

## Recent Characteristics of Long-Term Interest Rates and Stock Prices in the United States and Europe: with a Focus on the Effects of Increased Attention to Inflation Indicators

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Since last year, U.S. and European financial markets have experienced significant volatility in long-term interest rates and stock prices as market participants have been paying more attention to developments in inflation and monetary policy. In this paper, we use a simple sign-restricted VAR to analyze how changes in market participants' views on the economic outlook and monetary policy have affected long-term interest rates and stock prices, particularly in the United States. First, while an improvement in the economic outlook in the United States, due to an easing of the impact of COVID-19 and other factors, has pushed up U.S. stock prices, a tightening of monetary policy since the beginning of last year has pushed down U.S. stock prices. In addition, as inflation has become a market theme since last year, we found that fluctuations in interest rates and stock prices have widened at times when economic and price indicators, especially the CPI, were released. Moreover, the recent release of the U.S. CPI has affected the European markets in some cases, suggesting that changes in market participants' views have easily propagated between the United States and Europe.

### Introduction

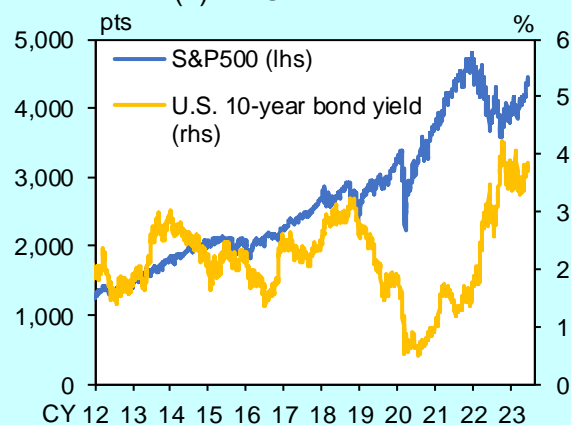
In the U.S. and European financial markets, since the start of the interest rate hike phase in the spring of 2022, changes in market participants' views on developments in inflation and monetary policy have had significant impacts on financial markets. With central banks in the United States and Europe taking the stance that monetary policy is data dependent, there have been occasions when stronger-than-expected economic and price indicators have led investors to anticipate persistently high inflation and the accompanying tightening of monetary policy, pushing long-term interest rates significantly higher.

This paper analyzes the features of the U.S. and European financial markets under conditions in which the developments of inflation are the focus of market participants' attention. In the following, we review recent developments in U.S. and European long-term interest rates and stock prices, and then conduct a quantitative analysis using a simple sign-restricted VAR (Vector autoregression) model.

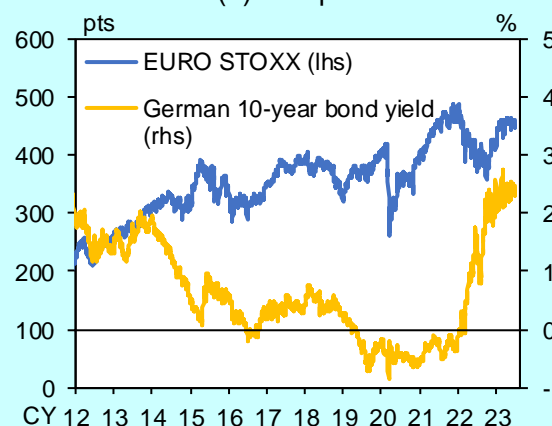
### Developments in Long-Term Interest Rates and Stock Prices in the United States and Europe

The U.S. long-term (10-year) interest rate, which

[Chart 1] Long-Term Interest Rates and Stock Prices in the United States and Europe  
(1) the United States



(2) Europe



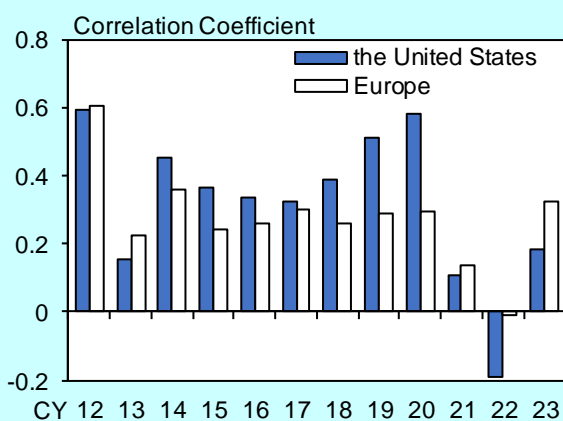
Source: Bloomberg.

Note: Latest data as of June 30, 2023.

was around 1.6 percent at the beginning of 2022, rose sharply as the Fed tightened monetary policy, reaching around 3.9 percent at the end of the year (Chart 1). On the other hand, U.S. stock prices (S&P 500) fell about 20 percent during 2022. Similarly, in Europe, long-term interest rates rose sharply and stock prices fell over the course of the year. This is the first time since 2001 that long-term interest rates have risen and stock prices have fallen throughout a year in both the United States and Europe.

Looking at daily data, in 2022, a negative correlation between long-term interest rates and stock prices (or a positive correlation between bond prices and stock prices) was confirmed in the United States. In Europe, unlike in previous years, there was no positive correlation between long-term interest rates and stock prices (Chart 2). In other words, the U.S. and European financial markets in 2022 were characterized by an increased tendency for interest rates to rise and stock prices to fall (or for interest rates to fall and stock prices to rise) simultaneously.

[Chart 2] Correlation Coefficient between Interest Rates and Stock Prices



Source: Bloomberg.

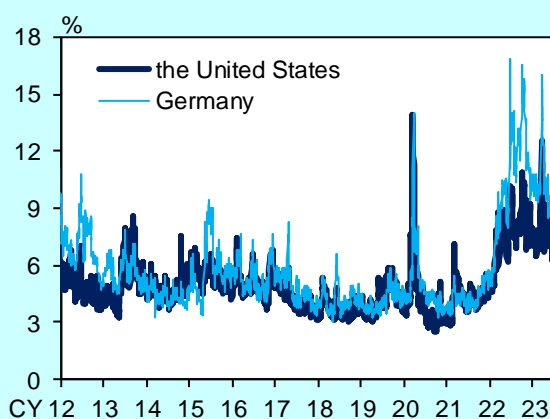
Note: Correlation coefficient between the daily change in long-term (10-year) interest rates and the logarithmic daily change in stock prices. Figures for CY2023 are calculated based on data through June 30.

These characteristics could be greatly attributed to the fact that market participants focused on inflation and monetary policy developments. In fact, there were many situations when the economic and price indicators being above market expectations led investors to anticipate prolonged high inflation and the accompanying tightening of monetary policy, leading to stock market declines (or vice versa). These situations were sometimes expressed in phrases such as "good news is bad news" (or "bad news is good news"). In addition, amid a focus on monetary policy, statements by officials of the Fed and the ECB also influenced market movements in some cases.

A growing uncertainty surrounding monetary

policy has also had a significant impact on the volatility of long-term interest rates (Chart 3). Through the second half of 2022, as rapid rate hikes continued and market participants' views on the peak level of the policy rate in this tightening cycle (terminal rate) remained unsettled, long-term interest rate volatility rose significantly. Since then, the pace of interest rate hikes has slowed in both the United States and Europe as inflation has peaked out, and uncertainty about the level of the terminal rate appears to have decreased. However, it remains difficult to accurately forecast inflationary trends, and uncertainty surrounding the future, including the timing of a shift to lowering the policy rates, remains significant. Against this backdrop, interest rate volatility remains high, albeit lower than in the recent past.

[Chart 3] Volatility of U.S. and European Interest Rates



Source: Bloomberg.

Note: Implied volatility of options on long-term JGB futures (1 month). Latest data as of June 30, 2023.

## Analysis Using Sign-Restricted VAR

To what extent have the increased attention to economic and price indicators and changes in views on monetary policy affected long-term interest rates and stock prices in the United States and Europe? To examine this point, the following analysis employs a sign-restricted VAR. A sign-restricted VAR is a type of structural VAR that quantitatively analyzes the impact of each shock on economic variables by imposing theoretically assumed sign conditions on the impacts of various factors (shocks) on economic variables.

### Previous Studies and Features of Our Analysis

There are several previous studies that have analyzed financial market movements using sign-restricted VAR. For example, Matheson and Stavrev (2014) conducts an analysis of the U.S. financial

market using two variables, stock prices and long-term interest rates, and shows that the "monetary policy shocks" can explain most of the increase in long-term interest rates that occurred during the taper tantrum in May 2013.<sup>1</sup> Other literature analyzes the international spillover of shocks or identifies shocks that affect the risk premium, by imposing sign restrictions on a larger number of variables.<sup>2</sup> However, as far as we know, there are no previous studies that analyze the recent developments of the U.S. and European financial markets, including data after 2022.

In this paper, we use data up to the most recent period to summarize the features regarding developments in the U.S. and European financial markets since last year, based on a simple framework using only two variables: long-term interest rates and stock prices, as in Matheson and Stavrev (2014). On top of that, we look at increases in price fluctuations in the financial markets when economic and price indicators are released, taking into account that inflation has become a major theme in the U.S. and European markets since 2022.

### Summary of Analysis Methods

As we have already pointed out, views on monetary policy appear to have had a significant impact on stock prices and long-term interest rates during 2022, but in reality, at the same time, views on the economic outlook should also have had an impact. Therefore, in the sign-restricted VAR analysis in this paper, we assume two fundamental shocks: "economic outlook shocks (changes in views on the economy)" and "monetary policy shocks (changes in views on monetary policy)" (Chart 4).<sup>3</sup>

[Chart 4] Sign Restrictions of Structural VAR

	(1) Economic Outlook Shock	(2) Monetary Policy Shock
Stock Prices	+	-
Long-Term Interest Rates	+	+

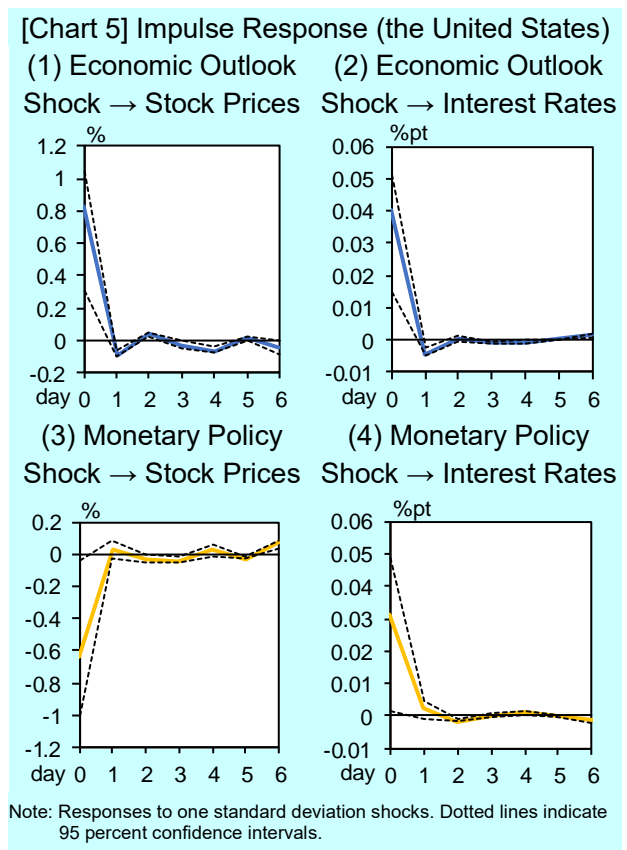
Specifically, we assume that an "economic outlook shock" moves interest rates and stock prices in the same direction, while a "monetary policy shock" moves them in opposite directions. With regard to the former, when the economic outlook is expected to improve, stock prices and interest rates are usually expected to rise together due to investors' actions of stock buying and bond selling. For example, such movements often occur when the economic outlook improves as a result

of an upturn in the business confidence index. In the latter case, when a tightening in the monetary policy is expected, it is natural to assume that interest rates will rise and stock prices will fall. For example, an upward swing in the CPI may trigger a rise in the expectation of tighter monetary policy.

Estimations were conducted independently for each of the United States and Europe.<sup>4</sup> For both cases, we used daily data from the beginning of January 2012 to June 30, 2023.<sup>5</sup> For stock prices, we used the S&P500 index for the United States and the EURO STOXX index for Europe (both in the form of logarithmic daily changes). For long-term interest rates, we used data for the 10-year bond yield for the United States and Germany (both in the form of daily changes). The following sections mainly focus on the results for the United States.

### Result 1: Impact of Each Shock on Interest Rates and Stock Prices

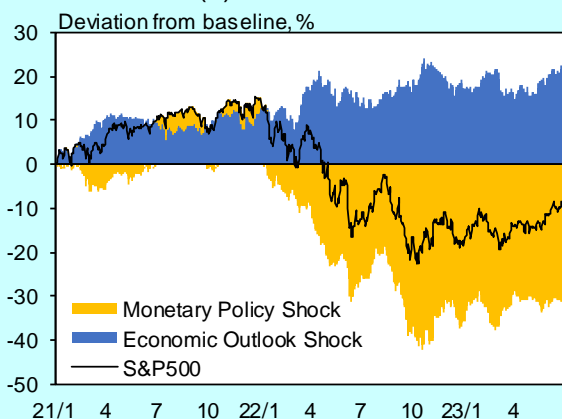
First, for impulse responses to shocks (shown in Chart 5), on the day of the shock, interest rates and stock prices respond in the same direction to the "economic outlook shock" and in opposite directions to the "monetary policy shock," as indicated by the sign restrictions imposed in Chart 4. However, both types of shocks have marginal impacts on the daily changes in financial variables from the next day onward. This



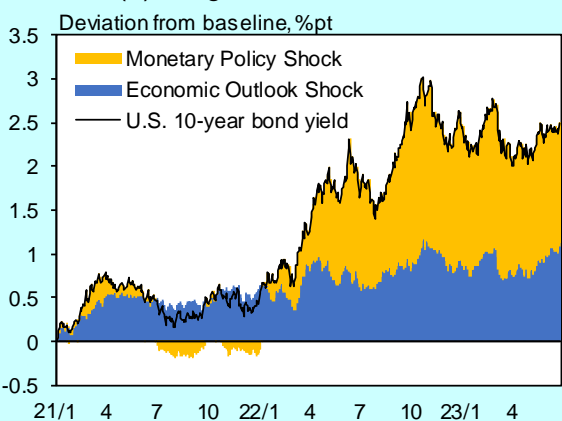
result suggests that, on average, most information on economic indicators is digested within a day in financial markets.

The historical decomposition confirms how two types of shocks have affected stock prices and long-term interest rates. The results show that while the "economic outlook shocks" have pushed up U.S. stock prices since 2021, the "monetary policy shocks" have pushed them down since 2022 (Chart 6). This suggests that while the economic outlook has improved on the back of an easing of the impact of COVID-19 and other factors, the rapid tightening of monetary policy has pushed down stock prices. Long-term interest rates, on the other hand, have risen sharply, pushed up by both types of shocks.

[Chart 6] Decomposition of Changes in Stock Prices and Long-Term Interest Rates (the United States, Cumulative since 2021)  
(1) Stock Prices



(2) Long-Term Interest Rates



Note: Latest data as of June 30, 2023.

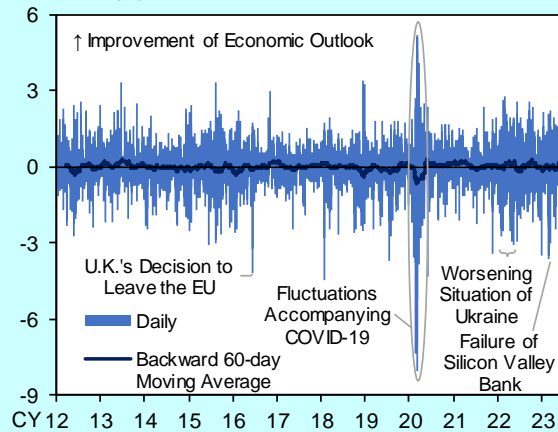
### Result 2: Magnified Shocks at the Time of Indicator Releases

Looking at the identified shocks for the United States, the fluctuation of "monetary policy shocks" has clearly expanded since the beginning of 2022 (Chart 7). Calculating a moving average, we see that shocks in the

direction of tightening have strengthened since the beginning of 2022, which is consistent with the results of the historical decomposition described above. Additionally, although the fluctuation of shocks seems to have decreased somewhat recently, it is still larger than in 2021 and before. On the other hand, the variability of "economic outlook shocks" has also widened, suggesting an impact of the war in Ukraine and increased uncertainty surrounding the financial sector following the failures of U.S. regional banks earlier this year.

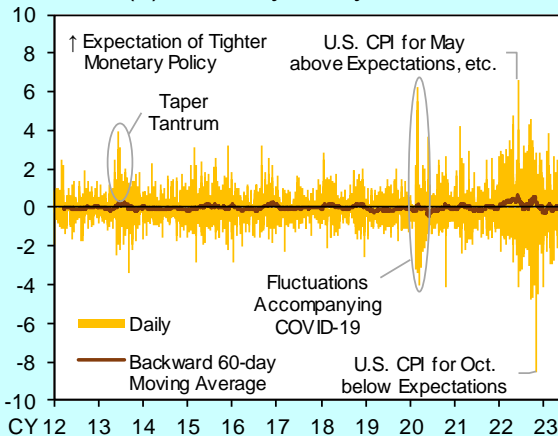
Looking further back in the past, the so-called taper tantrum in May 2013 has been detected as a "monetary policy shock," while the U.K.'s decision to leave the EU (Brexit) in 2016 has been detected as an "economic outlook shock." In addition to these, in the first half of 2020, when COVID-19 was spreading in the United

[Chart 7] Identified Shocks (the United States)  
(1) Economic Outlook Shocks



	Until 2021	2022	2023
Standard Deviation	0.96	1.20	1.19

(2) Monetary Policy Shocks



	Until 2021	2022	2023
Standard Deviation	0.84	1.86	1.33

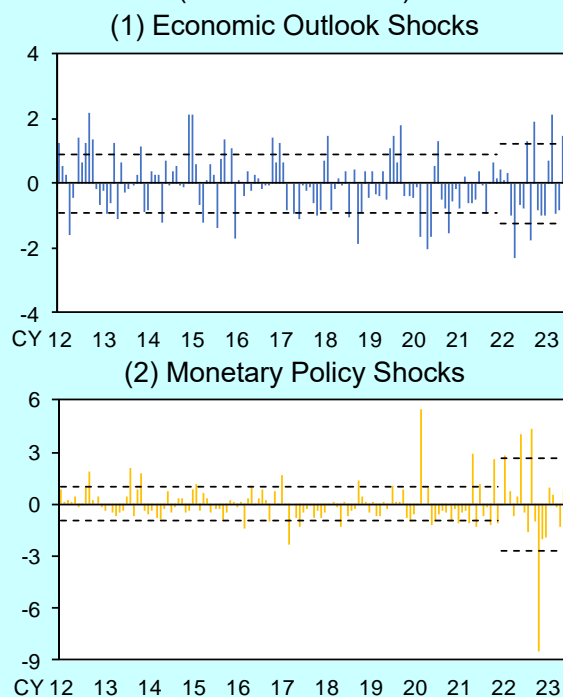
Note: Standardized to have a standard deviation of 1 for the entire period. Latest data as of June 30, 2023.

States and Europe, significant fluctuations accompanied by a deterioration in the economic outlook and its repercussions have been detected.<sup>6</sup>

Next, among the identified shocks, if we extract the shocks on the day of the U.S. CPI release, we can confirm that the expansion of "monetary policy shocks" is particularly pronounced<sup>7</sup>, although it should be noted that the release dates of indicators may coincide with other events<sup>8</sup> (Chart 8). In particular, in November 2022, a significant shock in the direction of monetary easing was observed after the U.S. CPI (for October) showed a slowdown in its rate of increase, as well as it being lower than market expectations.

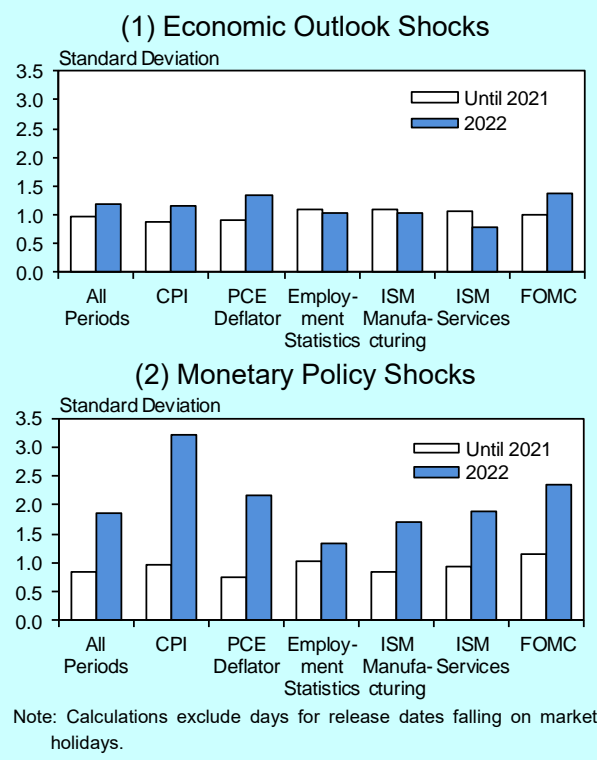
A widening of "monetary policy shocks" can be seen for the release dates of other indicators, such as employment data (non-farm payroll employment), as well as for the dates of the FOMC results, but widening of "monetary policy shocks" on the CPI release dates is particularly pronounced<sup>9</sup> (Chart 9). This result is consistent with the fact that inflation has been a major theme in recent financial markets.

[Chart 8] Shocks on the CPI Release Dates (the United States)



Note: From Chart 7, only the data on the U.S. CPI release dates are taken out. The dotted lines represent the standard deviations for (1) 2012 to 2021 and (2) after 2022. The data are excluded for release dates falling on market holidays. Latest data as of June 13, 2023.

[Chart 9] Expansion of Shocks at the Release Dates of Indicators etc.

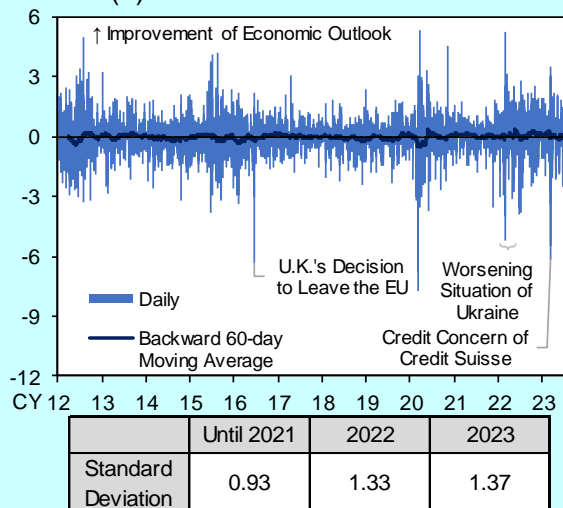


### Result 3: Increased Linkage between the U.S. and European Markets

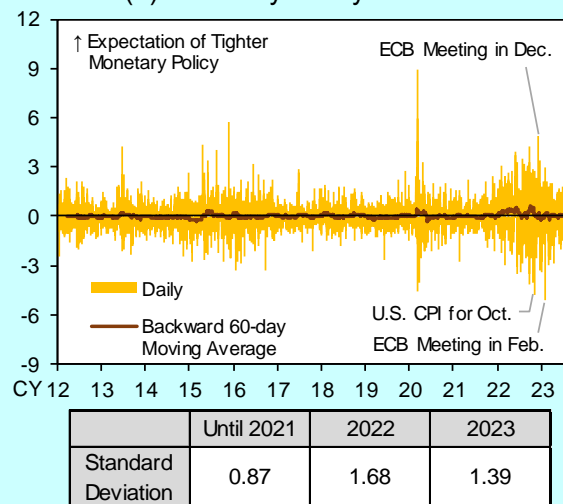
We conducted the same analysis for Europe, and the identified shocks show that the fluctuation of "monetary policy shocks" expanded after 2022 as with the United States. In some cases, the "monetary policy shocks" also expanded in Europe when the U.S. CPI was released, suggesting that shocks propagated across regions (Chart 10).

Measuring the correlation coefficients of shocks obtained from the respective estimates for the United States and Europe, we found that the correlation of "monetary policy shocks" increased in 2022 (Chart 11). Although a more detailed analysis is needed to draw a clear conclusion on the background of the increase in the correlation, it can be pointed out that market participants' speculations on inflation and monetary policy may have easily propagated between the U.S. and European markets, as inflation became a common theme in both markets.

[Chart 10] Identified Shocks (Europe)  
(1) Economic Outlook Shocks

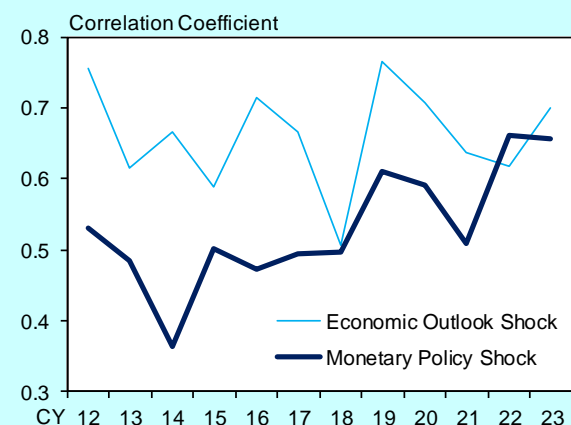


(2) Monetary Policy Shocks



Note: Standardized to have a standard deviation of 1 for the entire period. Latest data as of June 30, 2023.

[Chart 11] Correlation of Shocks between the United States and Europe



Note: Figures for CY2023 are calculated from data through June 30.

### Notes on Interpretation of Shocks

Finally, two points to keep in mind should be noted in this analysis.

First, it is important to note that the "monetary policy shocks" in this analysis do not necessarily correspond to actual monetary policy actions themselves, but rather capture "changes in market participants' views" on monetary policy. For example, even if the FOMC decides to tighten monetary policy, this does not automatically translate into a "tight monetary policy shock." If interest rates fall and stock prices rise because the degree of tightening is smaller than expected, this will rather be identified as an "accommodative monetary policy shock."

Second, it should be noted that, although actual asset prices fluctuate due to numerous factors, the analysis in this paper for simplicity assumes only two types of shocks. In particular, it seems important to note that the stock prices and long-term interest rates used in the analysis are "nominal values" and do not distinguish between real value growth and price changes.<sup>10</sup> For example, if the inflation rate increases with a growing ability of firms to pass on costs to prices, stock prices will rise due to higher expectations of future nominal corporate earnings, even if the outlook for real growth remains unchanged. In this analysis, the "economic outlook shocks" have pushed up stock prices since 2021 (Chart 6), and part of this may have been due to the higher inflation rate that accompanies progress in price pass-through.

### Conclusion

How economic and price indicators and various events are digested in financial markets can vary depending on what market participants focus on when trading. In this paper, we have pointed out that in the U.S. and European financial markets since 2022, the impacts of economic and price indicators, particularly the CPI, on long-term interest rates and stock prices have increased as market participants have paid more attention to inflation and monetary policy developments, and that such impacts may have become more likely to be transmitted across regions. While market volatility is lower than in the recent past, with a pervasive view that the United States and Europe are in the final phase of interest rate hikes, uncertainty surrounding inflation and monetary policy remains high. It is important to continuously monitor developments in financial markets, paying attention to the impact of economic and price indicators on market participants' views, given that central banks in the United States and Europe have indicated that monetary policy will be data dependent.

## BOX: U.S. Stock Prices and Long-Term Interest Rates at the Recent Major Events

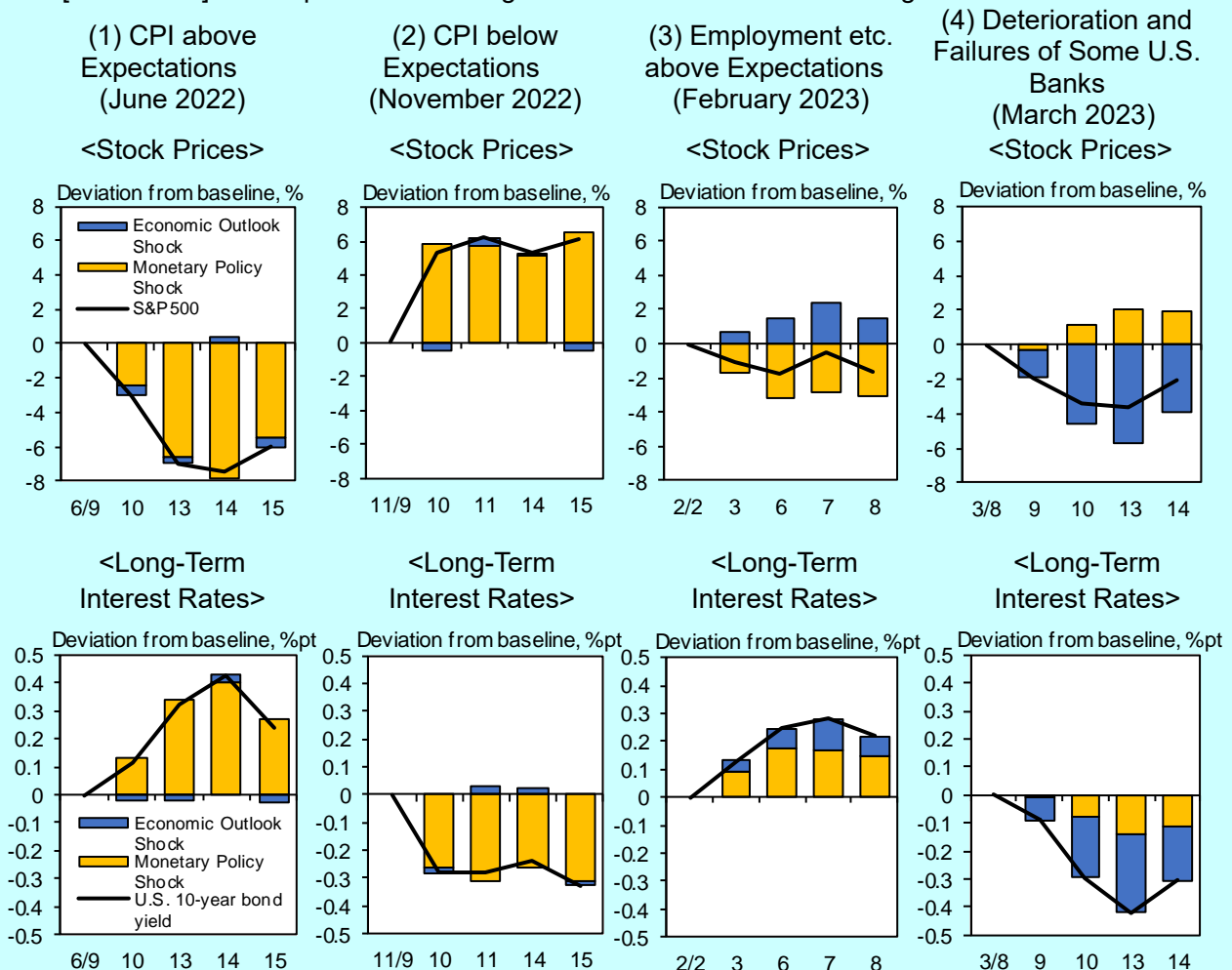
In this BOX, we analyze the movements of stock prices and interest rates in more detail for the times of recent major economic events, including the releases of economic and price indicators, using historical decompositions starting from such events.

First, let us review the movements at the times of CPI releases, whose importance is confirmed in this paper. When the U.S. CPI (for May) released in June 2022 was higher than market expectations, and market views that the future policy rate hike would be substantial disseminated over the following business day, we see that the "monetary policy shock" pushed up long-term interest rates and pushed down stock prices (BOX Chart 1). On the other hand, when the U.S. CPI (for October) released in November 2022 was lower than market expectations, the "monetary policy shock" pushed down interest rates while pushing up stock prices (Box Chart 2).

Financial markets also reacted significantly when employment statistics and other data were released. For example, in early February 2023, a stronger-than-expected non-farm payroll employment and the higher ISM services index (both for January) resulted in "monetary policy shock" that indicates policy tightening. On the other hand, the release of these economic indicators showing the strength of the real economy appears to have partially offset a decline in stock prices by improving the economic outlook (BOX Chart 3).

Various events other than releases of economic and price indicators have also had significant impacts on financial markets. For example, the failures of Silicon Valley Bank and Signature Bank in early March 2023 resulted in growing uncertainty surrounding the U.S. and European financial sectors, and uncertainty about economic outlook also increased. Looking at the developments at that time, the "economic outlook shock" pushed down interest rates and stock prices at the same time, suggesting that pessimistic views about the economic outlook had spread (BOX Chart 4).

[BOX Chart] Decomposition of Changes in U.S. Stock Prices and Long-Term Interest Rates



Note: Cumulative historical decomposition starting from the previous business day of each event.

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<sup>1</sup> Matheson, T., and E. Stavrev (2014), "News and Monetary Shocks at a High Frequency: A Simple Approach," *Economics Letters*, Volume 125, Issue 2, pp. 282-286.

<sup>2</sup> D'Amico et al. (2016) analyzed the impact of changes in views on economic growth, inflation, and monetary policy in the United States and abroad on U.S. asset prices using a sign-restricted VAR with eight variables, including U.S. and European stock prices and interest rates. Recently, Brandt et al. (2021) analyzed the linkage between the U.S. and European markets using a sign-restricted VAR with variables from both markets, and identified factors that are important for understanding European financial markets. Cieslak and Pang (2021) proposed a shock identification approach consisting of four variables -- stock prices and interest rates (2-, 5-, and 10-year) -- and showed that information dissemination at the FOMC meeting had affected stock prices through changes in the risk premium. For more details, see the following references.

Brandt, L., A. Saint Guilhem, M. Schröder, and I. Van Robays (2021), "What Drives Euro Area Financial Market Developments? The Role of US Spillovers and Global Risk," Working Paper Series 2560, European Central Bank.

Cieslak, A., and H. Pang (2021), "Common Shocks in Stocks and Bonds," *Journal of Financial Economics*, Volume 142, Issue 2, pp. 880-904.

D'Amico, S., T. B. King, and M. Wei (2016), "Macroeconomic Sources of Recent Interest Rate Fluctuations," FEDS Notes, Washington: Board of Governors of the Federal Reserve System, June 2, 2016, <http://dx.doi.org/10.17016/2380-7172.1777>.

<sup>3</sup> Matheson and Stavrev (2014) refers to the former as news shock and the latter as monetary shock.

<sup>4</sup> For analyzing the linkage between the U.S. and European markets, it is considered effective to include four variables (long-term interest rates and stock prices in the United States and Europe) in a single VAR at the same time. However, since this paper uses daily closing data for the United States and Europe, it is necessary to pay attention to the time difference between them when identifying shocks. In order to avoid such complications, this paper adopts the approach of estimating shocks in separate models for the United States and Europe and then observing the relationship (correlation) between the shocks estimated for the United States and Europe.

<sup>5</sup> Considering that this is a period in which no significant changes in the trends of stock prices and long-term interest rates are observed, the analysis covers the period from 2012 onward (only days for which both stock price and long-term interest rate data are available). Lag orders were selected based on AIC criteria (9 days for the United States and 7 days for Europe). The period during which the sign restrictions must be satisfied was set to one day (only on the day of the shock). Since there are an infinite number of coefficient matrices that satisfy the sign restrictions, this paper uses the matrix determined to be closest to the median after generating 10,000 matrices that satisfy the

sign restrictions through stochastic simulation.

<sup>6</sup> Amid the COVID-19 pandemic, there were occasions when liquidity in the government bond market declined significantly, and this may have also contributed to the expansion of identified shocks. For more information on the instability in the U.S. government bond market amid the COVID-19 pandemic, see the following reference.

Okamoto, T (2020), "Beikoku Kokusai Shijou no Fuanteika to Wagakuni Kokusai Shijou Eno Eikyo" (Destabilization of the U.S. Government Bond Market and Impact on the Japanese Government Bond Market — COVID-19 Pandemic and Financial Markets (1)) <Available only in Japanese>, *Bank of Japan Review Series*, 2020-J-9.

<sup>7</sup> There are two possible reasons for the widening of shocks at the times of the indicator releases: (1) deviations from forecasts themselves have become large, and (2) deviations from forecasts have had a greater impact on stock prices and interest rates. In this regard, given that the deviation between market forecasts and actual results for the CPI has not necessarily widened compared to the past, with the deviation from market consensus often remaining around plus or minus 0.2 percentage points after the start of 2022, it is likely that financial markets recently have reacted more strongly to deviations from market forecasts.

<sup>8</sup> For example, in March 2020, a large tightening "monetary policy shock" was seen on the CPI release date, most likely due to fluctuations associated with the COVID-19 pandemic.

<sup>9</sup> It should be noted that the release dates of different indicators sometimes overlap. For example, there are cases when the employment statistics and the ISM index are released on the same day, and analysis using daily data cannot identify which indicator has a greater impact.

<sup>10</sup> In addition, for example, the implication of a change in long-term interest rates may differ depending on whether the policy rate component based on expectations of future short-term interest rates or the term premium is the main driver of the change, but we do not consider this point in our analysis.

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