
The asymmetric effect of supply chain pressure on inflation


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# The Asymmetric Effect of Supply Chain Pressure on Inflation*

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**Abstract**

We estimate the effect of global supply chain disruptions on inflation for a panel of 28 European countries. Adverse shocks have a stronger and more persistent effect than favorable shocks.

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# 1 Introduction

Disruptions to global supply chains, e.g. due to natural disasters and lockdowns, are considered a major driver of the drastic increase in inflation in Europe and other advanced economies after the COVID-19 pandemic. The evidence (Carrière-Swallow et al., 2023; Burriel et al., 2023; Ascari et al., 2023; Laumer, 2023; Khalil and Weber, 2022; Finck and Tillmann, 2023; Finck et al., 2023; Liu and Nguyen, 2023; Elsayed et al., 2023; De Santis, 2023) suggests that supply chain shocks indeed have a significant effect on inflation.

More recently, supply bottlenecks eased and indices of supply chain conditions (Benigno et al., 2022) are back at pre-pandemic levels. However, inflation remains high. The Economist (2023) asks: "Supply chains are back to normal. Why is inflation still so high?" This note provides one potential answer to this question. We estimate local projections for a panel of 28 European economies between 2010 and 2023 in order to quantify the effect of a supply chain disruption on headline inflation, core inflation and producer price inflation. The supply chain shock we use is the purified change in the Global Supply Chain Pressure Index (Benigno et al., 2022). Importantly, we allow positive, i.e. restrictive, and negative, i.e. expansionary, shocks to have different absolute effect sizes.

Our results show that supply chain disruptions have a strong and significant effect on all three inflation rates. Producer price inflation responds twice as much as headline or core inflation. Our key finding is that positive shocks have a much stronger and more persistent effect than negative shocks. Hence, inflation is more sensitive to a tightening of supply chain bottlenecks compared to a relaxation. Ignoring this asymmetry risks misjudging the consequences of supply chain pressure. The results suggest that the easing of supply chain conditions in late 2022 and 2023 contributes much less to the decline of inflation than the tightening of conditions in 2021 and early 2022 contributed to its increase.

## 2 The empirical model

We estimate panel local projections following (Jordà, 2005), where $\pi_{t,i}$ is the inflation rate in country $i$ and month $t$. The dependent variable dated $t+h$ is regressed on a constant, a country fixed effect and the global supply chain shock, $\varepsilon_t^{GSCPI}$,

$$\pi_{t+h,i} = \alpha_h + \delta_i + \beta_h^{pos}\varepsilon_t^{GSCPI+} + \beta_h^{neg}\varepsilon_t^{GSCPI-} + \gamma X_{t,i} + u_{t+h,i}. \quad (1)$$

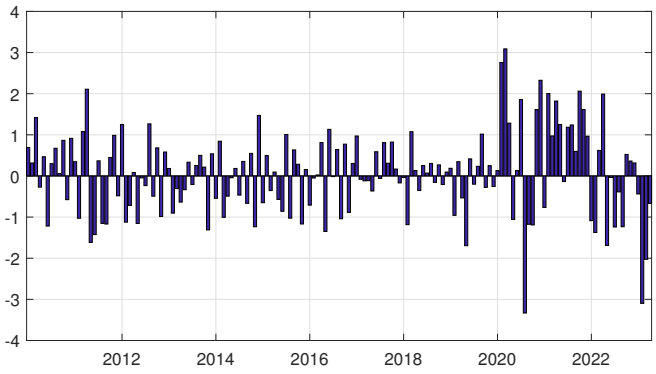
Importantly, we differentiate between positive, i.e. contractionary, shocks and negative, i.e. expansionary, shocks with $\varepsilon_t^{GSCPI-} = \min[\varepsilon_t^{GSCPI}, 0]$ and $\varepsilon_t^{GSCPI+} = \max[0, \varepsilon_t^{GSCPI}]$. The coefficients $\beta_h^{pos}$ and $\beta_h^{neg}$ reflect the impact on inflation in $t+h$ of a positive and negative supply chain shock in period $t$, respectively. The response of inflation is perfectly symmetric if $\beta_h^{pos} = \beta_h^{neg}$. Below, we plot the two estimated $\beta_h$ coefficients as a function of the horizon $h$ together with confidence bands derived from Driscoll and Kraay (1998) standard errors.

As a measure of supply chain shocks, we use the monthly growth rate of the Global Supply Chain Pressure Index (GSCPI) provided by Benigno et al. (2022). This index summarizes conditions in international container shipping such as container freight rates and shipping times. Benigno et al. (2022) estimate a factor model in order to purge the index from any demand-side effects such that the resulting index captures the supply-side only. It should be stressed that the resulting index reflects purely supply shocks only to the extent this factor model effectively removes demand-side effects.

Since the resulting index is relatively persistent and, hence, forecastable, we purify it further by regressing the growth rate on three lags of itself as well the measure of global economic conditions taken from Baumeister et al. (2022). The final shock series is the residual of this regression and is depicted in Figure (1). We can clearly spot the adverse shocks associated with the Tōhoku Earthquake in 03/2011 and the draconian lockdown policies by authorities in Shanghai in early 2022, which led to severe delays at the post of Shanghai.

We use three alternative inflation rates: the year-on-year changes of (1) the consumer price index, (2) the consumer price index excluding food and energy prices (core inflation) and (3) the index of producer prices. All inflation data is taken from Eurostat.

Figure 1: Global supply chain shock




*Notes:* The series shows the global supply chain shock used in the estimation. It is the residual from a regression of the Global Supply Chain Pressure Index (in percentage growth rates) on three lags of itself and global economic conditions.

The vector $X_{t,i}$ collects four lags of the dependent variable and the shock, the contemporaneous oil price and four lags of it as well as the contemporaneous growth rate of industrial production in country $i$ as well as four lags of it. It also includes four lags of the central bank's policy rate in order to account for the response of monetary policy. We estimate the model for the sample period 01/2010 to 04/2023 for 28 European countries.[1]

# 3 Results

The results are shown in Figure (2). We plot the estimated $\beta_h$ coefficients as a function of the horizon $h$ together 68% and 90% confidence bands. We find

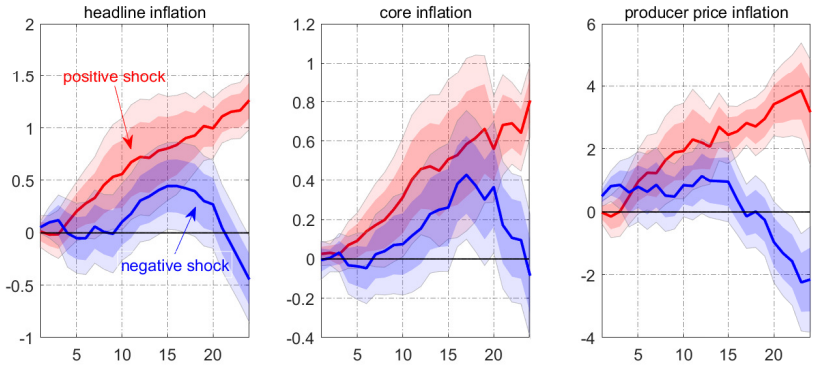
[1]The sample countries are Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain and Sweden.

that disruptions of global supply chains have strong and significant effects on inflation in Europe. After twelve months, inflation is about 0.5 percentage points higher. Interestingly, this effect is similar in size for both headline and core inflation. Producer price inflation responds more than twice as much to the shock.[2] Our key finding is that adverse and favorable supply chain disruptions have asymmetric effects: for the first twelve months, the two estimated $\beta_h$ coefficients are positive and indistinguishable from each other. Hence, inflation increases after a positive shock and falls after a negative shock. Our central finding is that the effect of supply chain disruptions is highly asymmetric a year after the shock occurred. The estimated effects of a restrictive shock remains high even after twelve months, while the effect of an expansionary shock quickly returns to zero and even become negative as $h$ increase. Two years after a positive shock, inflation remains high. Two years after a negative shock, in contrast, headline and core inflation is back at their means. The asymmetry is most pronounced for producer price inflation. This is intuitive as the shortage of intermediate goods due to supply chain bottlenecks should impact producer prices more than consumer prices.

These findings do not stem from the extraordinary increase of inflation after the COVID-19 pandemic. Figure (3) shows the coefficients from a model estimated over the sample period 01/2010 to 12/2019, i.e. excluding the pandemic. We still see that positive shocks have a stronger impact than negative shocks. Not surprisingly, the overall magnitudes of the coefficients are smaller once we exclude the 2022/23 inflation episode.

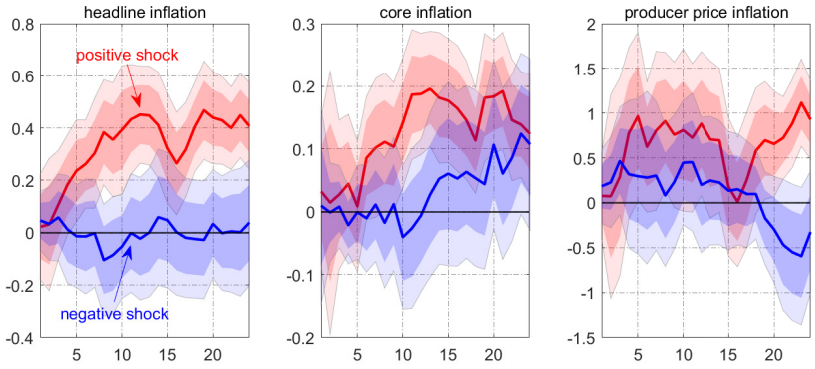
[2]The relative responses of headline and producer price inflation are consistent with Liu and Nguyen (2023). The fact that an increase in the price of intermediate goods raises PPI inflation, which in turn responds more strongly than CPI inflation is also consistent with general equilibrium models with input-output linkages, in which the effect of shocks is muted as it works its way through the supply chain (Huang and Liu, 2001).

Figure 2: Response of inflation to positive and negative supply chain shocks (2010 - 2023)




*Notes:* The graph shows the effect of positive and negative supply chain shocks on inflation (in percentage points) estimated on a panel of 28 European economies. The shaded areas represent 68% and 90% confidence bands, respectively. The GSCPI shock is the residual from a regression of the GSCPI on three lags and global economic conditions.

Figure 3: Response of inflation to positive and negative supply chain shocks (2010 - 2019)




*Notes:* The graph shows the effect of positive and negative supply chain shocks on inflation (in percentage points) estimated on a panel of 28 European economies. The shaded areas represent 68% and 90% confidence bands, respectively. The GSCPI shock is the residual from a regression of the GSCPI on three lags and global economic conditions.

In general, supply chain shocks can drive inflation through three main channels. First, bottlenecks in supply chains and disruptions could raise inflation expectations of households and firms. Second, a disruption of supply

chain increases the price of imported goods, that feed into the consumer price index. Third, the costs of intermediate inputs increase, which will ultimately also be reflected in higher consumer prices. Distinguishing these transmission channels is beyond the scope of this letter.

# 4 Conclusions

This note showed that the inflationary effects of disruptions to global supply chains are asymmetric. An increase in supply chain stress strongly contributes to the increase of inflation as seen after the COVID-19 pandemic. However, an easing of supply chain pressure contributes much less to the decline of inflation. Hence, our results provide one potential answer to the question asked by The Economist (2023).

Of course, asymmetric supply chain shocks are just one potential explanation of persistent inflation rates despite an easing of supply chain conditions. A tendency to de-globalize supply chains could raises costs even as shipping conditions normalize. Inflation could also remain elevated due to second-round effects of the initial spike in energy prices and costs of intermediate goods on wages. In addition, a shortage of labor post-Covid might also prevent inflation from returning to low levels. Finally, the sectoral shift of demand during the pandemic from services to goods is still visible in the data, which causes inflationary pressure in the presence of frictions.

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- Estimate the effect of global supply chain disruptions on inflation
- Panel of 28 European countries
- The effect is asymmetric: adverse shocks have a stronger and more persistent effect than favorable shocks