Bottlenecks and Corkscrews: Macroeconomic Implications of Maritime Supply Chain Disruptions

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Abstract

This paper investigates the macroeconomic impacts of exogenous maritime transportation shocks by analyzing vessel traffic flow through the Panama Canal, Suez Canal, and Strait of Malacca, focusing on China, the European Union, and the United States. Unlike previous studies relying on price-based indexes, this research incorporates vessel flow data to directly assess supply chain fragility and persistence, thereby eliminating endogenous factors related to container spot prices. Employing a Structural Vector Autoregression (SVAR) model with narrative sign restrictions, the main findings highlight the prolonged impacts on producer and consumer prices, underscoring the necessity for robust policy measures to mitigate vulnerabilities in global maritime networks.

Keywords: Supply Chain Shocks, Maritime Transport, Inflation, SVAR, Chokepoints.

JEL Codes: E31, F62, R41.

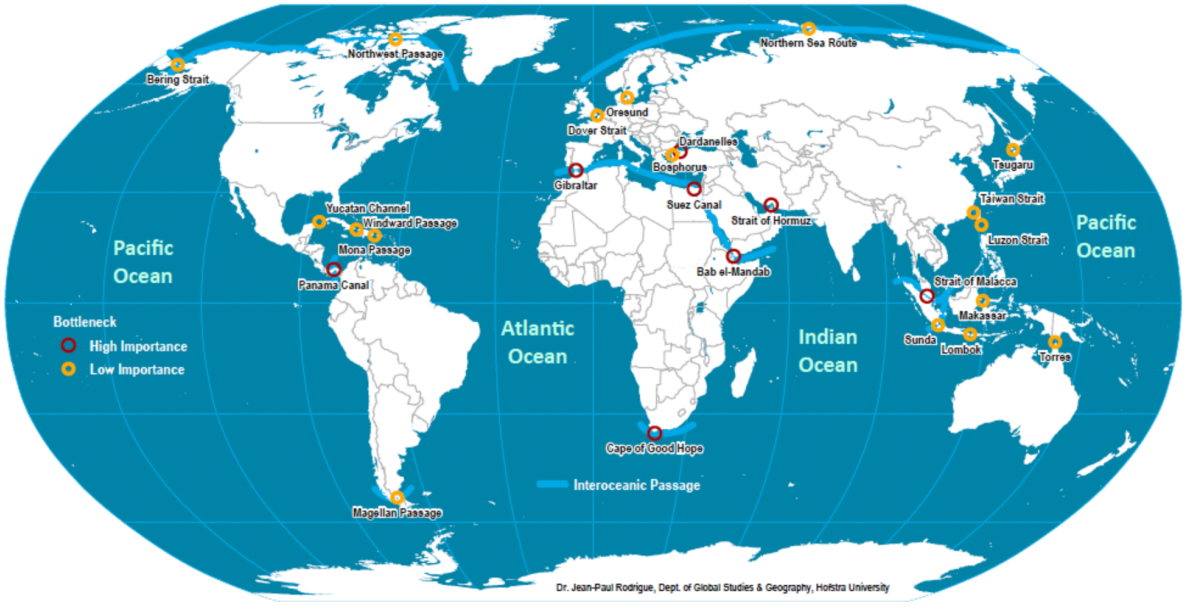
1 Introduction

Globalization has significantly transformed supply chains since the late 20th century, leading to increased delocalization of production to low-wage countries and greater fragmentation driven by raw material and labour costs. Current production processes heavily rely on primary commodities and semi-finished goods sourced from numerous suppliers across different countries. Consequently, transportation plays an increasingly critical role in supply chains, a phenomenon referred to as "upstreamness"(Antràs et al., 2012). Energy and

raw materials are the most critical upstream supply chain functions, followed by semiconductors and freight transportation (Rees & Rungcharoenkitkul, 2021). The increasing importance of transportation within value chains introduces additional price determinants for goods, commodities, and energy-related products and services. Moreover, the ripple effects of supply chain fragmentation and upstreamness extend beyond trade balances and carrier strategies, significantly influencing the real economy. Due to its cost efficiency, maritime transportation remains the primary method for hauling raw materials and semi-finished products. Consequently, seaports are crucial to global trade, handling over 80% of international commodity trade by volume (UNCTAD, 2019). Since the 1950s, containerization has revolutionized shipping and port management, reducing costs through shorter loading and unloading times and economies of scale. This innovation has not only transformed port development and infrastructure but has also reshaped the global trade of goods and commodities (Ducruet et al., 2024).

Shipping routes, although varied, typically see carriers favoring certain paths that include mandatory transit points: strategic locations that act as chokepoints, as illustrated in Figure 1. Chokepoints can be physical constraints, such as straits, canals, and political borders, that could be strongly affected by geopolitical tensions. A carrier's route choice depends on the supply and demand of goods, with the most frequently trafficked routes supporting the largest volumes of trade.

Figure 1: *The Geographical Space of Maritime Transportation – Chokepoints* (Notteboom et al., 2022)



This research aims to analyze the macroeconomic aggregates, particularly the inflationary effects, of maritime supply shocks by examining containership flows through major chokepoints.

Maritime corridors, including mandatory transit points such as straits and canals, can be strongly affected

by geopolitical tensions. One of the world's busiest maritime corridors is the circum-equatorial route, which interconnects North America, Europe, Africa, and Pacific Asia. This route includes critical chokepoints such as the Panama Canal, the Strait of Gibraltar, the Strait of Malacca, the Suez Canal, and the Bab el-Mandeb Strait.

When disruptions occur at major chokepoints, they can have long-lasting and widespread effects, including route rescheduling, rising insurance costs, and unexpected travel expenses such as increased fuel and labor costs. At the same time, the inelastic demand for commodities, goods, and services related to maritime transportation and ports exacerbates the economic impact of these shocks, making them particularly disruptive for industrial production.

2 Novelty and Related Literature

The macroeconomic implications of maritime supply shocks have garnered considerable attention in recent research. Many studies rely on price indexes as a proxy for analysis, but these indexes are highly endogenous, reflecting supply chain disruptions, oil and monetary shocks, and demand fluctuations. Moreover, container shipping companies generally maintain fixed routes for at least one year, as stipulated by contracts negotiated with major counterparties 6-12 months in advance. These agreements account for approximately 85% of vessel capacity, ensuring break-even costs. The remaining capacity is sold at spot rates in the weeks leading up to departure, meaning that price indexes primarily reflect a marginal share of the total transported volume. Given this endogeneity and the limited representativeness of price indexes, we adopt an alternative identification strategy. Instead of relying on prices, we use the number of containerships passing through three crucial choke points along the circum-equatorial route – namely, the Panama Canal, the Suez Canal, and the Strait of Malacca. This approach is based on the observation that, at least in the short term, ship routes might be considered relatively fixed. Using physical data, such as the number of ships, provides a more direct and less distorted signal of supply shocks than prices.

A similar research question has been explored by Finck and Tillmann (2023). They developed an identification scheme to isolate exogenous shocks in global supply chains and employed a Narrative Sign Restriction Structural Vector Autoregressive (SVAR) model to estimate their effects on real economic activity and inflation in the euro area, basing their analysis on the HARPEX index. Similarly, Carrière-Swallow et al. (2023) examined the macroeconomic impact of global shipping costs by analyzing spikes in the Baltic Dry Index (BDI) across a broad set of countries from 1992 to 2021, using the local projection method.

Central banks and international institutions have also contributed to this literature. The trailblazer contribution is Benigno et al. (2022), which introduced the Global Supply Chain Pressure Index (GSCPI) to

capture pressures arising at the global supply chain level. This index incorporates maritime and air transport indicators, manufacturing and production indexes, and is primarily based on spot prices across various transportation modes. However, this approach lacks the specificity needed to isolate maritime supply shocks. Arvis et al. (2024) extend Benigno et al. (2022) by incorporating port-level data and additional maritime indicators, but their analysis focuses primarily on vessels below the Panamax class, thereby excluding a substantial segment of the global container shipping market. Our approach, which employs flow variables, ensures that all container ships – regardless of size – are included in the analysis.

Further contributions from the IMF include Celasun et al. (2022) and Kemp et al. (2023), which explore the impact of maritime supply chain bottlenecks on manufacturing production using input-output tables and the local projection method. While these studies provide valuable insights, our analysis relies on maritime traffic flows as an objective measure, rather than non-transportation price indexes, which are subject to endogeneity concerns and suffer from a broader focus. Several studies, such as Elsayed et al. (2023) and De Santis (2024), examine supply chain shocks in conjunction with disruptions to input production and energy supply, primarily focusing on inflation. However, since our research aims to isolate the impact of maritime supply shocks mainly on inflation, merging different types of shocks would not be appropriate for our analysis. Another relevant contribution is Burriel et al. (2023), who propose the Supply Bottlenecks Index (SBI), constructed similarly as Benigno et al. (2022). This index captures supply disruptions related to geopolitical tensions, climate change, and labour strikes based on narrative analysis. As the SBI rises, industrial production and employment decline, while prices increase, creating significant trade-offs for monetary policy. By using flow data through chokepoints, our approach will offer a more direct and comprehensive measure of maritime supply shocks.

Bai et al. (2024) employ a methodology similar to ours, investigating the causal effects and policy implications of global supply chain disruptions by analyzing congestion at major ports worldwide. However, their analysis focuses primarily on the 50 largest container ports, with a strong emphasis on Asian ports (35 out of 50), while only 7 are located in the European Union and 4 in the United States [1]. Consequently, their study centres on port-level bottlenecks rather than the broader phenomenon of maritime supply shocks along global trade routes.

On the other hand, recent theoretical literature has extensively studied the propagation of supply chain shocks. Comin et al. (2023) analyze how these shocks influence inflation, while Acemoglu and Tahbaz-Salehi (2024) model supply chain disruptions, emphasizing firm-level networks, bargaining, and relationship adjustments that create inefficiencies and fragility, where small shocks lead to disproportionate output drops. Finally, Brancaccio et al. (2025) examine rigidities in maritime transportation, where inelastic supply meets

[1] See https://www.worldshipping.org/top-50-ports (accessed January 28, 2025) for the full list of ports.

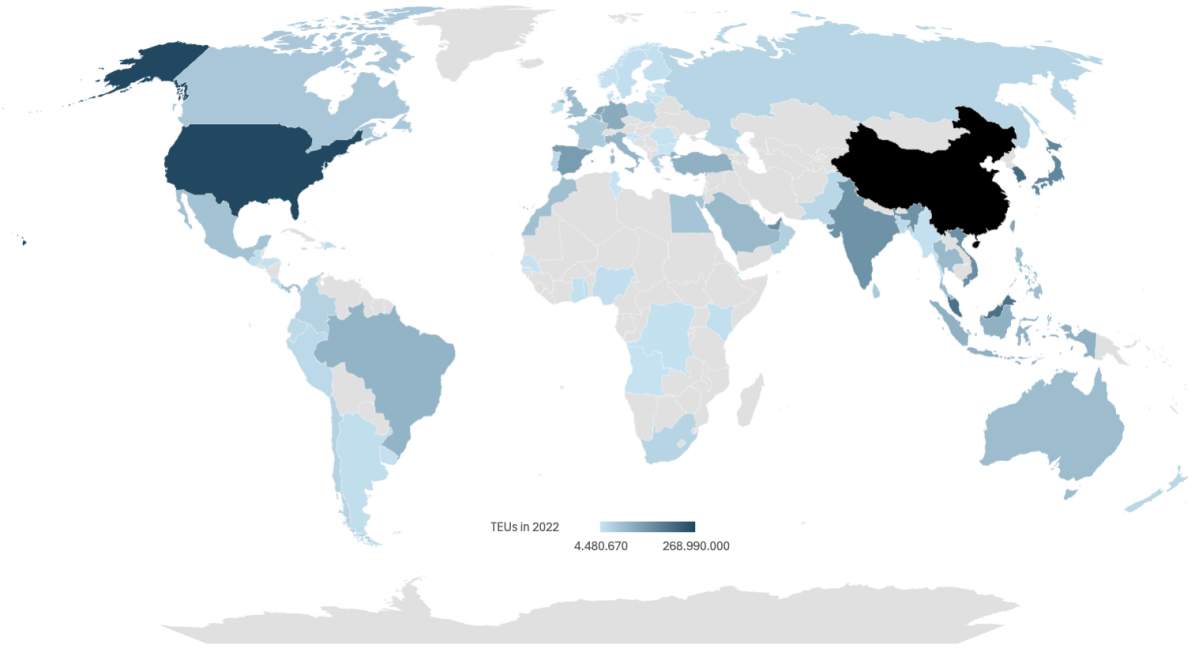
volatile demand, driving price spikes, port congestion, and broader macroeconomic effects on trade and inflation.

While prior research has made significant strides in understanding maritime supply chain disruptions, our approach offers a novel contribution by leveraging maritime traffic flows through key chokepoints to identify exogenous supply shocks. This approach allows for a more precise estimation of the macroeconomic effects of maritime supply shocks, avoiding the endogeneity concerns inherent in price-based indexes.

3 Data and Methodology

In order to refine our research question, we investigate the most significant maritime supply shocks (MSS) and assess their macroeconomic implications. Our empirical strategy is grounded in a Structural Vector Autoregression (SVAR) model, employing narrative sign restriction identification with Bayesian inference as per Antolín-Díaz and Rubio-Ramírez (2018). We estimate a monthly SVAR with three lags over the sample period 2019M1-2024M12, using a standard Minnesota prior, with tightness parameters chosen following Giannone et al. (2015). Specifically, we partially incorporate sign restrictions developed by Bai et al. (2024) to replicate their assumptions and ensure consistency in identifying flow shocks.

Figure 2: *Container port throughput – elaboration from UNCTAD (2023)*



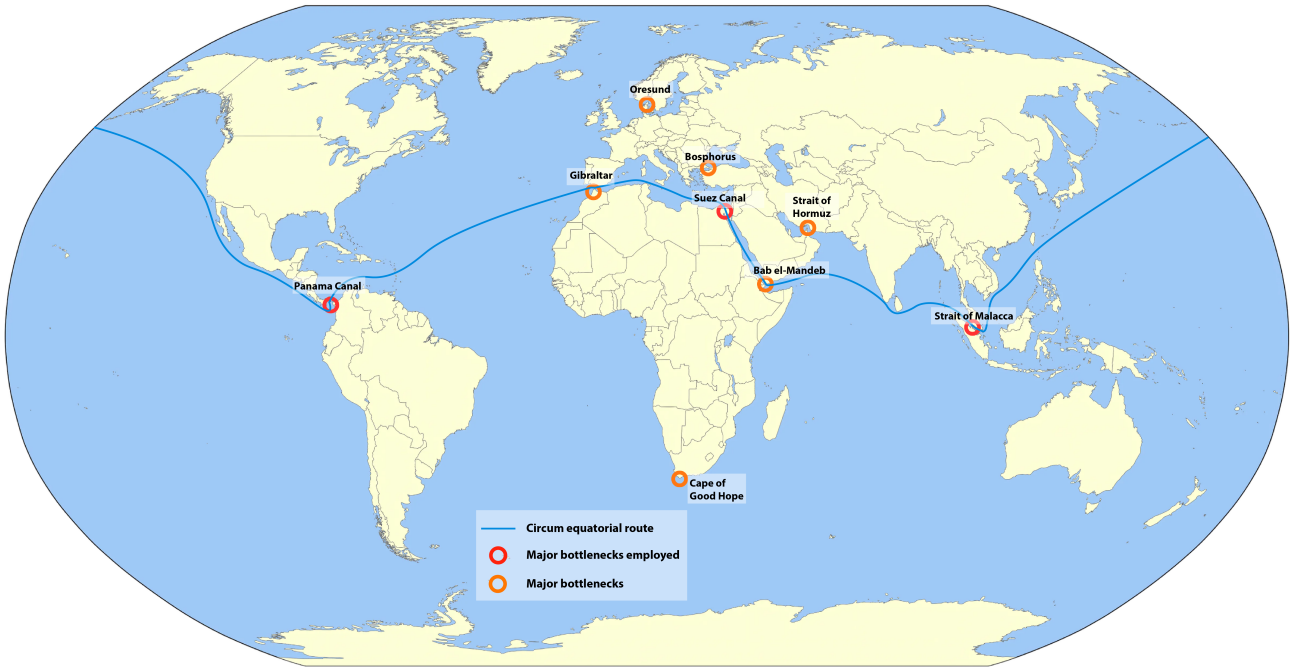
Our analysis concentrates on China, the European Union (27 member states), and the United States, which account for 31.6%, 11.8%, and 7.3% of annual global container port throughput, respectively, as illustrated in

Figure 2. This selection is motivated not only by their prominent role in global trade but also by their central position in generating spillover effects, owing to their economic significance and strategic locations along key maritime chokepoints. To isolate the impact of maritime supply shocks, we aim to exclude energy-related variables from the analysis wherever feasible, as fluctuations in energy prices can disproportionately influence macroeconomic aggregates.

3.1 Data analysis

Our main variable of interest is the vessel Flows, measured as the aggregate monthly count of cargo ships – primarily containerships – transiting the three chokepoints under consideration between January 2019 and December 2024. The sample period is constrained by data availability. This variable is sourced from the UN Global Platform via the IMF PortWatch database, which tracks transit trade volume based on the number of ships crossing through the relevant maritime corridors. Our first contribution lies in the analysis of cargo ship flows through these three key chokepoints, selected for their central role in the circum-equatorial shipping route, as illustrated in Figure 3. We exclude from the analysis Bab el-Mandeb, as its traffic largely overlaps with that of the Suez Canal, and we similarly omit the Strait of Gibraltar, which is less affected by political and natural crises than the other chokepoints considered.

Figure 3: *Circum-equatorial route and major world maritime chokepoints*



First, we incorporate the monthly World Industrial Production (IP) index, as provided by Baumeister and Hamilton (2019). In our analysis, we expect a maritime supply shock to directly reduce world industrial production while initially exerting positive effects on other macroeconomic aggregates analysed, with the exception of oil prices. In order to disentangle oil supply shocks, we include the monthly average crude oil price – West Texas Intermediate (WTI) – as a control variable, ensuring proper identification of the maritime supply shock affecting the economy.

To further investigate country-specific effects, we estimate three separate SVARs, incorporating the Producer Price Index (PPI), Consumer Price Index (CPI), and Unemployment Rate (UNRATE) for each economy considered. We source data from the National Bureau of Statistics of China, Eurostat, and the Federal Reserve Economic Data for China, the European Union, and the United States, respectively. While we anticipate broadly similar trends, we expect variations in the intensity of responses across countries and variables.

In order to capture the initial price effects of contracting industrial production, we include industrial production or intermediate goods PPIs, allowing us to explore the transmission of shocks to the manufacturing industry. To account for more comprehensive inflationary pressures, we employ core CPI wherever available or only excluding energy prices; for China, where core CPI data is unavailable for our sample, we instead use total CPI. Similar to PPI, we expect a slower but, at the same time, intense increase in inflation following a maritime supply shock because of pass-through costs. Finally, we analyse the unemployment rate, expecting that an initial contraction in industrial production will coincide with rising unemployment, thereby allowing us to assess the labour market implications of maritime disruptions.

3.2 Empirical Approach

Our approach relies on Kilian (2009), who analyzed the effects of oil supply and demand shocks on macroeconomic aggregates, not only to explain fluctuations in commodity prices but also to assess the broader response of the U.S. economy to these shocks. We extend this framework to maritime supply shocks, examining their macroeconomic implications in the world's major economies in terms of international container trade. The identification strategy follows the Narrative Sign Restrictions approach by Antolín-Díaz and Rubio-Ramírez (2018), employing a SVAR estimation framework with three lags and a standard Minnesota prior, calibrated following Giannone et al. (2015).

Narrative Sign Restrictions have been widely adopted in the study of maritime transportation shocks (e.g., Finck and Tillmann, 2023; Elsayed et al., 2023; De Santis, 2024) as they strengthen shock identification by incorporating narrative sign constraints derived from a limited number of historically significant events. By drawing on narrative analysis of key disruptions and the macroeconomic conditions surrounding them, we

argue that maritime supply shocks exert significant effects on macroeconomic aggregates.

However, as noted by Antolín-Díaz and Rubio-Ramírez (2018), this approach presents challenges. The limited number of sign restrictions often results in a broad set of structural parameters with widely varying implications for forecast error variance decompositions, historical decompositions, impulse response functions (IRFs), and elasticities. Even under favourable conditions, this variability complicates the extraction of clear economic insights.

To address these challenges, we replicate the sign restriction approach developed by Bai et al. (2024) to evaluate its applicability to maritime chokepoints and not only to port congestion outbreaks. We enhance the model by introducing a narrative component, improving our ability to isolate the effects of maritime disruptions and refine the interpretation of their economic consequences. In addition to their baseline model, we include the unemployment rate to examine the labour market responses to maritime supply shocks, providing further insights into their broader macroeconomic impact.

Table 1: *Sign Restrictions on Impact Responses*

Adverse shock to:	**Flows**	**IP**	**PPI**	**CPI**	**WTI**	**UNRATE**
Maritime Supply	-	-	+	Undetermined	0	Undetermined
Maritime Demand	-	-	-	Undetermined	Undetermined	Undetermined

An adverse shock to the maritime supply chain reduces industrial production, as increased costs and delays disrupt manufacturing processes. The resulting contraction in industrial output is expected to raise production costs for goods and commodities. Simultaneously, lower production activity may lead to higher unemployment, reflecting the decline in labour demand. Following these initial effects, consumer prices are expected to rise, though the timing of this adjustment may vary. These dynamics are consistent with theoretical predictions, as disruptions to key transportation routes – such as the chokepoints under study – create supply bottlenecks, delay shipments, and heighten uncertainty in global markets. The economic impact of these disruptions is extended among all industries directly dependent on maritime trade, propagating through upstream supply chains and affecting broader economic activity.

To distinguish between demand- and supply-driven shocks, we impose a positive sign restriction on the Producer Price Index (PPI). In the case of a demand shock, PPI would be expected to decline, in contrast to the price increases typically associated with a supply shock. While this restriction may introduce some trade-offs in the scope of our analysis, it is essential for a more precise differentiation between shock types. In addition, to isolate maritime supply shocks from oil supply shocks, we impose a zero restriction on WTI, ensuring that oil-related fluctuations do not influence our results, at least in the first horizons considered.

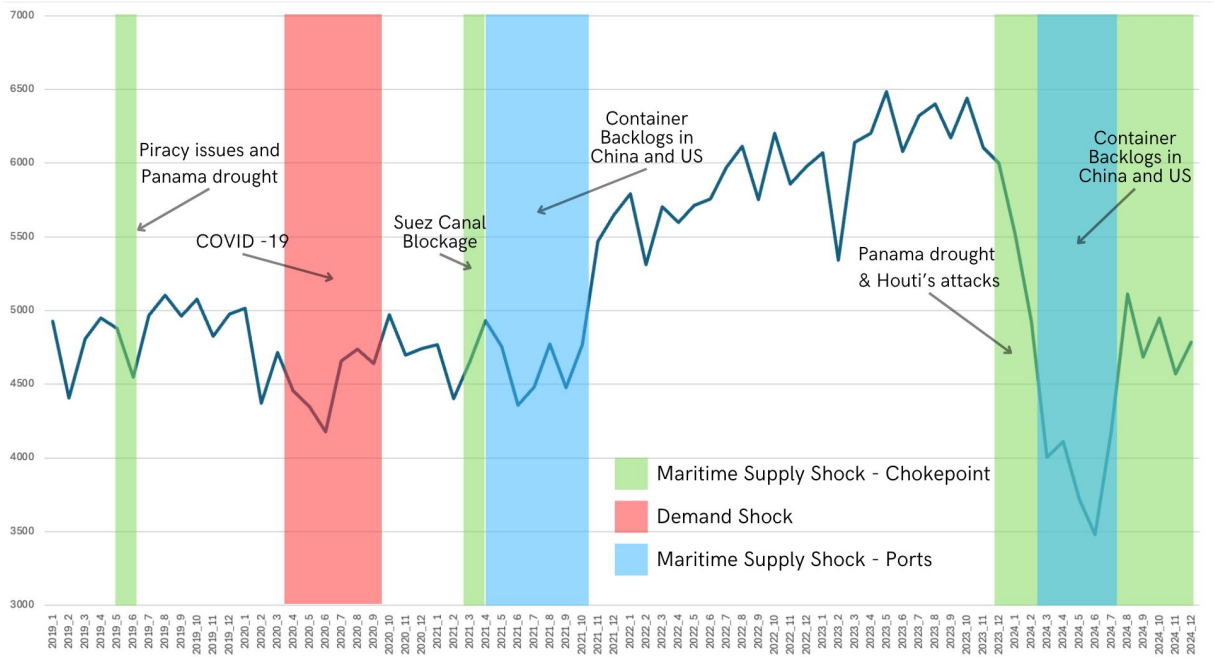
When examining the effects on the Consumer Price Index (CPI) and unemployment, we intentionally leave

these variables unrestricted. This agnostic approach follows the framework of Antolín-Díaz and Rubio-Ramírez (2018), allowing the data to determine the direction and magnitude of the response without imposing prior assumptions. By maintaining minimal constraints on these key macroeconomic variables, we aim to uncover the real effects of maritime supply shocks while preserving flexibility in our empirical identification.

3.3 Narrative review

To our knowledge, we identify the following major episodes, illustrated in Figure 4, where at least one of the chokepoints under analysis experienced a significant negative shock. These episodes are selected based on narrative evidence and provide key instances for our empirical identification. We distinguish between shocks occurring at maritime chokepoints and those affecting ports directly, disrupting vessel flows.

Figure 4: *Flows – Monthly Transited Vessels*



- **2019M6**: Safety issues and climate disruptions. In mid-2019, maritime security deteriorated across several chokepoints. Iran launched multiple attacks on vessels and seized ships transiting the Suez Canal, Bab el-Mandeb, and the Strait of Hormuz, culminating in missile strikes on tankers in June. Meanwhile, increased piracy incidents near the Malacca Strait prompted heightened security measures, further disrupting vessel routes. Concurrently, climate-related disruptions affected the Panama Canal, as a 50% decline in rainfall between February and April depleted water levels in Gatun Lake. By May, strict draft restrictions were imposed, preventing larger vessels (e.g., Neo-Panamax) from transiting

and leading to substantial delays and uncertainty, as waiting times fluctuated with water levels.

- **2020M3-2020M9**: COVID-19 pandemic. The COVID-19 pandemic significantly disrupted maritime transportation due to lockdown measures worldwide. While the pandemic became endemic in early 2020, the sharpest decline in maritime activity emerged in April as supply chain disruptions reverberated through global trade. Unlike other shocks, for our purpose, this episode represents a demand-driven contraction: maritime traffic fell alongside a decline in the first periods in price rates, rather than the price surges typically associated with supply shocks.

- **2021M3**: Suez Canal blockage. The containership *Ever Given* blocked the chokepoint for six days, from March 23 to March 29, after becoming wedged across the Suez Canal in Egypt banks, halting all traffic until the vessel was freed.

- **2021M5-2021M10**: Container backlogs in China and the U.S.. A renewed COVID-19 outbreak in southern China and other parts of Southeast Asia disrupted port operations and container flows, significantly affecting Malacca Strait traffic. Unlike the initial pandemic-induced shock, this disruption was not demand-driven but instead resulted from labour shortages at key ports. These delays, in turn, contributed to growing port congestion on the U.S. West Coast, exacerbating supply chain bottlenecks in the Panama Canal by September.

- **2023M11-2024M11**: Climate, security, and backlog disruptions. Beginning in mid-2023, Panama experienced its most severe drought in five decades, causing even greater transit restrictions and rerouting than in 2019. Unlike previous episodes, vessel traffic was constrained not only during the driest periods but also through a daily transit cap, leading to more than 30% of vessels diverting to the Strait of Magellan. Simultaneously, geopolitical risks escalated in the Red Sea. In November 2023, Houthi militants in Yemen began drone and missile attacks on commercial vessels, initially targeting specific container ships and tankers before expanding to all commercial transit through Bab el-Mandeb. From December 2023 to June 2024, over 150 commercial vessels – including container ships, tankers, and warships – were attacked, significantly disrupting Suez Canal traffic. Meanwhile, China and several Southeast Asian countries faced severe port congestion beginning in March 2024, driven by a combination of seasonal trade fluctuations, Red Sea disruptions, container shortages, and extreme weather conditions. At its peak, waiting times for loading and unloading exceeded one month. In October 2024, U.S. port strikes compounded the congestion, worsening bottlenecks at West Coast ports and amplifying the global supply chain crisis.

The list above is not exhaustive, as many additional shocks affected these chokepoints without significantly

impacting aggregate monthly flows. Several smaller disruptions, including episodes of collisions between tanker and cargo ships, geopolitical instability and recurrent piracy, created localized delays but did not substantially alter global maritime traffic.

To summarize, we divide the shocks into three different categories, as shown in Table 2.

Table 2: *Narrative review of the shocks*

Type of Shock	Period	Occurrence
MSS – Chokepoints	2019M6 & 2021M3	Short shocks in chokepoints
Demand Shock	2020M4-2020M6	COVID-19 pandemic
MSS – Ports	2021M4-2021M6	Persistent container backlogs
MSS – Chokepoints	2023M11-2024M2	Persistent shock in chokepoints
MSS – Chokepoints & Ports	2024M5-2024M7	Persistent shocks both in chokepoints and ports

4 Results

We begin by replicating the sign restrictions (SR) by Bai et al. (2024) to characterize the dynamics of the variables under the imposed constraints, allowing us to obtain the results for the three entities considered. Specifically, we impose negative restrictions on Flows and Industrial Production while setting a positive restriction on PPI and a zero restriction on WTI to further investigate Maritime Supply Shocks (MSS). All the restrictions were imposed only for one period. In order to identify our baseline model, we employ a narrative sign restrictions (NSR) approach on the first months of the major bottlenecks: 2021M3 and 2023M11. A detailed analysis of the Maritime Demand Shock NSRs is provided in Appendix C.

4.1 Baseline results

Starting from the SR results, the impulse response functions (IRFs) across China (Figure 5), the European Union (Figure 6), and the United States (Figure 7) highlight distinct regional economic reactions to maritime supply shocks. While all three economies exhibit an initial decline in maritime flows followed by a smaller recovery, the transmission of this shock to industrial production, price indices, and unemployment varies across them.

The U.S. and EU-27 exhibit similar patterns in industrial production (IP), both experiencing a significant decline in response to the maritime shock. The recovery is gradual, with no major divergence between the two territories, suggesting that their industrial sectors react similarly to maritime supply shocks. The NSR presents a faster industrial production recovery from the shocks, becoming positive in a quarter. In the EU-27, the recovery is even stronger than in the SR, instead of the United States. However, China's industrial production follows a different trajectory, displaying a persistent negative response without a subsequent

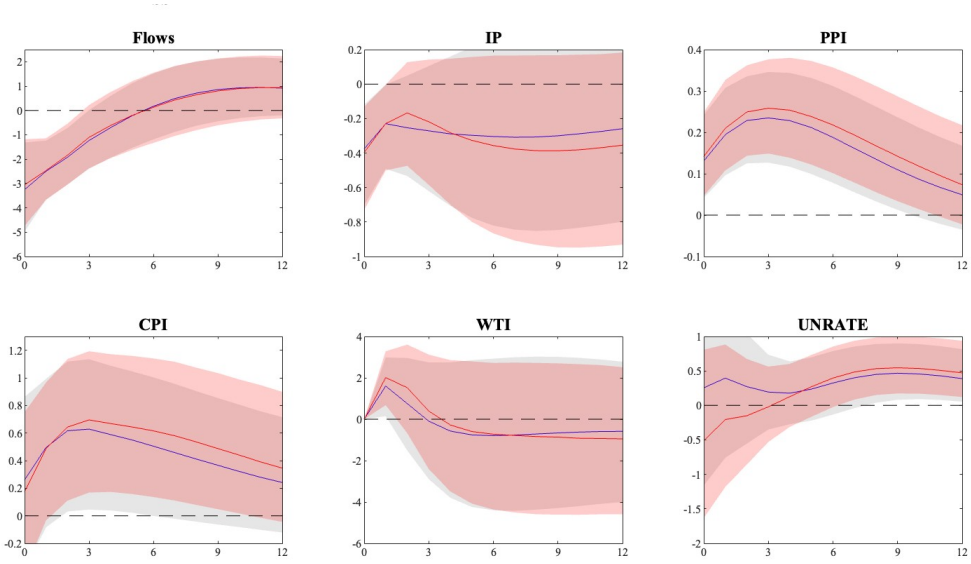


Figure 5: *China IRFs – 12 months – 68% CI – 3 lags – Blue: Sign Restriction & Red: NSR*

recovery – even if it is not significant after the first months analysed. This prolonged downturn suggests that China's industrial sector is more vulnerable to maritime disruptions, likely due to its export-driven manufacturing structure and the role of global supply chains in sustaining production. This pattern highlights the strong initial impact of disruptions to maritime shipping, mainly in the U.S. and EU-27. The observed resilience of the supply chain likely explains this trajectory, ports and the demand for goods and commodities exhibit significant inelasticity, and, at the same time, it is typical for productive activities adopting inventory buffers. This is one of the critical features of the analysis: when a vessel cannot cross a chokepoint, it typically reroutes via longer and more expensive paths. For instance, if the Suez Canal is blocked, vessels reroute via the Cape of Good Hope, and a similar dynamic occurs for the Panama Canal and Cape Horn. This is not possible in the case of Malacca Strait and so for China, because of the lack of alternative passages.

Inflationary responses to maritime shocks are positive across all three regions. Both the PPI and the CPI rose following the shock, reflecting increased transportation costs, supply chain frictions, and higher input prices. Among them, China experiences a positive PPI and the strongest CPI responses on impact, suggesting that maritime disruptions have a pronounced effect on prices, they come back to the initial level at the end of the period considered. The U.S. and EU-27 also experience PPI and CPI increase, their responses are comparatively moderate on impact – negative for the U.S. – even if the EU-27 shows the greatest growth on impact in PPI: they present persistency in the medium run. Meanwhile, inflation rises in all three economies, reflecting the widespread cost pressures on producers. These findings highlight how inflationary pass-through varies across economic structures. The NRS results indicate that the EU-27 area experienced a significant impact

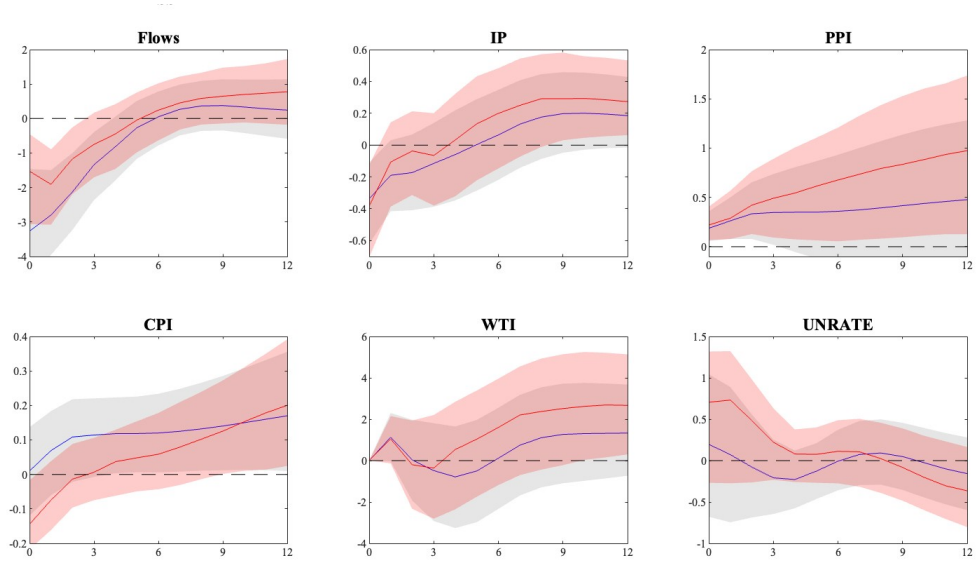


Figure 6: *EU-27 IRFs – 12 months – 68% CI – 3 lags – Blue: Sign Restriction & Red: NSR*

within the 12 months, with a PPI increase exceeding 1%, despite a recovery in the Industrial Production (IP) index. This evidence supports the hypothesis that price increases are due to longer shipping routes and, consequently, higher transportation costs.

Oil prices (WTI) initially spike in all regions, never reaching the significance level – excluding the U.S. in the first quarter, reflecting supply chain disruptions and increased uncertainty. The response of the labour market to maritime shocks varies significantly across regions. In the U.S., the unemployment rate surges immediately upon impact. This suggests that sectors heavily reliant on global trade, such as manufacturing and logistics, experience rapid job losses when shipping flows are constrained. In contrast, the EU's unemployment response remains near zero, indicating greater labour market rigidity (or stronger social protections) that buffer employment from short-term trade disruptions. From a narrative perspective, the labour market shows an initial impact in the early quarters, with a spike of 1%, but this does not reach statistical significance. This suggests that, although there is an initial reaction in the labour market, the effects do not translate into substantial and persistent changes. China's unemployment response is not significant upon impact, but it becomes after two quarters being positive and consistent. However, the more contained reaction could stem from China's labour policies, structural differences in employment arrangements, or government interventions that stabilize job markets during external shocks.

The findings underscore the heterogeneous effects of maritime flow shocks on advanced and emerging economies. The U.S. and EU face greater inflationary pressures in the medium run, while China experiences weaker inflationary effects and maintains labour market stability.

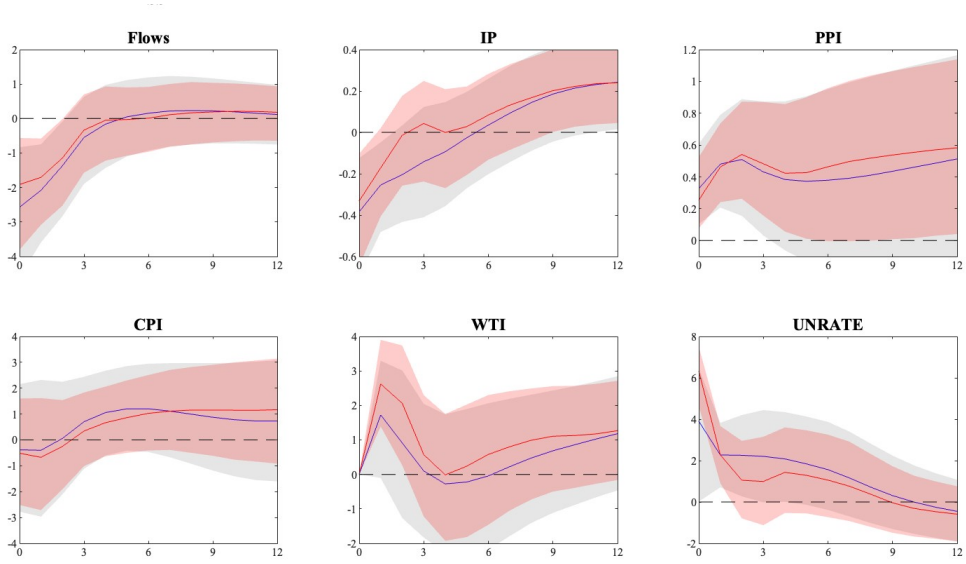


Figure 7: *U.S. IRFs – 12 months – 68% CI – 3 lags – Blue: Sign Restriction & Red: NSR*

4.2 Differentiating the type of MSS

This section aims to delineate the impact of different maritime supply shocks on the three economies. We categorize these shocks into those originating at chokepoints and those occurring at ports, further differentiating them by persistence, as we anticipate divergent effects on inflation and labour markets. Specifically, we hypothesize that shocks at chokepoints, due to their potential to cause widespread disruptions in shipping routes, will likely lead to more persistent inflationary pressures and greater volatility in labour market outcomes compared to port-specific shocks. Furthermore, we expect that the duration of these shocks will significantly modulate their impact, with more persistent shocks leading to more entrenched effects on prices and employment.

2019M6 and 2021M3 shocks are examined to assess the short-term shocks at critical chokepoints in global supply chains. Due to the lack of strong effects on the variables, the IRFs are illustrated in Appendix A Figure 10. The results suggest a heterogeneous response across regions, with the magnitude and persistence of the shock varying significantly. In China, the effects remain relatively small but exceed the thresholds established by the sign restrictions, particularly in PPI and CPI, where the shock's impact, while moderate, is more elevated. Meanwhile, in the EU-27 and the United States, the CPI response is more pronounced, especially in the first quarter, indicating stronger initial inflationary pressures. The unemployment rate increases by more than 1% in both economies, with a particularly sharp and immediate effect in the EU-27, where it turns positive on impact.

Figure 8 illustrates the effects of maritime supply shocks occurring between 2021M4 and 2021M6, driven by

persistent container backlogs in Chinese and U.S. ports. In China, the impact remains relatively contained, with both PPI and CPI registering moderate increases that exceed sign-restriction thresholds. This suggests a measurable yet controlled inflationary response, though CPI displays greater persistence over time. In contrast, inflationary dynamics are more pronounced in the EU-27 and the United States. In the EU-27, CPI responds strongly in the later stages, whereas in the U.S., the most significant price pressures emerge at the onset. The labour market reacts sharply in both economies, with unemployment in the EU-27 rising almost immediately. In the U.S., the response is even more pronounced, with unemployment surging by over 5% at its peak before gradually stabilizing.

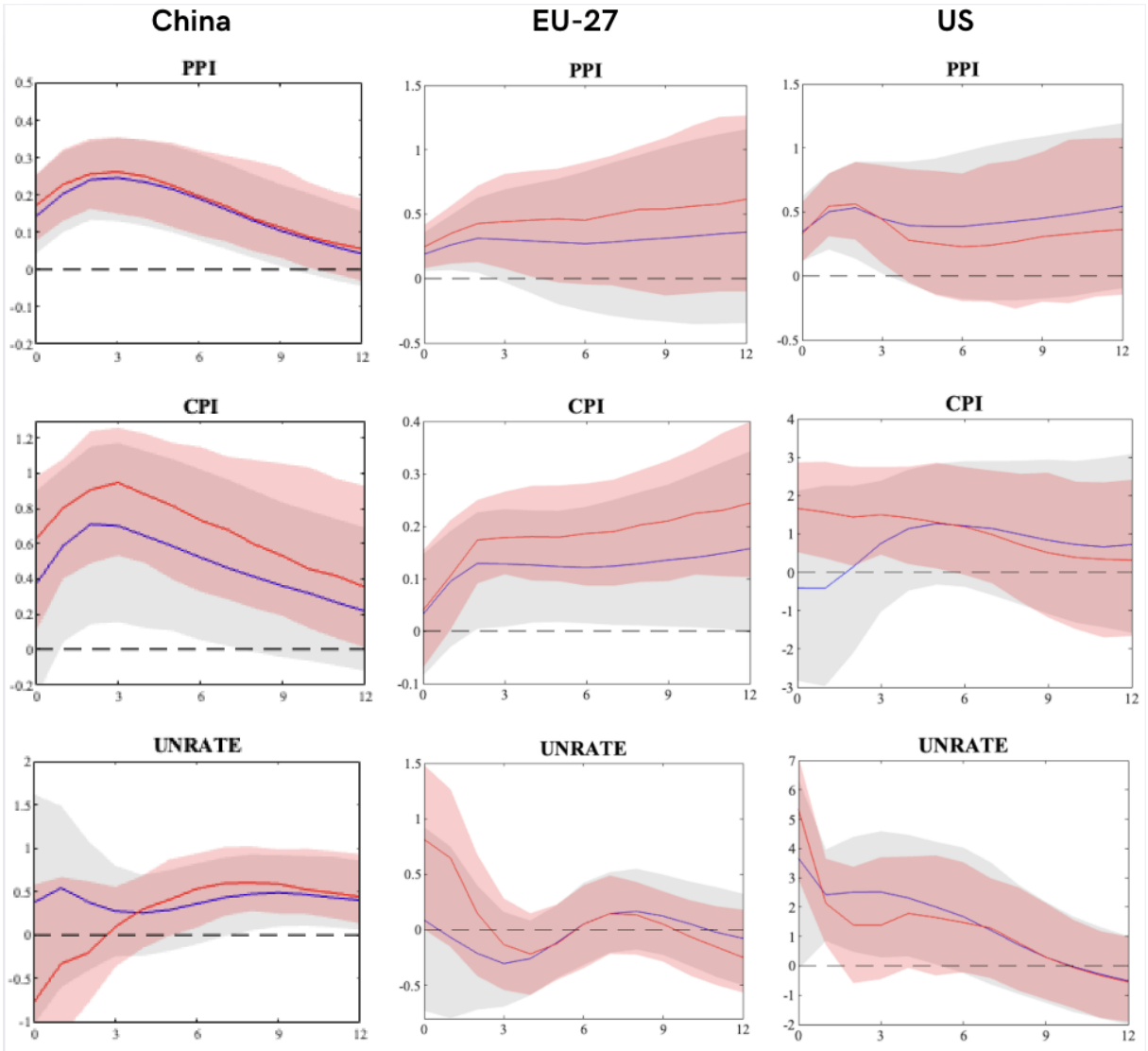


Figure 8: *Narrative SR IRFs on 2021M4-2021M6 – 12 months. 68% CI, 10.000 draws, 3 lags.*

Figure 9 shows the effects of chokepoint-related supply shocks between 2023M11 and 2024M2. Unlike maritime supply shocks caused by persistent container backlogs, these disruptions stem from bottlenecks at

critical transit hubs. In China, the effects remain relatively muted, though both PPI and CPI register moderate increases that surpass the sign-restriction thresholds. In contrast, inflationary dynamics are more pronounced in the EU-27 and the United States. In the EU-27, PPI exhibits a sharper and more persistent upward trajectory, highlighting the region's greater exposure to maritime supply disruptions. This prolonged effect suggests that supply-side pressures continue to pass through to production costs over time. The U.S. PPI response, while initially moderate, increases quickly after 3 months, indicating a relatively slower pass-through effect of input costs. In the EU-27, CPI reacts strongly after 6 months, suggesting a more gradual but sustained inflationary buildup, whereas in the U.S., price pressures do not emerge significantly. The labour market response is immediate across whole economies. Unemployment in China and the EU-27 rises almost instantly, reflecting the rapid transmission of chokepoint disruptions into labour markets – even if in the EU-27 it is not significant. In the U.S., the response is even more pronounced, with unemployment spiking by nearly 6% at its peak before exhibiting a gradual decline.

Due to the lack of strong effects on the variables, the IRFs that illustrate the macroeconomic impact of supply disruptions occurring between May and July 2024, driven by simultaneous bottlenecks at global chokepoints and persistent container backlogs at major Chinese ports, are illustrated in Appendix B Figure 11. Unlike previous shocks, which examined these factors separately, this period captures the compounded effects of logistical constraints at critical transit hubs alongside sustained congestion in maritime transport.

Across all three economies, the response of the PPI reflects the dual nature of the shock, as rising input costs stem both from supply chain frictions and prolonged transportation delays. While China and the EU-27 exhibit relatively lower narrative sign restrictions in CPI and PPI compared to standard sign restrictions, the EU-27 experiences a sharper and more persistent increase in PPI. Meanwhile, the U.S. registers the most pronounced PPI surge, peaking above 0.8%. Beyond producer prices, consumer inflation is significantly affected, particularly in the U.S., where the Consumer Price Index (CPI) rises rapidly in the initial months before stabilizing. The labour market response is equally striking. In China, the unemployment rate initially spikes by more than 1% relative to sign restrictions before stabilizing. In the EU-27, unemployment rises in the narrative approach over the first six months before converging towards baseline levels, indicating relative resilience despite cost pressures. By contrast, the U.S. experiences a sharper increase, with unemployment surging beyond 5% at its peak before gradually normalizing – highlighting the greater sensitivity of its labour market to supply shocks.

A series of successive shocks occurred, converging into a cumulative disruption. In this context, the shocks began before the contemporaneous shock, indicating that probably the supply chain had already adapted by developing alternative sourcing strategies. However, the unemployment rate faced a stronger impact due to the prolonged and compounding nature of these shocks.

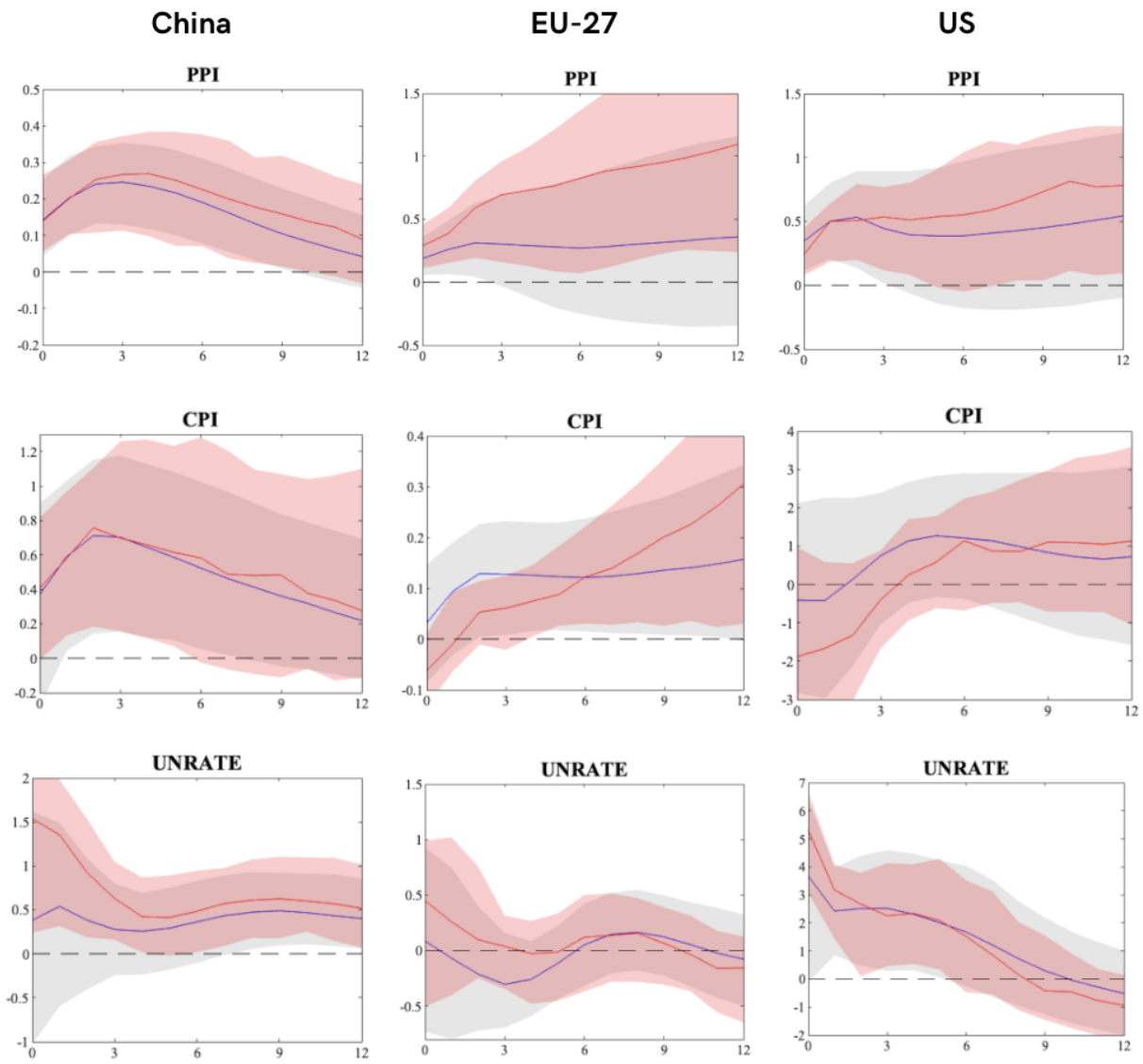


Figure 9: *Narrative SR IRFs on 2023M11-2024M2 – 12 months. 68% CI, 10.000 draws, 3 lags.*

5 Conclusions and Next Steps

This research underscores the significant impact of maritime supply chain disruptions on macroeconomic aggregates. Utilizing a Structural Vector Autoregression (SVAR) model with narrative sign restrictions and Bayesian inference allows for more precise identification of exogenous maritime supply shocks. The results reveal that these disruptions exert substantial inflationary pressures, with producer and consumer prices responding strongly. There are heterogeneous transmission effects across major economic regions.

Maritime supply chain disruptions consistently induce significant inflationary pressures, highlighting the vulnerability of global price stability to disruptions in maritime trade. The heterogeneous persistence of these effects suggests the importance of region-specific factors, such as monetary policy responses and supply chain

structure, in shaping inflationary outcomes. Industrial production contracts sharply in response to adverse shocks, reflecting the immediate impact of supply chain bottlenecks on productive capacity. The divergent recovery paths observed among China, the EU-27, and the United States underscore the role of domestic policies and structural characteristics in mitigating the long-term economic consequences of these disruptions. The effects on the labour market are similarly heterogeneous, with a more severe peak in unemployment in the United States, where it shows greater persistence. This may reflect differences in labour market institutions, the sectoral composition of employment, and the responsiveness of firms to supply-side shocks.

From a policy perspective, these results underscore the need for enhanced infrastructure resilience and strategic planning to mitigate the vulnerabilities of global maritime routes. Supply chain adaptability, including diversifying trade routes and investing in port efficiency, could help reduce the impact of future maritime shocks. Additionally, targeted fiscal and monetary policies may be required to address the inflationary consequences of transportation bottlenecks without exacerbating broader economic instability.

These findings, in light of Bai et al. (2024), suggest that central banks should respond vigorously to future disruptions in global supply chains and that restrictive monetary policy is more effective in taming inflation in the event of a supply chain shock. However, the heterogeneous impact of these disruptions across economies underscores the need for tailored policy responses that take into account country-specific characteristics. Moreover, investments in port infrastructure and supply chain resilience could prove critical to mitigating the adverse effects of future disruptions.

While this study advances the understanding of maritime supply shocks, several areas warrant further investigation:

- Future research should aim to refine the methodology by incorporating additional maritime flow data and extending the analysis to economies that are highly dependent on international trade, such as South Korea and Singapore.
- The integration of real-time vessel tracking and port congestion indicators could enhance the predictive capabilities of existing models, allowing for more dynamic assessments of supply chain disruptions.
- A further research path to follow is the literature on inflation expectations, which is examined in Appendix D for the U.S. case. Expanding the dataset to include China and the EU-27 could provide valuable insights, offering a broader perspective on the transmission of maritime supply shocks across different economic regions.
- Further exploration into the policy responses of central banks and governments to mitigate the effects of these shocks remains a critical avenue for research, particularly in the context of sustained global trade uncertainties.

For example, a deeper analysis of industrial policies aimed at reducing transport costs to boost trade, such as China's policy in the naval sector, could be assessed in terms of costs and benefits, considering the role of transport in international trade. The analysis should also take into account the geopolitical objectives that drive industrial policies, not only economic objectives.

Moreover, monitoring port congestion through indices such as the ACR (obtained via satellite data) could provide an early warning signal of potential disruptions, allowing for timely interventions. By deepening our understanding of these disruptions, policymakers and industry leaders can develop more effective strategies to safeguard economic stability and ensure the resilience of global supply chains. Finally, refining the measurement of supply chain disruptions by incorporating real-time data on container ship movements and integrating narrative sign restrictions based on well-documented historical events can further enhance the accuracy and reliability of macroeconomic assessments.

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Appendixes

A Narrative sign restrictions – 2019M6&2021M3

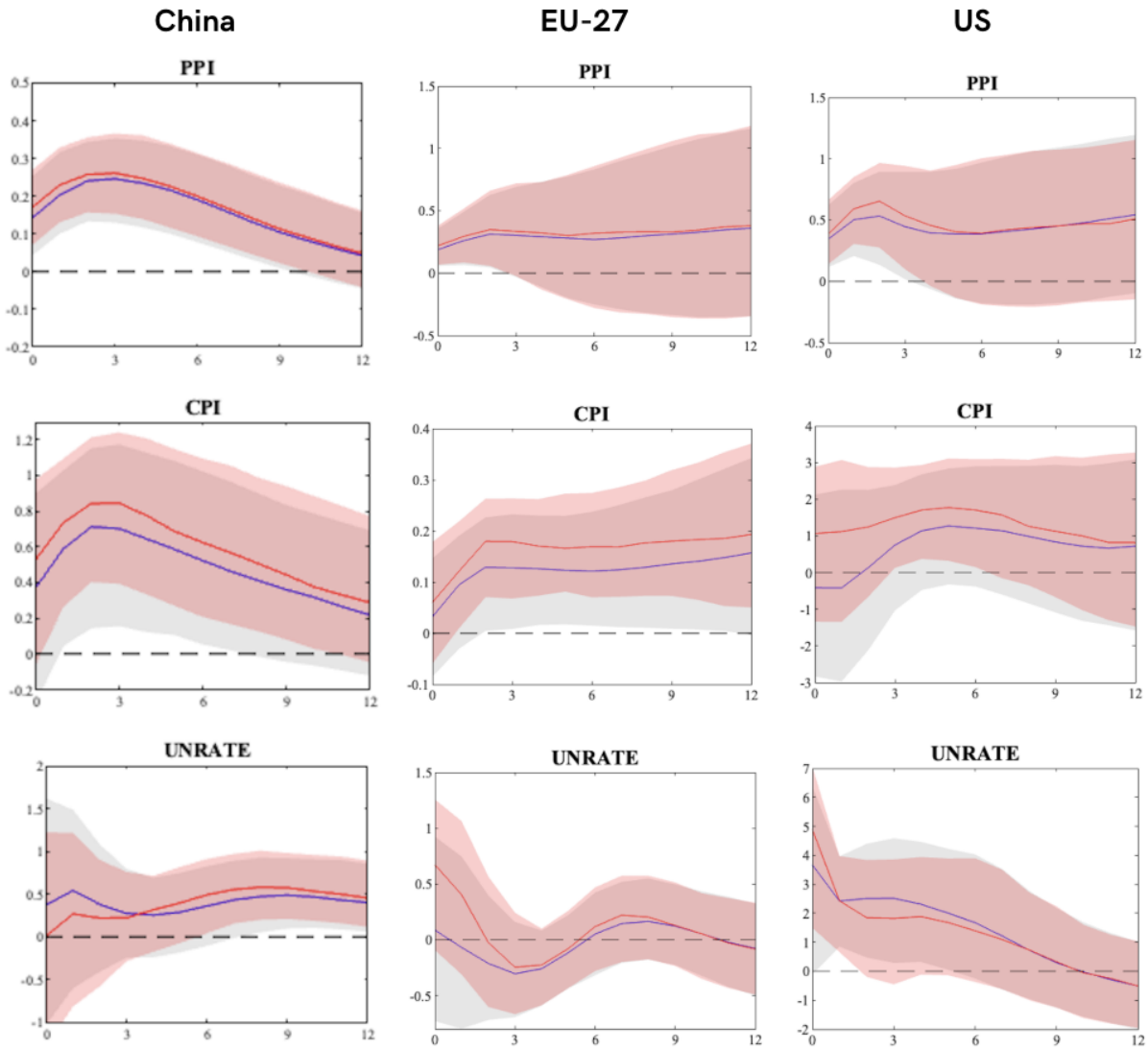


Figure 10: *Narrative SR IRFs on 2019M6 & 2021M3 – 12 months. 68% CI, 10.000 draws, 3 lags.*

B Narrative sign restrictions – 2024M5-2024M7

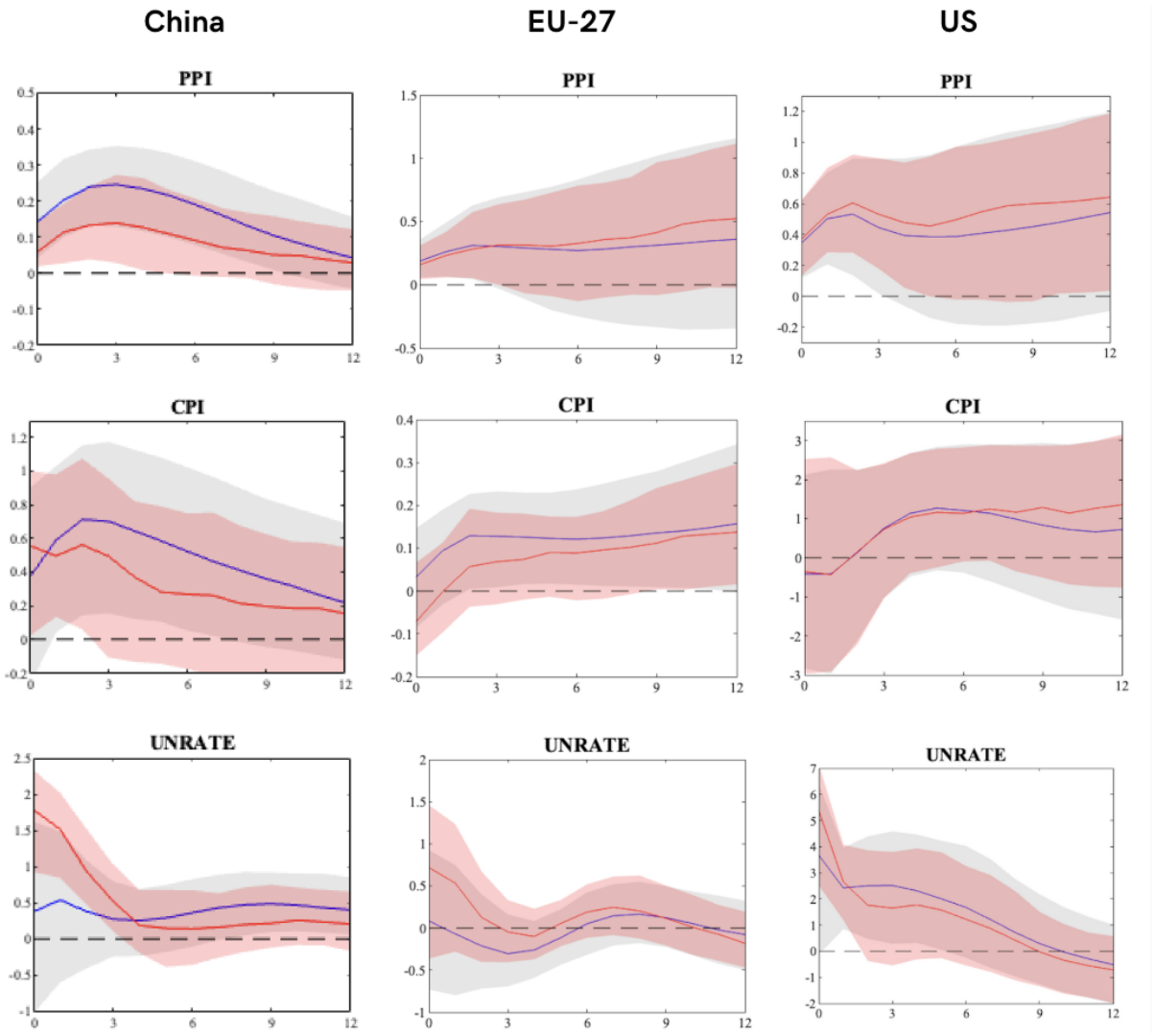


Figure 11: *Narrative SR IRFs on 2024M5-2024M7 – 12 months. 68% CI, 10.000 draws, 3 lags.*

C Demand Shock

In this appendix are presented the Demand Shocks IRFs. We impose for two periods negative Flows and Industrial Production, and only one negative PPI and zero restriction on WTI in order to look deeper into Demand Shocks (DS). We present the results of the COVID-19 shock 2020M4-2020M6 outlined in Table 2 with a Narrative SR approach for the three entities analysed.

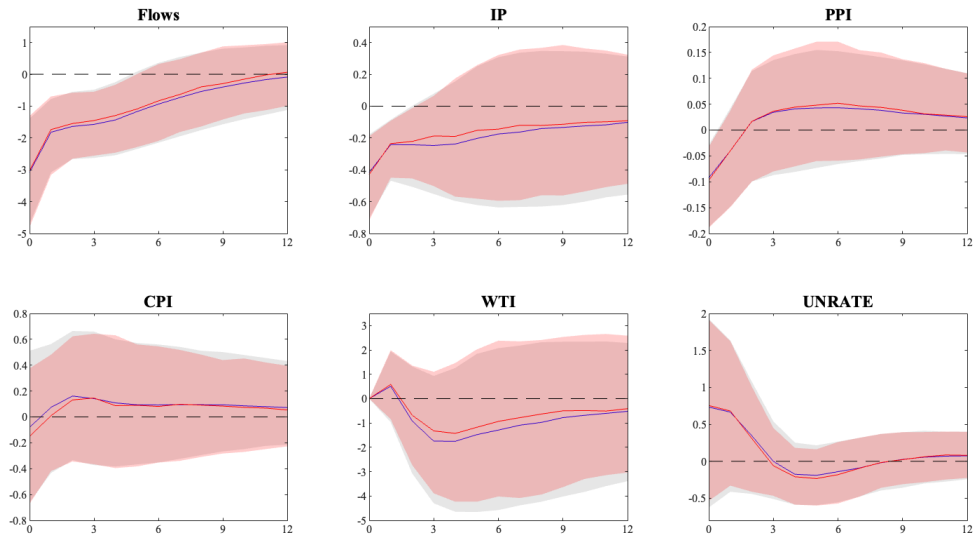


Figure 12: *China Narrative SR 2020M4-2020M6 IRFs – 12 months. 68% CI, 10.000 draws, 3 lags.*

A negative demand shock triggers a sharp contraction in flows, which decline significantly within the first three months before gradually recovering. However, they remain below baseline levels for a prolonged period, reflecting persistent adjustments in global markets. Industrial production contracts immediately, deepening over the initial months as supply chain disruptions amplify the downturn, leading to a sluggish and uneven recovery. The shock exerts downward pressure on producer prices, which decline persistently due to weakened firm pricing power and excess production capacity. Notably, China appears less affected in this regard, likely due to its lower reliance on imports and stronger export orientation. Similarly, consumer prices exhibit a more gradual but sustained decline, reflecting weaker consumption patterns and lagged price adjustments, particularly in non-tradable goods and services. The impact on crude oil prices is severe, with an abrupt initial drop driven by expectations of lower global demand, followed by a protracted period of price stabilisation at a depressed level. Labour market conditions also deteriorated, particularly in the United States, where the unemployment rate rose sharply in the aftermath of the shock. The recovery in employment proves sluggish, as labor market frictions and structural adjustments prolong the return to pre-shock levels. The recovery in employment proves sluggish, as labor market frictions and structural adjustments prolong the return to

pre-shock levels.

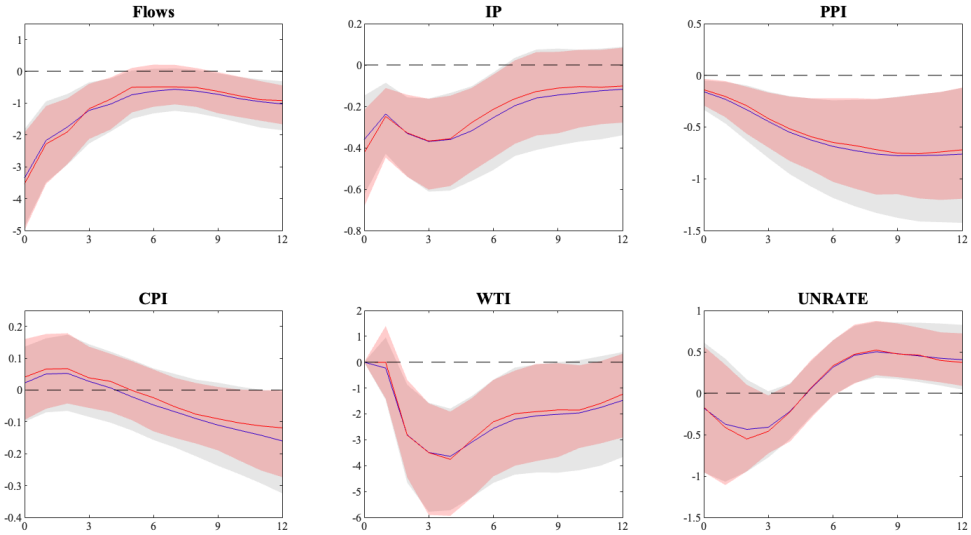


Figure 13: *EU-27 Narrative SR 2020M4-2020M6 IRFs – 12 months. 68% CI, 10.000 draws, 3 lags.*

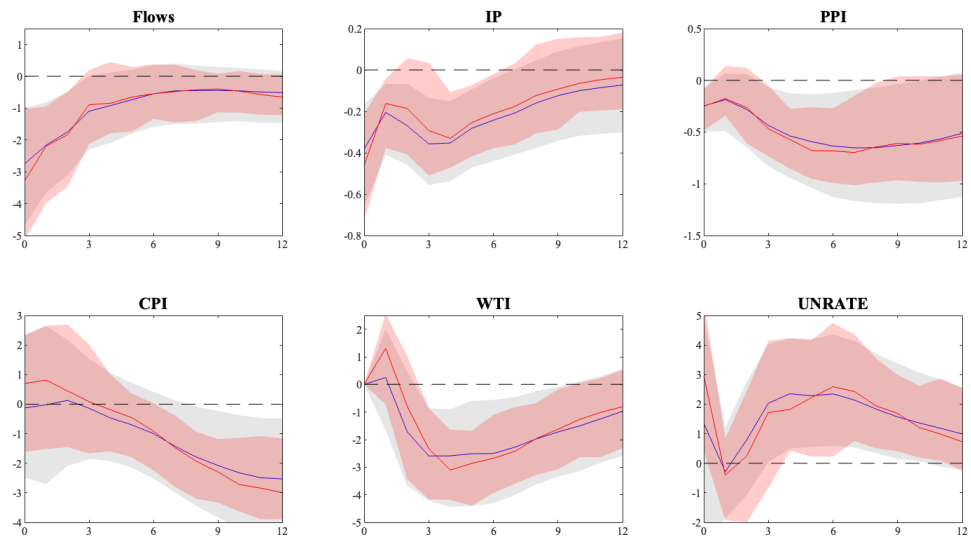


Figure 14: *U.S. Narrative SR 2020M4-2020M6 IRFs – 12 months. 68% CI, 10.000 draws, 3 lags.*

D Inflation Expectations – The U.S. Case

Inflation expectations are measured using the University of Michigan: Inflation Expectations (MICH) series from the Federal Reserve Economic Data (FRED), with the analysis focused on the United States due to data availability. Following a maritime supply shock, inflation expectations are expected to rise as disruptions in global shipping channels constrain supply and elevate costs. Figure 15 reports the impulse responses of inflation expectations under narrative sign restrictions.

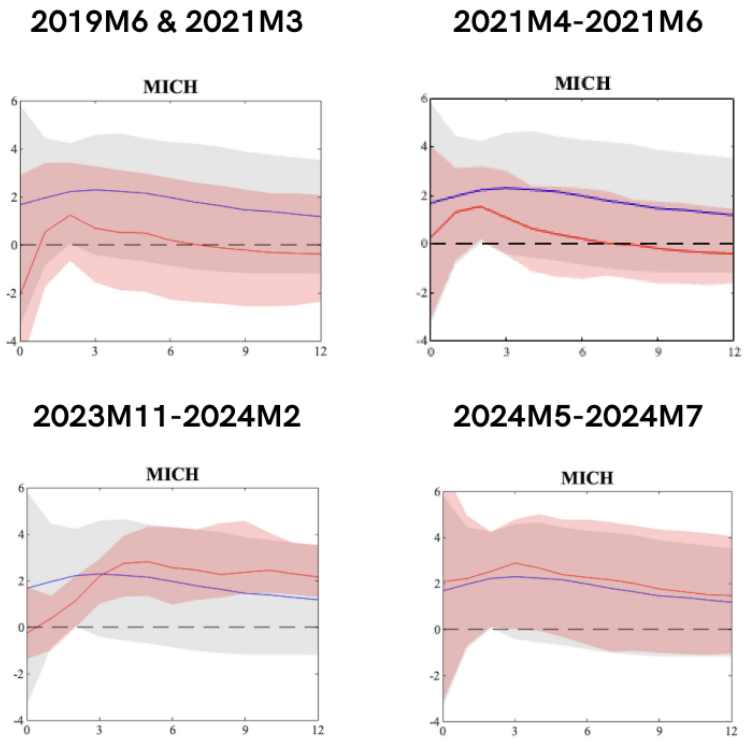


Figure 15: *U.S. Inflation Expectations IRFs – 12 months. 68% CI, 10.000 draws, 3 lags.*

The first two shocks exhibit weaker responses, likely due to the brevity of the first shock and the geographic concentration of the second one in Chinese ports, which may have limited its direct transmission to U.S. inflation expectations. In contrast, the final two shocks display a more persistent impact, particularly over longer horizons, potentially reflecting their closer proximity to the United States and a more direct influence on domestic supply chains. Sign restrictions indicate a robust positive response to maritime supply shocks, with inflation expectations rising by approximately 2% and remaining above 1% throughout the forecast horizon. These findings underscore the role of maritime disruptions as a significant driver of inflation expectations, reinforcing the importance of accounting for global supply chain frictions in macroeconomic analysis.