alistair, Romain Legrand, and Bjorn van Roye (2016). **"The Bayesian Estimation , Analysis and Regression Toolbox Technical guide".** In: *European Central Bank*.

Huang, Lei and Fangzhou Lu (2022). **"The Cost of Russian Sanctions on the Global Equity Markets".** In: *SSRN Electronic Journal*.

Karlsson, Sune (2013). **"Forecasting with Bayesian Vector autoregression".** In: *Handbook of Economic Forecasting* 2, pp. 791–897.

Kilian, Lutz (2009). **"Not All Oil Price Shocks are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market".** In: *American Economic Review* 99, p. 1053.

— (2022). **"Facts and fiction in oil market modeling".** In: *Energy Economics* 110, p. 105973.

References iii

Kilian, Lutz and Daniel P. Murphy (2014). **"The role of inventories and speculative trading in the global market for crude oil".** In: *Journal of Applied Econometrics* 29.3, pp. 454–478.

Kilian, Lutz and Xiaoqing Zhou (2021). **"The Impact of Rising Oil Prices on U.S. Inflation and Inflation Expectations in 2020-23".** In: *Federal Reserve Bank of Dallas, Working Papers* 2021.2116.

— (2022a). **"Oil prices, exchange rates and interest rates".** In: *Journal of International Money and Finance* 126, p. 102679.

— (2022b). **"Oil prices, gasoline prices, and inflation expectations".** In: *Journal of Applied Econometrics*.

— (2022c). **"The Econometrics of Oil Market VAR Models".** In: *Advances in Econometrics*.

Litterman, Robert B. (1986). **"Forecasting with Bayesian Vector Autoregressions: Five Years of Experience".** In: *Journal of Business & Economic Statistics* 4.1, p. 25.

Peersman, Gert and Ine Van Robays (2009). **"Oil and the euro area economy".** In: *Economic Policy* 24.60, pp. 603–651.

Scholtens, Bert and Cenk Yurtsever (2012). **"Oil price shocks and European industries".** In: *Energy Economics* 34.4, pp. 1187–1195.

References iv

Sussman, Nathan and Osnat Zohar (2015). **“Oil prices, inflation expectations, and monetary policy”.** In.

Tosun, Onur Kemal and Arman Eshraghi (2022). **“Corporate decisions in times of war: Evidence from the Russia-Ukraine conflict”.** In: *Finance Research Letters* 48.

Weale, Martin and Tomasz Wieladek (2016). **“What are the macroeconomic effects of asset purchases?”** In: *Journal of Monetary Economics* 79, pp. 81–93.

Wong, Benjamin (2015). **“Do Inflation Expectations Propagate the Inflationary Impact of Real Oil Price Shocks?: Evidence from the Michigan Survey”.** In: *Journal of Money, Credit and Banking* 47.8, pp. 1673–1689.