Is Finance a veil: the lead-and-lag relation between financial cycles and business cycles--The case of China

Chung-Hua Shen

College of Finance and Statistics, Hunan University , PRC;

E-mail: chshen01@ntu.edu.tw

Jun-Guo Shi

College of Finance and Statistics, Hunan University, PRC;

E-mail: shijunguo@hnu.edu.cn

Abstract: This research first constructs financial cycles (FC) based on three financial variables (credit-to-GDP ratios, house prices, direct financing ratios) in each provincial area. Our results show that financial cycles are not always overlapped with business cycles (BC) in 31 provincial areas. Next, once we have financial cycles in each provincial area, we test the lead-lag relationship between business cycles and financial cycles, and analyze the reasons behind the phenomenon. Furthermore, we provide robustness tests by dividing provincial areas into rich and poor groups, considering different financial cycle's component factors and changing the least phase length from one year to two years. Robustness test results also confirm our conclusion that financial cycles Granger cause business cycles not vice versa. Our study could help government know more about substantial economy-influencing financial factors and their cyclical behaviors, and provide the basis for government policy decisions.

Key words: financial cycles; business cycles; credit-to-GDP ratios; house prices; direct financing ratios

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1. Introduction

While the economists have investigated how to date the expansion and recession of business cycles (BC) for more than one hundred years, financial scholars have proposed the similar dating methods for financial cycles (FC) only recently. Claessens, Kose, and Terrones (2011) present the concept of financial cycles, which is measured by the circular movement of credit, house prices and equity prices. They use turning points analysis method to date the boom and bust of these three financial variables and find that there exist significant differences in frequency, duration, amplitude and slope between these three financial variables and business cycles. Drehmann, Borio and Tsatsaronis (2012) moving one step forward, innovatively constructing an aggregate FC index from four individual financial variables: credit, the credit-to-GDP ratios, property prices and equity prices, and demonstrate FCs have obvious different length and amplitude from business cycles. Borio (2014) reviews the past studies and compares the similarities and difference between BCs and FCs.[1]

This study has four aims. First, we construct an aggregate FC index (hereafter, FC index) of 31 Chinese provincial areas. We identify the dates of financial cycles of each province. We construct financial cycles from three financial variables proposed by Claessens, Kose, and Terrones (2011), namely, credit, house prices and equity prices. Our FCs are concise and conform to the rule "the most parsimonious description of the financial cycle is in terms of credit and property prices" (Drehmann, Borio and Tsatsaronis, 2012; Borio, 2014). Because there is no stock returns' data for each provincial area, we use the "direct financing ratio of non-financial institutions"

[1] While some studies also discuss business cycles and financial cycles (Egert and Sutherland, 2012; Bonis and Silvestrini, 2013; Akar, 2016), however, they do not construct the "cycle" of financial sector. Such as, Egert and Sutherland (2012) use share prices, house prices and credit to denote "financial cycle", Bonis and Silvestrini (2013) investigate the main features of the Italian financial cycle extracted by means of a structural trend-cycle decomposition of the credit-to GDP ratio, Akar (2016) use credit volume and BIST 100 to represent Turkey's "financial cycle". Hence, few studies are devoted to this new field. In addition, we know little about the interaction between business cycles and financial cycles.

as a proxy for this variable. Direct financing ratio equals the sum of stock financing ratio and bond (including convertible bond) financing ratio[2].

Second, we use concordance index (Harding and Pagan, 2002) to examine whether BCs and FCs are synchronized in each provincial area. Concordance index measures the degree of co-movement between the reference cycle (BCs) and the specific cycle (FCs), and is quantified by the fraction of time, in which both business cycles and financial cycles are in the same expansion or contraction (Harding and Pagan, 2002, 2006). Concordance index is a well-defined quantity even if both variables are integrated series, and by concordance index, we could know whether BCs and FCs are pro-cyclical or counter-cyclical.

Third, we investigate the lead-and-lag relationship between the two cycles using 31 provincial data. The debate on the direction of causality between economic growth and financial development has long been an ongoing study (King and Levine, 1993a, 1993b; Shen and Lee, 2006). Past studies commonly support the positive view that finance boosts the economic growth,[3] however, some find that it is the other way around.[4] Or even worse, finance development reduces the economic growth.[5] This study uses a different set of variables, BCs and FCs, to examine this issue. Given that our cycles are binary numbers, the conventional panel logit yields biased estimates in the binary panel dynamic model. Bartolucci and Nigro (2010a) use a Quadratic Exponential (QE) formulation (Cox, 1972) to approximate the dynamic logit (DL) model to resolve the biased estimates in panel dynamic logit model.

Fourth, to investigate the lead-and-lag relation between business cycles and

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[2] See 2004～2015 Chinese regional financial operation report, which are published yearly by People's Bank of China. Website: http://www.pbc.gov.cn/zhengcehuobisi/125207/125227/125960/126049/index.html.

[3] For finance leads economic growth, see King and Levine, 1993a, 1993b; Levine, Loayza and Beck, 2000; Tsouma, 2009; Beck, 2014.

[4] For economic growth leads finance, see Vazakidis and Adamopoulos (2010), Bader and Qarn (2008), Ghartey (2015).

[5] Such as Buffie (1984) and Van Wijnbergen (1983).

financial cycles. Furthermore, we use three methods, which are dividing provincial areas into rich and poor group, considering different financial cycles' component factors and changing the least phase length from one year to two years, to make robustness tests.

Studying the interaction between the two cycles using China provincial data is important. China became the second largest economy in 2010,[6] and its economy now significantly affects many countries (Messner, 2008; Mirza, Narayanan and Leeuwen, 2014). Thus, knowing how its BCs and FCs are interacted becomes important, which expands our knowledge about how business cycles and financial cycles interact with each other.

Our study contributes to the literature in three aspects. First, our study provides additional evidence that financial sector is not a veil. It may lead the real sector. Next, the expansion takes a longer time when there is a drop in financial sector. Third, this is the first study that constructs the financial cycles of 31 Chinese provincial areas.

The remainder of this study is organized as follows. Section 2 reviews previous theoretical and empirical literature related to financial cycles. Section 3 introduces the identification methodology of the peaks and troughs of financial variables, and presents the combination methodology of financial cycles. Section 4 talks about the panel dynamic logit model (PDLM). Section 5 describes our data. The main empirical results are presented in section 6. Section 7 shows the results of our robustness tests. Section 8 provides the conclusions of this study.

2. Literature review

The financial turmoil that started in the United States spread to a number of advanced and emerging countries and transformed into the most severe global financial crisis since the Great Depression (Claessens, Kose, and Terrones, 2008). The financial crisis has triggered a major rethink in macroeconomics (Drehmann, Borio

[6] Please refer to the website: http://www.chinanews.com/fortune/2011/02-15/2844193. shtml.

and Tsatsaronis, 2012), and has led to an intensive debate about how much the financial crisis will impact the broader economies (Claessens, Kose and Terrones, 2009). The dominant pre-crisis paradigms viewed finance largely as a sideshow to macroeconomic fluctuations[7]. The crisis demonstrated that this presumption was dangerously wrong. The past several years have seen recessions in virtually all advanced economies and many emerging markets. A common feature of these recessions is that they were accompanied by various financial disruptions, including severe contractions in credit and sharp declines in asset prices. Empirically, Taylor and Schularick (2012) show that credit growth is a predictor of financial crises. Recessions which are associated with financial disruptions are generally deeper and last longer (Claessens, Kose and Terrones, 2012; Jordà, Schularick and Taylor, 2013). These developments have led to an intensive debate in the profession about the links between macroeconomics and finance, and have propelled the study of interactions between business cycles and financial cycles to the forefront of research (Caballero, 2010; Woodford, 2010).

Against this backdrop, a rapidly growing literature is now seeking to study the interactions between business cycles and financial cycles. The prevailing approach is to incorporate richer financial sectors into dynamic stochastic general equilibrium (DSGE) models[8]. Whether this line of enquiry will ultimately prove fruitful is a legitimate subject of debate[9]. Regardless of the specific approach, however, any future work to model financial factors requires a better understanding of the stylized empirical regularities of the "financial cycle", with its booms and busts possibly leading to serious financial and macroeconomic strains. And yet, the meaning and

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[7] For a representative such analysis, see Woodford (2003).

[8] See, for instance, Meh and Moran (2010), Cúrdia and Woodford (2009) and Gerali, Neri, Sessa and Signoretti (2010).

[9] For a review and critique, see eg, Borio (2011); and for other critical perspectives, see Goodhart (2004), Buiter (2009) and Caballero (2010).

characterization of the financial cycles remain elusive (Drehmann, Borio and Tsatsaronis, 2012).

Business cycle is common to us. As early as in 1946, Burns and Mitchell had already described business cycles in detail.[10] Following the spirit of this broad characterization of a business cycle, National Bureau of Economic Research (NBER) (2001) defines a recession as "a significant decline in activity spread across the economy, lasting more than a few months, visible in industrial production, employment, real income, and wholesale-retail trade. A recession begins just after the economy reaches a peak of activity and ends as the economy reaches its trough."

Contrary to the well-studied business cycle field, the studies of financial cycles are still in infancy. Given that numerous business cycle studies, we do not review the evolutions of business cycle studies and history, please refer to Stock and Waston (2010) and Sinai (2010) for those who are interested in understanding the business cycles. Up to now, few scholars study financial cycles, although some researchers discuss some related topics, and there is still no clear definition for financial cycles (Borio, 2014).

There are two studies directly related to this field. Drehmann, Borio and Tsatsaronis (2012) first construct the financial cycles from dating the peaks and troughs of four financial variables: credit, the credit-to-GDP ratio, property prices and equity prices. Then, they identify the characteristics of financial cycles from duration and amplification, and compare the contractions of business cycles and financial cycles. They believe that it is hard for one to characterize financial cycles without credit and asset prices. They find financial cycles are visibly longer and have larger amplitudes than business cycles, and recessions are deeper when they coincide with

[10] The definition itself goes back to the pioneering work of Burns and Mitchell (1946) who defined a cycle to "consist[s] of expansions occurring at about the same time in many economic activities, followed by similar general recessions, contractions, and revivals which merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic; in duration, business cycles vary from more than one year to ten or twelve years."

the downturn phases of financial cycles.

Borio (2014) analyzes financial cycles' five core stylized features, systematic modeling requirements for financial cycles and the policy effects of financial cycles in theory. First, five core stylized features are most parsimoniously described in terms of credit and property prices, financial cycles have a much lower frequency than traditional business cycles, financial cycles' peaks are closely associated with financial crises, financial cycles help detect financial distress risks with a good lead in real time and financial cycle's length and amplitude depend on policy regimes.

Second, systematic modeling requirements for financial cycles refer to three basic features that a satisfactory model should be able to replicate. Three basic features are: (1) the financial boom should not just precede the bust but cause it; (2) the presence of debt and capital stock overhangs (disequilibrium excess stocks); (3) a distinction between potential output as non-inflationary output and as sustainable output. Besides, Borio (2014) proposes we should follow three steps to replicate these three features. Three steps are: (1) move away from model-consistent (''rational'') expectations; (2) allow for state-varying risk tolerance; (3) capture more deeply the monetary nature of our economies.

Third, Borio (2014) analyze the policy challenges for financial cycles in theory, that is the implementation and effect analysis of monetary policy and fiscal policy during financial booms and financial busts. For example, Borio (2014) believes we need stronger anchors in financial, monetary and fiscal regimes for addressing financial booms. These anchors can help constrain the boom, or at least improve the defensible space for policy manoeuvre to deal with the subsequent bust.

Besides, there are some studies indirectly related to financial cycles, but directly associated with financial variables' cycles. For example, Claessens, Kose and Terrones (2011) discuss the cyclical movements of three different financial variables: credit, house prices, and equity prices for 21 advanced countries over the period

1960-2007. Claessens, Kose and Terrones' (2011) conclusions can be summarized as below: First, equity and house price cycles are typically longer and more pronounced than credit cycles. Second, financial variables' cycles are highly synchronized within countries, particularly credit and house price cycles. Third, financial variables' cycles accentuate each other and become magnified, especially during coincident downturns in credit and housing markets. Moreover, globally synchronized downturns tend to be associated with more prolonged and costly episodes, especially for credit and equity cycles.

Claessens, Kose and Terrones (2012) expand Claessens, Kose and Terrones' (2011) sample to the period 1960:Q1-2010:Q4 for 44 countries. First, Claessens, Kose and Terrones (2012) get some conclusions almost the same as Claessens, Kose and Terrones (2011), such as downturns (upturns) of financial variables' cycles tend to last longer than recessions (expansions) of business cycles do. Second, Claessens, Kose and Terrones (2012) find the interactions between business cycles and financial variables' cycles could influence the basic features (eg, duration, amplitude) of recessions and expansions of business cycles. Third, in emerging markets, both business cycles and financial variables' cycles are usually more pronounced than in advanced countries.

3. Identification of the peaks and troughs

3.1 Three types of business cycle handling data

Three approaches are commonly used to handle variables, which are classical business cycle, growth cycle and growth rate cycle approaches. The first one is the classical business cycle proposed by Burns and Mitchell (1946), aiming to measure the fluctuation of absolute value. NBER uses this approach to estimate business cycle.[11] However, this cycle is difficult for countries with increasing growth rate,

[11] National Bureau of Economic Research (NBER) built a set of cyclical standard and procedure for business cycle around 1930, including establishing comprehensive leading index,

because it is hard to find the exact turning points of business cycles. Next, growth cycle (or deviation cycle) is proposed by Mintz (1969). It is commonly calculated first by removing the long trend of GDP (or called potential output), and then identifying the business fluctuation basing on its deviation part. Therefore, we also call the growth cycle as deviation cycle. However, the estimated trend can be easily affected by the adding of new observation (Canova, 1998). Third, growth rate cycle is measured by the symbol of one country's economic growth rate, and based on which we can judge whether the economic situation is in expansion or in contraction (Artis, Marcellino and Proietti, 2002). Economic Cycle Research Institute will update the peak and trough dates of the growth rate cycles in 22 countries regularly.[12] See Stock and Watson (2010) and Sinai (2010) for details.

3.2 Identifying the dates of turning points of individual variable

After deciding the manner in handling variable, the next step is to identify the turning points of the cycle[13]. There are only two methodologies, that is non-parametric turning points analysis method (Harding and Pagan, 2002) and frequency-based filter method (Comin and Gertler, 2006), for identifying financial cycles. The main thought of turning points analysis is based on the idea of identifying local maxima and minima over a specific window proposed by Bry and Boschan

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comprehensive consistent index and comprehensive backward index, by which they use to predict and identify the status transformation of business cycle. At the same time, they announce the turning point dates of business cycle in the United States regularly.

[12] Please refer to the website: https://www.businesscycle.com/ecri-business-cycles/international-business-cycle-dates-chronologies.
In China, it is NBS (National Bureau of Statistics) who publishes Chinese business cycle index and enterprise prosperity index regularly.

[13] In the view of methodology, the identification of business cycle is to provide the specific dates of peaks and troughs of business cycles. Once the peak and trough time points are determined, we can compute the recession and expansion phases of business cycles. For the identification of peaks and troughs, we should consider the changes in the overall economic departments. Because there exist complex relationships for the information delivering among different departments, so it is difficult for a single indicator to grasp the features of total economy. However, there are different compilation methods for economic cycle index, such as composite index, diffusion index, Markov switching model. However, the first step of these methods are usually adjusting the representative index seasonally.

(1971). And for quarterly data, it is called BBQ method (Harding and Pagan, 2002). Because the results of frequency-based filter method are influenced by parameter setting and turning point method does not have this problem.[14] Claessens, Kose and Terrones (2009, 2011, 2012) use Harding and Pagan's (2002) BBQ turning point method to identify peaks and troughs of business cycles and financial cycles. In this paper, we combine Harding and Pagan's (2002) BBQ turning point method with our yearly data to identify peaks and troughs of business cycles and financial cycles.

The main spirit of turning points analysis is as below. A peak in a series x_t occurs at time t, if :

$\{(x_t - x_{t-1})>0 \text{ and } (x_t - x_{t+1})>0\}$

Similarly, a cyclical trough occurs at time t, if :

$\{(x_t - x_{t-1})<0 \text{ and } (x_t - x_{t+1})<0\}$

where $j=1$ denotes the least period of each phase (recession/downturn or expansion/upturn), and $(2\times j+1)$ denotes the least length of each cycle.

Because our provincial data are available annually and starting in 2001, which restricts our use of the lagged and leading periods. Thus, we set $j=1$, that is, a complete cycle to be at least three years and each phase to be at least one year.

For business cycles, following Claessens, Kose and Terrones (2012), we define the recession phase as the period from peak to the next trough, the expansion phase as the period from trough to the next peak. For financial cycles, we call the recession phase of a financial cycle the "downturn" and the expansion phase the "upturn" as Claessens, Kose and Terrones (2012) do.

3.3 Combining individual cycles into an aggregate financial cycle

We adopt Drehmann, Borio and Tsatsaronis' (2012) medium distance approach to

[14] The frequency-based filter originates from Comin and Gertler (2006). Basing on Comin and Gertler's (2006) study, Drehmann, Borio and Tsatsaronis (2012) combine the band-pass filter suggested by Christiano and Fitzgerald (2003) to study individual financial variable cycles.

date the peaks and troughs of the aggregate financial cycles on the basis of three individual financial variables, which are credit/GDP, house prices and equity prices. In contrast, Claessens, Kose and Terrones (2012) only date the peaks and troughs of these three financial variables without constructing an aggregate financial cycle index. The medium distance approach involves three steps to identify peaks and troughs of financial cycles from the individual financial variables.

Step 1. Calculate the minimum number of quarters to the nearest peak (trough), which we call it as $DP_t^{Y_i}$ ($DT_t^{Y_i}$) for each series Y_i and each point in time *t*.

Step 2. Calculate the median MP_t (MT_t) across all $DP_t^{Y_i}$ ($DT_t^{Y_i}$).

Step 3. Search for local minima in MP_t (MT_t), then we get the basic turning points of financial cycles, which need to be censored in further.

4. Panel dynamic logit model (PDLM)

Panel dynamic logit model (PDLM) is a direct extension of a panel dynamic model with the binary dependent variable.[15] This study adopts Bartolucci and Nigro's (2010a) method and use a quadratic exponential formulation to consider binary dependent variable in a panel dynamic model. We apply their model to examine the lead and lag relation between BCs and FCs. In the following PDLM, we assume that lag length is equal to one. However, the extension to higher lag length is immediate.

$$y_{it}^{*} = \gamma_1 y_{it-1} + \beta_1 x_{it-1} + \alpha_i + \mu_{it} \tag{1}$$

$$y_{i0}^{*} = \theta z_{i-t\ 1} + \vartheta\alpha + {}_i\mu \tag{2}$$

$$y_{i\ t} = 1(y^{*}{}_{i\ t} \geq 0 \quad i = 1,...,N \quad \text{and} \quad t = 1,...,T \tag{3}$$

where *y* is either BC or FC, whereas *x* is either FC or BC, 1(·) is the indicator variable, y_{it}^{*} the latent variable (the unobservable propensity to be in recession of the cycle), β and γ are the unknown coefficient, α_i is the unobservable individual

[15] See Shen, Lee, Wu, Guo (2016), Shen, Bu, Lin, Wu (2016) and Dobbelaere, Lauterbach and Mairesse (2016) for the panel dynamic model.

heterogeneity (individual-specific effects) and μ_{it} is the random error.

Equation (1) suggests that the latent propensity to experience the recession of the cycle y_{it}^{*} depends upon the observed cycle status in the previous period y_{it-1}. The inclusion of y_{it-1} allows us to test for the presence of state dependence via estimation of the coefficient γ. Controlling for appropriate unobserved individual characteristics is necessary to obtain unbiased estimates of the state dependence parameter, thus distinguishing true from spurious state dependence.

The fixed effects specification does not require specification of a functional distribution of α_i, since individual effects are treated as parameters to be estimated together with the vector $\omega=(\beta,\gamma)$ and are allowed to be correlated with the explanatory variables. In Eq.(1), the vector ω of the explanatory variables and the state-dependence parameters are referred to as structural parameters, while the individual-specific intercepts, α_i, are referred to as incidental parameters.

Equation (2) describes the initial condition and y_{i0} should not be taken exogenous. Heckman (1981a, 1981b) suggest to approximate the reduced form of the marginal probability of y_{i0} given α_i with a probit model to allow free correlation ρ between y_{i0} and y_{it}.

Equation (3) suggests that recession is observed if their unobserved propensity to be in recession is greater than zero. That is, y_{it} equals one if y_{it}^{*} >0 and zero otherwise.

When following a joint maximum likelihood (JML) estimation method, the fixed effects specification suffers from the so-called ‘incidental parameter problem’ which, with a fixed *T,* causes inconsistency in the estimators of ω (Wooldridge, 2005). Honoré and Kyriazidou (2000) suggest the use of semi-parametric models, based on the Conditional Maximum Likelihood (CML) estimation strategy; however, semi-parametric identification hinges on some strong assumptions concerning the strictly exogenous covariates. As a consequence, random effects specification of the

model is generally assumed in the literature. Bartolucci and Nigro (2010a) solve this problem by introducing a fixed effects estimator, suited to dynamic binary panel data models, which closely resembles the dynamic logit model, avoids the incidental parameter problem and allows for the presence of time dummies among the regressors. They propose an estimation method for the structural parameters ω based on approximating the dynamic logit model by a quadratic exponential model. Interpretation of the parameters of this proposed approximating model is similar to the interpretation of those in the dynamic logit model, the 'true model'. Since the approximating model admits simple sufficient statistics for the incidental (individual-specific) parameters, the vector of structural parameters ω is estimated by maximizing the corresponding conditional likelihood via a pseudo- Conditional Maximum Likelihood (CML) estimator.

Bartolucci and Nigro's (2010a) approximating model is derived from a linearization based on a first-order Taylor series expansion around $\alpha_i = 0, \boldsymbol{\beta} = \bar{\boldsymbol{\beta}}$ and $\gamma = 0$ of the log-probability of $\boldsymbol{y}_i$ under the dynamic logit model. On the basis of the approximating model, a pseudo conditional log-likelihood is introduced:

$$l^*(\omega) = \sum_i 1\{0 < y_{1+} < T\} l_i^*(\omega) \tag{4}$$

where the individual log likelihoods are $l_i^*(\omega) = \log[p^*(\boldsymbol{y}_i \mid \boldsymbol{X}_i, y_{i0}, y_{i+})]$, and $p^*(\boldsymbol{y}_i \mid \boldsymbol{X}_i, y_{i0}, y_{i+})$ is the conditional probability of $\boldsymbol{y}_i$ given y_{i+}. Maximization of Equation (4) is possible through the Newton–Raphson algorithm, resulting in the pseudo-CML estimator of the structural parameters ω. The estimator is $\sqrt{n}$-consistent and has an asymptotic normal distribution, and, as shown in a simulation study (Bartolucci and Nigro, 2010b), has finite sample properties in terms of both bias and efficiency. The null hypothesis that FC does not lead BC assumes $\beta_1 = 0$ when *y* is the BC and *x* is FC. The null hypothesis that BC does not lead FC also assumes $\beta_1 = 0$ when *y* is the BC and *x* is FC.

5. Source of data

We construct an extensive data set using yearly series of financial variables for 31 provincial areas covering the period 2001-2015. Our sample include 22 provinces, 5 autonomous districts and 4 municipalities.[16]

The proxy indicator of business cycle is the GDP growth rate. We have two proxy variables for credit, one is aggregate claims on the private sector by deposit money banks, and the other one is aggregate financing to the real economy. We have two proxy variables for house prices, one is the growth rate of commercial house price, and the other one is the growth rate of commodity housing price. Equity price is proxied by the direct financing ratio of non-financial institutions, which equals to the sum of stock financing ratio and bond (including convertible bond) financing ratio.

We collect data of GDP growth rate, the growth rate of commercial house price and commodity housing price from NBS (National Bureau of Statistics in China). Data for aggregate claims on the private sector by deposit money banks and aggregate financing to the real economy come from PBC (People's Bank of China) and its branches. Data for direct financing ratios of non-financial institutions come from Chinese regional financial operation report.

6. Empirical results

6.1 Dating financial cycles in 31 provinces

Table 2 presents the empirical results of dating peaks and troughs of the BCs, FCs and three individual variables: credit cycles, house cycles, equity cycles. We conclude five features for provincial areas' financial cycles in China.

First, financial cycles' frequencies tend to be lower than those of business cycles. For example, there are usually three peaks and two troughs in each provincial area for business cycles, however, there are usually two peaks and one trough in each

[16] Twenty-two provinces include Anhui, Fujian, Gansu, Guangdong, Guizhou, Hainan, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Qinghai, Shandong, Shanxi, Shanxi, Sichuan, Yunnan, Zhejiang. Five autonomous districts are Guangxi, Neimenggu, Ningxia, Xizang and Xinjiang. Four municipalities are Beijing, Chongqing, Shanghai, Tianjin.

provincial area for financial cycles. This is in accordance with Drehmann, Borio and Tsatsaronis' (2012) study. Borio (2014) also argues that one of financial cycles' core stylized features is that financial cycle has a much lower frequency than the traditional business cycle.

Second, for provincial areas, peaks of financial cycles usually occur in 2005 and 2011. In 2005, the real estate market continued to boom and caused house price to increase continuously. With the introduction of macro-control, the house prices of most provincial areas reached their peaks[17]. Besides, direct financing ratios of most provincial areas also reached their peaks[18]. This led financial cycles to come to the peak. In 2011, Chinese economy gradually stepped out of the financial crisis erupted in 2008, and the effect of macro-regulation policy implemented in 2008, 2009 and 2010 came into play and gathered[19], both leading to the financial peak in 2011. Statistically, there are 7 provincial areas reaching their peaks of financial cycles in 2005, 13 provincial areas reaching their peaks of financial cycles in 2011.

Third, troughs of financial cycles for provincial areas often occur in 2008. Because in 2008, influenced by the U.S. subprime mortgage crisis and the overdrafts of Olympic business opportunities, the credit and house cycles of most provincial areas reached their troughs[20], and also, the direct financing ratios of individual provincial areas reached their troughs. Statistically, there are 21 provincial areas reaching their troughs of financial cycles in 2008, and 7 provincial areas reaching

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[17] "The real estate industry begins to return to reason under macro-control in 2005" by Xia Jinbiao, China Economic Times, December 30, 2005, p.003.

[18] See Chinese regional financial operation report of 2005, People's bank of China. Website: http://www.pbc.gov.cn/zhengcehuobisi/125207/125227/125960/126049/126092/2814683/index.html.

[19] See Chinese regional financial operation report of 2011, People's bank of China. Website: http://www.pbc.gov.cn/zhengcehuobisi/125207/125227/125960/126049/126074/2900268/index.html

[20] See Chinese regional financial operation report of 2008, People's bank of China. Website: http://www.pbc.gov.cn/zhengcehuobisi/125207/125227/125960/126049/126083/2843734/index.html.

their troughs of financial cycles in 2009. The numbers of provincial areas, who reach their troughs of financial cycles in other years except 2008 and 2009, are less than 4.

Fourth, provincial areas have similar turning points for financial cycles. Just as we describe above, 21 provincial areas reach troughs of financial cycles in 2008, and 13 provincial areas reach peaks of financial cycles in 2011. We propose two reasons for this phenomenon. First, monetary policy in China is formulated and enforced uniformly by PBC[21], and the main function of PBC's branches, such as Shanghai, is co-operating with PBC to implement monetary policy in provincial areas[22]. Therefore, credit scale and direct financing ratio in each provincial area may be influenced by similar monetary policy and presents the same changing trend. Second, the fluctuations of house prices in different cities are synchronized in China (Hong, Xi and Gao, 2010; Tan and Zhou, 2013). Tan and Zhou (2013) use CCE (the common correlated effects estimator) method proposed by Holley, Pesaran and Yamagata (2010), and find there exist strong synchronization for the house prices of different cities in China.

Fifth, financial cycles and three financial variables of most provincial areas reach their troughs in 2008, and the number of provincial areas which possess this feature is 21, 26, 7 and 18 for financial cycles, credit-to-GDP ratios, house prices and direct financing ratios, respectively. While business cycles of 31 provincial areas reach their troughs in 2009. Thus, the U.S. subprime mortgage crisis erupted in 2008 caused recession/downturn in both the real economy and financial sector. This phenomenon also indicates that financial cycle may be the leading indicator of business cycle.

6.2 Graphic evidence

In Figure 1, before 2011, we can see that credit cycles in 28 provincial areas, except for Fujian, Qinghai and Zhejiang, begin to contract ahead of business cycles'

[21] http://www.pbc.gov.cn/rmyh/105226/105436/index.html.

[22] http://shanghai.pbc.gov.cn/fzhshanghai/113568/index.html.

recessions. For all provincial areas, credit cycles begin to expand ahead of business cycles' expansions. After 2011, gradually downward economic situation stands in sharp contrast to the strong expansions of credit cycles for 30 provincial areas, except for Shandong.

Figure 2 shows the tendency charts of house price proxy variables in 31 provincial areas, and we almost get the same conclusion as in figure 2. The downturn phases of house cycles usually happen ahead of the recession phases of business cycles in 26 provincial areas, except for Henan, Fujian, Heilongjiang, Ningxia, Hunan. The upturn phases of house cycles usually happen ahead of the expansion phases of business cycles in 23 provincial areas, except for Henan, Fujian, Ningxia, Gansu, Shandong, Yunnan, Guangxi and Jiangxi.

Figure 3 depicts the tendency charts of equity price proxy variables in 31 provincial areas. The downturn phases of equity cycles usually happen ahead of the recession phases of business cycles for 28 provincial areas, except for Qinghai, Zhejiang and Jiangsu. The upturn phases of equity cycles usually happen ahead of the expansion phases of business cycles for 23 provincial areas, except for Beijing, Henan, Fujian, Ningxia, Xizang, Hunan, Jilin and Jiangsu.

Figure 4 depicts financial cycles in 31 provincial areas. Compared with the recession phases of business cycles, the downturn phases of financial cycles come earlier in 18 provincial areas, except for Hebei, Liaoning, Neimenggu, Tianjin, Heilongjiang, Xizang, Qinghai, Xinjiang, Guangxi, Zhejiang, Guizhou, Jiangxi and Shanghai. Compared with the expansion phases of business cycles, the upturn phases of financial cycles come earlier in 17 provincial areas, except for Henan, Neimenggu, Heilongjiang, Xizang, Gansu, Hubei, Guangdong, Shandong, Jilin, Zhejiang, Guizhou, Jiangsu, Chongqing and Shanghai. This may indicate financial cycle may be the leading indicator of business cycle

6.3 Correlation coefficient that BC and FC in the same phase

6.3.1 Concordance index

This subsection measures the fraction of time the two series are in the same phase of their respective cycles. Following Harding and Pagan (2002) and Claessens, Kose and Terrones (2011), we use the concordance index of two cycle variables as :

$$CI_{BC,FC} = \frac{1}{T}\sum_{t=1}^{T}[C_t^x \times C_t^y + (1-C_t^x)\times(1-C_t^y)]$$

$C_t^x = \{1, \text{if } BC \text{ is in recession phase at time } t;\ 0, \text{ if } BC \text{ is in expansion phase at time } t\}$

$C_t^y = \{1, \text{if } FC \text{ is in downturn phase at time } t;\ 0, \text{ if } FC \text{ is in upturn phase at time } t\}$

Where *CI* is a simple statistic measuring the fraction of time two series are in the same phase (recession/downturn or expansion/upturn), and its value is between 0 and 1. The higher the concordance index, the higher the extent of synchronization across business cycles and financial cycles is. Two series are perfectly pro-cyclical (countercyclical) if the index is equal to unity (zero).

6.3.2 Concordance coefficient of two cycles in the same phase

In Table 3, our concordance index of business cycles and financial cycles is 0.589. meaning that around 60% the two cycles move toward the same direction at the same time. Hence, when business cycles are in recession phases, financial cycles are also in the downturn phases more than half of chance. Accordingly, the two cycles are interacted simultaneously to a greater extent but financial cycle is not the mirror of the business cycle. Besides, the concordance indexes between paired business cycles with credit, house price and equity price cycles are 0.413, 0.624 and 0.462, respectively. Because the concordance index between business cycles and house cycles is the largest, suggesting the close relationship between Chinese economic development and real estate market.

From the aspect of each provincial area, the relationship between business cycles and financial cycles is significantly different for each provincial area. Such as, for

Guangdong and Hebei, the correlation coefficient of business cycles and financial cycles is high to 0.8. However, for Fujian and Heilongjiang, the correlation degree of business cycles and financial cycles is only 0.4. There are 20 provincial areas whose concordance indexes between business cycles and financial cycles are larger than 0.5. Furthermore, there are 16 provincial areas whose concordance indexes between business cycles and financial cycles are greater than or equal to 0.6. Then, there may exist the possibility that financial cycles cause business cycles in these provincial areas.

6.4 Lead-and-lag testing results in panel dynamic logit model

Table 4 examines the lead-and-lag relation between two cycles. We consider two lag length 1 and 2. Higher lag length reduce the degree of freedom $(T \times n - p \times n - q \times n - n)$[23] substantially because of small T (our T is 15). Shen and Chen (2008), Fiordelisi, Marques-Ibanez and Molyneux (2011) and Shen, Bu, Lin and Wu (2016) also use the same length when they consider the panel dynamic causality test.

When BC is the dependent and FC is independent variables, the Wald tests are found to be 2.597 and 2.562 for lag length=1 and 2, respectively. Both are significant at even the 1% level. Hence, we reject the null that FC does not lead BC. Also, the R^2 is 0.187 and 0.088 for lag length=1 and 2. Next, when FC is the dependent variable and BC is independent variables, the Wald tests are found to be 0.331 and 1.238 for lag length=1 and 2, respectively. Both are insignificant. Hence, we accept the null that BC does not lead FC. Also, the R^2 is 0.112 and 0.138 for lag length=1 and 2. Thus, FCs Granger cause BCs not vice versa.

7. Robust tests

7.1 Rich and poor provincial areas

We divide 31 provincial areas into two groups according to the GDP per capita,

[23] See Hurlin and Venet (2001).

namely rich and poor group, using threshold of 23135.15 RMB. Rich group includes 15 provincial areas, which are Shanghai, Beijing, Tianjin, Jiangsu, Zhejiang, Guangdong, Neimenggu, Liaoning, Fujian, Shandong, Jilin, Chongqing, Hebei, Hubei, Shanxi. Poor group includes 16 provincial areas, which are Heilongjiang, Xinjiang, Ningxia, Shanxi, Hainan, Qinghai, Hunan, Henan, Jiangxi, Sichuan, Anhui, Guangxi, Xizang, Yunnan, Gansu, Guizhou.

From table 5, we can see, for rich group, at lag 1 or 2, financial cycle is the Granger cause of business cycle at the significance level of 1%, respectively, but business cycles do not Granger cause financial cycles. For poor group, we get the same conclusion as for rich group. Namely, financial cycles Granger cause business cycles not vice versa.

7.2 Considering different individual financial variables

We try to replace the composition factors of financial cycles to see, whether the different components of financial cycles could influence our conclusion. We replace the private sector by deposit money banks with aggregate financing to the real economy, and replace commercial house prices with commodity housing prices. For direct financing ratio, we could not find an indicator to replace it considering its uniqueness, and we still utilize it. On the basis of updated financial variables, we construct a new financial cycle to do robust test. Results in table 6 show, we almost get the same conclusion as in Table 4. Namely, financial cycles Granger cause business cycles but not vice versa.

7.3 Two periods ahead and two periods after

We relax the condition to set $j=2$ to do robust test, namely, a complete cycle at least last five years and each phase at least last two years. Results in table 7 show they are in accordance with the conclusion in Table 4. That is, financial cycles Granger cause business cycles but not vice versa.

8. Conclusion

We construct a financial cycle index, which is combined based on the periodical rising and falling of three important financial variables (credit-to-GDP ratios, house prices, direct financing ratios) in each provincial area, and test the interaction between business cycles and financial cycles. First, each of 31 provincial areas has its own business cycles and financial cycles, and most provincial areas reach their troughs of FCs in 2008, furthermore, reaching their troughs of BCs in 2009, which indicates that financial cycle may be the leading index of business cycle. Besides, concordance index between business cycles and financial cycles shows that, when business cycles are in recession phases, financial cycles are also in the downturn phases more than half of chance. Next, we study the lead-lag relationship between business cycles and financial cycles, and we find financial cycles run ahead of business cycles but not vice versa. Furthermore, when we divide 31 provincial areas into rich and poor groups by GDP per capita, consider different individual financial variables and different phase length, we get the same conclusion.

Our research results could provide important knowledge for the policy makers of government or monetary policy authorities. From which, we can suggest that government could master the implement time points and strength of financial or monetary policy by the turning points of credit scale, house prices, equity prices or financial cycles. Furthermore, the supply and demand rule behind financial cycles will help banks to plan their risk aversion, investment and speculation activities.

Nevertheless, not like business cycles, for which we could use GDP growth rate to represent. For financial cycles, we could not find a suitable variable to denote. Therefore, finding an appropriate index to represent financial cycles is the direction of our future research.

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Table 1 Indicators and proxy variables

Indicator	Proxy Variable
Business cycles	GDP growth rates
Financial cycles	Combination of the credit to GDP ratios, house prices and equity prices by Harding and Pagan's method (2006).
Credit-to-GDP ratios	Aggregate claims on the private sector by deposit money banks
	Aggregate financing to the real economy
House prices	The growth rates of commercial house prices
	The growth rates of commodity housing prices
Equity prices	Direct financing ratios of non-financial institutions

Note: Equity prices are proxied by direct financing ratios of non-financial institutions, which equals to the sum of stock financing ratio and bond (including convertible bond) financing ratio. Data for GDP growth rates, the growth rates of commercial house prices and commodity housing prices come from NBS (National Bureau of Statistics in China). Data for aggregate claims on the private sector by deposit money banks and aggregate financing to the real economy come from PBC (People's Bank of China) and its branches. Data for direct financing ratio of non-financial institutions come from Chinese regional financial operation report. Following Drehmann, Borio and Tsatsaronis (2012), financial cycles are constructed by Harding and Pagan's method (2006) from three individual financial variables: the credit to GDP ratios, house prices and equity prices.

Table 2 The turning points of business cycles and financial cycles in each provincial area based on BBQ method (2001-2015)

Provincial areas	Business cycles		Credit cycles		House cycles		Equity cycles		Financial cycles	
	Peak	Trough	Peak	Trough	Peak	Trough	Peak	Trough	Peak	Trough
Anhui	2004 2007 2011	2005 2009	2003 2006	2005 2008	2005 2010	2006 2012	2007 2012	2004 2009 2013	2005 2011	2008 2013
Beijing	2003 2007 2010	2005 2009	2010	2007 2012	2007 2010	2008 2011	2008 2012	2004 2009	2010	2008
Fujian	2004 2007 2010	2005 2009	2003 2011	2004 2012	2006 2011	2003 2008	2008	2004 2013	2011	2004
Gansu	2004 2007 2011	2005 2009	2003	2008	2004 2009	2003 2008 2012	2006 2009	2008	2004 2009	2008
Guangdong	2005 2007 2010	2006 2009 2012	2003 2009	2008	2005 2013	2008	2007 2011	2005 2009 2013	2004 2010	2008
Guangxi	2004 2007 2010	2006 2009	2003 2009	2008 2011	2004 2007 2012	2005 2011	2007	2005 2009	2007	2005 2011
Guizhou	2005 2008 2011	2006 2009	2004 2010	2008	2009	2008	2007 2012	2009 2013	2011	2008
Hainan	2004 2007 2010	2005 2009	2003 2009 2011	2008 2010 2012	2010 2013	2007 2012	2006 2012	2009 2013	2006 2010	2009 2012
Hebei	2004 2007 2011	2006 2009	2004	2008	2007	2003 2008	2004 2007 2011	2005 2009 2013	2004	2008
Henan	2004 2007 2010 2013	2006 2009 2012	2003 2009	2008 2011	2005 2011	2003 2008	2007 2012	2005 2008	2004 2012	2008
Heilongjiang	2004 2008 2011	2006 2009	2006	2005 2008	2010 2013	2003 2012	2005 2012	2009 2013	2005 2011	2009
Hubei	2004 2007 2010	2006 2009	2003 2009	2008 2011	2005 2011	2003 2008	2007 2011	2003 2009 2013	2004 2011	2003 2008
Hunan	2004 2007 2010	2006 2009	2003 2009	2008 2011	2006 2011	2008	2006 2010	2005 2008 2013	2006 2010	2009
Jilin	2007 2011	2009	2009	2008 2012	2004	2003 2012	2012	2008	2011	2008 2012
Jiangsu	2005 2010	2009	2003 2009	2008 2011	2005 2009	2008	2007 2012	2004 2009 2013	2005 2009	2008
Jiangxi	2004 2011	2009	2003	2008	2011	2008	2007 2012	2004 2009 2013	2005 2011	2008
Liaoning	2005	2006	2003	2008	2005	2013	2003	2005	2003	2009

	2008 2010	2009					2007 2012	2009 2013		
Neimenggu	2008 2011	2006 2009	2010	2008 2011	2007	2003	2004 2007 2012	2003 2006 2009	2007 2011	2003 2009
Ningxia	2004 2008 2011	2005 2009	2003	2008	2005 2009	2003 2006	2005 2011	2009 2013	2004 2010	2008
Qinghai	2008 2010	2009	2004	2008	2007 2012	2006 2009	2007 2012	2008 2013	200720 12	2008
Shandong	2004 2008 2011	2007 2009	2003 2011	2008 2013	2004 2009	2008	2007 2012	2003 2009 2013	2004 2011	2008 2013
Shanxi	2004 2007 2010	2006 2009	2009	2008 2011	2005 2010 2013	2006 2011	2003 2006 2012	2005 2008 2013	2004 2010	2008
Shanxi	2005 2008 2010	2006 2009	2003 2009	2008 2012	2006 2011	2003 2007	2012	2009 2013	2005 2011	2008 2012
Shanghai	2004 2007 2010	2006 2009	2003	2007	2003 2009 2013	2008 2012	2007 2012	2004 2010 2013	2003 2012	2008 2013
Sichuan	2004 2007 2011	2005 2009	2003 2010	2007 2011	2007 2011	2009	2007 2012	2008 2013	2007 2011	2009
Tianjin	2005 2008 2011	2006 2009	2003	2008	2005 2010 2013	2003 2008 2012	2007	2005 2009	2004	2008
Xizang	2004 2007 2011	2005 2009	2003	2008	2004 2007	2005 2009	2010	2013	2003 2010	2008 2012
Xinjiang	2005 2008 2010	2007 2009	2002	2008	2010	2004	2007 2012	2004 2009 2013	2005 2011	2004 2009
Yunnan	2004 2007 2011	2005 2009	2006 2010	2008 2013	2006 2012	2003 2007	2010	2009	2006 2011	2008
Zhejiang	2003 2007 2010	2005 2009	2003 2009 2011	2004 2010 2012	2005 2009	2008	2007	2009	2006	2010
Chongqing	2005 2008 2011	2006 2009	2003 2010	2008 2011	2005 2010	2003 2008	2006	2003 2013	2005 2010	2003 2008

Note: Here we list the turning points of financial cycles, business cycles and three financial variables (credit-to-GDP ratios, house prices, equity prices) in each provincial area. In this paper, we combine Harding and Pagan's (2002) BBQ turning point method with our yearly data to identify peaks and troughs of business cycles and financial cycles. For the parameter of turning point analysis in this table, we set a complete cycle to be at least three years and each phase to be at least one year. For brevity, the Inner Mongolia autonomous region, Guangxi Zhuang autonomous region, Tibet autonomous region, Ningxia Hui autonomous region, Xinjiang Uygur autonomous region are short for Neimenggu, Guangxi, Xizang, Ningxia And Xinjiang. It can be seen from this table that, financial cycles' frequencies tend to be lower than those of business cycles.

Table 3 The concordance indexes between business cycles and financial cycles

Area	BC& FC	BC& Credit	BC& House	BC& Equity	Area	BC& FC	BC& Credit	BC& House	BC& Equity
Total sample	0.589	0.413	0.624	0.462	Jiangxi	0.800	0.400	0.800	0.400
Anhui	0.667	0.533	0.600	0.533	Liaoning	0.600	0.333	0.800	0.467
Beijing	0.800	0.467	0.600	0.667	Neimenggu	0.400	0.067	0.467	0.400
Fujian	0.400	0.467	0.733	0.267	Ningxia	0.800	0.400	0.467	0.533
Gansu	0.533	0.467	0.400	0.600	Qinghai	0.600	0.333	0.733	0.400
Guangdong	0.800	0.533	0.800	0.600	Shandong	0.333	0.667	0.467	0.333
Guangxi	0.467	0.467	0.533	0.400	Shanxi	0.733	0.267	0.667	0.333
Guizhou	0.467	0.400	0.733	0.400	Shanxi	0.533	0.400	0.533	0.600
Hainan	0.667	0.400	0.733	0.600	Shanghai	0.733	0.400	0.733	0.400
Hebei	0.867	0.600	0.533	0.800	Sichuan	0.933	0.333	0.933	0.467
Henan	0.667	0.533	0.467	0.467	Tianjin	0.333	0.400	0.533	0.333
Heilongjiang	0.400	0.200	0.467	0.467	Xizang	0.667	0.467	0.867	0.400
Hubei	0.533	0.467	0.600	0.467	Xinjiang	0.600	0.333	0.533	0.400
Hunan	0.667	0.467	0.667	0.400	Yunnan	0.400	0.600	0.467	0.467
Jilin	0.533	0.133	0.467	0.533	Zhejiang	0.400	0.467	0.600	0.467
Jiangsu	0.467	0.467	0.800	0.333	Chongqing	0.467	0.333	0.600	0.400

Note: Numbers in the grid denote the concordance index value. Credit, House and Equity stand for credit-to-GDP ratios, house prices and equity prices, respectively. Here we list the concordance indexes of BC & FC, BC & Credit, BC & House, BC & Equity from two aspects. One is total sample, the other one is each provincial area. Our focus is the concordance indexes of BC & FC in total sample and each provincial area.

Table 4 Panel Granger causality test

	FC		*BC*	
Lag length	1	2	1	2
BC_{t-1}	0.039	-0.099	0.701	0.871
	(0.412)	(0.452)	(0.000)	(0.000)
BC_{t-2}		0.195		-0.188
		(0.128)		(0.235)
FC_{t-1}	0.789	0.699	0.235	0.353
	(0.000)	(0.000)	(0.000)	(0.002)
FC_{t-2}		0.021		-0.071
		(0.822)		(0.501)
R^2	0.112	0.138	0.187	0.088
Nobs	434	403	434	403
Wald statistic	0.331	1.238	2.597	2.562
P value	(0.999)	(0.121)	(0.000)	(0.000)

Note: Nobs: number of observations. The p-values (the standard errors are robust to heteroskedasticity) are reported in parentheses. The Wald statistic is asymptotically distributed as $\chi^2(k)$ under the noncausality hypothesis, where k is the number of coefficients estimated. We used one or two lags given the short sample length, which is common in panel data. In their study on the causal relationship between banking and currency crisis, Shen and Chen (2008) consider both lagged one period and two periods because the estimation usually consumes a considerable degree of freedom. Fiordelisia, Marques-Ibanezc, and Molyneuxb (2011) consider two lags in their analysis of the causal relation between nonperforming loans and bank efficiency. This note is similar hereinafter.

Table 5 Panel Granger causality test for rich and poor provincial areas

	FC		*BC*	
Lag length	1	2	1	2
Panel A: Rich group				
BC_{t-1}	0.661	0.719	0.422	0.365
	(0.000)	(0.000)	(0.000)	(0.000)
BC_{t-2}		-0.084		0.011
		(0.347)		(0.847)
FC_{t-1}	0.108	-0.059	0.410	0.369
	(0.057)	(0.508)	(0.000)	(0.000)
FC_{t-2}		0.218		0.039
		(0.001)		(0.706)
R^2	0.259	0.238	0.302	0.253
Nobs	434	403	434	403
Wald statistic	0.033	0.492	5.563	2.223
P value	(1.000)	(0.987)	(0.000)	(0.000)
Panel B: Poor group				
BC_{t-1}	0.606	0.859	0.517	0.374
	(0.000)	(0.000)	(0.000)	(0.000)
BC_{t-2}		-0.304		0.073
		(0.000)		(0.319)
FC_{t-1}	0.187	0.187	0.310	0.257
	(0.002)	(0.041)	(0.000)	(0.004)
FC_{t-2}		0.057		0.110
		(0.426)		(0.214)
R^2	0.208	0.150	0.222	0.180
Nobs	434	403	434	403
Wald statistic	1.067	0.780	3.972	1.853
P value	(0.388)	(0.793)	(0.000)	(0.006)

Note: See Table 4. Rich group and poor group are divided by GDP per capita. Rich group includes Shanghai, Beijing, Tianjin, Jiangsu, Zhejiang, Guangdong, Neimenggu, Liaoning, Fujian, Shandong, Jilin, Chongqing, Hebei, Hubei, Shanxi. Poor group includes Heilongjiang, Xinjiang, Ningxia, Shanxi, Hainan, Qinghai, Hunan, Henan, Jiangxi, Sichuan, Anhui, Guangxi, Xizang,

Yunnan, Gansu, Guizhou.

Table 6 Panel Granger causality test for different components of financial cycles

	FC		*BC*	
Lag length	1	2	1	2
BC_{t-1}	0.790	0.904	0.418	0.342
	(0.000)	(0.000)	(0.000)	(0.000)
BC_{t-2}		-0.251		0.039
		(0.001)		(0.449)
FC_{t-1}	0.049	0.043	0.455	0.403
	(0.301)	(0.561)	(0.000)	(0.000)
FC_{t-2}		0.128		0.045
		(0.021)		(0.573)
R^2	0.221	0.165	0.237	0.202
Nobs	434	403	434	403
Wald statistic	0.681	0.696	3.724	1.403
P value	(0.903)	(0.957)	(0.000)	(0.032)

Note: See Table 4. Table 6's structure is similar as table 4. The difference is that we replace the private sector by deposit money banks with aggregate financing to the real economy, and replace commercial house prices with commodity housing prices to construct a new financial cycle.

Table 7 Panel Granger causality test for two periods ahead and two periods after

	FC		*BC*	
Lag length	1	2	1	2
BC_{t-1}	0.790	0.904	0.418	0.342
	(0.000)	(0.000)	(0.000)	(0.000)
BC_{t-2}		-0.251		0.039
		(0.001)		(0.449)
FC_{t-1}	0.049	0.043	0.455	0.403
	(0.301)	(0.561)	(0.000)	(0.000)
FC_{t-2}		0.128		0.045
		(0.021)		(0.573)
R^2	0.221	0.165	0.237	0.202
Nobs	434	403	434	403
Wald statistic	0.681	0.696	3.724	1.403
P value	(0.903)	(0.957)	(0.000)	(0.032)

Note: See Table 4. Table 7's structure is similar as table 4. The difference is that we relax the least cycle length from three to five years, and the least phase (recession/downturn or expansion/upturn) from one to two years.

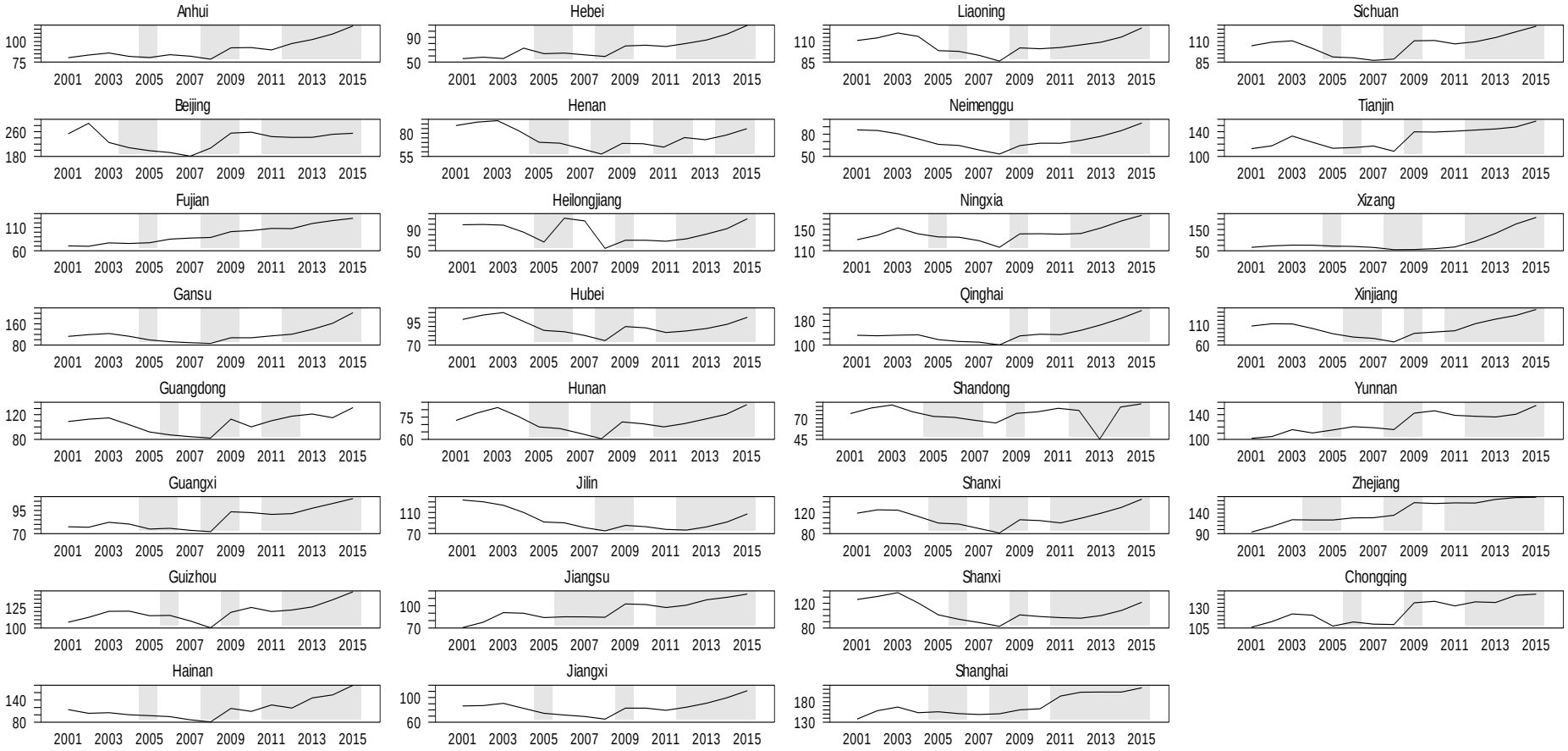

Figure 1 Credit cycles of 31 provincial areas (The shaded parts are the recession phases of business cycles)

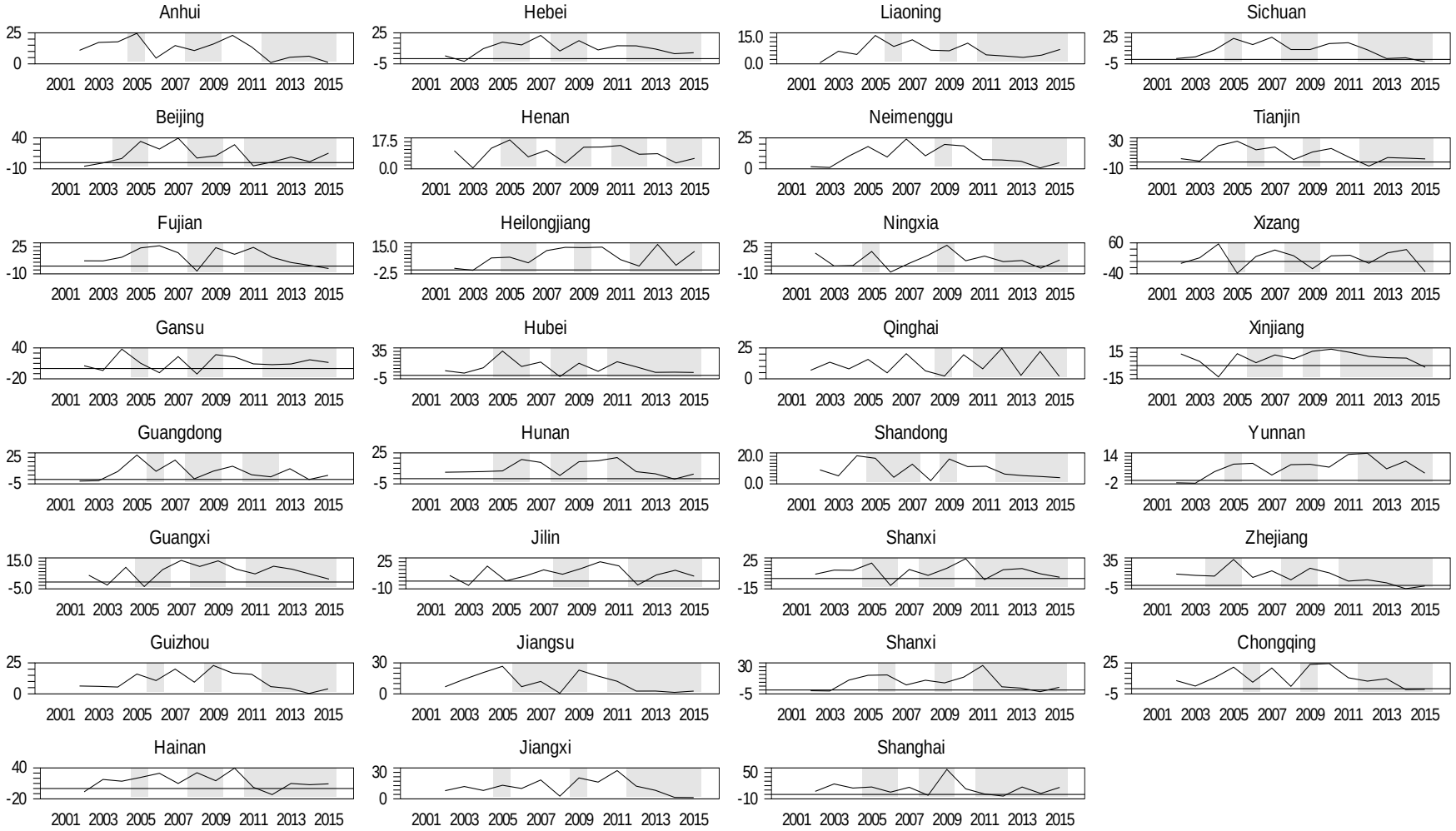

Figure 2 House cycles of 31 provincial areas (The shaded parts are the recession phases of business cycles)

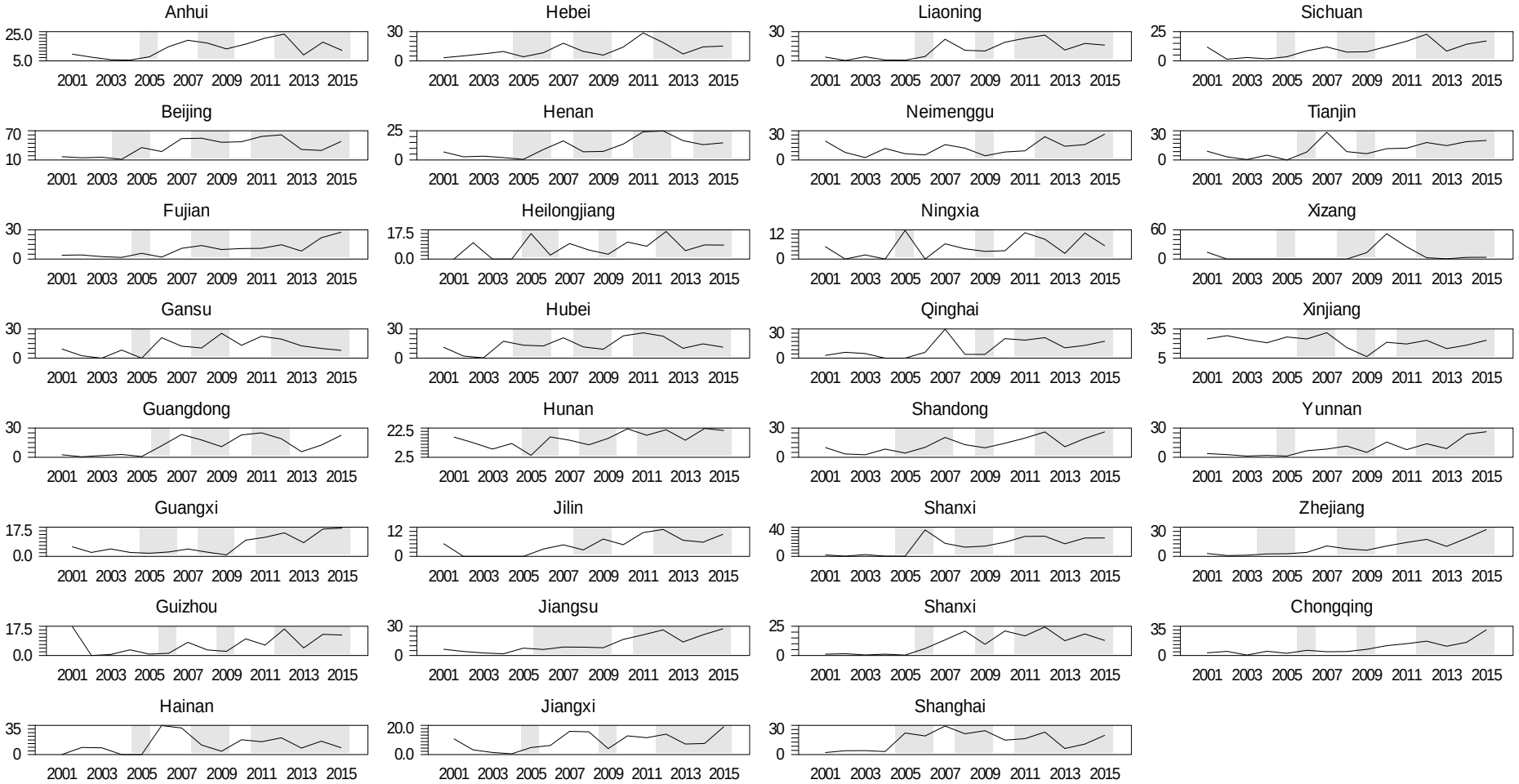

Figure 3 Equity cycles of 31 provincial areas (The shaded parts are the recession phases of business cycles)

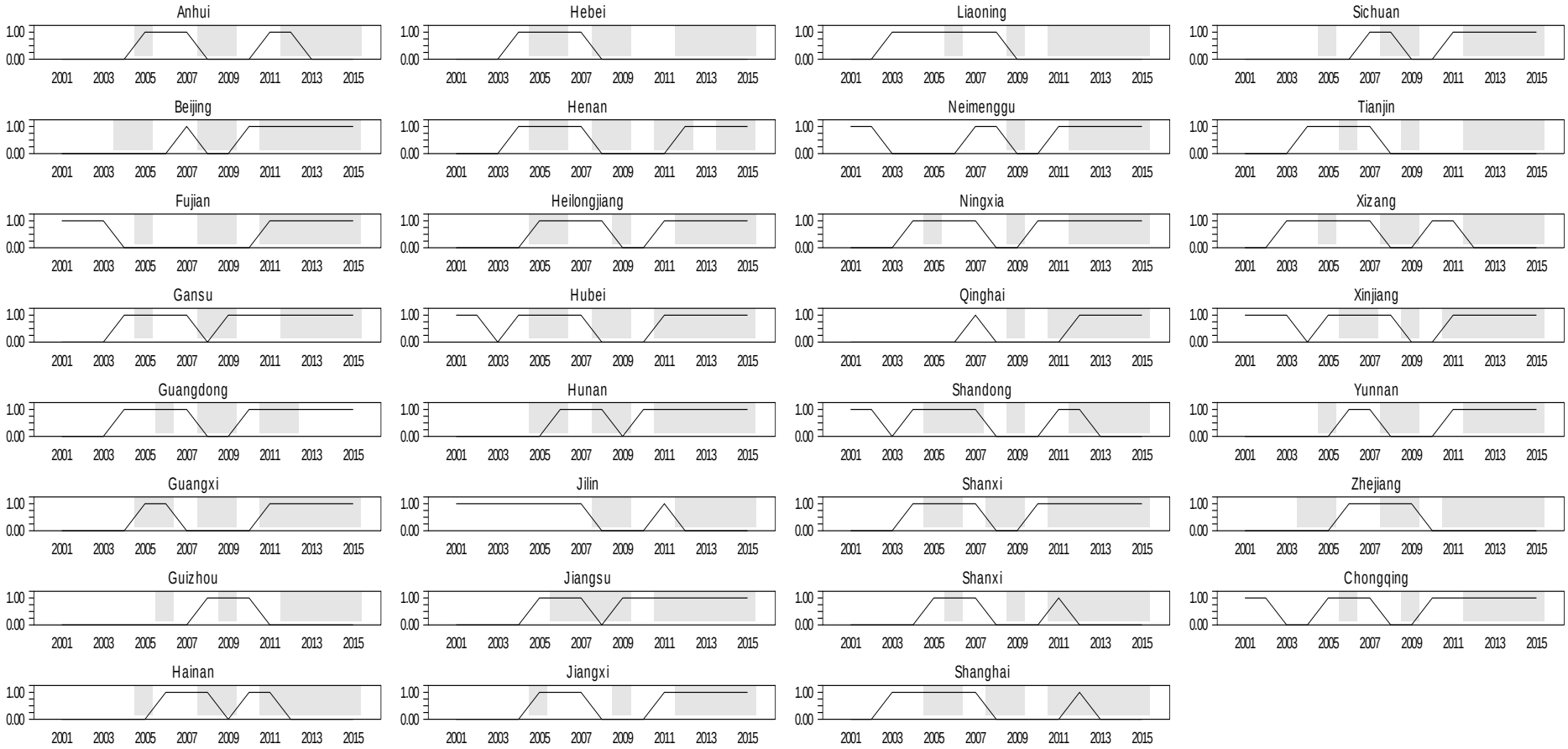

Figure 4 Financial cycles of 31 provincial areas (The shaded parts are the recession phases of business cycles)

Note: Financial cycle series is consisted of two numbers, one and zero. Zero denotes the upturn phases of financial cycles, and one represents the downturn phases of financial cycles.