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HOW DOES THE MACROECONOMY RESPOND TO STOCK MARKET FLUCTUATIONS? THE ROLE OF SENTIMENT

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This study estimates the response of macroeconomic variables to stock market fluctuations in Japan and the United States. It emphasizes the economy's reaction to stock market bubbles and crashes. To do this, I propose a new way to identify bubbles and crashes by testing price-to-fundamental ratios using the newly developed trend-filtering approach. Regardless of the measures used, both countries' macroeconomy tends to respond positively to the positive shock of stock price. Asymmetric effects of the stock market are observed. Japan's macroeconomic variables, especially investment and industrial production, are more sensitive to market crashes, while those of the United States are more sensitive to stock bubbles. Finally, I provide evidence that market sentiment can affect the economy either directly or indirectly through the stock market.

Keywords: Asset Bubbles, Crashes, Impulse Response, Macroeconomy

1. INTRODUCTION

The global financial crisis of 2008–2009 affected many nations. The crisis was caused by the collapse of the US housing market boom, and it renewed interest in understanding how asset markets cause economic fluctuations. Japan had a similar experience in the 1980s when its asset market bubbles burst, causing the economy to stagnate for more than a decade, so called "Lost Decades" [Okina et al. (2001)]. There is a consensus that bursting of bubbles leads to a steep decline in output and protracted recessions [Jordà et al. (2015)]. However, the effect of the existence of bubbles (before they burst) is debatable.

Conventional theory, as in Tirole (1985) and Weil (1987), suggests that asset bubbles are harmful for economic growth, as they have crowding-out effects on private investment and hinder capital accumulation. These theories are criticized by recent works as they poorly explain historical observations, such as Japan's case in the 1980s. Kunieda and Shibata (2016) observed that in the United States and Japan, a bubble accompanies an economic boom, while bursting of the bubble

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accompanies economic recession. They developed a theoretical model by considering the burst of an asset market bubble as a rational expectation equilibrium and showed that the bubble could stimulate economic growth. Farhi and Tirole (2011), Miao and Wang (2011), and Martin and Ventura (2012) also developed models in which asset bubbles promote economic growth and investment. Miao et al. (2016) showed that stock bubbles help reduce unemployment by alleviating firms' credit constraints.

Although several theoretical works debated this issue, few empirical studies comprehensively explored the impact of asset markets on the economy.[1] This article aims to fill the gap in empirical studies. In particular, I focus on cases wherein the stock market experienced rare events, including bubbles and crashes. This study has three main parts.

First, I look at the response of macroeconomic variables to stock price shocks using both the standard vector autoregressive (VAR) process and [Jordà's (2005, 2009)] local projections method. Second, I propose a new way and criteria to define bubbles and crashes using the trend-filtering approach by [Hamilton (2017)]. This detection framework successfully identifies all historical events in the Japanese and US stock markets. The impulse responses (IR) of several macroeconomic variables are estimated in terms of bubbles and crashes. The results suggest that a stock bubble has positive effects on the economy, and a market crash has negative effects, especially for Japan. However, the responses to bubbles and crashes are asymmetric. Third, I discuss the role of market sentiment and provide evidence that sentiment can cause economic fluctuations directly or indirectly through the stock market.

The rest of this paper is organized as follows. Section 2 reviews the related literature. Section 3 presents data sources. Sections 4 and 5 provide the econometric methods and report empirical evidence. Section 6 links the sentiment with the macroeconomy and stock market. Section 7 concludes the paper.

2. LITERATURE REVIEW

A large bulk of studies explored the relationship between asset markets and economic fluctuations. Many studies linked financial markets with output fluctuation; these include Bernanke and Gertler (1989), Bernanke et al. (1999), Carlstrom and Fuerst (1997), Jermann and Quadrini (2012), and Kiyotaki and Moore (1997). By incorporating stock price data, Christiano et al. (2014) argued that a risk shock, related to that described in Bloom (2009), displaces the marginal efficiency of an investment shock and is the most important shock driving business cycles. They also introduced a news shock to the risk shock rather than using total-factor productivity. They based their models on the work by Bernanke et al. (1999) and utilized the net worth of credit-constrained entrepreneurs as the stock market value in the data.

Asset markets can also affect real investment. Based on Diamond's (1965) overlapping generations model, Tirole (1985) showed that bubbles can exist, provided that the return on capital in the steady state is below the growth rate of the economy's output. He further showed that asset bubbles have crowding-out effects on private investment and hinder capital accumulation, which was also observed by Weil (1987). These effects occur because supply in the next period declines if individuals' savings take the form of intrinsically useless assets instead of capital. In line with these seminal works, Futagami and Shibata (2000), Grossman and Yanagawa (1993), and King and Ferguson (1993) developed endogenous growth models with overlapping generations to investigate the crowding-out effects of asset bubbles on private investment. However, recent works, such as those by Kunieda and Shibata (2016) and Martin and Ventura (2012) argued that these models poorly explain historical observations, such as the Japanese asset price bubble burst in the 1980s and the US subprime loan crisis in the late 2000s, and that asset bubbles promote, rather than slow, economic growth. They emphasized that asset bubbles have both crowding-out and crowding-in effects on investment. Using the overlapping generations modeling approach, Caballero and Krishnamurthy (2006) and Farhi and Tirole (2011) showed that bubbles can be a useful source of liquidity, Martin and Ventura (2012) showed that asset bubbles raise wealth or net worth, and Ventura (2012) showed that a bubble can lower capital costs. Takao (2017) showed that the presence of bubble can promote economic growth through in-house research and development.

Asset markets also have wealth effects on private consumption. Lettau and Ludvigson (2001, 2004) provided the theoretical model to link wealth and asset values. In their works, they showed that consumption is cointegrated with labor income and financial wealth. Many empirical studies, such as Carroll et al. (2011) and Ludwig and Sløk (2004) used their frameworks to explore how financial wealth affects consumption.

Regarding the effects of the asset market on labor markets, instead of searching for a fundamental explanation to close an indeterminate model of the labor market, Farmer (2012, 2013) proposed a model that replaces the wage-bargaining equation with the assumption that employment is demand determined; in particular, the author assumed that demand depends on market participants' beliefs about the future value of assets. Farmer (2012, 2013) showed that the unemployment rate can be explained as a steady-state equilibrium; assuming that market participants' beliefs are self-fulfilling resolves the indeterminacy of the equilibrium. Farmer (2015) and Pan (2018) used Farmer's (2012, 2013) model, respectively, to show that the stock market causes unemployment. Pan (2018) further pointed out this causal relationship is particularly strong in Group of Seven countries.

Vuillemey and Wasmer (2017) introduced stochastic bubbles into the Diamond–Mortensen–Pissarides model and showed that it can explain the volatility of labor market outcomes. Hashimoto and Im (2016) constructed a continuous-time overlapping-generations model with labor market friction and showed that asset bubbles can exist under low unemployment, which leads to higher economic growth through labor market efficiency. Miao et al. (2016) introduced credit constraints within a Diamond–Mortensen–Pissarides labor market, producing multiple equilibria. In one equilibrium, a bubble in the stock market relaxes credit constraints and allows firms to increase investment and hire more workers; thus, reducing unemployment. Liu et al. (2016) observed a similar mechanism using land prices. Kaas et al. (2016) provided some evidence, although they focused only on land prices and did not emphasize the role of bubbles.

In short, the effects of asset markets are well studied, and these effects are different for different economic variables. However, there are still some gaps in existing literature. The bulk of existing literature is relatively less to efficiently examine the possible asymmetric effects of asset markets. The economy may have different reactions to asset market crashes and bubbles. Although they theoretically pointed out the role of asset bubbles, empirical evidence on the effects of asset bubbles is scarce. A few studies, such as Anundsen et al. (2016) and Jordà et al. (2015) linked bubbles with economic fluctuations, but they focused on bursting bubbles (or the collapse of asset markets) only. Based on recent theoretical works, the expansion of bubbles could have positive effects.[2] Discussion on the effects of asset bubbles and crashes on real investment and consumption is even scarcer.

3. DATA

This study selects the United States and Japan to perform empirical analysis, since both countries experienced well-known historical asset bubble and crash events, such as the US dot-com bubble burst of the 1990s, and Japanese asset bubble burst of the 1980s [see Kindleberger and Aliber (2005)]. Data used are quarterly data from the first quarter of 1970 through the third quarter of 2017. I select six macroeconomic variables and examine their reactions to the stock markets. The data are from the following sources.

3.1. Output, Consumption, and Real Investment

Two common measures reflect the output of an economy. One is the gross domestic product (GDP) and the other is industrial production. The US GDP and industrial production index are collected from the Federal Reserve Economic Data provided by the Federal Reserve Bank of St. Louis. Japanese data are collected from the Organisation for Economic Co-operation and Development (OECD) Main Economic Indicators database.[3] This database also provides data on private consumption and investment (gross fixed capital formation) for the two countries.

3.2. Labor Market

The unemployment rate provides information on the supply of individuals looking for work in excess of those who are currently employed, whereas job vacancies reflect the demand side of the labor market. Thus, I select both instead of only unemployment rate, as this could provide more insights on the effect of asset markets on the labor market. US unemployment data, obtained from the US

Bureau of Labor Statistics, are seasonally adjusted. Job vacancy rates are obtained from two sources. For the period before December 2000, I use Barnichon's (2010) help-wanted index to represent job vacancies. This index is robust as it considers both "print" and "online" job advertising. For the period after December 2000, I use the Job Openings and Labor Turnover Survey to measure job openings. Regarding Japanese data, the seasonally adjusted national unemployment rates are collected from the Ministry of Internal Affairs and Communications. Japanese vacancy data are obtained from the Ministry of Health, Labour and Welfare.

3.3. Stock Prices and Fundamentals

Asset bubbles usually involve a surge in asset prices unwarranted by the fundamentals of the asset. To measure this, I use the price-to-dividend ratio to detect stock bubbles.[4] I collect Standard and Poor's 500 index series as well as its dividend series from Dr. Robert Shiller's website (http://www.econ.yale.edu/ shiller/data.htm). For Japan, although Nikkei Inc. provides historical data on dividend yield of the Nikkei 225 index, the data only cover the past 10 years, which is too short. I therefore use the MSCI Japan price index and MSCI Japan gross price index instead to derive the dividend series and calculate the price-to-dividend ratio. Based on the MSCI index calculation method, the price index purely reflects the changes in stock prices, while the gross price index reflects the changes in stock prices and dividends. Thus, I can simply calculate back to retrieve the dividend series.

4. RESPONSES TO ASSET MARKET FLUCTUATIONS

To explore the influences of the asset market, I estimate the following VAR models:

$$A_0 X_t = k + \sum_{i=1}^{p} A_i X_{t-i} + \varepsilon_t, \tag{1}$$

where A_0 and A_i are invertible $(n \times n)$ matrices of the coefficients, X_t is the vector of stationary endogenous variables, k refers to the vector of constants, and p is the number of lags. ε_t is the vector of uncorrelated white noise disturbances. X_t is defined as

$$X_t = \begin{pmatrix} Y_t \\ S_t \end{pmatrix},$$

where Y_t is the log of the macroeconomic variable, and S_t is the log of the stock price.[5]

The IRs derived from conventional VAR models could be biased and misleading when the underlying data generating process cannot be well approximated by a VAR(p) process. Therefore, Jordà (2005, 2009) proposed a local projections method by estimating a new set of values for each horizon, h, by regressing the dependent variable vector at $t + h$ on the information set at time t; thereby,

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avoiding escalation of the misspecification error through nonlinear calculations of the standard VAR-based IR technique. In other words, the *projections* of forward values of the dependent variable vector on the information set are *local* to each horizon. IRs generated by this method are simply a subset of the estimated slope coefficients of the projections. For robustness, I also employ the local projection method to estimate IRs using the following model specification:

$$Y_{t+h} = a_t^h + \sum_{s=1}^{S} \beta_s^h Y_{t-s} + \sum_{r=1}^{R} \gamma_r^h S_{t-r} + \varepsilon_t^h, \tag{2}$$

where Y_t is the log of the macroeconomic variable, S_t is the log of the stock price, and h denotes the horizon.

Figure 1 reports the VAR-based and projection-based IRs of macroeconomic variables. The line with the symbol is the IR estimated by VAR, while the solid line is the IR estimated using the local projections method with one-standard deviation error bands (area between the two dashed lines). IR coefficient estimates can suffer from serial correlation, which may lead to wider marginal error bands, and so I report conditional error bands to help remove the variability caused by the serial correlation [Jordà (2009)].

First, looking at Panel A in Figure 1 that shows the results of Japan, a positive shock to stock prices leads to a statistically significant increase in GDP, investment, industrial production, and consumption. The responses of GDP, industrial production, and investment are quite similar as they increase significantly with a peak in the first quarter but the effects of stock price quickly disappear by the fifth quarter. The impact of stock price on private consumption also peaks one quarter after the shock. However, the response of private consumption oscillates and gradually becomes zero. As regards responses of the Japanese labor market, unemployment (vacancy) has a negative (positive) response to stock price shock, showing that it tends to decrease (increase) after the shock. The stock price's impact on labor market peaks in the first quarter, but the market slowly recovers to its steady state by about the ninth quarter.

Turning to the US results (Figure 1, Panel B), a peak response is observed in the first quarter in the United States. Responses of US macroeconomic variables to stock prices are even more consistent. Private consumption, GDP, industrial production, and investment tend to increase by 0.05, 0.1, 0.23, and 0.2 percentage points, respectively. The effects of stock price disappear at about five quarters after the shock. The responses of US unemployment and vacancy are almost symmetric but with greater magnitude for vacancy.

Furthermore, this study examines the causal relationship between the stock market and macroeconomic variables. Although some studies tested the cointegration between variables before performing causality tests, Toda and Yamamoto's procedure for testing long-run Granger causality does not require pretesting for cointegration; thus, enabling feedback effects through several lags, just as shown by Soytas et al. (2007) and Zapata and Rambaldi (1997). Therefore, I follow Toda

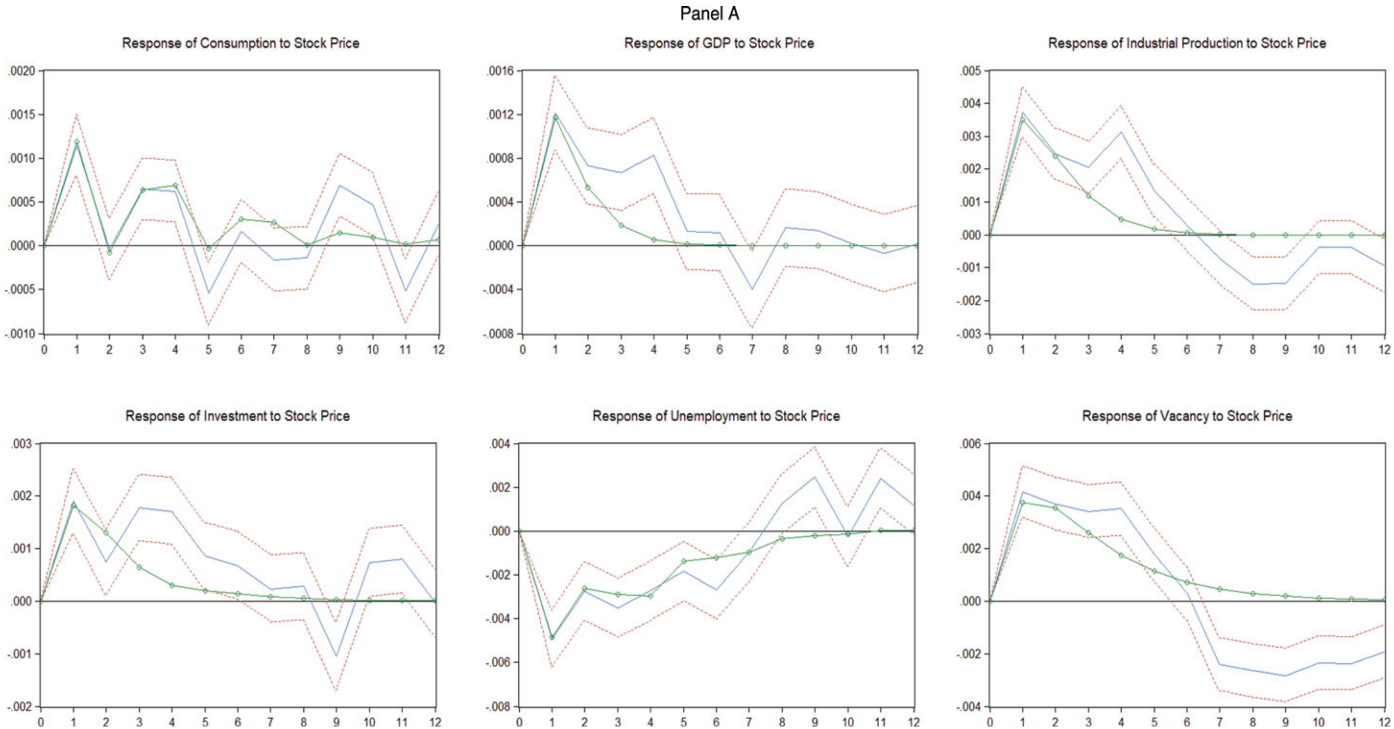

FIGURE 1. Estimated responses to stock price. (A) Responses to stock price in Japan. (B) Responses to stock price in the United States. The line with the symbol is the IR estimated by VAR, and the solid line is the IR estimated by the local projections with one-standard deviation error bands (area between the two dashed lines). The X-axis indicates the quarter after the shock.

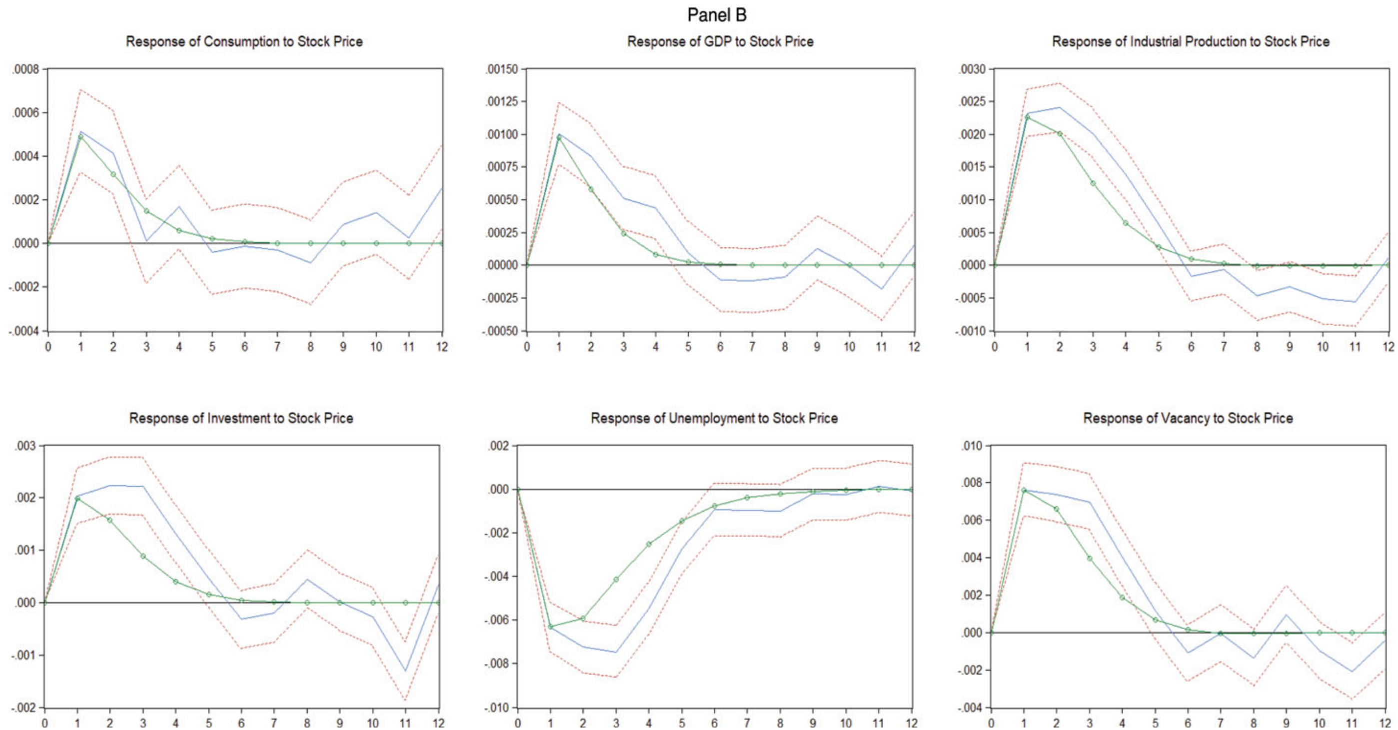

FIGURE 1. Continued

TABLE 1. Granger causality test for stock price and macroeconomic variables

Country	Variables	Lag structure	From stock price to macroeconomic variables	From macroeconomic variables to stock price
Japan	GDP	3, 3	0.000***	0.249
	IP	2, 2	0.000***	0.925
	Consumption	4, 4	0.001***	0.061*
	Investment	4, 4	0.000***	0.230
	Unemployment	4, 4	0.000***	0.277
	Vacancy	5, 5	0.005***	0.454
United States	GDP	3, 3	0.000***	0.840
	IP	3, 3	0.000***	0.798
	Consumption	4, 4	0.001***	0.072*
	Investment	3, 3	0.000***	0.601
	Unemployment	3, 3	0.000***	0.674
	Vacancy	6, 6	0.000***	0.001***

Note: *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively. IP refers to industrial production.

and Yamamoto's (1995) procedure. Compared with the traditional Granger (1969) method, their procedure has an advantage as it works even if both series are either *I(1)* or *I(0)*, or if they have different stationarity properties. The first step is to determine the maximum order of integration, *dmax*, for the two time series. If one series is *I(0)* and the other is *I(1)*, $dmax = 1$. Second, I estimate a kth optimal lag order VAR model in levels, regardless of their order of integration. The optimal lag is selected by standard techniques. Here, I choose the Schwarz information criterion. Third, the extra *dmax* lags are added to the preferred VAR model as exogenous variables. Finally, the Wald test is used to test the lags of the endogenous variables, and its statistic has an asymptotically chi-squared distribution when VAR ($k+$ *dmax*) is estimated.

Table 1 reports the Granger test results. Clearly, the hypotheses that the stock price does not Granger cause macroeconomic variables are rejected in all cases at the 1% significance level. This indicates that the stock market can cause macroeconomy fluctuations. In other words, stock price may improve forecasts of macroeconomic variables in the United States and Japan. This supports previous findings such as by Farmer (2015) and Pan (2018), who observed causality from stock price to unemployment, but I further found that stock price also affects labor demand as it causes vacancy. Because of the causality from macroeconomic variables to stock price, consumption also affects stock price at the 10% level in both countries. One interesting observation is that the US vacancy rate also Granger causes changes in stock price, showing that it could be a predictor for the stock market. In short, stock price increases tend to have positive effects on all macroeconomic variables.

5. RESPONSES TO ASSET MARKET BUBBLES AND CRASHES

Estimating the relationships between stock price and macroeconomic variables can help understand how the macroeconomy reacts to stock price. Would these responses be the same when extreme events, such as stock bubbles, occur? This section investigates how the macroeconomy reacts to stock bubbles and stock market crashes.

5.1. Defining Bubbles and Crashes

The term "bubble" is typically used when asset prices significantly deviate from their fundamental values. An asset market crash usually refers to a rapid decrease in asset price, and it often occurs after a bubble (i.e., once a bubble bursts). The bubble can be driven by rational expectations of investors, called a rational bubble, or heterogeneous beliefs of investors under asymmetric information [e.g., Brunnermeier and Oehmke (2013)].

Detecting bubbles and crashes empirically is not an easy task, and there are two popular methods to accomplish this. One is to follow Goodhart and Hofmann (2008), Herwartz and Kholodilin (2014), Jordà et al. (2015), and Mendoza and Terrones (2008) in applying the Hodrick–Prescott (HP) filter, introduced by Hodrick and Prescott (1997), to the real price series and defining bubbles as deviations of real asset prices above a specified threshold relative to an HP-filtered trend with a high smoothing parameter. The other method is to follow Phillips et al. (2011, 2015) to test the explosive property of price-to-fundamental ratios and to date them based on the sequence of test statistics and critical value. The proposed approach in this study belongs to the former.

Using the HP filter, Borio and Lowe (2002), Goodhart and Hofmann (2008), Herwartz and Kholodilin (2014), and Jordà et al. (2015) defined asset price booms (bubbles) as deviations of real asset prices above a specified threshold relative to an HP-filtered trend with a high smoothing parameter. This study builds upon this definition but with some differences. The main drawback of using this method is that most studies did not consider the changes of fundamental values. However, Jordà et al. (2015) used joint criteria to avoid situations wherein the fundamentals improved sufficiently to justify the price rise, or prices rose from the depressed levels and converged back to the fundamentals. Based on their criteria, they identified equity bubbles but failed to identify housing bubbles in the late 1980s in Japan.[6] Here, I suggest application of the filter to *log price-to-fundamental ratios* directly.

The bubbles, Bubble_t, and crashes, Crash_t, are determined by the following equations:

$$\text{Bubble}_t = I(\text{cycle}_t > \theta\sigma_t^c), \quad (3)$$

$$\text{Crash}_t = I(\text{cycle}_t < -\theta\sigma_t^c), \quad (4)$$

where $I(\cdot)$ is the indicator function, and cycle_t is the cyclical component at time t obtained from the actual price-to-dividend ratio minus the trend estimated by the filter. θ is the threshold factor, and I set it as one. The corresponding period

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is defined as a bubble (crash) if the cyclical component is higher (lower) than the predetermined threshold. To estimate the trend and cyclical components, I use the Hamilton filter, proposed by Hamilton (2017), as the HP filter produces series with spurious dynamic relations with no basis in the underlying data-generating process [Hamilton (2017)]. Moreover, the HP filter is sensitive to the choice of the smoothing parameter [Bjørnland (2000)]. In this study, use of the Hamilton filter involves conducting an ordinary least squares (OLS) regression of the variable at date $t + h$ on the four most recent values on date t to avoid these drawbacks and obtain a cyclical component series. The OLS regression is as follows:

$$x_t = \beta_0 + \beta_1 x_{t-h} + \beta_2 x_{t-h-1} + \beta_3 x_{t-h-2} + \beta_4 x_{t-h-3} + v_t, \tag{5}$$

where the cyclical components are the residuals, v_t, which can be obtained by

$$\hat{v}_t = x_t - \hat{\beta}_0 - \hat{\beta}_1 x_{t-h} - \hat{\beta}_2 x_{t-h-1} - \hat{\beta}_3 x_{t-h-2} - \hat{\beta}_4 x_{t-h-3}, \tag{6}$$

where $h = 8$ for quarterly observations as suggested by Hamilton (2017).

5.2. Bubble and Crash Detection Results

Table 2 summarized the dates of the detected bubbles and crashes using the above method. Here, I set that the bubble duration is restricted to no less than two quarters, as the run-up phase of a bubble is likely to be long and gradual [Caspi and Graham (2017)]. However, for crash periods, I do not restrict the duration, as a market crash tends to appear rapidly. I first look at the top panel of the table that reports the detected Japanese bubbles and crashes using the Hamilton filter. It detected three stock bubbles in Japan: It successfully detected the 1980s Japanese asset price bubble wherein the stock bubble began in the first quarter of 1984 and ended in the fourth quarter of 1988. The Japanese stock market experienced four crashes. Half of them occurred after the bubble periods or, in other words, after

TABLE 2. Bubbles and crashes detected by Hamilton filter

Country	Asset	Bubble	Crash
Japan	Stock	1984Q1–1988Q4; 2005Q1–2007Q3; 2013Q3–2015Q1	1974Q4–1975Q1; 1991Q2–1992Q3; 2001Q4–2003Q2; 2008Q4–2010Q3
US	Stock	1976Q3–1976Q4; 1983Q4–1984Q3; 1986Q2–1987Q3; 1996Q1–2000Q3; 2010Q4–2011Q2	1974Q2–1975Q4; 1978Q1–1978Q4; 2002Q2–2003Q2; 2008Q3–2009Q3

Notes: I denote years and quarters as YYYYQQ. For example, first quarter of 1984 is 1984Q1.

bubble bursts. For the United States, I detected five stock bubbles, including the dot-com bubble during first quarter of 1996 to third quarter of 2000. Four crashes were identified in the stock market, including crashes caused by the recent financial crisis (late 2008). These detected periods are similar to the results of Phillips et al. (2015). Overall, use of the Hamilton filter to determine the price-to-fundamental ratio could successfully identify historical bubble and crash events.

One interesting comparison is between the results detected by the Hamilton filter and HP filter. I report the results of the HP filter in Table A. I employ both one-sided and two-sided HP filters with a smooth parameter equal to 1,600.[7] The HP filter detected more bubble and crash periods, especially bubble periods, than the Hamilton filter, but most of the periods are very short. Looking at the dates closely showed that almost every spike of the price-to-dividend ratio is identified as a bubble, which seems inappropriate as asset bubbles do not occur at that high frequency. Besides, the HP filters tended to identify bubbles in the period just before the ratio reached the local peak. When a bubble is identified, it will burst within a short period after its identification. This may not give policy makers sufficient time to take action to prevent the potential negative effects of bursting bubbles. Finally, a severe problem is that the one-sided HP filter failed to identify even the US dot-com bubble, which means it poorly detects well-known historical events. Thus, I would suggest that researchers avoid using the HP filter (at least the one-sided HP filter) to identify bubble periods.

5.3. Response to Stock Bubbles and Crashes

In Section 5.2, I identified bubbles and crashes and created bubble and crash dummies. The bubble (crash) dummy variable takes the value of one when the bubble (crash) occurs, and otherwise zero. Then, I use the following two specifications to estimate the IRs of macroeconomic variables to asset bubbles and crashes:

$$Y_t = a_0 + \sum_{i=1}^{I} a_i Y_{t-i} + \sum_{l=0}^{L} a_l d_{t-l} + \varepsilon_t, \tag{7}$$

$$Y_{t+h} = a_t^h + \sum_{m=1}^{M} \vartheta_m^h Y_{t-m} + \sum_{n=0}^{N} \delta_n^h d_{t-n} + \varepsilon_t^h, \tag{8}$$

where Y_t is the log of the macroeconomic variables, d_t is the bubble or crash dummies, and h denotes the horizon. Equation (7) is used to estimate conventional VAR-based IRs, while equation (8) is employed to estimate the projection-based IRs.

Figures 2 and 3 plot the estimated IRs of the macroeconomic variables to stock bubbles and stock market crashes, respectively. As shown in Panel A of Figure 2, Japan's GDP and investment increased significantly in the first quarter after the shock. The responses of these two variables exhibit oscillating behaviors (estimated by local projections) or quickly decline (estimated by VAR). Private

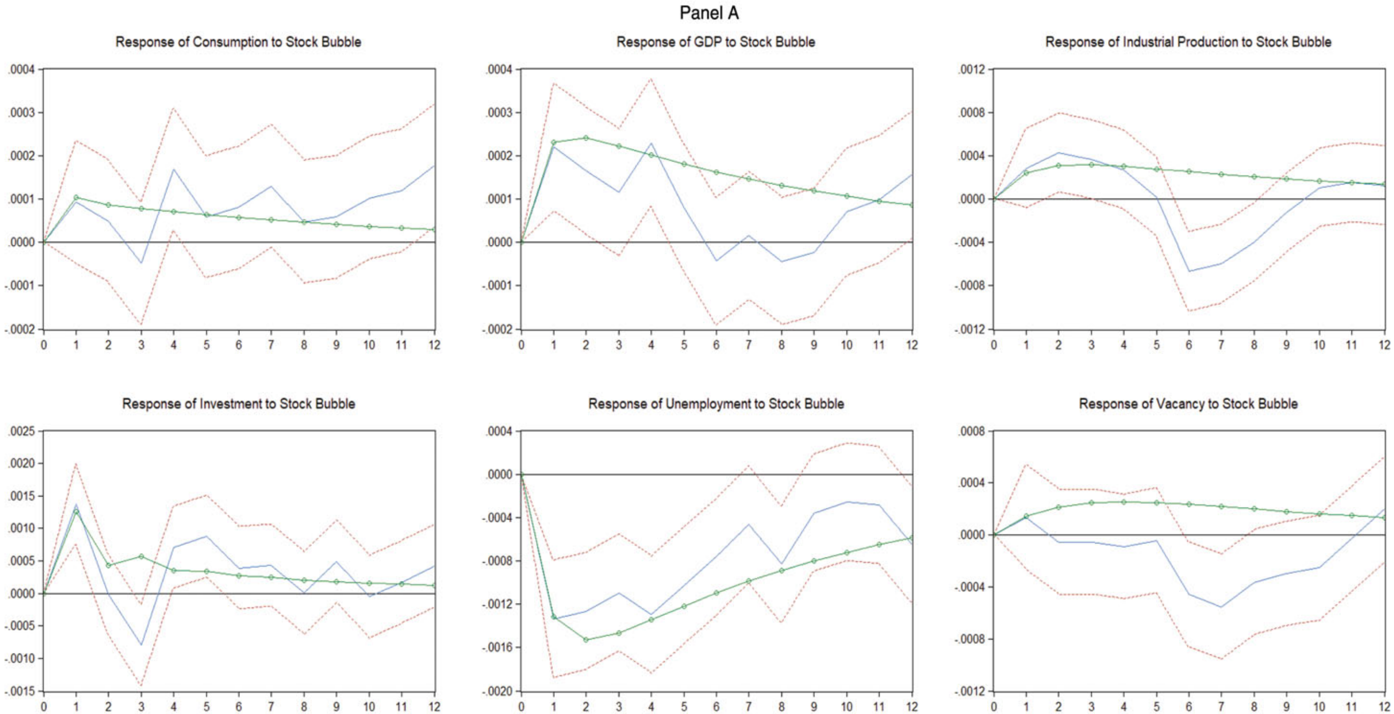

FIGURE 2. Estimated responses to stock bubble. (A) Responses to stock bubble in Japan. (B) Responses to stock bubble in the United States. The line with the symbol is the IR estimated by VAR, and the solid line is the IR estimated by the local projections with one-standard deviation error bands (area between the two dashed lines). The X-axis indicates the quarter after the shock.

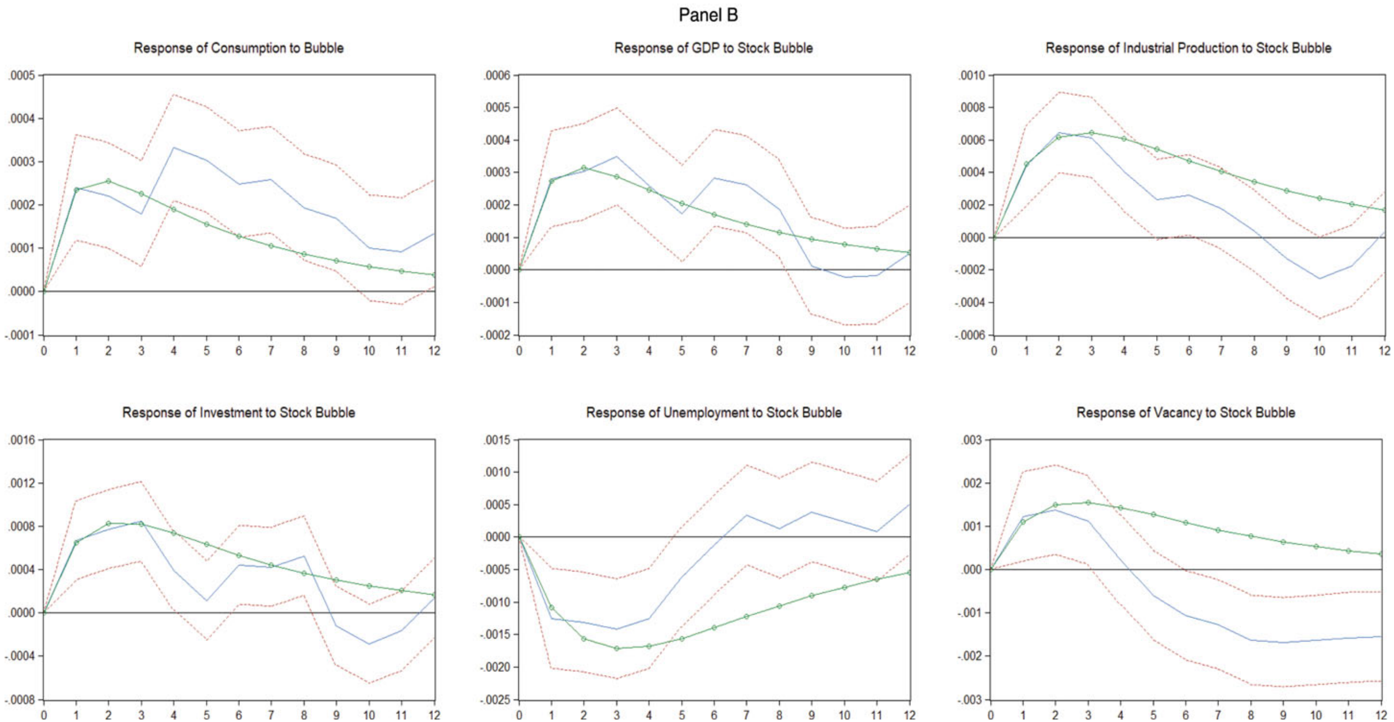

FIGURE 2. Continued

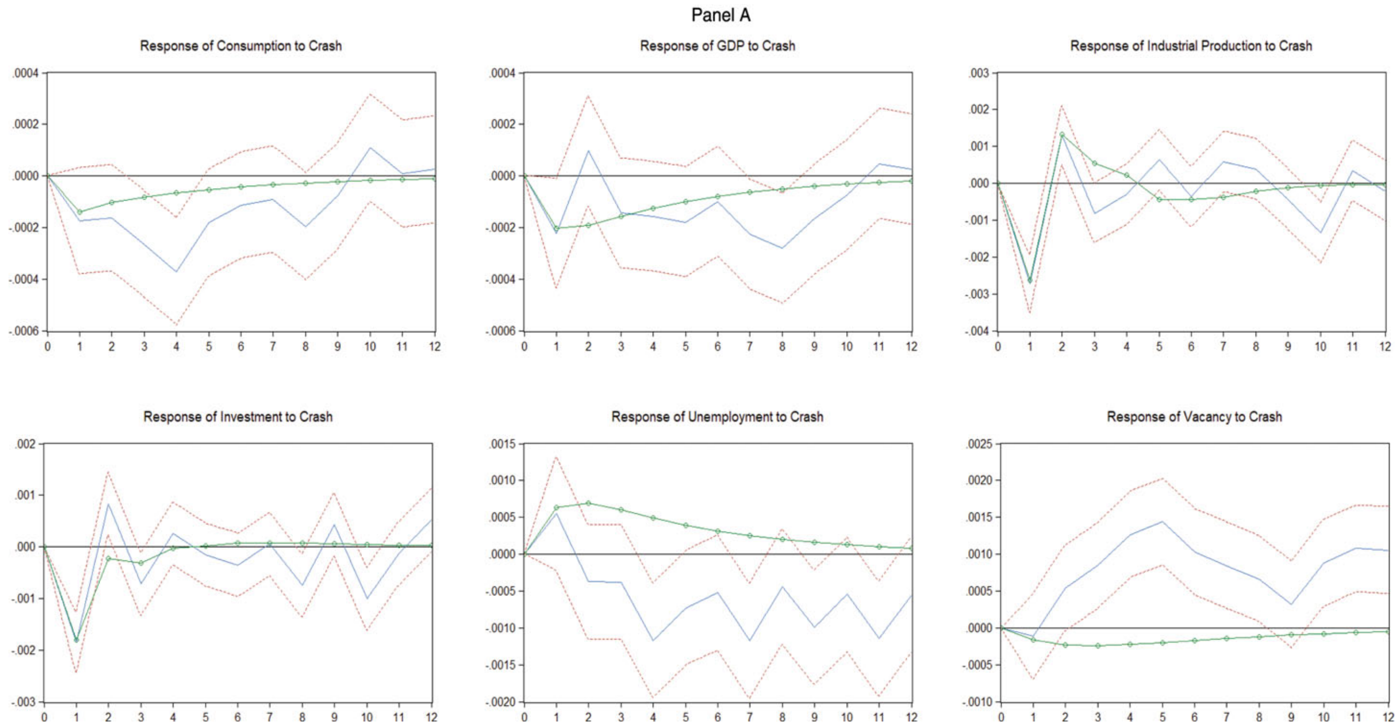

FIGURE 3. Estimated responses to stock market crash. (A) Responses to stock crash in Japan. (B) Responses to stock crash in the United States. The line with the symbol is the IR estimated by VAR, and the solid line is the IR estimated by the local projections with one-standard deviation error bands (area between the two dashed lines). The X-axis indicates the quarter after the shock.

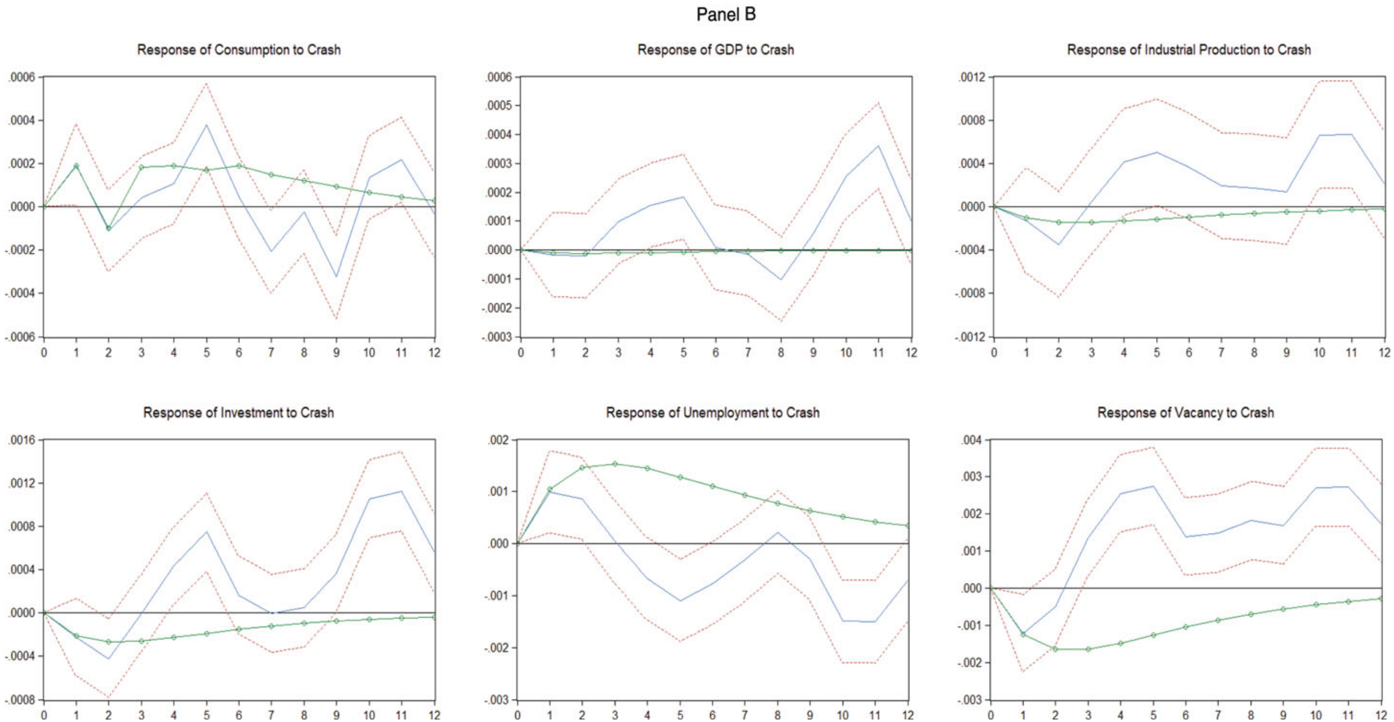

FIGURE 3. Continued

consumption and industrial production also increase after the shock of a stock bubble, but not all increases are significant. For the labor market, the unemployment rate decreased significantly, whereas IRs of vacancy did not significantly increase. However, the IR estimated from VAR suggests that vacancy increases after the shock, while that from local projections indicates it increases insignificantly in the first quarter and then decreases insignificantly subsequently. This finding suggests that the stock bubble improved Japan's labor market mainly through the supply side, not the demand side.

The positive effects of the stock bubble are more clearly observed in the United States. IRs in Panel B of Figure 2 indicate that the GDP in the United States increased by approximately 0.03 percentage points in second or third quarter, and the estimated responses declined after this period. VAR-based IR suggests that the effect of stock bubbles on US private consumption was at the peak in second quarter, while projection-based IR suggests that the effects became larger in the first four periods and peaked in fourth quarter. Industrial production and investment rose by about 0.08 percentage points in the second or third quarter. Both projections and VAR-based IRs indicate that unemployment rate decreased significantly and vacancy rate increased in first three periods, showing that existence of the stock bubble improved the US labor market.

Looking at the results of market crashes shown in Figure 3, market crashes have strong and negative effects on Japan's macroeconomy in the first quarter via the increase in unemployment and decrease in other variables. These effects are particularly strong for investment and industrial production, which both decreased by 0.2 percentage points in period 1. Compared with the effects of bubbles, the effects of crashes are more temporary, which shows that Japan can recover to its steady state faster. The results also show that the stock market has an asymmetric effect on Japan's economy, as investment and industrial production are more sensitive during a stock market collapse but not a bubble, while the other four variables seem to have a stronger response to stock bubbles and not a crash.

The stock market crash shock seems to have a less significant negative impact on the US macroeconomy. The graph shows that the responses of GDP and consumption to market crash shocks have an oscillating pattern, and VAR-based IR even suggests that a crash does not affect GDP. The crash negatively influences investment and industrial production in the first two quarters, but the negative effects are insignificant and start to decline after that period. Note that the response patterns of these two variables are very similar, indicating that industrial production adjustment is closely tied to the dynamics of investment. The response of unemployment rate to stock market crash first rises in the first quarter, and the vacancy rate moves in the opposite direction, clearly decreasing in the first quarter. Responses obtained using the local projection method suggest that the labor market is significantly affected by the market crash in the first quarter, whereas VAR-based IRs suggest that unemployment (vacancy) keeps increasing (decreasing) until the second or third quarters. Moreover, US macroeconomy responds more to stock bubbles, but not crashes.

The overall findings support the view that the stock market has asymmetric effects on the economy. The results also support recent theoretical literature that states that asset bubbles could drive economic growth and reduce unemployment [e.g., Liu et al. (2016), Miao et al. (2016)]. For the United States, bubbles increase the output through private consumption and investment, while for Japan, bubbles increase the output mainly through investment.

6. THE ROLE OF MARKET SENTIMENT

Keynes (1936) postulated that a large proportion of macroeconomic fluctuations depend on market sentiment (which he called animal spirits). He interpreted animal spirits as positive spontaneous action not caused by rational mathematical expectations, as opposed to inaction. Akerlof and Shiller (2010) went far beyond the notion of animal spirits by linking market sentiment to confidence.[8] They also argued that the impacts of confidence on the economy vary between economic downturns and upturns; the linkage between confidence and income is particularly strong during economic downturns. The role of animal spirits (or beliefs of agents) in explaining economic fluctuations has been examined in numerous studies [see, e.g., Acemoglu and Scott (1994), Chauvet and Guo (2003), Farmer and Guo (1994), Perli (1998), Weder (2000)], more recently by Farmer (2012, 2013), who shows that sentiment drives the stock market and then causes recession. Most studies empirically link sentiment to only one specific macroeconomic variable, such as output [e.g., Matsusaka and Sbordone (1995)] or stock market [e.g., Baker and Wurgler (2006), Jansen and Nahuis (2003)]. Relatively few discussed the linkages among the macroeconomy, sentiment, and stock market. This section aims to provide some evidence for it.

Before performing empirical econometric analysis, one key question is how to measure market sentiment. Baker and Wurgler (2007) provided a comprehensive discussion on this issue, and one common measure used is survey-based index, that is, directly asking investors how optimistic they are. Using the University of Michigan Index of Consumer Sentiment, Howrey (2001) and Qiu and Welch (2004) used the consumer confidence index to represent investor sentiment, and Qiu and Welch (2004) even showed that it is highly correlated with the investor-based survey index even if the consumer confidence index does not ask directly for consumers' views on securities prices. This study uses the OECD's consumer confidence index for both countries to proxy the market sentiment, as it provides longer observations than the University of Michigan Index and the index obtained from Japan's Cabinet Office.[9]

I similarly apply the Granger causality test to examine the relationships among investor sentiment, stock price, and macroeconomy, and the results, which are very clear, are shown in Table 3. In the case of Japan, there is a strong evidence of causality from market sentiment to all macroeconomic variables at the 1% significance level. Market sentiment also caused Japan's stock price at the 1% level. For the United States, there is a strong one-way causality from sentiment to

TABLE 3. Granger causality test results for sentiment and other variables

Country	Variables	Lag structure	From sentiment to other variables	From other variables to sentiment
Japan	GDP	3, 3	0.000***	0.294
	IP	4, 4	0.000***	0.058*
	Consumption	4, 4	0.011**	0.049**
	Investment	3, 3	0.003***	0.712
	Unemployment	4, 4	0.000***	0.361
	Vacancy	4, 4	0.000***	0.916
	Stock price	4, 4	0.000***	0.488
United States	GDP	4, 4	0.000***	0.539
	IP	4, 4	0.000***	0.158
	Consumption	2, 2	0.000***	0.450
	Investment	4, 4	0.000***	0.821
	Unemployment	4, 4	0.000***	0.035**
	Vacancy	5, 5	0.000***	0.149
	Stock price	4, 4	0.202	0.206

Note: *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively. IP refers to industrial production.

macroeconomic variables, except for unemployment rates, which showed a bilateral relationship between sentiment and unemployment. However, the hypothesis of noncausality from the US confidence index to stock price cannot be rejected, which shows that there is no causality from sentiment to stock price. Looking at Table 1 together, I find that market sentiment can directly cause aggregate fluctuations but also indirectly cause fluctuations of the economy by affecting the stock market. Nevertheless, such an indirect channel is significant in Japan, but not significant in the United States.

Finally, I plot the figures of IRs of all variables to the positive shock of sentiment shown in Figure 4. Clearly, both VAR- and projection-based IRs suggest positive (negative) responses of all other variables (unemployment) to the shock of sentiment, showing that when sentiment is optimistic, the Japan's macroeconomic performance is better. Similarly, stock prices react positively to the shock of sentiment, showing that stock prices tend to increase when sentiment is optimistic. The Japan's stock price tends to increase by 1.2 percentage points in the first quarter after the shock of sentiment. Strong positive effects of sentiment on the economy are also observed in the United States; however, US stock price's positive response to sentiment is insignificant. Both projection- and VAR-based IRs show that sentiment insignificantly and positively affects stock price in the first three quarters.

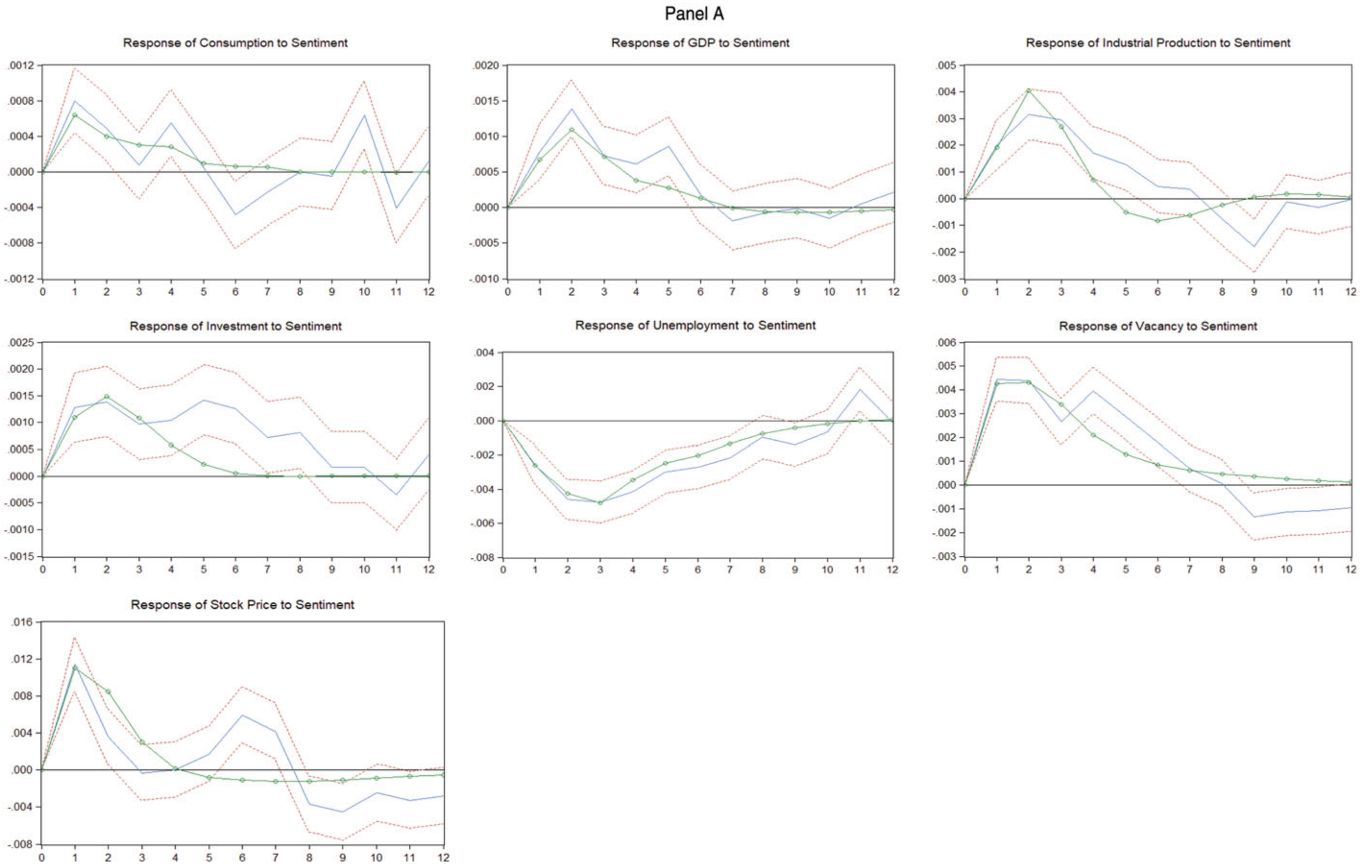

FIGURE 4. Estimated responses to sentiment shock. (A) Responses to market sentiment in Japan. (B) Responses to market sentiment in the United States. The line with the symbol is the IR estimated by VAR, and the solid line is the IR estimated by the local projections with one-standard deviation error bands (area between two dashed lines). The X-axis indicates the quarter after the shock.

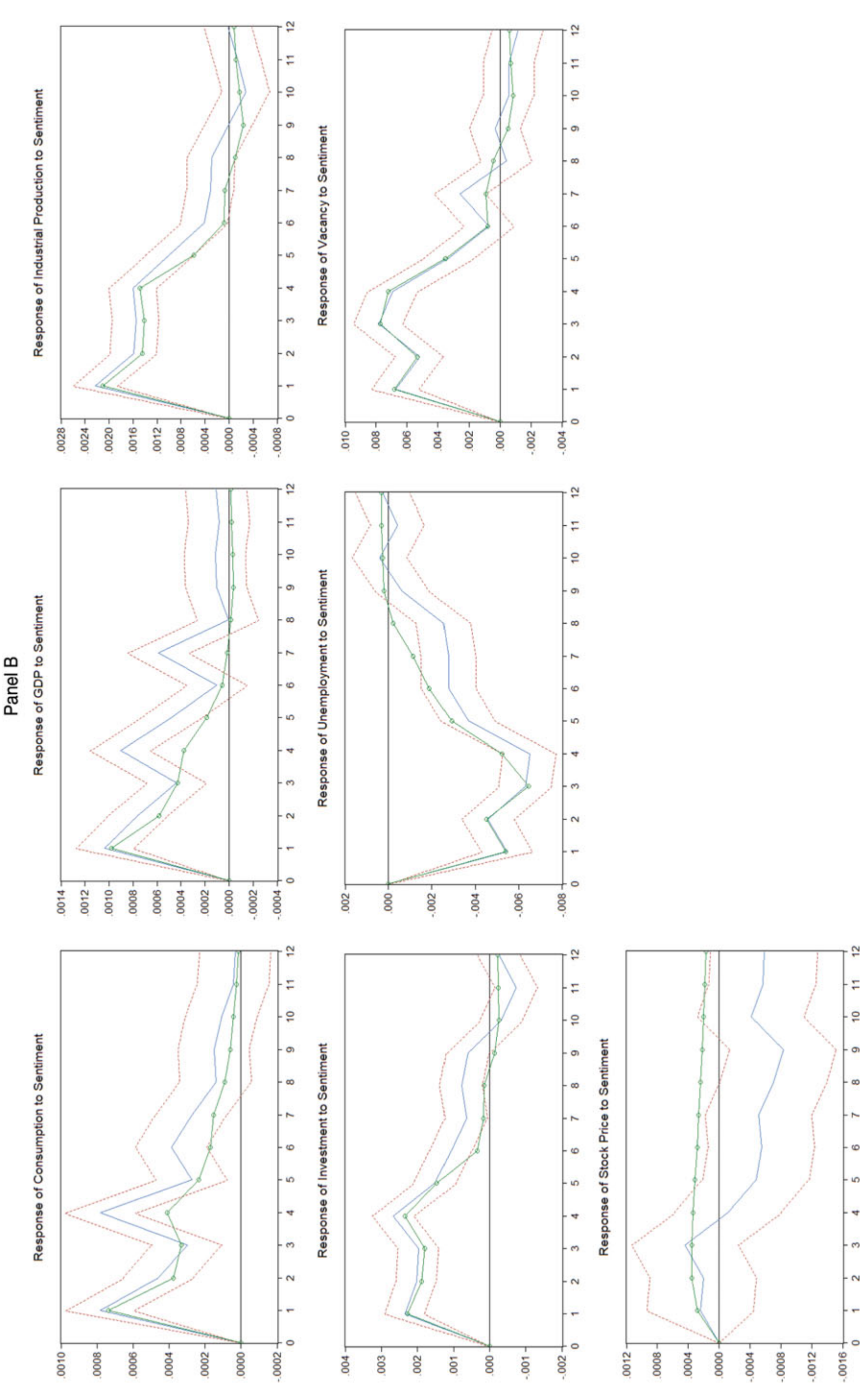

FIGURE 4. Continued

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7. CONCLUSION

This study examined how the macroeconomy responds to stock market fluctuations in Japan and the United States. The estimated IRs and Granger test results suggest that stock price can cause aggregate fluctuations, and the macroeconomy performs better when the stock price is rising. I further investigated how the macroeconomy responds to rare events, such as stock market bubbles and crashes. I observed that the economy reacts differently to bubbles and crashes. The results suggest that the presence of stock bubbles drive output but via different channels. Stock bubbles drive output through investment in Japan, whereas they increase US output through both private consumption and investment. This result confirms studies stating that asset bubbles can drive economic growth and have crowding-in effects on investment. Bubbles improve the US labor markets from both the supply and demand sides, while they improve Japan's labor market mainly through the supply side (decreasing unemployment). Market crashes tend to have negative effects on the economy, but the routes vary across countries. Japan's industrial production and investment significantly dropped after the shock of the market crash. For the US, the stock market crash had detrimental effects on the economy, except for private consumption, but these negative effects are small and insignificant.

Finally, I highlighted the role of market sentiment and observed that sentiment can directly cause aggregate fluctuations in both countries. Aside from such a direct channel, I also observed that sentiment can affect the macroeconomy through the stock market. This indirect effect is particularly strong in Japan.

These research results present suggestions for those who develop and model policy and propose some future research lines. First, although the existence of bubbles brings benefits for the economy, the collapse of bubbles could steeply reduce output and protract recessions. Thus, policy makers may wish to improve investment or private consumption to mitigate the negative effects of the collapse of asset bubbles. Note that motivating private consumption may not be a useful tool for Japan, as its private consumption responds insignificantly to stock bubbles and market crashes. Second, labor markets improve during stock bubbles, but why do stock bubbles affect both unemployment and vacancy in the United States and only have strong impacts on the unemployment rate and not vacancy rate in Japan? Future research may explore the mechanism behind this phenomenon. Finally, the results suggest that future policies may wish to aim at improving market psychology, as sentiment can directly affect the macroeconomy and indirectly affect the economy via the stock market.

NOTES

1. Most empirical studies focused on the negative impacts of bursting bubbles, but both positive and negative impacts should be explored. Besides, they mainly focused on one particular variable, especially output.
2. I do not argue that such positive effects can compensate for the negative impacts from the burst of the bubbles, but such positive effects should not be ignored by empirical studies.

3. Although the Statistics Bureau of Japan provides the IP index, the sample periods begin from 1978, which is a shorter time period than that of OECD data, and so I choose to use OECD data.

4. Some studies [e.g., Caspi and Graham (2017)] use the price-to-earnings ratio or book-to-market ratio to detect stock bubbles, but I follow the implications from the rational bubble theory and use the price-to-dividend ratio.

5. All variables are first differenced to ensure stationarity, as the unit root tests suggest that they are nonstationary in level but stationary when first differenced. Results obtained from the unit root tests are standard and available upon request.

6. They considered that price correction signals the fall of real asset prices by more than 15% over a three-year window looking forward.

7. The value of 1,600 is a commonly used for quarterly data in practice. Both Hodrick and Prescott (1997) and Ravn and Uhlig (2002) suggested this value.

8. They also linked it to corruption and antisocial behavior, money illusion, and stories.

9. Based on my calculation, the correlation between the University of Michigan Index and OECD's index is very high at 98%. The index provided by the Cabinet Office is similarly highly correlated with OECD's index at over 97%.

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APPENDIX

TABLE A. Bubbles and crashes detected by HP filter

Panel A: One-side HP filter

Country	Asset	Bubble	Crash
Japan	Stock	1972Q2–1973Q1; 1986Q3–1987Q2; 1996Q1–1996Q2; 1999Q4–2000Q1; 2004Q1–2004Q2; 2013Q1–2015Q2	1973Q4–1975Q1; 1975Q3; 1990Q1–1992Q4; 2001Q3–2002Q1; 2002Q3–2003Q1; 2008Q1–2009Q4; 2016Q2
US	Stock	1976Q1–1976Q3; 1980Q3–1981Q1; 1982Q4–1983Q4; 2009Q4–2011Q2	1973Q2–1975Q1; 1978Q3; 1987Q4–1988Q4; 1990Q4; 2000Q4–2003Q1; 2008Q3–2009Q1

Panel B: Two-side HP filter

Country	Asset	Bubble	Crash
Japan	Stock	1972Q3–1973Q3; 1987Q1–1987Q3; 1988Q4–1990Q1; 1999Q4–2000Q3; 2005Q4–2008Q2; 2015Q1–2015Q2	1970Q4–1971Q1; 1971Q4; 1974Q4; 1982Q3; 1985Q4; 1990Q4; 1992Q1–1993Q1; 1995Q2; 1998Q4; 2002Q3–2003Q3; 2008Q4–2009Q2; 2011Q3–2011Q4; 2012Q2–2012Q4
US	Stock	1972Q1–1973Q3; 1976Q1–1976Q4; 1987Q1–1987Q3; 1999Q2–2000Q4; 2007Q2–2007Q4; 2010Q4–2011Q2	1970Q2–1970Q4; 1974Q3–1975Q1; 1978Q1; 1982Q1–1982Q3; 1990Q4; 1994Q4–1995Q1; 1996Q3; 2002Q3–2003Q2; 2008Q4–2009Q3; 2016Q1

Notes: I denote years and quarters as YYYYQQ. For example, first quarter of 1984 denotes as 1984Q1.