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Understanding Post-Pandemic Inflation in Japan and the U.S.: A Narrative Sign Restriction Approach *

Kaori Ochi[†]

March 2026

Abstract

Following the COVID-19 pandemic, the surge in inflation which defined its aftermath created a heightened interest amongst academics and policy makers to identify the structural factors of inflation dynamics. Against this backdrop, this paper uses a structural vector autoregression (SVAR) with narrative sign restrictions to characterize how the inflation episode of the COVID-19 pandemic compared across Japan and the U.S. The findings are threefold: (1) Japan and the U.S. share similar cyclical patterns in the sense that the initial inflation run-up was driven by supply and global shocks, followed by pent-up demand factors, which ultimately led to inflationary pressures from labor market tightening shocks, (2) labor market tightness shows the non-negligible contributions on inflation for both countries, and (3) narrative sign restrictions are informative as a strategy for the identification of structural shocks.

JEL Classification: C32, E31

Keywords: Inflation, structural vector autoregression, labor market tightness, narrative sign restrictions

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1. Introduction

In the aftermath of COVID-19 pandemic, surges in inflation in many countries were characterized by a complex set of events (IMF (2024)). Initially, following the shut-down of economic activities came a sharp decline in production, the closure of shops and restaurants, job losses or people leaving their jobs, and high volatility in financial markets. As economic activities recovered rapidly, helped by fiscal stimulus measures and large-scale monetary easing, a global rotation in demand towards goods, accompanied by global supply chain disruptions put further upward pressure on the relative price of goods. In addition to these factors, the hike in commodity prices triggered by Russia's invasion of Ukraine exerted additional pressure on inflation.

Examining the structural shocks of inflation fluctuations is critical for central banks because the sources of shocks have different implications for inflation inertia, which could ultimately lead to different policy prescriptions. Therefore, this set of events has challenged researchers to identify the structural shocks underlying this high-inflation episode. However, ongoing academic discussions have not yet reached a consensus on two main dimensions.

The first is whether the run-up to the inflation was caused by supply or demand. In the U.S., much of the literature reports the large contribution of demand factors to surges in inflation, with some exceptions, showing the shock to supply chain disruption and productive capacity heightened and kept inflation elevated. In the Euro Area, the literature highlights the inflationary effects of global supply chain disruption. On the contrary, some papers assert the inflation was predominantly driven by unexpectedly strong demand forces. In Japan, the large contribution of global supply-side factors after the pandemic are reported.

The second dimension is the role of labor market conditions on inflation. Assessing how the COVID-19 episode is characterized from the perspective of labor market is critical. However, views on the relationship between inflation rates and labor market tightness in the existing research is mixed. In the U.S., several studies show the significant contributions of labor market tightness in the surge of inflation. In contrast, some papers report limited contributions. Other papers point out that the strengthening of the link between unemployment rate and inflation depends on structural shocks in the labor market. In Japan, the weaker impact of labor market tightness on inflation compared with that in the U.S. are reported. One of the aspects that makes the task of clarifying the role of the labor market difficult is the fact that the labor market context differs significantly among economies. Qualitatively, in Japan, demographic changes imply a chronically tight labor market over the long run, driven by an aging population and a shrinking workforce, which are a gradual yet persistent structural factor. By contrast, the labor markets in the U.S. are dynamic, experiencing sharp, short-term changes since the pandemic, including large-scale layoffs, the so-called "Great Resignation," and subsequent rapid expansions in hiring. These contrasts highlight how labor market affects inflation, underscoring the importance of identifying the shocks and trends in each economy quantitatively.

Against this backdrop, this paper seeks to shed light on post-pandemic inflation dynamics using a Structural Vector Autoregression (SVAR) model with narrative sign restrictions, which is a technique yet to be applied to inflation data in Japan. The findings are threefold: (1) Japan and the U.S. share similar cyclical patterns in the sense that the initial inflation run-up was driven by supply and global shocks, followed by pent-up demand factors, which ultimately led to inflationary pressures from labor market tightening shocks, (2) labor market tightness shows the non-negligible contributions on inflation for both countries, and (3) narrative sign restrictions are informative as a strategy for structural shock identifications.

Literature review

This paper is closely related to three strands of the literature. The first is literature which decomposes the inflation rate to structural factors. In the U.S., [Bergholt *et al.* \(2026\)](#) report the large contribution of demand factors inflation surges by a VAR model that deals with the uncertainty around the impulse response functions. [Di Giovanni *et al.* \(2023\)](#) show aggregate demand shocks explain roughly two-thirds of total model-based inflation, and that fiscal stimulus contributes half or more of the total aggregate demand effect by calibrating multisector macro-network model. [Eickmeier and Hofmann \(2025\)](#) also report the larger contribution of demand factors over supply factors with estimating indicators of aggregate demand and supply conditions based on a factor model. [Bai *et al.* \(2024\)](#) show the shocks to supply chain disruption and productive capacity heightened and kept inflation elevated, with an analysis using the global supply chain index from the container ships data. In the Euro Area, [Banbura *et al.* \(2024\)](#), [De Santis \(2024\)](#), [Bergholt *et al.* \(2026\)](#) and [Ascari *et al.* \(2024\)](#) highlight the inflationary effects of global supply chain disruption with empirical analyses using a Bayesian VAR. On the contrary, [Giannone and Primiceri \(2024\)](#) assert the inflation was predominantly driven by unexpectedly strong demand forces using an SVAR. In Japan, [Fukunaga *et al.* \(2025\)](#) examine global inflation synchronization and the respective roles of domestic and global factors in driving consumer price inflation, and document the substantial contribution of global supply-side factors in the post-pandemic period. Consistent with their findings, this paper also identifies the large contribution of global factors around 2022 through early 2023. In addition, whereas the previous studies do not closely examine developments thereafter, this analysis highlights the growing importance of domestic demand and labor market tightening shock from mid-2023.

The second strand is literature on the link between labor market tightness and price inflation. [Scott *et al.* \(2023\)](#) show that the price of processed food products, which are labor-intensive and have driven increases in grocery prices in the U.S., are affected by labor market tightness. Recasting the concerns regarding the role of labor market on inflation through the lens of the Phillips curve highlights the question of whether the relationship between labor market slack and inflation has steepened or shifted. If the Phillips curve has become steeper, inflation might respond more sensitively to changes in labor market conditions, implying that small improvements in employment could produce disproportionate price increases.

Alternatively, if the Phillips curve has shifted upward, the sensitivity of inflation to the labor market tightness is the same, but the same level of output or employment could now correspond to higher inflation, indicating a more fundamental change in the inflation formation such as the shift in long-term inflation expectation. Although a growing body of research examines the Philips curve, the debate remains far from settled. [Benigno and Eggertsson \(2024\)](#) state that the recent surge in inflation is driven mainly by a tight labor market, which also magnifies the impact of supply shocks. Therefore, the Phillips curve becomes steeper. Other papers report the steepness of the Phillips curve as well, but with limited magnitude on inflation by using detailed price and wage data. Hence, outward shifts such as higher inflation expectations, supply shocks, unprecedented fiscal stimulus, or other structural changes explain the surge in inflation ([Ari et al. \(2023\)](#) and [Ball et al. \(2022\)](#)). Their view aligns with [Bernanke and Blanchard \(2025\)](#) and [Nakamura et al. \(2024\)](#) who conclude that labor market tightness makes at most a modest contribution to inflation in the U.S. and Japan respectively, downplaying wages as a driver of inflation. Contrary to these earlier findings, the analysis in this paper suggests that, benefiting from corrections for biases in the measurement of labor market tightness and from the accumulation of data, labor market tightness contributed to the increase in inflation in the post-COVID period.

Third and lastly, this study is related to literature which applies narrative restriction techniques for shock identifications. The pioneering work of [Antolín-Díaz and Rubio-Ramírez \(2018\)](#) puts additional restrictions on parameters of the standard sign-restricted SVAR by confirming that in the case of a handful of key historical events, the structural shocks and historical decomposition agree with established narratives. They apply the method to the identification of supply and demand shocks in the oil market using several narrative episodes such as outbreak of the Iranian Revolution in 1978. They also apply the method to identify the monetary policy shocks with narrative during the anti-inflationary episode in 1979 after Paul Volcker became a chairman of the Federal Reserve. These two exercises show that narrative restrictions can be highly informative. Their methods have been widely applied to other countries and other historical narratives such as conventional monetary policy shocks or supply chain disruptions in the Euro Area ([Badinger and Schiman \(2023\)](#) and [De Santis \(2024\)](#)). As examples of applications in other regions, [Ha et al. \(2024\)](#) combine the technique with a Factor-Augmented VAR to investigate a common factor across price inflation in G7 countries by imposing narrative sign restrictions regarding oil price shocks such as Iran-Iraq war in 1980, OPEC production expansion in 1998, and oil price war between Saudi Arabia and Russia in 2020. Turning to the application of the narrative restriction method to Japanese data, [An et al. \(2021\)](#) examine the role of the regime-dependent exchange rate pass-through on consumer prices with narrative sign restrictions related to the Plaza Accord in 1985. They confirm that the estimates of exchange rate pass-through ratios to both import prices and consumer prices vary substantially in Japan depending on the sources of the shocks behind the exchange rate movements. [Yoshida et al. \(2022\)](#) investigate the time-varying exchange rate pass-through on price inflation and [Fujita et al. \(2026\)](#) evaluate the macroeconomic effects of unconventional monetary policy on

inflation and the real economy with narrative sign restrictions.

This paper is organized as follows. Section 2 presents the methodology and details of data. Section 3 then presents the results of SVAR estimations and analysis including an investigation of the effectiveness of narrative sign restrictions. Section 4 concludes.

2. Empirical methodology

2.1. Estimation model

I consider the following standard SVAR model:

$$y_t' A_0 = \sum_{l=1}^p y_{t-l}' A_l + c + \epsilon_t' \quad \text{for } 1 \leq t \leq T, \quad (1)$$

where y_t denote a vector of endogenous variables. A_0 is an invertible impact matrix which defines the contemporaneous structural relationship among endogenous variables. A_l is an $n \times n$ coefficient matrix of parameters ($1 \leq l \leq p$). p denotes lag order ($p = 3$).¹ c and T denote $1 \times n$ constant term and sample size. The vector ϵ_t , conditional on past information and the initial conditions y_0, \dots, y_{1-p} , is Gaussian with mean zero and covariance matrix I_n , the $n \times n$ identity matrix. Following [Arias *et al.* \(2018\)](#) and [Antolín-Díaz and Rubio-Ramírez \(2018\)](#), the SVAR model can be expressed simply as

$$y_t' A_0 = x_t' A_+ + \epsilon_t' \quad \text{for } 1 \leq t \leq T, \quad (2)$$

where $A_+ = [A_1' \dots A_p' c']$ and $x_t' = [y_{t-1}', \dots, y_{t-p}', 1]$ for $1 \leq t \leq T$. The dimension of A_+ is $m \times n$ and the dimension of x_t is $m \times 1$, where $m = np + 1$. The reduced-form VAR model implied by equation (2) can be expressed as

$$y_t' = x_t' B + u_t' \quad \text{for } 1 \leq t \leq T, \quad (3)$$

where the coefficient matrix $B = A_+ A_0^{-1}$, $u_t' = \epsilon_t' A_0^{-1}$, and a covariance matrix $\Sigma = (A_0 A_0')^{-1}$ are reduced-form parameters. The identification of the SVAR model amounts to map from reduced-form parameters B and Σ to structural parameters A_0 and A_+ .

Impulse response function

Given structural parameters $\theta = (A_0, A_+)$, the Impulse Response Function (IRF) of the i -

¹ The following results are robust to estimation with shorter or longer lags.

th variable to the j -th structural shock at horizon k corresponds to the element in row i and column j of matrix $L_k(\Theta)$, where $L_k(\Theta)$ is defined recursively by

$$\begin{aligned} L_0(\Theta) &= (A_0^{-1})', \\ L_k(\Theta) &= \sum_{l=1}^k (A_l A_0^{-1})' L_{k-l}(\Theta), \text{ for } 1 \leq k \leq p, \\ L_k(\Theta) &= \sum_{l=1}^p (A_l A_0^{-1})' L_{k-l}(\Theta), \text{ for } p \leq k \leq \infty. \end{aligned} \quad (4)$$

Historical decomposition

Given structural parameters (Θ) and data (y'_t, x'_t) , the structural shocks at time t are computed by

$$\epsilon'_t(\Theta) = y'_t A_0 - x'_t A_+ \quad \text{for } 1 \leq t \leq T. \quad (5)$$

The historical decomposition calculates contributions of structural shocks to the observed unexpected change in the variables between two periods. Formally, the contribution of the j -th structural shock to the observed unexpected change in the i -th variable between periods t and $t+h$ is

$$H_{i,j,t,t+h}(\Theta) = \sum_{l=0}^h e'_{i,n} L_l(\Theta) e_{j,n} e'_{j,n} \epsilon_{t+h-l}(\Theta), \quad (6)$$

where $e_{j,n}$ is the j -th column of I_n .

Sign restrictions

Let me assume that I want to identify the j -th structural shock by imposing sign restrictions on the IRF at different horizons. Formally, I consider any continuous function $F(\Theta)$ from the structural parameters (Θ) to $r \times n$ space, where r is a natural number. Sign restrictions will take the form

$$S_j F(\Theta) e_{j,n} > 0, \quad (7)$$

for $1 \leq j \leq n$, where S_j is an $s_j \times r$ matrix of full row rank, with $0 \leq s_j$. The value of s_j indicates the number of sign restrictions being used to identify the j -th structural shock.

Narrative sign restrictions

The narrative sign restrictions complement standard sign restrictions. The narrative approach, proposed by [Antolín-Díaz and Rubio-Ramírez \(2018\)](#), constrains parameters by ensuring

that, for a handful of key historical events the structural shocks and historical decomposition align with the established narrative.

Narrative sign restrictions consist of two classes of restrictions: (1) restrictions to the structural parameters so that the structural shocks are of a particular sign during a certain narrative episode, and (2) the restrictions to the structural parameters so that the contribution of a certain structural shock to the observed unexpected change in a variable is more important than others for some periods.

Two alternative ways are proposed for the second class of restrictions. The first is that a given structural shock was the most important driver of the unexpected change in a variable during some periods ([Antolín-Díaz and Rubio-Ramírez \(2018\)](#) name it "Type I"). To elaborate the idea, consider the case where I want to identify the j -th structural shock by imposing the restriction that the absolute value of the contribution of the j -th structural shock to the unexpected change in the i -th variable between periods t and $t + h$, and the contribution of the j -th structural shock is greater than the absolute of the contribution of any other structural shock to the unexpected change in the i -th variable between periods t and $t + h$. Then, the restriction can be imposed using sign restrictions by defining $F(\Theta) = (|H_{i,b,t,t+h}(\Theta)| - |H_{i,a,t,t+h}(\Theta)|)_{a,b}$ and S_j as an $(n - 1) \times n$ matrix equal to

$$S_j = \sum_{i=1}^{j-1} e_{i,n-1} e'_{i,n} + \sum_{i=j+1}^n e_{i,n-1} e'_{i,n}, \quad (8)$$

where $|H_{i,j,t,t+h}(\Theta)|$ is the absolute value of $H_{i,j,t,t+h}(\Theta)$.

The second way is that a given structural shock was the overwhelming drivers of the unexpected change in a given variable during specific periods, with its contribution accounting for more than the sum of the absolute value of the contribution of all other structural shocks ([Antolín-Díaz and Rubio-Ramírez \(2018\)](#) name it "Type II"). Suppose that I want to identify the j -th structural shock by imposing the restriction that the absolute value of the contribution of the j -th structural shock to the unexpected change in the i -th variable between periods t and $t + h$, and the contribution of the j -th structural shock is greater than the sum of the absolute of the contribution of all other structural shocks to the unexpected change in the i -th variable between periods t and $t + h$. Then, the restriction can be imposed using sign restrictions by defining $F(\Theta) = (|H_{a,b,t,t+h}(\Theta)| - \sum_{s \neq b} |H_{a,s,t,t+h}(\Theta)|)_{a,b}$ and $S_j = e'_{i,n}$.

2.2. Data and identification

*Data*²

The SVAR model in this paper contains five endogenous variables: consumer price, industrial production, unemployment rate gap, nominal interest rate, and import price.³ Departing from previous empirical work, this paper incorporates the unemployment rate gap into the model to identify labor supply shocks. This allows labor supply tightening, which caused the decrease in industrial production being captured separately from supply shocks, to be taken into account. In Japan, labor shortages are severe across a wide range of industries and among small and medium size firms. Tighter labor conditions mean industries with low elasticity of substitution between capital and labor face a severe supply constraint. These observations suggest the importance of assessing the dynamics in economic activity, prices, and wages by focusing on the labor market tightness especially in the current periods. From the perspective of forecasting future developments of inflation in Japan, labor markets are expected to be tighter because of the declining birthrate and aging population ([Ikeda *et al.* \(2025\)](#)). Therefore, the growing importance of the link between labor markets and inflation cannot be ignored. In the U.S., labor supply shocks played an important role on price and real economy as high wage growth and low labor force participation were observed after the outbreaks of COVID-19 pandemic. As [Kurozumi and Van Zandweghe \(2025\)](#) point out, anecdotes in the Federal Reserve's Beige Book contained 18 mentions of "supply chain disruptions" and 26 mentions of "labor shortage" in December 2021. These numbers stand in stark contrast to the mentions in 2019 of just one ("supply chain disruptions") and four ("labor shortage").

The Japanese dataset includes the consumer prices referred to the month-on-month growth rates of Consumer Price Index (CPI) for all items less fresh food and energy released by the Ministry of Internal Affairs and Communications.⁴ The industrial production refers to the month-on-month changes of Indices of Industrial Production (IIP) provided by the Ministry of Economy, Trade and Industry. The unemployment rate gap refers to the month-on-month difference of the gap calculated by subtracting structural unemployment rate from observed unemployment rate based on the broader coverage survey, not only with the data covered public employment services. The original data comes from Ministry of Health, Labour and

² Developments in endogenous variables are shown in Appendix 1.

³ The IIP consists of approximately 90% quantity indices based on units such as weight and the number of items. However, improvements in quality, such as enhanced machine performance, are not fully captured by the index. As a result, it is noted that the IIP tends to have a downward bias when compared to an index that properly reflects quality improvements ([Higo \(2025\)](#)). Additionally, it is important to note that the unemployment rate has remained low in recent years and has become less responsive to economic fluctuations.

⁴ The analysis focuses on the developments in CPI less fresh food and energy. This is because fresh food fluctuates due to temporary and idiosyncratic factors, and the contributions of import prices to CPI energy can be mechanically calculated using fuel cost adjustment equations disclosed by power companies. In contrast, the relationships of other items with structural shocks are unclear and should be explored. The CPI is the author's estimates and excludes mobile phone charges and the effects of the consumption tax hike, policies concerning the provision of free education, and travel subsidy programs.

Welfare of Japan, and Ministry of Internal Affairs and Communications. The interest rate is measured by the month-on-month difference of 5-year Japanese Government Bond (JGB) yields.⁵ The import prices refer to the month-on-month changes in yen-basis Import Price Index (IPI) by Bank of Japan. The dataset consists of monthly observations from January 1981 to December 2024.

The U.S. dataset includes the consumer prices referred to the month-on-month growth rates of Personal Consumption Expenditures Price Index (PCE) less food and energy by the Bureau of Labor Statistics. The industrial production refers to month-on-month changes of Indices of Industrial Production (IIP) provided by the Bureau of Economic Analysis. The unemployment rate gap refers to month-on-month difference of gap calculated by subtracting noncyclical rate of unemployment released by U.S. Congressional Budget Office from civilian unemployment rate of people 16 and over released by U.S. Bureau of Labor Statistics. Noncyclical rate of unemployment, which is on a quarterly basis, is converted to monthly data by linear interpolation. The interest rate refers to the month-on-month difference of Federal funds rate. The import prices (IPI) refer to the month-on-month changes in Import Price Index reported by Bureau of Labor Statistics.⁶ The dataset consists of monthly observations from January 1971 to December 2024.

Identification

I identify shocks by using sign restrictions on contemporaneous responses of variables to the structural shocks according to $u_t = A_0 \epsilon_t$ as follows:

$$\begin{pmatrix} u_t^{Consumer\ price} \\ u_t^{Industrial\ production} \\ u_t^{Unemployment\ rate\ gap} \\ u_t^{Interest\ rate} \\ u_t^{Import\ price} \end{pmatrix} = \begin{pmatrix} - & + & - & - & + \\ + & + & + & - & * \\ * & - & + & * & * \\ * & + & * & + & * \\ * & * & * & * & + \end{pmatrix} \begin{pmatrix} \epsilon_t^{Supply} \\ \epsilon_t^{Demand} \\ \epsilon_t^{Labor} \\ \epsilon_t^{Interest} \\ \epsilon_t^{Global} \end{pmatrix}, \quad (9)$$

where u_t and ϵ_t represent reduced form errors and structural shocks. "-", "+", and "*" represent response in the opposite direction, responses in the same direction, and no

⁵ 5-year JGB yields are employed to avoid the difficulty in observing interest rate fluctuations when the overnight call rate approaches the zero lower bound.

⁶ Before September 1982, estimated values from the regression with month-on-month changes in import prices as the dependent variable and the crude oil prices divided by nominal effective exchange rate are used as the independent variable.

restrictions, respectively.⁷

The standard sign restrictions broadly follow [Ha et al. \(2024\)](#), [An et al. \(2021\)](#) and [Forbes et al. \(2020\)](#). Specifically, restrictions are imposed on the contemporaneous IRFs to identify five shocks: a positive supply shock to goods market is assumed to be accompanied with lower consumer price and higher industrial production; a positive demand shock is assumed to be accompanied with higher consumer price, industrial production, interest rate and lower unemployment rate gap; a positive labor supply shock is assumed to be accompanied with lower consumer price, higher industrial production, and higher unemployment rate gap; a positive interest rate shock is assumed to be accompanied with lower consumer prices, industrial production and higher interest rate; and a positive global shock is assumed to be accompanied with higher consumer price and import price.^{8,9}

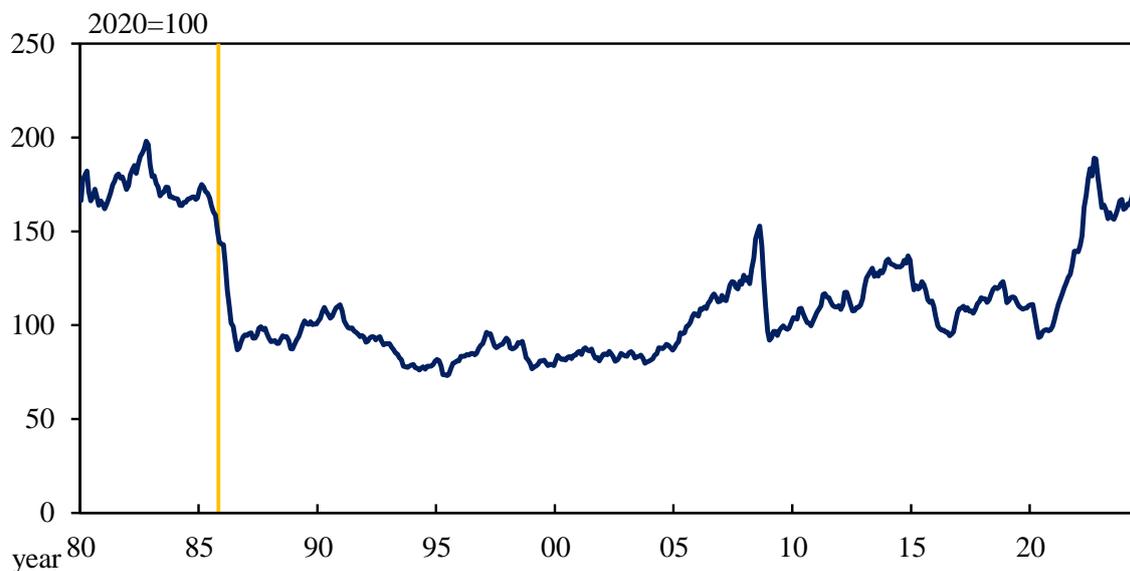
The restrictions for identifying supply and demand shocks indicate upward supply slopes and downward demand slopes. That is, positive supply shocks, for example an increase in productivity, induces greater competition across firms or lower marginal costs of production. Positive demand shock such as expansionary fiscal policy or an increase in the marginal propensity of consumption or investment increases consumption, and consequently labor demand to produce these goods and services (i.e., lower labor market slack). Monetary policy reacts to these developments by tightening financial conditions to stabilize the economy ([Ha et al. \(2024\)](#)). The exogenous positive interest rate shock, for example, the spillover of foreign monetary tightening or internal conventional and unconventional monetary tightening, increases medium-term interest rates, and thus, decreases inflation rate and output. I assume that positive global shock, which is included in the rise in commodity price on a dollar basis caused by positive oil price shocks or global demand shocks or depreciation of currency, increases domestic inflation since firms' pass-through increases in input costs to their product price.

⁷ Zero constraints are not imposed in this paper. Instead, following [Read \(2024\)](#), sign constraints are adopted, as imposing zero constraints in the estimation would be excessively restrictive.

⁸ Positive interest rate shocks could be expected to lead to a loosening of labor demand and supply; however, particularly in the context of the chronic labor shortage that has persisted since the late 2010s, the response may not be significant. Therefore, no sign restrictions were imposed in the estimation ex-ante. Looking at the estimation results (Figures A.2.1 and A.2.2), it is observed that while the interest rate shock does not lead to a loosening of the labor market in Japan, it significantly loosens the labor market in the U.S.

⁹ To identify whether a global shock is a demand shock, supply shock, or exchange rate shock in global goods markets, it is necessary to increase the number of endogenous variables and sign restrictions. This paper focuses on how global shocks have shaped domestic inflation dynamics, rather than identifying the sources of these global shocks, and therefore employs a simplified model. The relationship between the sources of global shocks and domestic inflation is discussed in detail in [Fukunaga et al. \(2025\)](#).

Figure 1. Developments in Japan's import price



Note: The yellow vertical line indicates the Plaza Accord episode.

Source: Bank of Japan.

In addition to these sign restrictions, narrative sign restrictions are imposed based on the narrative episodes in reference to the events proposed by [An et al. \(2021\)](#) and [Antolín-Díaz and Rubio-Ramírez \(2018\)](#).¹⁰ The standard sign restriction approach imposes constraints on the signs of impulse responses; however, in such cases, the signs of identified structural shocks may deviate from the narrative consensus during certain periods. Narrative sign restrictions offer the advantage of imposing additional constraints on the signs of shocks and/or that of the size of contributions for certain variable's fluctuations for periods with a well-established consensus, thereby enabling the extraction of plausible iterations. The restrictions for Japanese data are as follows:

Narrative sign restriction for Japan 1: For October to November 1985, the global shock during the Plaza Accord episode must be of negative value.¹¹

Narrative sign restriction for Japan 2: For October to November 1985, the global shocks are the most important contributor to the unexpected movements in import prices. The absolute value of contribution of the global shock is larger than the absolute value of the

¹⁰ As will be discussed later, the shocks to which narrative sign restrictions are applied differ between Japan and the U.S. (global shocks in Japan and interest rate shocks in the U.S.). This is because, historically, there have been relatively fewer episodes in Japan that interest rate surprises affected various variables compared with the U.S., and similarly, in the U.S., the impact of import prices or exchange rate fluctuations is limited compared to Japan.

¹¹ [An et al. \(2021\)](#) who analyze the shock-dependent exchange rate pass-through in Japan impose the similar restrictions only in October 1985. This is because the shocks that [An et al. \(2021\)](#) impose constraints on are exchange rate fluctuations themselves, whereas this paper focuses on shocks that spill over from the exchange rate to domestic prices through increases in import prices, and there should be a lag in the materialization of the shocks.

contribution of any other structural shocks (Type-I restriction).

The Plaza Accord was a policy initiative in the dollar foreign exchange market which signaled a shift of U.S. foreign exchange policy from a "minimalist approach to intervention" to an "activist approach" (Bordo *et al.* (2015)). Moreover, the success of these coordinated interventions was by no means obvious ex-ante (An *et al.* (2021)). In contrast to the broad conception taken by Frankel (2015), this paper takes the narrow viewpoint here that the Plaza Accord includes only the deliberations made on September 22 at the Plaza hotel. This is because the yen appreciated most sharply against the dollar during October and November 1985. During this period, the appreciation is believed to have a sizable impact on inflation dynamics through the decline in import prices in Japan as shown in Figure 1.

The restrictions for the U.S. data are as follows:

Narrative sign restriction for the U.S. 1: For October 1979, the interest rate shock during the Volcker Reform must be of positive value.

Narrative sign restriction for the U.S. 2: For October 1979, the interest rate shock is the most important contributor to the unexpected movements in Federal funds rate. The absolute value of contribution of the interest rate shock is larger than the absolute value of the contribution of any other structural shocks (Type-I restriction).

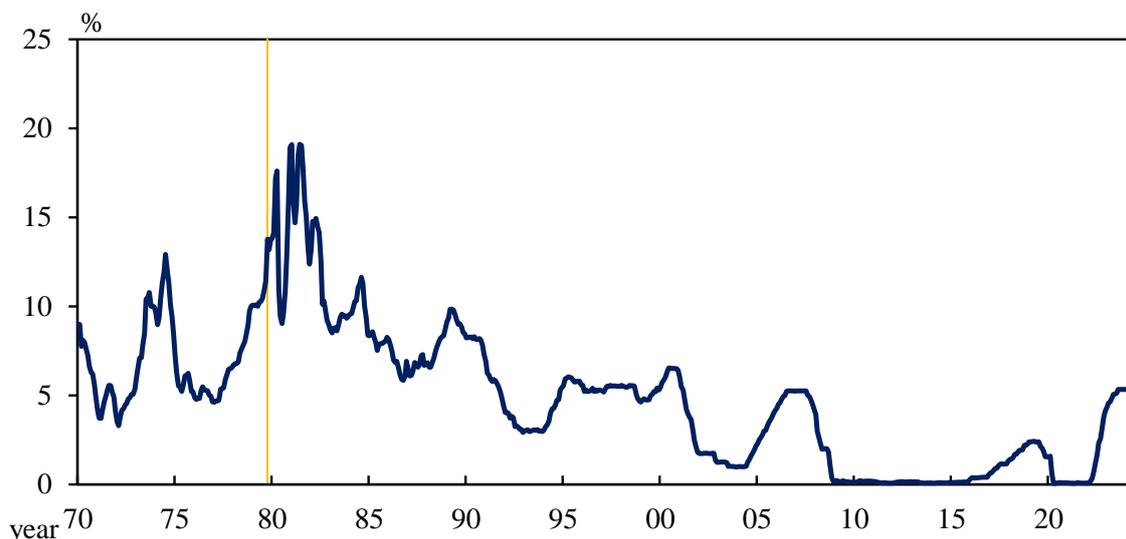
Romer and Romer (1989) described the monetary policy decisions of October 6, 1979, declared shortly after Paul Volcker became chairperson of the Fed, as "a major anti-inflationary shock to monetary policy." Lindsey *et al.* (2005) depicted the event in detail as follows: Volcker held a rare press conference on the evening of Saturday October 6, 1979, and announced the results of an unscheduled FOMC meeting held earlier that day, a dramatic move to attack inflation. In front of the reporters who had rushed to the building to cover the unexpected announcement, Volcker explained the FOMC would shift its focus to managing the volume of bank reserves in the system instead of trying to manage the day-to-day level of the Federal funds rate. Figure 2 shows the Fed funds rate fluctuated after the announcement of monetary tightening in 1979, which is in line with the point raised by Medley (2013), that "it was an approach that would lead to more fluctuation in rates and, Volcker hoped, rein in inflation."¹²

For Japanese data, I make 156,160,000 attempts in drawing from the joint posterior distribution to obtain 10,001 acceptances which satisfies the standard sign restrictions. 3,061 out of 10,001 accepted draws satisfy the narrative sign restrictions and 1,932 are unique. For the U.S. data, I make 196,620,000 attempts to obtain 10,000 draws which satisfy the standard

¹² As Clarida *et al.* (2000), Boivin *et al.* (2010), and Gertler and Karadi (2015) point out, the monetary policy regime and the correlation between output growth and the nominal interest rate had changed pre and post Volcker reform. The narrative restriction imposed in October 1979 uses the timing of this regime change to identify monetary policy shocks; however, it is important to note that it does not consider changes in the relationships among endogenous variables before and after the regime shift.

sign restrictions, and 1,428 out of 10,000 accepted draws satisfy the narrative sign restrictions and 914 are unique.

Figure 2. Developments in the Federal funds rate



Note: The yellow vertical line indicates the Volcker's announcement of Anti-Inflation Measures.

Source: FRED.

3. Estimation results

3.1. Impulse response functions

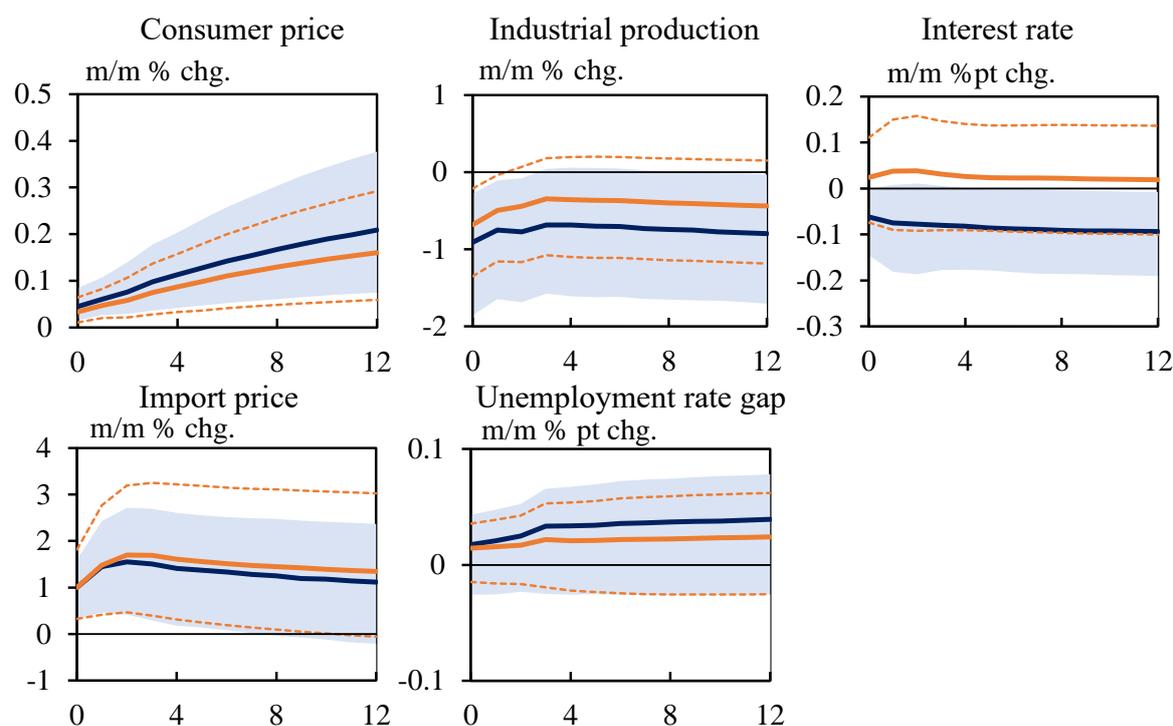
Figures 3 and 4 show the median impulse responses of key variables.^{13,14} The orange lines indicate the results of SVAR with standard sign restrictions, while blue lines indicate the results of SVAR with narrative sign restrictions. The dashed lines and shaded area indicate the 68% (point-wise) confidence bands for the IRFs. The results for Japan show the positive global shock causes a rise in import prices for both specifications. The impulse responses identified by narrative sign restrictions have narrower confidence bands than that with standard sign restrictions, which implies that the narrative restrictions can identify the global shock more sharply by efficiently reducing the uncertainty of many impulse responses. This is in line with the results reported by [An et al. \(2021\)](#). Furthermore, focusing on the size of the impulse responses, the reaction of the CPI to global shocks has become somewhat larger. With standard sign restrictions alone, it was difficult to distinguish between demand shocks and global shocks, but by imposing narrative restrictions, successful identification led to the above changes. The sign of the impulse response of interest rate to global shock has also

¹³ Full-results of the impulse response functions are shown in Appendix 2.

¹⁴ The change in the IRFs to structural shocks around COVID-19 pandemic are shown and discussed in Appendix 3.

significantly changed to negative. This can be interpreted as capturing a mechanism in which domestic demand declines and interest rates fall in response to adverse terms of trade shocks, such as the rise in oil prices, given Japan's heavy reliance on energy imports.

Figure 3. Accumulated impulse responses to global shocks: Japan

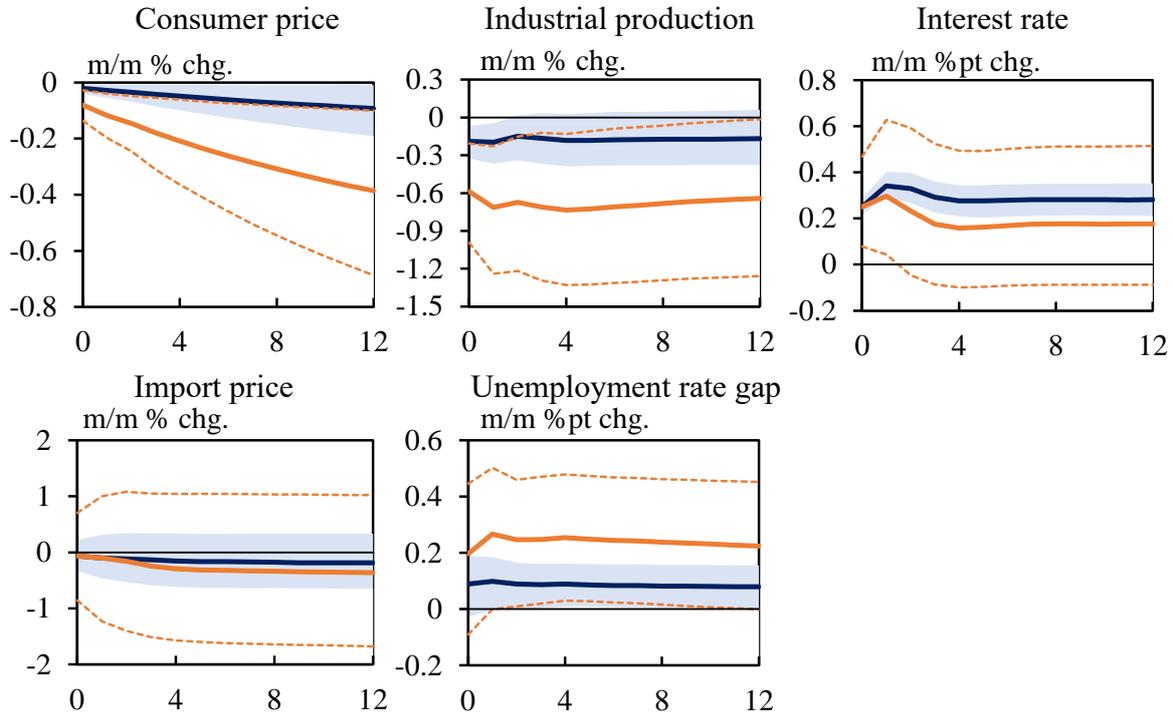


Note: The orange lines are the median IRFs to positive global shocks using the standard identification restrictions, and the blue lines are the median IRFs to positive global shocks using the narrative sign restrictions. The dashed lines and shaded areas indicate the 68% (point-wise) confidence bands for the IRFs. The IRFs have been normalized so that the global shock has an impact of 1 % points on the import price.

Sources: Japanese Ministry of Internal Affairs and Communications; Japanese Ministry of Economy, Trade and Industry; Japanese Ministry of Health, Labour and Welfare; Haver; Bank of Japan.

The results for the U.S. show that the positive interest rate shock causes a rise in interest rates for both specifications. The interest rate shock identified with narrative sign restrictions show narrower confidence bands as well and has greater and more persistent impacts on interest rates. In addition, the impulse responses of other variables to interest rate shock show narrower bands and different impacts. Overall, the narrative sign restrictions identify the structural shocks clearly in the U.S.

Figure 4. Accumulated impulse responses to interest rate shocks: the U.S.



Note: The orange lines are the median IRFs to positive global shocks using the standard identification restrictions, and the blue lines are the median IRFs to positive global shocks using the narrative sign restrictions. The dashed lines and shaded areas indicate the 68% (point-wise) confidence bands for the IRFs. The IRFs have been normalized so that the interest rate shock has an impact of 25 basis points on the Federal funds rate.

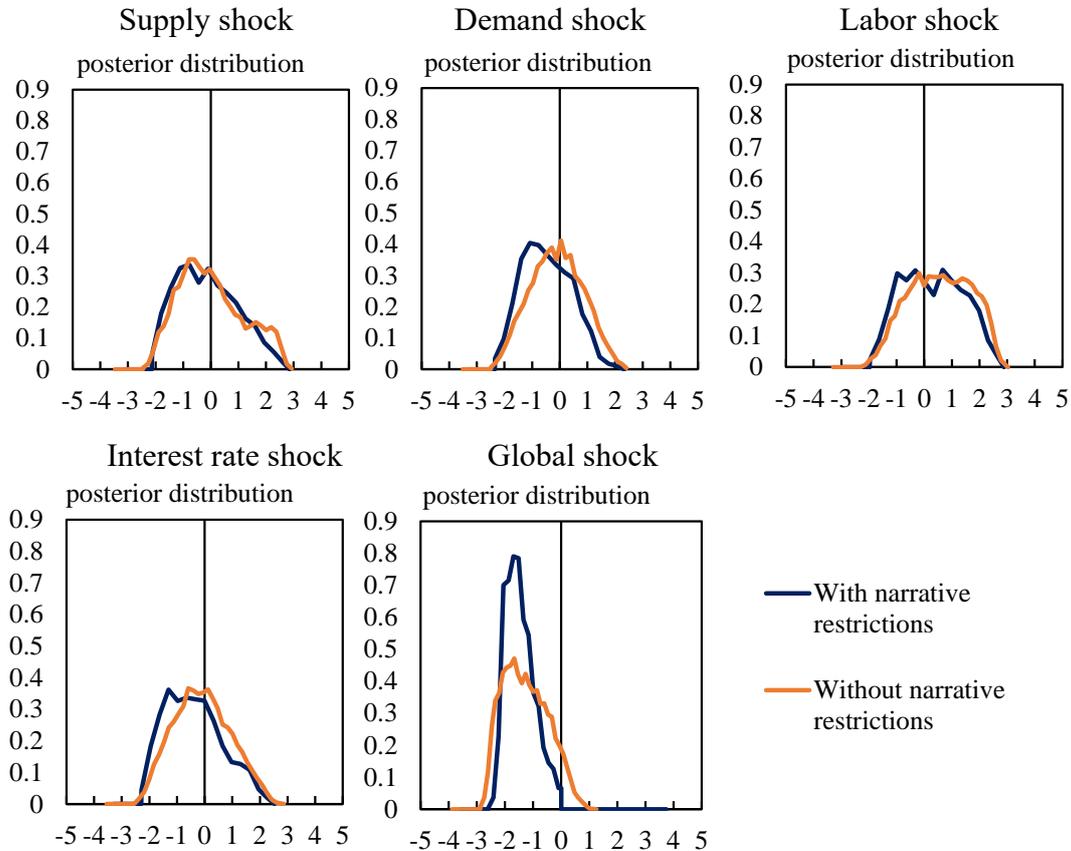
Sources: U.S. Bureau of Labor Statistics; U.S. Bureau of Economic Analysis; U.S. Congressional Budget Office; FRED.

3.2. Identified structural shock

To investigate how narrative sign restrictions support the identification of the structural shocks, Figures 5 and 6 show the identified shock distribution around the narrative events.¹⁵ The orange lines plot the posterior distributions of each shock using the standard sign restrictions. The blue lines plot the posterior distributions of each shock using the narrative sign restrictions.

¹⁵ The developments in median shocks are shown in Figures A.2.3 and A.2.4.

Figure 5. Shock distribution with and without narrative sign restrictions: Japan



Note: The orange lines plot the posterior distributions of each shock using the standard sign restrictions. The blue lines plot the posterior distributions of each shock using the narrative sign restrictions. Data as of October 1985.

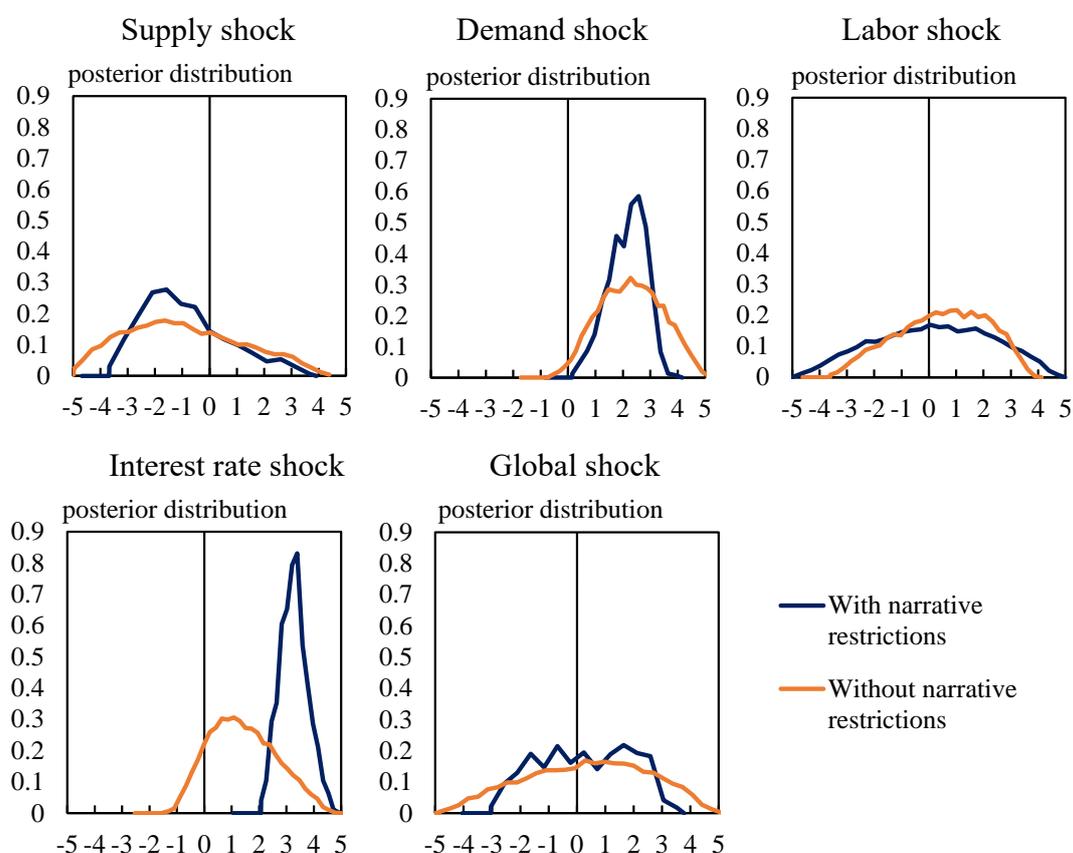
Sources: Japanese Ministry of Internal Affairs and Communications; Japanese Ministry of Economy, Trade and Industry; Japanese Ministry of Health, Labour and Welfare; Haver; Bank of Japan.

In the lower middle panel of Figure 5, which indicates the posterior distribution of global shock, a small portion of the shock distributions identified without narrative restriction are above zero. These results imply the standard sign restriction approach is uncertain about the size and the sign of the global shock to the import price movements in Japan during the period. Similarly, in the lower left panel of Figure 6, which shows the interest rate shock during Volcker's anti-inflationary monetary policy episode in the U.S., part of the identified shock without narrative restrictions are distributed below zero. This result implies that the standard sign restriction approaches which retain the iterations with structural parameters go against the widely shared narrative episodes. By contrast, the structural shocks identified with narrative restrictions are in line with narrative episodes by construction. The reported results highlight the fact that the structural parameters identified with narrative restrictions are more economically meaningful than the results without narrative sign restrictions.

Turning to the changes in the signs and sizes of other shocks that arise from imposing narrative restrictions, the results for Japan in Figure 5 show the slightly narrower distribution's tail in demand shocks, which implies narrative restrictions are helpful to deal

with the identification issues. As [Blanchard and Gali \(2007\)](#) discussed, the shock of rising energy prices, which composes a large portion of import prices, makes it difficult to distinguish it from demand shocks. For instance, if the rise in energy prices is driven by a global expansion in demand, including in Japan, it would act in a way that pushes both import prices and the CPI upward. Since the standard sign restrictions shown in Equation (9) do not fully identify global shocks, it is likely that additional narrative restrictions played a helpful role in this identification.

Figure 6. Shock distribution with and without narrative sign restrictions: The U.S.



Note: The orange lines plot the posterior distributions of each shock using the standard sign restrictions. The blue lines plot the posterior distributions of each shock using the narrative sign restrictions. Data as of October 1979.

Sources: U.S. Bureau of Labor Statistics; U.S. Bureau of Economic Analysis; U.S. Congressional Budget Office; FRED.

Regarding the results for the U.S. (Figure 6), the distribution's tail of demand shocks is noticeably narrower, which implies narrative sign restrictions are helpful in dealing with the typical identification issues for monetary policy shocks. As [Christiano *et al.* \(1999\)](#) highlight, distinguishing between demand and monetary policy shocks is particularly challenging because they often interact and manifest simultaneously. That is, monetary policy decisions, especially changes in interest rates, are typically responses to existing economic conditions, which include fluctuations in aggregate demand. By imposing narrative restrictions and

identifying the interest rate shock, the demand shock also shows a narrower distribution tail and can be identified more clearly. This suggests that conventional sign restrictions alone are insufficient for identifying these structural shocks.

3.3. Forecast error variance decomposition

In this section, in order to investigate how much of the forecast error variance can be explained by five structural shocks on average, Table 1 reports the results of the forecast error variance decompositions (FEVDs) identified with and without narrative sign restrictions.

In Japan, the results with narrative sign restriction methodology suggest a larger contribution of demand and global shock to consumer price, and a smaller contribution from interest rate shock. The contributions of demand and global shock to consumer price are 22.9 and 19.8 for the results without narrative restrictions, while it is 27.8 percent and 22.4 for the results with narrative restrictions, respectively. At the same time, the contribution of interest rate shock decreases from 26.1 percent to 21.8 percent.

In the U.S., the results with narrative sign restriction approach implies a more pronounced contribution of the interest rate shock to interest rate, and a less critical role for consumer price inflation. The contribution of interest rate shock to interest rate is 16.4 percent for the results without narrative restrictions, while it is 44.5 percent for the results with narrative restrictions. At the same time, the contributions of interest rate shock to consumer price decrease from 21.4 to 7.9. The contribution of demand shocks to consumer prices increases from 25.2 percent to 35.8 percent, which implies that identified structural shock with the standard sign restriction might confound the demand shock with the interest rate shock. The narrative sign restrictions have improved the understanding of underlying drivers of inflation fluctuations.

In addition, the results of the comparison for Japan and the U.S. highlight the feature that the demand shock is the largest contributor to the movement of inflation for both economies, while the share of interest rate to consumer inflation is much smaller in the U.S. The different proportion of the contribution of interest rate might also result in the second point, that is, the narrative restriction utilizing the Volcker Reform in the U.S. helps to identify the interest rate shock. While in Japan, the lack of established narratives might limit the effective identification of interest rate shock. The fact that the interest rate variable is short-term in the U.S. and medium-term in Japan may also lead to differences in interpretation. That is to say, the interest rate shock in Japan, which uses medium-term rates, may include not only the central bank's policy but also the effects of market liquidity and term premiums.

Table 1. Forecast error variance decomposition of endogenous variables

<u>Japan</u>					
Variable	Supply shock	Demand shock	Labor shock	Interest rate shock	Global shock
With narrative restriction					
Consumer price	16.5	27.8	11.5	21.8	22.4
Industrial Production	15.5	25.9	17.0	22.5	19.0
Unemployment rate gap	23.4	20.1	19.2	14.1	23.2
Interest rate	20.8	22.3	20.8	20.7	15.5
Import price	22.3	21.0	22.9	21.9	11.9
Without narrative restrictions					
Consumer price	17.8	22.9	13.4	26.1	19.8
Industrial Production	16.0	29.2	18.1	20.9	15.9
Unemployment rate gap	23.0	22.5	19.2	14.3	21.0
Interest rate	19.1	21.9	19.2	20.2	19.5
Import price	23.2	17.2	21.1	17.7	20.8
<u>The U.S.</u>					
Variable	Supply shock	Demand shock	Labor shock	Interest rate shock	Global shock
With narrative restriction					
Consumer price	20.4	35.8	14.2	7.9	21.8
Industrial Production	16.3	42.4	13.6	11.1	16.6
Unemployment rate gap	23.5	24.6	13.9	13.3	24.6
Interest rate	11.2	21.1	12.0	44.5	11.2
Import price	26.4	9.5	23.6	11.2	29.3
Without narrative restrictions					
Consumer price	18.2	25.2	13.7	21.4	21.6
Industrial Production	16.2	34.5	12.3	21.4	15.7
Unemployment rate gap	22.9	24.5	12.6	17.9	22.1
Interest rate	18.6	26.9	19.5	16.4	18.7
Import price	22.0	15.3	21.4	18.4	22.9

Note: The FEVDs are the average of the successful draws that satisfy the restrictions. The forecast horizon is 24 months.
Sources: Japanese Ministry of Internal Affairs and Communications; Japanese Ministry of Economy, Trade and Industry; Japanese Ministry of Health, Labour and Welfare; Haver; Bank of Japan; U.S. Bureau of Labor Statistics; U.S. Bureau of Economic Analysis; U.S. Congressional Budget Office; FRED.

On comparing the FEVDs in Japan with existing literature ([Fukunaga et al. \(2025\)](#), [An et al. \(2021\)](#)), this paper's results report relatively small contributions of global shocks and large contributions of supply and demand shocks. [Fukunaga et al. \(2025\)](#) report over 50 percent contributions of global shocks, which are expressed by the aggregate contributions of exchange rate, global supply, global demand, and global monetary policy shocks for the FEVDs of CPI less fresh food and energy using data from 1995/Q4 to 2023/Q2. On the other hand, [An et al. \(2021\)](#) report the contribution of global shocks, at around 30 percent in total, including exchange rate, permanent foreign export price, and transitory foreign export price

shocks for the FEVDs of CPI using data from 1980 to 2017. This paper reports a smaller portion as the contribution of global shock, which is around 20 percent using CPI less fresh food and energy data from 1981 to 2024. These differences are partly attributable to the difference in referenced data and estimation periods. [An et al. \(2021\)](#) estimate with CPI including energy, which is highly susceptible to commodity price and exchange rate compared to other items, resulting in the higher contribution of global shocks than in this study. As for [Fukunaga et al. \(2025\)](#), the contribution of global shock was around 20 percent with sub-sample estimation from 1995 to 2007 (before the Global Financial Crisis, hereafter GFC) but this had increased to around 40 percent over the entire sample period from 1995 to 2023. The starting point of their estimation is 1995, and the proportion of recent data, which is more susceptible to foreign influences due to the higher import penetration rate, is relatively high. This may explain why the relatively large magnitude of the contribution of global factors is relatively larger in their study compared to this study and [An et al. \(2021\)](#).

3.4. Historical decomposition

Before COVID-19 pandemic

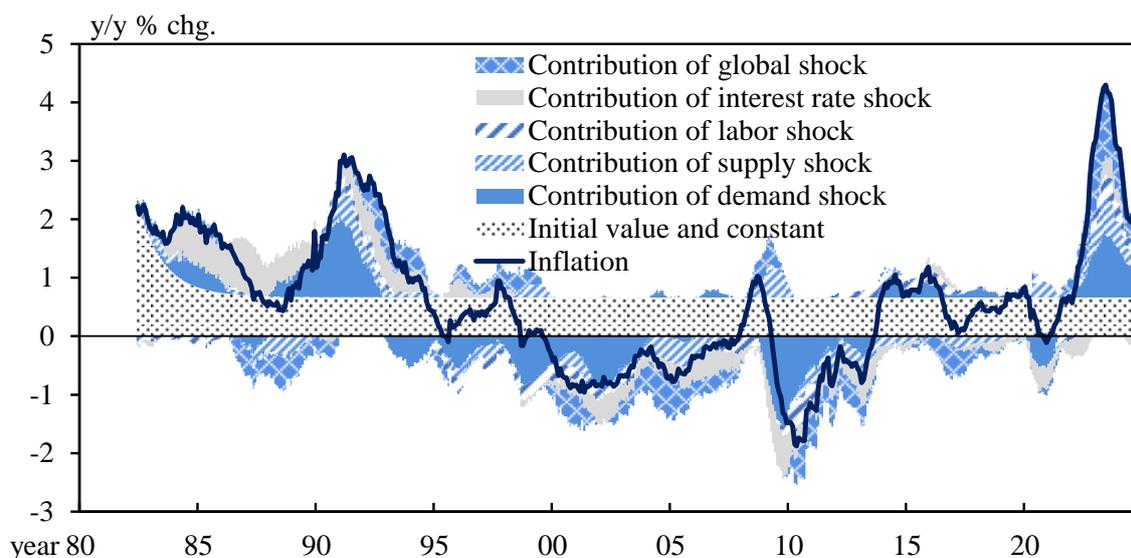
To begin with, Figure 7 shows the historical decompositions of inflation in Japan. I examine specific phases of the observation period from 1982 to 2019. The first phase is from mid-1980s to early 1990s when Japan's economy faced both the Plaza accord and the burst of the bubble economy. During this period, the contribution of global shock pushed down inflation, which is consistent with the results of [An et al. \(2021\)](#) that reports large part of decline in import prices and exchange rates were caused by the exchange rate shocks. The figure also shows that demand shock was the main driver of the decline in inflation during that period. The recession caused by the bursting of the bubble economy and the financial crisis during the 1990s put deflationary pressures on the economy.

The second phase is from late 1990s to early 2000s when the economy had stagnated after the burst of the bubble economy. Demand shocks consistently contributed to pushing down inflation during this period, and in addition, global factors resulted in low inflation. In light of the historical decomposition reported in [Fukunaga et al. \(2025\)](#), I obtain a similar result that domestic demand and global factors resulted in declining inflation, suggesting that the global factors were driven mainly by global supply factors reflecting the inflow of low-priced goods from emerging market economies along with the expansion of their production capacity.

The third phase is the period around the GFC. Prior to the GFC, inflation had been rising mainly because of the contribution of global shocks and supply shocks, which had previously remained negative, turned positive due to a hike in energy and commodity prices. However, after the GFC, the contribution of global shocks fell into negative territory accompanied by a sharp decline in energy and commodity prices and the appreciation of the yen against other currencies. Moreover, the prolonged economic downturn pushed down the inflation

represented by the decreasing contributions of demand shock. These results can be evaluated in light of [Fukunaga et al. \(2025\)](#), indicating that the global factor was driven by global demand, which is aligned with the sharp decline of global real economic activity index calculated by [Kilian \(2019\)](#), after the GFC. Furthermore, [Kaihatsu et al. \(2024\)](#) reached similar conclusions that supply and demand shocks contributed to the decline in the inflation after the GFC.

Figure 7. Historical decompositions of price inflation in Japan



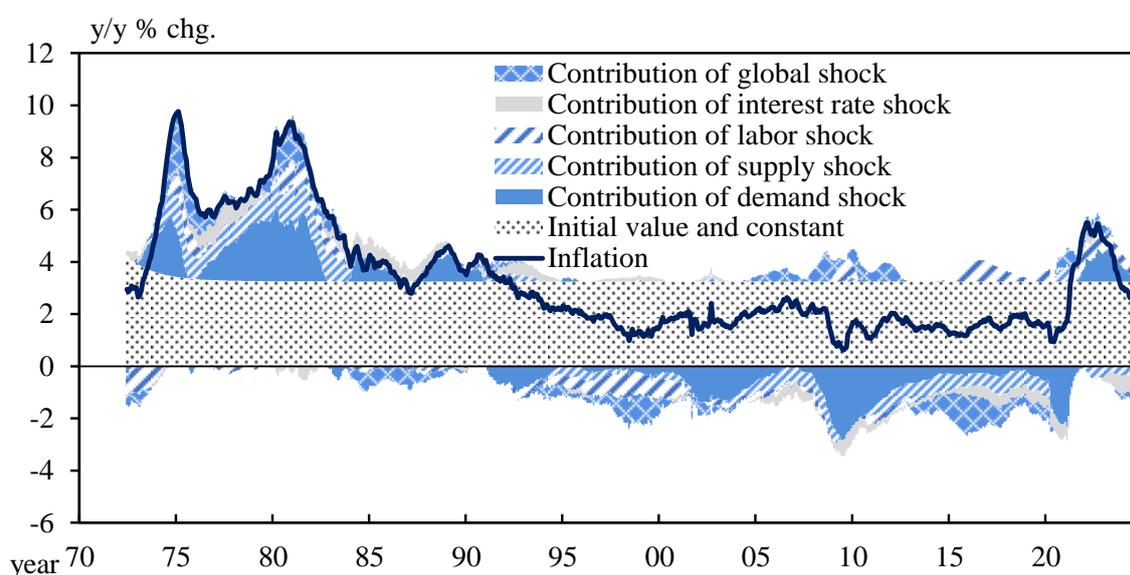
Sources: Japanese Ministry of Internal Affairs and Communications; Japanese Ministry of Economy, Trade and Industry; Japanese Ministry of Health, Labour and Welfare; Haver; Bank of Japan.

The fourth phase is the period in 2010s when the BOJ adopted a price stability target of 2 percent and introduced quantitative and qualitative monetary easing (QQE). During this period, the contribution of demand shocks turned into positive. The monetary easing pushed up economic activity and prices to some extent, and thereby contributing to moving Japan's economy out of a state of deflation. However, the sharp decline in crude oil prices in mid-2010s pushed down the inflation rate as represented by the decline in the contribution of global factors. The identified shocks in this period are somewhat different among [Fukunaga et al. \(2025\)](#), [Kaihatsu et al. \(2024\)](#), and this paper.¹⁶ [Fukunaga et al. \(2025\)](#) report that an accommodative domestic monetary policy shock became the main cause of the subsequent rise in inflation in the 2010s, while the downward pressure on prices due to global demand shocks since the global financial crisis continued and partly offset the inflationary effects of QQE. [Kaihatsu et al. \(2024\)](#) report that the rise in long-term inflation expectations during this period contributed to some extent to increasing inflation rates from 2013, however demand and supply shocks partly offset the effect since 2015. The accommodative monetary

¹⁶ Note that [Kaihatsu et al. \(2024\)](#) decompose CPI less fresh food, while this paper decomposes CPI less fresh food and energy. Therefore, the results during the periods with energy price fluctuations warrant closer attention.

policy, which is expressed as the increasing contribution of interest rate shock, and improving economic conditions, expressed as the increasing contribution of demand shock, and the upward pressure of global shock were main drivers for the inflation from 2013. At the same time, the tighter labor market continued to put upward pressure on inflation and its contribution increased gradually. Then, the sudden drop in crude oil prices captured as the decline in contributions of global shock put downward pressure after 2015. While this paper cannot further decompose global factors as in [Fukunaga et al. \(2025\)](#) or isolate the contributions of inflation expectations as in [Kaihatsu et al. \(2024\)](#), it does have the advantage of enabling a discussion of the impact of labor market tightness on inflation. To sum up, the results share a similar conclusion, that is, domestic factors have pushed up inflation in this period, although the identified shocks that caused inflation vary across the literature.

Figure 8. Historical decompositions of price inflation in the U.S.



Sources: U.S. Bureau of Labor Statistics; U.S. Bureau of Economic Analysis; U.S. Congressional Budget Office; FRED.

Figure 8 shows the historical decompositions of inflation in the U.S. Here, I examine specific phases of the observation period from 1982 to 2019. The first phase is from mid-1970s to mid-1980s in the midst of "The Great Inflation." During this period, almost all shocks put upward pressure on inflation. The contribution of global shocks can be interpreted as the exogenous oil supply shocks caused by the first and second energy crisis in 1973 and 1979. At the same time, supply, demand and labor shocks also show sizable contributions to the high inflation. In this period, the U.S. government pursued full employment in light of the lessons learned from Great Depression. However, the trade-off between lower unemployment and inflation had been larger than policymakers assumed. The positive contribution of interest rate shocks was diminished after the Volcker Reform in October 1979 but to a limited extent. It suggests that the hawkish monetary policy of this period was not

captured directly by the interest rate shocks, but it might be captured by other shocks through the transmission mechanism, such as public expectations for future economic and monetary policy. This is consistent with the FEVDs analysis in the previous section that shows the contribution of interest rate shock identified by narrative restrictions has limited contributions for forecast error of inflation. The second phase is from mid-1980s to 2007 known as the "Great Moderation," when the U.S. and many other advanced economies enjoyed significant decline in macroeconomic volatility. Inflation was hovering around moderate pace and economic expansion was the longest since World War II. The historical decomposition suggests that in this period, the only disturbing factor is the global shock around the late-1990s partly caused by the negative global demand shock due to the Asian financial crisis. The third phase is during the GFC from 2007 to 2009. A large portion of the inflation decline is explained by the contribution of negative demand shocks. Although the housing sector was the trigger of the crisis, it spread to broader economic activity mainly through the tighter financial conditions. The persistent downward pressures of demand shocks are in line with these observations: the recession ended in June 2009, but economic weakness persisted ([Weinberg \(2013\)](#)). The fourth phase is the aftermath of the GFC, when the inflation rate is relatively stable except the period with sharp decline in oil price in 2015, partly reflecting the sustained excess of crude oil supply over global demand and decelerated economic growth in emerging economy, which is captured by the global shocks in the decomposition.

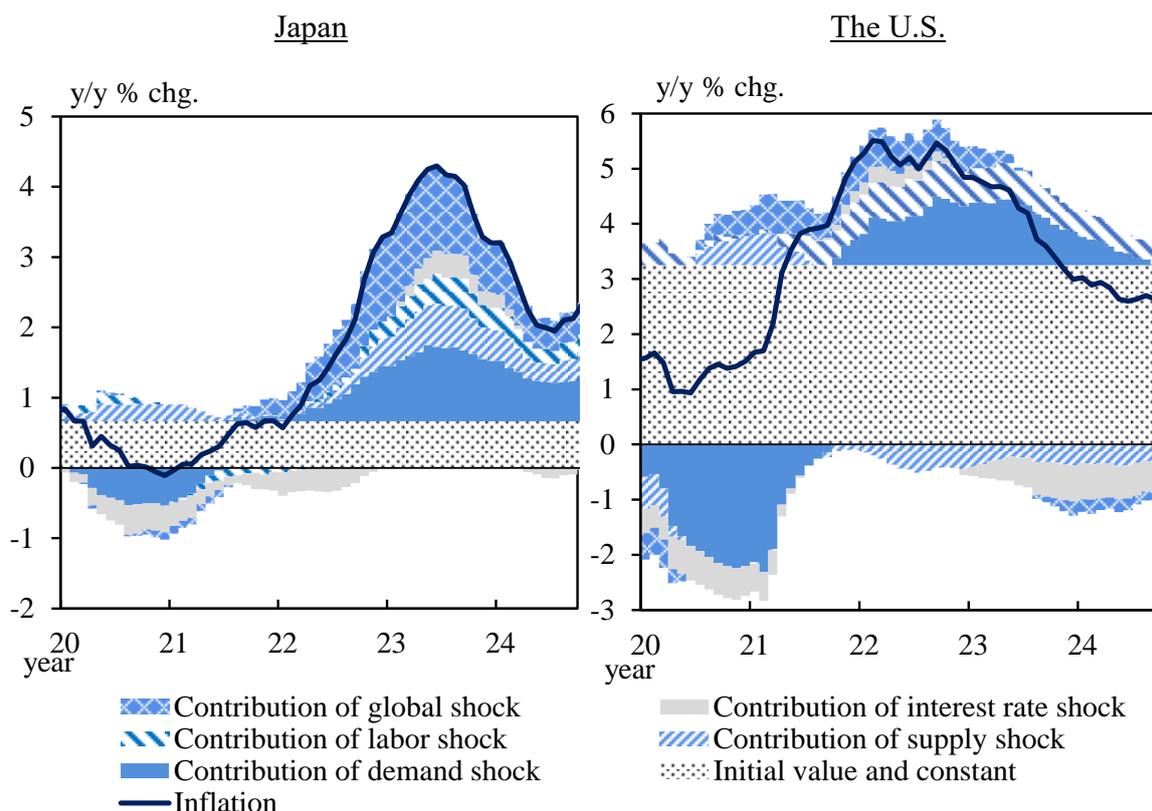
During and After COVID-19 pandemic

Figure 9 shows the historical decompositions of inflation since COVID-19 pandemic in 2020. The left panel, shows that in Japan in 2020, the contribution of supply shock was positive, while demand and interest rate shock were negative.¹⁷ From 2022, the rise in inflation was driven by global shocks at first, then as the economy reopened, other factors also contributed to the inflation. From mid-2023, the contributions of global factors were diminished, however the contributions of demand, labor, and supply shocks are persistent. The right panel shows that in the U.S. the decline in inflation from March 2020 was dominated by demand and labor market and interest rate factors, while supply shocks had an upward pressure on inflation. In early 2021, the negative demand effects sharply eroded and turned positive by mid-2021. The results are generally the same as [Shapiro \(2022\)](#) and [IMF \(2024\)](#). In addition, the observation that the contribution of labor shock had little effects on inflation at first but had sizable effects in the period from 2022 is consistent with the findings of [Ahn and Rudd \(2025\)](#), who investigated the joint dynamics of labor market outcomes and

¹⁷ It should be noted that the large-scale fiscal and monetary support in 2020 is not adequately captured by the endogenous variables represented by the 5-year interest rate. Therefore, given that the decline in interest rates was relatively limited compared to the significant drop in the IIP during this period, the model may have interpreted this as a positive interest rate shock. It is important to recognize that the model may not fully capture the underlying dynamics, which could affect the measured contribution of interest rate shocks to inflation.

inflation in the U.S. and showed that the non-negligible amount of pass-through from wages to prices appeared from 2022.¹⁸ From the end of 2022, the contribution of interest rate shocks put downward pressure on inflation, which shows that monetary tightening exerted some effect with lags. From mid-2023, demand and labor shocks become the dominant factors in the U.S. as well.

Figure 9. Price inflation after COVID-19 outbreaks



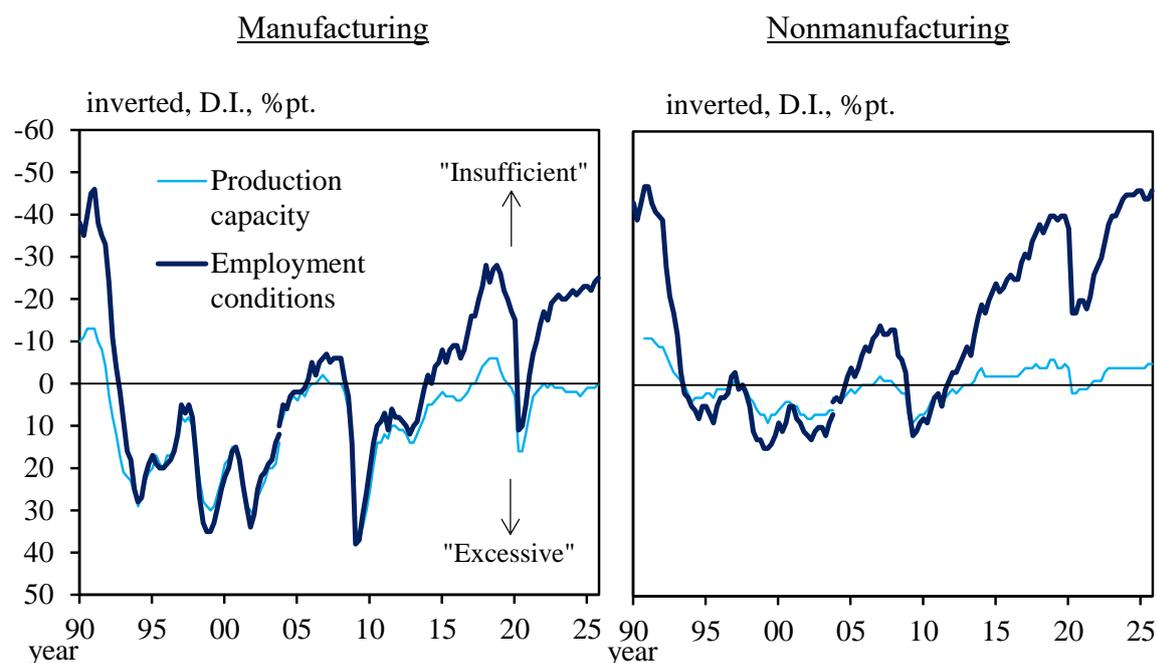
Sources: Japanese Ministry of Internal Affairs and Communications; Japanese Ministry of Economy, Trade and Industry; Japanese Ministry of Health, Labour and Welfare; Haver; Bank of Japan; U.S. Bureau of Labor Statistics; U.S. Bureau of Economic Analysis; U.S. Congressional Budget Office; FRED.

Comparing the results of Japan and the U.S., the two countries share similar cyclical patterns in the sense that the initial inflation run-up was driven by global shocks, followed by pent-up demand factors, which ultimately led to inflationary pressures from labor shocks. At the same time, upward pressure of supply and global shocks in Japan is more persistent than the U.S. Regarding the global shock, the persistence might be partly caused by the prolonged depreciation of yen. Regarding the supply shock, after the wake of COVID-19, industrial production has been stagnant in Japan reflecting labor supply scarcity. The production capacity Diffusion Index (D.I.) and employment conditions D.I. show the

¹⁸ In Appendix 4, I discuss the link between the labor market and the inflation rate through the shape of the Phillips curve.

tendency, in the past, to move in tandem, while the production capacity D.I. has recently tended not to indicate shortages, compared with employment (Figure 10). This observation implies the possibility of the labor supply constraints, which works as the upward pressure on inflation in Japan to some extent. By contrast, the contribution of supply shock to inflation in the U.S. turned negative from 2022, reflecting the rapid recovery of industrial production.

Figure 10. Production capacity and employment conditions in Japan



Note: Based on the *Tankan* (all enterprises, "excessive"- "insufficient"). There is a discontinuity in the data for December 2003 due to a change in the survey framework.

Source: Bank of Japan.

The result that the labor market tightness has recently pushed up inflation in Japan might appear puzzling, given that some previous studies have reported empirical evidence supporting the limited transmission mechanism through which labor market tightening raises the inflation in Japan (i.e., Nakamura *et al.* (2024)). Two possible explanations emerge. Firstly, in this paper, the unemployment rate gap is calculated from the vacancy ratio based on the broader coverage survey. This contrasts with much of the literature where the vacancy ratio is calculated using the data that covered public employment services only. Given the decline in the use of public employment services and the increasing reliance on private employment service, using statistics with broader coverage to measure labor market tightness might be helpful to gauge labor market conditions comprehensively. Secondly, the inclusion of the more recent period, when labor market conditions for full-time workers were tight, may lead to different results. It is well-known that one of the notable features of the

Japanese labor market is the dual-labor market structure between full- and part-time workers. Examining labor market conditions for full- and part-time employees separately shows that labor market conditions for full-time employees have recently become tighter and that the trends seem to be widely observed across industry and firm size. [Fukunaga et al. \(2023\)](#) discuss some of factors that have dampened nominal wage growth in Japan, such as wage rigidity of full-time workers, have been changing since around the COVID-19 outbreak. Such changes may have altered the relationship between the labor market and prices. In fact, nominal wages per employee have clearly increased in recent years due to ongoing base-pay increases. Further study is needed to understand clearly why wage and price increases were limited prior to the pandemic even though the labor market was similarly tight.

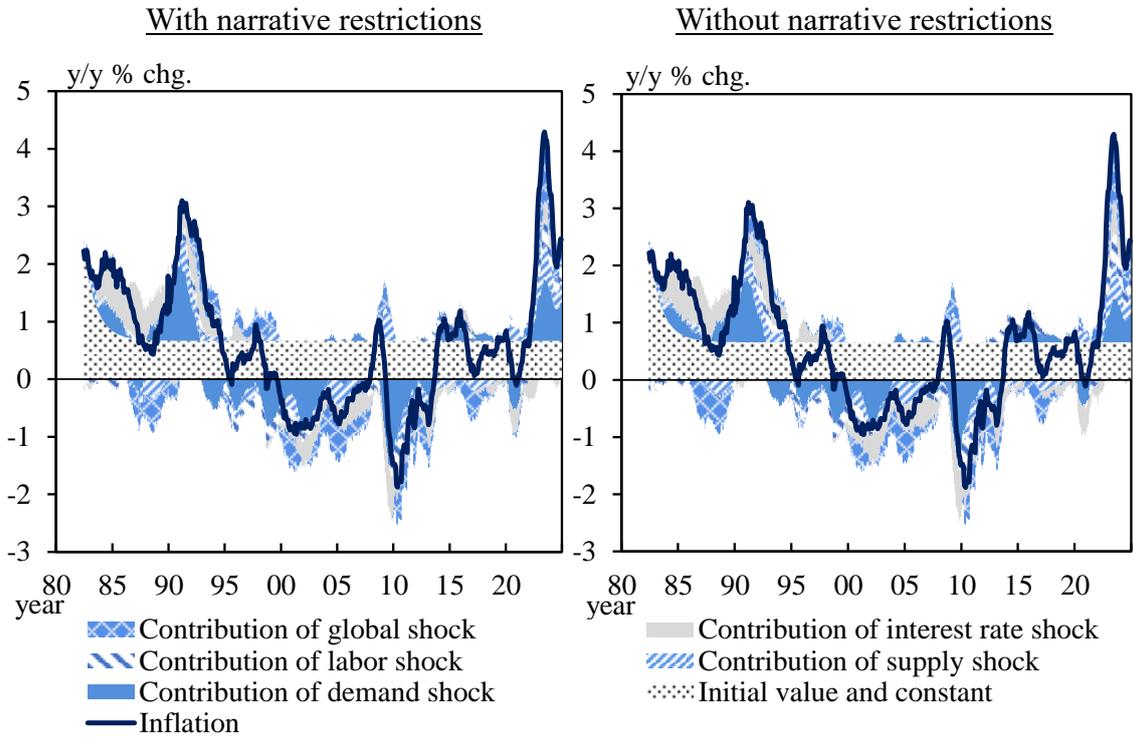
How do narrative restrictions change decompositions?

The comparison of estimation results with and without narrative restrictions has important implications for the evaluation of inflation. Figures 11 and 12 show the historical decomposition for inflation. Figure 13 shows the differences in the historical decompositions with and without narrative restrictions.¹⁹ The decomposition of inflation with narrative restrictions shows larger contributions of demand shocks, especially during those times with increasing volatility, such as the bubble economy in Japan around 1990, the burst of IT bubble in the around early-2000s, the GFC in 2008-09, and during and after COVID-19 outbreaks from 2020-present. Narrative sign restrictions are only imposed in 1985 in Japan and 1979 in the U.S. However, the historical decompositions differ not only in these periods, but also in other periods.

Specifically, the top table in Table 2 shows that, in Japan, the contributions of demand shocks with narrative sign restrictions are larger than that of those without narrative restrictions in 2022, which enables me to assess that the post-pandemic pent-up demand was pushing inflation upward by a reasonable amount. In 2024, demand shocks also show larger contributions in the results with narrative restrictions compared with those without narrative restrictions, and the contribution of global shock is smaller. By using narrative restrictions, it becomes clear that the primary driver of the increase in inflation in Japan shifted gradually from import price shocks to domestic demand factors driven by the economic recovery.

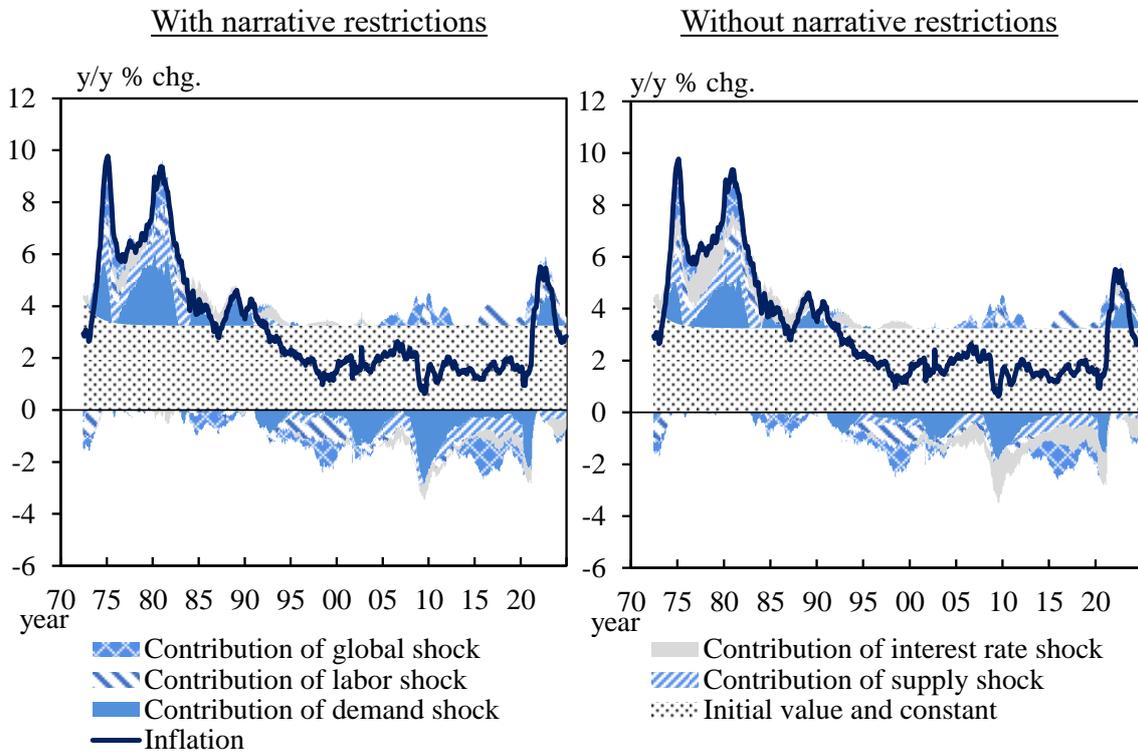
¹⁹ Figures A.2.3 and A.2.4 show how narrative restrictions change identified structural shocks.

Figure 11. Historical decompositions of price inflation in Japan



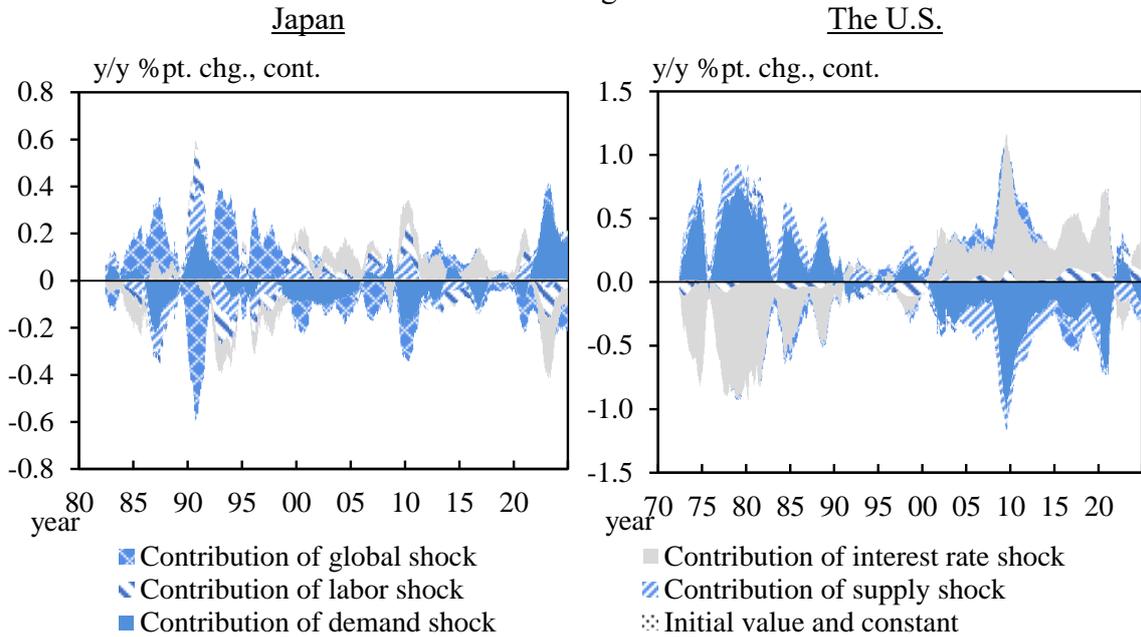
Sources: Japanese Ministry of Internal Affairs and Communications; Japanese Ministry of Economy, Trade and Industry; Japanese Ministry of Health, Labour and Welfare; Haver; Bank of Japan.

Figure 12. Historical decompositions of price inflation in the U.S.



Sources: U.S. Bureau of Labor Statistics; U.S. Bureau of Economic Analysis; U.S. Congressional Budget Office; FRED.

Figure 13. Differences in historical decompositions of price inflation with and without narrative sign restrictions



Sources: Japanese Ministry of Internal Affairs and Communications; Japanese Ministry of Economy, Trade and Industry; Japanese Ministry of Health, Labour and Welfare; Haver; Bank of Japan; U.S. Bureau of Labor Statistics; U.S. Bureau of Economic Analysis; U.S. Congressional Budget Office; FRED.

Table 2. Comparison of the contribution to inflation between 2022 and 2024

<u>Japan</u>					
Variable	y/y %pt chg, cont.				
	Supply shock	Demand shock	Labor shock	Interest rate shock	Global shock
Dec-22					
With narrative restrictions	0.39	0.79	0.24	-0.01	1.20
Without narrative restrictions	0.42	0.47	0.36	0.24	1.14
Dec-24					
With narrative restrictions	0.38	0.67	0.26	-0.02	0.48
Without narrative restrictions	0.34	0.49	0.29	0.05	0.59

<u>The U.S.</u>					
Variable	y/y %pt chg, cont.				
	Supply shock	Demand shock	Labor shock	Interest rate shock	Global shock
Dec-22					
With narrative restrictions	-0.45	1.07	0.61	-0.10	0.47
Without narrative restrictions	-0.29	0.92	0.52	0.04	0.41
Dec-24					
With narrative restrictions	-0.25	0.00	0.33	-0.43	-0.06
Without narrative restrictions	-0.14	0.15	0.24	-0.62	-0.05

Sources: Japanese Ministry of Internal Affairs and Communications; Japanese Ministry of Economy, Trade and Industry; Japanese Ministry of Health, Labour and Welfare; Haver; Bank of Japan; U.S. Bureau of Labor Statistics; U.S. Bureau of Economic Analysis; U.S. Congressional Budget Office; FRED.

In the U.S., as shown in the bottom table in Table 2, the contributions of demand shocks in the estimation with narrative sign restrictions are larger compared to without narrative restrictions in 2022, showing that post-pandemic pent-up demand was pushing inflation upward by a reasonable amount, similar to Japan. Comparing the results for interest rate shocks, the results without narrative restrictions show that interest rate shocks account for a large contribution with respect to the post-COVID high inflation and subsequent decline, while the results with narrative restrictions show moderate contributions for the fluctuations. Regarding the demand shocks, results with narrative sign restrictions show a large contribution to the decline in inflation from the end of 2022 to the end of 2024, compared with the results without narrative sign restrictions. These quantitative differences affect the measurement of the effects of monetary tightening on inflation, and also affect the slope of the Phillips curve, underscoring the importance of identifying structural shocks correctly by imposing appropriate constraints. The identified structural shocks changed with the presence or absence of narrative restrictions during the periods when the restrictions were imposed, but no significant changes were observed after COVID-19 (see Figure A.2.4). Therefore, the main cause of the changes in the historical decomposition is the variation in the IRFs. By imposing narrative restrictions, it becomes clear that the inflation rate responds less to monetary policy shocks in the U.S., highlighting the important role of other factors, such as demand shocks, in the formation mechanism of post-pandemic inflation.

4. Conclusion

The surge of inflation in the aftermath of the COVID-19 pandemic provided many lessons for gauging inflation at central banks and motivated researchers to investigate the underlying drivers of inflation during this episode. This paper uses an SVAR with narrative sign restrictions to characterize how the inflation episode of the COVID-19 pandemic compares across Japan and the U.S. Specifically, I decompose the inflation developments into supply, demand, labor supply, interest rate, and global shocks with a 5-variables SVAR, and compare the change in results of FEVDs, IRFs, and historical decompositions of the models with and without narrative restrictions.

The empirical analysis shows that (1) Japan and the U.S. share similar cyclical patterns in the sense that the initial inflation run-up was driven by supply and global shocks, followed by pent-up demand factors, which ultimately led to inflationary pressures from labor market tightening shocks, (2) labor market tightness shows the non-negligible contributions on inflation for both countries, and (3) narrative sign restrictions are informative as a strategy for structural shock identifications.

Although the results shed light on the underlying factors of inflation dynamics, such as those from the labor market, which have not been a central focus in previous literature, it does not necessarily mean that the empirical model captures all the complexities of price

formations. In this context, I raise four avenues for future research. First, the driving force of shift in trend inflation should be examined. In this study, the cyclical change in inflation is the main focus, while trend components may also shift through the estimation periods. It is essential for empirical and theoretical research on the formation of trend inflation in this field to continue to evolve. Second, the consequences of supply shocks need to be monitored carefully. When changes in trade policy cause the disruption of global supply chains, it is necessary to constantly monitor the possibility of materialization in upward pressure derived from negative supply shocks. In that case, it is worth considering adding variables and constraints to the model to identify shocks due to trade policy. Third, estimations in this paper assume that the relationships among variables remain constant over time. However, previous literature has reported changes in dynamics due to factors such as the regime shift in monetary policy before and after the Volcker reform (Clarida *et al.* (2000), Boivin *et al.* (2010), and Gertler and Karadi (2015)) and the zero lower bound (Cuba-Borda and Singh (2024)). One possible approach is combining the narrative sign restriction and the censored and kinked structural VAR (Mavroeidis (2021) and Ikeda *et al.* (2024)). Fourth and lastly, from the methodological perspective, investigating the optimal number of narrative restrictions is an interesting agenda for future research. Since the approach is a recent one, there is no clear consensus about the conditions for the most effective restrictions. The optimal number of the restrictions could depend on the frequency and/or length of time-series, and might differ across countries. I leave these points open for future research to pursue.

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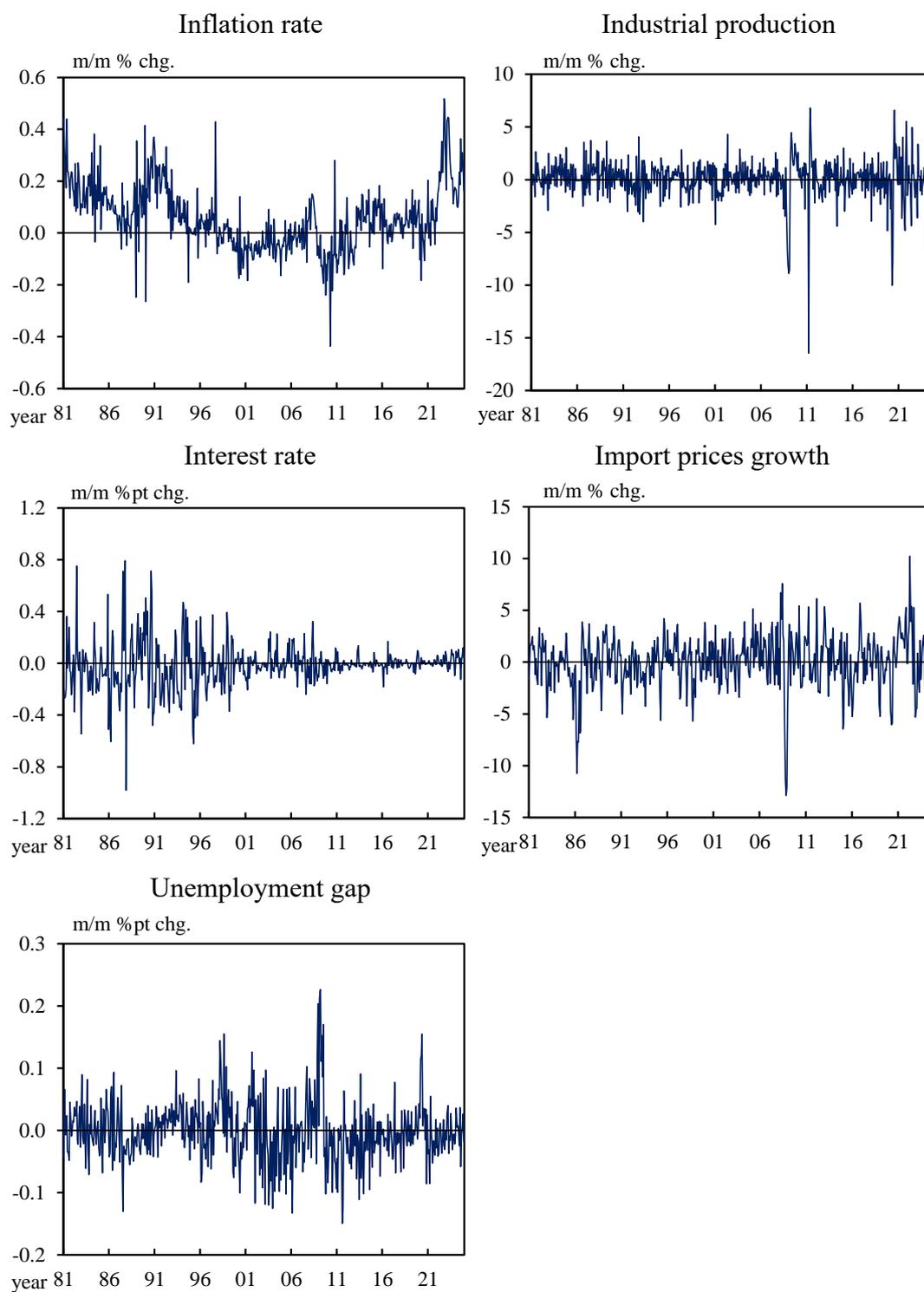
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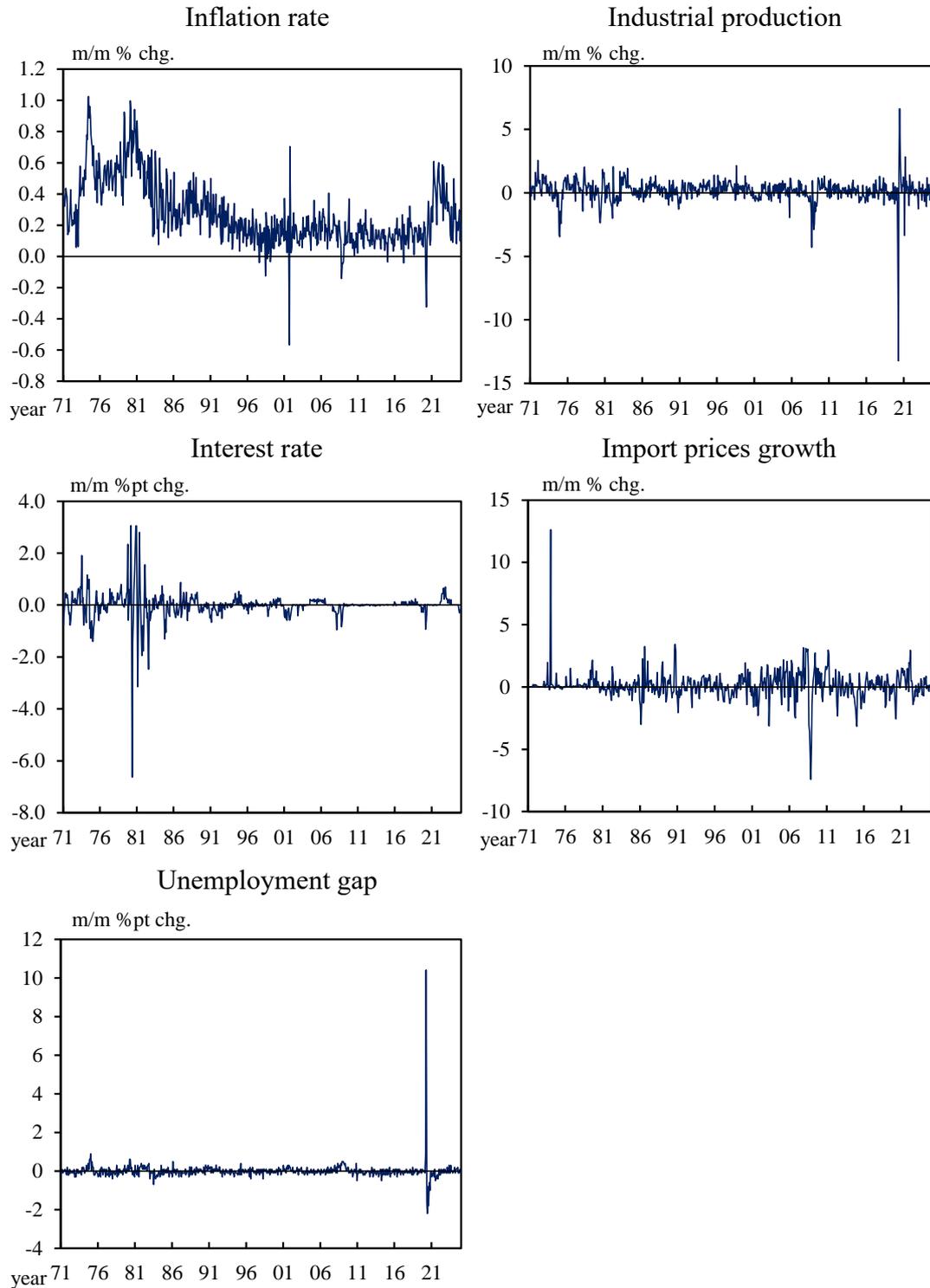
Appendix 1. Data Series

Figure A.1.1. Data series in Japan



Sources: Japanese Ministry of Internal Affairs and Communications; Japanese Ministry of Economy, Trade and Industry; Japanese Ministry of Health, Labour and Welfare; Haver; Bank of Japan.

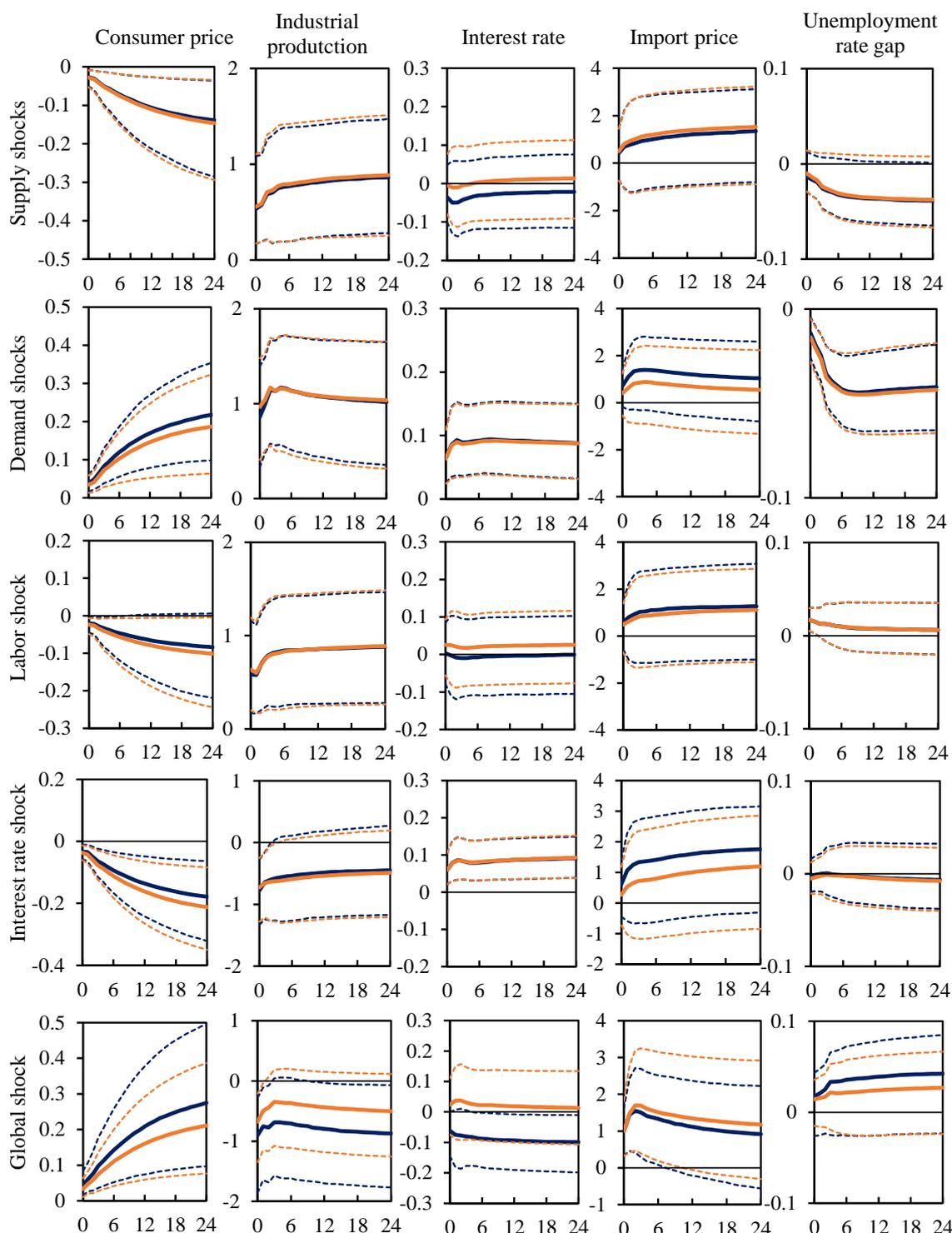
Figure A.1.2. Data series in the U.S.



Sources: U.S. Bureau of Labor Statistics; U.S. Bureau of Economic Analysis; U.S. Congressional Budget Office; FRED.

Appendix 2. Supplementary figures

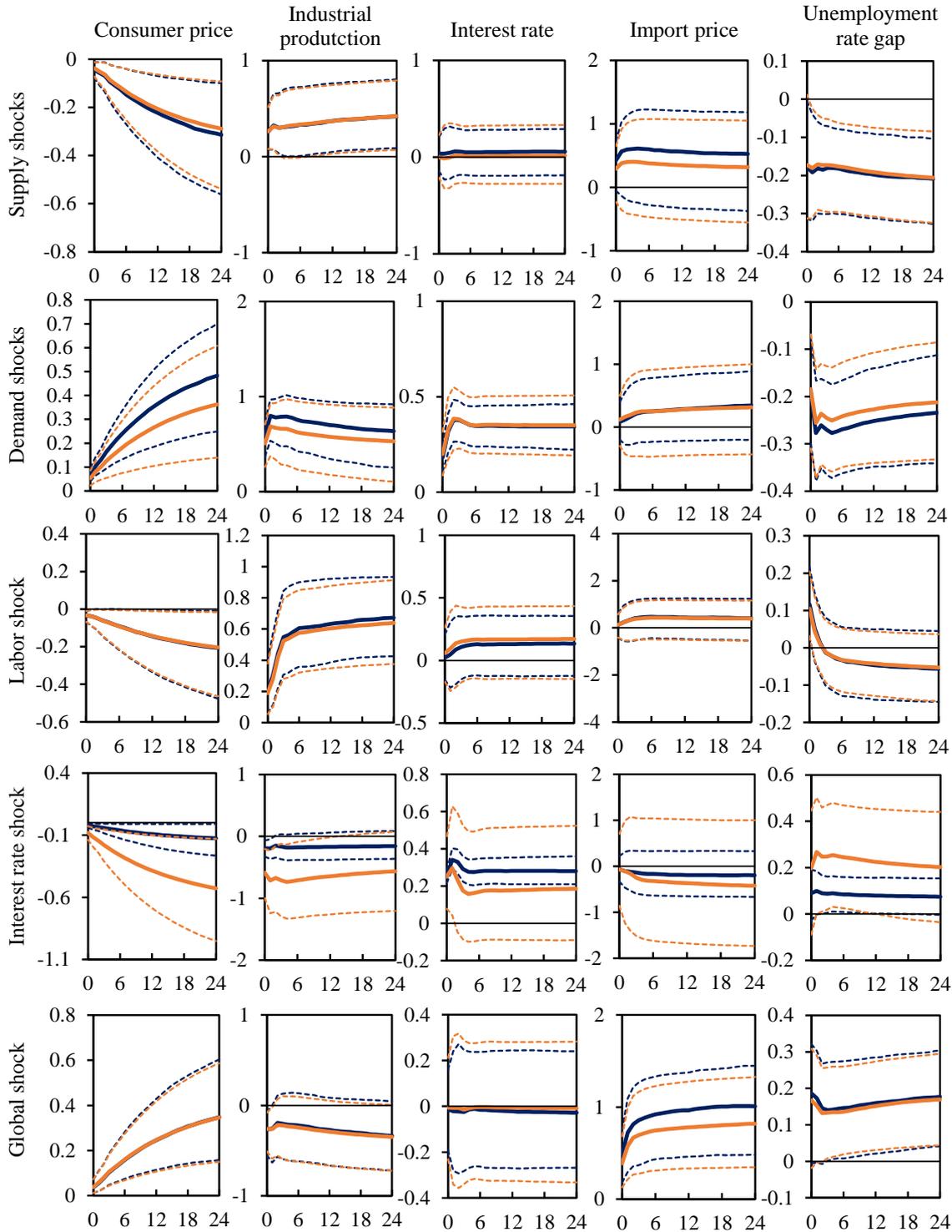
Figure A.2.1. Accumulated impulse responses for Japanese data



Notes: The orange lines are the median IRFs to positive one standard deviation shocks using the standard identification restrictions, and the blue lines are the median IRFs to positive one standard deviation shocks using the narrative sign restrictions. The dashed lines indicate the 68% (point-wise) confidence bands for the IRFs. The IRFs to global shocks have been normalized so that the global shock has an impact of 1 % points on the import price.

Sources: Japanese Ministry of Internal Affairs and Communications; Japanese Ministry of Economy, Trade and Industry; Japanese Ministry of Health, Labour and Welfare; Haver; Bank of Japan.

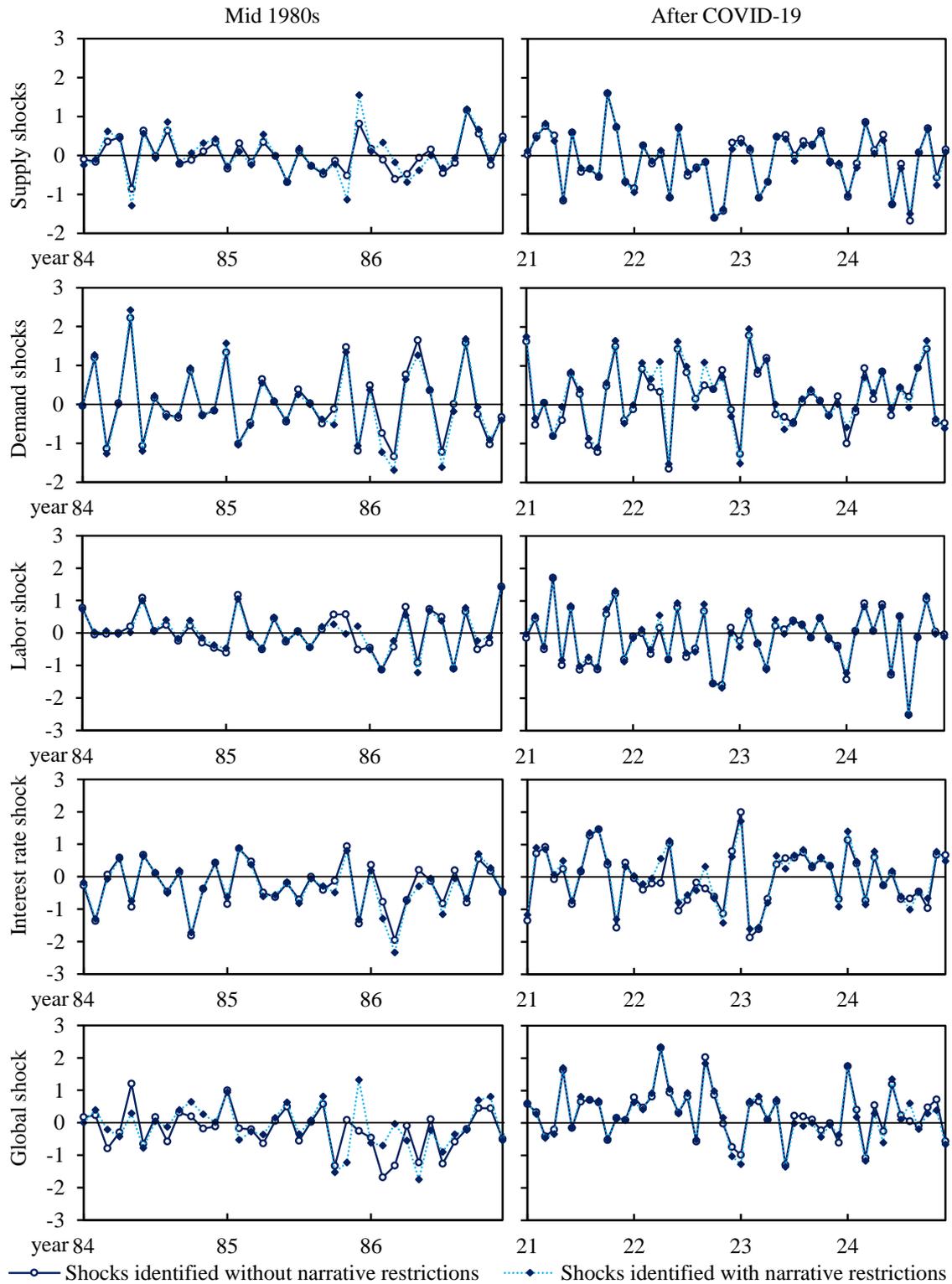
Figure A.2.2. Accumulated impulse responses for the U.S. data



Notes: The orange lines are the median IRFs to positive one standard deviation shocks using the standard identification restrictions, and the blue lines are the median IRFs to positive one standard deviation shocks using the narrative sign restrictions. The dashed lines indicate the 68% (point-wise) confidence bands for the IRFs. The IRFs to interest rate shocks have been normalized so that the interest rate shock has an impact of 25 basis points on the Federal funds rate.

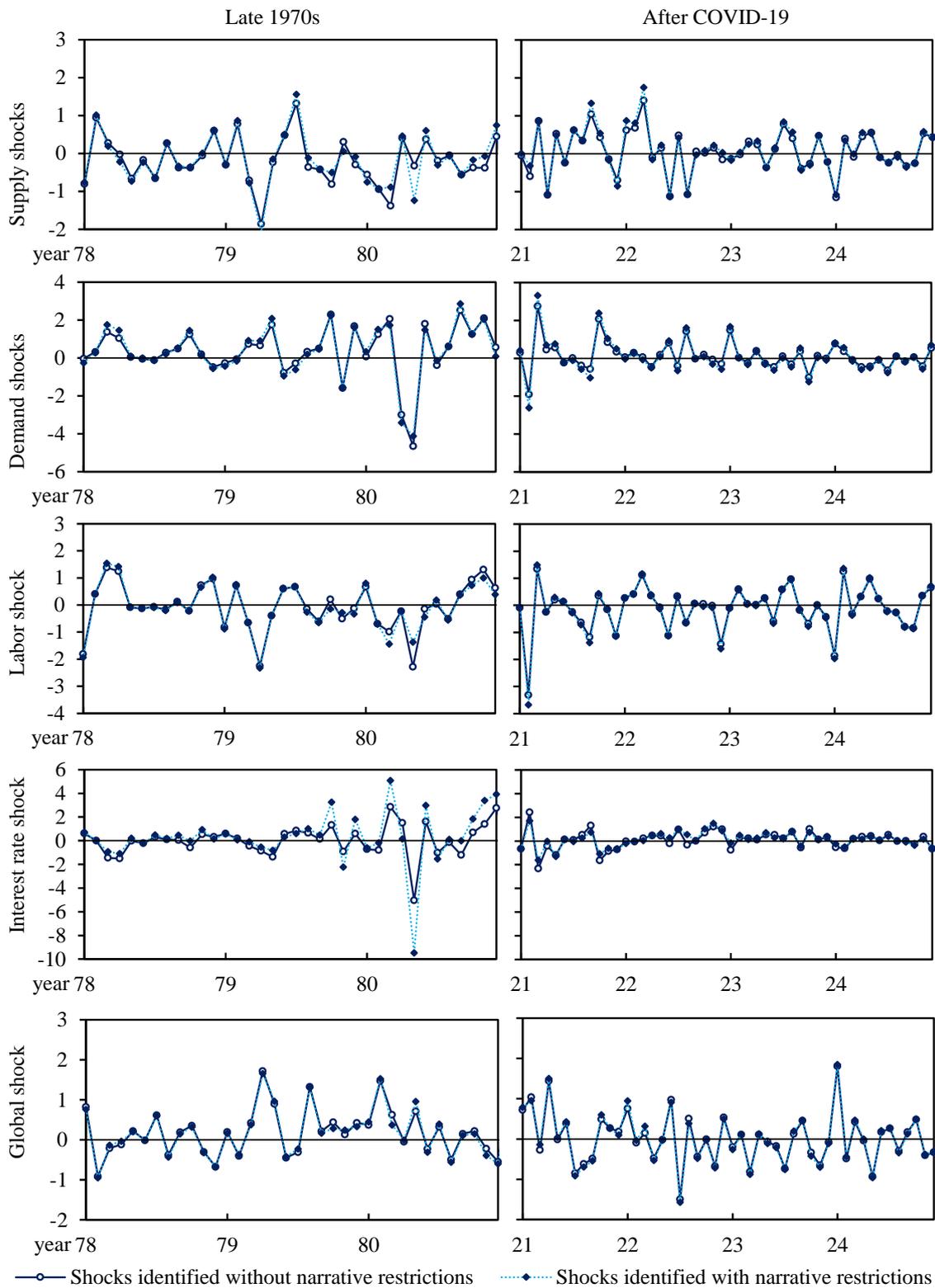
Sources: U.S. Bureau of Labor Statistics; U.S. Bureau of Economic Analysis; U.S. Congressional Budget Office; FRED.

Figure A.2.3. Structural shocks identified with and without narrative restrictions: Japan



Sources: Japanese Ministry of Internal Affairs and Communications; Japanese Ministry of Economy, Trade and Industry; Japanese Ministry of Health, Labour and Welfare; Haver; Bank of Japan.

Figure A.2.4. Structural shocks identified with and without narrative restrictions: the U.S.



Sources: U.S. Bureau of Labor Statistics; U.S. Bureau of Economic Analysis; U.S. Congressional Budget Office; FRED.

Appendix 3. The difference of impulse response functions in Japan

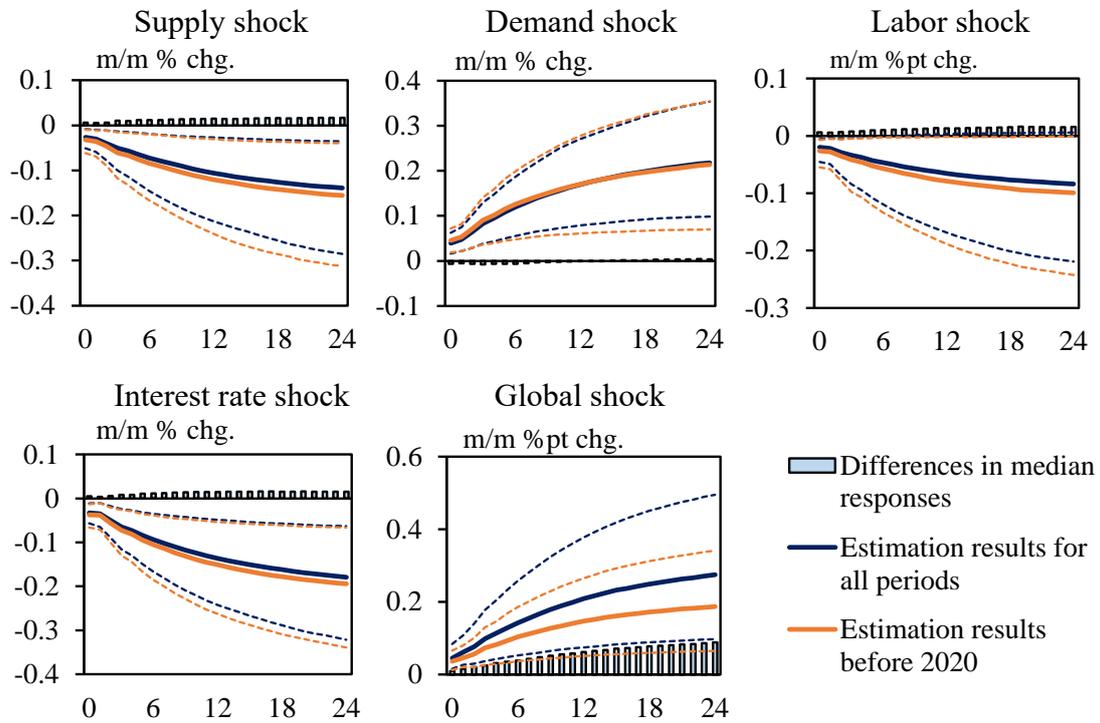
This appendix reports the nonlinearity in the impulse response function before and after the COVID-19 pandemic along with the relevant literature, mainly with [Sasaki *et al.* \(2026\)](#) using Japanese data. The SVAR models, as discussed in Section 3.1, capture the linear dependence of endogenous variables on its lags. However, in the literature, a number of pieces of research have noted the nonlinearity of the inflation dynamics ([Taylor \(2000\)](#), [BIS \(2022\)](#), [Borio *et al.* \(2023\)](#), [Gopinath \(2023\)](#), and [De Santi and Tornese \(2023\)](#)). [Sasaki *et al.* \(2026\)](#) have examined a possible nonlinearity in the pass-through to inflation of increases in firms' input costs represented by producer prices, exchange rates, and wages. Authors find that there is a statistically significant nonlinearity in that the pass-through to CPI inflation of increases in input costs once the increase exceeds a certain threshold. In light of the large changes in producer prices and other factors in the post-COVID period, the range of change in input variables exceeds this threshold, suggesting that the past linear relationship may not adequately capture the impact of these shocks on the inflation rate.

In the SVAR framework, one of the measures to observe the nonlinearity in relationships with shocks and endogenous variables is checking the change in impulse response functions with sub-sample estimations. Figure A.3.1 shows the impulse response functions of CPI to structural shocks. The blue lines show the estimation results for all periods and the orange lines show those from before 2020. The sensitivity of the CPI to global shocks is higher than that of the estimation including post-COVID-19 periods. Since global shocks include the effects of changing exchange rates and commodity prices, the observed nonlinearity in global shocks is in line with [Sasaki *et al.* \(2026\)](#).

Regarding the variable related to labor market, [Sasaki *et al.* \(2026\)](#) also report the nonlinear relationships of wages and CPI, though I cannot see the sizable differences in the impulse to labor shocks. The difference in the results is attributed to the difference in measurements of labor market conditions. [Sasaki *et al.* \(2026\)](#) use wages which showed higher inertia in growth, whereas I use the unemployment rate gap which directly captures the labor market slack. The unemployment rate gap rose during COVID-19 outbreaks and then fell sharply (i.e., labor supply and demand condition is tightened), while wages rose later and more slowly. Hence, the relationship between labor market tightness and inflation is captured in prior literature as a parameter nonlinearity, whereas in this analysis it might be captured as a difference in the magnitude of the shocks and not reflected in the differences in parameters.

I address a caveat regarding the quantitative evaluation on the degree of differences in median response. Estimation results might show a sharp difference if I could estimate with sub-sample before and after COVID-19 outbreaks. However, since I impose narrative sign restrictions in 1980s which is close to the estimation starting point, estimation without these periods would result in an incorrect interpretation of the obtained results. Therefore, I compare the estimation results for all periods and estimation results before 2020 here.

Figure A.3.1. Accumulated impulse responses of inflation rate to structural shocks in Japan



Note: The blue lines are the median IRFs with estimation with all period's data, and the orange lines are the median IRFs with estimation with data before 2020. The dashed lines indicate the 68% (point-wise) confidence bands for the IRFs. The IRFs have been normalized so that the global shock has an impact of 1 % points on the import price.

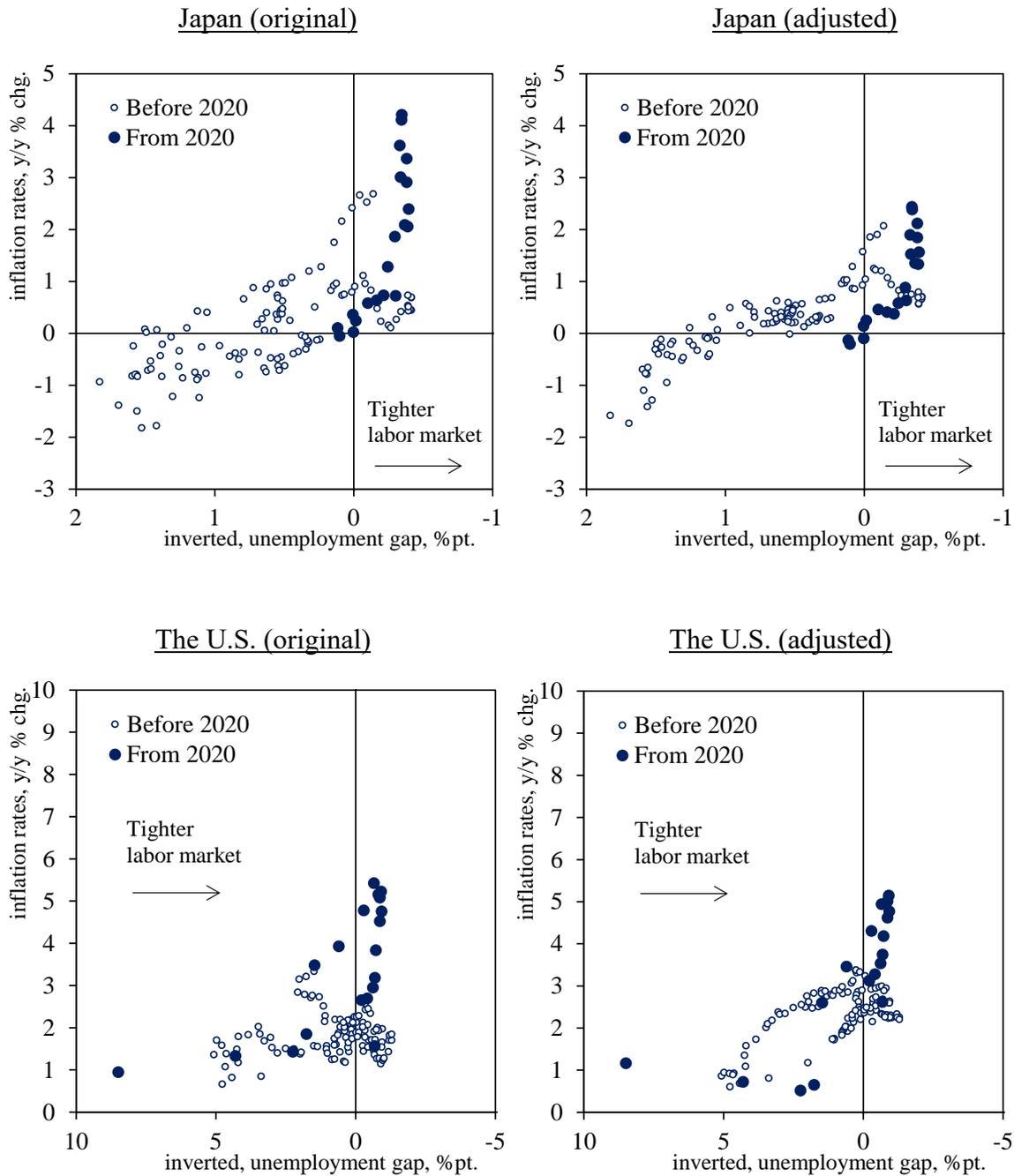
Sources: Japanese Ministry of Internal Affairs and Communications; Japanese Ministry of Economy, Trade and Industry; Japanese Ministry of Health, Labour and Welfare; Haver; Bank of Japan.

Appendix 4. The shape of the Phillips curve

In trying to assess the link between labor market tightness and inflation, this appendix discusses the shape of the Phillips curve. In Figure A.4.1, the y-axis in the left panels shows inflation rates without any adjustment, while the y-axis in the right panels shows inflation rates which filter out the contributions of supply and global shocks from original series. The basic idea for the adjusted series comes from [Banbura *et al.* \(2024\)](#) where core inflation is compared with its counterfactual version that filters out energy shocks such as oil supply, oil-specific demand, and gas price shocks and those linked to global supply chains. They report that the adjusted series is sizably lower but also exhibits a strong increase in the wake of COVID-19 pandemic, which suggests that there were indeed important shocks other than energy or supply chain that played a role and/or that the transmission of shocks was stronger.

In Figure A.4.1, panels with adjustment inflation rates show clearer relationships with labor market tightness and inflation in both countries, which indicates that the approach successfully removes the temporary factors driven by global and supply shocks that occurs outside of the labor markets. These observations suggest that most of the recent steepening of the Phillips curve is driven by global and supply factors. At the same time, the gradual upward shift implies that structural changes, such as rising inflation expectations or a shift in firms' price-setting stance, could be occurring behind the scenes. In order to gain confidence in the shift of the Phillips curve, it is necessary to monitor whether the long-term inflation expectations will keep rising and stabilize at a higher level than before the COVID-19 pandemic.

Figure A.4.1. Phillips curve



Note: "Original" indicates the value of y-axis is original inflation rates series without any modification. "Adjusted" indicates the value of y-axis is inflation rates which filter out the contributions of supply and global shocks from original series.

Sources: Japanese Ministry of Internal Affairs and Communications; Japanese Ministry of Economy, Trade and Industry; Japanese Ministry of Health, Labour and Welfare; Haver; Bank of Japan; U.S. Bureau of Labor Statistics; U.S. Bureau of Economic Analysis; U.S. Congressional Budget Office; FRED.

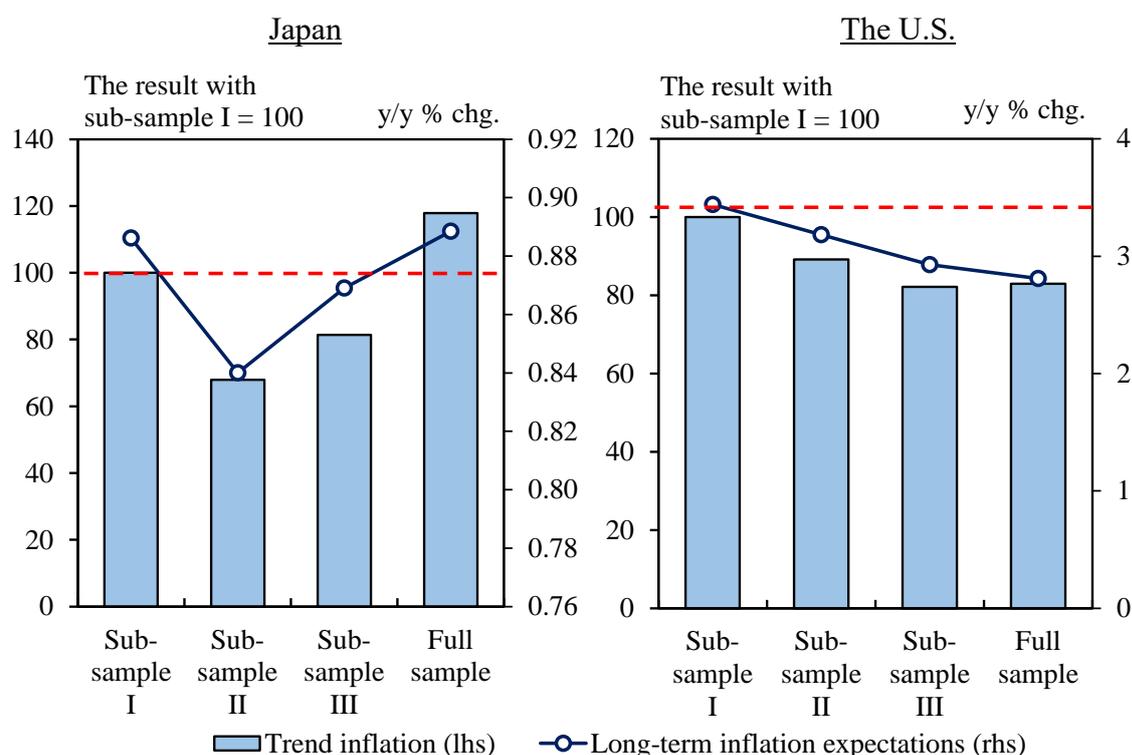
Appendix 5. Trend inflation as an initial value and constant term

The change in inflation dynamics is also caused by the change in trend inflation. Initial value and constant components in the estimations can be regarded as one of the indicators that represent trend inflation since the components are unaffected by structural shocks. If the inflation dynamic has changed especially in the periods before and after the COVID-19 outbreaks, the estimated initial value and constant terms may differ for sub-sample estimations. In this Appendix, I estimate the SVAR models with 3 different periods to investigate the hypothesis and show the relative level of initial value and constant term to the result with sub-sample I (1981-2007) for Japan, and the result with sub-sample I (1971-2007) for the U.S. in Figure A.5.1 to simplify the discussion.

In the left-hand chart in Figure A.5.1, the estimation results with Japanese data, trend inflation had been decreased with sub-sample II (1981-2012). In this period, GFC hit the Japanese economy and the inflation rate fell as low as -2 percent. The decline in trend inflation suggests that there was also more downward pressure on the inflation rate than had previously been explained by the contributions of structural shocks. The declining trend inflation during this period is also reported by [Saito *et al.* \(2012\)](#) where they use a DSGE model to decompose inflation dynamics in Japan. The trend inflation estimated with sub-sample III (1981-2019) rebounded slightly. It includes the periods of economic recovery and a correction of the strong yen, partly due to changes in conditions abroad. On top of this, the BOJ set a price stability target of 2 percent and introduced QQE, a large-scale monetary easing framework. The government also implemented various measures, including large-scale fiscal stimulus packages. The rise in trend factors implies that these measures lifted the trend inflation. With full-sample estimations, the trend inflation shows the highest level. After 2020, Japanese import prices rose sharply as a result of the global rise in inflation triggered by the rapid recovery from COVID-19 pandemic and Russia's invasion of Ukraine as well as the depreciation of the yen reflecting the rapid interest rate hikes by other central banks. These changes in external environment have pushed firms to change their price setting behaviors. [Furukawa *et al.* \(2024\)](#) studied the price-setting behavior of Japanese firms since 1990s and the causes of the emergence of the zero-inflation norm. They found that menu costs and the curvature of the demand curve should have risen, but these factors have gradually dissipated as inflation has risen in recent years. [Ikeda *et al.* \(2023\)](#) show evidence using microdata from the *Tankan* surveys that firms cautious about changing output prices, which are defined as the firms which replied that their output prices were "unchanged" for most of the period from 1991 to 2019, have raised prices after the surge of COVID-19 pandemic with some lags compared to other firms. The results of this paper and the findings of literature suggest that Japanese firms, which have held prices unchanged for a long time, are cautiously but steadily passing on cost increases to prices in the current phase. In addition to that, the inflation expectations, which are not included in the estimations, have risen moderately through the period, which might push up the inflation as indicated by [Nakamura *et al.* \(2024\)](#). I compare the estimated constant value and the average inflation expectations

estimated by [Osada and Nakazawa \(2024\)](#) during each period in the same panel, which shows that these two series are similar. The rise in trend inflation suggests that these factors raise general price inflation gradually.

Figure A.5.1. Sub-sample estimation of initial and constant term



Note: The panels show the relative level of the initial value and constant term of the end of the estimation periods in sub-sample and full-sample estimation and average long-term inflation expectations in the corresponding periods. For "trend inflation" in Japan, sub-samples I, II, III and full-sample are from 1981 to 2007, 1981 to 2012, 1981 to 2019, and 1981 to 2024, respectively. For "long-term inflation expectations" in Japan, sub-samples I, II, III and full-sample are from 1991 to 2007, 1991 to 2012, 1991 to 2019, and 1991 to 2024, respectively. For "trend inflation" in the U.S., sub-samples I, II, III and full-sample are from 1971 to 2007, 1971 to 2012, 1971 to 2019, and 1971 to 2024, respectively. For "long-term inflation expectations" in the U.S., sub-samples I, II, III and full-sample are from 1982 to 2007, 1982 to 2012, 1982 to 2019, and 1982 to 2024, respectively.

Sources: Japanese Ministry of Internal Affairs and Communications; Japanese Ministry of Economy, Trade and Industry; Japanese Ministry of Health, Labour and Welfare; Haver; Bank of Japan; U.S. Bureau of Labor Statistics; U.S. Bureau of Economic Analysis; U.S. Congressional Budget Office; FRED; Federal Reserve Bank of Cleveland; [Osada and Nakazawa \(2024\)](#).

For the U.S., in the right-hand chart of Figure A.5.1, I show the results with three sub-samples and the full sample. The initial and constant term in the estimation with sub-sample I periods during the Great Inflation is the highest. Whereas the results for other periods show that trend inflation calms down as the estimation period becomes longer and as more periods of stable inflation are included in the estimates. Notably, the level of trend inflation did not

change when the period of the post-COVID inflation surge was included in the estimates (Full sample), which is confirmed by the comparison with inflation expectations in the same panel. These results are in line with previous literature such that the rise in inflation was mainly driven by cyclical components and long-term components which are well-anchored ([Bernanke and Blanchard \(2025\)](#)). This indicates that the surge in inflation in this period were driven by cyclical components such as supply and demand factors rather than the rise in trend inflation, which contrasts to Japanese results.