



Supply chains shocks and inflation in Europe

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Summary

- **Key objective:** A set of stylized facts about macroeconomic effect of supply chains disruptions on inflation .
- **Motivation:**
 - ▶ Globalization and inflation nexus
 - ▶ Unprecedented tensions in global and regional value chains due to COVID-19 pandemics and the full-scale invasion of Ukraine
 - ▶ Europe is different
- **Key findings:**
 - ▶ proinflationary and persistent effect of shortages
 - ▶ larger effect for goods than services but affecting core inflation
 - ▶ a phase shift only for the producer prices of investment goods
 - ▶ shortages more important at the medium horizon rather than in short-run
 - ▶ asymmetric or regime-switching nature



Plan

Introduction

Methodology & Data

Baseline results

Robustness check

Conclusions

Literature background

- Early papers investigating the globalization and inflation nexus focus on the exchange rate channel which implies the steepening the Phillips curve (e.g. Romer, 1993; Lane, 1997).
- Empirical evidence in favor of the flattening Phillips curve (Ball, 2006).
- Increasing mobility of goods, capital and labor lowers the responsiveness of inflation to domestic demand shocks (Binyamini and Razin, 2008).
- Growing role of global factors in shaping domestic inflation (e.g. Ciccarelli and Mojon, 2010) or global inflation (e.g. Borio and Filardo, 2007).
- The Global Value Chains (GVC) development changed the nature of domestic inflation:
 - ▶ internationalization of the production process crucial for the link between global and domestic inflation (Auer et al., 2017),
 - ▶ complex international input-output linkages synchronized (producer) inflation across countries (Auer et al., 2019),
 - ▶ but existing international input-output networks preserve a fat-tailed nature of cost shocks.

Literature background

- Two unprecedented shocks: COVID-19 pandemic and the full-scale invasion of Ukraine:
 - ▶ The administrative anti-COVID measures seriously impaired the functioning and capacity of many branches but demand for some commodities, intermediates, electronics, and logistical services increased rapidly, resulting in bottlenecks, delivery delays, and higher costs and prices (Rees and Rungcharoenkitkul, 2021)
 - ▶ The semiconductor (Dunn and Leibovici, 2021; Celasun et al., 2022) and shipping industries (Carrière-Swallow et al., 2023) were among the worst hit due to their geographic concentration, supply rigidities and essential role for many branches
 - ▶ The adverse effects of bottlenecks were further aggravated by the so-called bullwhip effect leading to precautionary hoarding of inventories along the supply chain (Rees and Rungcharoenkitkul, 2021).
 - ▶ Upstream nature of the Ukrainian exports.
- Early estimates effects of disruptions in GVCs seemed to be rather limited and temporary (see e.g. Budianto et al., 2021; Rees and Rungcharoenkitkul, 2021).
- Growing literature documenting the proinflationary effect of tensions:
 - ▶ the New Keynesian framework (e.g. Baqaee and Farhi, 2022; di Giovanni et al., 2022),
 - ▶ the Bayesian VAR models (e.g. Szafranek et al., 2023; Kabaca and Tuzcuoglu, 2023),
 - ▶ the GE approach (Alessandria et al., 2023),
 - ▶ the LP approach (Carrière-Swallow et al., 2023).

Our study

- The macroeconomic effect of supply chains disruption on inflation.
- Narrative approach bases on nine measures of inflation.
- The country-specific proxy of supply chains shock.
- The panel LP.

Methodology

- The local projection approach (Jordà, 2005) for inflation measure (y_{it}):

$$y_{it+h} = \alpha_h + \beta_h \text{shock}_{it} + x'_{it} \gamma_h + \varepsilon_{ith}, \quad (1)$$

where β_h allows to identify the response of outcome variable (y_{it}) for the horizon h .

- ▶ x'_{it} is the set of explanatory variables, including lags of the variables in regression (Olea and Plagborg-Møller, 2021).
- ▶ Panel setting: individual effects + robust variance-covariance estimator proposed by Driscoll and Kraay (1998).

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 - Panel setting: individual effects + robust variance-covariance estimator proposed by Driscoll and Kraay (1998).
- The FEVD (*forecast error variance decomposition*) will be estimated as the R^2 from the following regression (Gorodnichenko and Lee, 2020):

$$\hat{\varepsilon}_{ith} = \alpha_0 shock_{it+h} + \alpha_1 shock_{it+h-1} + \dots + \alpha_h shock_{it} + \nu_{ith}, \quad (2)$$

where $\hat{\varepsilon}_{ith}$ are the residuals from the local projection, $\alpha_0, \alpha_1, \dots, \alpha_h$ is the set of parameter describing the impulse response.

Shortages of intermediates

- **Data:** $shortage_{ijt}$ is the share of enterprises reporting shortages of intermediates and investment goods at the 2-digits NACE.
- Source: the Business and Consumer Surveys carried out by the European Commission.
- Country-specific aggregates:

$$shortage_{it} = \sum_{j \in J} w_{ijt} shortage_{ijt}, \quad (3)$$

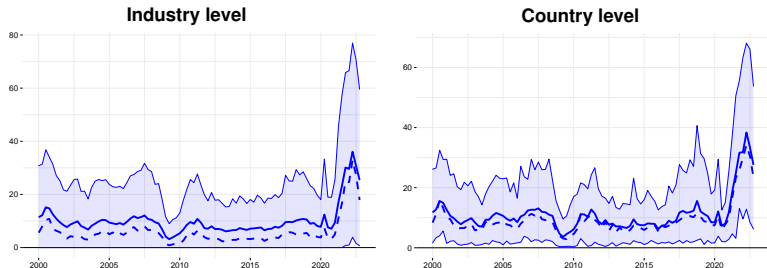
where w_{ijt} is the share of industry in total manufacturing production.

- The $shortage_{ijt}$ is standardized before aggregation.

▶ Shortages of intermediates

▶ Standardized shortages

Share of enterprises reporting shortages (in %)

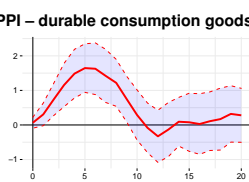
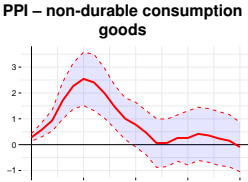
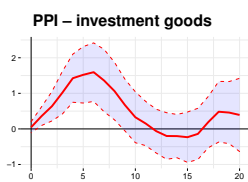
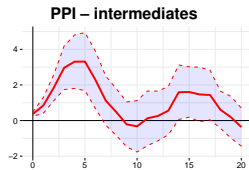
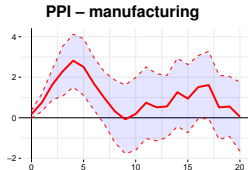
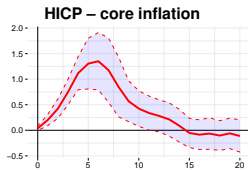
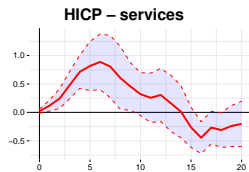
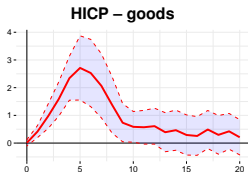
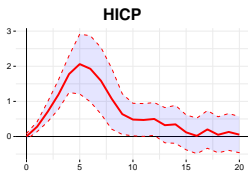


Note: the blue solid and dashed lines denote (unweighted) average and median measures of the shortages. The shaded areas capture variation in distribution of shortages of intermediates. For the country-level data the illustrated range of empirical values is constrained between the 5th and 95th quantiles while in the case of the industry variation the underlying limits are narrowed, i.e., the 10th and 90th quantiles. The country-specific measures of shortages are weighted by gross output.

▶ Standardized share of enterprises reporting shortages ▶ Description

Data

- **Inflation measure ($\times 9$):**
 - ▶ **Consumer inflation (HICP):** overall, goods, services and all times excluding energy, food, alcohol and tobacco (hereinafter called *core inflation*)
 - ▶ **Producer inflation (PPI):** overall, intermediates, capital goods, durable and nondurable consumer goods.
- **Control variables:**
 - ▶ output gap
 - ▶ energy prices (ppi for energy)
 - ▶ global prices of non-energy commodities
 - ▶ labor cost index
 - ▶ nominal effective exchange rates
 - ▶ survey-based factors limiting production (labor, financial, demand)
- **Data preparation:**
 - ▶ all price indexes are seasonally adjusted using the X-13 ARIMA-SEATS method
 - ▶ stationary series
- **Data:**
 - ▶ quarterly frequency
 - ▶ 19 countries
 - ▶ unbalanced panel: 1331 to 1577 observations



Note: the red solid lines denote the estimated impulse responses while the shaded areas refer to the 90% confidence intervals. The estimated effects correspond to one standard deviation shock in shortages of intermediates.

Baseline results – FEVD

Table: The role of supply chains shocks – FEVD (in %)

	horizon (in quarters)				
	4	8	12	16	20
HICP					
overall	9.3	12.2	19.6	19.4	27.9
goods	10.4	13.1	20.1	20.4	28.1
services	1.8	4.0	9.6	8.2	11.5
core inflation	4.7	8.2	16.7	15.3	22.7
PPI					
manufacturing	4.2	5.8	9.3	12.7	18.4
intermediates	8.7	10.3	14.3	19.2	23.7
capital goods	2.3	3.5	5.0	5.8	9.6
non-durable consumption goods	6.6	8.9	14.4	14.8	20.6
durable consumption goods	2.7	4.6	6.5	7.4	10.9

Baseline results – stylized facts

1. Supply chains disruptions are proinflationary and a larger effect can be observed for the inflation of prices of goods rather than services
2. The effect of supply chains disruptions on inflation builds up gradually at a moderate pace and is quite persistent
 - ▶ the peak effect can be observed 4-6 quarters after shock, i.e. similarly as Carrière-Swallow et al. (2023)
 - ▶ the effects die out gradually and becomes statistically insignificant (at 10% significance level) after 8-12 quarters
 - ▶ a negative productivity shock rather to markups shock
3. Limited evidence in favour of a phase shift between various measures of inflation, i.e., only response for investment goods is delayed.
4. Supply chain disruptions are much more important in explaining inflation changes at medium rather than short (forecast) horizon and are relatively more important for consumer goods.

Robustness check

1. Aggregation strategy of industry-specific shocks [figure](#)
2. Alternative measurement of supply chains shock [figure](#)
3. Monthly series [figure](#)
4. The effect of supply chains on the level of prices [figure](#)
5. Time variation in estimates [figure](#)
6. Non-linearities [figure](#)

Final remarks

- We document that supply chains shocks have positive and persistent impact on both producer and consumer inflation.
- Our evidence confirms that international vertical specialization preserved a fat-tailed nature of cost shocks.
- Policy implications?

Literature I

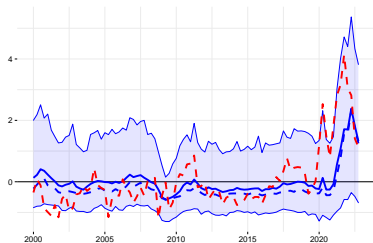
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Literature II

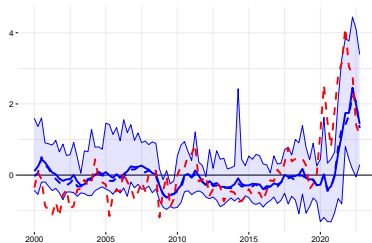
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Standardized share of enterprises reporting shortages

Industry level



Country level

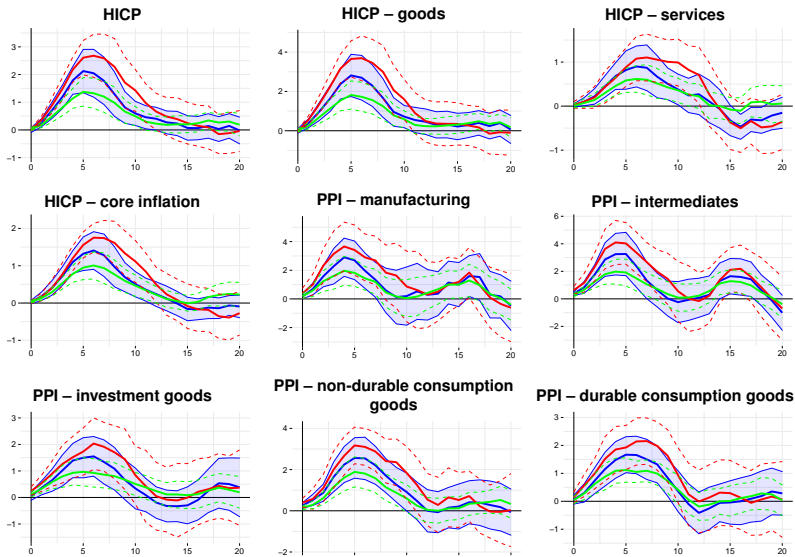


Note: the blue solid and dashed lines denote (unweighted) average and median measures of the shortages. The shaded areas capture variation in distribution of shortages of intermediates. For the country-level data the illustrated range of empirical values is constrained between the 5th and 95th quantiles while in the case of the industry variation the underlying limits are narrowed, i.e., the 10th and 90th quantiles. The country-specific measures of shortages are weighted by gross output. The red dashed lines in the bottom panel represent the Global Supply Chains Pressure Index. All presented moments of distribution are limited to sample that is used in the baseline estimation.

▶ Raw data

▶ Description

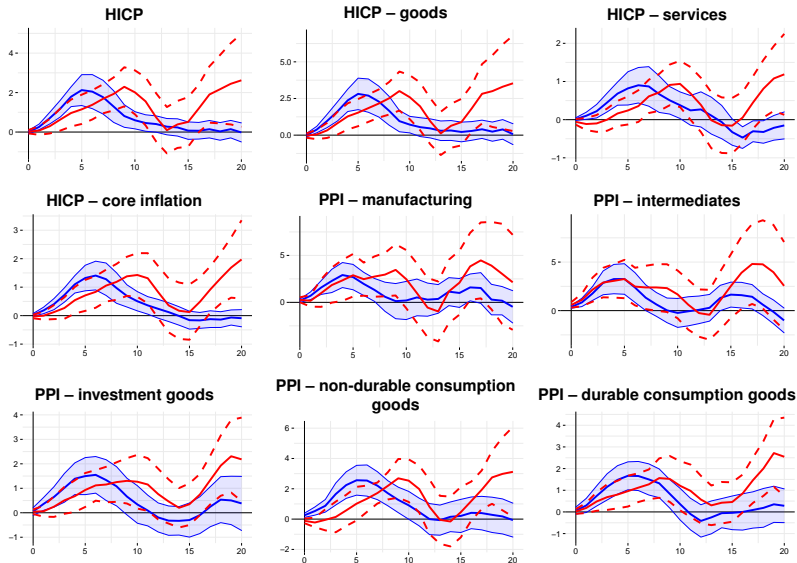
Figure: Comparison of different strategies of aggregating industry-specific tensions' measures



Note: the solid and dashed lines denote the mean estimated impulse responses with the corresponding 90% confidence intervals, respectively. The blue color refers to baseline results. The estimates obtained by using (unweighted) averages of unweighted industry-specific shortages are colored with red while green color captures the estimated IRFs that are based on the EC aggregates of variable of interest.

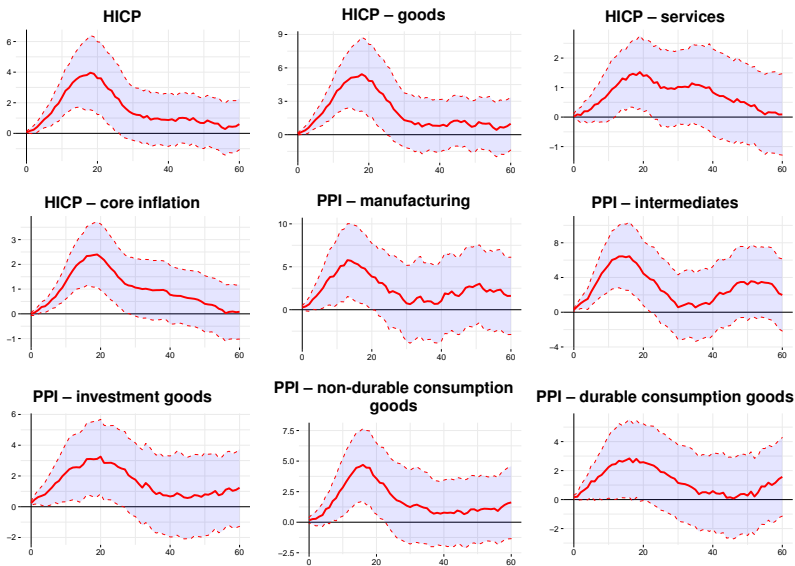
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Figure: The GSCP index as a proxy of global supply chains shock



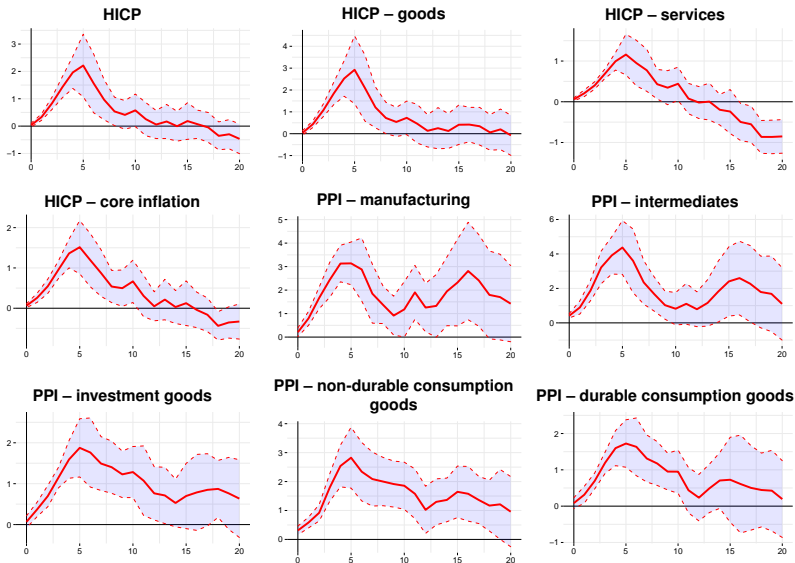
Note: the red colored IRFs denote the estimates that are based on the GSCP index while the blue responses are the baseline results. The estimated effects correspond to one standard deviation shock in shortages of intermediates. [▶ back](#)

Figure: An estimated effect of the supply chains disruptions on various annual inflation measures (monthly data)



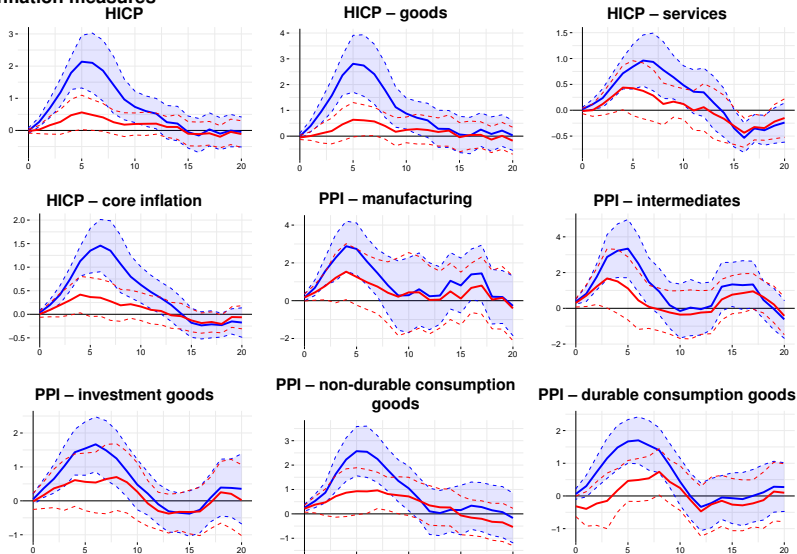
Note: the red solid lines denote the estimated impulse responses while the shaded areas refer to the 90% confidence intervals. The estimated effects correspond to one standard deviation shock in shortages of intermediates.

Figure: An estimated effect of the supply chains disruptions on various annual price levels (in %)



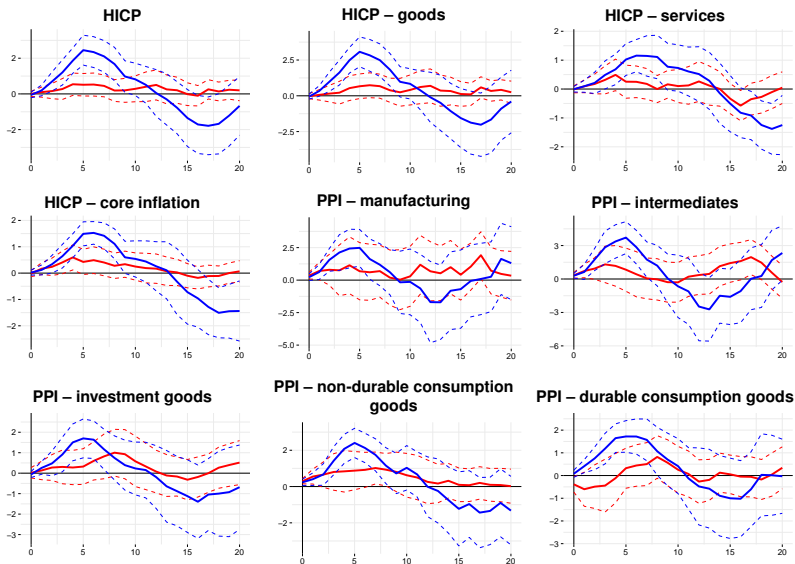
Note: the red solid lines denote the estimated impulse responses while the shaded areas refer to the 90% confidence intervals. The estimated effects correspond to one standard deviation shock in shortages of intermediates.

Figure: Time variation in estimated effect of the supply chains disruptions on various annual inflation measures



Note: the blue lines and shaded areas denote the full-sample estimates of the impulse responses with the corresponding 90% confidence intervals. The estimates for the pre 2020s sample are colored in red, i.e., the solid lines refer to the mean effect while the dashed lines represents the 90% confidence intervals. In all cases, the estimated effects correspond to one standard deviation shock in shortages of intermediates. [back](#)

Figure: Regime-specific impulse responses of various annual inflation measures to supply chains shock



Note: the blue and red colors refer to regimes characterized with high and low global supply chain pressure, respectively. In both cases, the solid lines denote mean estimates while the dashed lines are the 90% confidence intervals. [back](#)