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THE CORRELATION BETWEEN THE FINANCIAL CYCLE AND BUSINESS CYCLE: EVIDENCE FROM CHINA AT DIFFERENT EVENT PERIODS

Abstract. *This paper uses EMD method to construct the structural components of the financial cycle and business cycle and analyzes their lead-lag relationships and dynamic correlation mechanism at three specific periods (2008Q3, 2012Q3, and 2017Q3). We find that during the period of the financial crisis, financial cyclical fluctuations precede business cyclical fluctuations; during the period of the new normal of the economy, the peaks and valleys of the financial cycle and the business cycle are the same; during the period of strong financial supervision, the business cycle precedes the financial cycle. Furthermore, compared with the other two periods, the negative effects of financial shocks during the period of strong financial supervision are largest, the spillover effect of the financial cycle on the business cycle is strongest.*

Keywords*: Financial cycle, Business cycle, EMD, Structural components, TVP-VAR.*

JEL Classification: G17, M21

1. Introduction

Traditionally, the Keynesian economic cycle theory and the real business cycle theory believe that under the condition of perfect competition, the financial market presents neutral characteristics, that is, the financial cycle will not have a substantial impact on the business cycle (Plosser and Jr, 1983). However, Japan in 1990 and the United States in 2007 encountered severe financial crises while their economy grew rapidly and inflation remained stable. The outbreak of these two financial crises, on the one hand, showed that price stability does not mean financial stability, while the traditional monetary policy control model with price stability as the main goal does not take into account financial stability; on the other

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hand, it showed that not paying attention to financial market fluctuations is not enough to maintain economic sustainability (Kiyotaki and Moore, 1997; Bernanke et al, 1999). Therefore, Borio (2014) first proposed the concept of financial cycles. He believed that there are interactions between the financial cycle and the business cycle. The large fluctuations of the financial cycle not only have a huge impact on the real economy, but even the excessive prosperity of financial factors may become the root cause of the economic crisis.

At present, China's economy is in a critical period of transforming growth momentum, optimizing the economic structure, and transforming development mode. At this stage, China's real economy is under tremendous downward pressure, and the financial system has a tendency to deviate from serving the real economy; long-term financial imbalances accumulate behind major events, and systemic financial risks continue to increase; financial shocks have significantly changed the operation of the real economy through the accelerator mechanism of the financial market. Such complicated internal and external environments have put forward higher requirements for the smooth operation of the economy and finance. Therefore, understanding the cyclical changes of the financial situation and exploring the relationship of the financial market and the macroeconomy affected by different events are of great significance for preventing and dissolving major risks, guiding finance to return to serving the real economy, and achieving stable economic and financial development.

2. Literature review

Since Borio (2014) proposed the concept of the financial cycle, scholars have used different indicators to measure the financial cycle. A reasonable measurement of the financial cycle is not only an important prerequisite for accurately judging the dynamics of cyclical waves in the financial system but also the basis for exploring the correlation between the financial cycle and the business cycle. Initially, scholars used several representative financial indicators such as credit/GDP and house prices to measure the financial cycle, but one or two financial indicators cannot fully reflect the volatility of the entire financial system. Therefore, some scholars (Swiston, 2008; Brave and Butters, 2011) began to try to construct a multidimensional financial indicator system. Cerutti et al (2019) selected many center-country variables and capital flow data, such as the volatility index (VIX) and the volatility index for the Deutscher Aktienindex (VDAX), to quantify the global financial cycle using factor analysis. Yan and Huang (2020) used principal component analysis (PCA) method to construct a composite financial cycle of the United States. They found that the financial cycle not only becomes the main driver of real interest rate, the financial cycle, and the business cycle, but also serves as an important source of the business cycle fluctuations. Jawadi et al (2021) constructed two indicators based on PCA to measure financial and real business cycles. They found that there is a significant relationship between the financial cycle and the business cycle.

Moreover, some scholars have focused on the correlation between the financial cycle and the business cycle. Aikman et al (2015) used spectrum analysis and found that financial cyclical variables are strongly correlated with the macroeconomy in the medium and long terms. The peak of this sequence is generally followed by a financial crisis. Therefore, monitoring such low- and medium-frequency fluctuations tends to identify the risks of future financial distress or financial crises in advance. Menden and Proaño (2017) conducted a Granger causality test in the factor-enhanced VAR setting to study whether the financial cycle components have predictive power for economic activities. They found that financial cycle indicators can significantly improve the quality of recession forecasts. Strohsal et al (2019) used parametric spectrum estimation to the analysis of financial cycles. They formally tested properties of financial cycles and to characterize their international interaction in the frequency domain. Liu et al (2020) analyzed the relationship between China's financial cycle, business cycle and global financial cycle in the time-frequency domain based on wavelet analysis method. They found that the Chinese business and financial cycles are basically decoupled from the global financial cycle since 2015.

Our work is the same as the message conveyed by these papers, that is, there is a close relationship between the financial cycle and business cycle, especially the middle and low frequency series. However, our perspective is different. Most of the existing literature analyzed from the perspective of time domain. One prominent example is Jawadi et al (2021), who studied the relationship between the financial market and the business cycle in the US. They found that there is a significant relationship between the financial cycle and business cycle, especially in the "expansion-growth" phase. In contrast, from the perspective of frequency domain decomposition, we use empirical mode decomposition (EMD) method to divide the financial cycle into structural components of different frequencies, including: high-frequency components, low-frequency components, and trends. We find that the low-frequency components are highly correlated with their original series and reflect the influence of major events. Therefore, we focus on the lead-lag relationship and dynamic correlation mechanism between China's financial cycle and business cycle under the influence of major events. This new perspective generates new insights which may provide useful suggestions for optimizing China's monetary policy.

The remainder of the paper is organized as follows. Section 3 and Section 4 describe the methods and data, respectively. Section 5 presents the main empirical results. Section 6 gives the conclusions.

3. Methods

First, in accordance with Huang et al (1998), we employ the empirical mode decomposition (EMD) method to deal with the indicators of China's financial cycle and business cycle to synthesize financial cycle and business cycle components of different frequencies.

Based on the characteristics of the time series, EMD can adaptively pass the screening process to decompose the original series, $x(t)$, into multiple intrinsic mode functions (IMFs) with different frequencies and a residual series, $r(t)$. The equation is as follows:

$$x(t) = \sum_{i=1}^{n} IMF_i(t) + r(t), t = 1, 2, ..., T \quad (1)$$

where n represents the number of IMFs decomposed.

Then, according to Zhang et al (2008), we composite the corresponding IMFs to obtain the structural components (high-frequency components, low-frequency components, and trends) of the financial cycle and business cycle. The composition process mainly has the following three steps:

1) Calculate the average period of each $IMF_{i,j}(t)(i = 1, 2, ..., n; j = 1, 2, ..., m)$, where j represents the number of the proxy variable;

2) For proxy variable j, if the average period of $IMF_{k,j}(t)$ is greater than 10, then add $IMF_{k,j}(t)$ to $IMF_{n,j}(t)$ as the low-frequency part of the j-th series, $IMFL_j$, add $IMF_{1,j}(t)$ to $IMF_{k-1,j}(t)$ as the high-frequency part of the j-th series, $IMFH_j$, and use $r_j(t)$ as the trend of the original series:

$$IMFH_j = \sum_{i=1}^{i=k-1} IMF_{i,j}(t), t = 1, 2, ..., T \quad (2)$$

$$IMFL_j = \sum_{i=k}^{i=n} IMF_{i,j}(t), t = 1, 2, ..., T \quad (3)$$

3) Add the high-frequency parts of all indicators of the financial cycle as the high-frequency components of the financial cycle (FCIH), and add the middle and low frequency parts of all the indicators of the financial cycle as the low-frequency components of the financial cycle (FCIL); in the same way, the high-frequency components, and the low-frequency components of the business cycle (BCIH and BCIL, respectively) can be obtained.

Based on the calculation results, we use the Bry-Boschan (BB) method and TVP-VAR model to study the lead-lag relationship and the dynamic correlation mechanism between the financial cycle and business cycle.

4. Data

We include eight of the main financial indicators as representative variables of the financial cycle: (i) house prices (HP); (ii) the scale of credit (SC); (iii) stock prices of Shanghai securities composite index (SP_SSEC); (iv) stock prices of Shenzhen securities component index (SP_SZI); (v) interbank rates (IR); (vi) government bond interest rate (GBIR); (vii) money supply (M2); (viii) real effective exchange rate index (REER). The reasons for choosing these variables are as follows. Some research believed that credit and house prices are the main basis for cyclical fluctuations in the financial system (Drehmann et al, 2012). Credit is

the most important variable factor connecting savings and investment. As the most common collateral price, house prices can usually be used as indicators to represent asset prices and identify value risks, and are used to study economic fluctuations when macroeconomic disorders (Gorton and He, 2008). The linkage between credit and real estate prices can vividly describe the effect of increased interaction among credit constraints, asset prices, and risk perception. Claessens et al (2011) not only selected house prices as a representative of asset prices, but also used share prices as another important asset price representative for measure of the financial cycle. In the case of a relatively single financial market, the above single financial sub-market is reasonable for measuring the financial cycle, but it is obviously not comprehensive for the increasingly complex financial system. Cerutti et al (2019) selected many center□country variables and capital flow data, such as the volatility index (VIX) and the volatility index for the Deutscher Aktienindex (VDAX), to quantify the global financial cycle using a factor analysis.

Therefore, we select the above eight indicators as representative variables of the China's financial cycle. These indicators describe the operating status of the entire financial system based on four aspects: the real estate market, capital market, credit market, and money market; thus, they can be used as good basic indicators for measuring China's financial cycle. Based on the availability of data, the quarterly data relates to 58 quarters from 2005Q3 to 2019Q4, which are selected as the samples. All samples come from the Wind database. All series are seasonally adjusted and their trend components are eliminated. In addition, in order to eliminate the dimensional difference of the cycle components, each variable is standardized to ensure the reliability of the measurement results. The equation is defined as follows:

$$X'_{it} = \frac{X_{it} - mean(X_i)}{std(X_i)} \tag{4}$$

where X_{it} is the value of index i at time t, $mean(X_i)$ is the mean values of index i in the sample interval, $str(X_i)$ is the standard deviation of index i in the sample interval, and X'_{it} is the standardized index value.

CEMAC-GS coincident indicator (CEMAC-GS-CI) is used to represent China's business cycle. The reason why we choose this indicator instead of the gap of GDP (GGDP) is that there is currently no official GGDP data, and existing studies have large differences in the calculation results of GGDP. However, CEMAC-GS-CI is an important indicator regularly published by the China Economic Monitoring & Analysis Center (CEMAC) to comprehensively reflect the overall economic changes. It includes production, employment, income distribution, demand and other aspects of economic activities, which can fully reflect the overall macroeconomic operation. In addition, the results show that the CEMAC-GS-CI and the GGDP trend are very similar, and the correlation coefficient between them over the same period exceeds 0.8 (Deng and Shi, 2011).

Therefore, it is reasonable to use the CEMAC-GS-CI as a representative variable of the business cycle.

We use principal component analysis (PCA) to construct the China's financial cycle index (FCI) by using the eight variables above. Table 1 shows the PCA results. We can see that the eigenvalues of principal components 1-3 (PC1-PC3) are all greater than 1, and can explain over 75% of the sample variation. It shows that PC1-PC3 can more comprehensively describe the trend and fluctuation of the financial market.

Table 1. The results of principal component analysis

	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8
Eigen value	3.3857	1.5999	1.0723	0.7841	0.6607	0.2779	0.1508	0.0684
Proportion	0.4232	0.2000	0.1340	0.0980	0.0826	0.0347	0.0189	0.0086
Cumulative proportion	0.4232	0.6232	0.7573	0.8553	0.9379	0.9726	0.9914	1.0000

Therefore, we select PC1-PC3 and uses their respective contribution rates to construct the FCI to measure China's financial cycle fluctuations. The result of FCI is shown in Figure 1. In 2008, the US subprime mortgage crisis broke out, China's stock market bubble burst rapidly, and the financial environment deteriorated sharply. To cope with the impact of the global financial crisis, China made major adjustments to the macroeconomy: monetary policy changed from tight to loose, fiscal policy changed from prudent to proactive, and a huge investment plan involving trillions of RMB was proposed. The FCI climbed rapidly from its lowest point to its highest point at the end of 2011. With the gradual recovery of the economy, macro-control also returned from active to stable. Since 2012, China's financial reform has entered a deep-water zone, and the financial environment has shown a trend of gradual improvement. The FCI returned to a benign range and fluctuated slightly. In 2017, to proactively prevent and resolve systemic financial risks, the China Banking Regulatory Commission issued a series of financial regulatory documents, setting off a regulatory storm, and the financial cycle entered a new era of contraction in the second half of the year. We can see that the FCI we constructed can better describe the operational reality of China's financial system.

In order to unify the dimension, we subtract 100 from CEMAC-GS-CI to get the China's business cycle index (BCI). The BCI is shown in Figure 1. Affected by the financial crisis, the business cycle dropped to its valley point in 2008Q4. In 2019, in order to curb the recession of the real economy, the Chinese government issued a four trillion stimulus policy. From 2009 to 2011, China's business cycle

showed a brief upward phase. However, after the end of the stimulus policy, the long-term accumulation of financial imbalances caused the real economy to enter a more serious dilemma of unfinished recession. From 2011 to 2015, the business cycle continued to decline. In 2016, China's housing prices soared, causing the business cycle to peak in 2017Q2. After 2017, China entered a period of strong financial supervision. The tightening of financial markets had a downward impact on the business cycle.

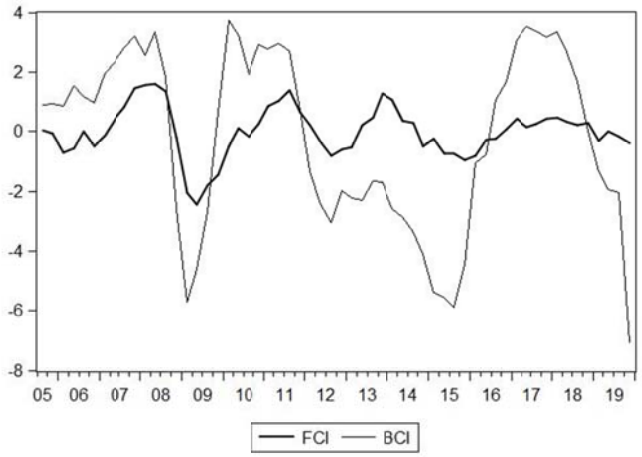

Figure 1. The calculation result of China's financial cycle index and China's business cycle index

5. Empirical Results

5.1. How are the China's financial cycle and business cycle affected by different events?

In order to explore the influence of the financial cycle and the business cycle in different frequency domains by events, we decompose the financial cycle and business cycle index by EMD method. Through the EMD method, the China's financial cycle is decomposed into four IMFs and one residual series, and the business cycle is also decomposed into four IMFs and one residual series.

To get the structural components of the different frequencies of the financial cycle and the business cycle, we calculate the average period of each IMF. Table 2 shows the calculation of the average period. We choose to divide IMFs with an average period of less than 10 into high-frequency components, and those more than 10 into low-frequency components. Specifically, for the financial cycle, IMF1 is divided into high-frequency components and marked as FCIH. IMF2-4 is divided into low-frequency components and combined into FCIL by simple weighting methods. The residual sequence is FCIRES. Similarly, we can get

the high-frequency components of the business cycle (BCIH), the low-frequency components of the business cycle (BCIL), and the residual sequence (BCIRES).

Table 2. The average period of each IMF after EMD

Variable	Average period (Quarterly)	
	Financial cycle	Business cycle
IMF1	9.67	6.44
IMF2	14.50	19.33
IMF3	29	19.33
IMF4	58	29
RES	-	-

Figure 2 shows the fluctuation trends of FCIH and BCIH. As we can see, both FCIH and BCIH fluctuate around the mean value. The vibration frequency is large, and the fluctuation period is short. Those indicate that the high-frequency components show the influence of short-term market volatility.

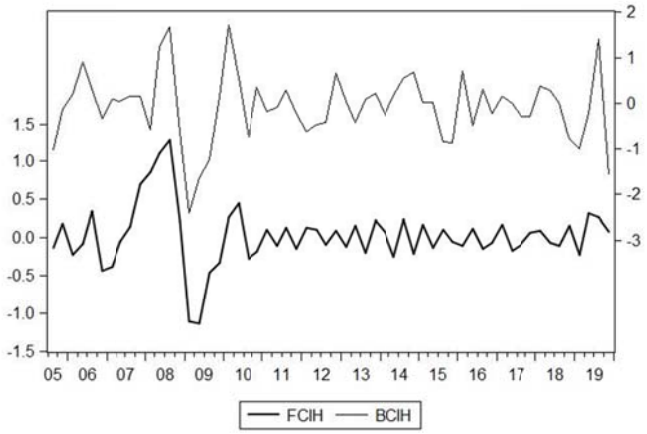

Figure 2. The results of FCIH and BCIH.

Figure 3 shows the trends of FCIL and BCIL. FCIL and BCIL show obvious periodic characteristics, with higher frequency components that have a longer period of change, and the peaks and valleys that appear are all related to the major events. The first valleys of FCIL and BCIL occurred around 2008, which shows that the financial crisis that occurred during that period had an impact on both the financial cycle and the business cycle. In 2011, affected by the spillover

effects of the European debt crisis, investors were reluctant to hold the new market currency. Thus, China's financial market risks increased. In 2014, the stock market bubble burst, and FCIL and BCIL fell sharply. In 2017, the China Banking Regulatory Commission issued a series of financial regulatory policy to tighten cross-border flows of financial assets. Therefore, we can draw that the fluctuations of the low-frequency components reflect the impact of major events, including market factors and policy factors.

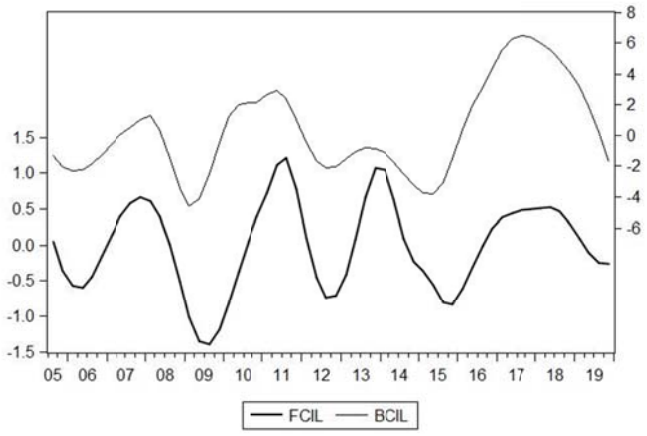

Figure 3. The results of FCIL and BCIL.

Table 3 shows the four indicators related to the characteristics of the structural components of the financial cycle and the business cycle. In Table 3, the low-frequency components (FCIL and BCIL) have the largest correlation coefficients with their original series, which are 0.89 and 0.72, respectively. The low-frequency components also have the largest proportion in the variance of the original series and decomposition series, with the proportion more than 50% of the variance. It means that FCIL and BCIL have the strongest interpretation of the original series and decomposition series, and they are the dominant components leading the changes of the financial cycle and business cycle.

Table 3. The characteristics of the structural components of the financial cycle and the business cycle

Variable	Financial cycle					Business cycle			
	(1)	(2)	(3)	(4)		(1)	(2)	(3)	(4)
High frequency components	0.715	0.000	22.016	27.677		0.449	0.000	6.368	4.114

Low frequency components	0.885	0.000	56.285	70.755		0.711	0.000	99.085	64.011
Trends	0.001	0.994	1.247	1.568		0.253	0.054	49.340	31.875

Notes. Columns (1) and (2) report the correlation coefficient between the structural components and original series, and its significance. Columns (3) shows the proportions of the structural components in the variance of the original series. Columns (4) shows the proportions of the structural components in the variance of the decomposition series.

5.2. The relationship between the financial cycle and the business cycle under the influence of major events

Intuitively, fluctuations in the low-frequency components reflect the impact of major events. The low-frequency components dominate the financial cycle and business cycle changes. In order to verify this view, we empirically analyze the correlation between FCIL and BCIL below.

Table 4 shows the correlation coefficient between FCIL and BCIL. In the overall period, the correlation coefficient between FCIL and BCIL is 0.567, which is moderate. Besides, we calculate the correlation coefficient between FCIL and BCIL in three event periods, including: (i) 2008Q1-2009Q4 (financial crisis event period), (ii) 2011Q2-2012Q3 (European debt crisis event period), and (iii) 2017Q1-2019Q4 (strong financial supervision event period). The correlation coefficient between FCIL and BCIL during the financial crisis event period is 0.716, and the correlation coefficient during European debt crisis event period and the strong financial supervision event period is higher than 0.9, which is highly correlated. This further shows that the fluctuations of the low-frequency components are affected by major events intensely.

Table 4. The correlation coefficient between the low-frequency components of financial cycle and the business cycle

	Pearson Correlation coefficient
Overall period	0.567
2008Q1-2009Q4	0.716
2011Q2-2012Q3	0.985
2017Q1-2019Q4	0.963

Then, we apply turning point recognition to analyze the lead-lag relationship between the financial cycle and business cycle under the influence of major events. Table 5 shows the peaks and valleys of FCIL and BCIL identified by the BB method from 2015Q3 to 2019Q4. Around 2008, the major emergencies that occurred were a market factor of the global financial crisis. Affected by the major events caused by this market factor, financial cycle began to decline from the peak 2007Q4 and fell to the valley point in 2009Q3. Business cycle reduced from the

peak 2008Q1 and reached the valley point in 2009Q1. It means that the FCIL peak preceded the BCIL peak. In 2009, China's government implemented a four trillion RMB fiscal stimulus plan to stimulate economic recovery. Affected by this policy, the financial cycle and business cycle began to rebound. FCIL rose to the peak in 2011Q3, and BCIL reached the peak in 2011Q2. At this time, the BCIL peak preceded the FCIL peak. In 2011, due to the spillover effect of the European debt crisis on China's economy, China's economy declined. Affected by this market factor, FCIL fell to a valley in 2012Q3, and BCIL fell to a valley in 2012Q3. In 2012, to stimulate the increase in total social demand, China's central bank continuously promoted the reform of interest rate marketization and relaxed the floating range of loan interest rates. This policy stimulated the vitality of the financial system and promoted economic growth. Therefore, FCIL rose to their peak in 2013Q4, and BCIL rose to their peak in 2013Q4. In 2014, under the extremely loose monetary environment brought by successive required rate of return (RRR) cuts and interest rate cuts, the leverage ratio of physical enterprises increased, which caused financing difficulties, and a large amount of funds flowed into the financial market. In 2015, to control the scale of credit expansion, the China Securities Regulatory Commission issued a document to deleverage and tighten financing account funds. Under the influence of those policy, the stock market bubble burst, and the SSEC plummeted. FCIL fell to the valley in 2015Q4, and BCIL fell the valley in 2015Q2. After 2017, the China Banking Regulatory Commission issued a series of financial regulatory documents, setting off a regulatory storm. Affected by those policy, FCIL and BCIL began to shrink. Moreover, after 2018Q3, the Sino-US trade war had an impact on China's finances and economy, creating huge downward pressure. FCIL and BCIL fell to a valley at the end of 2019.

Table 5. The peaks and valleys of FCIL and BCIL

	FCIL	BCIL
peak	2007Q4	2008Q1
valley	2009Q3	2009Q1
peak	2011Q3	2011Q2
valley	2012Q3	2012Q3
peak	2013Q4	2013Q4
valley	2015Q4	2015Q2
peak	2018Q2	2017Q3
valley	2019Q4	2019Q4

From the above analysis, we know that the peaks and valleys of the financial cycle and business cycle are highly coincident. During the financial crisis, financial cyclical fluctuations precede business cyclical fluctuations, which has a certain early warning effect on macroeconomic development. From 2012 to 2014,

the peaks and valleys of the financial cycle and the business cycle are the same. After 2015, the peaks and valleys of the business cycle precede the financial cycle. So, government departments should comprehensively monitor the operation of the financial system and various financial sub-markets, and understand the dynamic correlation mechanism between the structural components of financial cycle and business cycle. To further study the correlation between the financial cycle and the business cycle at different periods, we use a TVP-VAR model to investigate their dynamic correlation mechanism.

5.3. The dynamic correlation mechanism of the financial cycle and business cycle during the major events periods

In this section, we apply the TVP-VAR model to describe the dynamic correlation mechanism among the financial cycle, the business cycle, and inflation rate at specific periods. The proxy variable of inflation is CPI growth rate. We also use the EMD method to obtain the low-frequency components of inflation.

Combined with the dates of the major events above, the dates for the comparison are (i) 2008Q3, (ii) 2012Q3, and (iii) 2017Q3, which are the important dates in the economic and financial development process of China. The period around (i) 2008Q3 represents the period of economic and financial crisis: In 2008, when the global financial crisis broke out, the financial systems of many countries, including China, suffered major impacts. The period around (ii) 2012Q3 represents the period of the new normal of the economy: Since 2012, China's GDP growth rate has gradually shifted from a high-speed growth state to a medium-high-speed growth state. The economic growth has undergone a fundamental phase change. The period around (iii) 2017Q3 represents the period of strong financial supervision: In 2017, the Financial Stability and Development Committee of the State Council was established to strengthen the responsibilities of the People's Bank of China for macro-prudential management and systemic risk prevention and the supervisory responsibilities of financial supervisory authorities. Financial stability has increasingly become a strategic issue related to the overall economic development.

In Figure 4, we plot the impulse response functions for a positive shock in the financial cycle. Figure 4(a) shows the responses of business cycle to a positive financial cycle shock. First, the impact of the financial cycle on the business cycle has similar dynamic characteristics at different periods, all of which have the process of rising first, then fall, and finally approach zero. Second, comparing the two curves before and after the crisis (2008Q3 and 2012Q3), the impact of the financial shock before the crisis was more significant and showed long memory. This is due to the fact that since China has promoted market economic reforms, in order to ensure rapid economic development, the government has generally preferred to implement proactive fiscal and monetary policies to promote investment and foreign exports. Therefore, the financial shocks in 2008Q3 had a greater effect on the real economy, and caused the extent and duration of the shocks to be prolonged. Third, compared with other periods, the negative effects of

financial shocks during the period of strong financial supervision are largest. Currently, China's economy is in a critical period of transforming growth momentum, optimizing economic structure, and transforming the development mode. Financial risks are rapidly accumulating and exposed. Through the mechanism of amplifying and accelerating various shocks by the financial market, the impact of financial shocks on the real economy has become more prominent.

Figure 4(b) shows the responses of inflation to a positive financial cycle shock. First, inflation reacted positively to the positive shock of the real interest rate, and reached the largest response in third quarter. This is because the financial market had a spillover effect on the real economy, leading to an increase in inflation. Then, in order to prevent prices from overheating, the government adopted counter-cyclical policy control, which caused inflation to decrease. However, under the combined effect of too frequent policy adjustments and the time lag of the policy, the spillover effect of the financial market on the real economy further promoted, turning from negative to positive in the 11th to 13th quarters. The government and the central bank re-examined the abuse of policy control and strengthened supervision of financial institutions, leading to a decline in the intensity of financial shocks. In addition, compared with the other two periods, the spillover effect of the financial cycle on the business cycle during the period of strong financial supervision is strong. It means that based on stabilizing economic growth at this stage, the government should further promote financial supply-side reforms, deepen financial reforms, enhance the economic capabilities of financial service entities, and reduce the spillover of financial risks.

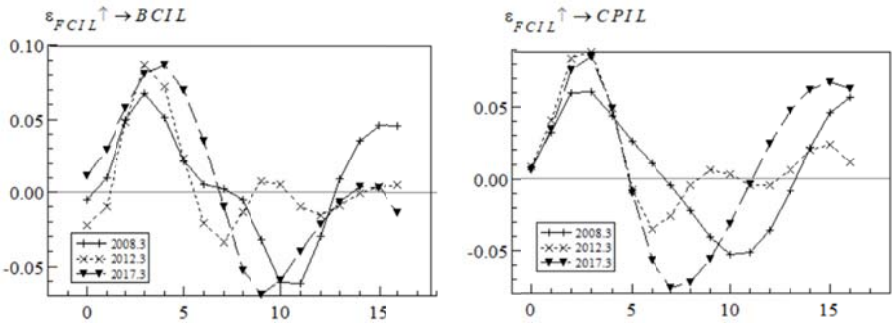

Figure 4. Impulse-response functions. (a) The impulse-response functions of business cycle to a positive financial cycle shock. (b) The impulse-response functions of inflation to a positive financial cycle shock.

Figure 5 shows the impulse response functions for a positive shock in the business cycle. Figure 5(a) shows the responses of financial cycle to a positive business cycle shock. Compared with the responses of business cycle to financial cycle, the business cycle has a relatively small impact on the financial cycle. The shock of the financial cycle significantly affects macroeconomic fluctuations. The impact of financial instability on the macro economy is likely to lead to conflicts

and failures of macroeconomic control policies, thereby inhibiting economic coordination and inclusive development. Therefore, it is necessary and urgent to incorporate the financial cycle into the monetary policy control framework. In addition, the dynamic correlation mechanism between the financial cycle and the business cycle has significant asymmetric characteristics. The financial cycle has a driving effect on the business cycle, but the business cycle has a restraining effect on the financial cycle. The main reason for this asymmetry is the structural disconnect between the financial market and the real economy. In recent years, China's stock market has been volatile, the real estate market has been over-expanded, and the corporate debt ratio and leverage ratio have remained high. These phenomena indicate that the uncertainty of the financial market has further increased and financial risk factors have continued to accumulate. At the same time, the investment rate has fallen sharply and the economic growth rate has slowly shifted to a low-to-medium rate, indicating that the real economy has contracted to a certain extent, and economic cyclical fluctuations have entered a contraction stage. This structural disconnect leads to the difference in the effects between the two cycles.

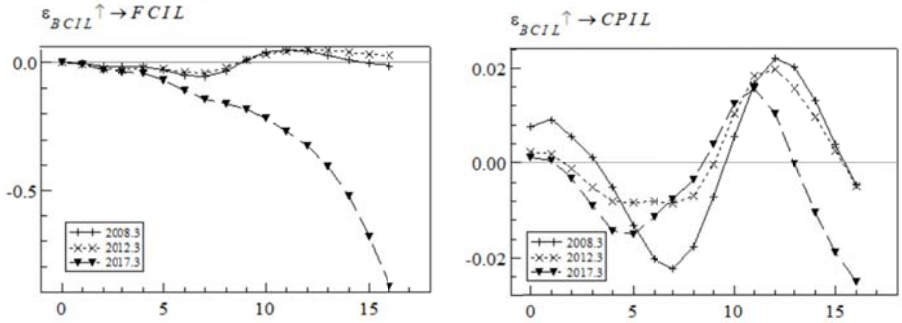

Figure 5. Impulse-response functions. (a) The impulse-response functions of financial cycle to a positive business cycle shock. (b) The impulse-response functions of inflation to a positive business cycle shock

6. Conclusions

China is in a critical period of economic system reform that there are many financial risk factors and great downward pressure on the real economy. It is even more important to achieve a balance between stable growth and risk prevention. In this paper, based on the financial cycle and business cycle components obtained by EMD method, we analyze the lead-lag relationship and dynamic correlation mechanism between China's financial cycle and business cycle. The main findings of this study are as follows.

First, the volatility of the financial system is formed by the superposition of periodic fluctuation components of different frequencies, and each component is compounded by different financial submarkets. The correlation between the financial cycle and business cycle is not only reflected in the full frequency domain but also in the structural components of the financial cycle and business cycle at

different frequencies. Thus, government departments should comprehensively monitor the operation of the financial system and various financial submarkets, and understand the correlation between the structural components of the financial cycle and the business cycle.

Second, there is a strong correlation between the low-frequency components of China's financial cycle and the business cycle. The peaks and valleys of the financial cycle and business cycle are highly coincident. Before 2017, financial cyclical fluctuations precede business cyclical fluctuations, which has a certain early warning effect on macroeconomic development. But after 2017, this phenomenon seems to have changed. However, due to the relatively small sample size, this conclusion needs further study.

Third, during the period of strong financial supervision, the negative effects of financial shocks are largest and the spillover effect of the financial cycle on the business cycle is strongest. The interaction between the financial cycle and the business cycle is asymmetric. Thus, on the basis of achieving stable growth, we must pay attention to monitoring the generation and evolution channels of financial risks to avoid the occurrence of systemic financial risks. More importantly, when designing a policy framework, financial cycle factors should be incorporated into the traditional monetary policy framework to achieve the goal of economic sustainability.

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