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THE SPILLOVER EFFECTS OF JAPAN'S QUANTITY-BASED AND PRICE-BASED MONETARY POLICIES ON CHINA'S ECONOMY

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Abstract. *The paper selects the macroeconomic data of China and Japan from July 2008 to December 2021 for 162 months to establish TVP-VAR model, and empirically analyzes the spillover effect of Japanese monetary policy on Chinese economy. The results show that Japan's quantitative and price-based monetary policies have certain impacts on China's output, price level, exchange rate and foreign trade, and have time-varying characteristics. The overall effect of Japan's loose monetary policy on China's economic growth is negative, but over time, the adverse effects will gradually weaken. Therefore, in the face of Japan's monetary policy spillover effect, China should improve the independence of monetary policy, enhance the international status of RMB, enhance the international discourse power, and realize the dual cycle and supply and demand balance.*
Keywords: Quantitative monetary policy, Price-based monetary policy, Spillover effect, TVP-VAR model

1. **Introduction.** Under the background of accelerating the process of economic globalization, China, as Japan's largest trading country, cannot ignore the spillover effect of Japan's monetary policy. Considering the close economic and trade exchanges between China and Japan and the adjacent geopolitical economy, it is significant to analyze the mechanism of Japanese monetary policy's influence on China's economy.

The research on spillover effects of monetary policy mainly focuses on the existence and transmission channels of spillover effects. On the existence of monetary policy spillover effect, Antonakakis et al. studied the transmission of international monetary policy spillover between developed economies based on Bayesian time-varying parameter vector autoregressive (TVP-VAR) linkage method. The results show that foreign monetary policy spillover is spillover [2]. Liu et al. built TVP-SV-FAVAR model to analyze the dynamic impact of Fed's quantitative and price-based monetary policy on China's macro economy, which has typical heterogeneity, asymmetry and time-varying characteristics [4].

About the transmission channel of monetary policy spillover effect, it is generally believed that the spillover effect mainly affects the economy of other countries through four channels: interest rate, exchange rate, trade balance and commodity price. Wang and Ruan explored the spillover effect of Japan's unconventional monetary policy on China's economy. The results show that Japan's monetary policy changes have a negative impact on China's output level mainly through the Sino-Japanese trade path, and are beneficial to the development of small manufacturing enterprises in China, but unfavorable to large manufacturing enterprises [3]. Ganelli and Tawk found that spillovers from Japan's QQE

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to Emerging Asia tended to be positive; QQE affected other countries through improvements in confidence and expectations; movements in the shadow interest rate do not fully capture the spillover effects [1].

This paper has certain research value in three aspects. Firstly, from the perspective of the research object, the existing literature mainly focuses on the mutual influence of monetary policy between China and the United States, while this paper studies the spillover effect of Japanese monetary policy on China's economy. Secondly, in order to better analyze the impact of Japan's monetary policy on China's economy, the paper analyzes the impact of Japan's monetary policy on China from the perspective of quantity and price. Thirdly, COVID-19 (Corona Virus Disease 2019) time node is considered in time-varying analysis, which is in line with the current background.

The structure of this paper is as follows. The first part is the introduction. The second part analyzes the quantitative and price monetary policy tools. The third part constructs TVP-VAR model for empirical analysis. The fourth part draws the conclusion, in which the overall effect of Japan's loose monetary policy on China's economic growth is negative, and has time-varying characteristics; however, over time, the adverse effects will gradually weaken.

2. **Theoretical Analysis.**

2.1. **Quantitative and price monetary policy instruments.**

Quantitative monetary policy tools refer to tools that focus on direct regulation of money supply (base currency, money supply), mainly including statutory deposit reserve policy, open market operation, and discount. The change of monetary policy is mainly that the total amount of policy tools has an impact on the real economy, for example, adjusting the size of the money supply through quantitative tools such as open market operations and deposit reserve ratio, thus affecting the main economic variables and regulating the macro economy.

Price-based monetary policy tools are tools that focus on indirect control, including interest rates, exchange rates and other price variables. Price-based monetary policy tools mainly affect the financial costs and income expectations of micro-subjects through asset price changes, so that micro-subjects adjust their behavior according to macro-control signals. Usually by means of the long-term and short-term interest rate term structure of the financial market to affect market expectations and economic individual behavior, resulting in financial market price fluctuations, further through the wealth effect, balance sheet effect, Tobin effect and other effects on household consumption and corporate investment.

2.2. **Transmission channels of monetary policy spillover effect.**

The spillover effect of monetary policy means that the monetary policy formulated by a country will not only affect its macro economy, but also affect the macro economy of other countries through interest rates, trade output, exchange rates and other asset prices, which can be divided into positive spillover effect and negative spillover effect.

3. **Empirical Analysis.**

3.1. **Model construction.**

To explore the impact of Japanese monetary policy on China's economic spillover, this paper uses TVP-VAR model to analyze the impact of Japanese quantitative monetary policy on China's economy. The main formulas of the model are

$$y_t = X_t\beta_t + A_t^{-1}\sum_t \varepsilon_t, \quad t = k+1,\ldots,n,\ \varepsilon_t \sim N(0, I_m) \tag{1}$$

Among them, y_t is the $m \times 1$ dimension observable vector, $X_t = I_k \otimes (y_{t-1},\ldots,y_{t-k})$ ($\otimes$ represents the Crocker product), β_t is the $m^2k \times 1$ dimension time varying coefficient vector.

Suppose A_t is $m \times m$ dimensional lower triangular matrix, Σ_t is $k \times k$ dimensional diagonal matrix:

$$A_t = \begin{bmatrix} 1 & 0 & \cdots & 0 \\ a_{21,t} & 1 & \ddots & \vdots \\ \vdots & \ddots & 1 & 0 \\ a_{m1,1} & \cdots & a_{m,m-1,t} & 1 \end{bmatrix}, \quad \Sigma_t = \begin{bmatrix} \sigma_{1,t} & 0 & \cdots & 0 \\ 0 & \sigma_{2,t} & \ddots & 0 \\ \vdots & \ddots & \ddots & \vdots \\ 0 & \cdots & 0 & \sigma_{m,t} \end{bmatrix} \tag{2}$$

Among them, the coefficient vector β_t, matrix A_t and covariance matrix Σ_t are all time-varying. Time-varying matrix A_t means that the impact of the 'I' variable shock on the 'j' variable changes over time. In order to avoid the error of parameter estimation, Markov chain Monte Carlo (MCMC) algorithm is used for Bayesian estimation of parameters, and the impulse response between each variable is further calculated [2].

3.2. **Variable selection and data test.** In view of the availability of data and the need of TVP-VAR model for sample size, this paper selects monthly data from July 2008 to December 2021. Japan's monetary policy changes are divided into quantitative and price type, this paper selects the Japanese money supply (JM2, real value) and the Japanese bank unsecured lending rate (JI, overnight, average) to represent [3]. Since China's GDP has no monthly data, this paper selects GDP to represent China's output level. China's consumer price index (CPI, year-on-year in the month) is used to reflect the price level [4], and the exchange rate of yen against CNY (CJE, 100 foreign currency against local currency, monthly average) is used to reflect the exchange rate change. The total import and export volume of China and Japan (CJXM) is selected to reflect the Sino-Japanese trade.

This paper uses ADF method to test the stability, and the results are shown in Table 1. After the first-order difference of the original series, all the series are stationary, which can be further empirical analysis.

Table 1. Data stationary test results

Variables	t-statistic	Prob.	1% level	Conclusion
GDP	−0.682940	0.4198	−2.579680	Destabilization
CPI	−0.071497	0.7040	−2.580574	Destabilization
CJX	−0.403488	0.5370	−2.579495	Destabilization
CJXM	0.646394	0.8548	−2.579404	Destabilization
JM2	5.382755	1.0000	−2.579495	Destabilization
JI	−4.812541	0.0000	−2.579680	Stabilization
DGDP	−11.50696	0.0000	−2.579680	Stabilization
DCPI	−6.348405	0.0000	−2.580574	Stabilization
DCJE	−8.843183	0.0000	−2.579495	Stabilization
DCJXM	−13.18017	0.0000	−2.579495	Stabilization
DJM2	−6.594383	0.0000	−3.471454	Stabilization
DJI	−5.638227	0.0000	−2.579680	Stabilization

3.3. **Empirical analysis process.** Before constructing TVP-VAR model, it is necessary to determine the optimal lag order of the model. Use HQIC and SBIC minimum criterion to select the lag order of the model, determine the lag order of the money supply model Lag = 4, the lag order of the VAR model of interest rate is Lag = 2, and then establish the TVP-VAR model.

In this paper, MCMC method is used for sampling estimation. The number of samplings is 5000 to form an effective sample. The results of money supply model and interest rate model are shown in Table 2 and Table 3, respectively. The invalid factors of most

TABLE 2. Parameter estimation results of quantitative monetary policy

Parameter	Mean	Stdev	95% U	95% L	Geweke	Inef.
sb1	0.0023	0.0003	0.0018	0.0028	0.997	7.47
sb2	0.0023	0.0003	0.0018	0.0029	0.924	12.19
sa1	0.0057	0.0020	0.0033	0.0107	0.021	79.30
sh1	0.8804	0.1214	0.6276	1.1155	0.097	96.91
sh2	0.9185	0.1235	0.7086	1.1931	0.908	142.48

Note: The 'sb1, sb2, sa1, sh1, sh2' denote random sampling values in Table 2. The following is the same.

TABLE 3. Parameter estimation results of price-based monetary policy

Parameter	Mean	Stdev	95% U	95% L	Geweke	Inef.
sb1	0.0023	0.0003	0.0018	0.0029	0.004	8.28
sb2	0.0023	0.0003	0.0018	0.0029	0.006	5.62
sa1	0.0058	0.0018	0.0035	0.0102	0.009	49.31
sh1	0.5812	0.0982	0.3944	0.8135	0.000	194.65
sh2	0.8325	0.1655	0.5446	1.1852	0.145	47.29

parameters in the model are less than 100, indicating that the estimation results can reflect the dynamic relationship between variables, and the next impulse response function analysis can be performed.

3.4. **Impulse response analysis.**

(i) Spillover effects of quantitative monetary policy on Chinese economy

Figure 1 shows the response of GDP, CPI, CJE and CJXM to a positive impact of JM2, reflecting the impulse response of different lag periods, and describing the impulse response curves of lags 4, 8 and 12, respectively.

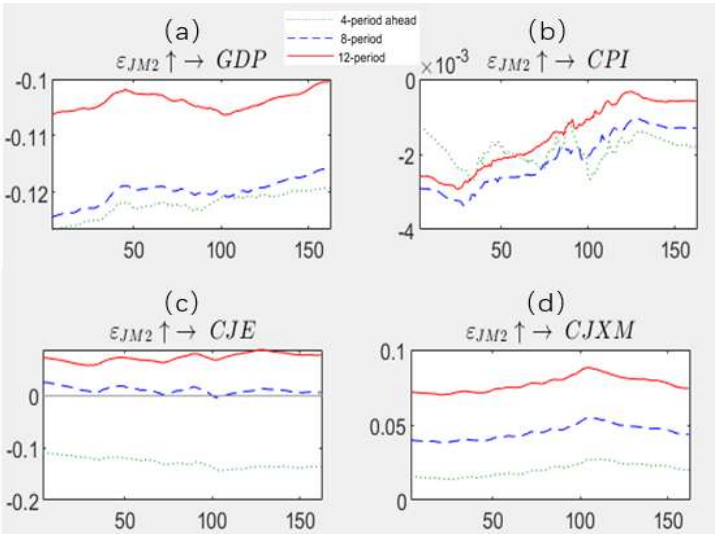

FIGURE 1. Impulse response diagrams of different lag periods of quantitative monetary policy

From Figure 1(a) to Figure 1(d), it can be seen that the positive impact of JM2 on China's economic variables in different lag periods varies greatly. The positive impact of JM2 has a time-varying impact on the added value of GDP in different lag periods. The negative impact of the lag period of 4 is the largest, and the negative impact of the lag period of 12 is weak. Before 60 periods, the impact effect of CPI in lag 4 period is less

than that in lag 8 period and lag 12 period. After 98 period, the impact of lag 4 period is greater than that of lag 8 period and lag 12 period, and both are negatively affected by fluctuations. After a positive shock to Japan's money supply, it will have a negative impact on CJE at a lag of 4 periods, but a positive impact at a lag of 8 periods and 12 periods; CJXM is positively impacted, and the longer the lag period, the greater the impact.

Based on the change time of Japan's quantitative monetary policy and the time of Japan's major economic crisis, this paper sets four time points: 4, 28, 58, 141, to show the impulse response of different time points. These four-time nodes respectively represent the financial crisis in October 2008, Japan's opening of a comprehensive monetary easing policy in October 2010, Japan's setting monetary supply as a monetary policy target in April 2013, and the outbreak of COVID-19 in March 2020, to observe the time-varying effect of Japan's quantitative monetary policy on Chinese economy.

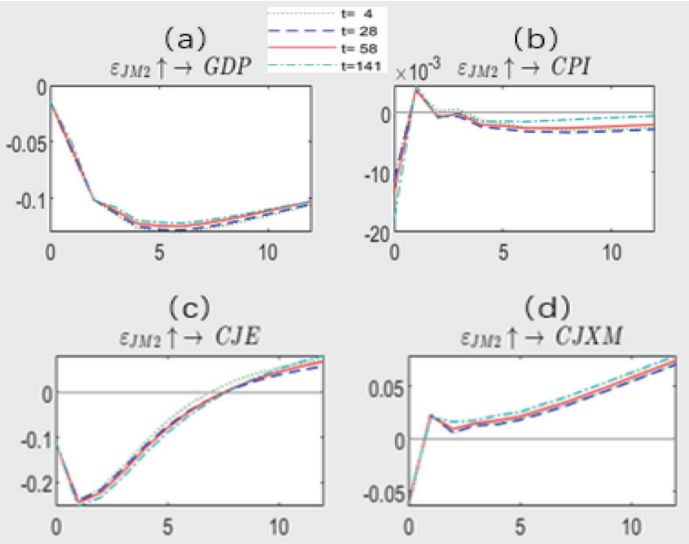

FIGURE 2. Impulse response diagram of different time-varying nodes of quantitative monetary policy

It can be seen from Figure 2(a) to Figure 2(d) that the change trend of the impact of Japan's quantitative monetary policy at four time points is roughly the same. The impact on GDP is obviously negative impact, and reached the maximum negative impact in the fifth phase; in the first period, the impact of JM2 change on CPI reached the maximum positive impact, but after the third period, the impact effect at four time points showed obvious variation. The impact on CJE is gradually weakening the negative impact, in the eighth phase into a gradually enhanced positive impact. In 2008, the negative impact on the financial crisis was less than that at other time points, but the impact was greater than that at other time points after turning to positive in the eighth period. It has a positive influence on CJXM, and the impact at the time point of COVID-19 was greater than that at other time points. It may be due to the epidemic prevention and control policy implemented in China, which limits China's import and export.

(ii) Spillover effects of price-based monetary policy on Chinese economy

Figure 3 reflects the impulse response diagram that the positive impact of JI will have a time-varying impact on China's variables in different lag periods, and describes the time-varying parameter impulse response of lags 4, 8 and 12.

From Figure 3(a) to Figure 3(d), it can be seen that the positive impact of JI on the time-varying impact of GDP in different lag periods is quite different. The impact of the lag period of 4 is the largest, and the impact of the lag period of 12 is weak, close to no impact, and the absolute value is relatively small. The impact on CPI is a

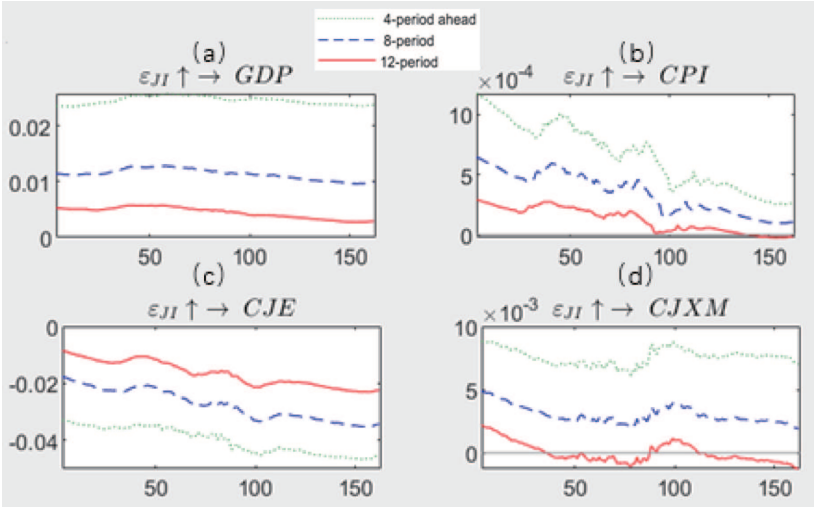

FIGURE 3. Impulse response diagrams of different lag periods of price-based monetary policy

gradually decreasing positive impact effect, and it shows a gradually increasing negative impact after 100, but the shorter the lag period, the greater the impact, the longer the lag period, the faster the response; the different lag periods of CJE have a gradually increasing negative impact, the shorter the lag period, the stronger the impact effect; the shorter the lag period of Sino-Japanese import and export volume, the stronger the degree of shock response, and the lag 12 period will have a process of mutual transformation from positive and negative effects.

According to the change time of Japan's price-based monetary policy and the time of Japan's major economic crisis, this paper sets four time points: 4, 28, 90, 141. These four time-nodes respectively represent the financial crisis in October 2008, the implementation of zero interest rate policy in October 2010, the return of Japan's monetary policy target to interest rates and negative in February 2016, and the outbreak of COVID-19 in March 2020. It can be seen from Figure 4 that the impact of changes in JI on GDP has basically the same trend at four time points; the impact on CPI at different time points is different. China's CPI was most affected by the financial crisis. In 2016, the impact effect of Japan's monetary policy target changed and the COVID-19 changed from negative to positive, and the four time points finally tended to 0. The degree of reaction to the impact of CJE

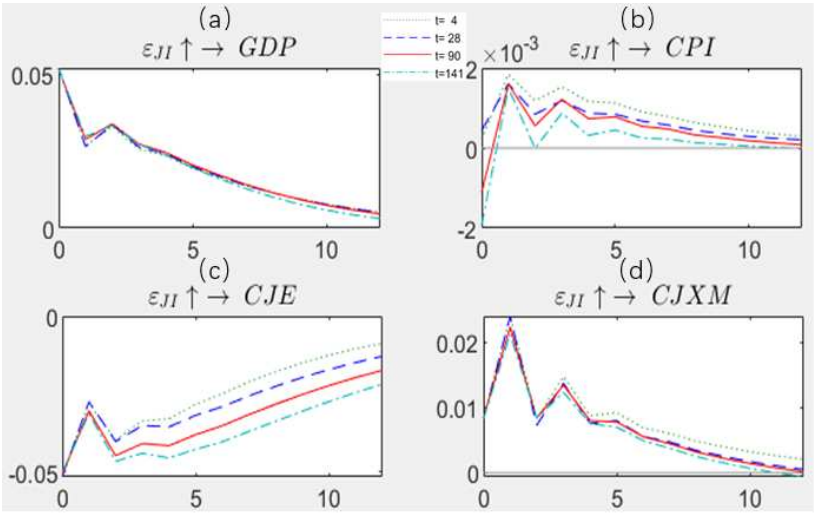

FIGURE 4. Impulse response diagram of different time-varying nodes of price-based monetary policy

at four time points varies greatly, but the negative effects are gradually weakened. The change trend of CJXM at four time points is consistent, and the positive impact of the first peak weakened over time.

4. **Conclusions.** This paper constructs TVP-VAR model to analyze the spillover effect of Japan's monetary policy on China's economy. The results show that Japan's quantitative and price-based monetary policies do have spillover effects on China's economic growth, and have time-varying characteristics. The response and direction of Japan's monetary policy are different in three different lag periods, which reflects that China's economy is affected by external influence at different stages of development. The specific conclusions are as follows.

First, Japan's expansionary monetary policy, whether it is to adjust the money supply or interest rates, will have a significant spillover effect on all aspects of China's macroeconomic. The Bank of Japan's increase in money supply will cause China's output decline and RMB appreciation; the Bank of Japan's reduction of overnight unsecured lending rate will lead to a decline in the total import and export to a greater extent.

Second, the loose monetary policy implemented by Japan has been detrimental to China's overall economic growth. China is facing the pressure of RMB appreciation and the pressure of output growth caused by the adverse effects of foreign trade, which has led to the deterioration of China's trade with Japan for a long time.

Third, with the passage of time, the pressure on the spillover effect of China's economy caused by changes in Japan's monetary policy is gradually weakening, in the face of major global economic crises such as the financial crisis and COVID-19, the spillover effect of Japan's monetary policy on China's macro economy has gradually weakened, which is precisely the result of the continuous optimization of China's monetary policy in recent years.

In view of the limit availability of data, breakthroughs can be made in time span and variable selection in the future. In addition, we should explore the mutual spillover effect of monetary policy between China and Japan in the future to enrich the current research.

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