Changes in Inflation Dynamics in Korea: Global Factor, Country Factor, and their Propagation*

Yun Jung Kim†
Department of Economics
Sogang University, Korea

Noh-Sun Kwark‡
Department of Economics
Sogang University, Korea

January 16, 2023

— Preliminary —

Abstract

To investigate the extent to which global and country factors have driven inflation movements in Korea, this study estimates global and country factors for inflation using a multi-level factor model. We find that the contribution of global factors to inflation in Korea was large in the era of high inflation in the 1970s, and recent periods after COVID-19, while country factors played an important role in inflation around the Asian financial crisis. We construct structural models to identify global and country shocks, and find that the effect of global shocks persists longer while the immediate impact of country shocks is larger. Global shocks are more important in PPI than in CPI or in core CPI inflation. Oil prices appear to closely comove with global factors and exchange rates are highly correlated with country factors in Korea.

JEL Classifications: E31, E30, E37, F41
Keywords: Inflation dynamics, Global factor, Country factor, Oil price shocks, Real exchange rate shocks

*We thank Sangyup Choi, Wontae Han, and participants at the Bank of Korea-Korea Economic Association International Conference 2022 and Korea International Economic Association Winter Conference for valuable comments and suggestions, and Junseok Hwang for research assistance. Financial support from the Bank of Korea is gratefully acknowledged. The usual disclaimer applies.

†Department of Economics, Sogang University, 35 Baekbeom-ro, Mapo-gu, Seoul, 04107, Korea, +82-2-705-8506, yunjungk@sogang.ac.kr.

‡Department of Economics, Sogang University, 35 Baekbeom-ro, Mapo-gu, Seoul, 04107, Korea, +82-2-705-8770, kwark@sogang.ac.kr.

1 Introduction

In the aftermath of the COVID-19 pandemic, Korea and many other countries are experiencing inflation at levels not seen for the past several decades. There are various causes, including rising demand, supply chain disruptions, and energy price hikes, contributing to the inflation surge. Some shocks are originated from global sources and others from domestic origins. Policy implications would be different depending on how much global versus domestic factors have contributed to inflation dynamics. If inflation is largely determined globally, countries may experience large swings in inflation under unstable global economic environment. It also implies that inflation may be less responsive to domestic monetary policy and thus calls for international policy coordination. By contrast, if inflation is largely affected by domestic conditions, central banks can expect stronger monetary policy transmission and may need to make smaller adjustments in interest rates to stabilize inflation. Understanding to what extent inflation is affected by global versus domestic factors would be particularly important for a small open economy. Korea is a small open economy highly integrated with the world goods and financial markets, and thus it is important to identify the sources of inflation in Korea to improve the effectiveness of the monetary policy.

In this context, we study the extent to which global and country factors have driven inflation movements in Korea. In particular, we aim to address the following questions. First, how much of inflation variation has been accounted for by global versus country factors? Has the relative importance of global versus country factors changed over time? Second, what are the roles of global and country *shocks* in inflation dynamics in Korea? How large and how persistent are the effects of global versus country shocks in the dynamics of various inflation measures? Is there any asymmetry in the propagation mechanisms of global/country shocks across high versus low inflation phases? Lastly, what macroeconomic information is reflected in global and country factors?

To answer these questions, we first estimate global and country factors from major monthly inflation series in G-7 and Korea, using a multi-level factor model developed by Choi et al. (2018). To weigh the relative importance of the global versus country-specific factors in explaining inflation, we compute the fraction of inflation variance due to the global and country factors for various inflation measures for different subperiods. Second, we construct a factor-augmented vector autoregressive (FAVAR) model including the estimated factors and inflation, and identify structural global and country shocks. Through an impulse response analysis, forecast error variance decomposition, and historical decomposition, we investigate global and country shocks' propagation to various inflation measures in Korea for different subperiods. We also examine the existence of asymmetry across high versus low

inflation phases using the local projection method. We then add oil price and exchange rate to the VAR framework and analyze the effects of these shocks and their interaction with the global and country shocks. Lastly, to understand what economic information global and country factors are capturing, we regress the estimated global and country factors on various macroeconomic variables representing different aspects of the global economy and Korea, and investigate what macroeconomic variables are most closely related with the estimated global and country factors.

The estimated global and country factors appear to closely track inflation in Korea. We find that the relative importance of the global versus country factors has changed over time, with greater importance of the global factor in the era of high inflation of the 1970s and 1980s, and recent periods after 2020. The country factor played an important role in inflation around the Asian financial crisis. As for the strength and persistence of inflation responses to the structural global and country-specific shocks, the effect of the global shock persists longer while the immediate impact of the country shock is larger. We also find that inflation responses to the global shock are larger in a high-inflation phase than in a low-inflation regime. Across different inflation measures, global shocks are more important in PPI inflation than in CPI inflation or in core CPI inflation. We find that oil price shocks generate a significant inflation response primarily through global factors, while real exchange rate shocks have a strong impact on inflation through country factors. In addition, the estimated global factor itself closely comoves with oil prices, and the country factor is most closely correlated with exchange rates.

There is a large literature on the role of global factors in inflation dynamics. Some studies add *observed* variables that capture global aspects to a Phillips curve framework and assess the explanatory power of the global variables. Recent studies of this strand include Obstfeld (2019), Kamber et al. (2020), and Bańbura and Bobeica (2023) among others. The other strand of research such as Auer et al. (2019) and Ha et al. (2019) uses factor models to estimate *unobserved* global common factors for inflation in a set of countries and assess the importance of global factors in national inflation. We expand this second strand of research by separately estimating global and country factors in a unified framework to analyze inflation in Korea. Most previous studies have focused primarily on the period of high inflation in the 1970s and the period of stable inflation prior to the recent inflation hike. We help understand recent inflation episodes by including the inflation data post COVID-19 pandemic.

This paper is organized as follows. In Section 2, we review the previous literature on the sources of inflation. In Section 3, we estimate global and country factors with a multi-level factor model, analyze factor-augmented VAR models, and present empirical results. We

present our conclusions in Section 4.

2 Literature

Over the last few decades, we have observed substantial advances in globalization. Whether globalization has increased the role of global factors in inflation dynamics has been debated heavily in the literature. Studies use different approaches to assess the role of global factors.

One approach adds observed variables that capture global aspects to a Phillips curve framework and assess the explanatory power of the global variables. Gamber and Hung (2001) find globalization increases U.S. inflation's sensitivity to import prices. Borio et al. (2007) find that global excess demand has had a greater effect on inflation in advanced countries over time, even supplanting domestic factors in some cases. Ihrig et al. (2010) and Bańbura and Bobeica (2023), however, find no evidence supporting the growing importance of global variables. Eickmeier and Pijnenburg (2013) find that the common component of changes in unit labor costs has a notable impact on inflation in OECD countries. LeBlanc and Chinn (2004), Gregorio et al. (2007), and Chen (2009) examine the impact of oil price shocks on inflation in a Phillips curves framework. Obstfeld (2019) concludes that there are important interactions between the global economy and U.S. inflation. Kamber et al. (2020) find an important role of the foreign output gap in an open economy hybrid Phillips curve model, with generally larger effects of external driving forces for emerging market economies.

Other studies use factor models to estimate unobserved global common factors for inflation in a set of countries and assess the importance of global factors in national inflation. Hakkio (2009) estimates measures of common principal components in OECD inflation rates and shows that the common factor helps forecast national inflation in OECD countries. Ciccarelli and Mojon (2010) find that the inflations of 22 OECD countries have a common factor that accounts for nearly 70 percent of their variance. This phenomenon is robust to different sample periods, or to different frequencies (trend versus cyclical components). Mumtaz and Surico (2012) show that a global factor tracks the level and persistence of national inflation rates reasonably well in ten advanced economies. Monacelli and Sala (2009) find that one international common factor explains between 15 percent and 30 percent of the variance of consumer prices of 948 disaggregated products in OECD countries. Auer et al. (2019) find that a single common factor explains nearly half of the fluctuations in PPI inflation in 30 countries, and that international input linkages contribute to PPI comovement. Ha et al. (2019) find evidence of an increased role of global factors in inflation both in advanced and developing economies across different inflation measures. Forbes (2019), using principal component, a Phillips curve framework, and a trend-cycle decomposition, evaluates the role

of global factors in the dynamics of different inflation measures and finds that global factors are increasingly significant drivers of CPI inflation, while their roles are limited in core and wage inflation.

We take the second approach and use a factor model to analyze inflation in Korea, focusing on the relative importance between global versus country-specific factors. Previous studies generally find a significant global component in inflation, but mixed evidence on whether its role has increased over time. Across country groups, they find generally larger effects of external driving forces for emerging market economies than for advanced countries. Most of the previous studies focus mainly on the high inflation period of the 1970s and the subsequent period of stable inflation before the inflation hike post COVID-19 pandemic. Our analysis also includes the inflation data after the COVID-19 pandemic.

3 Empirical Analysis

In this section, we empirically investigate the extent to which global and country factors have driven inflation movements in Korea. To do that, we first estimate global and country factors from the inflation series in G-7 and Korea, then weigh the relative importance of the global versus country-specific factors in explaining inflation. We then incorporate the estimated factors into a factor-augmented VAR framework and analyze the roles of structural global and country shocks in various inflation dynamics. We also explore the economic contents of global and country factors.

3.1 Multi-level Factors

In this subsection, we estimate global and country factors from various inflation measures in Korea and other countries, using a multi-level factor model. We first document global and country factors' movements over the past several decades along with inflation measures. In addition, we examine the relative importance of global versus country factors in explaining the variance of different inflation measures in Korea for different periods.

3.1.1 Multi-level Factor Model and Data

We use a multi-level factor model proposed by Choi et al. (2018) to estimate global and country factors. The model has the following structure:

$$x_{mit} = \gamma'_{mi} G_t + \lambda'_{mi} C_{mt} + e_{mit}, \tag{1}$$
$$(m = 1, \ldots, M;\ i = 1, \ldots, N_m;\ t = 1, \ldots, T)$$

where x_{mit} is an i^{th} inflation measure in country m in month t, G_t is a global factor affecting all inflation series in all countries, C_{mt} is a country factor affecting inflation within each specific country, γ_{mi} and λ_{mi} are the factor loadings, and e_{mit} is an idiosyncratic component in each inflation series. Factors are estimated by a sequential procedure based on canonical correlation and principal component analysis. Choi et al. (2018) show that the model performs well in finite samples.

In order to analyze factors affecting inflation in Korea, we include Korea and the G-7 countries in the sample. The G-7 countries (the U.S., U.K., France, Germany, Italy, Canada, and Japan) are important trading partners of Korea and have major influences on the global economy. The sample countries are divided into six country groups–Korea, the U.S., the U.K., Japan, Canada, and EU (Germany, France, and Italy). Our sample period is from January 1975 to June 2022, which captures enough time-series variations in global inflation. We estimate factors from a balanced panel of monthly inflation series based on the consumer price index (CPI), the producer price index (PPI), the export price index, the import price index, the measures of core CPI (excluding food and energy prices), CPI excluding agricultural products oils, or core personal consumption expenditures (PCE) price index, depending on the sample countries. Each inflation measure is relative to the same month of the previous year, quadratic detrended, and standardized to have a zero mean and unit standard deviation prior to estimation. The list of inflation series included for each country is listed in Appendix A. The choice of the sample countries reflects the economic importance of each country on one hand, but is also restricted by the data availability of inflation series. There are a few countries that have long monthly time-series data for different inflation series. For robustness, we experiment with a sample of 38 countries, both advanced and developing, in Section 3.1.2.

We assume a single global factor and one country factor in each country group. Given the structure of the multi-level factor models, we cannot allow many factors since the number of global plus country factors cannot exceed the number of included data in each country group. When we apply Bayesian and Hannan-Quinn information criteria under the upper limit of two factors, the optimal number of the global and country factors is chosen to be one.

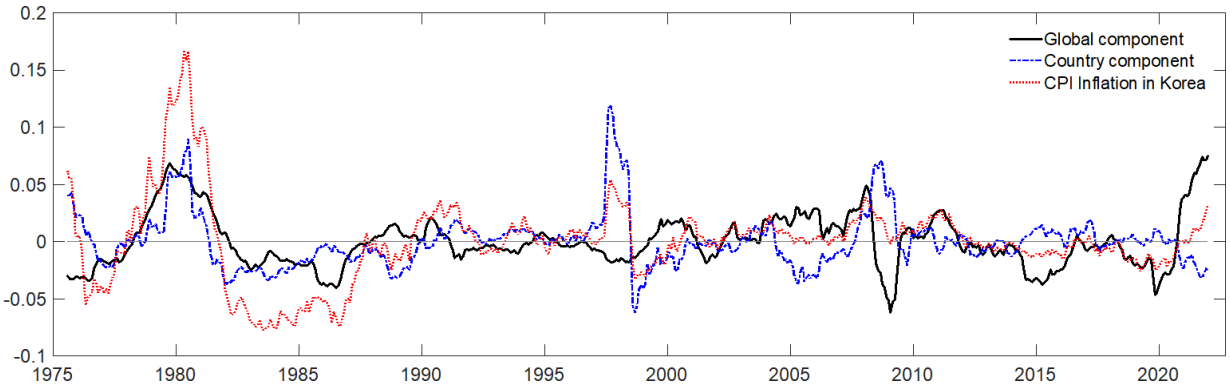
3.1.2 Estimated Global and Country Factors

Figure 1 shows the estimated global component, Korea-specific country component, and CPI inflation from January 1976 to June 2022.[1] Overall, both the global and country factors

[1]CPI inflation is quadratically detrended. The estimated factors are also based on inflation series detrended quadratically.

appear to explain CPI inflation well. The global factor tends to be smoother than the country factor. The global factor appears to capture particularly well a strong inflation hike after the COVID-19 pandemic in 2020 as well as high inflation in the late 1970s and early 1980s and a subsequent slowdown in inflation in the mid 1980s. A sharp rise in the global factor after the COVID-19 pandemic seems to suggest that the inflation spike after 2020 may have been driven by the contribution of the global factor. The global factor, however, exhibits substantial deviations from CPI inflation in the late 1990s around the Asian financial crisis. This is the period when the country factor closely co-moved with CPI inflation. The estimated country factor appears to explain inflation movements in the 1970s and 1980s reasonably well. After the mid 2010s, the country factor poorly tracks CPI inflation in Korea.

Figure 1: Global and Country Components in CPI inflation in Korea



Notes: The figure plots the global component (factor × loading), country component, and CPI inflation in Korea. CPI inflation is detrended by quadratic detrending.

One of the reasons we include Korea and only the G-7 countries in our sample is that we need at least three different monthly inflation measures in each country group for the entire sample period to be able to separately estimate the global and country factors within the multi-level structure of the model. To see whether the inclusion of more countries into the sample changes the result substantially, we experiment with a bigger sample of countries. We collect data on monthly CPI inflation from 38 countries, both developed and developing countries. We cannot use a multi-level structure, since each country has only one inflation measure in this sample. Thus, we estimate a global factor using a principal component analysis based on the CPI inflation data from 38 countries. We then regress various inflation measures in Korea on the estimated global principal component. We interpret the residuals from these regressions as the combination of the country component and the idiosyncratic component in each inflation measure. Our estimate of the country factor is the principal component extracted from these residuals. Figure B1 in Appendix B displays the estimated

global and country components using this method. Overall, the movements in the global and country factors are similar to those in Figure 1. Both the global and country factors track CPI inflation fairly well. They both rose in the early episode of high inflation in the late 1970s. During the short rise in inflation around the Asian financial crisis, the country factor closely co-moved with CPI inflation. The global factor rose sharply along with CPI inflation after the COVID-19 pandemic.

3.1.3 Relative Importance of Global and Country Factors

To weigh the relative importance of the global versus country-specific factors in national inflation in Korea, we perform variance decomposition of the realized inflation series. Since the global, country-specific, and idiosyncratic components in equation (1) are orthogonal, the variance of the ith inflation series in country m can be written as:

$$Var(x_{mit}) = \gamma_{mi}^2 Var(G_t) + \lambda_{mi}^2 Var(C_{mt}) + Var(e_{mit}).$$

Then, the importance of the global factor in explaining inflation is measured by the fraction of the total variance of inflation due to the global factor. The share of variance in inflation attributable to the global factor is

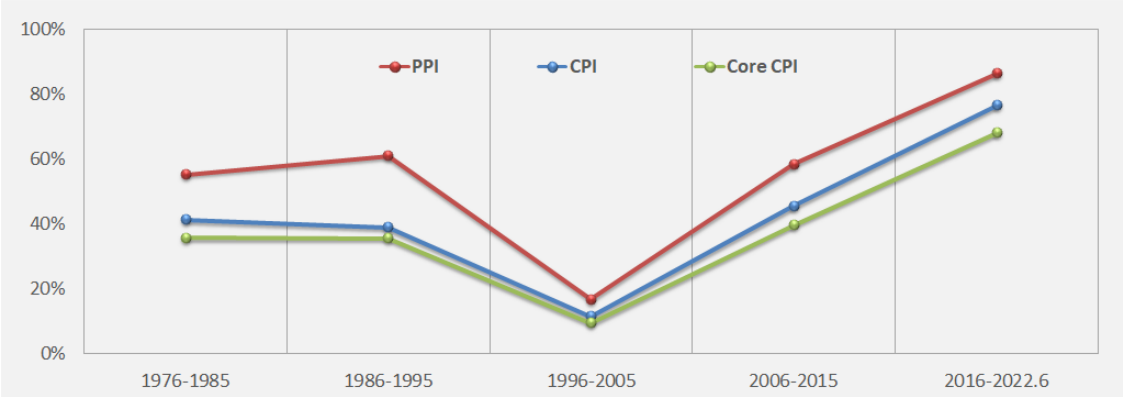
$$\frac{\gamma_{mi}^2 Var(G_t)}{Var(x_{mit})}.$$

The variance shares due to the country factor and inflation-specific idiosyncratic component are calculated similarly.

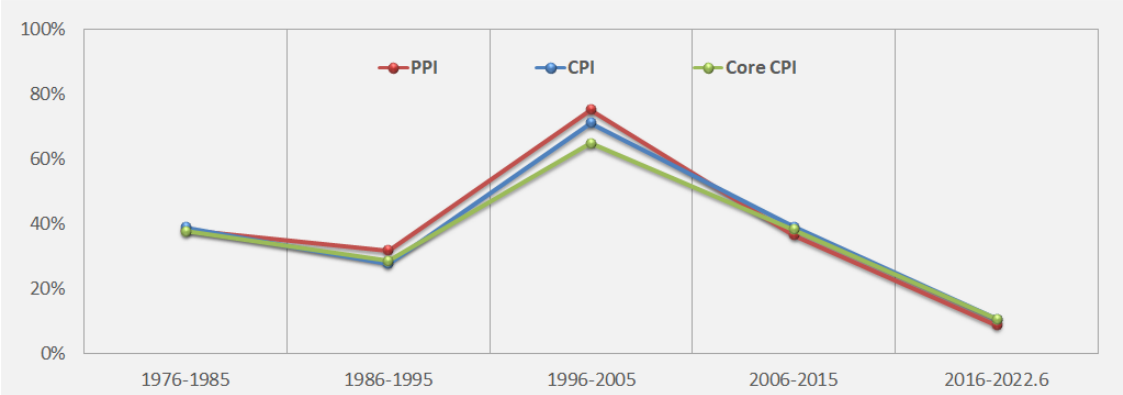
Figure 2 displays the variance shares of CPI, PPI, and Core CPI inflation explained by the global factor (Panel (a)) and by the Korea-specific country factor (panel (b)) for five non-overlapping windows, 1976-1985, 1986-1995, 1996-2005, 2006-2015, and 2016-June 2022.[2] In the first subperiod from 1976 to 1985, the importance of the global and country factors was similar in CPI and core CPI inflation. The variance shares of the global and country factors in CPI inflation were 41 percent and 39 percent, and those in Core CPI inflation were 36 percent and 38 percent, respectively. This implies that the global and country factors were almost equally important in CPI variations for the high inflation episode in the late 1970s and for the subsequent slowdown of inflation in the early 1980s. In PPI inflation, however, the importance of the global factor was higher than that of the country factor, 56 percent versus 38 percent, suggesting a bigger contribution of the global factor in PPI inflation. The global factor share remained similar in the second subperiod from 1986 to 1995 in CPI and Core CPI inflation (39 percent and 36 percent, respectively), while it rose to 61 percent in

[2]Core CPI inflation refers to inflation in the consumer price index excluding agricultural products and oils.

Figure 2: Percent of Inflation Variance Explained by Global and Country Factors



(a) Variance Share due to the Global Factor



(b) Variance Share due to the Country Factor

Note: The figure plots the share of variance of CPI, PPI, and Core CPI inflation due to the global component (panel (a)) and due to the country component (panel (b)) for each subperiod.

PPI inflation. The importance of the country factor fell in all three inflation measures in the 1986-1995 window.

The relative importance of the global versus country factor changes drastically in the third subperiod of 1996-2005 which includes the Asian financial crisis. The importance of the global factor fell sharply in this period, suggesting a limited role of the global factor in inflation during the Asian financial crisis and in the subsequent recovery period. The variance shares of the global factor in CPI, PPI, and Core CPI inflation were only 12 percent, 17 percent, and 9 percent, respectively. This was the period when the country factor dominated in inflation variation. The variance shares due to the country factor were quite high at 71 percent, 75 percent, and 65 percent in CPI, PPI, and Core CPI inflation, respectively. It implies that the short rise in inflation during the Asian financial crisis and the following price movement in the early 2000s were mainly driven by factors with domestic origins.

The importance of the global factor rose sharply afterwards, and even exceeded 80 percent for PPI inflation in the last subperiod after 2016. During the period 2006-2015, the variance shares of the global factor in CPI, PPI, and Core CPI inflation rose to 46 percent, 58 percent, and 40 percent, respectively, similar to the levels in the 1970s and 1980s. The importance of the global factor continued to rise and reached to 77 percent, 86 percent, and 68 percent in CPI, PPI, and Core CPI inflation, respectively, in the last subperiod from 2016 to June 2022. The variance shares of the country factor, on the other hand, sharply fell over the last two subperiods. During the period 2006-2015, the variance shares of the country factor in CPI, PPI, and Core CPI were 39 percent, 37 percent, and 38 percent, respectively, similar to the first subperiod. In the last subperiod, the importance of the country factor shrank to around 10 percent in all three inflation measures. Thus, the main drivers of muted inflation over the 2000s before 2020 and the recent inflation hike after the COVID-19 pandemic appear to be global rather than country factors.[3]

Across different inflation measures, the global factor is the most important driver of PPI inflation and does less to CPI or Core CPI inflation. Core CPI inflation, in particular, has the smallest importance of the global factor in its variation. This is consistent with the findings in Forbes (2019). The importance of the country factor does not vary greatly with inflation measures.

3.2 Factor-augmented VAR Models

In this subsection we incorporate the estimated factors into a factor-augmented VAR framework and analyze the roles of structural global and country shocks in various inflation dy-

[3]The results for the variance decomposition based on the 38 sample countries are similar to the benchmark results. The results are available upon request.

namics.

3.2.1 Three-Variable FAVAR Model: Global Factor, Country Factor, and Inflation

We first construct a three-variable structural vector autoregressive (SVAR) model with the global factor and the country factor extracted above, and the CPI inflation rate for the case of Korea as follows.

$$\begin{bmatrix} G_t \\ C_t \\ \pi_t \end{bmatrix} = \begin{bmatrix} A_{11}(L) & A_{12}(L) & A_{13}(L) \\ A_{21}(L) & A_{22}(L) & A_{23}(L) \\ A_{31}(L) & A_{32}(L) & A_{33}(L) \end{bmatrix} \begin{bmatrix} u_t^G \\ u_t^C \\ u_t^\pi \end{bmatrix} \tag{2}$$

$$A_{ij}(L) = \sum_{k=0}^{\infty} a_{ij}^k L^k$$

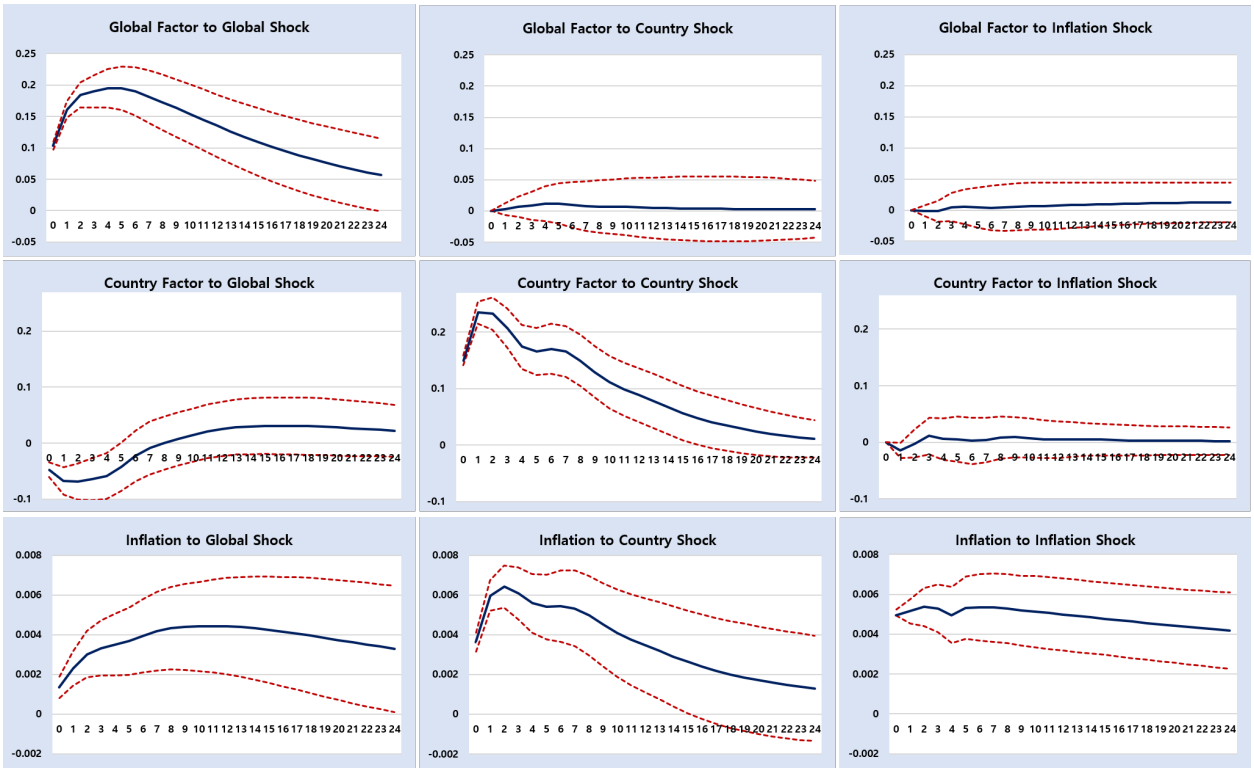
where G_t, C_t, and π_t are the global factor, the country factor, and the inflation rate, and u_t^G, u_t^C, and u_t^π are global shocks, country shocks, and idiosyncratic inflation shocks, respectively. L is a lag operator. The three structural shocks are identified with three short-run restrictions of no contemporaneous effect of country shocks on the global factor and no contemporaneous effect of idiosyncratic inflation shocks on the global factor and country factor, implying that the structural shocks are recovered by the Cholesky decomposition of the covariance matrix of residuals from a finite-lag unrestricted VAR estimation model ordered as the global factor, the country factor, and inflation. The lag length is six in the estimation.[4] A one standard deviation global shock raises the inflation rate by 0.13 percent point immediately and makes its peak at 0.44 percent point around ten months later. CPI inflation rate rises by 0.36 percent point at the impact period and reaches quickly its peak at 0.64 percent point in two months.

Figure 3 shows impulse responses of global factor, country factor, and inflation to a one standard deviation of the three structural shocks identified as global shocks, country shocks, and idiosyncratic inflation shocks. Global factor is explained by its own shocks, global shocks and the responses to country shocks and idiosyncratic inflation shocks are insignificant, which is intuitively reasonable. The country factor also responds mainly to country shocks but has a slightly negative response to global shocks in a half-year horizon, which may be related to an absorption process domestically in the short run. The focus of this study is on the relative importance of structural shocks in explaining inflation behavior. The bottom panel of Figure 3 shows impulse responses of Korean CPI inflation to the three

[4]The conventional lag-length selection methods such as AIC, SIC, etc. give different numbers of lags. Thus, the lag length is determined as a case that produces stable impulse responses to the structural shocks. The VAR estimation model includes a constant term and including a linear trend or a quadratic trend does not change the results qualitatively.

shocks. The immediate impact of country shocks on CPI inflation is stronger than that of global shocks. Global shocks have a more persistent effect on CPI inflation than country shocks. The peak effect occurs in two months for country shocks, while in eleven months for global shocks. In sum, global shocks have a more persistent and longer effect on Korean CPI inflation than country shocks, which is also confirmed in the forecast-error variance decomposition presented in Table 1 below.

Figure 3: Impulse Responses to Global, Country, and Idiosyncratic Shocks



Note: Blue solid lines are impulse responses of the variables to a one standard deviation increase in each of the structural shocks and red dotted lines are 95 percent confidence intervals.

Table 1 presents the relative importance of each of the structural shocks in explaining the fluctuations of global factors, country factors, and CPI inflation. The numbers are the percentages of fluctuations in global factor, country factor, and CPI inflation explained by global shocks, country shocks, and idiosyncratic inflation shocks, respectively. As expected from the construction of multi-level factors described in the previous subsection, the global factor is almost entirely explained by global shocks over all the horizons and the country factor also fluctuates mainly due to country shocks. The fluctuations in CPI inflation are attributed to the three structural shocks evenly in the long run while mostly to idiosyncratic shocks and country shocks in the short run.

It would be interesting to see whether the relative importance of the three structural

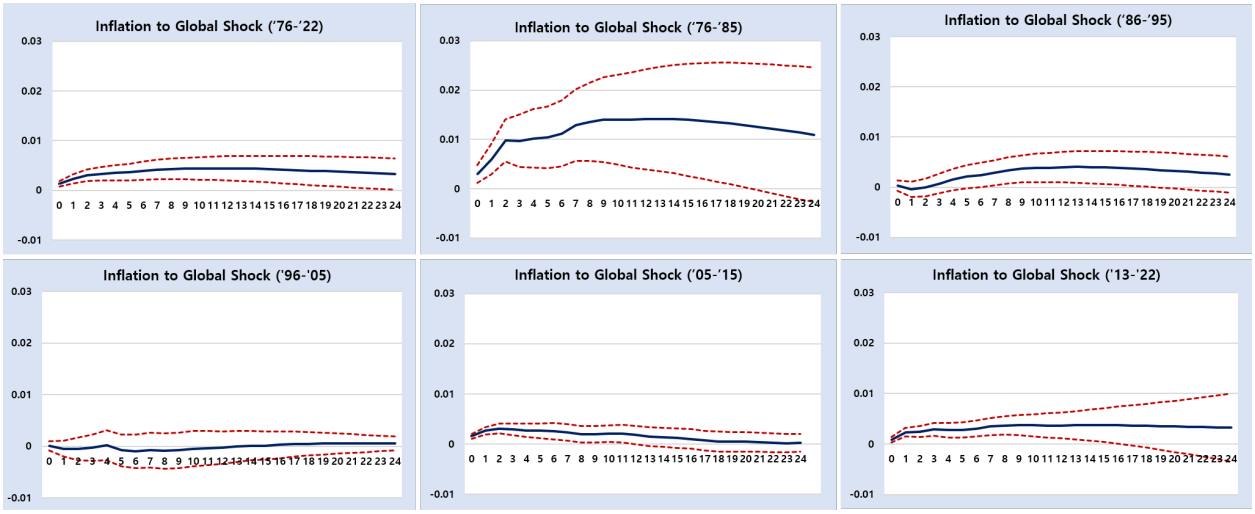
Table 1: k-Period Ahead Forecast-Error Variance Decomposition

k	Global shocks	Country shocks	Idiosyncratic shocks
		Global Factor	
1	100.0	0.0	0.0
2	100.0	0.0	0.0
4	99.9	0.1	0.0
8	99.7	0.2	0.0
12	99.7	0.2	0.1
18	99.6	0.2	0.2
24	99.5	0.2	0.3
		Country Factor	
1	9.2	90.8	0.0
2	8.1	91.7	0.2
4	8.2	91.6	0.2
8	6.9	92.9	0.1
12	6.0	93.9	0.2
18	6.8	93.0	0.2
24	7.7	92.1	0.2
		CPI Inflation	
1	4.6	33.4	62.0
2	6.6	45.7	47.7
4	10.4	48.5	41.1
8	15.7	44.7	39.7
12	20.2	39.7	40.1
18	24.7	33.4	41.9
24	26.8	29.3	43.9

Note: The numbers are the percentages of fluctuations in global factor, country factor, and CPI inflation attributed to global shocks, country shocks, and idiosyncratic inflation shocks, respectively, identified with the short-run restrictions.

shocks in explaining CPI inflation changes over time. Figure 4 shows impulse responses of CPI inflation to global shocks over different time periods. The top left panel of Figure 4 is estimated impulse responses for the whole period from January 1976 to June 2022 and the other five impulse responses are for each of the ten-year subperiod spans.[5] It is clear that the effect of global shocks on Korean CPI inflation varies significantly over time. The response of inflation to global shocks is largest in the 1976-1985 period. This suggests that the sharp oil price increase during the second oil price shock in 1979-1980 and the decline in the oil price after 1981 through 1985 turned out to be the main driver of inflation movements globally over the subperiod 1976-1985. On the contrary, the impact of global shocks is insignificant over the 1996-2005 years when Korea experienced significant economic turmoil during the Asian financial crisis of 1997-1998.

Figure 4: Impulse Responses of Inflation to Global Shocks across Subperiods



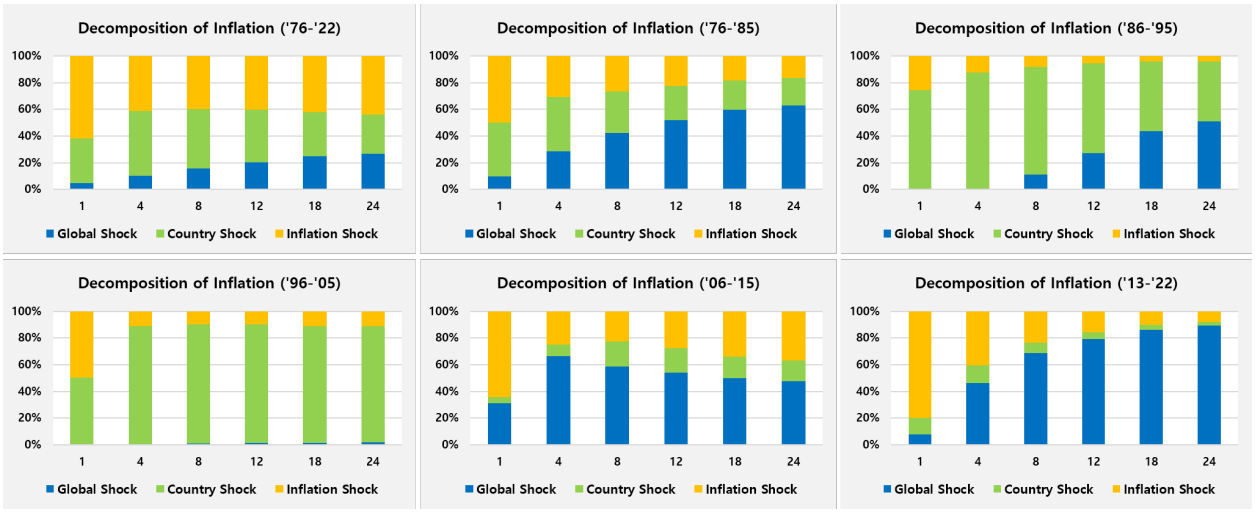
Note: Blue solid lines are impulse responses of the variables to a one standard deviation increase in global shocks and red dotted lines are 95 percent confidence intervals.

Figure 5 shows the relative share of each of the structural shocks in explaining the fluctuations of CPI inflation in terms of forecast error variance at selective horizons of 1, 4, 8, 12, 18, and 24 months across the ten-year subperiods. The relative importance of global shocks is higher during the subperiod 1976-1985 and disappears during the subperiod 1996-2005. Clearly, country shocks are a dominant factor for CPI inflation during that period. However, global shocks regain influence over the subperiod 2006-2015. Global shocks are a more important factor (accounting for about 90 percent of the forecast error variance) in explaining CPI inflation behavior than country shocks in the medium and long run in recent

[5]The impulse response in the bottom right panel is estimated over the period from January 2013 to June 2022, which is overlapped with the previous ten-year subperiod, since we need about ten year observations to get a stable impulse response in the three-variable SVAR model.

years including the COVID-19 period. In general, there is a tendency that the explanatory power of global shocks is growing at a longer horizon. Similar exercises are executed for PPI inflation and core inflation over the same subperiods, of which forecast error variance decompositions are presented in Figure C1 and Figure C2 in Appendix C. We find that the contribution of global shocks to Korea's PPI inflation becomes greater than the case of CPI inflation but global shocks are less important in explaining Korea's core inflation and instead, idiosyncratic inflation shocks explain more.

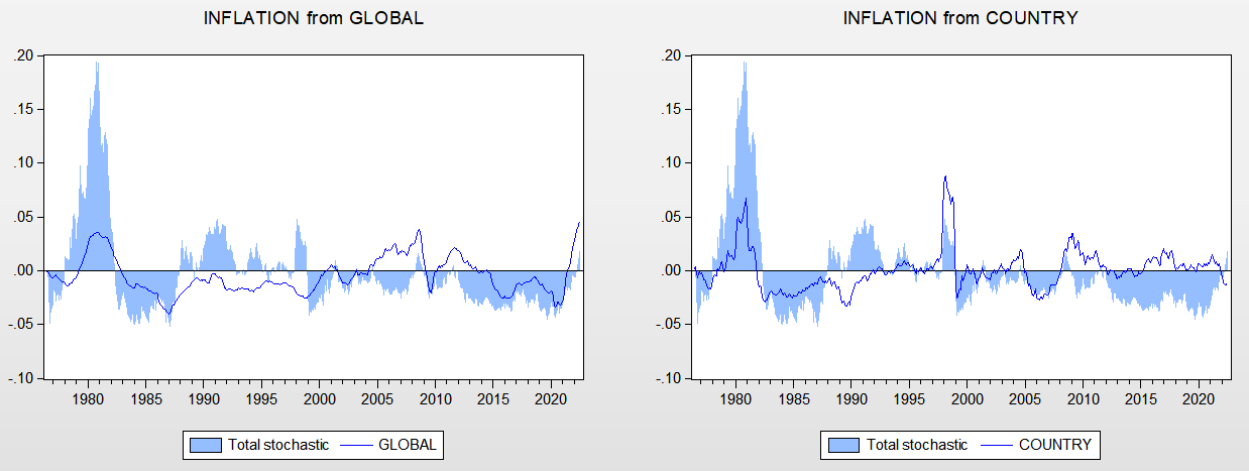
Figure 5: Forecast Error Variance Decomposition across Subperiods



Note: The bar graphs show the relative share of each of the structural shocks in explaining the fluctuations of CPI inflation in terms of forecast error variance at selective horizons of 1, 4, 8, 12, 18, and 24 months across the ten-year subperiods.

It may be informative to see how much of the stochastic component is historically decomposed into global shocks and country shocks, which is presented in Figure 6. In Figure 6 the light blue area indicates the total historical stochastic components of CPI inflation and the solid lines are the parts explained by global shocks in the left panel and country shocks in the right panel, respectively. It shows that global shocks and country shocks explain equally important parts of the total stochastic component during the 1980s. However, the contributions of global shocks and country shocks are small during the 1990s before the Asian financial crisis period of 1998-2000. Country shocks are an important factor during the Asian financial crisis and the low inflation years from 2005 to 2008. During the low inflation period from the global financial crisis to the recent hike in inflation global factors are the main driving source of inflation. The most recent sharp increase in inflation rates is also from global shocks. The historical decomposition of CPI inflation extracted from the three-variable SVAR model generally captures experiences consistent with historical episodes.

Figure 6: Historical Decomposition of CPI Inflation

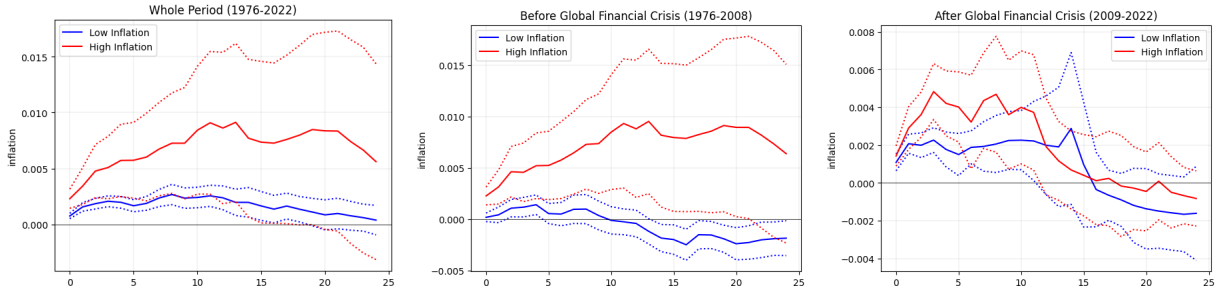


Note: The light blue area indicates the total historical stochastic components of CPI inflation and the solid lines are the parts explained by global shocks in the left panel and country shocks in the right panel, respectively.

3.2.2 Asymmetric Impulse Responses across Inflation Regimes: Local Projection Method

Another interesting aspect of the SVAR analysis is the existence of asymmetry of impulse responses to structural shocks depending upon threshold variables. In particular, we are interested in whether there is any difference in the propagation of global shocks to Korean inflation across inflation regimes such as a high inflation regime versus a low inflation regime. Figure 7 compares impulse responses of Korean CPI inflation rates to global shocks in high inflation regimes and low inflation regimes estimated by the local projection method developed by Jordà (2005). The red solid lines are impulse responses of Korean CPI inflation during high inflation regimes with the two red dotted lines as a 95 percent confidence interval and the blue sold lines are impulse responses during low inflation regimes. It appears that there is an asymmetry across regimes. From the left panel of Figure 7 global shocks influence Korean inflation rates much more in high inflation regimes in Korea than in low inflation regimes. We may think of reasons of the asymmetry of impulse responses in two aspects: one is the size of the shock and the other is a change in the behavior of inflation across the regimes. The size of one standard deviation global shocks may be different across inflation regimes such that it is larger in a high inflation regime than in a low inflation regime. We also examine whether this asymmetry has changed over time, in particular, for the two subperiods, before and after the global financial crisis, which is identified from the center panel and the right panel of Figure 7. It is observed that the asymmetry is found before the global financial crisis but this asymmetry weakens after the global financial crisis.

Figure 7: Asymmetry in Responses of Inflation to Global Shock across Regimes



Notes: The red solid lines are impulse responses of Korean CPI inflation during high inflation regimes with the two red dotted lines as a 95 percent confidence interval and the blue sold lines are impulse responses during low inflation regimes. The left panel is for the whole period, 1976-2022, the center panel is for the period before the global financial crisis, 1976-2008, and the right panel is for the period after the crisis, 2009-2022, respectively.

3.2.3 Five-Variable FAVAR Model: Roles of Oil Prices and Real Exchange Rates

We now turn to alternative SVAR models to see what global shocks and country shocks really are. It has been considered that oil prices exert a great influence on global inflation. The Korean economy is very highly dependent on the import of oil and vulnerable to oil price shocks.[6] Another critical aspect of inflation dynamics in Korea to be considered is exchange rate behavior. Since Korea is a small open economy heavily dependent on international trade, Korea's CPI inflation may be highly affected by changes in exchange rates. In fact, a sharp depreciation of the Korean currency during the Asian financial crisis and the recent experience of depreciation over global inflation has been considered to contribute to Korea's inflation. Therefore, it is a natural extension of the model to include two more variables: oil prices and real exchange rates for a small open economy such as Korea. The motivations to add the two variables are to see how much global shocks are influenced by oil price shocks and country shocks by real exchange rate shocks. We construct a five-variable VAR model as follows.

$$\begin{bmatrix} \Delta \ln O_t \\ G_t \\ \Delta \ln REX_t \\ C_t \\ \pi_t \end{bmatrix} = \begin{bmatrix} B_{11}(L) & B_{12}(L) & B_{13}(L) & B_{14}(L) & B_{15}(L) \\ B_{21}(L) & B_{22}(L) & B_{23}(L) & B_{24}(L) & B_{25}(L) \\ B_{31}(L) & B_{32}(L) & B_{33}(L) & B_{34}(L) & B_{35}(L) \\ B_{41}(L) & B_{42}(L) & B_{43}(L) & B_{44}(L) & B_{45}(L) \\ B_{51}(L) & B_{52}(L) & B_{53}(L) & B_{54}(L) & B_{55}(L) \end{bmatrix} \begin{bmatrix} v_t^O \\ v_t^G \\ v_t^{REX} \\ v_t^C \\ v_t^\pi \end{bmatrix} \tag{3}$$

[6]The Korean economy performed badly during the first and the second oil shock period, for example, recording the GDP's lowest growth rate of about -5 percent in several decades.

$$B_{ij}(L) = \sum_{k=0}^{\infty} b_{ij}^k L^k$$

where O_t and REX_t are oil price changes measured by the growth rate of Dubai crude oil prices relative to a year ago and changes in real effective exchange rates of Korean Won relative to the previous month, country factor, and inflation rate, and v_t^O, v_t^G, v_t^{EX}, v_t^C, and v_t^π are oil price shocks, global shocks, real exchange rate shocks, country shocks, and idiosyncratic inflation shocks, respectively.[7] The sample period for the five-variable SVAR model is from January 1991 to June 2022 due to the data availability of oil prices.[8] The structural shocks are identified with short-run restrictions of a lower triangular matrix in the impact period impulse response matrix and the variables are ordered as oil price growth rates, global factor, changes in real exchange rates, country factor, and CPI inflation rates. Oil prices are considered to be exogenous to all the other shocks at the impact period and real exchange rate shocks have no effect on oil prices and the global factor but affect the country factor and CPI inflation at the impact period. Country shocks and inflation-specific shocks have no contemporaneous effect on the real exchange rate, which reflects a characteristic of a small open economy and the purchasing power parity. Finally, inflation-specific shocks are assumed to have no contemporaneous effect on Korea's country factor.[9]

Figure 8 presents impulse responses of selected variables of interest to oil price shocks and real exchange rate shocks. Global factor responds significantly to oil price shocks and thus CPI inflation does too. The impact of oil price shocks on the global factor and CPI inflation remains significant for more than a year. On the contrary, the country factor does not respond to oil price shocks but significantly to real exchange rate shocks. Therefore, we may summarize the estimated impulse responses as that oil price shocks generate a significant CPI inflation response primarily through global factors, while real exchange rate shocks have a strong impact on inflation through country factors.[10]

[7]Korea's import share of crude oil from the Middle East countries has been about 80-90 percent even though it recently fell to 60 percent. Thus, the Dubai crude oil price is frequently used as a benchmark international oil price for Korea.

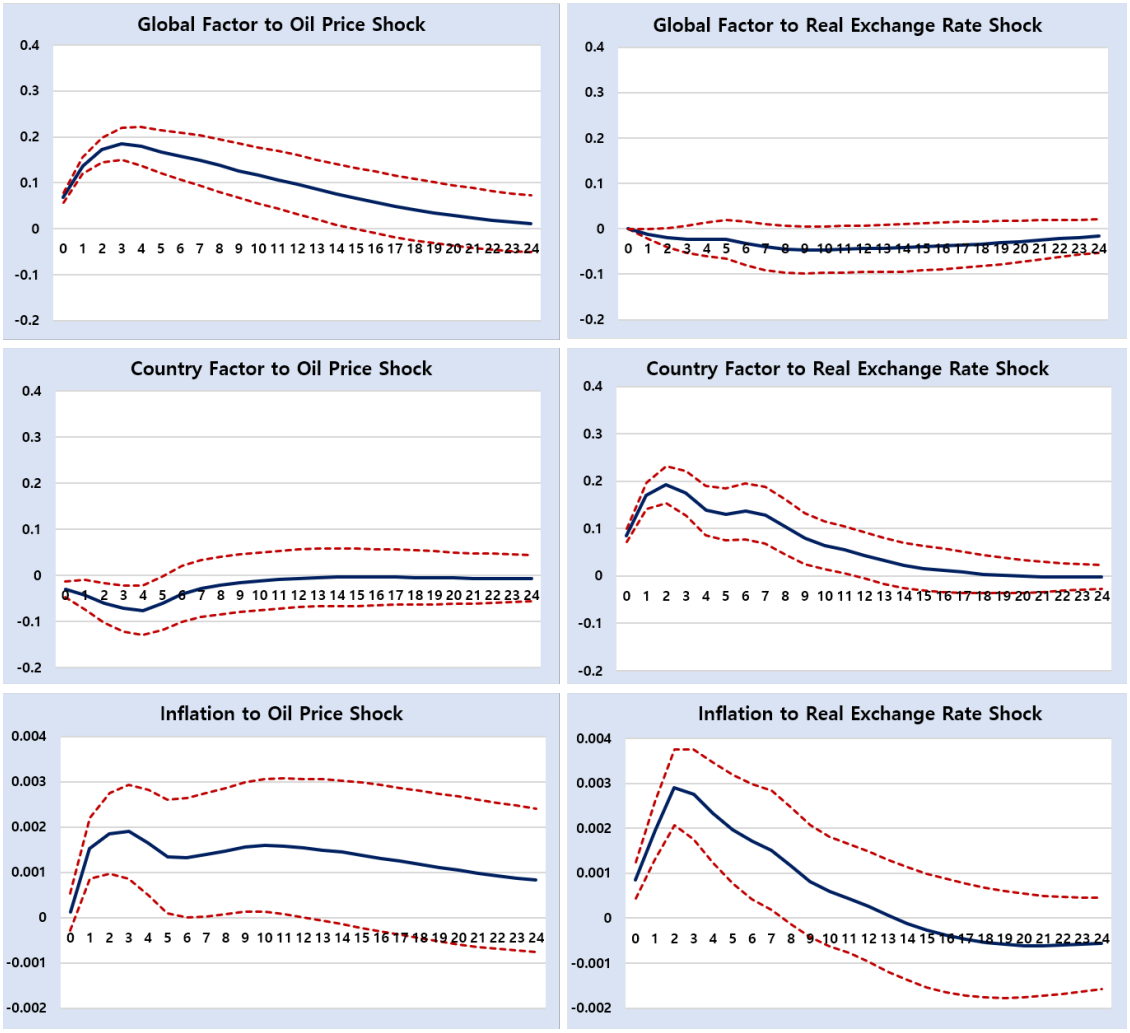
[8]The Dubai crude oil price is available from January 1990 and we use the growth rate of oil prices relative to a year ago.

[9]This set of identifying restrictions is summarized as

$$b_{12}^0 = b_{13}^0 = b_{14}^0 = b_{15}^0 = b_{23}^0 = b_{24}^0 = b_{25}^0 = b_{34}^0 = b_{35}^0 = b_{45}^0 = 0.$$

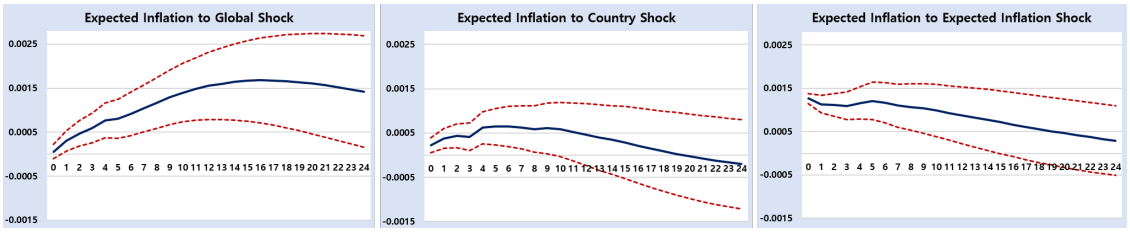
[10]When we use alternative measures of inflation such as PPI inflation, core inflation, and import price inflation, the impulse responses are somewhat different as follows, which is presented in Appendix, Figure C3. PPI inflation and import price inflation tend to respond significantly to both oil price shocks and real exchange rate shocks while core inflation tends to respond only to real exchange rate shocks in the short run.

Figure 8: Impulse Responses to Oil Price and Exchange Rate Shocks



Note: Blue solid lines are impulse responses of the variables to a one standard deviation increase in global shocks and red dotted lines are 95 percent confidence intervals.

Figure 9: Impulse Responses of Expected Inflation to Global and Country Shocks



Note: Blue solid lines are impulse responses of the variables to a one standard deviation increase in global shocks and red dotted lines are 95 percent confidence intervals.

3.2.4 Effects of Global Shocks and Country Shocks on Expected Inflation

The formation of expected inflation of economic agents has become more important since rational expectations were introduced and the role of information was emphasized. We replace the actual CPI inflation with the expected inflation surveyed for the upcoming 12-month period by the Bank of Korea in the three-variable FAVAR model. Figure 9 shows impulse responses of expected inflation to global shocks, country shocks, and idiosyncratic expected inflation shocks. The effect of global shocks on expected inflation is long-lasting and significant even though the confidence interval of the response in the long run is wide. Relatively country shocks have a short-lived effect on the expected inflation.

Table 2 presents the relative importance of the three structural shocks in the fluctuations of global factors, country factors, and expected inflation for selected horizons. It is the same as the benchmark three-variable model with the actual CPI inflation in the aspect that global factors are almost explained solely by global shocks but country factors are explained by global shocks and country shocks. The forecast error variance of expected inflation is explained by the idiosyncratic component of expected inflation in the short run but the importance of global shocks grows as the horizon is longer. At a one and half year or longer horizon global factors are a dominant factor for expected inflation. It is interesting that country shocks do not play an important role in forming expected inflation. It appears that expected inflation is affected by factors that have a persistent effect.

3.3 Nature of Factors

One drawback of factor models is that the mapping of the factors to observed economic variables is not straightforward and thus it is not easy to explain what is behind the global and country factors. Even though factors in our framework have been extracted from inflation series only, they contain information on underlying economic variables influencing inflation. The estimated global factor could reflect the global supply factor or global demand, or

Table 2: k-Period Ahead Forecast-Error Variance Decomposition of Expected Inflation

k	Global shocks	Country shocks	Expected Inflation shocks
		Global Factor	
1	100.0	0.0	0.0
2	99.8	0.2	0.0
4	99.8	0.1	0.1
8	98.8	1.0	0.2
12	96.8	2.8	0.4
18	93.1	6.0	0.9
24	90.3	8.2	1.5
		Country Factor	
1	20.9	79.1	0.0
2	23.9	76.0	0.1
4	32.8	66.9	0.3
8	26.9	71.9	1.2
12	21.9	76.1	2.0
18	19.7	77.3	3.1
24	19.2	77.0	3.7
		Expected Inflation	
1	0.2	3.0	96.8
2	3.1	6.0	90.9
4	10.3	8.4	81.3
8	23.1	12.9	64.1
12	37.7	11.9	50.4
18	55.0	8.3	36.7
24	64.2	6.4	29.5

Note: The numbers are the percentages of fluctuations in global factor, country factor, and CPI inflation attributed to global shocks, country shocks, and idiosyncratic inflation shocks, respectively, identified with the short-run restrictions.

Table 3: Global Factor and Global Economic Variables

	Variable	R^2
Oil and Commodity	Brent oil prices	0.605
	Dubai oil prices	0.599
	WTI oil prices	0.466
	Copper prices	0.264
	Wheat prices	0.281
	Corn prices	0.228
	Natural gas prices	0.575
Real	OECD industrial production	0.065
	OECD composite leading indicator	0.000
	OECD business confidence index	0.004
Uncertainty	VIX index	0.010
US Monetary Policy	US monetary aggregate (M1)	0.032
	US federal funds rate	0.129

Note: The table reports the values of R^2 from the regressions of the global factor on each variable.

global uncertainty or liquidity conditions. It could be affected by real economic variables or nominal forces. The country factor could reflect real domestic economic conditions or nominal variables, or domestic response to global shocks. We will not be able to precisely identify the driving force behind the global and country factors. By examining what kind of observed economic variables are most closely related to the estimated factors, however, we can get an idea of what economic information the factors are capturing.

We regress the estimated global factor on some variables representing various aspects of the global economy. The R-squared (R^2) values from those regressions are reported in Table 3. Note that the R^2 value is the square of the correlation coefficient and remains the same when the dependent variable and the regressor switch around. We examine various oil and commodity prices, the measures of real economic activity, the measure of uncertainty, and the U.S. monetary policy variables as measures of global liquidity. The variables that have the highest association with the global factor are the Brent oil prices, Dubai oil prices, and natural gas prices, with values of R^2 of 0.605, 0.599, and 0.575, respectively. Other oil prices are also highly related with the global factor. Prices of commodities such as wheat, copper, and corn have some explanatory power for the global factor. The global factor's correlation with global real activities is surprisingly low. The global factor does not appear to reflect uncertainty in financial markets (VIX index), while it has some association with global liquidity conditions measured by the U.S. Federal Funds rate.

Table 4 reports the values of R^2 from the regression of the estimated Korean country factor on economic variables. Here, we test variables capturing various aspects of the Korean

Table 4: Country Factor and Global and Domestic Variables

	Variable	R^2
Global	Brent oil prices	0.225
	Dubai oil prices	0.239
	Copper prices	0.204
	Wheat prices	0.129
	Natural gas prices	0.048
	OECD industrial production	0.075
	OECD composite leading indicator	0.061
	OECD business confidence index	0.081
	VIX index	0.028
	US federal funds rate	0.003
Korea	Industrial production	0.266
	Monetary aggregate (M1)	0.031
	Call rate	0.130
	CD rate	0.122
	Monetary stabilization bond 2-year	0.167
	Corporate bond 3-year	0.135
	Nominal Won-Dollar exchange rate	0.568
	Real effective exchange rate	0.338

Note: The table reports the values of R^2 from the regressions of the country factor on each variable.

economy as well as global variables. Korea's country factor appears to be most closely related with the exchange rate. The value of R^2 for the nominal exchange rate and for the real effective exchange rate are 0.568 and 0.338, respectively. Industrial production has reasonably high explanatory power for the country factor, with the R^2 values of 0.266. The country factor is also related to interest rates. Among the interest rates, the two-year monetary stabilization bond has the highest association with the country factor. Among the global variables, Brent and Dubai oil prices, and copper prices have the biggest association with Korea's country factor.

In Figure 10, we plot the global factor with WTI oil prices in panel (a). Both Brent and Dubai oil prices have higher correlation coefficients with the global factor (0.78) than WTI oil prices, but are available only from 1990. Thus we plot WTI oil prices for which longer time series are available. As can be seen in the figure, the global factor and WTI oil prices closely co-move, with their correlation coefficient being 0.68. In panel (b), we plot the country factor together with the nominal exchange rate (Korean Won-U.S. dollar). The two series are highly correlated with a correlation coefficient of 0.75. To sum up, even though we cannot exactly identify what is behind the global and country factors, we can infer the factor content that the global and country factors convey. Oil prices and exchange rates have the

Figure 10: Estimated Factors and Correlated Variables

Notes: The global and country factors are estimated values from the sample of Korea and the G-7 countries using the multi-level factor model. The WTI oil price and the exchange rate have been log-differenced relative to the same month of the previous year, and standardized to have a zero mean and unit standard deviation.

greatest explanatory power for the global and Korea-specific inflation factors, respectively.

4 Conclusion

It has always been an interesting issue whether fluctuations in macroeconomic variables are attributed to worldwide components or country-specific components in an economy integrated to the world. Examining sources of inflation, in particular, has key importance because the transmission mechanisms and the effectiveness of monetary policy critically depend on how much global versus domestic factors contribute to inflation dynamics.

To investigate the extent to which global and country factors have driven inflation movements in Korea, we estimate global and country factors for inflation using a multi-level factor model developed by Choi et al. (2018). We find that the contribution of global factors to inflation in Korea was large in the era of high inflation in the 1970s, and recent periods after

COVID-19, while country factors played an important role in inflation around the Asian financial crisis. We also examine the roles of global and country-specific shocks in factor-augmented structural VAR models. We find that the effect of global shocks persists longer while the immediate impact of country shocks is larger. Global shocks are more important in PPI than in CPI or in core CPI inflation. Oil prices appear to closely comove with global factors and exchange rates are highly correlated with country factors in Korea.

The growing influence of global factors on inflation can be a challenge for policymakers since it may imply a weakening of monetary policy transmission and require international policy coordination. Policy makers at least need to consider the global environment more than before in a small open economy such as Korea when setting monetary policy.

References

Auer, Raphael A., Andrei A. Levchenko, and Philip Sauré, "International Inflation Spillovers through Input Linkages," *The Review of Economics and Statistics*, 2019, *101* (3), 507–521.

Bańbura, Marta and Elena Bobeica, "Does the Phillips Curve Help to Forecast Euro Area Inflation?," *International Journal of Forecasting*, 2023, *39* (1), 364–390.

Borio, Claudio E.V., , and Andrew Filardo, "Globalisation and Inflation: New Cross-Country Evidence on the Global Determinants of Domestic Inflation," *BIS working paper*, 2007, *227*.

Chen, Shiu-Sheng, "Oil Price Pass-Through into Inflation," *Energy Economics*, 2009, *31* (1), 126–133.

Choi, In, Dukpa Kim, Yun Jung Kim, and Noh-Sun Kwark, "A Multilevel Factor Model: Identification, Asymptotic Theory and Applications," *Journal of Applied Econometrics*, 2018, *33*, 355–377.

Ciccarelli, Matteo and Benoît Mojon, "Global Inflation," *Review of Economics and Statistics*, 2010, *92*, 524–535.

Eickmeier, Sandra and Katharina Pijnenburg, "The Global Dimension of Inflation - Evidence from Factor-Augmented Phillips Curves," *Oxford Bulletin of Economics and Statistics*, 2013, *75*, 103–122.

Forbes, Kristin J., "Inflation Dynamics: Dead, Dormant, or Determined Abroad?," *Brookings Papers on Economic Activity*, 2019, pp. 257–319.

Gamber, Edward N. and Juann H. Hung, "Has the Rise in Globalization Reduced U.S. Inflation in the 1990s?," *Economic Inquiry*, 2001, *39*, 58–73.

Gregorio, José De, Oscar Landerretche, Christopher Neilson, Christian Broda, and Roberto Rigobon, "Another Pass-through Bites the Dust? Oil Prices and Inflation," *Economia*, 2007, *7* (2), 155–208.

Ha, Jongrim, M. Ayhan Kose, and Franziska L. Ohnsorge, "Global Inflation Synchronization," *World Bank Policy Research Working Paper*, 2019, *8768.*

Hakkio, Craig S., "Global Inflation Dynamics," *Federal Reserve Bank of Kansas City Working Paper*, 2009, *RWP 09-01.*

Ihrig, Jane, Steven B. Kamin, Deborah Lindner, and Jaime Marquez, "Some Simple Tests of the Globalization and Inflation Hypothesis," *International Finance*, 2010, *13*, 343–375.

Jordà, Oscar, "Estimation and Inference of Impulse Responses by Local Projections," *American Economic Review*, 2005, *95* (1), 161–182.

Kamber, Güneş, Madhusudan Mohanty, and James Morley, "Have the Driving Forces of Inflation Changed in Advanced and Emerging Market Economies?," *BIS Working Papers*, 2020.

LeBlanc, Michael and Menzie Chinn, "Do High Oil Prices Presage Inflation? The Evidence from G-5 Countries," *Business Economics*, 2004, *39*, 38–48.

Monacelli, Tommaso and Luca Sala, "The International Dimension of Inflation: Evidence from Disaggregated Consumer Price Data," *Journal of Money, Credit, and Banking*, 2009, *41*, 101–120.

Mumtaz, Haroon and Paolo Surico, "Evolving International Inflation Dynamics: World and Country-Specific Factors," *Journal of the European Economic Association*, 2012, *10* (4), 716–734.

Obstfeld, Maurice, "Global Dimensions Of U.S. Monetary Policy," *NBER Working Paper*, 2019, *26039.*

Appendices

A Data

Table A1: Data Included in Multi-level Factor Estimation

Country	Data	Data Source
Korea	CPI	Bank of Korea
	PPI	Bank of Korea
	CPI excluding agricultural products and oils	Bank of Korea
	Export price index	Bank of Korea
	Import price index	Bank of Korea
United States	CPI	IMF
	PPI	FRED
	Core PPI	FRED
	PCE	FRED
	Core PCE	FRED
United Kingdom	CPI	IMF
	PPI	OECD
	Core CPI	OECD
Japan	CPI	IMF
	PPI	OECD
	Core CPI	OECD
Canada	CPI	IMF
	PPI	OECD
	Core CPI	OECD
France	CPI	IMF
	PPI	OECD
	Core CPI	OECD
Germany	CPI	IMF
	PPI	OECD
	Core CPI	OECD
Italy	CPI	IMF
	Core CPI	OECD

Notes: In the estimation of the multi-level factors, France, Germany, and Italy are included in a single country group. FRED indicates Federal Reserve Economic Data at the federal reserve bank of St. Louis.

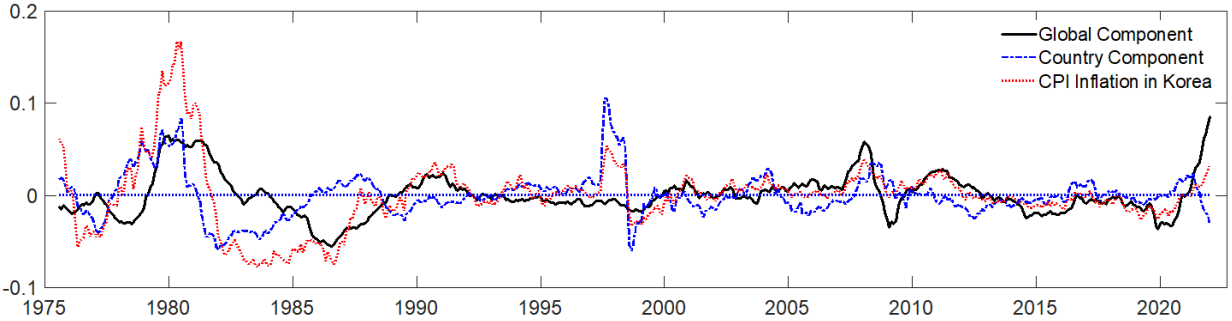
Table A2: Data for Factor-augmented VAR Models

Country	Data	Data Source
World	Dubai Crude Oil	FRED
	WTI Crude Oil	FRED
	Brent Crude Oil	FRED
	Copper Prices	FRED
	Wheat Prices	FRED
	Corn Prices	FRED
	Natural Gas Prices	FRED
Korea	Expected inflation	Bank of Korea
	Real Exchange Rate Index	IMF
	Industrial Production Index	Bank of Korea
	M1	Bank of Korea
	Call Rate	Bank of Korea
	CD Rate	Bank of Korea
	Monetary Stabilization Bond 2-year Rate	Bank of Korea
	Corporate Bond 3-year Rate	Bank of Korea
	Nominal Won-Dollar Exchange Rate	Bank of Korea
United States	VIX Index	FRED
	M1	FRED
	Federal Funds Rate	FRED

Note: FRED indicates Federal Reserve Economic Data at the federal reserve bank of St. Louis.

B Factors Estimated from the Sample of 38 Countries

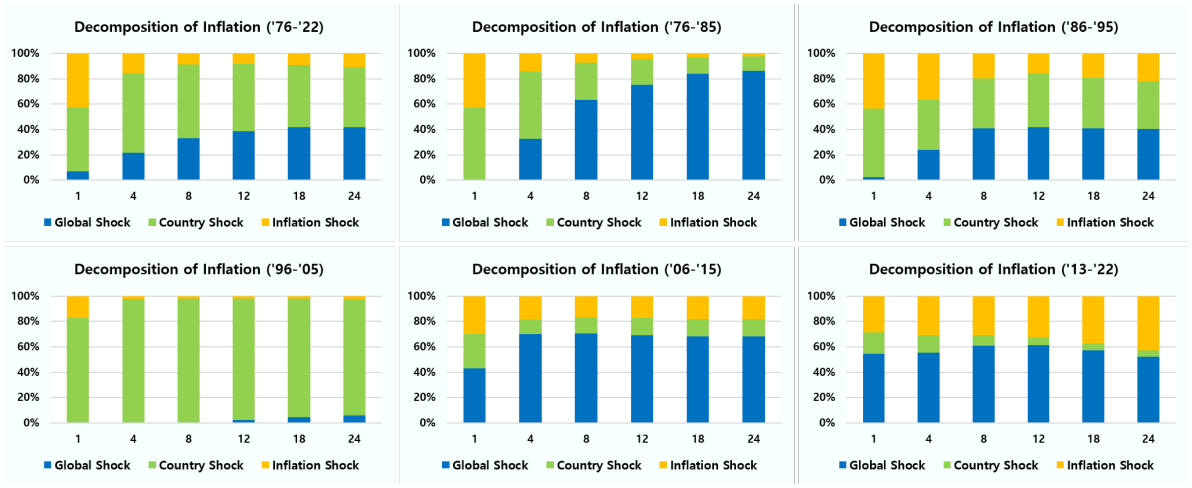
Figure B1: Global and Country Factors using the Sample of 38 Countries



Notes: The figure plots the global component (factor × loading), country component, and CPI inflation in Korea. CPI inflation is detrended by quadratic detrending. The global factor is estimated from CPI inflation in 38 countries, and Korea's country factor is estimated from the residuals from the regression of various Korean inflation measures on the global factor. Factor estimation is done by a principal component analysis. 38 Countries include Austria, Belgium, Canada, Colombia, Denmark, Egypt, Finland, France, Germany, Greece, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Malaysia, Mauritius, Mexico, Morocco, Netherlands, Nigeria, Norway, Pakistan, Philippines, Portugal, Singapore, South Africa, Spain, Sweden, Switzerland, Thailand, Türkiye, the UK, and the US.

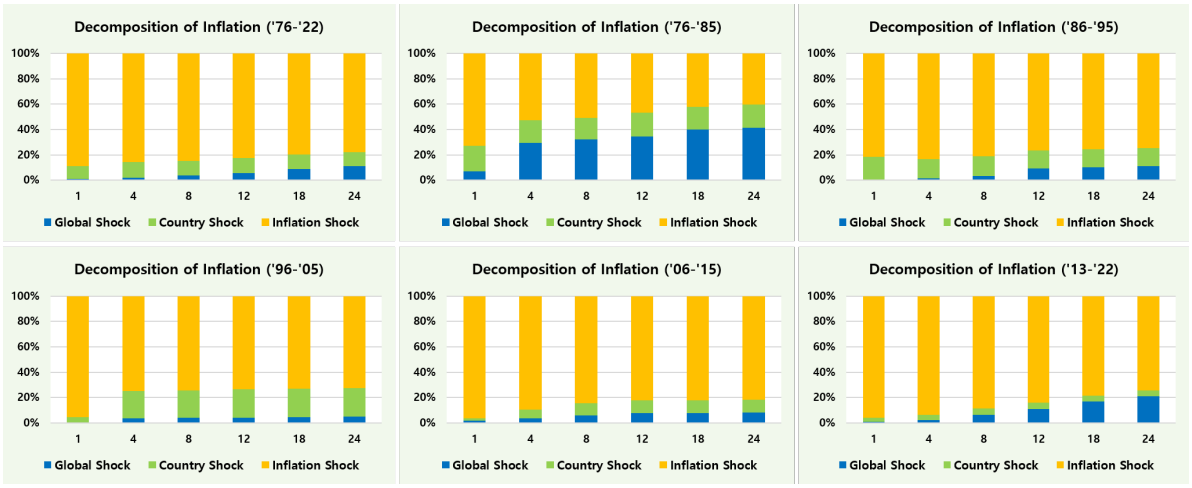
C SVAR Models with Alternative Inflation Measures: PPI and Core Inflation

Figure C1: Forecast Error Variance Decomposition of PPI Inflation



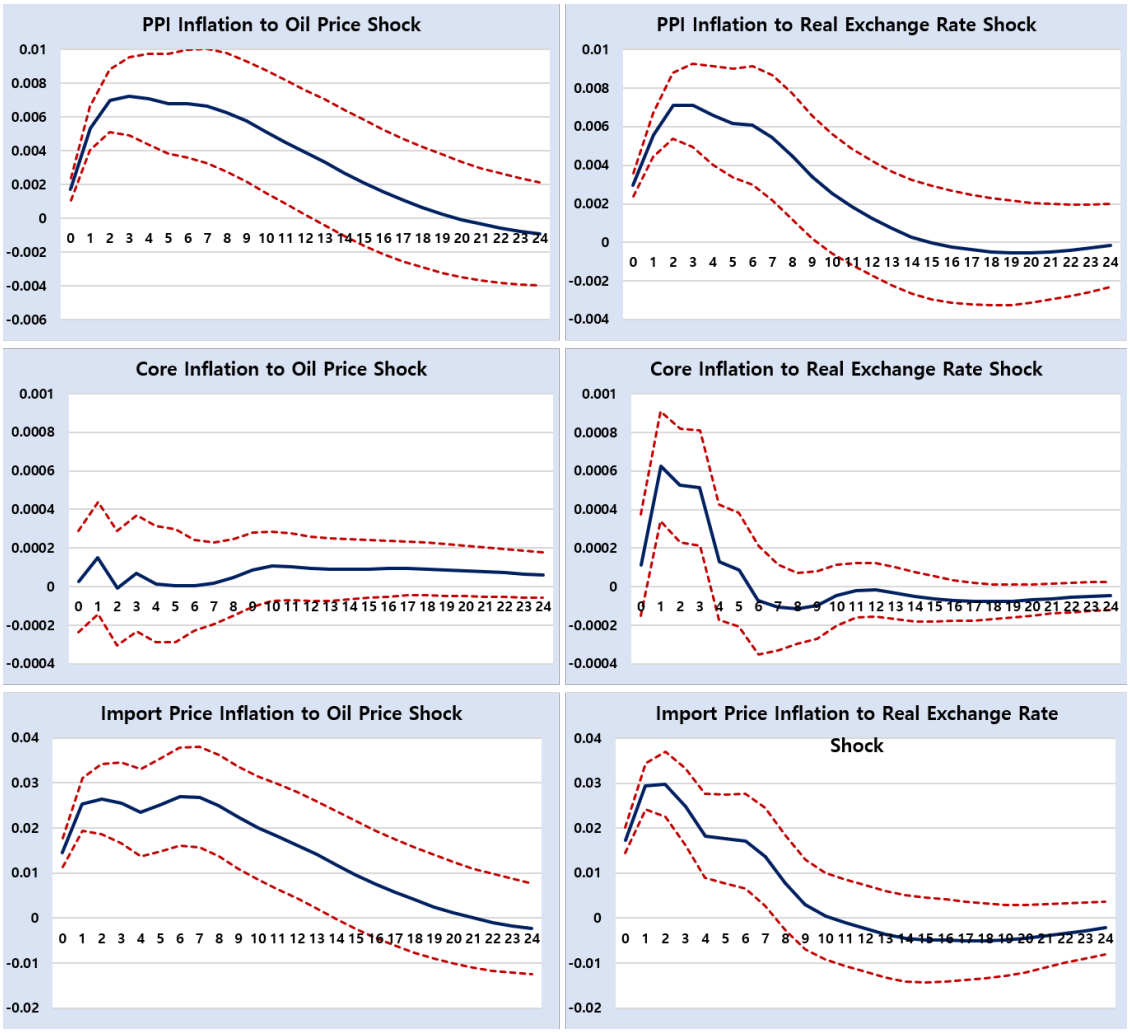
Note: The bar graphs show the relative share of each of the structural shocks in explaining the fluctuations of PPI inflation in terms of forecast error variance at selective horizons of 1, 4, 8, 12, 18, and 24 months across the ten-year subperiods.

Figure C2: Forecast Error Variance Decomposition of Core Inflation



Note: The bar graphs show the relative share of each of the structural shocks in explaining the fluctuations of core inflation in terms of forecast error variance at selective horizons of 1, 4, 8, 12, 18, and 24 months across the ten-year subperiods.

Figure C3: Impulse Responses of Alternative Inflation Measures to Oil Price and Exchange Rate Shocks in the Five-Variable SVAR Model



Note: Blue solid lines are impulse responses of the variables to a one standard deviation increase in global shocks and red dotted lines are 95 percent confidence intervals.