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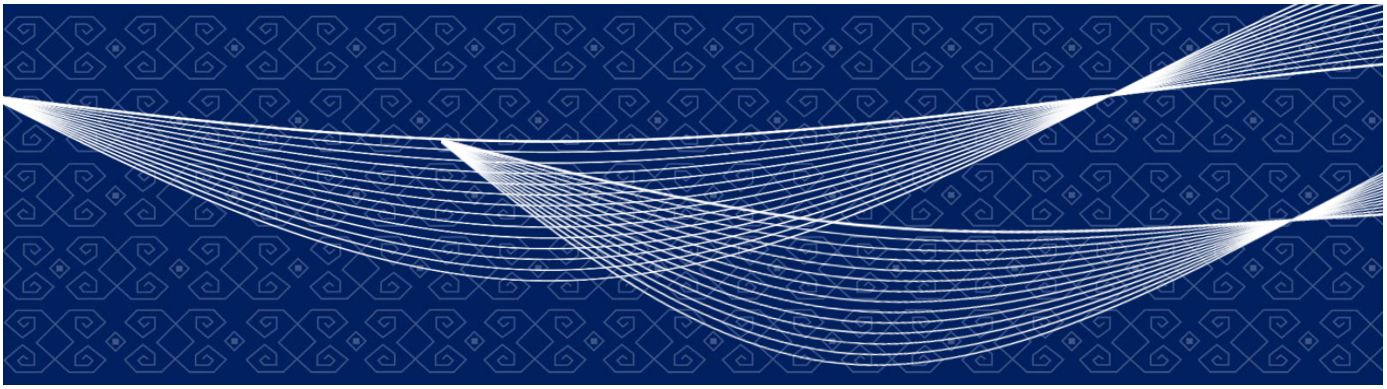

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WORKING PAPER

BUSINESS AND FINANCIAL CYCLE IN INDONESIA: AN INTEGRATED APPROACH

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Abstract

This study discusses business cycle and financial cycle in Indonesia. In the first stage, the multivariate Kalman Filter estimation is carried out on the output gap and credit gap specifications which are derived by considering the IS curve, dominant currency pricing, financial frictions, and credit shocks. In the second stage, the financial cycle is constructed via common cycles and principal components by combining various financial indicators, including indicators of total credit obtained based on the results in the previous stage, asset prices, risk taking, banking indicators, corporate leverage, external exposure, and risk appetite. Based on several evaluation metrics, the resulting business and financial cycle are consistent to the dynamics of economic and financial conditions in Indonesia, which were triggered either by domestic or external events. The business cycle and financial cycle have been shown to have similar characteristics, although financial cycle has a longer average duration. Business cycle tends to precede the financial cycle.

Keywords: Business cycle, financial cycle, output gap, multivariate filtering, Kalman filter, principal component analysis, risk taking, dominant currency pricing, capital flows, commodity prices

JEL Classifications: E32, C32, C38, E50, F30, F40

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1. Introduction

An assessment of the current state of the business and financial cycle has a major influence on how the authorities determine the appropriate policy formulation. In addition, the knowledge of the duration of the business and financial cycle are useful in determining a forward-looking policy mix so that it can provide forward guidance for the public on the policy stance to be taken in the future. Fluctuations of economic activity in a small open economy is heavily influenced by external and domestic factors. From the external side, changes in global economic conditions to also affect the movement of domestic economic activity. From the domestic side, supply and demand factors also contributed to the ups and downs of economic activity.

This study aims to revisit the movement of the Indonesian business and financial cycle, the duration of both cycles, interrelationships and the factors that influence both cycles. The analysis of the Indonesian economic and financial cycles has been carried out several times on Indonesia data. Several earliest empirical estimates after the global financial crisis are Wimanda and Djuranovik (2014), Alamsyah et al. (2014) and Harun et al. (2014). Harahap et al. (2017) updates frequency-based estimation and adds spectral analysis. Bary et al. (2019) adds some time-varying discussion on monetary policy effects. Harahap et al. (2018) adds discussion on linkage with global cycles. Harahap and Bary (2017) estimates finance-neutral output gap. Surjaningsih et al. (2019) constructs composite financial cycle. Considering these past papers, there is very limited analysis that directly considers the relationship between business and financial cycle, and estimates those two simultaneously.

The link between business and financial cycle is not new in the literature. Baba et al (2020) extracts the economic cycle and the financial cycle in an integrated manner by considering other macroeconomic variables as control variables by Multivariate Filtering (MVF) approach. The domestic cycle can also be correlated with global cycle through various ways, e.g. as global banks being financially connected to domestic banks (Bruno and Shin, 2015), via international trade, or as commodity prices is a determinant of global financial cycle (Miranda-Agrippino and Rey (2020). Aldasoro et al (2020) indicate the link between short term business cycles and global financial cycles, and between medium term business cycles and domestic financial cycles. However, cycles duration between emerging and advanced economies are likely differ (Pontines, 2017). Prabeesh et al. (2021) also note a different synchronization of global and domestic cycles between India and Indonesia.

Aside from providing a simultaneous estimation of business and financial cycles of Indonesia, this paper provides some potential contributions to the literature as follows. First, this paper combines two different approaches by initially estimating multivariate filtering and followed by forming a synthetic financial cycle. Second, this paper uses a relatively simple approach but covers implication of macrofinancial linkages, dominant currency paradigm and several other micro-founded insights. Third, this paper adds case study in an emerging economy, which has some idiosyncratic issues.

2. Conceptual Overview

2.1. Business cycle

The economic cycle is defined as fluctuations in economic activity as reflected by fluctuations in real output around potential output. The economic cycle is formed from the phases of the economy, namely the expansion (acceleration) and contraction (deceleration)

phases. The expansion phase occurs when the economy's output rises and vice versa if output falls it is called the contraction phase. The New-Keynesian theoretical model explains that the economic cycle is basically a short-term economic fluctuation that occurs due to fluctuations in aggregate demand. This was driven by fluctuations in investment activity and consumption spending.

In the economic cycle literature, there are several types of cycles that are distinguished according to their length, namely Kitchin (2-5 years), Juglar (5-10 years), Kuznets swings (10-30 years), and Kondratieff (30-50 years) (see Tsirel, 2010). However, some literatures are skeptical of types of cycle that are too long, particularly Kondratieff. Since 1980, studies related to business cycles have focused more on cycles with a maximum duration of 30 years. When viewed from the source aspect, the Kitchin cycle is related to the interaction of inventory dynamics (supply-demand gap) and unemployment. The Juglar cycle is related to the rate of machine depreciation (reinvestment), Kuznets swings is related to demographics, and the Kondratieff cycle is related to changes in the technology used. Of the various sources of the cycle, the cause that is most relevant to the context of macroeconomic stabilization and monetary policy is a shorter cycle, because it is related to inventory and unemployment which have an impact on inflation. In line with this thinking, one study looked at the impact of monetary policy on the development of manufacturing firms' sales and inventories (see Gertler and Gilchrist, 1994).

At the theoretical level, the business cycle with these characteristics is related to aggregate fluctuations whose analysis begins with a real business cycle approach. The empirical literature of this approach finds that the movement of output in the economy is not constant, where there are random disturbances that occur from time to time, which are ultimately transmitted to the economy. For example, unemployment will increase because output goes into a recession. In addition, real wages have also decreased. McCallum (1989) proved that the real business cycle theory implies an output dynamic where the output deviation from the normal path follows a second order autoregressive process. This will make the output response to the disturbance with a "hump-shaped" pattern. Eventually, the output will fluctuate smoothly up and down over its normal path.

Real business cycle theory is less able to explain source of fluctuations well considering that the only source of disturbance is technology – while technological change is often considered to have a very long duration. For this reason, the discussion of aggregate fluctuations, at least for monetary and macroprudential policy purposes, should be developed using the Keynesian approach. Given that the business cycle is represented by output, and the dynamics of output in the macroeconomic literature is influenced by the IS (investment-saving) curve, the discussion of the business cycle will also be related to the formation of the IS equation. As is well known, the IS curve explains that output will be negatively affected by the real interest rate. Proof of microfoundations through maximization of intertemporal utility function, among others, in the New Keynesian literature provides consistent results supporting this relationship (see, among others, Woodford, 2003).

As a small open economy, the relevant discussions for Indonesia are those related to the open economy. To develop the New Keynesian closed economy model to an open economy, the effects of international goods markets and international financial markets on the domestic economy must be taken into account. Therefore, on the demand side of the economy described by the IS equation, it is necessary to include net exports as an additional determinant of the demand side in addition to domestic demand. Thus, the dynamics of output depends not only on the real interest rate, which is under the control of the central bank, but also on the real exchange rate.

2.2. Financial cycle

The financial cycle is defined as fluctuations in activity or activity in the financial sector characterized by an acceleration of growth in banking credit and financing (expansion phase) followed by a decline in growth in banking credit and financing (contractive phase). Ng (2011) states that the financial cycle refers to fluctuations in perceptions and attitudes towards financial risk from time to time. This definition is in line with that proposed by Borio (2012), where the financial cycle is defined as the interaction between perceptions of value and risk, behavior towards risk and financing constraints, which is translated into a boom and followed by a bust. Such interactions can amplify economic fluctuations and may cause financial distress and economic dislocations. In the BIS Annual Report (2018), it is stated that the term financial cycle generally refers to the interaction between perceptions of value and risk, risk taking and financing constraints that can amplify fluctuations in the economic cycle and are reflected in the joint behavior of credit and asset prices.

Research related to the financial cycle is still developing in various countries. In general, there are several empirical findings from research that attempt to characterize the financial cycle, including: 1) the financial cycle is well described by credit behavior and property prices; and 2) the financial cycle has a longer duration than the economic cycle, where the financial cycle has a long term duration (medium term cycle, 8 – 32 years) while the traditional economic cycle has a short term duration (short term cycle, 2 – 8 years). One of the studies that is widely used as a reference for the formation of financial cycles in various countries is the study of Drehmann et al. (2012). In this study, financial cycles were arranged for 7 (seven) developed countries (Australia, Germany, Japan, Norway, Sweden, England, and the United States) by combining 2 (two) analytical approaches, namely turning point analysis and frequency-based filter. The variables used as components of the financial cycle are credit, credit to GDP ratio, and property prices. The results of this study indicate that the financial cycle has a longer duration than the traditional economic cycle. In addition, the expansion phase is also longer than the contraction phase.

However, Pontines (2017) proves that we must be careful in setting prior assumptions regarding the frequency range or cycle duration of the proxy variables that make up the financial cycle. By using parametric spectral analysis, Pontines (2017) shows that the financial cycle of developing countries is a cycle with a short-term duration, which is 2-8 years which tends to be the same as the duration of the business cycle, while the financial cycle of developed countries has a cycle duration that tends to be longer, which is 8 years. - 32 years.

As the definition of the financial cycle continues to evolve, evolution also occurs in the various alternative components that make up the financial cycle. Drehmann et al. (2012) formed a financial cycle which is a combination of financing components, which consist of real credit and the ratio of credit to GDP; and asset prices represented by real stock prices, real property prices, and an aggregate index of real asset prices. The findings in this study indicate that the best composite indicator in describing the characteristics of the financial cycle is the combination of real credit, credit to GDP ratio, and real property prices. Stremmel (2015) builds a financial cycle based on information from various financial indicators, including credit aggregates, asset prices, and banking indicators. The credit aggregate consists of the ratio of credit to GDP and credit growth. Asset prices are represented by indicators of nominal house prices to nominal disposable income (per head) and growth in house prices. Meanwhile, the banking indicators used include (short term) funding-to-total assets which reflects cyclical behavior in bank funding, net income-to-total assets which describes bank profitability, and proportion of loans to total assets to capture dynamics. banking financing on the cycle. The results of the study conclude that the financial cycle consisting of the ratio of credit to GDP,

credit growth, and house prices to income ratio is the most appropriate component of the financial cycle in Europe.

3. The Integrated Approach

The estimation of business and financial cycle in this paper is conducted via two consecutive stages. First, business cycle (output gap) and credit cycle (credit gap) are estimated using Multivariate Kalman Filter. Second, the credit cycle is combined with other financial variables to form financial cycle.

3.1. Multivariate Kalman Filter

To form the MVF model used in this study, we review several results of micro-founded equations in the literature and made several simple derivations. For business cycle, the starting point is the typical IS curve for small open economy (for instance, Gali and Monacelli, 2005). This IS curve explains that output dynamics of a small open economy, particularly in terms of its deviation from trend, depends on domestic real interest rate and terms of trade.

The modification is needed as there is strong implicit assumption of producer currency pricing and the law of one price. This modification is necessary in view of the dominant currency pricing problem for developing countries where the depreciation effect of real exchange rate has less impact on competitiveness which is indicated by the terms of trade. This is due to the price stickiness for commodity prices which refers to the dominant currency. Dominant currency pricing conditions affect the net export performance of major commodity exporting countries such as Indonesia, where most of the prices of export goods follow international market valuations that use the dominant currency.

Basu et al. (2020), explains the difference in terms of trade between producer currency pricing (PCP) and dominant currency pricing (DCP). The difference is mainly related to the price of exported goods, but not to imported goods. The terms of trade for the PCP regime are influenced by the real exchange rate, while the DCP regime is influenced by price ratios that are independent of the real exchange rate. In other words, in a small open economy with DCP, it takes fluctuations in the price of export commodities. Thus, assuming that a certain proportion of the effect of international trade for Indonesia is influenced by DCP, and taking into account the linear relationship of real exchange rate and terms of trade (as in Gali and Monacelli, 2005, for example), the terms of trade in output gap equation can now be replaced by two variables, which are real exchange rates and commodity prices – especially those related to exports.

Next, the thing to consider is financial frictions. According to Borio (2014), the impact of the financial cycle on the business cycle is more in the context of financial shocks. Therefore, according to Baba et al. (2020), this can be represented by including financial shocks in the business cycle model. The description of this credit shock is ad hoc, but to some extent it is also in line with the implications of the DSGE modeling with the money in utility function conducted by Benchimol and Fourçans (2012), where one of the results of the microfounded equation is the output (IS equation) which also influenced by the structural money shock. Therefore, assuming that money shock is correlated with credit shock, the addition of credit shock is also in the same direction as that implied by the microfounded equation. By also adding productivity shock, the resulting output gap equation is as follows

$$\hat{y}_t = \beta_{lag}\hat{y}_{t-1} - \beta_r\hat{r}_t + \beta_z\hat{z}_t + \beta_p\hat{p}_t + \beta_\varepsilon\varepsilon_t^c + \varepsilon_t^y \quad (1)$$

Where $\hat{y}_t$ and $\hat{r}_t$ are output gap and real interest rate gap, respectively. $\hat{z}_t$ and $\hat{p}_t$ denote real exchange rate and export commodity prices, respectively. ε_t^c and ε_t^y are credit and output shocks, respectively. The rest are parameters.

In models with open economy, credit is often not modeled explicitly - but only implicitly in the direction of economic movement. Over time, some of the literature has explicitly included the banking sector (among others Gerali et al., 2010; Glocker and Towbin, 2012). However, the final equation form often does not include the form of credit volume – leaving only the dynamics of interest rates. Alternatively, there is a branch of literature that includes money in the utility function. These literatures are more likely to leave the final equation in the form of volume of money.

By using a utility function involving money, Benchimol and Fourçans (2012) produce one of the microfounded equations, namely the real money balance which is influenced by output and interest rates. As is known, money is composed by banking third party fund, which is closely related to credit. Assuming that the dynamics of credit is determined by the dynamics of money with proportion and error ε_t^m, then the microfounded equation of Benchimol and Fourçans (2012) can be written in the form of real credit as follows

$$c'_t = \mu y_t - \sigma r_t + \varepsilon_t^m \tag{2}$$

Where c' is the equilibrium credit level. By design, ε_t^m in the above equation also indicates a leveraging condition – the extent to which credit is moving away from its fundamentals. The above equation will then be further modified based on two thoughts. First, according to Krznar and Matheson (2017) that banks cannot immediately adjust credit levels (for example, because of the inability to withdraw credit that has been given). Thus, there is persistence of credit levels. This thinking can be explicitly facilitated here by a partial adjustment process, where

$$c_t - c_{t-1} = \delta(c'_t - c_{t-1}) + \varepsilon_t^a \tag{3}$$

Where $0 < \delta < 1$, and c_t is a real credit at time t. Second, according to Baba et al. (2020), banks are assumed to set the desired credit level based on past – not current – levels of economic activity (demand) because banks need time to make adjustments. In accordance with these two thoughts, y_t in equation (12) is changed to y_{t-1}, and then substituted in equation (13), so that it can be obtained

$$c_t = (1-\delta)c_{t-1} + \delta\mu y_{t-1} - \delta\sigma r_t + \varepsilon_t^a + \delta\varepsilon_t^m \tag{4}$$

By reducing the above equation with the neutral path of each variable, and also by assuming $E(\varepsilon_t^a) = E(\varepsilon_t^m) = 0$ which occurs in neutral conditions, the gap form of equation (14) can be obtained as follows

$$\hat{c}_t = (1-\delta)\hat{c}_{t-1} + \delta\mu\hat{y}_{t-1} - \delta\sigma\hat{r}_t + \varepsilon_t^c \tag{5}$$

Where $\varepsilon_t^c = \varepsilon_t^a + \delta\varepsilon_t^m$. In other words, credit shock is actually the sum of credit dynamics that are not explained by money dynamics in general – or fundamentals – and shocks from the partial adjustment process. Overall, equation (15) indicates the dynamics of the credit gap that can be predicted from the previous credit gap value, the previous output gap value, interest rate gap, and credit shock.

Allowing $\theta_{lag} = 1-\delta$, $\theta_y = \delta\mu$ and $\theta_r = \delta\sigma$, adding expression of cyclical disaggregation and trend definition, the MVF model can be represented as follows:

Signal equations:

$$C_t = c_t^* + \hat{c}_t \quad (6)$$

$$Y_t = y_t^* + \hat{y}_t \quad (7)$$

State equations:

$$c_t^* = 2c_{t-1}^* - c_{t-2}^* + e_{1,t} \quad (8)$$

$$y_t^* = 2y_{t-1}^* - y_{t-2}^* + e_{2,t} \quad (9)$$

$$\hat{c}_t = \theta_y \hat{y}_{t-1} + \theta_{lag} \hat{c}_{t-1} - \theta_r \hat{r}_t + \epsilon_t^{\hat{c}} \quad (10)$$

$$\hat{y}_t = \beta_{lag} \hat{y}_{t-1} - \beta_r \hat{r}_t + \beta_z \hat{z}_t + \beta_p \hat{p}_t + \beta_{\epsilon^{\hat{c}}} \epsilon_t^{\hat{c}} + \epsilon_t^{\hat{y}} \quad (11)$$

where $e_{1,t} \sim N(0, \sigma_{e_1}^2)$, $e_{2,t} \sim N(0, \sigma_{e_2}^2)$, $\epsilon_t^{\hat{c}} \sim N(0, \sigma_{\epsilon^{\hat{c}}}^2)$, and $\epsilon_t^{\hat{y}} \sim N(0, \sigma_{\epsilon^{\hat{y}}}^2)$.

The MVF model consists of two signal equations for the observed variables: real credit, C_t, and real GDP, Y_t. Each observed variable is decomposed into trend and cycle components, with asterisk and hat, respectively. In addition, the MVF model consists of four state equations for unobserved components, which are the cycle and trend of total real credit and real GDP. The trend component is assumed to be deterministic, where the first difference of the trend follows a random walk process, as implied by equation (8) and (9). The real interest rate gap, the real exchange rate gap and the real commodity price gap are exogenous variables obtained by extracting the cycle component from real interest rates, real exchange rates, and real commodity price using the one-sided HP Filter.

3.2. Synthetic financial cycle

For financial cycle, we start with one of the aim of macroprudential policy – which is to reduce the risk of excessive procyclicality in the financial system. During periods of economic expansion, there was a rapid increase in bank credit expansion, soaring asset and property prices, excessive debt accumulation, and heavy inflows of foreign capital. This cause an increase in the accumulation of risk and vulnerability in the financial system. This phenomenon is a consequence of the dynamic interaction between the financial sector and the real economic sector (macro-financial linkage). Furthermore, procyclicality is also influenced by cyclical behavior towards risk, namely behavior characterized by excessive optimism when the economic cycle improves (Nijathaworn, 2009). Therefore, we consider accommodating developments in various segments of the financial sector. Therefore, the components that are candidates for financial cycle indicators are not only credit and asset prices as per the classical definition (Borio, 2012), but also include leverage, risk appetite, risk taking and various other indicators according to the characteristics of a country.

In this study, the financial cycle is composed of several candidate components, including credit gap, risk taking gap, asset prices gap, banking indicator gap, corporate leverage gap, external gap, and risk appetite gap which are believed to be able to influence the dynamics of the financial cycle movement in Indonesia, both expansion and contraction phases. Each of the gaps mentioned is self-explained in Figure 1. In addition to covering interactions with the business cycle that has been accommodated by credit cycle movements (already incorporated through the MVF model), the various candidate components also incorporate various risk

behavior indicators to capture the risk taking cycle, both from the investors' side and financial institutions (in this case the banking sector) as well as other complementary indicators.

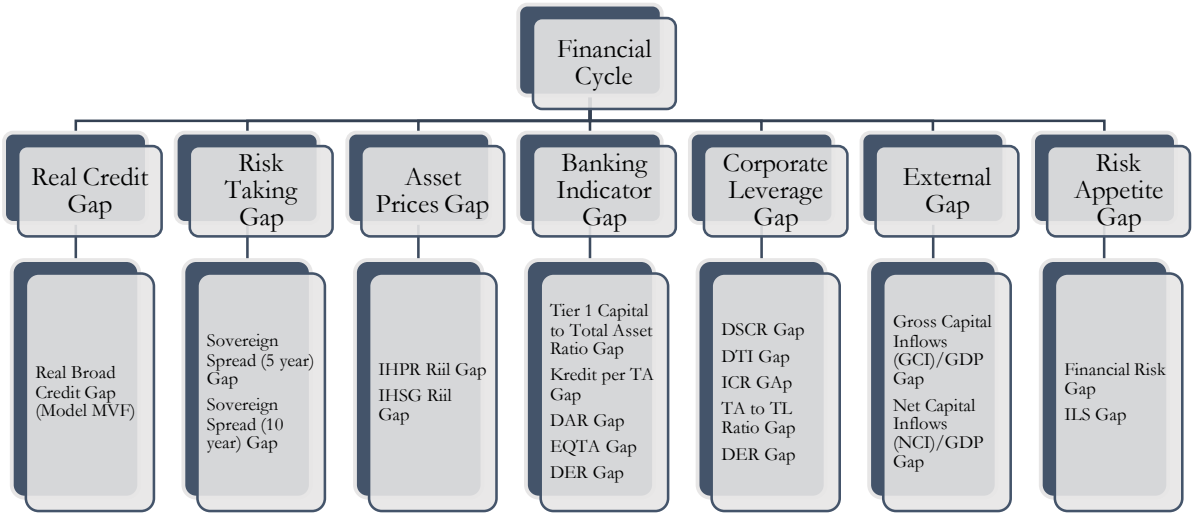


Figure 1. Candidates for the Components of the Financial Cycle

After obtaining the credit cycle through the MVF model, the next step is to compile a composite index of the Indonesian financial cycle as adapted from Stremmel (2015) with modifications. Identification of the common cycle of the candidate indicators This stage will measure co-movement using Turning Point Analysis and Concordance Index (Harding and Pagan, 2006). Second, the formation of a synthetic financial cycle (SFC) is carried out by compositing individual cycles that have co-movements by using Principal Components Analysis (Hiebert et al, 2014). This step resulted in various alternative SFCs that have the potential to become Indonesia's financial cycle. Further, SFC performance evaluation was carried out using Area Under the Receiver Operating Characteristics (AUROC) analysis (see Camacho and Palmieri, 2020).

3.3. Data

Macroeconomic indicators consist of real GDP, consumer price index (CPI), policy interest rates (BI 7 Days Repo Rate), real interest rates, real exchange rates, and the Indonesian export commodity price index (IHKEI). The financial indicators used include non-financial private sector credit which includes credit from all sources, hereinafter referred to as total credit. Total credit is the total financing originating from bank loans, capital markets, external debt, and Non-Bank Financial Institutions (NBFI). Bank credit includes commercial bank loans and rural credit banks. The capital market includes corporate bonds, sukuk, Asset Backed Securities (EBA), Medium Term Notes (MTN), Initial Public Offerings (IPOs), and Right Issues (RI). In addition, there are also tier 1 variables of capital to total asset ratio, credit per asset ratio, debt to asset ratio (DAR), equity to asset ratio (EQTA), and debt to equity ratio (DER), financial risk which is the difference in interest rates. loan interest with the policy interest rate, and the index of lending standard (ILS) as an indicator of bank financing appetite.

From the corporate side, there are several measurement variables to consider, namely Debt-Service Coverage Ratio (DSCR), Debt to Income ratio (DTI), Interest Coverage Ratio (ICR), Total Assets (TA) to Total Liabilities (TL) ratio, and corporate DER. Meanwhile, external financial variables include the sovereign spread, namely the difference between SBN yields and US treasury yields, both 5 years and 10 years, as well as gross capital inflows (GCI) to GDP ratio and net capital inflows (NCI) or financial accounts (FA) to GDP. ratio. Another indicator is asset prices, which consist of Jakarta Composite Index (JCI) as a representation of stock prices and residential property price index (IHPR) as a representation of property prices.

4. Results

4.1. First stage: Multivariate Kalman Filter

The estimation results are generally in line to the predictions given by the derivation of the model. In the credit gap equation, the lag output gap, lag credit gap has a positive impact on the credit gap, while real policy interest rates have a negative impact on the credit gap. A positive lag credit gap but with coefficient below unity implies a decaying response of the credit gap when a shock occurs. The persistence occurs partly because the credit that has been given cannot be withdrawn instantaneously (according to Krznar and Matheson, 2017). The positive sign of lag output gap implies the procyclicality of credit, but it takes a quarter for the credit growth to adjust after a change in income. In addition, real policy interest rates indicate credit fluctuations that are more influenced by the demand side, where interest rate has negative effect on the volume of credit.

In the output gap equation, in general, the parameter estimation results are also in accordance with the theory. Lag output gap which is positive but below unity implies a tendency for a decaying pattern. The negative interest rate coefficient is in accordance with the hypothesis in the IS equation. A significant and positive credit shock indicates the effect of financial frictions in influencing the shape of the business cycle – the macroeconomic response pattern will be different if there is a credit shock. This also proves the importance of maintaining financial stability to achieve price stability.

The real exchange rate (RER) generally has a positive impact on output (real depreciation increases output). However, the impact of RER is close to zero. The minimal impact of RER on output indicates the influence of dominant currency pricing – so that RER has no impact on competitiveness in international trade, as well as the influence of financial channels - where the existence of foreign debt on companies makes depreciation reduces output. In addition, commodity prices are also indicated to have a positive impact on output dynamics, although they are not always significant in all specifications.

Table 1. State Space Estimation Results

State eq	Variable	Model A		Model B		Model C		Model D		Model E	
Obs		2002Q2-2019Q4		2004Q1-2019Q4		2002Q2-2019Q4		2003Q2-2019Q4		2003Q2-2019Q4	
credit gap	lag output gap	0.143		0.150	***	0.149	***	0.149	***	0.157	***
	lag credit gap	0.503	***	0.342	***	0.198	***	0.208	***	0.166	***
	Real interest rate	-0.503		-0.605		-0.672	*	-0.504		-0.654	*
output gap	lag output gap	0.502	***	0.445	***	0.436	***	0.489	***	0.479	***
	Real interest rate	-0.011		-0.005				-0.003		-0.005	

	Real exchange rate	0.005	0.012		0.000		0.008		0.013	
	credit shock	0.000	0.010	***	0.010	***	0.010	***		
	commodity price		0.008	*	0.010	*	0.006		0.006	
	lag credit gap								0.001	***

Note: *,**,***: Significant at 90%, 95% and 99% confidence level, respectively.

For the ability to estimate the output gap and credit gap, each model produces a standard error of estimates that are relatively similar. However, in general the standard errors of the credit gap estimates are higher than those of the output gap estimates. One reason is that credit data has larger historical fluctuations. If those alternative specifications are compared, the two alternatives with the smallest standard error for the credit gap are model C and D.

Table 2. Standard error of state variables

	Credit cycles	Business cycles
A	2.344	0.272
B	2.198	0.256
C	2.049	0.269
D	2.074	0.274

By comparing the data of policy rate and the resulting implied policy rule based on the estimated output gap (a comparison that is suggested by Guisinger et al., 2018), it can be seen that the output gap is quite capable of providing guidance on monetary policy. In addition, there is no significant difference between alternative estimation results in providing guidance on monetary policy. Moreover, all of the resulting output gap alternatives implies a policy rule series with a higher correlation to the policy rate than the policy rule series that is generated by the HP filter output gap (in the period up to 2016). However, after 2016, alternatives A and D suggest policy rate series which has better correlation to actual policy rate compare to policy rate generated by HP Filter output gap (see Figure 2). To note, 2016 is the year in which monetary policy reformulation was implemented in Indonesia. The reformulation changed tenor in which policy rate is equivalent to.

In addition, the estimated movement of the economic cycle indicates that it is quite good in modeling the movement of inflation and capacity utilization. A linear regression results suggest that the output gap from the MVF shows a significant coefficient and has positive implications for the movement of inflation (CPI) and the core inflation. The regression results from the four alternative output gap also appear to be better (significance of the coefficient and adjusted R2) compared to the regressions with HP Filter output gap. The MVF output gap is also able to describe the dynamics that are in line with the capacity utilization survey, especially in a certain time range.

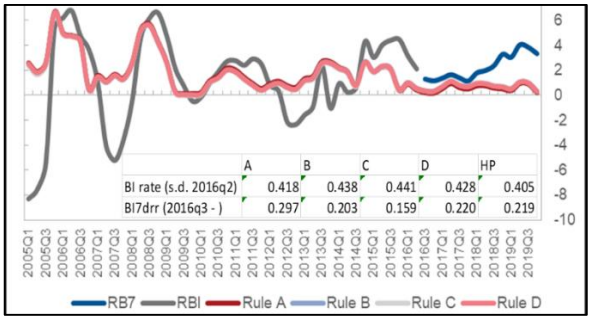


Figure 2. Output gap estimates, policy rule and correlation table

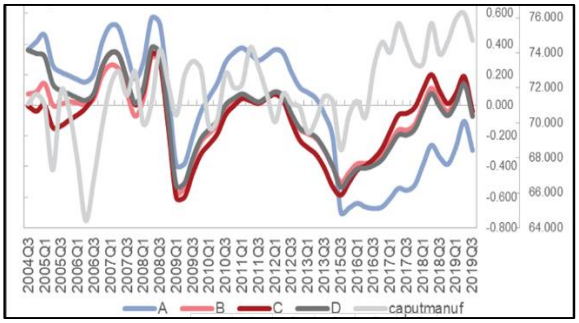


Figure 3. Output gap estimates and capacity utilization

Table 3. Output gap estimates to inflation regression results

Dep.	**Independent**	**A**		**B**		**C**		**D**		HP Filter	
		Coef	AdjR^2	**Coef**	AdjR^2	**Coef**	AdjR^2	**Coef**	AdjR^2	**Coef**	AdjR^2
Headline	Output gap	1.089***	0.13	1.088**	0.08	0.994**	0.065	1.153***	0.093	0.1254	-0.011
inflation	Lag output gap	1.136***	0.13	1.083**	0.07	0.957**	0.05	1.164**	0.085	0.0136	-0.013
Core	Output gap	0.784***	0.18	0.762***	0.11	0.711***	0.095	0.818***	0.13	0.0922	-0.012
inflation	Lag output gap	0.835***	0.19	0.786***	0.11	0.728***	0.092	0.85***	0.13	0.0227	-0.014

Based on observations from various aspects as a whole, the best model is model D which is able to explain event analysis in both the business cycle and the credit cycle. Model D is one of the two best models in several aspects evaluated, namely: (1) completeness of variables and conformity with historical events; (2) low standard error, especially for credit gaps; (3) the ability to provide historical guidance for monetary policy; (4) the ability to predict inflation; (5) conformity with capacity utilization.

The resulting business cycle from all alternatives A-D are indicated to be relatively robust and generally outperform results from a more standard methodology as indicated from several assessments: (1) Sufficiently consistent with historical events that affect the economy; (2) outperform a more standard method in explaining the dynamics of inflation and capacity utilization; (3) more consistent to historical monetary policy decision if embedded in a policy rule, compare to a more standard method.

Further analysis shows that the movement of the economic cycle and the credit cycle are interrelated. Credit cycles have phases that are similar to business cycles – with about 70-80% compatibility of cycle phases (acceleration vs deceleration). Sequentially, the results of the Granger causality indicate that the business cycle moves first, followed by the credit cycle.

Table 4. Concordance Index – Credit and Business Cycle

Period	A	B	C	D
2004-2020	0.65	0.71	0.65	0.68
2011-2020	0.73	0.80	0.73	0.75

Table 5. Granger Causality (Fstat) – Credit and Business Cycle

	A	B	C	D
Business to credit cycle	3.73	3.88	4.43	3.31
Credit to business cycle	1.42	1.14	0.97	0.91

Two graphs below show factors that determine movement of output and credit gaps, which are derived from data and state space coefficients. The largest contributors for both gaps are its lags. Credit shocks emerge as contributors in output gaps particularly within the peak or trough. Apart from persistence and macrofinancial relationships, the movement of the credit cycle is largely driven by interest rates. while movement in the business cycle was contributed by, among other things, commodity price movements.

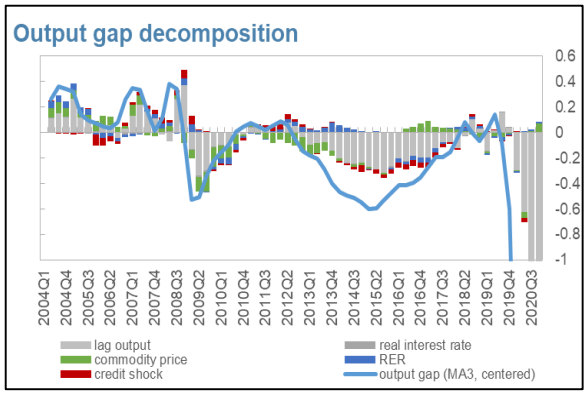


Figure 4. Business cycle decomposition

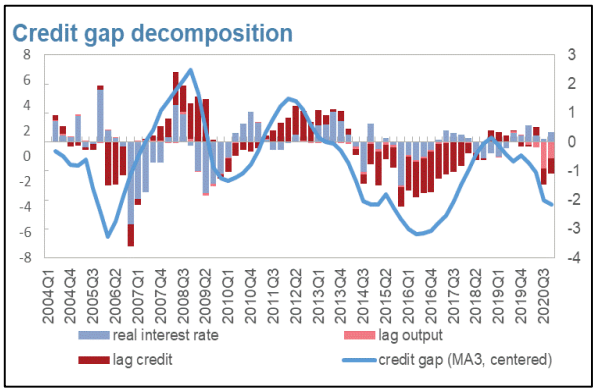


Figure 5. Credit cycle decomposition

4.2. Second stage: synthetic financial cycle

Indonesia's financial cycle is composed from a common cycle of candidate variables making up the financial cycle that have the same cyclical movement or called the co-movement cycle, namely the similarity of expansion and contraction phases. Common cycle identification is done using Concordance Index (CI). CI or also known as the synchronization index can measure the level of co-movement between two cycles of candidates making up the financial cycle (bivariate). CI values are in the range of 0% to 100%. The higher the CI value, the better the co-movement between the two cycles.

The credit cycle or credit gap which is the main component of the financial cycle is obtained from the MVF model. Meanwhile, the other variable gaps that are candidates for preparing the financial cycle are obtained by extraction using a One-sided HP Filter with a lambda of 1600. CI is calculated for each pair of cycles (gaps) of candidates for the financial cycle.

Because the credit gap is the main variable that makes up the financial cycle, it is important to look at the size of the co-movement between the credit gap and other variable gaps. Based on the CI value in the table above, the credit gap has a fairly high co-movement with the real IHPR gap, the real stock index gap, credit ratio per asset gap, DSCR gap, ICR gap, GCI to GDP gap, NCI to GDP gap, and ILS gaps. The selection of other variables as a constituent of the financial cycle assumes that there is only 1 (one) variable as a representation of each component.

Based on the CI value, there are several candidates for the financial cycle, hereinafter referred to as the synthetic financial cycle (SFC). SFC candidates were selected based on the highest average CI score.

Table 6. Candidates of Synthetic Financial Cycle

	Candidates of *Synthetic Financial Cycle* (SFC)	Average CI
7 components		
SFC1	Credit Gap – Sovereign Spread (5 years) Gap – Real Stock Index Gap – Credit per TA Gap – DSCR Gap – NCI to GDP Gap – ILS Gap	61.28%
6 components		
SFC2	Credit Gap – IHSG Riil Gap – Credit per TA Gap – DSCR Gap – NCI to GDP Gap – ILS Gap	60.91%
SFC3	Credit Gap – Real Stock Index Gap – Credit per TA Gap – DSCR Gap – GCI to GDP Gap – ILS Gap	60.80%
5 components		
SFC4	Credit Gap – IHSG Riil Gap – Credit per TA Gap – DSCR Gap – NCI to GDP Gap	61.36%
SFC5	Credit Gap – IHSG Riil Gap – Credit per TA Gap – DSCR Gap – GCI to GDP	60.45%

Financial cycle components are dominated by credit gap – and capital flows direct role is limited. In addition to the credit gap, the components that are included on all SFCs are the real JCI gap, the credit ratio per asset gap, the DSCR gap, and the external gap variable, which is either NCI to GDP ratio gaps or GCI to GDP ratio gaps. In general, total financing and banking indicators are still the drivers of the dynamics of the financial cycle in Indonesia. Credit gap has the largest weight on all SFCs, which is more than 30%. Meanwhile, the credit per asset gap ratio has the second largest weight, except for SFC4. This is in line with the financing structure, namely bank credit, which still dominates the Indonesian financial system. Meanwhile in SFC4, the gap that has the second largest weight is the real JCI gap as a representation of asset prices, which at the same time shows the magnitude of the perception and risk appetite of investors in the stock market in influencing financial conditions in Indonesia.

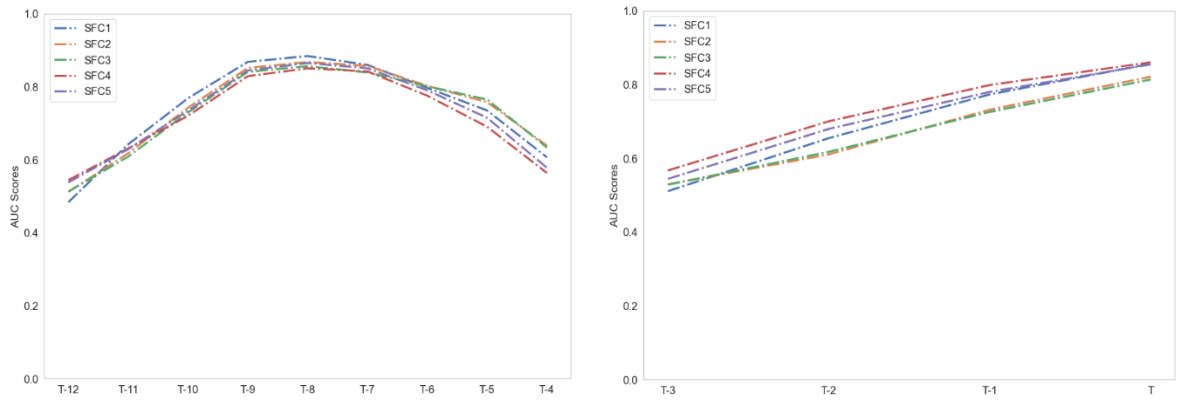
Table 7. Weight of synthetic financial cycle components

SFC Components	SFC Candidate				
	SFC1	SFC2	SFC3	SFC4	SFC5
Credit Gap	0.373	0.375	0.328	0.345	0.372

Real stock index *Gap*		0.155	0.131	0.089	0.270	0.215
Credit to asset ratio *Gap*		0.222	0.226	0.227	0.229	0.217
DSCR *Gap*		0.107	0.110	0.153	0.064	0.111
GCI *to* GDP *ratio Gap*		-	-	0.111	-	0.086
NCI *to* GDP *ratio Gap*		0.029	0.048	-	0.093	-
ILS *Gap*		0.078	0.110	0.091	-	-
Sovereign Spread (5 years) Gap		0.036	-	-	-	-

Further analysis was conducted to evaluate the performance of the five SFCs in predicting periods of distress. The analysis was carried out using the parametric Area Under the Receiver Operating Curve (AUROC) method based on the SFC logistic regression model for the period of distress. The higher AUROC value describes the level of goodness of the model in predicting periods of distress and non-distress. The AUROC value is between 0 and 1, where a value of 1 represents the correct level of prediction while a value below 0.5 represents an uninformative specification.

The period of distress in the Indonesian financial system refers to various events in the past, including the increase in fuel prices in 2005 (2005Q3 – 2006Q1), the Global Financial Crisis in 2008 (2008Q4 – 2009Q4), Taper Tantrums in 2013 – 2015 (2013Q3 – 2015Q3), and the COVID-19 Pandemic in 2020 (2020Q1 – 2020Q4). The estimation of the logistic regression model is carried out many times, namely SFC for the distress period, and SFC for the lag from the distress period to lag 12. This is done to evaluate the SFC as an early warning to detect signals of impending distress.



Note: Left figure are AUROC values during 1 to 3 years prior to distress period, while the right figure are AUROC values less than a year prior to distress period.

Figure 6. ROC curve from SFC candidate

Table 8. AUROC value from SFC candidate

Period	SFC1	SFC2	SFC3	SFC4	SFC5	Max
T-12	0.483	0.511	0.513	0.544	0.538	0.544
T-11	0.642	0.617	0.608	0.631	0.629	0.642
T-10	0.768	0.742	0.729	0.720	0.734	0.768

T-9	0.868	0.851	0.840	0.828	0.844	0.868
T-8	0.884	0.867	0.856	0.850	0.864	0.884
T-7	0.859	0.857	0.839	0.842	0.850	0.859
T-6	0.796	0.802	0.801	0.775	0.790	0.802
T-5	0.735	0.757	0.765	0.690	0.715	0.765
T-4	0.606	0.638	0.633	0.563	0.578	0.638
T-3	0.511	0.529	0.528	0.567	0.544	0.567
T-2	0.654	0.610	0.617	0.700	0.679	0.700
T-1	0.773	0.731	0.725	0.798	0.780	0.798
T	0.856	0.821	0.813	0.860	0.854	0.860

The five SFCs have a fairly good performance in giving signals 1 to 3 years before the occurrence of distress. This can be seen from the AUROC value which is greater than 0.5. SFC1 has the largest AUROC value in the period T-7 to T-11 so that SFC1 can detect signals of distress early. Meanwhile, SFC4 has the largest AUROC value in the period T to T-3 which indicates it is able to provide information on detecting the occurrence of distress when approaching the distress period. The results of the analysis are complemented by the significance level of the AUROC value of the SFC in each period.

The five SFCs have a significant AUROC value on average with a 95% confidence level. SFC4 has more significant AUROC values when compared to the other four SFCs, namely in the T-2 period before distress, the AUROC value of SFC4 is significant while the other four SFCs are not significant. From the results of graphic analysis and evaluation of the performance of each SFC, SFC4 is recommended to be the Indonesian financial cycle. Statistically with CI value, SFC4 has the highest mean CI. Thus, in the next subsection, SFC4 will be referred to as the Indonesian Financial Cycle.

Table 9. Average duration of cycles (Quarter)

	Business cycle	Financial cycle
Expansion	7.40	9.70
Contraction	4.20	10.70
Cycle	11.40	20.00

Judging from the relationship, the economic cycle and the Indonesian financial cycle have a short-term cycle duration, where the period of one cycle for the economic cycle is around 12 quarters, while for the financial cycle it is slightly longer, namely 20 quarters. The economic cycle and the financial cycle also have a relationship where the movement of the business cycle tends to precede the financial cycle which is confirmed based on the results of event analysis.

Indonesia's financial cycle is indicated to be able to properly describe the dynamics of financial conditions in Indonesia, both historically and based on recent developments. For example, in 2007, there was an increase in commodity prices and capital inflows that pushed up the economic and financial cycles. The cyclical downturn in 2009 occurred in line with the global financial crisis that impacted Indonesia's export demand. After that, in 2010-2012 the

business cycle was in the acceleration phase, when there was a significant increase in commodity prices (commodity boom). During this period, the financial cycle also experienced an increase. This movement was followed by a cyclical decline in 2013-2015, where there was a decline in commodity prices accompanied by an increase in capital outflows triggered by the US Taper Tantrum.

The financial cycle is also also consistent to the historical path of macroprudential policies, especially those aimed at financial stability. In accordance with the argument of Warjiyo and Juhro (2016), the policy tightening is carried out when there is an upswing and conversely it is relaxed during a downswing. The period of pressure caused by the Global Financial Crisis at the end of 2008 was responded by easing monetary policy as reflected by the benchmark interest rate since early 2009. The boom phase of the 2010 to 2013 cycle was accompanied by a tightening of the policy mix in terms of both macroprudential policy and policy tightening. Loan to Value (LTV), Statutory Reserves – Loan to Deposit Ratio (LDR), and Secondary Statutory Reserves as well as monetary policy with gradual increases in the benchmark interest rate starting in mid-2013. Furthermore, the period of distress shown by throughs in the economic cycle and financial cycle from late 2015 to 2016 was followed by easing in the policy mix with easing LTV and the increase in the upper limit on the Statutory Reserves – Loan to Funding Ratio (LFR) policy since mid-2015 as well as a decrease in the benchmark interest rate in 2016.

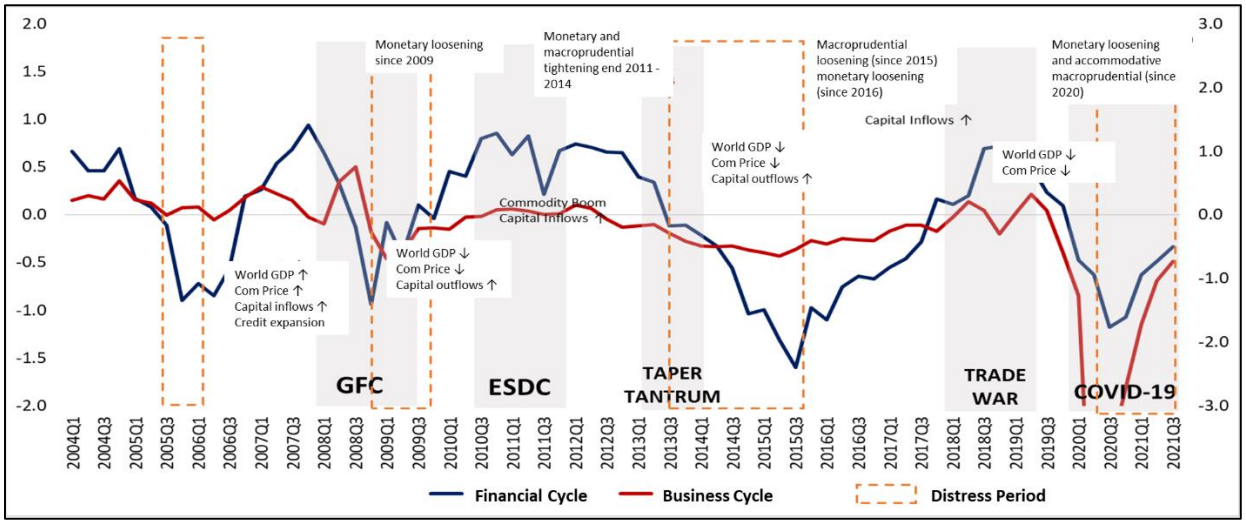


Figure 7. Event analysis of business and financial cycle

5. Conclusion

The estimation of Indonesia's economic and financial cycles has been carried out in an integrated manner by estimating the two cycles simultaneously in a system of equations. This integrated approach will synchronize views on economic and financial cycles, while also explicitly considering the mechanism of inter-cycle linkages. The main caveat on this research is that other factors in the financial cycles other than credit gap are treated as exogenous. However, the consequences for Indonesia data is relatively limited as Indonesia is a credit-dominant country. Therefore, the area for improvement in further research is to integrate two steps into single step of MVF estimation, but covering the various variables on financial cycles – this is particularly necessary in economies in which credit are not dominant.

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