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Interaction between Financial Cycles and Business Cycles in Iran: A Bayesian Approach

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ABSTRACT

Investigation of effective factors in business cycles in Iran, from 2009:3 to 2018: 3, based on Bayesian approach with emphasis on the effects of financial cycles, is the major purpose of this paper. At first, using Hodrick-Prescott filter, we extract business and financial cycles, then we study the causal relationship between financial and business cycles, using Granger causality test. There is a two-way causal relationship among the variables (GDP, Tehran Stock Exchange index, land value (per square meter), current government and non-government credits, oil revenues and current government payments), except for the credits and business cycles. Based on Bayesian approach, we found that housing sector cycles has negative and current government payment cycles has positive effect on the business cycles, and both of them are significant. However, Tehran Stock Exchange index, current government and non-government facilities and oil revenues do not have a significant effect on the business cycles.

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1. Introduction

Economists used to think that financial factors were not important in the business cycle, but the global financial crisis of 2008 revealed that financial cycles play a much greater role in macroeconomic dynamism. In this regard, they try to incorporate financial factors into macroeconomic models (Yang et al., 2016). Recession has usually been seen in advanced economies and many emerging markets. A common feature of recessions is that it has been accompanied by a variety of financial disturbances, including a sharp decline in credit and asset prices. These developments have led to intensive discussions about the relationship between macroeconomics and finance, and have led studies to investigate the correlations between business cycles and financial cycles (Woodford, 2010). Business cycles are a kind of regular fluctuations in the macroeconomic activities of countries. A cycle begins with a period of economic prosperity that occurs simultaneously in multiple economic activities and leads to a period of recession and contraction. These series of changes are repeated repeatedly, but they are not regular and periodic (Bronze and Mitchell, 1946). Real GDP is one of the most important economic indicators in countries. It can contain useful information to gain a correct understanding of the country's economic situation. Examining the historical trend of GDP of each country, as a measure of the level of economic activity, shows that this variable has fluctuated around a long-term growth trend over the years. Since the most important goal of economists is to stabilize the economy and prevent economic fluctuations, business cycles are one of the most important and attractive topics in macroeconomics. Without understanding how GDP fluctuates, the cause and root of these fluctuations make no sense (Sayad Zadeh and Dikaleh, 2008). The meaning of the financial cycle is the cycle of prosperity and recession in financial markets, which can intensify economic fluctuations and lead to financial turmoil (Adrian and Shin, 2010; Brunnermeier et al., 2009). The introduction of financial variables varies in different studies, but according to studies

by Drehmann et al. (2012), Borio (2012), Dees (2016), and Eickmeier and Ng (2015) stock price index, housing price and credit are considered financial sector variables in this study. The stock market is a factor in managing indicators and determining business cycles Barrio (2012) proved that trade recessions occur simultaneously with stock market recessions. Credits are a natural set for analyzing financial cycles (Mendoza and Terrones, 2008). With the help of credit policies, the means of economic growth and development or vice versa with its contraction can cause economic stagnation (Saeedi, 2012). In addition, the developments in the housing sector play an important role in intensifying the fluctuations of the boom and recession of economic activities. Extensive previous and subsequent circles of the housing sector with other sectors and activities highlight the study of the type of relationship between this sector and other macroeconomic variables at different time scales. In addition, the role of housing prices in the occurrence of business cycles is taken into account (Beheshti and Zenozi, 2010). The correlation between financial and business cycles cannot be limited to a single process. The relationship between them is the result of dynamic interaction, which is due to the influence of different financial sectors (such as stock index, housing prices and credit) on the dynamics of the business cycle. The studies of Kindlebrger and Hoot (2009), Kiyotaki et al. (1995) and Claessens et al. (2011b) present different types of correlations between financial cycles and their relationship and effect on the business cycle. Changes in the financial cycle can be caused by various characteristics of the financial sector. Negative change in one financial sector can spread and affect other sectors, and this will affect the business cycle.

Therefore, the purpose of this study is to investigate the relationship between business and financial cycles. The data are considered quarterly and logarithmically for the period from 2009:3 to 2018: 3 at a fixed price. The source of data in this study is the website of the Central Bank of the Islamic Republic of Iran and the Tehran Stock

Exchange Organization. In this study, for the first time, the effects of several financial variables on business cycles in Iran have been studied simultaneously**.** Bartoletto (2019), Tayebi et al. (2009), and Sarani (2017) investigated the relationship of a financial variable or combined financial index with business cycles. However, no study has specifically been done for Iran, and this is the first study in this field. Another innovation of this research is that the background conditions of Iran's economy have also been included in the model. Accordingly, oil cycles have been included in the research. In fact, oil revenues can directly or indirectly affect Iran's business cycles, which, in the long run, is considered a Dutch disease. Government expenditures are also included in this research as an indicator in the research model. The third innovation of the research is to examine the impact of sanctions and their impact (or lack of impact) on business and financial cycles and their relationship. The correlation of financial and business cycles in Iran has been studied through Bayesian models that allow analysis based on probability conditions. This is the first study to look into the relationship between business and financial cycles in the Iranian economy based on Bayesian method. The organization of the article is research background, theoretical foundations, model and estimation, and conclusion and policy suggestions.

2. Literature Review

Yan et al. (2020) analyzed business cycles and financial cycles based on US data. First, the relationship between business cycles and financial cycles was investigated in terms of frequency and time. Then the interactions and dynamics mechanisms of financial cycle, business cycle, real interest rate and exchange rate are investigated using VAR model. Experimental results show that the financial cycle is closely related to the business cycle, especially in the medium-term frequencies (8-30 years), the business cycle has a highly positive correlation with the financial cycle. However, the relationship between them is not significant when the period is 2 to 4 yeas long. In

addition, the financial cycle is not only the main factor in real interest rates, but also acts as an important source of business cycle fluctuations.

Deng-Kui et al. (2019) investigated the causality relationship between the business cycle and the stock market cycle by wavelet analysis in China. H-P filter was used to obtain the business cycle and the stock market cycle. GDP has been examined as a proxy for the business cycle. The results show that, during the boom period, the stock market cycle leads to the business cycle, while, during the recession, the business cycle leads to the stock market cycle. When the stock market cycle tends to lead the business cycle, the correlation between them is positive. On the other hand, this correlation is negative when the business cycle tends to drive the stock market cycle. The causality relationship can be affected by interest rates and business cycle shocks.

Using Bayesian analysis, Akbar et al. (2019) examined the dynamic relationships among gold prices, stock prices, exchange rates and interest rate using monthly data from the Pakistani economy. Hence, this study has been used to compare the performance of the classical VAR model and the Bayesian VAR model under four types of posterior distribution functions. All four variables remained fixed once differentiated. With the posterior normal function, the Bayesian VAR model was selected as the best model. Using MCMC simulation, better results can be obtained from Bayesian econometrics.

Yong Ma et al. (2016) examined the business cycles, financial cycles, and monetary policy. Financial cycles are studied in a four-equation model to study the relationships and interactions among financial cycles, business cycles, and monetary policy. The results show that financial cycles play an important role in business cycles, and financial cycle shocks have become a major driver of macroeconomic fluctuations, especially in financial instability.

In their article, Jalaei et al. (2016) extracted business cycles and examined the effect and size of cycles of total demand variables in

creating business cycles in the Iranian economy. In this regard, Hodrick–Prescott filter and Markov-Switching Model were employed to study the business cycles. The results indicate an asymmetry in production cycles in Iran. The results also show that the three variables of consumption, investment and government spending are all simultaneous and directional variables with business cycles. The causal relationship of all three variables was bilateral with business cycles.

Makian et al. (2016) investigated the relationship between theft and income inequality using Bayesian approach with Jeffrey's prior function. In order to perform statistical inference using the Metropolis-Hastings algorithm, the results indicate a positive and significant effect of income inequalities on theft. Education costs also had a negative relationship with theft, but inflation did not have a significant effect on this variable.

Gholami et al. (2014) examined business cycles and the impact of financial stimuli on this cycle in Iran. First, they used the Hodrick–Prescott filter and then estimated a VAR pattern. The results show that the best financial incentive for the government to stimulate economic growth during recession is to increase government spending and tax cuts in prosperity. Ainian et al. (2014) identified and dated the business cycles of the Iranian economy.

Ainian et al. (2014) identified and dated the business cycles of the Iranian economy. In this paper. After identifying business cycles, a reliable dating was presented for the boom and recession between 1988 and 2008 using a large set of economic data and Bry-Boschan algorithm. The results show that the date obtained from GDP without the oil sector is relatively valid.

Apostoaie et al. (2014) studied the behavior and interaction between business cycles and credit cycles in developed European countries. This study considers quarterly data including GDP and the total credits given to the non-bank private sector by credit institutions for 20 European countries. BK filter was used to de-trend as well as

Granger causality to examine the relationship between these two variables. First, the short-term dynamics of the relationship is examined between credit development and economic growth. On the other hand, the cyclic components of the two variables are examined through statistical analysis of the medium-term relationship among them (fluctuations, amplitude, correlation and overflow effects). The results show a strong dynamic relationship between credit development and economic growth in all countries. The results also show that the two variables experience co-movement.

Ball (2014) assessed the long-term effects of the global financial crisis on actual and potential output in the 23 countries of OECD. The results show that the level of potential production has decreased by 8.4 percent on average.

Claessens et al. (2012) examined the interaction between business cycles and financial cycles. The quarterly series data includes 44 countries, 21 developed OECD countries and 23 emerging countries. GDP is considered for business cycles because it is a comprehensive measure of the economic activity of a large group of countries over a long period. For financial cycles, they studied three financial markets: credit, housing, and stock markets. The results show that there are strong correlations between different phases of business and financial cycles. In particular, the economic crisis associated with financial disturbances, especially falling stock and housing prices, tends to be deeper than other economic crises. Conversely, if followed by an improvement, the fall in asset prices will be reduced, and the improvements associated with the rapid growth in housing and credit prices will often be stronger. These findings underscore the importance of developing financial markets for the real economy.

Houshmand et al. (2008) investigated the co-movement of macroeconomic variables and business cycles in Iran. They used the Hodrick-Prescott (HP) filter. Their results showed that consumption, investment, government spending and exports are in line with cyclical variables in Iran. Money supply, consumer price index and inflation,

on the other hand, were anti-cyclical variables. The results of Granger causality test indicate that fluctuations in oil and gas exports can be recognized as the main source of business cycles in the Iranian economy.

Karimlou et al. (2006) compared the Bayesian and classical methods for estimating the parameters of the logistic regression model. Using the likelihood function, the parameters are estimated using both the classical maximum likelihood method and the Bayesian method using the Markov chain Monte Carlo (MCMC), and the values are then compared. The model estimates presented in this study by Bayesian method were closer to the standard model estimates for complete data than other estimation methods.

In comparison with other studies, the innovation of this research is to take advantage of Bayesian econometric method. In addition, incorporating the most up-to-date data of Iranian economy is considered as strength.

3. Theoretical Foundations

3.1 Business Cycles

Burns and Mitchell (1946) define the business cycle as a pattern seen in each Y_t series that represents total economic activity. In defining cycles, the logarithm of each Y_t series ($y_t = \ln (Y_t)$) is usually considered.

The business cycle will largely determine whether real GDP is growing or declining (Jeffrey et al., 2019). The business cycle, according to the descriptions of Lucas (1977) and Kydland and Prescott (1990), is expressed as deviations from real GDP. In this study, the business cycle index is GDP at a constant price in 2011 because it is a comprehensive measure that follows the economic activity for a large group of countries over a long period. The same variables were used in the studies by Clasness (2012) and Si (2019).

3.2 Financial cycles

Choosing financial variables to build the financial cycle is challenging. According to the existing literature, it can be seen that financial variables (credits, housing prices, stock prices) generally show the financial cycle in many studies, including Yan, 2019; Clasness, 2011; StéphaneDees, 2016, Apostoaie, 2014; Woodford 2010; Oliveira, 2014; Tyler, 2012; Antonakakis et al., 2016; and Chen, 2012.

3.2.1 Stock Market Cycles

The stock market can approximate the economic structure. In fact, the overall stock market index, like a thermometer, shows the overall state of the economy and market. Decreasing index usually means economic recession, while its increase means economic prosperity, which was evaluated in the studies of Karimzadeh (2006), Samadi (2006), Rostami (2013), Si (2019), Clasness (2012) have been evaluated.

3.2.2 Housing Market Cycle

Real estate activity (housing) has either a direct effect on the economy (revenue generation) or an indirect one (affecting the development of other commercial sectors, such as construction, steel, iron, concrete, and wood). Despite the complex relationship between the housing sector and other economic activities, housing cycles have certain characteristics that differentiate their formation and structure from the stock and credit cycle (Oliveira, 2014). Depending on the country of origin, housing prices follow different indicators of house or land prices (Clasness, 2012). In this study, the average value per square meter is considered. This financial index has been evaluated in the studies of Deez, 2016; Clasness, 2012; and King, 2017.

3.2.3 Credit Cycle

Credits are natural sets for analyzing the financial cycles because they show the relationship between savings and investment (Mendoza and Thrones, 2008). Due to the expansion of the Iran’s banking system in

recent years and the increase in credits and services of banks, the study of the impact of banking performance on business cycles has become very important (Taybi 1389). This has been used as a measure of the financial cycle in many studies, including Bartolto, 2019; Diz, 2016; Clasness, 2012; and Lambertini, 2011.

Government current payments have also been used to examine fiscal policies and the role of government in shaping business cycles. Barro (1990) designed a model to show that government spending can lead to an upward cycle and economic prosperity when government spending is to correct side effects, monopolies, and public goods issues. Numerous researchers, including Barseghyan et al. (2013); Mourre et al. (2014); and Papageorgiou (2016) have examined the different effects of government spending on business cycles in recent years and Due to the heavy dependence of Iran's economy on oil revenues and the high share of oil in Iran's economy, the occurrence of shocks in oil revenues can affect the structure of Iran's economy (Sayadi, 2015: 87), which was investigated in the present study. This variable was also evaluated as a variable affecting business cycles in Shariati (2010) and Damirchi (2010).

3.4 Measuring Cycles

One of the most important topics in the analysis of cycles is the separation of trends and epochs in time series. For this purpose, several methods have been developed and introduced, among which the Hodrick-Prescott filter is one of the most prominent ones. To study the characteristics of business and financial cycles, the fluctuations of series cycles should be separated from its long-term growth. In the present study, to extract time series components, the Hodrick-Prescott filter was used in two stages.

In the first stage, this filter is used to extract the long-term trend (y_t-τ_t) and in the second stage, the cycle component is extracted from stable long-term trend (Tayeb Nia and Ghasemi, 2010).

3.5 Assessing the Causality of Variables

Although regression analysis examines the dependence of one variable on others, this does not mean that there is a cause or, in other words, a cause-and-effect relationship. Therefore, this study first examines the direction of causality between the indicators of financial cycles and business cycle with the help of Granger causality test.

With the help of Granger causality or periodic causality, the causal direction can be statistically detected while there is a relationship between precedence and lag between the two variables.

Before estimating the model, we must first obtain the optimal interval length of the variables. This step is extremely important because the results of the causality test depend on the number of intervals. Few and too many numbers may cause problems. Too many lags mean that some important variables are removed from the model. Therefore, incorrect results will be obtained.

4. Methodology

4.1 Bayesian Model with Jeffrey's Prior Distribution Function

According to the studies of Karimloo et al. (2006), Akbar et al. (2019), Sims (2007), Literman (1986) and Robertson and Talman (1999), the Bayesian model is superior to the classical model because it overcomes the problem of over-fitting by combining previous parameter information with sample one. Approaches that use previous information and knowledge in this area, in addition to data, are inevitable. Since the samples related to these variables are small in volume, the statistical inference associated with them has high error. Therefore, an approach that does not rely solely on sample size and take into account researchers' knowledge of the relationships between variables is required. Accordingly, in the present study, the relationship between business cycles and financial cycles has been investigated using a Bayesian model with a strong multivariate Jeffrey's prior function. In this study, the following regression model

has been used to investigate the factors affecting business cycles in Iran:

$$Y = \alpha + \beta_1 stock + \beta_2 house + \beta_3 facility + \beta_4\ oil + \beta_5\ payment + \varepsilon \quad (1)$$

where the dependent variable Y represents the cycles of GDP (business cycles), *Stock* represents the total index cycles of the stock exchange, *House* represents the cycles of the housing market, *Facility* represents the cycles of current lending facilities, *Oil* represents the cycle of oil revenue and *Payment* reflect the government's current payment cycles.

Assuming that the distribution of the dependent variable Y is normal, the parameters of model (1) with the Jeffrey prior distribution will be as follows:

$Y_t \sim N(X\ \beta\ \sigma^2)$;

$X = \{dtock, house, facility, oil, payment\}\ \&\ \beta = (\alpha, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5)$

g $(\beta\ , \sigma^2) \sim 1/\sigma^2$

where the prior density is g $(c\ , \sigma^2) \sim 1/\sigma^2$ assuming the independence of σ and β and K; K = 1,2,…, 5. The marginal densities of the coefficients are g$(\beta) \propto constant$ and the marginal densities of the variance are $g\ (\sigma^2) \propto \frac{1}{\sigma^2}$. Based on this, the business cycle orthogonality function, Y, is defined as follows:

$$l\ (\beta, \sigma^2) = (2\pi)^{\frac{5}{2}}\sigma^{-5}\exp\{-\frac{1}{2\sigma^2}[(Y - X\beta)'(Y - X\beta)]\}$$

After removing the fixed expression from the above equation and some algebraic calculations of the above function, it can be rewritten as follows:

$$l(\beta, \sigma|Y) \propto \sigma^{-5}\exp\left\{-\frac{1}{2}\left[\hat{\sigma}^2 + \left(\beta - \hat{\beta}\right)' X'X\left(\beta - \hat{\beta}\right)\right]\right\} \quad (2)$$

Now, we combine the likelihood function (2) and the prior density function to obtain the posterior density function according to the Bayesian rule and reach the following result:

$$g\ (\beta, \sigma^2|Y) \propto g\ (\beta, \sigma^2) l(\beta, \sigma^2|Y) \propto \sigma^{-6}\exp\left\{-\frac{1}{2}\left[\hat{\sigma}^2 + (\beta - \hat{\beta})' X'X\left((\beta - \hat{\beta})\right)\right]\right\} \quad (3)$$

This function combines the posterior margin densities of the parameters as follows:

$$g\ (\beta, \sigma|Y) = g(\beta|\sigma, Y).\, g(\sigma|Y) \quad (4)$$

To calculate the first-order torque (mathematical expectation) of the posterior density of parameters (as the final output of the model), we will have the following general form:

$$E[g(\theta)] = \int g(\theta)\, p(\theta|Y)\ d\theta \quad ; \theta = \beta, \sigma \quad (5)$$

This relationship is not possible, except in rare and exceptional cases, with analytical methods for solving integrals, so simulation methods should be used for these calculations. For this purpose, the Monte Carlo method can be used to approximate the integral (8) (Tierney, 1994). The integrated Monte Carlo simulation method solves the Bayesian problem of calculating posterior density moments using sampling of that posterior distribution, but this method has certain disadvantages, such as curse of dimensionality (Von Neumann, 1951). An alternative solution to this problem is to use Markov chains to generate sequences of sample points dependent on the amplitude of the posterior density distribution at a reasonable acceptance rate. To perform Bayesian analysis and obtain parameter estimation, data analysis cannot be performed in a usual way. In this case, we have to sample complex retrospective distributions using simulation methods, including the Markov chain Monte Carlo (MCMC) method. To increase the accuracy and control of the error, it is necessary to sample from the Metropolis-Hastings algorithm and then estimate the parameters. The Metropolis algorithm was proposed by Metropolis Ulam (1949) and has also been used in studies by Makian and Eskandari.

4.2 Research Data

In this study, the effect of the logarithm of 5 explanatory variables, as described in Table1, was investigated on the logarithm of GDP (as a dependent variable of the business cycle).

Table 1. Research Data

Variable group	Introduction of variables and associated remarks	Source of data collection
Dependent	GDP logarithm, GDP, at the base price of 2011 (Billion IRR)	Central Bank of Iran
Independent	The logarithm of the total index of Tehran Stock Exchange, taken from the market performance report (monthly). This report was prepared by the Statistics and Information Office.	Tehran Stock Exchange Organization
Independent	The logarithm of the value of one square meter. (Billion IRR), these data are collected from the sector of buildings completed by the private sector in urban areas.	Central Bank of Iran
Independent	Logarithm of bank credits granted to governmental and non-governmental sectors (Billion IRR)	Central Bank of Iran
Independent	Logarithm of resources resulting from the sales of oil and petroleum products (Billion IRR)	Central Bank of Iran
Independent	Logarithm of current government payments (Billion RIRR)	Central Bank of Iran

Source: Research finding.

4.3 Estimation of Econometric Model

This section discusses the estimation of Model 1 presented in the research methodology section. Before estimating the regression model, stationarity and structural break tests must first be applied to ensure the accuracy of the model. Causality must also be tested to examine the relationships between variables. After confirming the accuracy of the model and the relationship between the variables, the numerical results of the model parameters are estimated and interpreted using the Metropolis-Hastings algorithm. It should be noted that before Bayesian inference, the fit of the model should be confirmed using the graphs for the dependent variable, explanatory variable and variance of intercept, and to ensure the average posterior density of all model parameters, the sampling efficiency should also be examined. According to Graphs 3 to 8, the goodness of fit of the model is confirmed, and according to Table 8, the efficiency of the sample is confirmed.

4.3.1 Stationary Test

Prior to estimating the model, it is essential to ensure the stationary state of variables in order to have reliable results. Dickey-Fuller is one of the most common and simple tests to determine the grade of non-stationary series. First, the Dickey-Fuller unit root test is run to measure stationary or non-stationary state. In this test, the absolute value of the statistic must be greater than the critical values and the Prob level must be less than 0.05, in which case the desired series will be stationary. According to this test, the logarithm of the cycles of all variables is stationary at the level of 5%.

Table 2. Interpolated Dickey-Fuller

variable	t-Statistic	5% Critical Value	prob	Result
Business cycles	-2.572	-1.950	0.0116	stationary
Stock Exchange Index Cycles	-4.750	-2.957	0.0006	stationary
Housing sector cycles	-2.983	1.953-	0.0043	stationary
Credit cycles	-2.428	-1.950	0.0166	stationary
Oil Revenues Cycles	-2.038	-1.951	0.0414	stationary
Current government payment cycles	-9.397	-1.951	0.0000	stationary

Source: Research finding.

4.3.2 Structural Break Test

Structural break is common in economic time series due to shocks such as war, sanctions, etc. Structural break causes the regression results to be inadequate and will lose the ability to predict correctly. Due to the importance of the subject and to validate the estimation model, it is necessary to first perform a stationarity test with structural break for the variables used, and if a structural break is shown, a structural break test should be applied.

The stationarity test with structural break shows a structural break for the business cycle variables (GDP) and the housing cycles (Figures 1 and 2) over the period 2009–2011. Therefore, this hypothesis should be confirmed for the mentioned variables by a structural break test.

From the test for structural break (Tables 4 and 5), at probability level less than 0.05, the null hypothesis that the first 20% of the data have no break is rejected. Considering the fact that structural break was visible in 20% of the data examined and there is no structural

break in the other 80%, it is concluded that the model is approved in terms of structural stability given the larger amount of data with no structural break.

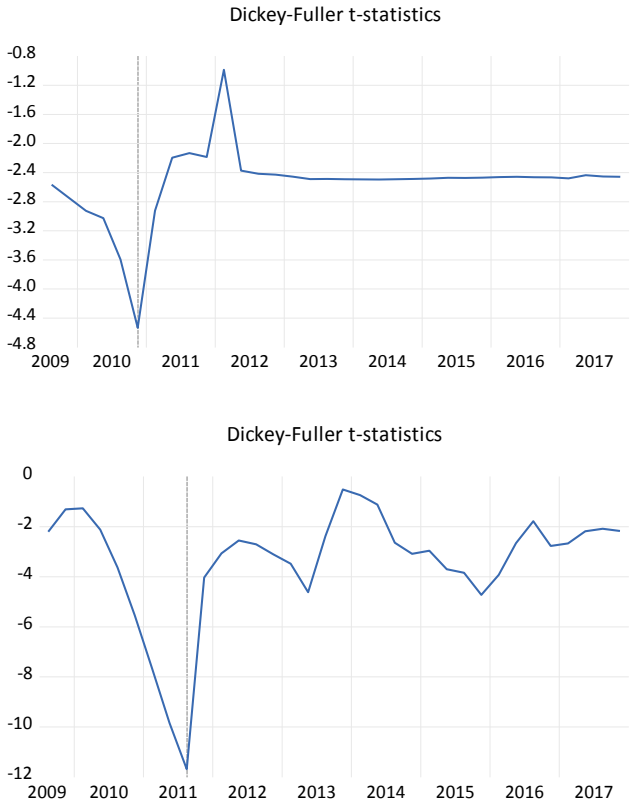

Figure 2. Stationary Test With Structural Break Of Housing Sector Cycle Variables
Source: Research finding.

Table 4. Quandt-Andrews Unknown Breakpoint Test Null Hypothesis: No breakpoints within 20% Trimmed Data

Statistic	**Value**	**prob**
Maximum LR F-statistic (2016Q2)	9.137093	0.0326
Maximum Wald F-statistic (2016Q2)	9.137093	0.0326

Source: Research finding.

Granger causality is then examined between business and financial cycles. According to Schwartz Criterion (SC) in Table 5, the best lag is 2.

Table 5. Results of Optimal Lag Length Test in VAR Model Based on SC

LogL	LR	FPE	AIC	SC	HQ
764.7634	NA	5.96e-27	-43.35791	-43.09128	-43.26587
1284.333	831.3110	6.15e-39	-70.99045	-69.12403	-70.34616
1742.779	576.3325*	2.44e-49*	-95.13024*	-91.66403*	-93.93370*

Source: Research finding.

Table 6. Granger Causality

Null Hypothesis	F Stat.	Probability
Oil revenue cycles are not the Granger cause of economic growth cycles.	27.9376	0.0000001
Economic growth cycles are not the Granger cause of oil revenue cycles.	17.5996	0.000009
Stock index cycles are not the Granger cause of economic growth cycles.	17.5043	0.000009
Economic growth cycles are not the Granger cause of stock index cycles	8.59828	0.0011
Current payment cycles are not the Granger cause of economic growth cycles.	41.4030	0.000000002
Economic growth cycles are not the Granger cause of current payment cycles.	646.142	10-25*2
Housing sector cycles are not the Granger cause of economic growth cycles.	35.5917	0.00000001
Economic growth cycles are not the Granger cause of housing sector cycles.	202.484	10-18*4
Credit cycles are not the Granger cause of economic growth cycles.	1.30025	0.2874
Economic growth cycles are not the Granger cause of credit cycles.	0.85855	0.4339

Source: Research finding.

As can be seen from Table (6), due to the significance of F-statistic and the probability of less than 0.05, the existence of a two-way causal relationship is confirmed between cyclical variables of oil revenues, stock index, current government payments and housing with business cycles. However, since the F-statistic obtained from the credits and business cycles is not significant, the existence of a causal relationship cannot be accepted.

4.4 Bayesian Model Estimation

After introducing the method, the numerical results of the parameters of model (1) are estimated and interpreted. In order to perform the statistical inference using the Metropolis-Hastings algorithm for 12,500 repetitions (the number of repetitions by MCMC simulator), the following results are reported for samples of 10,000 and the acceptance rate of 0.2363. In the metropolis simulation method, the acceptance rate or, in other words, the acceptance rate of the algorithm operation should be within the confidence level between 0.15 and

0.25. Then the estimation model is associated with relative efficiency. Table 7 shows these results:

Table 7. Results of Bayesian Model

	Median Posterior distribution	**Posterior - distribution standard deviation**	**Average Posterior distribution**	**95% Significance Interval**	
Business cycles					
Stock Exchange Index Cycles	0.62612	0.103448	0.631267	- 0.1340415	0.2740263
Housing sector cycles	-1.126334	0.2220227	-1.132571	- 1.565554	- 0.6911448
Credit cycles	0.0011893	0.0021832	0.0012546	- 0.0032415	0.0054959
Oil Revenues Cycles	-0.465779	0.2809401	-0.4663944	- 1.014	0.0706241
Current government payment cycles	0.9932064	0.1958815	0.9874922	0.6088188	1.374868
Var_0	0.000067	0.0000171	0.0000641	0.000041	0.0001079
_Cons Y	0.5552252	0.3077435	0.545071	- 0.0521856	1.158392

Source: Research finding.

Before interpreting the results of the table above, it should be noted that the last two columns of the table show the 95% validity interval of posterior mean of each estimated parameter. These two columns do not contain zero for the cyclical variables of the housing sector and current government payments, which means that business cycles have a significant relationship with these two variables. However, business cycles have no significant relationship with stock index cycles, oil revenues and credits. The proximity of posterior distribution mean and median indicates the symmetry of the posterior distribution of the parameters.

According to the results, based on the posterior mean of the coefficients of the explanatory variables, the coefficient of the cyclical variables related to the housing sector is negative and significant so that one percent increase in housing sector cycles leads to a decrease in business cycles by 1.126334 percent. This is due to the economic situation in Iran. In fact, it is expected that, under normal circumstances, the relationship between housing cycles and business cycles will be a positive one, but it is negative because, in the Iranian economy, there are macroeconomic instability conditions, such as high inflation with exchange rate fluctuations and the frequent Dutch disease. We can point out to the results of Nademi and Khochiani

(2018) and Naji Maidani et al. (2010) in order to compare the results of this study with others. According to their results, the housing price index has been in line with business cycles and their findings are not consistent with the findings of our model. However, the findings of Yarmohammadian (2017), Rostamzadeh et al. (2017) and the study of the Building and Housing Research Center (2010) have evaluated a significant and negative relationship between housing and business cycles, and these studies are consistent with our results.

According to the estimation results, the relationship between current government payment cycles and business cycles is significant and positive. As expected, the government expenditure cycle index has a positive effect on the business cycle index, so that one percent increase in government expenditure cycles leads to an increase in business cycles by 0.9932064%. The positive nature of this variable indicates the important position of the government in the Iranian economy. Also, the cycles of government expenditures in studies by Dargahi and Charkhandeh (2006), Gholami (2014), Molaei and Golkhandan (2014), Jalaei (2015), Dimerchi (2010), and Samadi (2006) have been determined as research findings in accordance with the cycle.

Considering the 95% validity lag of estimated posterior mean, there is no significant relationship between oil revenue cycles and business cycles. Given Iran's small role in determining world oil prices (Hemmati and Zamani, 2007), it can be said that the business cycles of Iran's economy are not affected by the exogenous shock of oil prices. Similar to the results of research conducted by Bashiri et al. (2017) and Shahmoradi et al. (2011), oil revenue shock does not explain many production fluctuations, which are consistent with our model. In addition, considering the estimated confidence interval, the effect of the stock exchange index cycles on business cycles is not significant. According to the study of Avoee et al. (2005) and Rostami and Karroubi (2014), the stock period is shorter than GDP, so they may

not be in the same frequency or correlation with each other, which confirms our results. Finally, the effect of governmental and non-governmental credit cycles on business cycles is not significant. In this regard, Nili and Mahmoudzadeh (2014) and Seifi and Mohseni (2015) studied business and credit cycles. Their results indicate a significant yet negative relationship that has not been achieved in this study. Another way to confirm the fitting power of the model is to use dependent, explanatory and variance diagrams of sections, which are specified as follows:

In order to enable valid Bayesian inference based on the sample obtained from the MCMC simulation, the convergence of the Markov chains of the algorithm was investigated. The flatter the autocorrelation diagram, the better the fit of the integral sampling algorithm and the more valid the estimation model. If the flattening of the plot of variance of intercept and variables is slow, it indicates a weakness in the model due to the small amount of random data (West, 2013: 1). Figure 3 is a simulated multiple posterior density variable of the stock market cycles, where the autocorrelation diagram shows the convergence of the algorithm in simulating the parameters from about the 20-lag. The trace diagram represents a complete diagram and shows no trend, which also indicates convergence of the model. The density plot shows normal distribution. The autocorrelation diagrams also converge almost after the 20-lag for the variables of housing market cycles (Figure 4), credit cycles (Figure 5), oil revenue cycles (Figure 6), government payment cycles (Figure 7) and model variance (Figure 8). The trace diagrams converged almost after the 20th lag. They show no specific trend and indicate convergence of the model. Their distribution is also normal. In general, we can say that these variables are convergent.

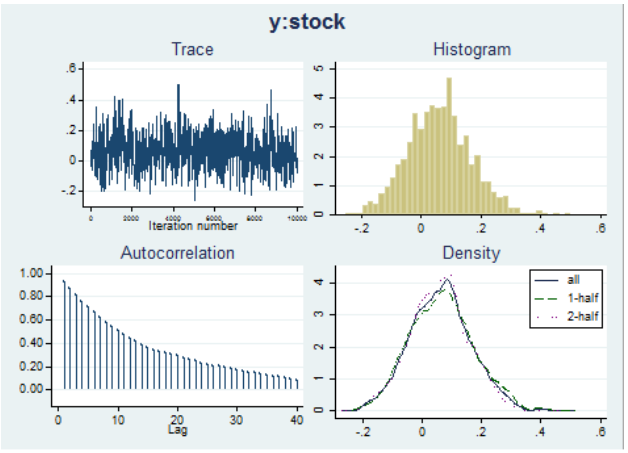

Figure 3. Multiple Posterior Density Simulated with MCMC for Stock Market Cycles
Source: Research finding.

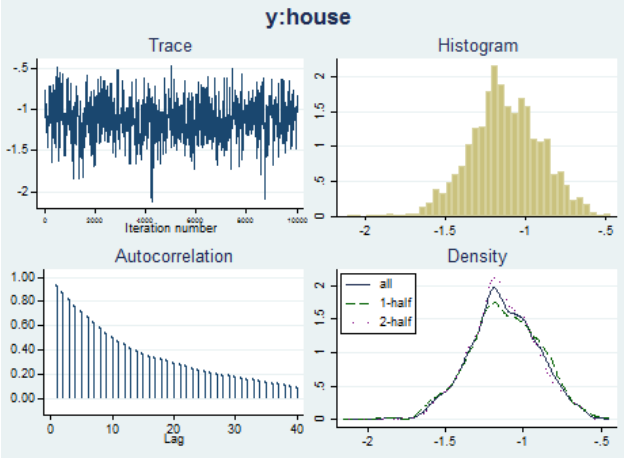

Figure 4. Multiple Posterior Density Simulated with MCMC for Housing Market Cycles
Source: Research finding.

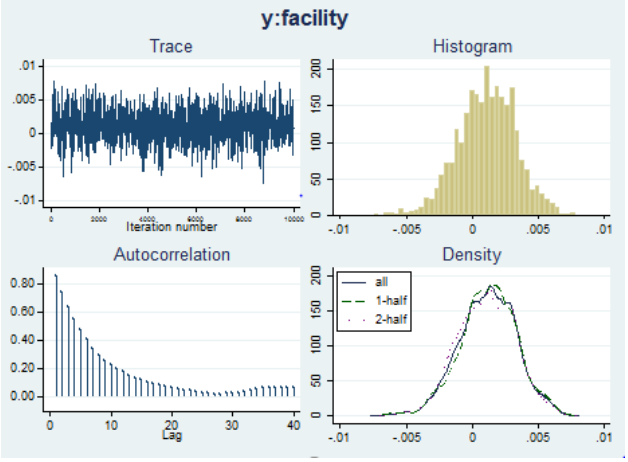

Figure 5. Multiple Posterior Density Simulated with MCMC for Credits
Source: Research finding.

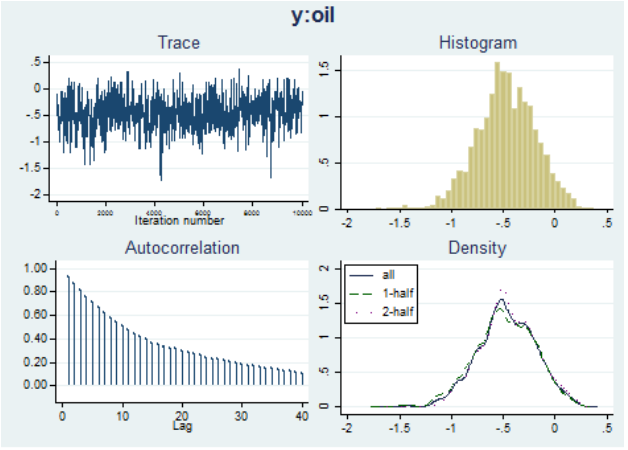

Figure 6. Multiple Posterior Density Simulated with MCMC for Oil Revenues
Source: Research finding.

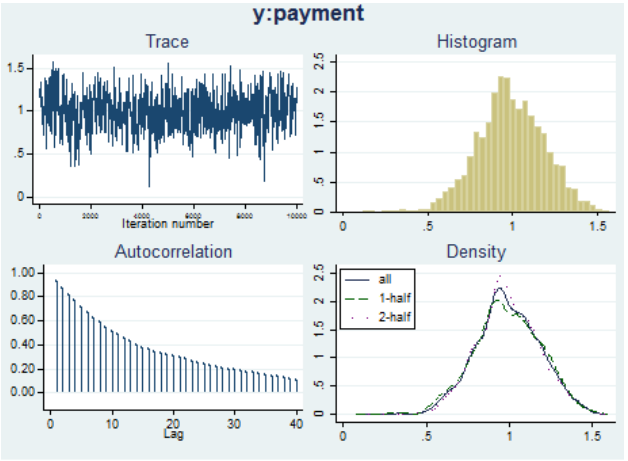

Figure 7. Multiple posterior Density Simulated with MCMC for Government Payments
Source: Research finding.

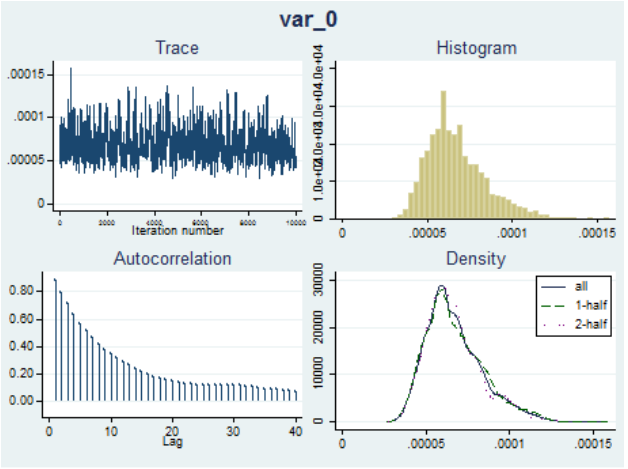

Figure 8. Multiple Posterior Density Simulated with MCMC
Source: Research finding.

Another important criterion to consider before inferring Bayesian is the Effective Sample Size (ESS) shown in Table 5 for simulated MCMC of EMS:

Table 8. ESS of Equation Variables

	ESS Effective Sample Size	**Corr. time Correlation of Time**	**Efficiency**
Business cycles			
Stock Exchange Index Cycles	298.34	33.52	0.0298
Housing sector cycles	310.66	32.19	0.0311
Credit cycles	648.13	15.43	0.0648
Oil Revenues Cycles	286.08	34.96	0.0286
Current government payment cycles	277.23	36.07	0.0277
Var_0	412.36	24.25	0.0412
_Cons Y	277.74	36.00	0.0278

Source: Research finding.

The table above shows that the efficiency of the sample for estimating the mean posterior density of all parameters of Equation (1) is not less than one percent. For example, the efficiency of the sample size for the stock market index cycles is about 2%, meaning that, according to the sample size of 10,000 obtained from the MCMC simulation, almost 200 (0.02 * 10000) independent observation is available for the approximation of the transfer kernel. Therefore, based on this quantity, among the post-density variables, housing cycles and credits will have a relatively more accurate estimate, because there are more independent observations for this estimate.

5. Conclusion

Economic fluctuations and changes in a country's business cycles play an important role in the economic performance and destiny of every country. This makes is important to examine the state of the business cycle in a country and to identify periods of recession and economic prosperity, and the global financial crisis of 2008 has revealed that financial cycles play a much greater role in macroeconomic dynamism. These developments have led to intensive discussions about the relationship between macroeconomics and finance, and have directed studies to the interactions between business and financial cycles. As a result, the main purpose of this study is to investigate the

relationship between financial and business cycles for the period from 2009:3 to 2018: 3. According to the research background and theoretical foundations in this study, variables such as the total index of Tehran Stock Exchange, the average value of one square meter of land, current government and non-government credits, oil revenues and current government payments were used. Gross Domestic Product (GDP) is considered as an indicator of the business cycle. In this study, the periods of recession and economic prosperity were identified using Hodrick-Prescott with the knowledge of the existence of cycles in the Iranian economy. In the second stage, the stationary test and structural failure were performed in order to ensure the validity of the model. The validity of the model was confirmed. Granger causality test was performed to investigate the relationship between financial cycle and business cycle. Finally, Bayesian econometric method was used to estimate the model. Like the classical methods, this method is not involved with large samples. Bayesian inference is also accurate due to the use of posterior distribution in the estimation and forecasting stages, which posterior distribution is calculated either analytically or numerically. In order to avoid being affected by the anterior density function, the Jeffrey anterior density function was used. The results indicate that the housing sector has an inverse and significant effect on business cycles, showing that, in a situation where the Iranian economy is entering a recession, it is possible to get out of the recession by applying appropriate policies in the housing sector. Housing is one of the most important economic sectors which can, as a leading sector, can mobilize other economic sectors due to the wide level of interaction between other sectors with other economic sectors. The government can also play an important role in controlling and organizing the destructive effects of housing market cycles. For example, to prevent the occurrence of the Dutch disease, taking special measures into account to reduce the dependence of the economy on oil revenues

along with proper management of these revenues can largely prevent fluctuations in the housing sector. In other words, the government can make optimal use of foreign exchange earnings from oil and gas, such as investing these resources in profitable options, storing these revenues in capital funds, allocating these resources to infrastructure, and generally changing the attitude of officials towards oil sales from consumerism to capitals, which can reduce the flow of resources toward capital markets and trading activities. Government payments cycles have a positive and significant effect on business cycles, which shows that business cycles and current payments are in the same direction and strengthen each other. This indicates the favorable behavior of the current payments of the government. That means that positive (negative) changes in production are associated with positive (negative) changes in current government payments in the Iranian economy in the period under review. In fact, when the economy enters a period of recession, the government is unable to borrow and smooth its spending, thus reducing public spending. The government's inability to borrow leads to a pro-cyclical behavior of public spending in the recession. Therefore, in times of recession, the necessary policy should be applied for economic stability and reduce economic fluctuations. Theoretically and practically, this article can be a starting point for further research on the characteristics of financial cycles and the interaction between the variables of financial and business cycles in the Iranian economy and comparison with other countries. Therefore, it seems interesting to examine the channels that indirectly affect oil revenues and pay attention to the interaction of interest rates in formal and informal markets.

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