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Research Article

RESEARCH ON THE SPILLOVER EFFECT OF JAPAN'S NOMINAL NEGATIVE INTEREST RATE POLICY ON CHINA'S ECONOMY

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Abstract

This paper takes the spillover effect of Japan's nominal negative interest rate policy on China's economy as the research object. Using LT-TVP-VAR model, we find that Japan's nominal negative interest rate policy has a positive spillover effect on China's economy. Specifically, the nominal negative interest rate policy has a positive effect on China's interest rate, exchange rate and asset prices, while it has a negative effect on China's output growth, price changes and sino-Japanese trade balance. This paper further analyzes the transmission mechanism and finds that the spillover effect of Japan's nominal negative interest rate policy is mainly through income absorption effect and interest rate channel to affect China's output and prices.

Keywords: Japan's nominal negative interest rate policy, Spillover effect, China's economy, LT-TVP-VAR.

INTRODUCTION

In 1999, the Japanese government innovatively used the zero interest rate policy to cope with the trough of economic stagnation and deflation, but this unconventional monetary policy tool failed to pull the Japanese economy out of the deflationary abyss. For this reason, the Japanese government took another strong medicine and provided a large amount of liquidity to the market through the implementation of quantitative easing (QE) in 2001. The global financial crisis hit the global economy hard in 2008, and the Japanese economy, which had just turned around, returned to negative growth and deflation, with a GDP growth rate of -5.7% and a CPI decline of 1.4% in 2009, both of which were the worst in nearly 30 years. In 2009, Japan's GDP growth rate was -5.7% and CPI fell by 1.4%, both of which were the worst in the past 30 years. In order to cope with the indifferent situation of economic stagnation and deflation, Japanese policy restarted the zero interest rate policy and QE policy on October 5, 2010. in March 2013, the Japanese government further deepened the easing efforts and launched a qualitative quantitative easing policy (i.e. QQE, also known as super QE) to increase the injection of liquidity into the market. on January 29, 2016, the Japanese government announced the implementation of NIRP, specifically by dividing the standing reserve accounts of financial institutions deposited with the central bank into three categories, with the base balance portion paying 0.1% interest, the macro-additional balance portion having a zero interest rate, and the balance portion outside of these two implementing a -0.1% interest rate, with the aim of maintaining an annual monetary base increase of 80 trillion yen. Since then, the level of NIRP has been maintained. on September 21, 2016, the Japanese authorities highlighted the yield curve control policy on the basis of the original QQE and NIRP to prevent excessive leveling of the yield curve. in 2020, the new crown epidemic brought a large impact on the economies of various countries, in order to cope with the epidemic, the United States entered the "zero interest rate era ", and countries such as the UK, Russia and Australia have also lowered interest rates. Low interest rates are still prevalent in most countries, despite the US entering a rate hike cycle in 2021 due to inflation. The nominal negative interest rate policy has challenged the traditional economic and financial theory and opened up a new field of central bank monetary policy tools. With the development of global economic integration process, the NIRP is bound to bring certain impact on the development of global financial markets and economies. frenkel (1983) pointed out that the spillover effects of monetary and fiscal policies originate from two important links between domestic economy and the rest of the world economy trade exchanges and international capital flows [1]. Japan is China's fifth largest trading partner with a total trade value of over $57.3 billion. With the increasing external sensitivity of China's economy, the NIRP is bound to have certain spillover effects on China's monetary policy. Therefore, the study and analysis of the spillover effects of Japan's NIRP on China's monetary policy can provide the central bank of China with a reasonable monetary policy to cope with external shocks and achieve stable and healthy economic development. This paper analyzes the spillover effects of NIRP on China's monetary policy using Japan's NIRP as a representative. The spillover channel of monetary policy is first analyzed theoretically, and then the interest rate channel, trade channel, asset portfolio channel and price channel are analyzed separately to empirically test the spillover effects of Japan's NIRP on China's economy. Based on the theoretical analysis of monetary policy spillover effects, this paper selects LT-TVP-VAR as the empirical analysis tool and finds that the NIRP has a greater impact on interest rates and exchange rates, and asset prices (this paper mainly uses the stock market as a proxy for asset prices) are relatively less affected, while China's economic growth, price changes and trade balance present negative shocks to Japan's NIRP. In terms of transmission channels, this paper finds that Japan's NIRP affects China's output and prices mainly through the income absorption effect of the trade channel and the interest rate channel, while the expenditure switching effect of the trade channel, the price

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channel and the asset portfolio channel have insignificant effects. The marginal contributions of this paper are: (1) this paper classifies the spillover transmission channels of Japan's negative interest rate policy into four types, and observes the actual effects of different channels to understand the main spillover channels of Japan's NIRP on China's economy by analyzing the spillover effects of Japan's NIRP in a hierarchical manner; (2) based on the dynamic changes of Japan's economic environment on China after the implementation of easing monetary policy, the nonlinear parametric time-varying of LT-TVP-VAR model to examine the short-, medium-, and long-term changes of Chinese economic variables in order to assess the spillover effects of Japan's NIRP on the Chinese economy and provide a comparable reference basis for the response of Chinese monetary policy.

Related Literature

With the development of world economic integration process, scholars not only consider domestic factors but also begin to pay attention to external factors when studying national economic growth. Kim (1999) found that tight monetary policy in the United States has a negative short-term spillover effect on output in G6 countries [2]. Kim (2001) further found that an expansionary monetary policy shock through the channel of international capital markets causes a significant increase in output in G6 After the 2008 financial crisis, scholars began to focus on the spillover effects of U.S. quantitative easing (QE) policy on other countries. Bowman *et al.* (2015) find that U.S. unconventional monetary policy has a significant effect on sovereign bond returns in emerging markets, while the spillover effects on exchange rates and stock prices in these countries have large variability [4]. Feldkircher *et al.* (2015), after using BVAR empirical analysis, find that U.S. expansionary monetary policy has strong spillover effects on international output through the financial channel and the trade channel [5]. Sammi *et al.* (2019), based on a DSGE model, find that the large U.S. asset purchase program, despite leading to currency appreciation and worsening terms of trade in other countries , but stimulates the increase of output in other countries through the asset portfolio channel, meanwhile, the more open the financial market, the stronger the spillover effect [6]. Ying Xu *et al.* (2020) found through a TVP-VAR model that changes in the U.S. balance sheet lead to an increase in China's M2, while there is a significant long-run negative shock spillover effect on China's exchange rate and central bank balance sheet size [7]. Han Jingsuo (2020) empirically finds that U.S. quantitative easing monetary policy will have a larger negative impact on the Chinese economy through the exchange rate mechanism, compared to price easing monetary policy that will stimulate the Chinese economy to a small extent through the interest rate channel [8]. Since the implementation of unconventional monetary policy in the euro area, some scholars have focused their research on the spillover effects in the euro area, most of which found positive spillover effects of unconventional monetary policy in the euro area. Fratzscher *et al.* (2016) found that unconventional monetary policy in the euro area would have positive spillover effects on global stock prices and reduce the sovereign risk and bank credit risk of G20 countries by boosting confidence risk and bank credit risk [9]. Roman, Klara (2016) argue that euro area monetary policy has positive spillover effects on non-euro area countries [10]. By constructing a factor-increasing nonlinear econometric model, Zhang, Pu *et al.* (2021) find that European quantitative monetary policy has a greater impact on China's macroeconomy, especially output, during periods of high economic growth, while price-based monetary policy has a greater impact on China's macroeconomy, especially inflation, during periods of economic depression, and that China's employment level is insensitive to both the ECB's quantitative and price-based monetary policies [11]. Japan is also one of the economic agents that implemented unconventional monetary policies. Therefore, studying the spillover effects of Japan's unconventional monetary policy has also attracted some scholars. Dekle *et al.* (2014) empirically find that Japan's expansionary monetary policy has a positive spillover effect on U.S. GDP despite leading to the appreciation of the U.S. dollar [12]. He, G. and Peng, Y. (2014) find a negative spillover effect of Japan's expansionary monetary policy on Chinese output mainly through the expenditure switching effect using the SVAR method [13]. Fukuda (2018) finds a significant positive effect of the decline in Japanese long-term bond returns on Asian stock prices excluding Korea during the implementation of Japan's negative interest rate policy [14].Spiegel *et al.* (2018) found through a FAVAR model that compared to the U.S. interest rate shock, Japan's NIRP not only has a smaller impact on the Japanese economy, but also has a very limited impact on output and inflation in China and South Korea [15]. Wang Ruohan and Ruan Jia (2020) used TVP-VAR model to find that Japanese monetary policy changes negatively affect China's output level mainly through the Sino-Japanese trade path, and improve China's output level through the monetary policy and asset price paths [16].Ganelli *et al.* (2019) studied the spillover of Japanese QQE policy on Asian emerging markets through GVAR model effect, the empirical results show that there is no significant spillover effect on interest rates, and that Japan's QQE policy mainly counteracts the expenditure switching effect by affecting expectations and boosting confidence in a positive spillover effect to influence inflation and capital inflows in other emerging Asian countries [17]. From the existing literature, it can be seen that scholars generally agree that monetary policy, especially in developed countries, has certain spillover effects. And in general, there is a more pronounced heterogeneity in the spillover effects, with the more developed the economy and the more open the market, the larger the spillover effects. The spillover effect of monetary policy in the United States has been the object of study in most of the previous literature, while monetary policy in Europe has also attracted the attention of some scholars, but the scope of research is mainly focused on the analysis of spillover effects in European countries or emerging markets, or comparing the spillover effect of monetary policy in the euro area with that in the United States. The spillover effect of Japan's NIRP on emerging market countries such as China is currently very little research literature, so this paper has a certain complementary effect on the development of the literature.

Mechanism analysis of the spillover effect of NIRP on China's monetary policy

The spillover channels of foreign monetary policy to other countries are usually considered to include international capital flow channels, exchange rate channels, trade channels, inflation channels, etc. Kazi (2013) analyzed that the factors influencing foreign monetary policy are divided into fast-moving and slow-moving factors, and the variables that can respond quickly to changes in foreign monetary policy are generally: interest rates, exchange rates, and stock prices, while employment, output, and other The response of factors such as employment and output usually has a certain lag [18]. In this paper, referring to Kazi (2013), the transmission mechanism of NIRP spillovers is divided into two layers, with NIRP in other countries first affecting the fast-moving factors of interest rates, stock prices, and exchange rates in their own countries, and then finally affecting the slow-moving factors through monetary policy transmission channels such as the interest rate channel, the asset price channel, and the exchange rate channel.

Specifically, first, when another country or region implements a NIRP, there will be a linkage mechanism for domestic interest rates, and the NIRP will drive down Chinese interest rates through the interest rate channel and the signaling channel. The negative nominal interest rate leads to a widening of the spread between the two countries that exceeds the bid-offer rate, and a large amount of international arbitrage capital will flow from the country with NIRP to China with relatively high interest rate, and the increase of short-term capital inflow will make the money supply rise and drive down the domestic interest rate while the short-term money demand remains unchanged. When international arbitrage capital sells the currency of the country with negative nominal interest rates in the current period and shifts to the domestic currency, it also causes the exchange rate of the country with negative nominal interest rates to depreciate. At the same time, the NIRP usually leads to higher asset prices and lower investment yields in the home country, so that investors turn their attention to other countries that can bring higher yields, and international capital flows out of the implementing country and into the home country, leading to an increase in liquidity in the home capital market, thus driving asset prices higher.

Second, when the fast-moving factors change accordingly, they will also affect the macroeconomy through the relevant channels. Specifically, it includes: first, the interest rate channel. When the national interest rate is changed by the spillover effect, it will make investment and consumption rise through the interest rate channel, balance sheet channel, etc., thus affecting output and prices, making output increase and prices rise. Second, the asset portfolio channel. When the national capital market prices are affected by spillover effects and rise, it makes investment and consumption rise through Tobin's Q and wealth channel, which leads to the same direction of output and price increase. Third, the trade channel. The trade channel is mainly divided into the expenditure switching effect and the income absorption effect. Under the expenditure switching effect, the currency of the country implementing the negative interest rate policy depreciates, which causes an increase in exports of the implementing country, a decrease in exports of the country, and an increase in imports, which worsens the terms of trade of the country and leads to a decline in both output and prices, bringing about the "beggar-thy-neighbor" effect; the income absorption effect refers to the implementation of the NIRP, which leads to an increase in the income of the region and an increase in the demand for imports. The income absorption effect is that the implementation of negative interest rate policy will lead to an increase in the region's income and import demand, which will lead to the growth of domestic exports and eventually increase output and prices. Fourth, the price channel. The depreciation of the exchange rate of the currency of the country implementing the NIRP and the decrease in the price of domestic imports lead to a decrease in the production cost of manufacturers, which leads to an increase in output and a decrease in the CPI. The spillover channel of Japan's NIRP is shown in the specific flow in Figure 1, which forms the basic framework for the analysis in this paper.

DATA AND METHODOLOGY

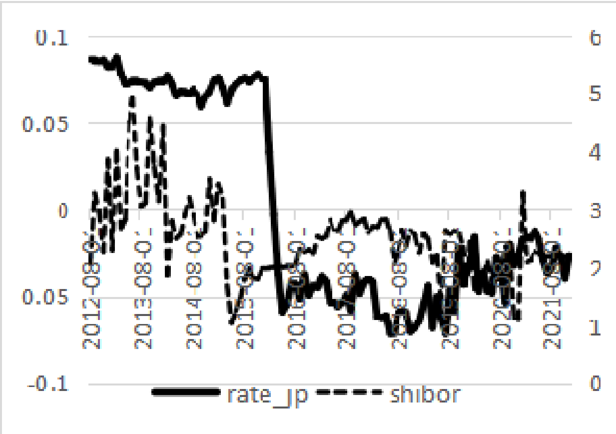
Data

For the selection of explanatory variables, Japan's short-term interest rate is chosen as a proxy variable for the NIRP, specifically the monthly average of Japan's overnight unsecured borrowing rate. The fast-moving factors are selected as the month-end value of China's overnight SHIBOR, the yen to RMB exchange rate and capital market prices. The capital market is usually represented by the stock market and the real estate market, and the stock market is the typical representative of the rapid response of asset prices, so the China SSE Composite Index is chosen as a proxy variable. The quarterly adjusted chain rate of China's GDP is chosen as a proxy for output growth, while the chain rate of consumer price index is chosen as a proxy for price changes. The time interval of the data is monthly indicators from August 2012 to December 2021 (where the quarterly GDP chain rate is a quarterly indicator, adjusted to a monthly indicator by the quadratic-average method). This interval covers the beginning of Japan's QE policy and NIRP. All data are from the WIND database.

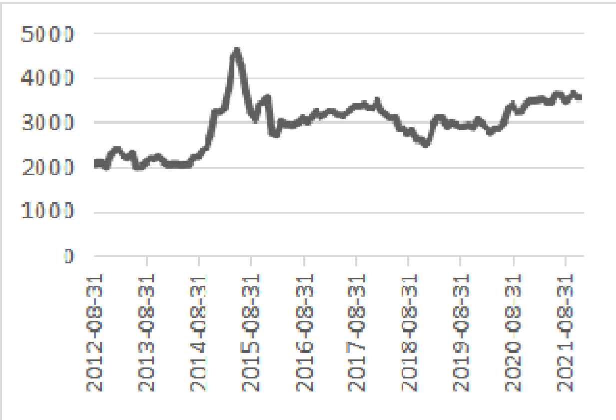
Table 1. List of variables

Nature of indicators	Indicator content	Abbreviation
Explanatory variable	Monthly average of Japanese overnight unsecured borrowing rates	rate_jp
Policy base variables	Chinese overnight SHIBOR month-end value	shibor
	Average monthly exchange rate of 100 yen to RMB	ex_jp
	Chinese Shanghai Stock Exchange Composite Index	spi
Final target variable	Month-on-month index of Chinese GDP	ip
	Month-on-month index of Chinese consumer price index	cpi
	Sino-Japanese trade balance	trade_jp

Figure 1(a) shows the graphs of the Japanese unsecured overnight borrowing rate and the Chinese overnight SHIBOR. As seen in the figure, the trend of Japanese interest rates is divided into two distinct phases, with rates in a relatively stable state before the implementation of negative nominal interest rates in 2016. after January 2016, influenced by negative policy rates, market rates experienced a precipitous and rapid decline to negative territory, and then showed a small oscillation. In comparison, Chinese short-term market interest rates are more volatile, with market liquidity tightening due to factors such as RMB devaluation in January 2014 and before March 2015, and then the central bank took a series of liquidity injection measures to make short-term interest rates fall back quickly, with 2 significant downward adjustments in SHIBOR overnight rates, and although there was a correction in 2016 compared to the previous year, the overall interest rate level was significantly lower than pre-2015 interest rate levels. Figure 1(b) shows China's SSE Composite Index, China's SSE entered a bear market after the bull market in 2009, and the stock index rose sharply in June 2014 under the influence of multiple good news such as interest rate cuts and quotations cuts, and the formation of a stock market bubble driven by leveraged investment in 2015, and then the China Securities Regulatory Commission strengthened regulation, and the stock market fell back rapidly in July of that year until it entered a slow upward phase after June 2016, under the influence of China-US Trade war and other negative news, the SSE index turned down in February 2018 and only started to pull up in January 2019, and after 15 months of shock adjustment, the stock index entered the next round of slow upward phase in May 2020.



(a)Monthly average of Japanese overnight unsecured borrowing rates and Chinese overnight SHIBOR



(b)Chinese Shanghai Stock Exchange Composite Index

Figure 1. Monthly average of Japanese overnight unsecured borrowing rates, Chinese overnight SHIBOR and Chinese Shanghai Stock Exchange Composite Index

Figure2 shows the average exchange rate trend of 100 yen to RMB. The figure shows that the US and European economies were greatly affected since 2007, and a large amount of safe-haven funds shifted to the Japanese market, and the yen experienced a more obvious appreciation phase. in 2013, Japan implemented QQE policy, which led to a rapid depreciation of the yen in the market. in 2014, the US withdrew from QE, which led to a rise in the market risk premium and a significant decline in China's investment return , directly manifested by the increase in China's cross-border capital outflows starting in 2014. According to UBS Securities (2015), capital outflows, excluding FDI, were estimated to be as high as \$324 billion in 2014 [1]. This led to a significant increase in the depreciation pressure on the RMB. 2015 saw the implementation of the 811 exchange rate reform by the Chinese government and the RMB entered a more rapid depreciation phase. late 2016 saw the RMB enter a period of less volatile and stable development.

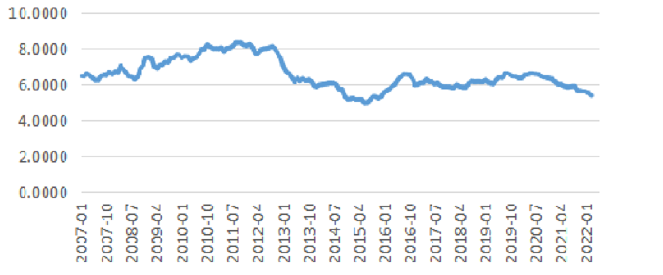
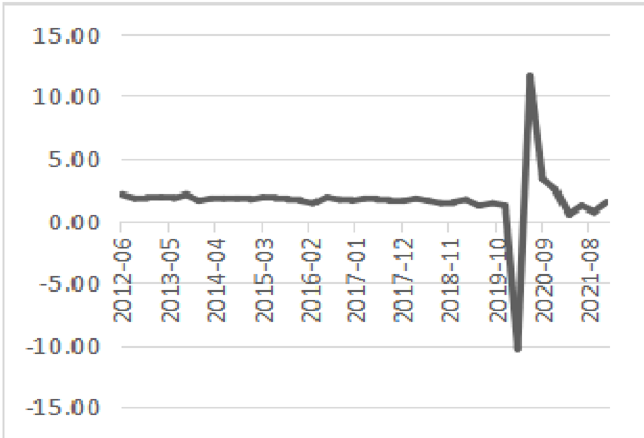
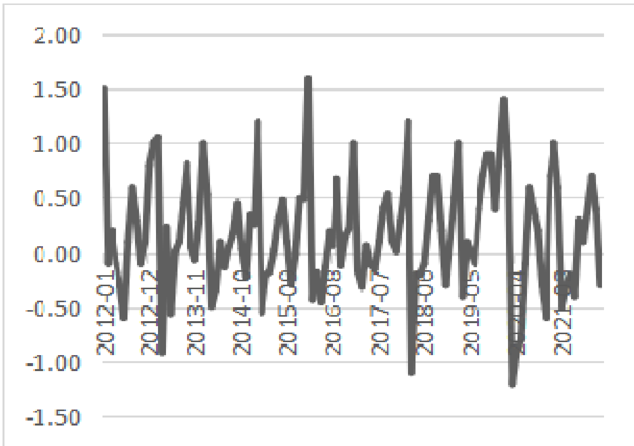


Figure 2. 100 Japanese Yen to RMB Exchange Rate Chart

Figure 3(a) shows that China's GDP maintained a relatively stable growth with less volatility before 2020, which indicates that our government's means of regulating the economy gradually matured. 2020 encountered a sudden outbreak of the new crown epidemic, our country sacrificed the economy as a price to protect the interests of the people, GDP declined significantly, our government "hedged the impact of the epidemic with greater policy efforts " and achieved a rapid economic recovery. This indicates the diversification and maturity of our government's response to the crisis and a much higher degree of risk resistance. Figure 3(b) CPI chain index chart, on the other hand, shows more volatility, which shows more positive growth, and the positive growth is greater than the negative growth. Due to the sluggish economic growth after the foreign crisis and slow growth of domestic and foreign demand, most of China's CPI monthly growth rate is below 1.5% and there is a certain risk of deflation.



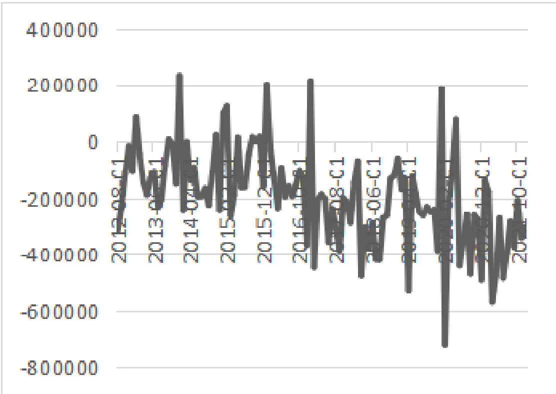
(a) Quarter-on-quarter index of Chinese GDP



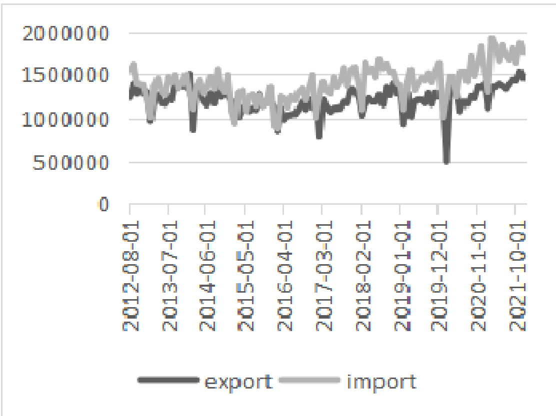
(b) Month-on-month index of Chinese consumer price index

Figure 3. Quarter-on-quarter index of Chinese GDP and Month-on-month index of Chinese consumer price index

Figure 4(a) shows that the Sino-Japanese trade balance fluctuates around zero, showing more of a negative deviation, and the deficit increases in magnitude after 2017. Specifically, Figure 4(b) shows that China's exports to Japan maintain a more stable trend, while imports show a volatile growth trend. China's trade surplus with Japan is mainly in agricultural and forestry products and some labor-intensive products, while the deficit is in machinery, chemicals and other technology-intensive products. 2017 saw the introduction of policies related to the reduction of import tariffs on consumer goods, which has contributed to the expansion of the trade deficit between China and Japan.



(a) Sino-Japanese trade balance



(b)Sino-Japanese export and import

Figure 4. Sino-Japanese trade balance, export and import

Empirical Design

In terms of model selection, this chapter chooses a time-varying vector autoregressive model with latent threshold parameters (LT-TVP-VAR). The transmission of monetary policy has time-varying characteristics, and most of the current literature uses time-varying parameter models in analyzing the spillover effects of monetary policy to other countries. While LT-TVP-VAR has time-varying parameters, its setting on the latent threshold can effectively smooth out the sharp fluctuations of the data, overcome the over fitting problem of the TVP-VAR model, reduce the estimation error of the covariance matrix, and improve the validity and robustness of the estimation results. Therefore, LT-TVP-VAR is chosen as the model used for the study. The specific models are divided into 2. The specific models are divided into 2. Model 1 is a model of the fast-changing factors of Japanese interest rate policy on China, and the variables include Japanese interest rate policy proxy variables, Chinese short-term interest rate SHIBOR, exchange rate and Chinese stock price index. Model 2 is a model examining the slow change factors of Japanese interest rate policy on China, and the variables include Japanese interest rate policy proxy variables, China's GDP chain growth rate, CPI chain growth rate and China-Japan trade balance. Since the regression of non-stationary series may cause "pseudo-regression", the stationarity of each time series should be tested first. In this paper, the ADF unit root test is used, and the series of all variables are smooth at least at the 10% level of significance. Based on the AIC principle of the lag order of the model, the lag order of the model of the impact of Japanese interest rate policy on the policy base variables is chosen to be the first order lag, while the lag order of the model of the impact on the final monetary policy target is chosen to be the second order lag. The specific estimation results under the MCMC simulation method are shown in Tables 2 and 3. In terms of convergence, the Geweke values of the parameters do not exceed the critical value of 5%, indicating that the pre-burn-in period is sufficient to enable the Markov chain to converge based on the fact that the CD statistic cannot reject the original hypothesis of convergence to the posterior distribution at the 5% level of enclosure. The largest inefficient factors in the results are 274.61 and 222.26, which are both small relative to the number of 10,000 simulations for the MCMC estimation results, and therefore, can support the posterior inference of the LT-TVP-VAR model.

Table 2. Estimation results of the MCMC component of the model LT-TVP-VAR

Parameter	**Model1**				model2			
	Mean	Stdev	Geweke	Inef.	Mean	Stdev	Geweke	Inef.
μ_β	-0.0868	0.0914	0.000	38.00	0.0192	0.0196	0.002	67.16
ϕ_β	0.9175	0.0762	0.859	183.58	0.7856	0.0985	0.367	144.15
$(\Omega_\beta)_1$	0.0229	0.0026	0.069	101.67	0.0232	0.0022	0.221	128.05
μ_α	0.3858	0.2542	0.000	57.73	-0.2830	0.3996	0.002	4.86
ϕ_α	0.9245	0.0662	0.908	118.22	0.9454	0.0437	0.008	105.71
$(\Omega_\alpha)_1$	0.0840	0.0334	0.213	274.61	0.1490	0.0336	0.016	222.26
μ_h	0.0192	0.0148	0.038	102.72	0.0142	0.0111	0.000	95.69
ϕ_h	0.9331	0.0376	0.978	28.37	0.9655	0.0216	0.016	32.53
$(\Omega_h)_1$	0.9072	0.2255	0.158	84.19	1.0344	0.2080	0.234	80.10
$(d_b)_1$	0.1721	0.1754	0.028	157.87	0.0082	0.0051	0.423	124.45
$(d_b)_2$	0.0483	0.0342	0.000	119.58	0.0126	0.0060	0.404	67.84
$(d_a)_1$	0.9755	0.5219	0.005	77.32	1.1587	1.0012	0.000	20.74
$(d_a)_2$	0.5727	0.4977	0.000	66.54	0.4776	0.3171	0.006	29.85

In addition, the estimates of autoregressive coefficients, in the posterior results of each parameter are all less than 1 and not 0, which satisfy the smoothness requirement of the autoregressive process, and in summary, the posterior distribution of the model parameter estimates is credible. The acceptable rates of potential threshold values in Table 3 are all higher than 9%, the acceptable rates of model 1 coefficient threshold values are higher than 28%, and the acceptable rates of constraint relationship threshold values are higher than 44% in the same period; the acceptable rates of model 2 coefficient threshold values are higher than 9%, and the acceptable rates of constraint relationship threshold values are higher than 30% in the same period. This implies that the original hypothesis of no threshold effect cannot be rejected statistically, and the NIRP in Japan has a threshold effect on the adjustment of the base variables and the final target of monetary policy in China, which has a structural mutation characteristic, and it is reasonable to use the LT-TVP-VAR model for the study.

Table 3. Acceptability Rate of Potential Threshold Values（%）

	$(d_b)_1$	$(d_b)_2$	$(d_a)_1$	$(d_a)_2$
model 1	28.3	33.2	53.5	44.5
model 2	9.4	44.8	32.2	50.2

EMPIRICAL RESULTS

Spillover effects of Japanese interest rate policy on China's rapid response factors

Figures 5 and 7 depict the time-varying response plots of Japanese interest rate policy on the underlying and final target variables of Chinese monetary policy, which represent the impulse responses of a unit standard deviation shock to the other variables after a specific and identical time interval. In this paper, the impulse response durations of 4, 8 and 12 periods are chosen to represent the short-, medium- and long-term effects. The black solid line in each of the following figures indicates a 4-period lag, the long dashed line indicates an 8-period lag, and the short dashed line indicates a 12-period lag. The graphs show that the short-term effects of the impulse response plots for each variable are more volatile and longer lasting than the medium-term and long-term effects, indicating that the short-term effects of the spillover from Japanese interest rates to Chinese interest rates are more significant. There are some differences in the three-period impulse responses of the variables in the figure, indicating the scientific validity of using the LT-TVP-VAR model.

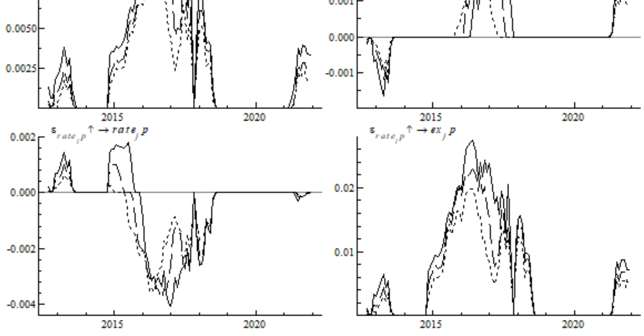
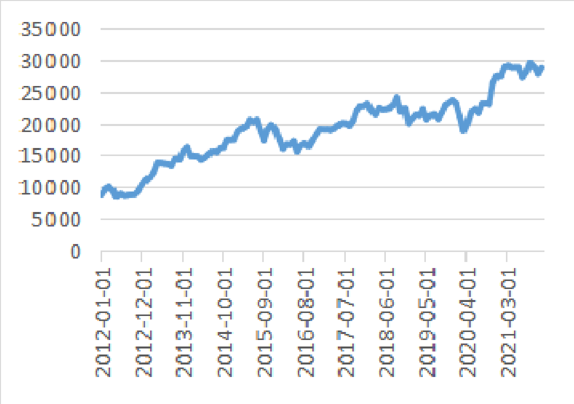


Figure 5. Time-varying impulse response plot for model 1

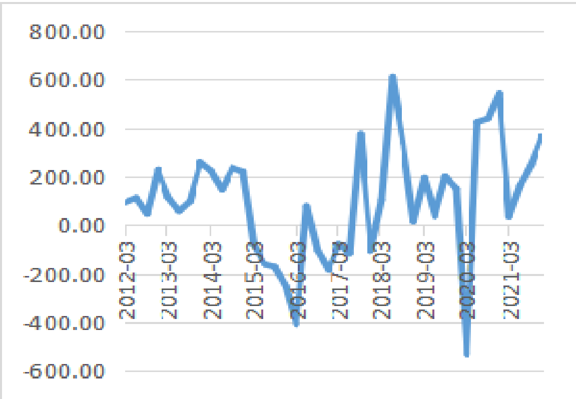
The first column of the first row of Figure5 responds to the impulse response of the Japanese interest rate on the Chinese interest rate. The effect of Japanese interest rates on Chinese interest rates shows a non-time-varying positive shock relationship, i.e., a decrease in Japanese interest rates leads to a decrease in Chinese interest rates. The short-term effect is much larger than the medium- and long-term effect in the three-period impulse response. The figure shows that the impulse response of Chinese interest rates climbs to a stage high of 0.004% in 2013 quickly slides down to zero level, then pulls up again at the end of 2014, and the shock response is more significant in 2016, forming a wave with an impulse change of 0.011%, and it lasts until around 2019 when the impulse response returns to zero. This shows that the implementation of a NIRP on top of QQE brings a significantly higher depth and breadth of impact on Chinese interest rates than a single quantitative easing monetary policy.

The second column of the first row of Figure5 shows the impulse response of Japanese interest rates on the Chinese stock market. In 2013, when the QQE policy was implemented in Japan, the Chinese stock market showed a significant negative impulse effect and the magnitude of the shock increased and formed a phase extreme of -0.0016%, but the duration of the impulse response was short, converging to zero by the end of 2013. 2016 saw a negative nominal After the implementation of the negative interest rate policy in 2016, the Chinese stock market turned to positive shocks and the magnitude of the shocks kept increasing, with the impulse response value forming a wave in 2017 with a maximum shock change of nearly 0.0003%. at the beginning of the QQE implementation, the ultra-loose monetary policy raised positive expectations for the recovery of the Japanese economy, and the QQE in Japan not only promoted the Japanese stock market, but also coincided with the rising phase of the Chinese stock market. After the implementation of Japan's NIRP in 2016, the impulse response of the Chinese stock market changed to a positive effect, i.e., the decline in Japanese interest rates caused the Chinese stock market to fall in the same direction. As seen in the figure, at the beginning of the introduction of Japan's NIRP, as well as the impact of enhanced risk of uncertainty at home and abroad, both short-term and medium- and long-term yields fell to negative values, causing a significant drop in market liquidity, and the Japanese Nikkei 225 index also entered a downward phase (as shown in Figure 6(a)), which also had a dampening effect on the Chinese stock market, which was already in a rapid decline, and then the positive shock effect on the Chinese stock market continues to expand until the impulse response converges to a zero value in 2018. Yili Zhang (2020) finds that negative interest rate policy in Japan has a negative spillover effect on stock markets in neighboring emerging markets initially, which turns positive later [19].

The stock markets of peripheral countries and regions such as New Zealand, Thailand, and Taiwan, China, all experienced gains of more than 20% after the initial adjustment, while the Chinese stock market entered an adjustment phase after a sharp decline in 2015, and thus the investment attractiveness of the Chinese stock market is limited compared to the peripheral markets, as shown in Figure6(b),Chinese portfolio investment under finance largely showed a capital outflow in 2016. The NIRP in Japan has a significant dampening effect on the Chinese stock market.



(a)Nikkei 225 Index Trend



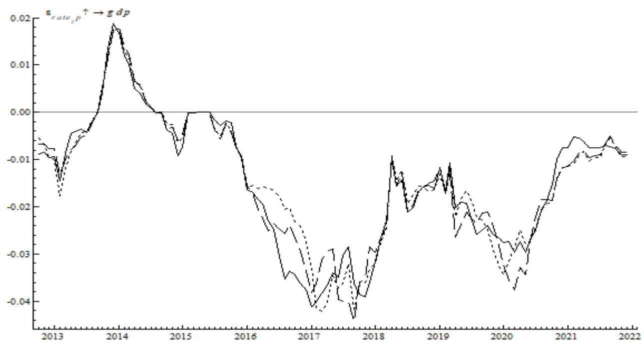
(b)Chinese Portfolio Difference

Figure 6. Nikkei 225 Index and Chinese Portfolio Difference

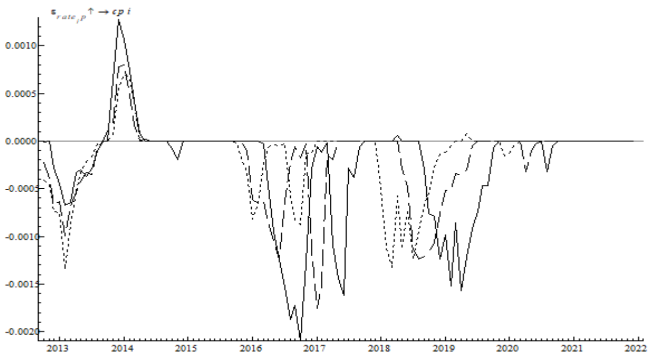
The impact of Japanese interest rate policy on China's exchange rate in the second row and second column of Figure5 shows that the three-period pulse is a non-time-varying positive response, i.e., a decline in Japanese interest rates is accompanied by a decline in the exchange rate of the yen against the renminbi, i.e., a depreciation of the yen and an appreciation of the renminbi. Both the Japanese QQE and negative nominal interest rate policies have positive shocks on the Chinese and Japanese exchange rates, and the superposition effect of the policies is most pronounced, with the exchange rate response time to the shocks of the QQE policy lasting shorter, while the NIRP has a longer sustained response time. As can be seen from the graph of the Sino-Japanese exchange rate in Figure2, the yen mainly experienced an appreciation phase from 2007 to 2012, a depreciation phase from 2013 to 2015, an appreciation phase from 2015 to 2017, and a stable development phase in the latter phase. at the beginning of Japan's NIRP in 2016, the yen did not depreciate significantly against the RMB, but instead, due to uncertainties such as the UK's exit from the EU, the U.S. presidential election and other uncertainty risks enhanced, and once again became a more attractive safe-haven currency with rising market rates. This indicates that although the nominal negative interest rate policy has a positive impact on the exchange rate between China and Japan, the factors affecting the exchange rate movement are more complex, and Japanese monetary policy may not be the key factor affecting the exchange rate at this stage, and the world risk premium changes and capital flows have an important impact on the exchange rate. As can be seen from Figure5, Japan's NIRP has a significant spillover effect on the underlying variables of China's monetary policy, specifically, it has a significant positive spillover effect on the interest rate, exchange rate and stock market, among which the spillover effect on the stock market is relatively small, while the impact of the NIRP and QQE compound policy on the interest rate, exchange rate and stock market is larger than the impact of a single quantitative monetary policy on these three, and the impact is longer lasting. The duration of the shocks is longer. Because China's stock market exhibits a positive impulse response, there is no spillover effect from Japan's NIRP to China through the asset mix channel. In contrast, the factors affecting the exchange rate are complex, and although the exchange rate has a positive impulse response to NIRP, the magnitude and duration of its impact on the appreciation of the yen are more limited.

Spillover effects of Japanese interest rate policy on slow-moving factors in China

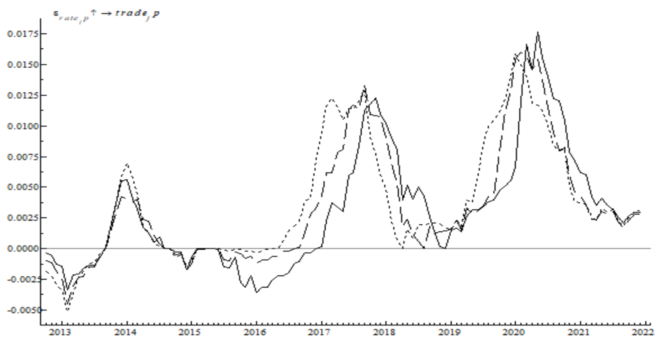
The time-varying response of Japanese interest rate policy to the final target variable of Chinese monetary policy in Figure7 shows that the short- and medium-term effects are significantly time-varying, and the three-period time-varying effects are significantly different in 2016, indicating that the use of the model is justified.



(a)Japanese interest rates on China's output growth



(b)Japanese interest rates on Chinese price changes



(c)Japanese interest rates on sino-Japanese trade balance

Figure 7. Time-varying impulse response plot for model2

Figure 7(a) shows a plot of the impulse response of output growth in China to the Japanese interest rate shock. The figure shows that the impulse response value of output growth is negative in 2013, i.e., a decline in Japanese interest rates leads to an increase in output growth in China with a maximum shock change of nearly -0.02% and a short duration, which turns into a positive impulse response in 2014. after the implementation of NIRP in Japan in 2016, the impulse response of China's economic growth returns to the negative range again and the effect keeps increasing, a trough was formed at the end of 2016, with a shock change of about 0.04%, and after more than a year of volatility adjustment a rapid return to zero in 2018, after which the impulse response behaved as a constant oscillation. The volatility of the short-term effect is significantly larger than the medium- and long-term effect during the beginning of the NIRP in Japan.

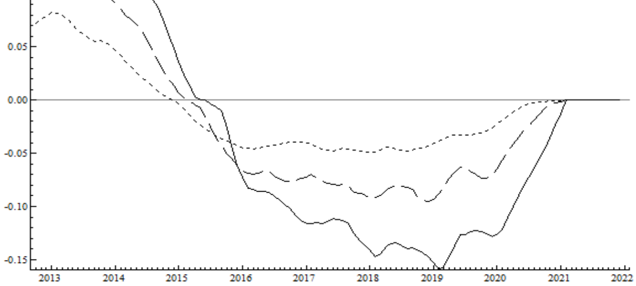
Figure 7(b) shows the impulse response of price changes in China to the interest rate shock in Japan, which is broadly similar to the impulse response of economic growth. 2013 shows a negative shock with a shock change of -0.0014% and a more significant long-term effect. The impulse response is negative in 2016, while the short- and medium-term effects show a lag, and a trough is formed in the second half of 2016, with a maximum shock change of -0.002%, followed by a volatile adjustment trend. The long-term effect generates volatility only in the month of the Japanese interest rate cut and then quickly goes to zero.

Figure 7(c) shows the impulse response plot of the Sino-Japanese trade balance to the Japanese interest rate shock. The graph shows that the impulse response is similar to that of output growth and price changes until 2016, and the long-term effect is most pronounced in 2013 when the response is negative and then rapidly rises to positive values. 2013 is the year when the yen enters a depreciation phase, but it is generally believed that the depreciation is a correction of the excessive appreciation of the yen after the crisis. Therefore, the devaluation had little impact on China-Japan import and export, while the sharpening of political contradictions between China and Japan in 2013 led to a significant reduction in Japan's exports to China and an expanding trend in the Sino-Japanese trade deficit. the impulse response returned to the negative region in mid-2015 and the three-period effect diverged, with the short- and medium-term effects producing an obvious lag and the volatility of the short-term effects being greater than the medium- and long-term effects, with the long-term effects being more pronounced from 2015 to The long-term effect is basically zero until mid-2016. The impulse response of the Sino-Japanese trade balance enters the negative region in early 2016 and forms a trough with a maximum shock amplitude of nearly -0.005%, and the effect is smaller than the implementation of a single QQE policy in Japan. Notably, unlike the first two final monetary policy target variables, the impulse effects in the latter three periods begin to pull up to positive territory, forming peaks in 2017 and 2020 with shocks much larger than the spillover effects from quantity-based and price-based monetary policies. This shows that factors such as the adjustment of China's import tariffs and the rapid recovery of the Chinese economy after the epidemic have important implications, and that Sino-Japanese trade is less affected by Japan's monetary policy and more vulnerable to factors such as import and export policies and demand. Since the impact of Japan's NIRP on China-Japan exchange rate and trade volume is limited, its "beggar-thy-neighbor" impact on trade through the expenditure switching effect may be smaller. As can be seen from Figure 7, China's output growth, price changes and trade balance show negative shocks to Japan's NIRP, i.e., Japan's NIRP increases China's GDP, price changes and trade balance, while China-Japan trade balance is affected by the relevant policy and quickly shows positive shocks after a short period of time, i.e., China-Japan trade deficit continues to widen as Japan's interest rate decreases. The impact on GDP is the most significant among them. Moreover, the spillover effect of a single QQE policy on China is smaller than the superimposed effect of NIRP and QQE policy. The analysis shows that the expenditure switching effect of the trade channel of Japan's NIRP has basically little impact.

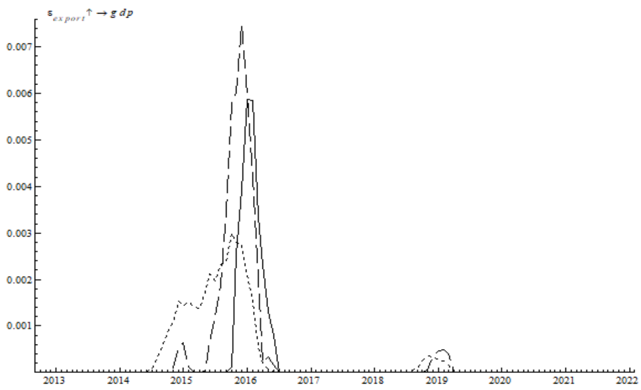
Trade channel mechanism and interest rate mechanism test

Based on the above analysis, it is clear that the spillover effect of Japan's negative nominal interest rate policy on China does not work through the asset portfolio channel and the expenditure switching effect of the trade channel. The effect is analyzed below with respect to the other channel through the LT-TVP-VAR model.

Trade channel mechanism analysis: According to the theory, the negative nominal interest rate policy led to an increase in Japan's output along with a rise in residents' income and thus a corresponding increase in import demand. After the implementation of the accommodative monetary policy, the Japanese economy ended the rapid post-crisis decline and began to grow steadily and positively. As Japan's economy recovered and market confidence was partially restored, Japan's imports of goods and services also showed a general trend of growth, which will bring positive spillover effects to the economies of trade exporting countries through the income absorption effect. The Figure8 is a further analysis of the income absorption effect of the trade channel of Japan's negative nominal interest rate policy using the LT-TVP-VAR model. This is model 3 of this paper, since an increase in demand for Japanese imports leads to an increase in Chinese exports, which ultimately leads to an increase in output. The variables are thus chosen to be the monthly average of the Japanese overnight unsecured lending rate, China's trade exports to Japan, and China's GDP quarter-on-quarter. The same data are treated as above, with China's trade exports to Japan first logged and then normalized to increase smoothness. The data are monthly indicators from August 2012 to December 2021. After robustness tests and determination of the optimal lag order, time-varying impulse response plots are obtained in Figure 8. (Due to space constraints, the relevant estimation results are not included in the paper).



(a) Japanese interest rate to Chinese exports to Japan

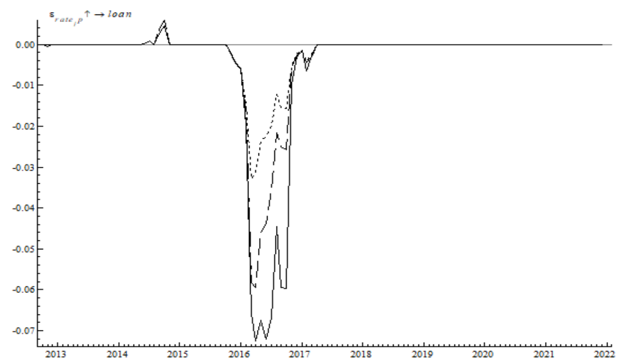


(b) Chinese exports to Japan to Chinese output growth

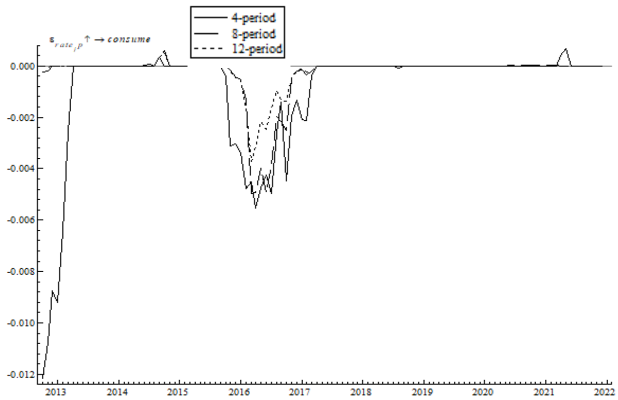
Figure 8. Time-varying impulse response plot for model 3

Figure 8(a)(b) shows the impulse responses of Japanese interest rate on China's export volume to Japan and China's export volume to Japan on China's output growth, respectively. Combined with Figures 5,7 and 8, it can be seen that after the implementation of negative nominal interest rate policy in Japan in 2016, Japanese interest rates are showing negative shocks to China's export volume to Japan as well as China's output growth and price changes, i.e., a lower Japanese interest rate increases China's exports and output, the rate of price changes increases, and the impulse changes of China's exports are -0.1%, respectively, while the positive shocks of China's exports to output growth also in 2016 reaches a maximum of 0.007%, but with a shorter duration. This shows that the income absorption effect is an important transmission channel for the short-term spillover effects of Japan's NIRP on China.

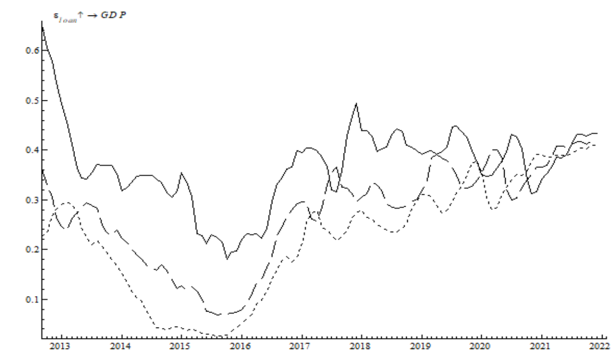
Interest rate mechanism analysis: Under the interest rate regime, when Japan implements a negative nominal interest rate policy, the spillover effect and the interest rate linkage mechanism affect China's interest rates in the same direction, and the lower cost of loans leads to higher credit and consumption, which affects output growth and price changes. This section uses the LT-TVP-VAR model to analyze in depth the effect of the interest rate channel of the negative nominal interest rate policy in Japan. For model 4 in this paper, the variables chosen are the monthly average of the Japanese overnight unsecured borrowing rate from August 2012 to December 2021, new RMB loans to Chinese financial institutions, and the quarterly chain index of total retail sales of consumer goods in China as proxy variables for Japanese interest rates, Chinese credit, and consumption. To standardize the quantiles, new RMB loans are first seasonally adjusted and then logarithmically treated. After robustness tests and optimal lag order determination, time-varying impulse response plots are obtained in Figure 9. (Due to space constraints, the relevant estimation results are not placed in the paper.). Combining Figures 5, 7 and 9, it can be seen that the implementation of a negative nominal interest rate policy in Japan in 2016 has a positive shock impact on Chinese interest rates and a negative shock impact on Chinese credit and consumption, with shock changes of about -0.07% and -0.005%, respectively. In contrast, Chinese credit and consumption have a positive impact on output growth, with shocks of about 0.4% and 0.125%, respectively. Meanwhile, China's consumption is more sensitive to Japan's QQE policy, while credit is more sensitive to the negative nominal interest rate policy. The NIRP in Japan affects the downward movement of interest rates in China and increases credit and consumption, which ultimately leads to higher output and higher price changes in China. The effect of the credit channel is more pronounced, and thus the interest rate channel of the spillover from Japan's negative nominal interest rate policy to China is effective.



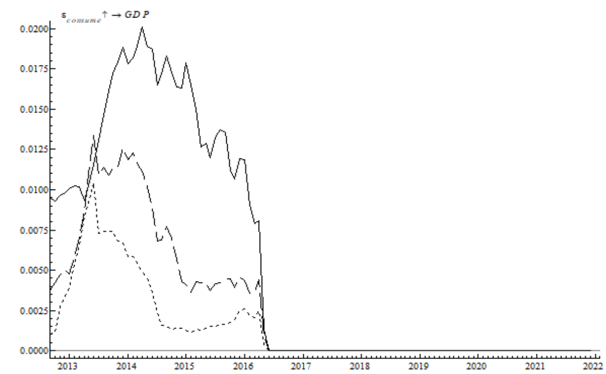
(a) Japanese interest rates on Chinese credit



(b) Japanese interest rates on Chinese consumption



(c) Chinese credit to Chinese output growth



(d) Chinese consumption to Chinese output growth

Figure 9. Time-varying impulse response plot for model 4

Conclusion

This paper empirically investigates the spillover effects of Japan's negative nominal interest rate policy on China's monetary policy using the LT-TVP-VAR model. Japan's negative nominal interest rate policy affects China's fast-response factors - interest rate, stock price, and exchange rate; secondly, it affects the slow-response factors of the Chinese economy (economic growth, price stability, and balance of payments) through spillover effects. The next empirical study follows the idea of this two-tier system. Using monthly data from August 2012 to December 2021, this paper examines the transmission channels of the spillover effects of Japan's negative nominal interest rate policy on China by verifying the impulse responses of the variables in the two-tier system, i.e., the dynamic shocks of Japanese interest rates on Chinese interest rates, the exchange rate of the yen against the renminbi, and the Chinese stock market, and the dynamic shocks of Japanese interest rates on Chinese output growth, price changes, and import and export trade. The results show that Japan's negative nominal interest rate policy has significant positive spillover effects on China's interest rate, exchange rate and stock market, while China's output growth, price change and trade balance present negative shocks to Japan's negative nominal interest rate policy, while the Sino-Japanese trade balance is affected by the relevant policies and has a shorter duration. Meanwhile, the superimposed spillover effect of negative nominal interest rate policy and QQE is more significant and longer-lasting than that of a single quantitative easing policy. In addition, since the exchange rate and trade balance are less affected by Japan's negative nominal interest rate policy, the expenditure switching effect of the trade channel has little impact. Further examination of the separate mechanisms reveals that Japan's negative nominal interest rate policy affects our output growth and price changes mainly through the income absorption effect of the trade channel and the interest rate channel. Overall, the negative nominal interest rate policy in Japan does not have a negative "beggar-thy-neighbor" spillover effect on China's monetary policy, but rather the increase in output growth and price changes in China due to the increase in market liquidity. Therefore, the paper concludes that the negative nominal interest rate policy not only led to the steady development of the Japanese economy, but also had positive spillover effects on the Chinese economy. Among them, the income absorption effect of the trade channel and the interest rate channel are the main mechanisms through which Japan's negative nominal interest rate policy affects China. The reason why Japan's negative nominal interest rate policy did not have negative spillover effects on China through the trade channel is that the increased risk of uncertainty in the world led to the flow of safe-haven funds to Japan, which offset the pressure of the depreciation of the yen. With the marketization of interest rates and the increasing openness of China's capital account, the monetary policies of other countries are bound to produce greater spillover effects. Therefore, how to deal with the spillover effects of other countries' monetary policies in the future is one of the important objectives of central banks in developing countries.

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