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Financial Conditions Index's Construction and Its Application on Financial Monitoring and Economic Forecasting

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Abstract

Financial Conditions Index (FCI) is a comprehensive index which is constructed based on the combination of some variables, such as currency price and asset price. It can make up the shortage of some conventional indexes, such as money supply and interest rate, in measuring the financial conditions and forecasting the economic trend. FCI has become an important reference index in financial analyzing and policy making in some central banks and international institutions. In this paper, money supply, interest rate, exchange rate, stock price and house price are selected as the variables to construct FCI first. Second, we select the percent change rate of the variable as indicators to construct the FCI, which not only effectively describe the indicators, but also avoid errors arising from of gap measuring. Third, based on the principal component analysis method, dynamic factor model is also introduced to build FCI. Then, the FCIs constructed by two methods are compared, and the robustness of the FCI is tested. The results indicate that FCI can reflect China's financial conditions and can be a crucial financial conditions indicator as well; FCI can also well forecast the overall economy trend, and it is a better leading indicator of GDP and CPI than single variables.

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1. Definition of FCI

Financial Conditions Index (FCI) is a comprehensive index which is constructed based on the combination of

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variables, such as currency price (For example, money, exchange rate), and asset price (For example, stock index and house price). Therefore, FCI can make up the shortage of using the conventional indexes, such as money supply and interest rate, in measuring the financial conditions and forecasting the economic trend.

In 1990s, Central Bank of Canada developed the Monetary Conditions Index (MCI). MCI is better to measure the financial conditions and analyze the implications of monetary policy than many single variables. In consideration of the rational theoretic base and simple construction method, MCI has been widely applied in many central banks and international institutions. With the development of economy and finance, the information of asset price has been paid more and more attention to evaluate financial situation. Against this backdrop, some researchers developed FCI that adding some asset price variables into the combination of index.

In China, with the improvement of market reformation, the markets of stock and house have been developed further. Some variables, foreign exchange rate, interest rate, stock price, house price and so on, provide more and more important impacts on the running of economy. Therefore, it is very important to construct China's FCI for investigating China's economic and financial situation more precisely.

2. Introduction of current research and the FCI construction method

This section firstly reviews the theory and applied research of the FCI; then describes the current development of FCI's construction on the indicators selecting, model forms, and construction methods; thirdly put forward methods to construct FCI.

2.1. An overview of the research

Researchers have used different methods to build FCI for many countries, and study the FCI's function on inflation forecasts and the role of monetary policy formulation. For example, Mayes and Viren (2001)¹ applied the Reduced Aggregate Demand Equation model to construct FCI of 17 European countries, arguing that FCI plays a part in guiding the formulation of monetary policy of the European countries. Montagnoli and Napolitano (2005)² used Kalman filtering algorithm for capturing the weight changes of financial variables in the explanation of the output gap, and constructed the FCI of the United States, Canada, euro area and the United Kingdom. Swiston (2008)³ used vector autoregression and impulse response function to build the FCI of the United States, and suggested that FCI could predict the United States' real GDP growth. Hatzius (2010)⁴ used the principal component analysis method to select the first principal component as the FCI, and forecast the economic growth by using the FCI. Gomez (2011)⁵ extracted the main ingredient from indicators such as interest rates, exchange rates and asset prices, and constructed the FCI for Colombia using variance probability of the principal components as the weights. Studies have shown that FCI was an effective tool of macro-prudential regulation and financial stability. Angelopoulou (2013)⁶ built the FCI of European countries using the principal components analysis to study the impact of monetary policy on the financial conditions.

Chinese scholars mainly study on the forecast capacity of the FCI on economic growth and inflation, and also focus on the introduction of the FCI into monetary policy rules. Dai Guoqiang et al (2009)⁷ argued that the FCI which contained asset price information could forecast inflation timely and effectively. Lu Jun (2011)⁸ found that dynamic FCI had better predictive ability for the output and inflation of the next quarter. Studies of Wang Weiguo (2011)⁹, Ba Shusong (2011)¹⁰, Bian Zhicun (2012)¹¹, Guo Ye (2012)¹², and Wan Guangcai (2013)¹³ have reached similar conclusions. Besides, FCI is also used for studies of monetary policy rules, such as Xiao Kuixi (2011)'s study¹⁴. Based on the Taylor equation, a generalized Taylor rule function which contained the FCI was constructed.

2.2. Introduction of the FCI constructing methods in the literature

In General, three aspects need to be taken into account in constructing the FCI: selection of the indicators, the construction model, and the determination of constituent weights of FCI.

- Indicator selection

Monetary policy mainly transmits through three channels, namely money supply, interest rates and exchange rate. And share prices and house prices will also impact on output and prices through wealth effects and the balance

sheet effects. Therefore, indicators structuring the FCI are mainly selected from the five categories mentioned above (see table 1).

Table 1. Indicators often used to construct the FCI in the literary

Type	Indicators
Money Supply	narrow money supply(M1),broad money supply(M2)
Exchange Rate	bilateral exchange rate exchange rate index, such as efficient exchange rate from BIS
Interest Rate	market interest rate: short term interest rate, bond interest rate, bond interest margin policy interest rate: deposit or loan benchmark interest rate
Capital Market	market value/GDP, price earnings ratio, stock wealth owned by household, stock price
Real Estate Price	house average price, real estate climate indices

- Common forms of the FCI

The FCI's estimation equation is:

$$FCI_t = \sum_i w_i (q_{it} - \bar{q}_{it})$$

Where q_{it} is indicator i 's value at time t , \bar{q}_{it} is indicator i 's long-term trends or equilibrium values at time t , w_i is indicator i 's weight.

In addition, the FCI's form by principal component analysis method is:

$$FCI_t = \sum_i w_i F_{it}$$

Where F_{it} is principal component i 's value at time t , w_i is principal component i 's weight.

- Classification of the methods building the FCI

Reduced Aggregate Demand Equation model: First, establish the IS curve which is reflecting the relationship among output gap, interest rates, exchange rates and other variables, and the Phillips curve which is reflecting the relationship between inflation and output gaps; then, calculate the weights in the FCI based on the coefficients and significance probability of the variables in the equation.

The VAR model: First, establish VAR models; second, use this VAR's impulse response functions to reflect the impact of the money supply, interest rates, exchange rates and asset price on the aggregate demand; third, calculate the weight of each variable based on the impact level.

Weighted principal components: We first extract the principal components of a number of financial variables, and then compute the weighted average of these principal components. There are two methods to determine the weights of the principal component. One method is to choose the coefficients of variables as the weights in the linear regression models, whose dependent variable is the GDP growth, and independent variables are the principal components. Besides, we can also take the significance probability of the principal component as the weights.

2.3. The shortage of existing methods and innovation of this paper

There are mainly some limitations in existing methods to construct the FCI. One problem is about the estimation models. Deviation from equilibrium of each variable need to be estimated in the common measuring form of the FCI, which may cause large error; in addition, there are several problems in the existing methods when measuring deviation value. Another one is about the determination of the weights, whose estimation models will differ depending on the purpose of FCI.

With respect to shortage of existing construction methods and application of the FCI, this paper makes following improvements. First, we select the percent change rate of the variable as indicators to construct the FCI, which not only effectively describe the indicators, but also avoid errors arising from of gap measuring. Second, the Principal Component Analysis and Dynamic Factor methods are both introduced to build FCI. Principal Component

Analysis method can extract the main information from variables, and Dynamic Factor method can directly extract factor sequences which depict the characterized fluctuation of variables, without determining weights. Also, the FCIs constructed by two methods are compared, and the robustness of the FCI is tested. The third, the FCI constructed by these two methods can study not only the relationship between the FCI and GDP, but also that the ones between the FCI and CPI.

3. Calculate China's FCI

3.1. Variables, data and formula of constructing FCI

In this paper, five variables, money supply, interest rates, exchange rates, stock index and house price index, are selected to construct FCI (see Table 2). These five variables cover the major aspects of our financial running.

All of these indicators are taken monthly data from January 1998 to June 2013. Taking into account the negative yoy growth may occur, each index plus 100. Then, they are seasonally adjusted for removing the seasonal factors, and the trend-cycle (TC) series are used to study.

Table 2. Indicators and data

Type	Indicators	Sign	Data resources
Money supply	M2, the current growth rate of balance at period-end	M2	People' s Bank of China
Interest rate	7 days interbank funding weighted average nominal interest rates	in	The national interbank funding center
Exchange rate	RMB's nominal effective exchange rate index, the current growth rate	ex	Bank for International Settlements
Stock index	Shanghai securities composite index, the current growth rate	stock	Shanghai Stock Exchange
House price	Commercial housing sales price(Commercial housing sales divided by the number of commercial housing sales area), the current growth rate	hp	National Bureau of Statistics

We use the following formula to construct FCI

$$FCI_t = \sum_i w_i \frac{q_{i,t} - q_{i,t-12}}{q_{i,t-12}}$$

Where $q_{i,t}$ is indicator i 's value at time t , $q_{i,t-12}$ is indicator i 's value at the same period of last year,

$\frac{q_{i,t} - q_{i,t-12}}{q_{i,t-12}}$ is indicator i 's growth rate at time t , w_i is indicator i 's weight.

3.2. Calculating methods

In this paper, the principal component analysis method is applied to construct FCI. Based on this, dynamic factor method, don't need to calculate the weights, is also used to study this issue.

3.2.1 The Principal Component Analysis

Principal component analysis was carried out on the above five variables. First, select the appropriate principal component. The problem, how many principal components should be used, is determined by the criteria ---- their cumulative contribution value should more than 80%.

Second, FCI is measured by weighted average of these selected principal components, and the corresponding accompanying probabilities are their weights. The accompanying probability of each principal component reflects the degree of the principal components of significance, and may effectively reveal the degree of the role of principal components. Therefore, this kind of FCI can describe the overall trend of these financial indicators.

3.2.2 Dynamic Factor method

Dynamic Factor method was proposed by Stock and Watson to find common factor series from a series of macroeconomic variables. This method supposed there was a potential trend component among many macroeconomic variables, namely common factor. This potential variable drives system of the information diffusion process, reflects the true state of the economic system, and, determines the trend of observed variables.

These characteristics of this potential variable meet the need to construct FCI for describing the situation of finance. Therefore, potential variable of some important financial variables can be extracted by dynamic factor model, and used as the FCI.

3.3. Calculate FCI

3.3.1 FCI constructed by principal component analysis method

With reference to the above method, we firstly calculate the principal components based on above five variables. The results are as follows:

Table3. The results of principal components

Principal component	Comp1	Comp2	Comp3	Comp4	Comp5
Eigenvalue	2.063	1.020	0.919	0.612	0.385
Contribution rate	0.413	0.204	0.184	0.122	0.077
Cumulative contribution rate	0.413	0.617	0.801	0.923	1.000

Seen from Table 3, the contribution rate of the first principal component is 41.3%, the contribution rate of the first two ones is 61.7%, while the contribution rate of the first three ones is 80.1%. Thus, the first three principal components may express the main trend of these variables.

Expressions of these first three main components are:

$$comp1 = -0.449M2 + 0.522i + 0.343ex - 0.259stock - 0.542house$$

$$comp2 = 0.146M2 - 0.438i + 0.201ex - 0.872stock + 0.080house$$

$$comp3 = 0.285M2 + 0.173i + 0.853ex + 0.158stock + 0.368house$$

Then, FCI is weighed by these three principal components and their accompanying probabilities respectively:

$$FCI = 0.14M2 - 0.16in - 0.34ex + 0.26stock + 0.14hp$$

As is we all known, the easing monetary policy will accelerate the growth of money supply, lower interest rates, lead to devaluation of the nominal effective exchange rate (namely lower its growth), and rise the growth of stock index and house price. So, according to the above formula, we can know FCI will rise up under the easing monetary policy. Similarly, the tightening monetary policy will cause FCI to fall. Therefore, FCI can clearly reveal the monetary policy easing and tightening state.

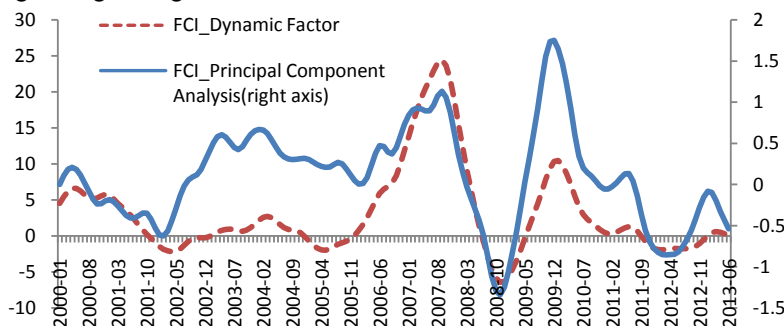


Fig. 1. The Financial conditions index(FCI)

3.3.2 FCI constructed by Dynamic Factor method

The calculating results show that FCI built by dynamic factor method reveal the similar trend as FCI built by principal component analysis method (See Figure 1). Thus, we mainly use principal component analysis calculation results in the following analysis.

3.4. Calculate MCI

As mentioned earlier, FCI is developed on the basis of MCI by adding two variables: stock index and house price. In order to see the functions of these extra two variables, MCI is also established (generally include money supply, interest rates and exchange rates) and compared with FCI. Data selection and processing of variable are consistent with that of FCI. MCI estimation results are shown in Figure 2. MCI displays the similar trend as FCI. Therefore, until now, the introduction of stock and house price hasn't brought more information.

4. FCI can reflect the situation of financial operation in China

The period of China's financial operation from 2000 to now can be divided into five phases by the monetary policy conditions. Seen from Figure 2, the movement of the FCI and MCI fit the financial situation well.

The first phase is from 2000 to 2002. To meet the challenges of the Asian financial crisis on the domestic economy, prudent monetary policies was implemented in this phase, and the FCI and MCI first decreased and then increased overall.

The second phase is from January 2003 to May 2007. Under the prudent monetary policy, the monetary authority moderated the amount of the money supply and the credit in response to repetitive construction, high expanding rate of the fixed-asset investment and rising prices. The MCI fluctuated downward, but the FCI began to rise in the latter stage.

The third phase is from June 2007 to October 2008. To further ease the pressure of excess liquidity in the banking system and credit expansion, moderately tight monetary policy changed to tight policy. In this phase, the FCI and MCI quickly fell to their lowest level in nearly a decade.

The fourth phase four is from November 2008 to November 2010. In response to the impact of the international financial crisis, a moderately loose monetary policy was implemented in this phase. MCI rose gradually from November 2008, which was its lowest level in nearly ten years, and reached a peak in December 2009. In 2010, the monetary policy was overall moderately loose, and the policy's pertinence and flexibility was increased. In this phase, the FCI and MCI declined from highs continuously.

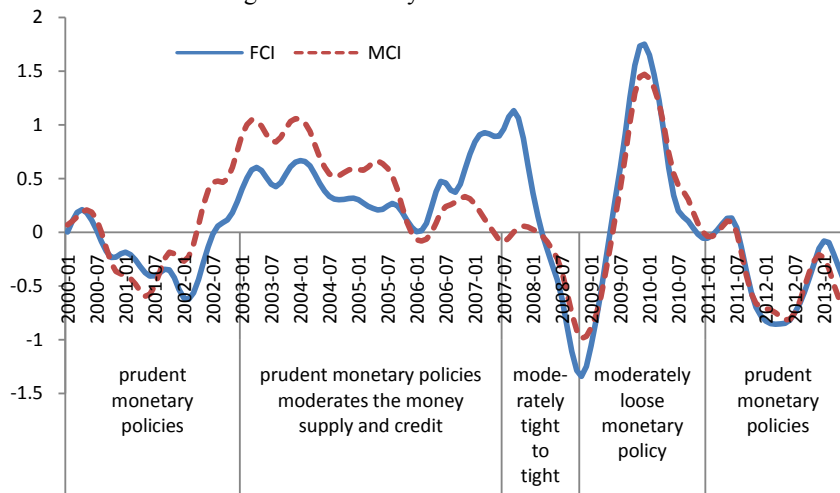


Fig. 2. The Financial conditions index (FCI) and monetary conditions index (MCI)

The fifth stage is for December 2010 till now, in which the monetary authority implemented the prudent monetary policy. The FCI and MCI overall continued the decline trend in the beginning of 2010, and in May 2012, they dropped to the second lowest point during the international financial crisis.

5. The FCI can predict the economic trends better

5.1. FCI performs better as a leading indicator of CPI

We apply Time Correlation Analysis(TCA) to compare the indicators' leading positions. The results show that the leading length of the FCI to the CPI is 10 months, and the coefficient of correlation is 0.72; M2, interest rates and exchange rates' correlation coefficients are significantly smaller than the FCI. Thus the FCI performs better as a leading indicator of the CPI.

5.2. FCI performs better as a leading indicator of GDP

Similarly, FCI performs better as a leading indicator of the GDP compared with M2, interest rates, exchange rates. The TCA results show that the leading length of the FCI to GDP is 2 quarters, and the correlation coefficient is 0.82. The single indicator, such as M2, interest rates and exchange rates are all not passed the statistical tests of the TCA.

Table 4.: The FCI, M2, interest rate and exchange rate's leading length to the CPI (Time Correlation Analysis)

	coefficient of correlation	leading length(months)
FCI	0.72	10
M2	0.48	12
interest rate	-0.41	12
exchange rate	0.59	11

Table 5. The FCI, M2, interest rate and exchange rate's leading length of the GDP (Time Correlation Analysis)

	coefficient of correlation	leading length(quarters)
FCI	0.82	2
M2, interest rate and exchange rate	No passing the statistical test, and the anteriority is not significant	

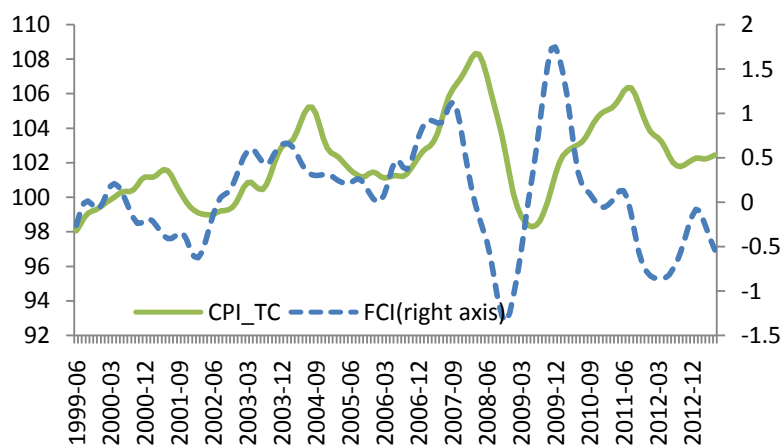


Fig. 3. The FCI and CPI's TC(trend cycle) components

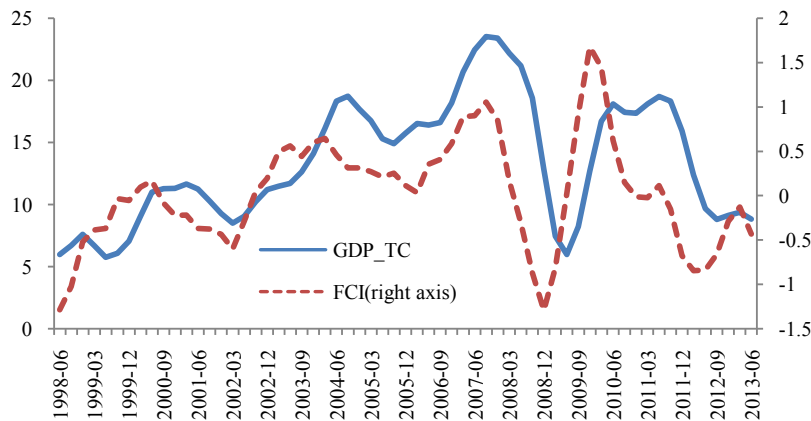


Fig. 4. The FCI and GDP's TC(trend cycle) components

6. Conclusion and Enlightenment

Seen from the construction and application of the FCI, FCI can better reflect the situation of China's financial operation, and can better predict the economic trends. Therefore, FCI can serve as an important reference index, whose performance is superior to single financial variables.

Though the literature found that introducing asset-price variable into MCI to design FCI is an important approach to improve the MCI's performances in economic forecasting and policy decision-making, but assets price in China's FCI provides limited information. With further developing of the financial market, asset prices information will be more important.

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