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FROM BOTTLENECKS TO INFLATION: IMPACT OF GLOBAL SUPPLY-CHAIN DISRUPTIONS ON INFLATION IN THE PHILIPPINES

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Abstract

Supply-chain bottlenecks emerged alongside unprecedented inflationary surges amid the resulting mismatches in supply and demand for goods and services throughout the COVID-19 pandemic. This study employs a local projection approach to investigate the inflationary impact of global supply-chain pressures in the Philippines. We find that supply-chain disruptions are followed by sizable and statistically significant increases in headline inflation in the Philippines. Supply-chain shocks also have a considerable impact on the tradable segment of core inflation. Meanwhile, non-tradable inflation has a generally smaller, short-lived, and insignificant response to global supply-chain pressures reflecting the limited presence of second-round, indirect effects.

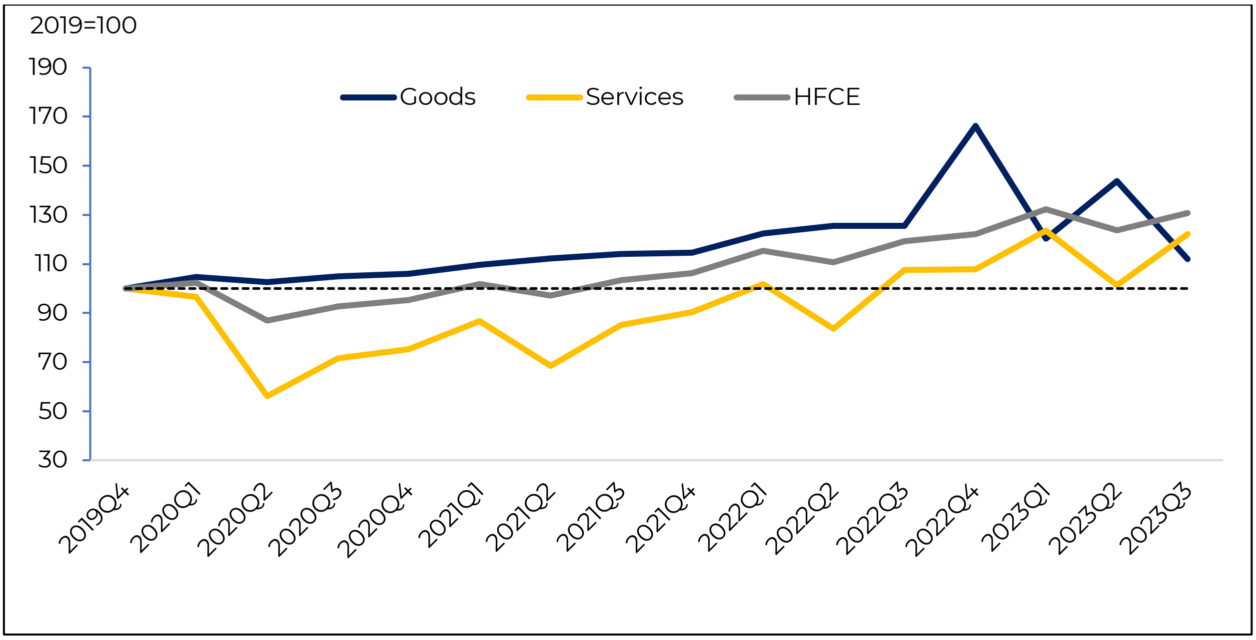
1. Introduction

The COVID-19 pandemic reallocated global demand from services to goods while also inducing shutdowns in manufacturing activity and labor shortages around the world. Consequently, supply-chain disruptions have emerged alongside unprecedented inflationary surges amid the resulting mismatches in supply and demand for goods and services.

The early phases of the COVID-19 pandemic brought about a shift in household spending from contact-intensive services toward more durable goods as the Philippines imposed one of the strictest and longest containment measures in the world. Relative to the fourth quarter of 2019, Figure 1 shows a sustained decline in household consumption of services from the second quarter of 2020 until the first quarter of 2021. Meanwhile, expenditures on goods stayed above pre-pandemic levels after briefly slowing down in 2020Q2 and continued to expand thereafter. This was initially driven by purchases of technological goods and household furniture and equipment needed when people were forced to stay home for work, school, and leisure.

The pandemic also induced factory shutdowns, border controls, and port closures, which all caused a long list of shortages including that of labor and intermediate inputs. Hence, there was a mismatch of an overheating demand and constrained supply. This is at the core of global supply-chain (GSC) disruptions often characterized by heavily congested ports, spikes in shipping costs, and longer delivery times.

Figure 1. Nominal Household Final Consumption Expenditure



Note: Goods include expenditures on food and beverages, tobacco, clothing and footwear, housing, water, electricity, gas and other fuels, furnishings, household equipment and routine household maintenance. Services include expenditures on health, transport, communication, recreation and culture, education, restaurants, and hotels.
Sources: Philippine Statistics Authority, staff calculation

This study aims to estimate the impact of GSC pressures on headline inflation and its sub-components in the Philippines and compare it with global commodity price shocks. The approach follows Benigno et al. (2022) and Andriantomanga et al. (2023), which examined the contribution of GSC pressures to the recent bout of inflation surge in the US and Euro area and in sub-Saharan Africa, respectively. To this end, the paper follows a string of recent literature that utilizes the local projection model proposed in Jordà (2005) to examine the response of different inflation measures to exogenous shocks in global supply chains.

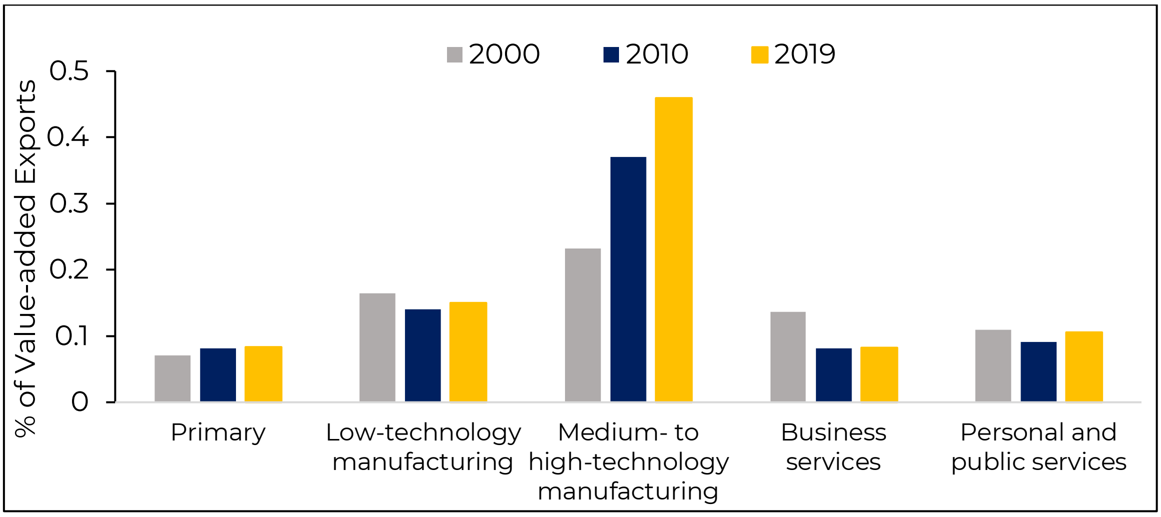
We find that supply-chain disruptions are followed by sizable and statistically significant increases in headline and food inflation. Supply-chain shocks also have a considerableimpact on the tradable segment of core inflation. Meanwhile, non-tradable inflation has a smaller, short-lived, and delayed response but is nevertheless significant to GSC pressures reflecting the presence of second-round effects.

2. Measuring global supply-chain bottlenecks

The emergence of pandemic-related bottlenecks also draws our attention to vulnerabilities of the current production and consumption structure. In terms of using foreign value-added from other countries in its own exports orbackward global value chains (GVC) participation, the Philippines has steadily increased its import content of exports in the medium to high-tech manufacturing sector before the pandemic. This is driven mostly by the expanding GVC activities of the Philippines in the electrical and optical equipment sector, mostly focusing on more downstream stages, such as product testing and packaging (Figure 2).

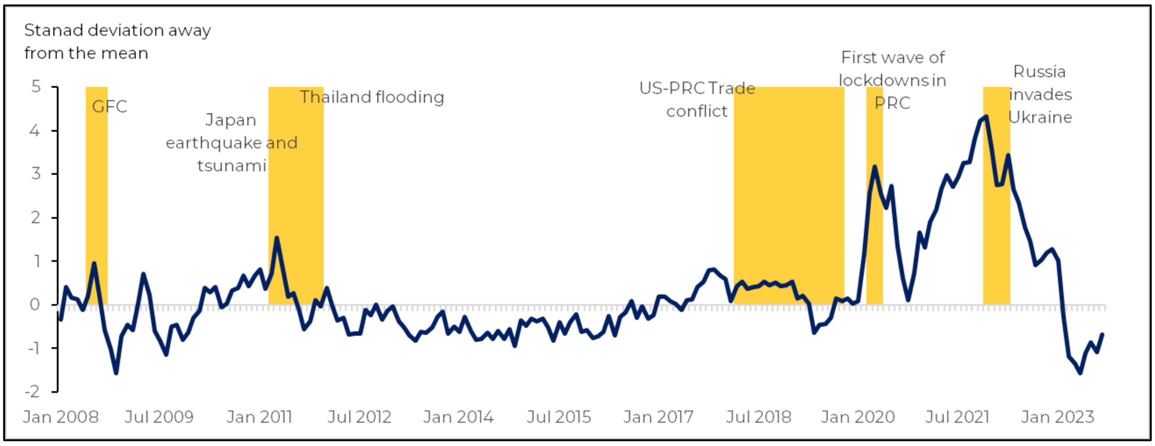
Shipping costs, supplier delivery times, port congestions, and manufacturing activity are only a few of the several measures to assess the state of GSCs. While these indicators capture specific aspects of the supply-chain dynamics, the Federal Reserve Bank of New York developed a new composite indicator called the Global Supply-Chain Pressure Index (GSCPI) to capture the multi-dimensional nature of supply-chain disruptions. The index has 27 components, 21 of which are purchasing managers indexes (PMIs) for three subcomponents, including backlogs, purchased stocks, and delivery times for seven major economies—the United States, European Union (EU), United Kingdom China, Japan, South Korea and Taiwan. The rest are airfreight and ocean freight indexes in major trading routes (Benigno et. al.,2022). The index is calculated monthly and is expressed in terms of standard deviation from its historical average.

Figure 2. GVC Participation in the Philippines



Source: Asian Development Bank multi-regional input-output tables

Figure 3. The evolution of global supply-chain pressures



Note: Values of the index are normalized to zero and reported as standard deviations from the average index value.
Source: Federal Reserve Bank of New York

Before the pandemic, there were a few notable spikes in GSCPI as seen in Figure 1. One was during the Global Financial Crisis in 2008, and another in 2011 when two major natural disruptions occurred — the earthquake in Japan and huge floods in Thailand. The impact of the disasters in Japan mainly disrupted automobile production and distribution. The index was also above the historical average at the height of the US-China trade tensions in 2018 to early 2019. However, these episodes were overshadowed by a substantial rise in the index seen during the COVID-19 pandemic.

The first peak was in April 2020 when the index rose three standard deviations away from its historical average, coinciding with the widespread lockdowns and border closures around the world. It improved briefly toward the end of 2020 but started rising again in 2021 amid new COVID variants and the Suez Canal blockage. Renewed pressures driven by major port closures in China and the trade-related sanctions in Russia's invasion of Ukraine sustained pressures on supply chains until April 2022. Since then, the GSCPI showed signs of easing albeit still elevated by historical comparison for the rest of 2022. Since then, the pressures have steadily eased.

3. Empirical methodology

3.1 Data

To quantify the impact of supply-chain disruptions on domestic inflation, we use monthly data on four consumer price index (CPI) measures – headline, food, tradable and non-tradable from 2000 to March 2023. The tradable and non-tradable components[1] of core inflation are constructed using the disaggregated CPI series released by the Philippine Statistics Authority (PSA). The weights are based on components of the CPI at the two-digit level (division) of the 2020 Philippine Classification of Individual Consumption According to Purpose (PCOICOP) with 2018 as the base year.

GSC conditions are proxied by GSCPI as a summary indicator of the key aspects of the supply chain bottlenecks. Further, we include control variables to account for both global and domestic factors. The baseline specification also includes world food prices and oil prices as well as the world output gap. Adding global food and oil inflation enables us to control for global demand affecting the supply chain pressures. It also allows for the comparison of the magnitude and duration of supply-chain shocks with commodity price shocks as these were the often-cited inflation drivers during the pandemic. The domestic output gap is used to control for domestic conditions. To check the robustness of the results, we also use data on market volatility, monetary policy rates, and exchange rates. In particular, we include the Chicago Board of Options Exchange Market Volatility Index (VIX), BSP's weighted monetary operations rate (WMOR), and the nominal effective exchange rate (NEER).

3.2 Analytical Framework

To understand the channels by which global supply chain pressures affect inflation, we first express the headline consumer price index P_t as follows:

$$P_t = (P_t^T)^{\delta}(P_t^N)^{1-\delta}$$

where T and N denotes the tradable and non-tradable sectors in the economy, and δ is the share of tradable goods in the consumption basket. Both sectors are assumed to be using inputs from each other. Let m be the share of the tradable goods that are imported from the rest of the world. Modelling exogenous supply-chain shocks at time t denoted by $\tau_t^S > 1$, we write:

[1] The tradable segment includes Alcohol, Clothing and Footwear, Furnishing, and Transport sectors while the non-tradable segment includes Health, Restaurants and Accommodation, Information and Communication, Education, and Recreation and Culture, and Miscellanous goods and services.

$$d\ lnP_t = (\delta m + (1-\delta)\gamma^N) d\ ln\tau_t^S + \epsilon_t$$

The first term of the above equation reflects how supply-chain shocks directly raise the price of imported goods. The effect via the non-tradable sector occurs due to its spending on imported inputs, denoted in share terms by γ^N. This indirect, second-round effect is captured by the second term of the above equation.

To follow the local projection approach by Jordà (2005). we perform a sequence of ordinary least squares (OLS) estimation of the following reduced-form equation (1): where h denotes the response horizon in months, $h = 0, \ldots, H$; y_{t+h} is the year-over-year log change in the price index, $t+h$; $x_t$is the GSCPI capturing exogenous supply-chain shocks. The set of controls includes the lags of y_t *and* x_t, X^G, the global factors i.e. global output gap, world oil, and food prices, and X^D includes the domestic output gap and bilateral exchange rate against the dollar.

To address potential seasonality in price series, J is set to 12. Newey-West heteroskedasticity and autocorrelation consistent (HAC) estimator is used to compute the robust standard errors.

One advantage of the local projection approach is that impulse response functions (IRFs) can be generated directly from the regressions. Further, for sufficiently large sample sizes, the IRFs are more robust to misspecification compared to standard vector autoregressive (VAR) specifications (Montiel Olea and Plagborg-Møller, 2021; Nakamura and Steinsson, 2018).

The forecast errors for the horizon h from the local projection in Equation 1 is given by Equation 2, where $\Omega_{t-1} \equiv \{\Delta y_{t-1}, z_{t-1}, \Delta y_{t-2}, z_{t-2,\ldots}\}$. To estimate the forecast error $\hat{f}_{t+h|t-1}$, we get the residual of the following regression in Equation 3: Then we run the following regression and calculate its R^2 in Equation 4.

$$y_{t+h} = \alpha_h + \beta_h x_t + \sum_{j=1}^{J} \beta_{hj} x_{t-j} + \sum_{j=1}^{J} \delta_{hj} y_{t-j} + \sum_{j=0}^{J} \theta_{hj}^G \Delta X_{t-j}^G + \sum_{j=0}^{J} \theta_{hj}^D \Delta X_{t-j}^D + \epsilon_{t+h} \quad (1)$$

$$f_{t+h|t-1} \equiv (y_{t+h} - y_{t-1}) - P[y_{t+h} - y_{t-1} | \Omega_{t-1}] \quad (2)$$

$$y_{t+h} - y_{t-1} = c_h + \sum_{i=1}^{L_y} \gamma_i^h \Delta y_{t-i} + \sum_{i=1}^{L_z} \beta_i^h \Delta z_{t-i} + f_{t+h|t-1} \quad (3)$$

$$\hat{f}_{t+h|t-1} = \alpha_{z,0} z_{t+h} + \cdots + \alpha_{z,h} z_t + \tilde{v}_{t+h|t-1} \quad (4)$$

4. Discussion of results

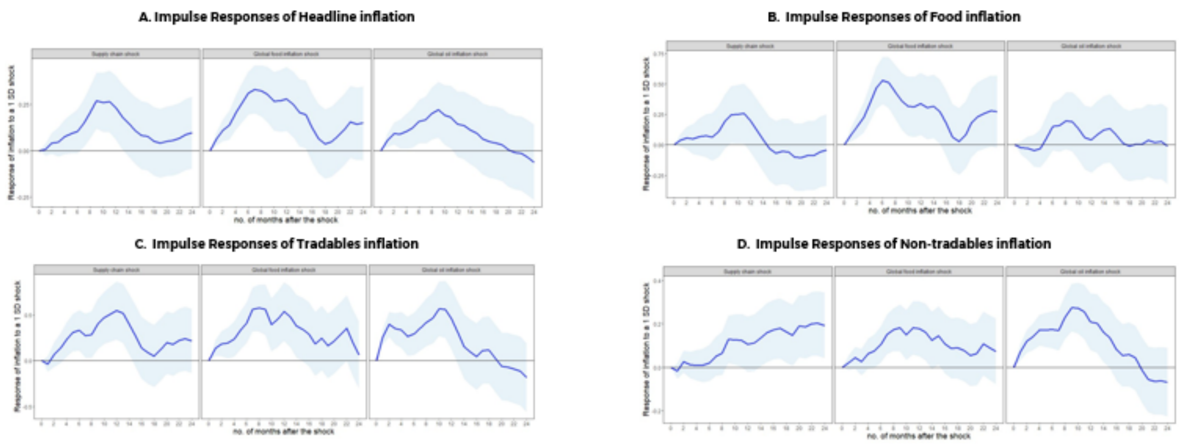
4.1 Impulse responses of inflation to global shocks

In Figure 4, the leftmost chart shows the estimated impact of a one standard deviation shock to GSCPI on four inflation measures: headline inflation, food inflation, tradables inflation, and non-tradables inflation. The impact of a one standard-deviation shock on global oil and food prices is also shown in the panel to compare the magnitude and duration of GSC shocks.

Panel A shows that the impact of GSC disruptions on headline inflation builds over time, which is reflective of how the shock works itself through the different stages of the supply-chain network. It peaks 11 months after a one-standard-deviation shock to GSCPI at 0.27 percentage point and persists until the 13th month. This is in contrast to the immediate impact of world oil and world food prices on headline inflation.

The response of domestic food inflation to a one-standard-deviation shock to the GSCPI starts flat but becomes significant, albeit weakly, in the 9th month after the shock and stays so until the 12th month (Panel B). Since the Philippines is generally a net food importer, global food inflation understandably has an immediate, highly significant, and prolonged impact on domestic food prices.

Figure 4. Response of domestic prices to a one standard deviation shock in GSCPI, global oil and food prices

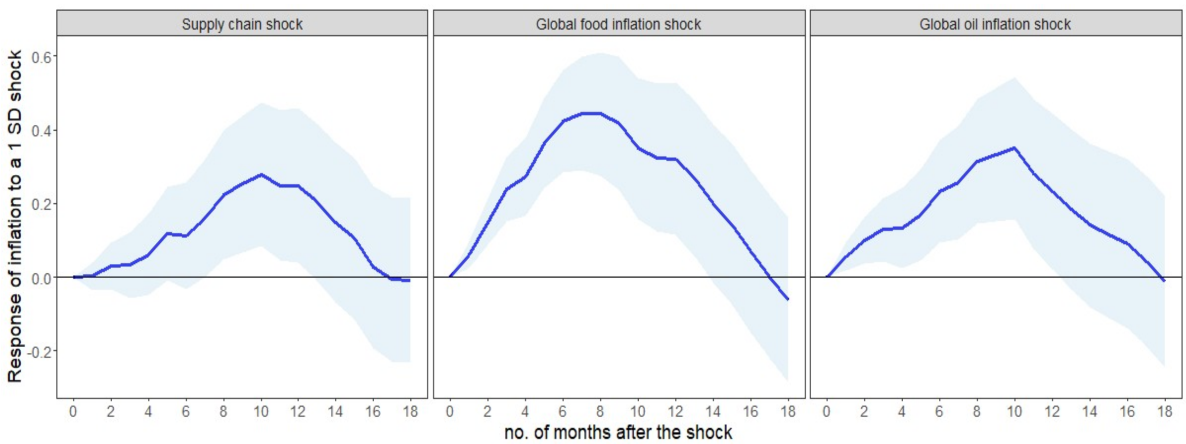


Source: BSP staff calculation

When it comes to the less volatile components as captured in the tradable and non-tradable segments of inflation, GSCPI shocks have sizable, significant, and more persistent impact on the former. In Panel C, tradables inflation rises by about half a percentage point 12 months after the GSCPI shock. The response is felt significantly beginning in the 4th month after the shock and stays elevated until one year later. This points to the country's reliance on imports of other manufacturing final goods. The impact on tradable inflation is quick to materialize and remains significant throughout the first year following the shocks to global oil and food prices.

The presence of second-round effect is reflected by the positive, non-negligible impact on non-tradable goods and services as shown in Panel D. There is a delay in the response and the magnitudes are smaller compared to other inflation measures. The smaller magnitude reflects the second-round nature of the impact that is dependent on the intensity of imported inputs use in the non-tradable sectors. A shock to oil prices produces larger and more immediate responses by non-tradable inflation given its pass-trough to energy and transport costs.

Figure 5. Response of month-ahead inflation to a one standard deviation shock in GSCPI, global oil and food prices



Source: BSP staff calculation

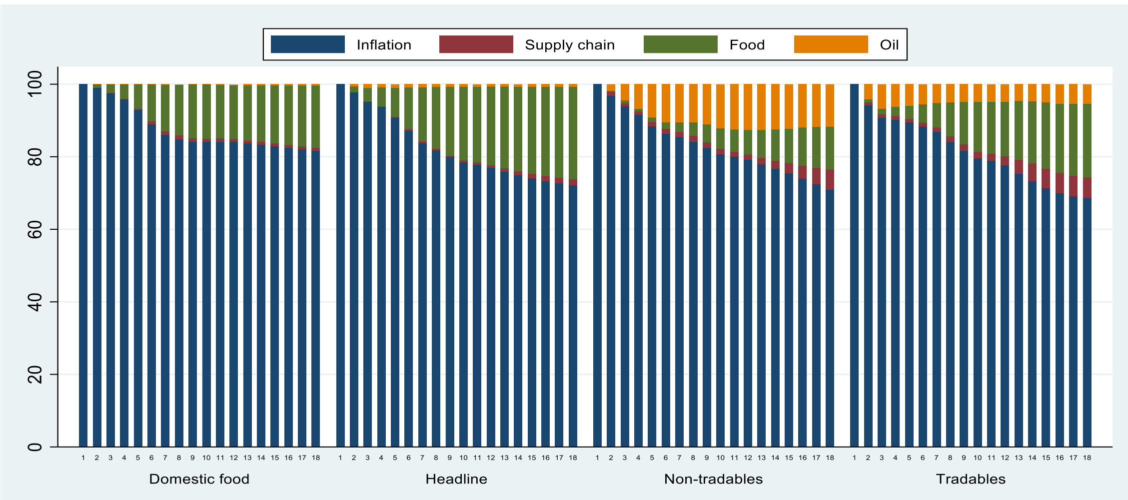
To prevent short-run supply shocks from spilling into the longer run, policymakers evaluate how these shocks are transmitted to inflation expectations. To get a sense of whether forecasters use disruptions along the supply chain to form expectations about aggregate inflation, Figure 5 shows the response of median month-ahead inflation expectations from Bloomberg to the same shocks in GSCPI and global commodity prices. The resulting impact on inflation expectation to a GSC shock is similar to the impact on headline inflation showing a significant response from 9 months up to 13 months.

4.2 Forecast Error Variance Decomposition

To construct the forecast error variance decomposition (FEVD), we follow the method introduced by Gorodnichenko and Lee (2019). In essence, we regress the estimated forecast errors on the shocks from *t* to *t+h*. The R^2 of this regression measures the share of the forecast error variance explained by the shock at horizon *h*.

The forecast error variance (FEV) for the different measures of inflation are explained mostly by global commodity prices, particularly oil and food (Figure 6). The contributions of GSC shocks to non-tradables and tradables FEV increase after about a year, consistent with the lagged impact shown in the IRFs in Figure 4.

Figure 6. Forecast Error Variance Decomposition



Source: BSP staff calculation

5. Concluding remarks

GSCs are starting to show signs of recovery on the back of demand and supply realignment. However, the resolution of supply-chain bottlenecks remains largely uncertain given the size of the initial shocks brought about by such a unique event like the COVID-19 pandemic. As the present study suggested, shocks to global supply chains tend to induce a significant, sizeable, and persistent impact on inflation that cuts across the food, tradable and non-tradable segments of inflation. Gauging the contribution of GSC pressures to the surge in inflation during the pandemic can provide insights into how sensitive the short-term inflation outlook is to both new supply shocks and dissipating old ones. The extent of second-round effects also highlights the importance of maintaining a sound and credible monetary policy.

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