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Contributions of Global Drivers to Inflation in Slovenia

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This paper examines the contribution of global shocks to headline inflation in Slovenia. In recent years, several global shocks have hit the Slovenian economy, causing a substantial increase in headline inflation. These global shocks have reflected disturbances related to oil supply, supply-chain disruption, and excessive demand in the wake of the reopening of economies. Based on the sign, forecast error variance decomposition, and narrative-restricted structural VAR model, we can distinguish between the identified shocks and evaluate their historical contributions. The analysis shows that global shocks triggered an acceleration of headline inflation in the second half of 2021 and 2022, but the composition has, over time, progressively shifted towards domestic drivers. The global factors contributing to the inflation rate in Slovenia are expected to fade by the end of 2024.

Introduction

Ability to distinguish between global and domestic inflationary shocks plays a crucial role in appropriate policy considerations.

Supply chain disruptions associated with COVID-19 lockdowns positively contributed to inflation in 2020–21 (Benigno et al., 2022), but the contribution was hindered by the lockdowns that prevented stronger price pressures. Inflation in Slovenia started to pick up in late 2021 and has remained above the 2% target ever since. With growing global demand on the back of 2022 post-pandemic recovery and the unprecedented commodity price shock induced by the military conflict in Ukraine, inflation in Slovenia reached double digits. Given the common notion of the transitory nature of supply shocks, the appropriate policy response has importantly hinged on an ability to properly identify shocks and their persistence.

This paper aims to disentangle global shocks through the lens of the structural VAR model identified by the sign, forecast error variance decomposition and narrative restrictions in the spirit of Kabaca and Tuzcuoglu (2023). Specifically, the identified shocks pertain to global demand, oil supply, supply chain, and other global supply shocks.

The results of the analysis indicate that global shocks have a significant impact on headline inflation.

The analysis indicates that global shocks were responsible for a sizeable part of the headline inflation in Slovenia during the pandemic and post-pandemic period. While supply chain shocks have made a persistent positive contribution to inflation since the COVID-19 outbreak, inflation was further accelerated by the energy price shocks that occurred as a consequence of Russia's war in Ukraine and the release of pent-up demand after the phasing-out of Covid measures. Results suggest that the identified shocks will affect headline inflation in Slovenia throughout the medium-term projection horizon (from 2023 to 2025), mostly on the back of supply chain shocks and global demand shocks.

1 Data

The dataset consists of seven variables at a quarterly frequency spanning between 1998Q1 and 2023Q1. The endogenous dataset aims to capture global developments in energy markets and supply chains, and the general state of the global economy.

Global variables include the OECD real gross domestic product (Y_{OECD}), the OECD consumer price index (P_{OECD}) and the real crude oil price (ROIL), calculated as the Brent crude oil price deflated by the OECD consumer price index. Furthermore, global variables include the global supply pressures index (GSCPI), which can be used to gauge the importance of supply constraints concerning economic outcomes. To control for monetary policy decisions, the euro area short-term interest rate (STN) is adjusted by the shadow short-term interest rate provided by Wu and Xia (2020). Domestic variables include the real gross domestic product (Y_{SI}) and the harmonised consumer price index (P_{SI}). A detailed description of sources and transformations of variables is available in Table 1.

Table 1: **Data description**

Variable	Ticker	Transformation	Source
Real gross domestic product, OECD	Y_{OECD}	y-o-y growth rate (%)	OECD database
Consumer price index, OECD	P_{OECD}	y-o-y growth rate (%)	OECD database
Real crude oil price	ROIL	level	FRED database
Global Supply Chain Pressure Index	GSCPI	level	FRED database
Euro area 3-month interest rate (Shadow rate)	STN	level	ECB SDW, Wu and Xia (2020)
Real gross domestic product, Slovenia	Y_{SI}	y-o-y growth rate (%)	SORS
Harmonised consumer price index, Slovenia	P_{SI}	y-o-y growth rate (%)	SORS

The Applied Macroeconomics and Econometrics Center (AMEC) developed the Global Supply Chain Pressure Index to quantify the supply chain disruptions that have become a major challenge since the start of the COVID-19 pandemic. The intensity of global supply pressures is difficult to quantify as the more common metrics focus only on specific dimensions of global supply chains. The GSCPI bridges this challenge by integrating global transportation costs and components related to the supply chains from the Purchasing Managers' Index surveys to meaningfully represent the potential supply chain disruptions in seven interconnected economies: China, the eurozone, Japan, South Korea, Taiwan, the United Kingdom and the United States. (Benigno et al., 2022) Demand side factors are eliminated from the index by the orthogonalisation of supply factors with respect to demand factors (new orders and quantities purchased). The index is finally constructed as a principal component of 27 supply-side variables related to global transportation costs and other supply chain measures.

2 Econometric framework

The assessment of the impacts of global shocks on the Slovenian economy is based on the identified VAR model. This section introduces the reduced form model and the identification of structural shocks based on narrative sign restriction and restrictions on the forecast error variance decomposition.

The reduced form VAR model has the following form:

$$\boldsymbol{Y}_t = \boldsymbol{\alpha} + \sum_{i=1}^{p} \boldsymbol{A}_i \boldsymbol{Y}_{t-i} + \boldsymbol{u}_t,$$

where $\boldsymbol{Y}_t = (Y_{SI,t}, P_{SI,t}, Y_{OECD,t}, P_{OECD,t}, ROIL_t, GSCPI_t, STN_t)'$ is the 7x1 vector of endogenous variables, $\boldsymbol{A}_i$ are the 7x7 matrices of coefficients[1] for $i = 1,...,p$, $\boldsymbol{\alpha}$ is a vector of constants, while $\boldsymbol{u}_t$ is a vector of reduced form errors assumed to be $i.i.d.\ WN(0,\boldsymbol{\Sigma}_u)$, $\boldsymbol{\Sigma}_u = E(\boldsymbol{u}_t \boldsymbol{u}_t')$.[2]

The identification process pertains to the relation of reduced form innovations to structural shocks through the notion that $\boldsymbol{u}_t = \boldsymbol{B}\boldsymbol{\varepsilon}_t$, where $\boldsymbol{B}$ is commonly called the impact matrix. To identify Matrix $\boldsymbol{B}$, the sign restriction identification process by Arias et al. (2018) is followed; the methodological source of the forecast error variance decomposition restrictions is Weale and Wieladek (2016). Narrative restrictions are based on Anatolín-Díaz and Rubio-Ramírez (2018).[3]

In the identification process, the imposed restrictions follow Kabaca and Tuzcuoglu (2023), with some adjustments relevant to the small open economy of Slovenia. The sign restrictions imposed on Matrix $\boldsymbol{B}$ are summarised in Table 2.

Table 2: **Sign restrictions**

	Global Demand	Global Supply	Supply Chain	Oil Shock
Y_{OECD}	+	-	-	-
P_{OECD}	+	+	+	+
Y_{SI}	+	-	-	-
P_{SI}	+	+	+	+
ROIL		-		+
GSCPI		-	+	+
STN	+			

Note: Signs in this table show the restrictions imposed on Matrix $\boldsymbol{B}$. Empty spaces indicate that no restrictions are imposed on a particular coefficient. Restrictions are imposed only on the impact.

Global demand shock is distinguished from other shocks by the output and inflation responses in the same direction. Restriction follows the economic theory, where an increase in the aggregate demand causes a shift in equilibrium towards higher output growth and higher inflation. In contrast, negative supply shocks shift the aggregate supply curve to the left, causing inflation to rise and output growth to decline. In this paper, I distinguish between three types of supply shock: supply chain pressure shock, oil price shock and residual global supply shock.

[1] Coefficients that pertain to the transition of changes in Slovenian economy on the global economy were restricted to zero.

[2] I choose one lag based on the information criteria, test for residual autocorrelation and the length of the dataset.

[3] Note that the estimation approach of the VAR model is frequentist, which means that there are some differences to the Bayesian approach during the identification process.

Table 2 shows that sign restrictions alone do not allow one to distinguish between supply chain pressure shocks and oil shocks. The identification process therefore further relies on restrictions on the forecast error variance decomposition and historical decomposition.

Supply chain shocks are expected to explain the largest share of variation of the global supply chain pressure index among the identified structural shocks.

Identification based on the bounded restrictions on the forecast error variance decomposition reduces the number of admissible impulse responses to the supply chain shock. In this case, it is reasonable to assume that supply chain shocks explain the largest share of variation in the global supply chain pressure index among the shocks identified, or at least a larger share than the oil price shocks. However, the restriction only implies that the supply chain shocks commove with GSCPI relatively more than other shocks.

Historical events that generate a significant variation in GSCPI can help us to apply additional restrictions on the set of admissible supply chain shocks.

Further differentiation of supply chain shocks can be attained by using the narrative restriction approach (Anatolín-Díaz and Rubio-Ramírez, 2018), by imposing constraints on the time series of historical contributions of the structural shock. Such an identification approach is based on historical events on which the expected contribution of the supply chain shock is expected to be positive. In this sense, no restrictions are placed on other structural shocks in the system. Using narrative restrictions in isolation is therefore not sufficient for theoretical identification. However, combining it with other identifying restrictions provides a strong empirical identification (Kabaca and Tuzcuoglu, 2023).

Table 3: **Narrative restrictions**

Event	Quarter of restriction	Restriction on the supply chain shock
Wuhan lockdown	2020Q1	positive
Shanghai lockdown	2022Q2	positive

Note: Positive restriction means that the sign of the shock in the quarter has to be positive, and all other draws are discarded.

The number of imposed narrative restrictions is small compared to other studies, e.g. Kabaca and Tuzcuoglu (2023); however, the identification restrictions are sufficient with the inclusion of main events related to the COVID-19 pandemic.

Many studies have shown the severity of the pandemic lockdowns for international trade, e.g. (Liu et al., 2022; Bonadio et al., 2021). Narrative restrictions based on the pandemic lockdowns therefore serve as a well-founded empirical justification for such restrictions.

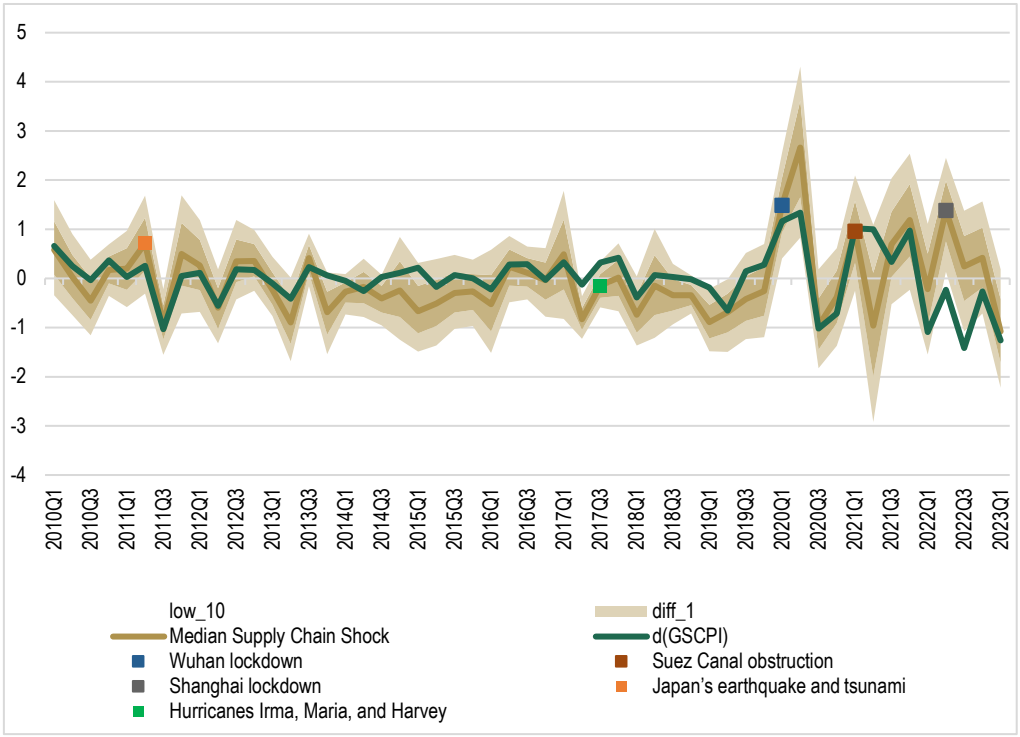
3 Results and discussion

This section presents the results of the structural VAR model. The identified supply chain shock series provides reasonable matching with historical global supply chain disruptions primarily related to the COVID-19 pandemic. The identified global shocks have played an important role in explaining the acceleration in headline inflation in Slovenia in the period between 2021 and 2022, and are expected to fully dissipate by the end of 2024.

The identified supply chain shock series shows the increases around the events of strengthened global supply chain pressures.

Events important for the identification process are shown in Figure 1. In line with other studies, I placed the narrative restrictions of positive contributions of supply chain shocks to the GSCPI during the Wuhan lockdown (2020Q1) and Shanghai lockdown (2022Q2). I did not restrict the contribution of the shock during the Christmas lockdown (2021Q1), where the estimated median shock was nevertheless positive. Furthermore, the estimated shock spikes in 2011Q2 in response to an earthquake and tsunami in Japan. However, it remained neutral during hurricanes Irma, Maria and Harvey, when the GSCPI index also did not exhibit a high increase. It is worth noting that the dynamics of supply chain shock align with the GSCPI due to the restrictions placed on the forecast error variance decomposition.

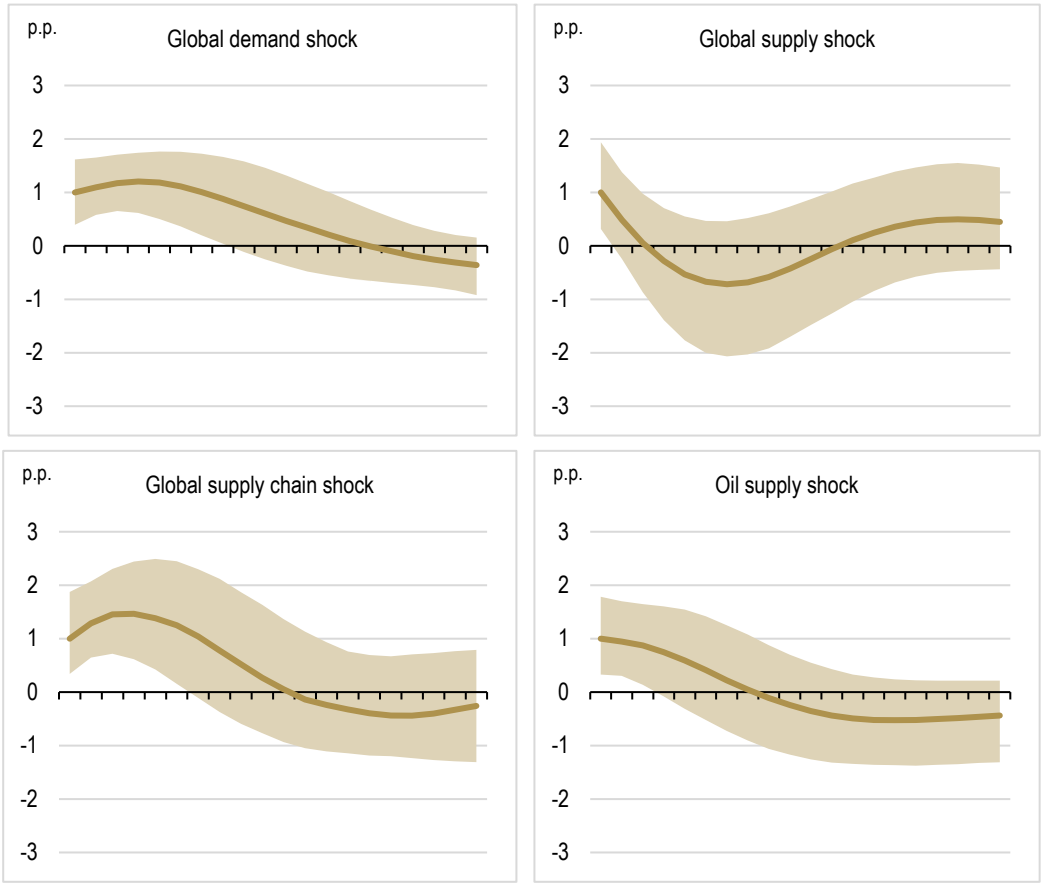
Figure 1: **Identified supply chain shocks and GSCPI**



Of all the identified set of structural shocks, global demand and supply chain pressure index shocks have the most persistent impact on headline inflation in Slovenia.

Figure 2 shows the headline HICP year-on-year inflation rate responses to the identified global shocks. The effects of global demand shocks stay statistically significant for two years after the shock. Similarly, global supply chain shocks have an extremely persistent impact on inflation, with a hump-shaped impact that lasts approximately seven quarters. On the other hand, the effects of the other global supply shocks and oil supply shocks are short-lived, remaining significant only for one and three quarters, respectively.

Figure 2: **Impulse responses of the HICP to the identified global shocks**



Source: Own calculation.
Note: The shaded area represents the 68% interval of sign restriction draws around the median response. The horizontal axis shows the quarters after the shock. Shocks are normalised so that the impact on inflation amounts to 1 p.p.

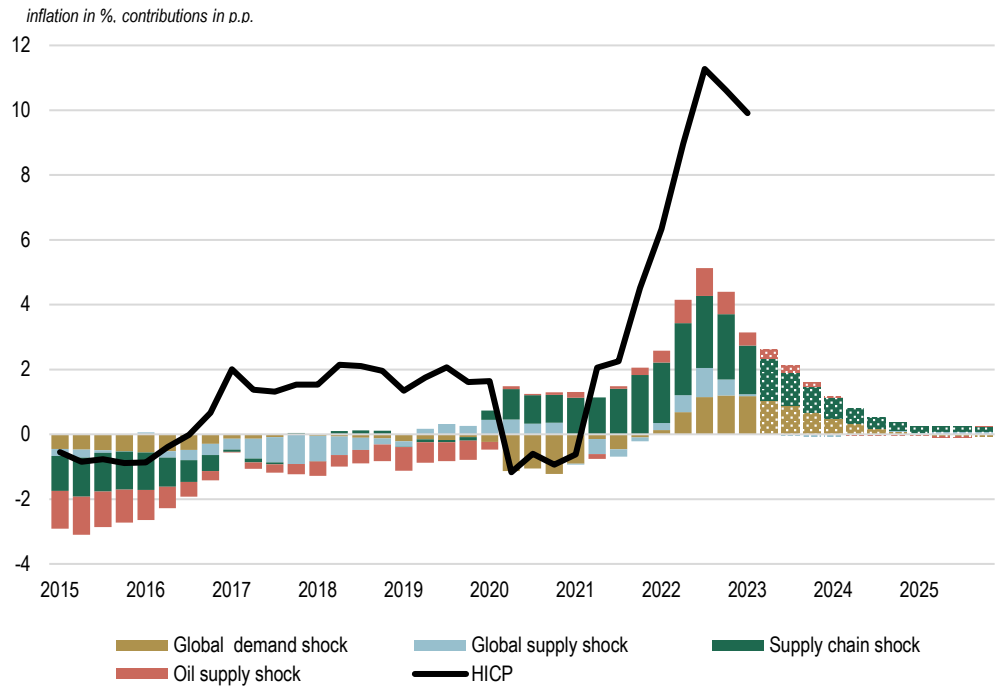
Global shocks contributed significantly to last year's inflation in Slovenia. In the absence of new shocks, global drivers of headline inflation in Slovenia are expected to dissipate by 2024.

The historical decomposition of the headline year-on-year Slovenian inflation rate is shown in Figure 3. Relatively low oil prices in 2015 and 2016, combined with low global supply chain pressures, were the main contributors to low inflation rates in this period.

The negative contribution of the global factors persisted between 2017 and 2020, primarily on the back of low oil prices and high global supply. After the COVID-19 outbreak in 2020, inflation remained low due to low global demand caused by government-imposed lockdown and social distancing measures. On the other hand, the widespread lockdowns worldwide caused disruptions to the global supply chains that are still affecting the global economy. These shocks were further amplified by disturbances related to excessive demand after the reopening of economies and the conflict between Russia and Ukraine that put pressure on energy markets.

Results indicate that the global shocks identified with the structural VAR model can explain approximately 40% of inflation in Slovenia in 2022. The major share can be attributed to global supply chain shocks and global demand shocks. The direct contribution of oil supply shocks to the headline inflation amounted to 0.7 p.p. over the course of 2022. Global supply shocks contributed approximately 0.5 p.p., presumably on the back of elevated electricity and gas prices. Part of the effect of elevated energy prices is hidden in the contribution of robust global demand, which allowed the energy prices to transition to consumer prices to a greater extent. With supply chain pressures easing in the first quarter of 2023, their elevated contributions to headline inflation stem from the lagged effects of past shocks.

Figure 3: **Decomposition of HICP inflation**



Source: SORS, own calculations.

The main part of the analysis pertains to the estimation of effects of accumulated structural shocks to the inflation rate. Assuming that there are no additional structural global shocks, I simulate the contributions of the identified past shocks to inflation dynamics over the medium term (2023–2025). The shaded time frame of Figure 3 pertains to the hypothetical development of headline inflation in Slovenia if it were affected only by past global shocks.

We can see that the contribution of the global shocks still amounts to 2.3 p.p. over 2023 and 0.4 p.p. in 2024, while it is negligible in 2025. In line with conventional wisdom, global supply side shocks fade away relatively faster, contributing only 1.4 p.p. and 0.1

p.p. to headline inflation in Slovenia in 2023 and 2024, respectively. While the contribution of global components is decreasing, the results suggest that the drivers of Slovenian inflation are increasingly related to developments in the domestic economy.

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