The impact of China's financial cycle fluctuation on metallurgy and mining industry

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Abstract
Metallurgy and mining industry is an important part of China's economy. As China's basic construction investment increasing, the cyclical fluctuations of the China's financial have more and more important impact on the metallurgy and mining. Therefore, the article analyzes the impact of China's financial cycle fluctuation on mining industry and metallurgy. Based on the advantages of automation in production process, the influence of production process automation on metallurgy and mining industry is analyzed and three types of economic cycle asymmetric are introduced. The implementation of the plans for automation and mechanization of the metallurgical industry, which will promote the solution of a number of important national economic problems are outlined. The influence of China's financial cycle fluctuation on metallurgical and mining industry is explained. The corresponding policy meaning is finally given.
Keywords: FINANCIAL FLUCTUATION, METALLURGY, MINING INDUSTRY, PRODUCTION PROCESS AUTOMATION

1. Introduction

Modern macroeconomic theory insists that economic fluctuations are inevitable phenomenon in the process of economic development. While along with cyclical economy fluctuations, total financial revenue and expenditure would grow constantly and also fluctuate around its trend. Therefore, it will exhibit cyclical fluctuations. On the whole, the financial period refers to the cyclical fluctuations in balance of financial revenue and expenditure. With the growing proportion of capital investment in the national economy, financial revenue and expenditure has become an important economic indicator in the economic life. Because of financial revenue and expenditure, fiscal revenue and expenditure, fiscal revenue and expenditure of alternating cyclical fluctuations, deficits and surpluses are important economic variable which will affect the stability of economic. Therefore, the article analyzes the periodic fluctuation of financial Chinese from non symmetrical angle [1], in order to provide a reference for macroeconomic regulation.

2. The Asymmetry Types of Economic Cycle

Simply, asymmetric economic cycle means the mirror of expansion and contraction cannot be coincident or varying degrees and track of the expansion and contraction is different (normal mirror of asymmetric cycle waveform are coincident, as shown in Figure1). In fact, as early as 1927 and 1936, Mithcell and Keynes and other scholars put forward the asymmetry of the economic cycle and then described it [2].For example, Keynes argued that the downward extent of the economic cycle is more severe contraction, or steep, while upward extent of the economic cycle is moderate. After that, a large number of scholars such as Burns and Mitchell (1946), Neftci (1984), Hamilton (1989), Brunner (1992), Sichel (1993), Ramsey and Rothman (1996) [3-6] and others did a lot of researches, and obtained a series of important conclusions where the definition of the economic cycle asymmetric type is the most important. The typical is classification of two asymmetric types gi-ven by Sichel [5] in 1993, which can be divided into the type of deepness and steepness. He believed that steepness asymmetry refers to the different slopes between expansion and contraction, and it can be divided into type of slow risings and steep dropping, and the type of steep risings and slow dropping according to slopes. Deepness asymmetrical means the different amplitudes during the period of expansion and contraction, or the peaks and troughs' deviation from the trend are different, for example, if troughs are further below trend than peaks, it is called contracted steepness asymmetry. Deepness and steepness asymmetry are not absolutely independent, they can exist at the same time, such as a waveform can be deepness and steepness asymmetry. On the basis of deepness and steepness asymmetry, McQueen and Thorley (1993) developed sharpness asymmetry where the asymmetry is defined by difference between curvature of peaks and troughs. For example, the changes from expansion to contraction is relatively bigger than from contraction to expansion, which can be called diverging sharpness asymmetry, on the contrary, it can be called contracted sharpness asymmetry.

On the basis of brief introduction of the type of economic cycle, the periodicity of financial revenue and expenditure will be inspected from the above three types, in order to analyze whether asymmetry exists in Chinese financial cyclical fluctuations.

3. The Analysis of Deepness Asymmetry in China

In this section, HP filter method is introduced to verify volatility characteristics of Chinese financial period's asymmetry. For financial data include revenue and expenditure (the gross of the two indicators are y_t and z_t , and their growth rate sequences are considered as Δy_t and Δz_t), the test will be done by those two kinds of indicators. Data come from the "China Statistical Yearbook 2012".

Firstly, we will compute the trend value of revenue and expenditure volatility, and followed by sequence of the volatility index. Then we verify the existence of obvious asymmetry is through the peaks and troughs of the wave.

We introduce the HP filter method before testing. HP filter method is a filtering method founded by Hodrick and Prescott in 1980[7]. They said a logarithmic time series variable here. The series is made up of a trend component, which is denoted by a cyclical component, such that:

$$y_t = g_t + c_t \qquad (t = 1, 2, 3, ..., T)$$

Firstly, a HP filter is designed, and a smooth sequence is obtained from a time series by using the symmetrical moving average principle:

$$\text{Min}\left\{\sum_{t=1}^{T}(y_t - g_t)^2 + \lambda\sum_{t=1}^{T}\left[(g_t - g_{t-1})(g_t - g_{t-2})\right]\right\} \quad (1)$$

Where λ is the smoothing parameter used to adjust the proportion of two components. The adjustment of the sensitivity of the trend to short-term fluctuations is achieved by modifying a multiplier λ. In general, if it is annual data, L = 100; if it is quarterly data, L = 1600; if it is monthly data, L = 14400. In this paper, λ=1600.

China's fiscal revenue trend is computed by using HP filter method, and the sequence of the index's volatility is obtained by actual growth rate of revenue minus the value of its tendency, as shown in Figure 1. Intuitively, the fluctuation frequency of China's revenue is also higher, there are seven times fluctuations during 1978-2011(six times fluctuation of GDP during the same period), the fluctuation frequency reached 0.2, the fluctuation range is also larger, the average reached 18%, far higher than the volatility of GDP (5.4%). Furthermore, from the waveform, it appears that the absolute value of the peak wave is larger than trough wave. In order to verify the deviation from the trend values more precisely, "Valley - Valley" [8] is introduced to divide the cycle of China's fiscal revenue and list peaks and troughs of each round cycle, based on above, then to compare the absolute value of its peaks and troughs.

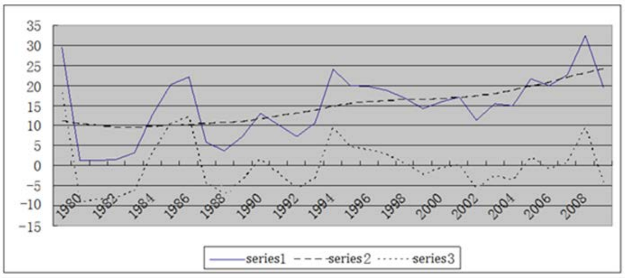

Figure 1. China's fiscal revenue trend and sequence of the index's volatility（%）

In Fig.(1), Sequence 1 is growth rate of revenue, Sequence 2 is trend value, and Sequence 3 is trend volatility.

From China Statistical Yearbook-2012

The divided cycle of China's revenue, and peaks and troughs are show in Table 1.

From Table 1, the absolute value of the peak is significantly larger than the trough except for the second cycle, which shows that the peak deviation from the trend is larger than the trough.

Let's look at the HP trend values and volatility series of fiscal expenditure shown in Figure 2, which shows that China's fiscal expenditure showed a total of 5 cycles, and fluctuation frequency is smaller than the revenue, but its volatility range also reached 16%. Although lower than the revenue, it is still far higher than the volatility of GDP. According to the same method as fiscal revenue, we can also list peaks and troughs of each round cycle, shown in Table 2.

Table 1. The peaks and troughs of China's fiscal revenue

Sequence	Time	Peaks (%)	Troughs(%)
1	1978-1980	18.37	-9.15
2	1981-1985	1.6	-7
3	1986-1989	9.35	-5.76
4	1990-1993	9.4	-2.2
5	1994-2000	9.4	-6
6	2001-2004	9.624	-6.022
7	2005-2011	12	-10
Mean value		10	-8.2

Table 2 shows the absolute peaks and trough value of expenditure is same to revenue, that is to say peak deviation from the trend is larger than the trough.

Table 2. The peaks and troughs of China's fiscal revenue

Sequence	Time	Peaks (%)	Troughs (%)
1	1978-1984	18.9	-15.5
2	1985-1989	10.47	-8.2
3	1990-1993	8.43	-4.2
4	1994-1999	3.83	-1.6
5	2000-2011	5.12	-6.7
Mean value		9.35	-7.2

By calculating the deviation degree of the peaks and trough, it can be concluded that the mirror of contraction and expansion not match, and it exists significant expanded deepness asymmetry [9].

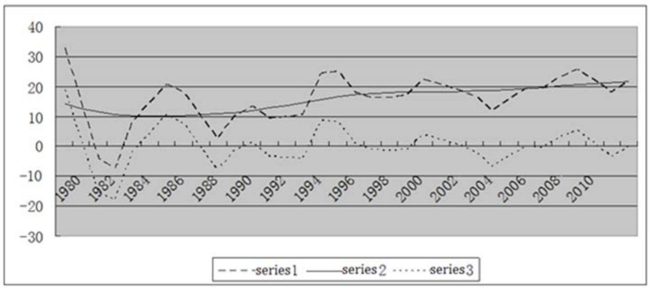

Figure 2. China's fiscal expenditure trend and sequence of the index's volatility（%）

In Fig.(2), Sequence 1 is growth rate of expenditure, Sequence 2 is trend value, and Sequence 3 is trend volatility.

The divided cycle of China's expenditure, and peaks and troughs are show in Table 2.

4. The Analysis of Steepness Asymmetry in China

The steepness asymmetry of China's financial cycles will be tested by BK model method which was founded in 1993 by Beaudry and Koop. Its main idea: due to the asymmetry of economic cycle, asymmetric term and nonlinear components are introduced when the model of the economic is built. BK model is mainly based on ARMA model [10], specific as follows:

$$K(L)\Delta y_t = \alpha + \beta_1 S_{t-1} + \beta_2 S_{t-2} + \ldots.. + \beta_n S_{t-n} + M(L)\varepsilon_t \quad (2)$$

Equation (2) introduce asymmetric componentε_t, coefficient K(L) and M(L) is lagging behind the lag operator L order polynomial, and St, which is recession variable of time series yt, the largest is *n*, so equation (2) is a ARMA (*p, q*) model which contains a recession variable. Whether equation (2) contains the asymmetry? Assuming that K(L) and M(L) are both equal to 1, equation (2) becomes to equation (3):

$$\Delta y_t = \alpha + \beta S_{t-1} + \varepsilon_t \quad (3)$$

If value of$\beta$is zero, the sequence will produce asymmetry ,if β=*0* andε_{t-1}<0 , the sequence of yt will contract, the impact will make the actual value lower than the value trend, and the variables did not change. Therefore, the impact of reverse recession is smaller than positive impact whenε_t>0 ; however, if ε_{t-1}>0, yt and Δ yt will both appear asymmetry[11].

Declining variables includes average declining variables, absolute declining variables and threshold declining variables. For average declining variables and absolute declining variables are likely to cause too long memories, here we use threshold declining variables to test.

In fact, threshold declining variables is the difference between the peak of each period and the real annual growth rate. Therefore, we can use the "Valley - Valley" method to get the threshold declining variables of annual revenue and expenditure cycle, as shown in Table 3 and Table4(due to the different rate indicators of revenue growth, the cycles are different from Table 1). Then to compute the difference between it and actual growth rate, the curve of threshold declining variables are shown in Figures 3 and 4.

From Figure 3 and Figure 4, the threshold declining variables of revenue or expenditure are larger in early days of the reform and opening up. With the deepening of reform, it has weakened. This shows that as China's macroeconomic stability, revenue has strong protection, both the revenue and expenditure have a considerable degree of growth, the ability of anti-recession is getting stronger [12].

After building the threshold declining variables of two indicators, BK model of revenue and expenditure will be established based on ARMA model [13]. First, the lag of ARMA model will be determined. Through computing the autocorrelation coefficient and partial correlation coefficient by EVIEWS, it can conclude that truncation appears at 4 logs, and when n=4, BK model is the best model. So we choose ARMA(4, 4) and n=4 to build the regression model formula of BK model.

Table 3. The threshold declining variables of annual revenue cycle

Sequence	1	2	3	4	5	6
Time	1978 – 1980	1981 – 1986	1987 – 1991	1992 – 1998	1999 – 2001	2002 – 2011
Threshold declining variables (%)	29.5	22	13.1	24	17	32.4

Table 4. The threshold declining variables of annual expenditure cycle

Sequence	1	2	3	4	5
Time	1978 – 1984	1985 – 1989	1990 – 1994	1995 – 1999	2000 – 2011
Threshold declining variables (%)	33	17.8	24.8	22	25.7

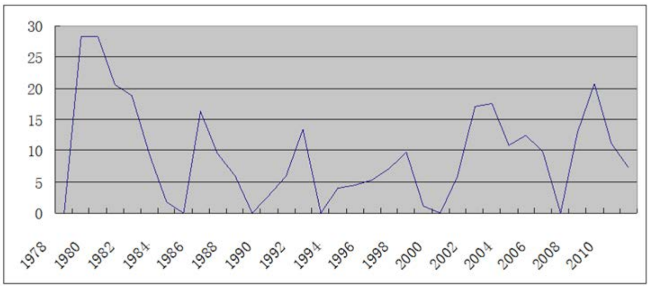

Figure 3. The curve of threshold declining variables of China's fiscal revenue

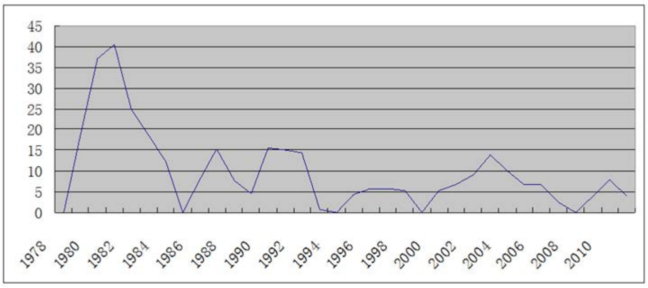

Figure 4. The curve of threshold declining variables of China's fiscal expenditure

First, BK Model of revenue is established:

$$\begin{aligned}\Delta y_t = {} & \underset{(0.34)}{1.65} + \underset{(2)}{1.167}\times \Delta y_{t-1} - \underset{(-0.46)}{0.39}\times \Delta y_{t-2} + \underset{(0.026)}{0.021}\times \Delta y_{t-3} \\ & - \underset{(-0.06)}{0.03}\times \Delta y_{t-4} + \underset{(2)}{0.52}\times s_{t-1} - \underset{(-0.03)}{0.01}\times s_{t-2} - \underset{(-0.45)}{0.18}\times s_{t-3} - \underset{(-0.001)}{0.00066}\times s_{t-4} \\ & - \underset{(-0.75)}{0.48}\times Ma(1) - \underset{(-0.15)}{0.08}\times Ma(2) - \underset{(-1.06)}{0.59}\times Ma(3) + \underset{(0.34)}{0.174}\times Ma(4)\end{aligned} \quad (4)$$

$R^2 = 0.67$

Then, BK Model of expenditure is established:

$$\begin{aligned}\Delta z_t = {} & \underset{(2.7)}{1.15}\times \Delta z_{t-1} + \underset{(0.0002)}{0.000177}\times \Delta z_{t-2} - \underset{(-0.62)}{0.36}\times \Delta z_{t-3} + \underset{(0.47)}{0.169}\times \Delta z_{t-4} \\ & + \underset{(2)}{0.408}\times s_{t-1} + \underset{(0.4)}{0.113}\times s_{t-2} - \underset{(-0.96)}{0.27}\times s_{t-3} - \underset{(-0.14)}{0.038}\times s_{t-4} - \underset{(-1.33)}{0.65}\times ma(1) \\ & - \underset{(-0.4)}{0.95}\times ma(2) - \underset{(-0.4)}{0.25}\times ma(3) - \underset{(-0.8)}{0.4}\times ma(4)\end{aligned} \quad (5)$$

$R^2 = 0.84$

The fitting degree of two regressions is high, which indicates the regression results are better. Secondly, both revenue or expenditure are significant first-order lag limit recession variable *t* statistics, it indicates that threshold declining variables can explain the revenue and expenditure to some extent, and it indicates the asymmetry of cyclical fluctuations based on threshold declining variables, the images of expansion and contraction do not match.

Furthermore, from the two regressions it can be seen that the first order coefficient gate lag limit recession variable is greater than zero; the positive impact of financial fluctuations in China is bigger than reverse impact. That is to say, financial fluctuations in China are dilated steepness asymmetric [14].

5. The Analysis of Sharpness Asymmetry in China

In this section we will be use the second derivative as an analytical tool to test the sharpness asymmetry of financial cycle in China. Since sharpness asymmetry is to compare the growth rate of peak change, and the growth rate can be characterized by the derivative of rate, so we will calculate the each derivative of revenue and expenditure in each round, then compare the two to test whether exist sharpness asymmetry in financial fluctuations [15]. First, we introduce the second derivative method:

$$g_t = \frac{\overset{*}{y}}{y} \qquad (6)$$

Where $\overset{*}{y} = \lim_{\Delta t \to \infty} \frac{f(t+\Delta t) - f(t)}{\Delta t}$,

g_t denotes the growth rate of revenue in one year.

In annual time series, Δ t=1, the following formula will be expressed approximately:

$$\left[\frac{\overset{*}{y}}{y}\right]' \approx \frac{y(t)-y(t-1)}{y(t-1)} - \frac{y(t-1)-y(t-2)}{y(t-2)} = g_t - g_{t-1} \qquad (7)$$

From equation (7), we can use the difference between two adjacent growth rates to measure the change of fluctuations. Assuming revenue reaches the peak in the *t* years, the rate of peak is Δ=gt-1 –gt . If the greater the rate of Δ, it indicates that the severe the change of rate. According to equation (6), we can also compute the second derivative values of revenue and expenditure in each year, as shown in Figure 5. It shows that second derivative curve of revenue in China is smooth; the curve of fluctuation is smoother.

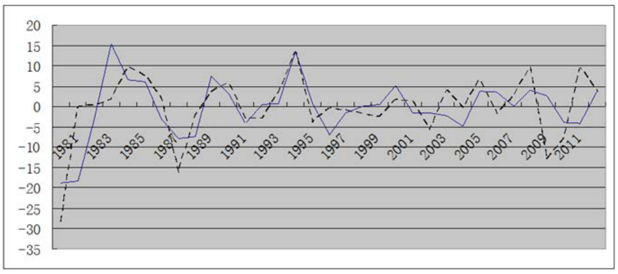

Figure 5. The second derivative values of revenue and expenditure in each year

Dotted line is second derivative values of revenue and solid line second derivative values of expenditure.

According to the divided cycle results in Tables 3 and Table 4, we calculate the derivative of peaks and troughs of revenue and expenditure in each period, as shown in Table 5 and Table 6.

Table 5. Derivative of peaks and troughs of revenue = in each period

Sequence	peaks		troughs	
	Time	Derivative (g_{t+1}- g_t)	Time	Derivative (g_{t+1}- g_t)
1	1978	-28.3	1980	0.2
2	1985	-16.2	1986	3.6
3	1993	-4	1991	3.4
4	2000	-5.7	1998	1.7
5	2008	-12.9	2001	4.1
Mean value		-13.42		2.6

As shown in Table 5 and Table 6, regardless of revenue or expenditure, the absolute value of the second derivative value of its peak is significantly greater than the derivative in trough year. It indicates that curvature of the peak is sharper than the trough, at least in the sample period, we can say that our financial volatility should be dilated sharpness asymmetry [16].

In summary, the article fully proved that there are three types of asymmetry- deepness，steepness and the sharpness in financial fluctuation of China by using HP filter, BK model and the second derivative method. Whether it is revenue or expenditure, the impact of expansionary period is larger than contraction period, therefore the deviation degree of peaks is higher than valleys.

Table 6. Derivative of peaks and troughs of expenditure in each period

Sequence	peaks		troughs	
	Time	Derivative (g_{t+1}- g_t)		Time
1	1978	-18.8	1981	15.4
2	1984	-2.9	1987	7.5
3	1989	-4.1	1997	0.6
4	1994	-7	1998	3.8
5	2008	-3.8	2003	3.8
Mean value		-7.32		6.22

6. Conclusion

Metallurgy and mining industry is an important part of China's macroeconomic, analysis on fluctuation of the two indicators is of great significance for macroeconomic stability. Asymmetry of financial fluctuation period is analyzed by Metallurgy and mining industry as an example which both have significant asymmetry. Outlined the implementation of the plans for automation and mechanization of the metallurgical industry will promote the solution of a number of important national economic problems. By starting up the output of large capacity automatic units, for example, per blast furnace will increase by 29%, per oxygen converter by 51%, and per roiling mill by 32%. At last, it introduces the influence of China's financial cycle fluctuation on metallurgical and mining industry.

Therefore, through a comprehensive analysis, we can conclude that China's financial cycle fluctuation has a great impact on mining and metallurgy. Firstly, with investment's intensity in the metallurgy and mining industry our country has become more and more big. Therefore, the impact of China's economic cycle on mining and metallurgy is more and more deep; secondly, automation and mechanization of the metallurgical industry will promote the solution of a number of important national economic problems. The introduction of automation means and systems will make it possible to intensify metallurgical processes. Thus, automation of the existing blast furnaces and oxygen converters in the planned volume will result in the additional production of about 1 million tons of pig iron and 1.0-1.2 million tons of steel. Without automation it is impossible to introduce successfully into production many new production processes thermal hardening of steels, electrolytic tinning and coating of sheet steel with thin films of polymers, production of dynamo steel with good electrical engineering properties, etc. The use of these materials in various branches of the national economy will save hundreds of millions of rubies.

So the fluctuation of China's financial cycle can also affect the fluctuation of investment in mining and metallurgical industry, which will influence the research progress of production process automation, which will influence the development of metallurgy and mining industry.

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