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UNDERSTANDING MONETARY AND FISCAL POLICY RULE INTERACTIONS IN INDONESIA

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Abstract

We examine the interaction of monetary and fiscal policies in Indonesia over a period of 1974Q2 to 2019Q1. Within a standard structural vector autoregression (SVAR) framework, we show that the reaction of the policy rules is quite consistent with theoretical predictions. For instance, a contractionary monetary policy is trailed by a contractionary fiscal policy of lower government expenditure. We extend the analysis to evaluate the interaction of the policy rules during active and passive regimes. We show that monetary and fiscal policies are not synchronized over the full sample period, suggesting presence of structural and institutional rigidities, particularly in the past. Restricting the sample to a recent time period, we find the policies to be harmonized to some extent owing to recent joint policy coordination initiatives by the monetary and fiscal authorities.

Keywords: Fiscal policy; Monetary policy; Policy interactions; Indonesia

JEL Classification: E61; E63
1. Introduction

In this paper, we examine the interaction of monetary and fiscal policy rules in Indonesia. Recent events motivate this investigation. To overcome the global recession of 2007 to 2009, the US and other major economies pursued a mix of monetary and fiscal policies and often concurrently. To stimulate growth and enhance financial market activities, policy rates were reduced to nearly zero in the post-2007 period. With policy rates nearly zero, conventional monetary policy became almost ineffective. Hence, central banks resorted to the purchase of assets (i.e. targeting the balance sheets) in order to inject money into the economy. This approach is commonly referred to as unconventional monetary policy or quantitative easing.

On the other hand, in the quest to create jobs and stimulate private consumption, governments in these advanced economies implemented expansionary fiscal policies. In the US, for instance, the Economic Stimulus Act of 2008 and the American Recovery and Reinvestment Act of 2009 were passed, allowing the government to inject $125 billion and $787 billion, respectively, into the economy (Davig and Leeper, 2011).

These reactions of the authorities, governments and central banks drew attention of the recent literature, prompted by the lack of clarity on whether expansionary fiscal policies necessarily lead to economic stabilisation (Mountford and Uhlig, 2009; Cevik, Dibooglu, and Kutan, 2014). In fact, the channel through which a fiscal expansion or stimulus is expected to ramp up economic activity—the private consumption channel—itself is highly contentious (Davig and Leeper, 2011). For example, while the standard IS-LM framework shows that fiscal expansion backed by a certain level of monetary expansion leads to an increase in interest rates and thus crowds-out private consumption, the non-Ricardian framework implies that private consumption would be boosted by an increase in income (see also Cevik, Dibooglu, and Kutan, 2014).

Despite the relevance of the interaction between monetary and fiscal policy rules in determining equilibrium outcomes in the economy, previous arguments were that the two should be separated (Sargent and Wallace, 1981; Leeper, 1991). Three fundamental factors are identified as having led to the lack of coordination between monetary and fiscal policies (see among others Blinder, 1982; Dodge, 2002). First, monetary and fiscal authorities generally have different policy objectives. This can be due to the mandate of a different constitution, or because of different views on the best way to achieve social welfare. Second, monetary and fiscal authorities have different views on how monetary and fiscal policies affect the economy. The government, for example, considers that tax cuts can be done to encourage growth without adversely affecting investment. Meanwhile, monetary authorities perceive tax deduction as resulting in an increase in budget deficits leading to crowding-out of private investment. Third, monetary and fiscal authorities have different predictions regarding economic conditions, which results from beliefs in different economic theories and forecasting approaches. These factors make it difficult to formulate a universal form of monetary and fiscal policy coordination framework to be applied in all countries.

Nevertheless, a growing number of studies shows that monetary and fiscal policies should be jointly examined (Davig and Leeper, 2011; Cevik, Dibooglu, and Kutan, 2014; Kliem, Kriwoluzky, Sarferaz, 2016; Wang, 2018). With the exception of Cevik, Dibooglu, and Kutan (2014), these studies have generally focused on the US and other advanced economies. The growing pattern in emerging, developing or transition economies is a gradual shift towards inflation-targeting regimes and the adoption of both monetary and fiscal policy frameworks of advanced economies. Thus, it would be interesting to see how such policies interact in these economies. Our aim is to shift the focus to developing country experience of monetary and
fiscal policy rules. We develop several extensions to conventional models of monetary and fiscal policy rules as discussed in Section III.

We examine the interactions of monetary and fiscal policy rules in Indonesia. There are studies on monetary policy rules in Indonesia but those on fiscal policy rules remain limited. For instance, Juhro and Mochtar (2009), and Warjiyo and Juhro (2016) observe, in their studies, that monetary policy has countercyclical effects on the Indonesian economy, while fiscal policies are likely to have procyclical effects. However, we know nothing about the interaction of these policy rules in the Indonesia.

Our empirical analysis exploits relevant Indonesian monetary and fiscal policy variables over a period of 1974Q2 to 2019Q1. We show, using a structural vector autoregressive (SVAR) model, that the reaction of the monetary and fiscal policy rules is quite consistent with theoretical predictions. We observe, for example, that a contractionary monetary policy is trailed by a contractionary fiscal policy of lower government expenditure. To better understand the interaction of the policy rules, we evaluate these rules during active and passive regimes. This important extension of the Indonesian policy rules uses a two-regime Markov switching framework. We show that monetary and fiscal policies are not synchronized over the full sample period, suggesting presence of structural and institutional rigidities. Restricting the sample to a more recent time period (2000Q1 to 2019Q1), we find that the policies are more harmonized, owing to the recent joint policy coordination initiatives by the monetary and fiscal authorities.

There are two contributions we make to the literature. First, as we discuss in Section II, Indonesia offers a unique policy setting to study the interaction of monetary and fiscal policy rules. The uniqueness comes from the joint policy coordination stance adopted by Bank Indonesia (BI, the country’s central bank) and the government. This partnership was brought into law in 1995 and gained momentum over time becoming more active following the Asian financial crisis in 1997. Our study shows that when this time period is modelled there is greater synchronization of monetary and fiscal policies. We attribute this to the joint policy coordination in Indonesia. Our results highlight that granted the joint policy coordination efforts have brought monetary and fiscal policies together, active fiscal policies outlive active monetary policies. This suggests that while the policy direction is on the right path future policy coordination work should focus on achieving greater optimality (or synchronization) between these policies.

Our second contribution goes towards easing tensions on the effectiveness of monetary and fiscal policy literature on Indonesia. In this literature, there is debate on the effectiveness of policies. Sumando (2015), for instance, argues that only monetary policy is effective and fiscal policy has no role to play. Yunanto and Medyawati (2014) show that monetary policy is more effective than fiscal policy. In the work of Kuncoro and Sebayang (2013), there is a similar evidence—that monetary policy reacts to fiscal policy and is more effective. These results have contrasted those of Hermawan and Munro (2008) and Simorangkir and Adamanti (2010), who show a role for fiscal policy too. Two features of this literature distinguish them from our empirical analysis: (1) they do not jointly consider the interaction of monetary and fiscal policies—therefore, it is difficult to deduce whether and to what extent monetary and fiscal policies can be used to obtain policy optimality; and (2) these studies are not based on recent dataset such that in light of policy developments in Indonesia these studies can be considered out-dated because they do not consider the effect on policy formulation over a period when government and BI began undertaking joint policy coordination.
The rest of the paper focuses on details. In the next section, for instance, we provide an overview of monetary and fiscal policy rule interactions in Indonesia. This gives motivation to our research question. Then, Section III presents our model of monetary and fiscal rule coordination as well as the data used in the empirical estimations. Section III explains our results. Section IV explores extensions of our baseline analysis. The idea is to generate greater insights on the interaction of monetary and fiscal policy rules. Section V concludes.

2. Overview of monetary and fiscal policy rule interactions in Indonesia

2.1. Why Indonesia—a motivation

Indonesia is an interesting case to study the relevance of monetary and fiscal policy rules. Indonesia was amongst the top three countries that was severely impacted by the 1997/98 Asian financial crisis, which later developed into a monetary crisis in the country. And more recently, the country also suffered from the global recession, with its growth declining to 4.5% (see Juhro, Narayan, Iyke, and Trisnanto, 2018). Indonesia has engaged in various monetary and fiscal policy reforms to deal with these economic setbacks. Indonesia’s central bank tried to strike an optimal balance by conducting pro-stability and pro-growth strategy. As part of its pro-growth policies, BI reduced interest rates multiple times since 2016. In 2019, there were four interest rate cuts. Importantly, BI successfully maintained inflation within the target range of 3 to 5%. During the same period, the government implemented a fiscal reform programme through the Indonesia Fiscal Reform Development Policy Loan of $400 million. The aim was to enhance revenue collection and quality of spending.

Motivated by these setbacks emanating from crises, policy coordination in Indonesia has taken a unique path. The government and BI undertake policy deliberations and formulations in unison. An important outcome of this coordinated policy making was evident in the post-2007 global financial crisis (Juhro and Goeltom, 2015). At a time when global economic growth was subdued and negative, the Indonesian economy emerged resilient to the crisis recording an economic growth rate of 4.5% in 2009. A large part of this unified policy making is inspired by the recognition that both demand pull and cost push factors determine Indonesia’s inflation. The monetary and fiscal policy coordination features BI’s participation in Cabinet meetings chaired by the President. The role of BI is to opine information that allows it to achieve the target inflation rate. BI also participates in the Indonesian parliament during deliberations of State Budget Macro Assumptions. BI and the government coordinate debt management operations too.

The government–BI policy relation has roots in 2005 with the establishment of the Ministerial level inflation targeting, monitoring and control team. The BI, as a result, works with several line Ministries such as the Ministry of Finance, the Ministry of Trade, the Ministry of Agriculture, the Ministry of Transport and the Ministry of Manpower.

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3 Based on Bank Indonesia Law of 1999, BI has a single monetary policy objective of achieving and maintaining stability of the rupiah. Following this law, BI formally adopted the ITF in July 2005 (see Juhro and Goeltom, 2013 and 2015, for details).
and Transmigration. This effort aims at maintaining a stable inflation rate in order to achieve sustainable economic growth.⁴

These recent policy directions require an in-depth understanding regarding how monetary and fiscal policy rules interact. A practical (policy) issue that requires addressing is how to formulate an “optimal” interaction (policy mix) between monetary and fiscal policies. Optimal in the sense that both policies should be mutually supportive (or their effects should not negate each other) in order to support sustainable economic growth targets. It is this need to understand the optimality of monetary and fiscal policy rules in light of Indonesia’s unique policy setting that motivates our study.

2.2. Salient empirical studies

Since the global financial crisis, the need for a better understanding of how fiscal and monetary policies interact is important. Monetary policy aims to maintain price level stability, while on the other hand fiscal policy aims to achieve higher economic growth to obtain high employment. Interaction between fiscal policy and monetary policy in developing countries has been examined in several papers. However, it is relatively limited studies that examine degree of fiscal policy interaction in Indonesia.

Hermawan and Munro (2008) used an estimated open economy dynamic stochastic general equilibrium (DSGE) model to examine the role of fiscal policy for stabilization and explore the interaction between monetary and fiscal policy in Indonesia for three periods, namely the whole period (June 1992 to December 2006), the post float period (September 1998 to December 2006), and the inflation targeting period (1999 to December 2006). This study used sticky prices and wages, non-Ricardian agents and tax distortions, output gap. The fiscal position includes foreign currency reserves and domestic and foreign currency debt, while the monetary policy is conducted through a Taylor-type rule. The study found that fiscal policy does play an important shock absorber role, allowing active fiscal stabilisation and absorption of exchange rate valuation effects on the stocks of debt and reserves. Even in the absence of a direct effect on the exchange rate in the model, reserves accumulation is contractionary, leading to a small depreciation of the exchange rate. In the absence of an active countercyclical fiscal policy, monetary policy would need to be less aggressive in terms of inflation but more aggressive in terms of the output gap to minimise a standard loss function, but losses would still be higher.

Kuncoro and Sebayang (2013) examined the interaction between monetary and fiscal policies and identified the determinants factors that influence the interaction between both decision such as interest rate and primary balance surplus. This study used two separated econometric model of monetary and fiscal policy using a simple analytical tool, Ordinary Least Square (OLS). The variables consist of output gap, price stability, oil price, debt to GDP ratio, depreciation rate Rupiah against US Dollar, foreign interest rate, money supply growth, and government policy for quarterly data covering the period 1999 – 2009. The study found that monetary policy is responsive to the fiscal policy where monetary policy is more dominant in Indonesia and it reacts as expected to the fiscal policy in the short term. The movement of inflation rate, real money supply growth, depreciation, and oil price are the main determinants of monetary policy in Indonesia. While, the movement of inflation, depreciation, and oil price is significantly determining fiscal surplus. In the opposite direction, real money supply also plays an important role in determining fiscal surplus.

Sumando (2015) explored the interaction of fiscal and monetary policy and the effectiveness of inflation targeting framework in Indonesia using vector autoregression (VAR). This study mentioned that the main problem of the interaction of fiscal and monetary policy lies in the short-term trade-off between the achievement of price stability and economic. Hence, the purpose of this study is to examine the interaction of fiscal and monetary policy in Indonesia and to assess the effectiveness of policy mix. To answer the question, four variables (output gap, inflation, government expenditure and interest rate) were selected for the period of 2000 – 2013. The study found that fiscal policy indicates a pro-cyclical movement to inflation and unemployment, while on the other hand monetary policy is highly sensitive to shocks in inflation and it responds in counter-cyclical manner. This study also explained that expansionary fiscal policy is effective in raising the level of output to the potential level only in the short run. However, in longer term fiscal expansion leads to economic slowdown.

Yuan and Nuryakin (2018) examined the optimal level of monetary and fiscal policy pertaining to monetary and fiscal policy interaction using non-cooperative game theory model for each quarter in 2014 and 2015. This study used a loss function of monetary policy, which uses the Surat Berharga Bank Indonesia (SBI) rate as its instrument, and fiscal policies with government spending as their tool, as the payoff for each authority. The results showed that the actual SBI rate and government expenditure have yielded in non-Nash equilibrium and non-Pareto efficiency equilibrium. Thus, there is much room to improve the policies, especially the smoothing of government expenditure throughout the year; that is, improving government expenditure absorption in the second quarter and moderating it in the third and fourth quarters, as well as lowering SBI rates.

Yunanto and Medyawati (2014) studied the effectiveness of fiscal and monetary policy using error correction model (ECM) for short-term models and a system of simultaneous equations two stage least squares (TSLS) for sensitivity analysis of shocks to the policy change of important macroeconomic indicators. Fiscal Policy Multiplier (FPM) and Monetary Policy Multiplier (MPM) are used to test the effectiveness of fiscal and monetary policy. The quarterly data were taken from Government consumption as a proxy for fiscal policy, while monetary policy is measured by interest rates covering the period of 1990 – 2011. The study found that Multiplier monetary policy greater than fiscal policy multiplier in the economy of Indonesia, then monetary policy is believed to be more effective in affecting an increase in GDP.

Simorangkir and Adamanti (2010) used financial computable general equilibrium (FCGE) to examine the impacts of fiscal stimulus and interest rate cut on Indonesian. The study found that combination between fiscal and monetary policy have a significant multiplier effect that boost GDP, while this combination compounded the fiscal deficit due to a decline in revenue from taxes and more spending in government budget.

From the foregoing, it can be observed that existing literature are majorly on monetary policy as the main stabilisation instrument, while fiscal policy has often been seen as either ineffective as a stabilisation instrument or unable to respond in a timely manner. As noted by Kuncoro and Sebayang (2013), Simorangkir and Adamanti (2010), Hermawan and Munro (2008), the role of monetary policy in macroeconomic stabilization is well established, while the role of fiscal policy is less well understood. Hermawan and Munro (2008) suggest that fiscal policy will contributes meaningfully to macroeconomic stabilization in Indonesia, leading to better outcomes than monetary policy alone.

However, these studies are not specifically portray the behaviour of fiscal and monetary policies. For instance, the mechanism of policy rule in the study conducted by Kuncoro and Sebayang (2013) was not a typical reaction function in nature. The other previous study conducted by Hermawan and Munro (2008) & Yunanto and Medyawati (2014) was considered
good in explaining the interaction between monetary and fiscal rule, although the sample and calibration used in both studies focus on pre-global financial crisis. In addition, the interaction behaviour in the previous studies used very simple and partial method. For examples, the studies conducted by Kuncoro & Sebayang (2013) used partial OLS estimation and Sunando (2015) used simple VAR which are not enough to create a robust estimation.

3. Model and data

A. Model

We examine monetary and fiscal policy rules interaction using the monetary policy rule of Taylor (1993) and the fiscal policy rule of Davig and Leeper (2007). Following Taylor (1993), the monetary policy rule can be stated as:

\[ i_t = \bar{r} + \pi^* + \alpha_1(\pi_t - \pi^*) + \alpha_2(y_t - y^*_t) \]  \hspace{1cm} (1)

where \( i_t \), \( \bar{r} \), \( \pi_t \), \( \pi^* \), and \( (y_t - y^*_t) \), denote, respectively, the desired interest rate, the equilibrium real rate, inflation rate, the inflation target, and the output gap. The parameters \( \alpha_1 \) and \( \alpha_2 \) are typically believed to be around 0.5. Based on Eq. (1), Taylor (1993) argued that the policy rate would increase in response to an increase in inflation or output gap.

The classic Taylor rule incorporates the deviation of inflation over the last four quarters from its target. However, subsequent studies contend that central banks use expected inflation as a target as opposed to past or current inflation. Thus, Clarida, Galí, and Gertler (1998) develop a forward-looking monetary policy rule to reflect rational expectations of central banks. They show that the desired interest rate depends on the deviation of \( k \) periods ahead expected inflation from its target and the \( p \) periods ahead expected output gap, expressed as:

\[ i_t = \bar{r} + \pi^* + \alpha_1(E\pi_{t+k} - \pi^*) + \alpha_2(Ey_{t+p} - y^*_{t+p}) \]  \hspace{1cm} (2)

where \( E\pi_{t+k} \) is the expected accumulated inflation rate (computed as \( k \) quarters ahead forecast of inflation), and \( Ey_{t+p} \) is the expected output (computed as \( p \) quarters ahead forecast of output).

An implication of Eq. (2) is that \( \alpha_1 \), the weight of the inflation gap, and \( \alpha_2 \), the weight of the output gap, should be above unity and positive, respectively, to ensure monetary policy stability (Cevik, Dibooglu, and Kutan, 2014). An active monetary policy is one whereby \( \alpha_1 \) is above unity causing the central bank to increase the policy rate in response to high inflation. The stabilizing effect comes from the lower interest rate associated with a positive \( \alpha_2 \) (whereby output is below the normal levels). Central banks engage in interest rate smoothing (i.e. gradual adjustments in the policy rate) and, therefore, do not adjust policy rates to the desired level. This creates autocorrelation in the interest rate. This dynamic adjustment process is formulated as:

\[ i_t = \left(1 - \sum_{i=1}^n \rho_i\right)\hat{i}_t + \sum_{i=1}^n \rho_i i_{t-i}, \text{where } 0 < \sum_{i=1}^n \rho_i < 1 \]  \hspace{1cm} (3)

Replacing \( \hat{i}_t \) in Eq. (3) with Eq. (2), we have the following monetary policy rule:
\begin{align}
i_t = & \left(1 - \sum_{i=1}^{n} \rho_i \right) \left[ \bar{r} + \pi^* + \alpha_1 (E\pi_{t+k} - \pi^*) + \alpha_2 (Ey_{t+p} - y_{t+p}^*) \right] + \sum_{i=1}^{n} \rho_i i_{t-i} \\
\text{(4)}
\end{align}

By assuming that long-run real interest rate and the inflation target are a constant, i.e. \(\alpha_0 = \bar{r} - (\alpha_1 - 1)\pi^*\), and ignoring the unobserved forecast variables, then we have that: 5

\begin{align}
i_t = & \left(1 - \sum_{i=1}^{n} \rho_i \right) \left[ \alpha_0 + \alpha_1 \pi_{t+k} + \alpha_2 x_{t+p} \right] + \sum_{i=1}^{n} \rho_i i_{t-i} + \varepsilon_t \\
\text{(5)}
\end{align}

where \(x_{t+p}\) denotes the output gap \((Ey_{t+p} - y_{t+p}^*)\). The error term, \(\varepsilon_t\), is assumed to be a linear combination of the forecast errors of inflation and output gap. Stated formally,

\begin{align}
\varepsilon_t = & - \left(1 - \sum_{i=1}^{n} \rho_i \right) \left[ \alpha_1 (\pi^* - E\pi_{t+k}) + \alpha_2 (y_{t+p}^* - Ey_{t+p}) \right] + v_t \\
\text{(6)}
\end{align}

In application, a much simpler formulation of Eq. (5) is preferred. Eq. (5) implies that the nominal interest rate \((i_t)\) is a function of the \(k\) quarters ahead inflation rate \((\pi_{t+k})\), \(p\) quarters ahead output gap, lagged nominal interest rate \((i_{t-i})\). Hence, Eq. (5) can be simplified, without loss of generality, as:

\begin{align}
i_t = & \alpha_0 + \alpha_1 \pi_{t+k} + \alpha_2 x_{t+p} + \sum_{i=1}^{n} \rho_i i_{t-i} + \varepsilon_t \\
\text{(7)}
\end{align}

where \(\varepsilon_t\) is the error term. We assume that the parameters \(\alpha_i\) and \(\rho_i\) are not regime dependent.

For the fiscal policy rule, we follow Davig and Leeper (2007) and use the following fiscal policy rule:

\begin{align}
\tau_t = & \gamma_0 + \gamma_1 d_{t-1} + \gamma_2 (y_t - y_t^*) + \gamma_3 g_t + \sum_{i=1}^{k} \rho_i \tau_{t-i} + \varepsilon_t \\
\text{(8)}
\end{align}

where \(\tau_t\), \(d_{t-1}\), \(y_t - y_t^*\), \(g_t\), and \(\varepsilon_t\) denote, respectively, the ratio of tax revenue to gross domestic product (GDP), lagged debt to GDP ratio, output gap, government expenditure to GDP ratio, and the error term. Note that, unlike Davig and Leeper (2007), the parameters \(\gamma_i\) and \(\rho_i\) are not regime dependent. A passive fiscal policy regime is one whereby \(\gamma_1 > 0\). That is, an increase in the outstanding public debt stock leads to a substantial decrease in government deficit. The government is constrained by the debt stock, and, hence, is forced to either reduce expenditures, raise revenue via an increase in taxes or both in order to intertemporally balance the budget. Similarly, an active fiscal policy implies \(\gamma_1 \leq 0\). In this case, the government is not

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constrained by the level of the public debt stock. In other words, changes in taxes and government expenditures are not determined by the level of the debt stock.

By combining Eqs. (7) and (8), we obtain the following simple functional form of monetary and fiscal policy interactions:

$$Y_t = F(i_t, \pi_t, (y_t - y^*_t), \tau_t, d_t, g_t).$$  

Indonesia is a small open economy and as such the exchange rate functions prominently in its monetary and fiscal policies (see Juhro and Mochtar, 2009). Hence, we augment Eq. (9) by introducing the exchange rate into the policy rule interaction model. The functional form of Eq. (9) is represented in vector autoregression (VAR) framework as:

$$Y_t = \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \cdots + \beta_q Y_{t-q} + u_t$$  

where \(Y_t\) is an \(n \times 1\) vector of variables in Eq. (9), \(\beta_i\) are parameter matrices of size \(n \times n\), \(u_t\) is an error term whose variance-covariance matrix is \(\Sigma\), \(t\) and \(q\) are time and lag subscripts, respectively.

B. Data

We use quarterly data for our empirical analysis. Data on all variables are sourced from different databases, including Bank Indonesia, the Global Financial Database, the International Monetary Fund, and the Organisation for Economic Co-operation and Development. To be specific, we collect data on monetary policy variables: the nominal interest rate \((i_t)\), inflation rate \((\pi_t)\) computed as the first difference of logarithm of consumer price index \((\text{CPI})\); fiscal policy variables: the ratio of tax revenue to GDP \((\tau_t)\), debt to GDP ratio \((d_t)\), government expenditures to GDP ratio \((g_t)\); and the common variables between both policy rules, output \((y_t)\) and the exchange rate \((e_t)\). We calculate the variable output gap as the difference between actual output \((y^*_t)\), and potential output \((y^*_t)\) (i.e., output gap is \(y_t - y^*_t\)). We obtained \(y^*_t\) by extracting the trend component of \(y_t\) using the Hodrick-Prescott (HP) filter. The sample period is from 1974Q2 to 2019Q1. This is the longest sample period available for the nominal interest rate. Table A1 in the appendix provides full information regarding these variables.

Data on \(d_t\) is available only on an annual basis. To match it with other variables, we apply the linear interpolation method, which calculates a linear approximation of the missing value using the preceding non-missing value and the succeeding non-missing value. Formally, the interpolation method can be stated as

\[d_i = (1 - \sigma)d_{i-1} + \sigma d_{i+1},\]

where \(d_i\) is the missing value of debt to GDP ratio, \(d_{i-1}\) is the preceding non-missing value, \(d_{i+1}\) is the succeeding non-missing value, and \(\sigma\) is the position of the missing value \((\sigma)\) relative to the number of missing values in a given row.

We filtered out seasonality in the data using the TRAMO/SEATS filter. The seasonally adjusted variables are shown in Figure 1. The variables, \(g_t\), output gap \((y_t - y^*_t)\), \(\pi_t\), \(d_t\), and \(e_t\) exhibit significant spikes around the second quarter of the year 1999, which is the recovery phase of the Indonesian banking crisis and just before the introduction of the inflation targeting

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framework in 2000 (see Juhro and Iyke, 2019). Other significant spikes are observed in the data: the interest rate and the tax revenue ratio show significant spikes in 1988Q3 and 2015Q4, respectively. The sharp rise in interest rates in 1988Q3 coincided with the Bank Indonesia’s banking reform package (PAKTO ‘88) of 1988. This reform package sort to, among other things, lift the restriction on incumbent banks from establishing new branches and allowing the operation of private and foreign-owned banks (see Bennett, 1999). The Indonesia economy recorded the highest number of taxpayers (more than 30 million) in 2015, since the first significant tax reform (the income tax law of January 1984), coinciding with the sharp increase the tax revenue ratio.7

4. Empirical Results

A. Preliminary Analysis

We begin our empirical analysis by reporting the summary statistics in Table 1. The average government expenditure is 18.1% of GDP compared to an average tax revenue ratio of 9.8%. During this period, the government on average spent more than it generated revenue. Other factors unchanged, the government accumulated a mean debt ratio of 36.1% during this period. Indonesia nominal interest rate averaged 13.1% and inflation was 2.4% during the sample period. The average output gap recorded is 0.003 (or 0.09%).8 Given that the output gap was positive, the country ran an inflationary gap during the sample period. However, the inflation rate was moderate because the output gap was small coupled with the introduction of the inflation targeting framework.

As part of the preliminary analysis, we test the variables for unit roots. The results based on the Augmented Dickey-Fuller (ADF) and the Ng-Perron tests are shown in Table 2. All variables, except government expenditure and exchange rate, are stationary (have no unit roots). Those two variables are also found to be non-stationary in the Indonesian literature (Hirnissa, Habibullah, and Baharom, 2009; Sharma, Tobing, and Azwar, 2018). By construction, since output gap is obtained using the HP filter and inflation is the first difference of the logarithm of CPI, both variables are stationary. Interest rates are theoretically stationary and our test confirms this. We difference government expenditure and exchange rate and find them to be stationary. The VAR analysis to follow rests on the unit roots properties of the variables established in Table 2.

Figure 1 shows significant structural breaks in the variables. This corroborates evidence from prior studies (see, inter alia, Juhro, Narayan, Iyke, and Trisnanto, 2018; Sharma, Tobing, and Azwar, 2018; Iyke, 2019; Juhro and Iyke, 2019) that discover significant structural breaks. These breaks are mainly associated with the Asian financial crisis and the Indonesian banking crisis of 1997–1998. We formally identify breaks by employing the Narayan and Popp (2010) two-break test. The test results, which are reported in Table 3, statistically confirm the graphical evidence of structural breaks in the variables. Hence, we proceed with our analysis by filtering the identified structural breaks, in addition to the crisis period of 1997–1998, from the data. In other words, the variables are adjusted for structural breaks. The filtering process is as follows. Firstly, we create a dummy variable for the structural breaks for each variable. Secondly, we estimate a simple regression of the variable on an intercept term and the dummy variable.

7 See Prasetyo (2018) for a thorough synthesis of Indonesia’s tax reforms.
8 In percentage terms, output gap is calculated as \( \left( \frac{y_t - y^*_t}{y^*_t} \right) \times 100 \), where \( y_t \) is the actual output and \( y^*_t \) is the potential output. The average potential output is 3.520, while the gap is 0.003. Hence, output gap is 0.09%.
Finally, we compute the adjusted variable (new structural break adjusted), by adding the error term generated from the regression to the model’s intercept term.

In Table 4, we report the estimates based on five lag selection tests. On the one hand, choosing several lags would compromise the efficiency of our parameter estimates. On the other hand, choosing few lags could make the model underfitted. Thus, the lag selection tests provide guidance on how to proceed with the analysis. From the tests, four alternative choices are plausible (i.e., 2, 3, 4, and 7 lags). It is evident that a maximum of 7 lags is permissible. In theory, 4 lags are naturally the best candidate since the data are quarterly. However, our preliminary estimates suggest that the model fails to converge when 4 lags are included. This issue does not vanish when 3 lags are included in the model. Consequently, the impulse responses are not intuitive. We overcome this issue by including 2 lags in the model, consistent with Juhro and Iyke (2019).

\[ \begin{align*} B. \text{Impulse responses from standard VAR} \end{align*} \]

We now examine the impulse responses obtained through estimating Eq. (9). Recall that since Indonesia is a small open economy, we enriched this model by introducing the exchange rate in line with Juhro and Mochtar (2009). We identify structural shocks via the error term \( u_t \). We do this by normalizing \( u_t \) into \( v_t \) such that \( E[v_t v_t'] = I_n \). The normalized error term, \( u_t \), can then be written conveniently as \( u_t = Av_t \). This means the \( j^{th} \) column of \( A \) is the instantaneous impact of the \( j^{th} \) innovation on all variables. We constrained this instantaneous impact (or innovation) to be one standard deviation in size following prior studies (Iyke, 2018, 2019; Juhro and Iyke, 2019). Using this information, the variance-covariance matrix becomes:

\[ \Sigma = E[u_t u_t'] = AE[v_t v_t']A' = AA'. \] (11)

The matrix \( A \) is restricted such that we are left with \( n(n - 1)/2 \) degrees of freedom in the model, which is insufficient when identifying structural shocks to \( u_t \). To overcome this problem, we let \( A \) be a Cholesky factor of \( \Sigma \). This implies the variables are ordered recursively.

The identification by recursive ordering relies on the degree of exogeneity of the variables. We believe that government expenditure (indicating fiscal policy stance) is the least exogenous variables, since it can be influenced by the remaining variables. It is followed by the output gap (representing inflationary or recessionary pressures), inflation (indicating demand push inflation pressures), tax revenue (indicating fiscal policy pressures), debt ratio (debt channel of fiscal policy), the nominal interest rate (the interest rate or monetary policy channel), and the nominal exchange rate (for the exchange rate channel). The exchange rate is the most exogenous because Indonesia is a small open economy whose exchange rate is predominantly determined by external forces.

The corresponding impulse responses are generated based on 10000 Markov Chain Monte Carlo (MCMC) draws, 2 lags, and 30-quarters ahead forecast horizon. Because the structural shock is one standard deviation in size, the impulse responses are bounded in the region of 16% and the 84% quantiles. The plots of the impulse responses are shown in Figure 2.

A positive government expenditure shock increases output gap on impact. Inflation react negatively for few quarters before rising. Since government expenditure is part of output, its impact is immediate through the IS curve. This in turn translates into inflationary pressures, forcing prices to rise. This impact does not force interest rate to rise immediately but only after
inflation has increased. The sudden rise in government expenditure, which subsequently forces interest rate to rise, increases debt. From the government’s perspective, the rise in spending requires a concomitant rise in tax revenue, in order to make public debt sustainable. Chronologically, this implies that expansionary fiscal policies in the form of higher government expenditure lead to contractionary monetary policies through higher interest rates, which then conclude with contractionary fiscal policies through higher taxes.

A contractionary fiscal policy via a tax rise has a temporary impact on the economy. A shock to the tax revenue forces consumers to spend less, output gap falls, raising inflation through marginal cost. A positive tax shock enhances government’s spending capacity. However, since this shock has a temporary effect, spending falls faster to the baseline after just two quarters. The increase in taxation reduces the debt stock by the fourth quarter. From Figure 2, the increase in inflation following the tax increase does not last beyond the fifth quarter. In anticipation of the fall in inflation, the monetary authority applies an expansionary monetary policy in order to stimulate the economy. The impact of a tax shock on inflation and interest rate is controversial. For instance, Perotti (2002) observed a mixed impact of tax shocks on interest rates and inflation across countries. Mountford and Uhlig (2009) show that following a tax shock, interest rates increase if the tax shock is not delayed, and decrease if the tax shock is delayed by four quarters. In contrast, Favero and Giavazzi (2007) show that inflation declines following a contractionary fiscal policy via tax increase and this causes interest rates to decline as well.

A debt shock appears to last for about 19 quarters, although debt starts to decline in the fifth quarter, following the shock (see Figure 2). Government spending initially rises before declining by the second quarter. By the fourth quarter, government spending falls below its baseline. Tax revenue responds by initially falling and eventually rising by the sixth quarter. The eventual rise in taxes ensures that debt is restored to its baseline. The fall in government expenditure coupled with the rise in taxes leads to a fall in the output gap and an increase in inflation—a finding contrary to expectations. However, this becomes clear once we take into account the reaction of the exchange rate. A debt shock causes the exchange rate to depreciate because such a shock generates negative sentiments. This depreciation leads to an increase in the cost of imported goods and services and inflationary pressures. To restore inflation to its equilibrium level, the monetary authority pursues a contractionary monetary policy via an increase in interest rates. Monetary and fiscal policies interact to restore debt and inflation to a sustainable level. To achieve this objective, the government and the monetary authority have to compromise output, as seen in Figure 2.

A positive output shock increases the output gap. The corresponding decline in interest rates does not immediately force up inflation. Government responds by increasing spending for few quarters following the output shock. However, since the fall in the nominal interest rate is temporary, debt begins to rise. In response, taxes are increased in anticipation of a rise in interest rates. Thus, an output shock does not lead to an expansionary fiscal policy beyond the fourth quarter. The immediate decline in interest rates do translate into lower marginal cost and a decrease in inflation on impact.

A positive shock to inflation (a demand push shock) leads to an increase in the inflation rate. The monetary authority responds by pursuing a contractionary monetary policy through an increase in nominal interest rate. Anticipating a fall in the output gap, the government initially responds with an expansionary policy through an immediate increase in government spending. However, this policy is temporary because the increase in inflation is offset by an increase in the nominal interest rate causing debt to rise. To lower debt, the government implements a contractionary fiscal policy via an increase in taxation and a decrease in spending.
Thus, a demand push shock forces the implementation of a contractionary monetary policy, followed by an expansionary fiscal policy and finally by a contractionary fiscal policy.

An interest rate shock is transitory in our setup, consistent with theory. A positive interest rate shock raises the level of nominal interest rate causing an intertemporal substitution of savings for consumption. This causes inflation and output gap to fall with a delay. The higher nominal interest rate raises debt. To restore debt to its equilibrium, the government pursues a contractionary fiscal policy with a delay via a decrease in government expenditure. The response of taxation is negligible. In short, the contractionary monetary policy is trailed by a contractionary fiscal policy of lower government expenditure.

Finally, an exchange rate shock leads to a depreciation in the exchange rate for three quarters following the shock. In response, inflation increases because the depreciation makes imports expensive, which means that the additional cost of imports is transferred to buyers in the form of high prices (i.e. cost/imported inflation). The increase in inflation demands a contractionary monetary policy through an increase in the interest rate. This increase in the interest rate increases the cost of borrowing and production, and, hence, results in an initial decline in the output gap. On the fiscal side, the government responds by cutting taxes, and increasing debt and expenditure, which restores the economy back to its equilibrium path, as depicted in Figure 2.

5. Extension: A regime-switching analysis

A number of recent studies have argued that both monetary and fiscal policy rules are not constant over time (Clarida, Gali, and Gertler, 2000; Davig and Leeper, 2011; Ito, Watanabe, and Yabu, 2011; Cevik, Dibooglu, and Kutan, 2014; Amir-Ahmadi, Matthes, and Wang, 2016). Davig and Leeper (2007) argued that monetary and fiscal policy rules change between peace and wartime. Thus, since these policy rules are regime dependent, the aforementioned studies have employed two-state Markov regime-switching models to analyse the interactions of these rules. In what follows, we extend Eq. (9) in various ways and our contributions to this literature are developed from these extensions.

A. Active vs. passive monetary and fiscal policy interactions

We examine whether monetary and fiscal policies are well-coordinated across active and passive regimes. To do this, we use a two-state Markov regime-switching model to evaluate the effectiveness of these policies. This approach allows us to characterize the policies as active or passive if certain conditions are met. A two-state Markov regime-switching model for the monetary policy rule in Eq. (7), whereby the nominal interest rate \(i_t\) is a function of the \(k\) quarters ahead inflation rate \(\pi_{t+k}\), \(p\) quarters ahead output gap, and lagged nominal interest rate \(i_{t-1}\), is:

\[
i_t = \alpha_0(s_t) + \alpha_1 \pi_{t+k}(s_t) + \alpha_2 x_{t+p}(s_t) + \sum_{i=1}^{n} \rho_i i_{t-i}(s_t) + \epsilon_t
\]

where \(\epsilon_t\) is the error term. We assume that the parameters \(\alpha_i\) and \(\rho_i\) are regime dependent (i.e. they depend on the regime or state, \(s_t\). The parameters, therefore, change between passive and active monetary policy regimes. A passive monetary policy regime is one whereby \(\alpha_1 < 1\), whereas an active regime is one whereby \(\alpha_1 \geq 1\).
Similarly, the two-state Markov regime-switching model for the fiscal policy rule in Eq. (8) is of the form:

\[\tau_t = \gamma_0(s_t) + \gamma_1 d_{t-1}(s_t) + \gamma_2 y_t(s_t) + \gamma_3 g_t(s_t) + \sum_{i=1}^{k} \rho_i \tau_{t-i}(s_t) + \varepsilon_t\]  

(13)

where \(\tau_t\), \(d_{t-1}\), \(y_t\), \(g_t\), and \(\varepsilon_t\) denote, respectively, the ratio of tax revenue to GDP, lagged debt to GDP ratio, output gap \((y_t - y_t^*)\), government expenditures to GDP ratio, and the error term. Consistent with Davig and Leeper (2007), the parameters \(\gamma_i\) and \(\rho_i\) depend on the fiscal policy regime or state, \(s_t\). A passive fiscal policy regime is one whereby \(\gamma_1 > 0\). This means that an increase in the outstanding public debt stock leads to a substantial decrease in government deficit because the government is forced to increase taxes to balance the budget. An active fiscal policy implies \(\gamma_1 \leq 0\), meaning that the government is not constrained by the level of the public debt stock or taxes do not respond to the level of the public debt stock.

We estimate both Eqs. (12) and (13) using the maximum likelihood approach, allowing a maximum of 10,000 iterations during the optimisation via the Broyden–Fletcher–Goldfarb–Shanno (BFGS) algorithm. We generate the t-statistics based on the Huber-White robust standard errors and covariance and allowing the error variances to be regime-specific, given the volatility of the variables (see Table 1). Table 5 shows the estimated regime-switching policy rules. The regime-switching monetary policy rule is shown in Panel A. We are able to identify the monetary policy regimes based on the estimates. In regime 1, the response of interest rate to inflation is greater than one, meaning that this regime is active. Similarly, in regime 2, the response of interest rate to inflation is less than one, which means that the regime is passive.

We note that the reaction of interest rate to inflation in both regimes is not statistically different from zero. Developing countries, such as Indonesia, generally have structural and institutional rigidities, which impede the transmission of monetary policies. Since our data covers episodes of structural and institutional rigidities, these estimates appear consistent with our expectations. The BI implemented the Inflation Targeting Framework (ITF) in July 2005 in order to strengthen its monetary policy. Since the inflation rate is the primary target of the policy, we expect interest rates to react effectively to changes in inflation. In fact, Juhro and Mochtar (2009) find, using a recent sample (i.e. from 2000 to 2009) that interest rates react significantly to inflation deviation. The reaction of interest rate to output gap is positive in the passive regime, consistent with Juhro and Mochtar (2009). This indicates that the passive regime is stable. However, in the active regime, the reaction is negative. This follows similar intuition, namely that the sample covers episodes of structural and institutional rigidities, which may influence the transmission mechanism. The transition probabilities and duration statistics show that the active regime is more persistent. That is, the probability of staying in an active regime is nearly 95%, lasting for about 20 quarters. In contrast, passive monetary policy regimes are relatively short-lived, lasting for about 8 quarters with 88% probability of persisting.

Panel B shows the estimates of the regime-switching fiscal policy rule. The results suggest that the first regime is a passive regime since lagged debt ratio coefficient is positive and significant, while the second regime is the active regime since the coefficient of lagged debt ratio is negative and insignificant. In the active regime (regime 2), the government expenditure ratio is positive, suggesting that the fiscal authority increases tax revenue to fund its expenditure. We find similar reaction in the passive regime, consistent with theoretical
reasoning. The transition probabilities and duration statistics indicate that the active regime is more persistent, with a probability of staying in an active regime being nearly 98%, lasting for about 81 quarters. Passive fiscal policy regimes are generally short-lived, lasting for about three quarters with a 63% probability of persisting.

Are the monetary and fiscal policies synchronised? Leeper (1991) and Davig and Leeper (2007) argue that these policies should be well-coordinated in order be effective and sustainable. The evidence we gather suggest that the policy regimes are not synchronized over the full sample period. Both authorities (monetary and fiscal) recognised this, as evidenced by the formation of Coordination Meetings and a regular meeting of BI with the Cabinet chaired by the President of Indonesia, and a joint formulation of the State Budget Macro Assumptions deliberated with the Indonesian Parliament to enhance monetary and fiscal policy coordination. Over time, we expect these initiatives to harmonize the policy regimes in the country.

Figure 3 shows the plots of the transition probabilities across active and passive policy regimes. These plots are generated from the Markov regime-switching monetary and fiscal policy rules in Eqs. (12) and (13), which are presented in Table 4. The plots suggest that active monetary policy is a relatively recent policy direction of Indonesia. The figure shows that BI shifted to an active regime somewhere in the early parts of the 2000s, which is consistent with the timing of the ITF. Prior to that, passive monetary policy was persistent. With regards to fiscal policy, the government alternated between active and passive policy regimes until the year 2000. From then onwards, passive fiscal policies are persistent.

B. Active vs. passive monetary and fiscal policy interactions in recent periods

We hypothesize that more recent periods may show synchronization of monetary and fiscal policies. We test this hypothesis by restricting our sample to the period of 2000Q1 to 2019Q1. Table 6 reports the estimates of the two-state Markov regime-switching monetary and fiscal policy rules using this sample. Unlike the full sample estimates in Table 4, the restricted sample suggests that interest rate reacts positively and significantly to inflation in the active regime, consistent with theory (see Panel A). The reaction is also positive in the passive regime, although statistically insignificant. The active regime persists with a probability of 79% and a duration of approximately 5 quarters. The passive regime does not persist since it lasts for only slightly above a quarter with a probability of 21%.

The fiscal policy-based results are reported in Panel B of Table 6. They are the direct opposite of those in Table 5. Here, we can clearly identify the regimes. In regime 1, the coefficient of lagged debt ratio is nearly zero, indicating an active fiscal policy regime. Similarly, in regime 2, the coefficient is statistically significant and greater than zero, indicating a passive fiscal policy regime. Moreover, in the active fiscal policy regime, the government expenditure ratio is positive and statistically significant, suggesting that the fiscal authority increases tax revenue to fund its expenditure. In the passive regime, taxes react negatively to government expenditure, consistent with Cevik, Dibooglu, and Kutan (2014), who find this for Hungary and Slovenia.

A closer look at these results suggests that the monetary and fiscal policy regimes are synchronized in the recent periods. Active monetary policies are followed by active fiscal policies. Noteworthy is that active fiscal policies outlive active monetary policies by nearly 22 quarters. Prior studies find also document varying levels of fiscal policy persistence across countries. For example, Afonso, Agnello, and Furceri (2010) find, using a sample of 132 developed and developing countries over the period of 1980 to 2007, that persistence dominates any component of fiscal policy. Gemmell, Kneller, and Sanz (2011) observe that changes in fiscal policies are often not persistent in OECD countries. But why may fiscal policies be more
persistent relative to monetary policies? Claeys (2006) argues that persistence in fiscal policies is more natural since the budgetary process entails prolonged parliamentary processes and sunk decisions. Fatás and Mihov (2007) observe that fiscal policies are more persistent because they are more influenced by institutions, politics, and constraints. For example, political parties in power generally spend more or reduce taxes during electoral years to increase their chances of remaining in power; moreover, the public may demand larger provision of certain services (Fatás and Mihov, 2007). Thus, a downside of (discretionary) fiscal policies is that they are often difficult to reverse, once implemented. An increase in government spending, for instance, may be followed by fiscal consolidations requiring spending cuts, whose implementation is daunting (Fatás and Mihov, 2007). Afonso, Agnello, and Furceri (2010) find that government size, income, and country size enhance fiscal policy persistence.

The evidence that active fiscal policy regimes tend to outlast active monetary policy regimes in Indonesia is consistent with these arguments. That is, whereas fiscal policies are largely influenced by State institutions and politics, BI monetary policies are to a large extent more independent and follow the ITF. The Indonesian President presented the 2020 budget of 2,528.8 trillion rupiah ($177.56 billion) to parliament, which aims to enhance spending on human resources, while also planning a 5% corporate tax cut (equivalent of $6 billion reduction in revenue) commencing in starting in 2021. Before these fiscal policies, the government implemented a fiscal reform programme through the Indonesia Fiscal Reform Development Policy Loan of $400 million. The aim was to enhance revenue collection and quality of spending. Similarly, the BI pursued pro-growth policies entailing a reduction in interest rates three and four times, respectively, in 2016 and 2019, and successfully maintaining inflation within the target range of 3 to 5%. This interest rate policy is aligned with BI's macroprudential policy, which is also set in an accommodative (expansive) stance to synchronise with the fiscal policies. However, by comparison, these fiscal and monetary policies are not exact in magnitude—they are close though.

An implication of our finding that active fiscal policies outlive active monetary policies suggesting that the policies are not fully synchronized will required extra high-level coordination initiatives to achieve a balance. Nevertheless, the main conclusion is that the formation of Coordination Meetings and a regular meeting of BI with the Cabinet chaired by the President of Indonesia, and a joint formulation of the State Budget Macro Assumptions deliberated with the Indonesian Parliament to enhance monetary and fiscal policy coordination have harmonized the policy regimes to some extent.

6. Concluding remarks

In this paper, we examine the interaction of monetary and fiscal policy rules in Indonesia. Our empirical analysis utilizes data over a time period of 1974Q2 to 2019Q1. We show that the reaction of the monetary and fiscal policy rules is quite consistent with theoretical predictions. A contractionary monetary policy is trailed by a contractionary fiscal policy and
vice versa. To better understand the interaction of the policy rules, we analyse them in active and passive regimes. We show that monetary and fiscal policies are not synchronized over the full sample period, suggesting presence of structural and institutional rigidities. In the post-1995 period through prompted in large part by the 1997 Asian financial crisis, the government and BI have undertaken policy decision making in unison inspired us to analyse monetary and fiscal policy rules over the period 2000Q1 to 2019Q1. When done, we see that the policies are more harmonized. More specifically we discover that active fiscal policy tends to me longer lasting compared to active monetary policy. The search for policy optimality, therefore, continues for Indonesian policy makers. A sound and sustainable joint policy coordination effort will help identify an “optimal” interaction (policy mix) between monetary and fiscal policy. Optimal in the sense that both policies should be mutually supportive (or their effects should not negate each other) in order to enhance the economy. Our findings imply that the recent policy initiatives by the monetary and fiscal authorities are in the right direction to attaining a balanced policy interaction and to achieving an optimal growth path.
References


Figure 1. Plots of variables

The graph displays the movements of the variables employed in the study. The variables are: government expenditure ratio ($g_t$), output gap ($y_t - y^*_t$), inflation ($\pi_t$), tax revenue ratio ($\tau_t$), debt ratio ($d_t$), short rate ($i_t$), and exchange rate ($e_t$). The variables are seasonally adjusted using TRAMO/SEATS filter. The sample period is from 1974Q2 to 2019Q1.
Table 1. Summary statistics

<table>
<thead>
<tr>
<th></th>
<th>$g_t$</th>
<th>$y_t - y_t^*$</th>
<th>$\pi_t$</th>
<th>$\tau_t$</th>
<th>$d_t$</th>
<th>$i_t$</th>
<th>$e_t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>18.078</td>
<td>0.003</td>
<td>0.024</td>
<td>9.839</td>
<td>36.136</td>
<td>13.103</td>
<td>8.049</td>
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<tr>
<td>Median</td>
<td>18.324</td>
<td>-0.001</td>
<td>0.017</td>
<td>9.760</td>
<td>29.979</td>
<td>10.944</td>
<td>7.764</td>
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<td>Max</td>
<td>45.943</td>
<td>1.076</td>
<td>0.232</td>
<td>29.639</td>
<td>92.260</td>
<td>66.633</td>
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<tr>
<td>Min</td>
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<td>-0.017</td>
<td>2.647</td>
<td>17.820</td>
<td>2.682</td>
<td>6.028</td>
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<tr>
<td>SD</td>
<td>5.480</td>
<td>0.431</td>
<td>0.027</td>
<td>3.583</td>
<td>15.673</td>
<td>9.439</td>
<td>1.218</td>
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<tr>
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<td>1.024</td>
<td>1.774</td>
<td>3.303</td>
<td>-0.300</td>
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<tr>
<td>Kurtosis</td>
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<td>81.384</td>
<td>30.727</td>
<td>7.537</td>
<td>5.784</td>
<td>17.022</td>
<td>1.595</td>
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<tr>
<td>JB</td>
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<td>47565.29</td>
<td>6384.98</td>
<td>185.821</td>
<td>152.502</td>
<td>1801.821</td>
<td>17.501</td>
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<tr>
<td>P-value</td>
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<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
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<tr>
<td>Obs.</td>
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<td>180</td>
<td>180</td>
<td>180</td>
<td>180</td>
<td>180</td>
</tr>
</tbody>
</table>

The table shows summary statistics on government expenditure ($g_t$), output gap ($y_t - y_t^*$), inflation ($\pi_t$), tax revenue ($\tau_t$), debt ($d_t$), short rate ($i_t$), and exchange rate ($e_t$). The sample period is from 1974Q2 to 2019Q1. Max, Min, SD, JB and Obs. denote, respectively, maximum, minimum, standard deviation, Jarque-Bera statistic, and observations.

Table 2: Test for unit roots

<table>
<thead>
<tr>
<th></th>
<th>Augmented Dickey-Fuller test</th>
<th>Ng-Perron test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t-statistic</td>
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<tr>
<td>$g_t$</td>
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</tr>
<tr>
<td>$\Delta g_t$</td>
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<tr>
<td>$y_t - y_t^*$</td>
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<td>0</td>
</tr>
<tr>
<td>$\pi_t$</td>
<td>-5.609***</td>
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<tr>
<td>$\tau_t$</td>
<td>-4.955***</td>
<td>1</td>
</tr>
<tr>
<td>$d_t$</td>
<td>-3.391**</td>
<td>5</td>
</tr>
<tr>
<td>$i_t$</td>
<td>-5.339***</td>
<td>1</td>
</tr>
<tr>
<td>$e_t$</td>
<td>-0.906</td>
<td>3</td>
</tr>
<tr>
<td>$\Delta e_t$</td>
<td>-8.913***</td>
<td>2</td>
</tr>
</tbody>
</table>

The table shows the results of the Augmented Dickey-Fuller and Ng-Perron tests for unit roots. The variables are government expenditure ($g_t$), output gap ($y_t - y_t^*$), inflation ($\pi_t$), tax revenue ($\tau_t$), debt ($d_t$), short rate ($i_t$), and exchange rate ($e_t$). The null hypothesis is that the variables have a unit root. *** and ** denote rejection of the null hypothesis at 1% and 5% significance levels, respectively. $\Delta$ denotes first difference. The sample period is from 1974Q2 to 2019Q1.
Table 3. Test for structural breaks

<table>
<thead>
<tr>
<th>Variable</th>
<th>Test stat.</th>
<th>TB1</th>
<th>TB2</th>
<th>k</th>
<th>Status</th>
<th>Test stat.</th>
<th>TB1</th>
<th>TB2</th>
<th>k</th>
<th>Status</th>
</tr>
</thead>
<tbody>
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<td>$g_t$</td>
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<td>2001Q3</td>
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<td>I(0)</td>
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<td>2006Q4</td>
<td>4</td>
<td>I(0)</td>
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<tr>
<td>$y_t - y_t^*$</td>
<td>-11.543</td>
<td>2008Q2</td>
<td>2009Q4</td>
<td>4</td>
<td>I(0)</td>
<td>-12.751</td>
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<td>4</td>
<td>I(0)</td>
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<tr>
<td>$\pi_t$</td>
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<td>2009Q4</td>
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<td>I(0)</td>
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<td>2003Q3</td>
<td>2009Q4</td>
<td>4</td>
<td>I(0)</td>
</tr>
<tr>
<td>$\tau_t$</td>
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<td>2000Q4</td>
<td>2002Q2</td>
<td>2</td>
<td>I(1)</td>
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<td>2000Q4</td>
<td>2002Q2</td>
<td>2</td>
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<tr>
<td>$d_t$</td>
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<td>$i_t$</td>
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<td>2009Q4</td>
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<tr>
<td>$e_t$</td>
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<td>2009Q4</td>
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<td>1994Q3</td>
<td>2009Q4</td>
<td>4</td>
<td>I(0)</td>
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</table>

The table reports the Narayan and Popp (2010) test results for unit roots and structural breaks. We compare the the M1 and M2 statistics with the tabulated critical values in Narayan and Popp (2010). The optimal lags are chosen using Hall’s (1994) procedure. The test can identify two endogenous structural breaks in the data. The regression includes only the intercept term. Test stat., TB1, TB2, and k are, respectively, the test statistic, first and second structural break dates, and the chosen optimal lag. The variables are government expenditure ($g_t$), output gap ($y_t - y_t^*$), inflation ($\pi_t$), tax revenue ($\tau_t$), debt ($d_t$), short rate ($i_t$), and exchange rate ($e_t$). The null hypothesis is that the variables have a unit root. I(0) and I(1) denote, respectively, rejection and acceptance of the null hypothesis at the conventional significance levels. The sample period is from 1974Q2 to 2019Q1.

Table 4. Lag selection tests

<table>
<thead>
<tr>
<th>Lag</th>
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<th>FPE</th>
<th>AIC</th>
<th>SC</th>
<th>HQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>NA</td>
<td>2.211</td>
<td>20.659</td>
<td>20.783</td>
<td>20.709</td>
</tr>
<tr>
<td>1</td>
<td>1002.412</td>
<td>0.011</td>
<td>15.375</td>
<td>16.369</td>
<td>15.778</td>
</tr>
<tr>
<td>3</td>
<td>163.309</td>
<td>0.002</td>
<td>13.803</td>
<td>16.535</td>
<td>14.911*</td>
</tr>
<tr>
<td>4</td>
<td>101.488</td>
<td>0.002*</td>
<td>13.675</td>
<td>17.276</td>
<td>15.135</td>
</tr>
<tr>
<td>5</td>
<td>77.380</td>
<td>0.002</td>
<td>13.682</td>
<td>18.152</td>
<td>15.495</td>
</tr>
<tr>
<td>6</td>
<td>74.487</td>
<td>0.002</td>
<td>13.683</td>
<td>19.022</td>
<td>15.848</td>
</tr>
<tr>
<td>7</td>
<td>78.583*</td>
<td>0.002</td>
<td>13.623*</td>
<td>19.832</td>
<td>16.140</td>
</tr>
<tr>
<td>8</td>
<td>55.976</td>
<td>0.002</td>
<td>13.712</td>
<td>20.790</td>
<td>16.582</td>
</tr>
</tbody>
</table>

The table shows lag selection tests, which provide guidance on the maximum lag to be included in the model. The model contains variables in Equation (8) and the exchange rate ($e_t$). The tests are: sequential modified likelihood ratio (LR) test statistic; final prediction error (FPE); Akaike information criterion (AIC); Schwarz information criterion (SC); and Hannan-Quinn information criterion (HQ). * indicates lag order selected by the criterion at 5% level.
Figure 2. Impulse responses from standard VAR
Table 5. Active vs. passive fiscal and monetary policy regimes

<table>
<thead>
<tr>
<th>Panel A: Monetary Policy Rule</th>
<th>Regime 1: Active</th>
<th>Regime 2: Passive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
<td>Coefficient (P-value)</td>
<td>Coefficient (P-value)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.734(0.072)</td>
<td>8.030(0.015)</td>
</tr>
<tr>
<td>$\pi_{t+2}$</td>
<td>3.820(0.803)</td>
<td>-24.209(0.513)</td>
</tr>
<tr>
<td>$y_{t+4} - y'_{t+4}$</td>
<td>-1.141(0.030)</td>
<td>2.635(0.114)</td>
</tr>
<tr>
<td>$ln\sigma(t)$</td>
<td>0.269(0.011)</td>
<td>2.349(0.000)</td>
</tr>
<tr>
<td>$p_{ij}$</td>
<td>0.949</td>
<td>0.882</td>
</tr>
<tr>
<td>$d$</td>
<td>19.792</td>
<td>8.440</td>
</tr>
</tbody>
</table>

Panel B: Fiscal Policy

<table>
<thead>
<tr>
<th>Variable</th>
<th>Regime 1: Passive</th>
<th>Regime 2: Active</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>21.674(0.000)</td>
<td>2.188(0.007)</td>
</tr>
<tr>
<td>$d_{t-1}$</td>
<td>0.401(0.000)</td>
<td>-0.004(0.706)</td>
</tr>
<tr>
<td>$y_t - y'_t$</td>
<td>-21.422(0.000)</td>
<td>0.556(0.032)</td>
</tr>
<tr>
<td>$\Delta g_t$</td>
<td>1.340(0.000)</td>
<td>0.026(0.419)</td>
</tr>
<tr>
<td>$\tau_{t-1}$</td>
<td>-0.868(0.000)</td>
<td>0.783(0.000)</td>
</tr>
<tr>
<td>$ln\sigma(s_t)$</td>
<td>-0.837(0.000)</td>
<td>0.640(0.000)</td>
</tr>
<tr>
<td>$p_{ij}$</td>
<td>0.631</td>
<td>0.988</td>
</tr>
<tr>
<td>$d$</td>
<td>2.708</td>
<td>80.749</td>
</tr>
</tbody>
</table>

The table shows the Markov regime-switching fiscal and monetary policy rules in Eqs. (12) and (13). We use Huber-White robust standard errors and covariance and allow error variances to be regime-specific, given the volatility of the variables. The optimisation relies on the BFGS algorithm. Coefficients and p-values are outside and inside the parentheses, respectively. $ln\sigma(s_t)$ is the logarithm of the standard error of the regression in each regime. $p_{ii}$ and $d$ are the transition probabilities and the expected duration of regimes, respectively. The variables are government expenditure ($g_t$), output gap ($y_t - y'_t$), inflation ($\pi_t$), tax revenue ($\tau_t$), debt ($d_t$), and short rate ($i_t$). $\Delta$ denotes first difference. The sample period is from 1974Q2 to 2019Q1.
The figure shows the smoothed transition probabilities for the active and passive policy regimes. These plots are generated from the Markov regime-switching fiscal and monetary policy rules in Eqs. (12) and (13). We use Huber-White robust standard errors and covariance and allow error variances to be regime-specific, given the volatility of the variables. The optimisation relies on the BFGS algorithm. The sample period is from 1974Q2 to 2019Q1.
Table 6. Active vs. passive policy regimes in recent periods

<table>
<thead>
<tr>
<th>Variable</th>
<th>Regime 1: Active Coefficient</th>
<th>Regime 2: Passive Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.203(0.563)</td>
<td>0.136(0.142)</td>
</tr>
<tr>
<td>$\pi_{t+2}$</td>
<td>13.520(0.048)</td>
<td>0.948(0.495)</td>
</tr>
<tr>
<td>$y_{t+4} - y'_{t+4}$</td>
<td>-1.398(0.010)</td>
<td>-1.241(0.000)</td>
</tr>
<tr>
<td>$l_{t-1}$</td>
<td>0.942(0.000)</td>
<td>0.973(0.000)</td>
</tr>
<tr>
<td>$ln\sigma(s_t)$</td>
<td>0.028(0.813)</td>
<td>-2.866(0.000)</td>
</tr>
<tr>
<td>$p_{ij}$</td>
<td>0.792</td>
<td>0.206</td>
</tr>
<tr>
<td>$d$</td>
<td>4.814</td>
<td>1.260</td>
</tr>
</tbody>
</table>

Panel B: Fiscal policy

<table>
<thead>
<tr>
<th>Variable</th>
<th>Regime 1: Active Coefficient</th>
<th>Regime 2: Passive Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>4.129(0.000)</td>
<td>11.925(0.000)</td>
</tr>
<tr>
<td>$d_{t-1}$</td>
<td>0.005(0.788)</td>
<td>0.103(0.000)</td>
</tr>
<tr>
<td>$y_t - y'_t$</td>
<td>0.655(0.562)</td>
<td>7.451(0.000)</td>
</tr>
<tr>
<td>$\Delta g_t$</td>
<td>0.114(0.083)</td>
<td>-13.803(0.000)</td>
</tr>
<tr>
<td>$\tau_{t-1}$</td>
<td>0.602(0.000)</td>
<td>-0.072(0.000)</td>
</tr>
<tr>
<td>$ln\sigma(s_t)$</td>
<td>0.758(0.000)</td>
<td>-4.766(0.002)</td>
</tr>
<tr>
<td>$p_{ij}$</td>
<td>0.963</td>
<td>0.405</td>
</tr>
<tr>
<td>$d$</td>
<td>26.786</td>
<td>1.682</td>
</tr>
</tbody>
</table>

The table shows the Markov regime-switching fiscal and monetary policy rules in Eqs. (12) and (13) restricting the sample to more recent periods. We use Huber-White robust standard errors and covariance and allow error variances to be regime-specific, given the volatility of the variables. The optimisation relies on the BFGS algorithm. Coefficients and p-values are outside and inside the parentheses, respectively. $ln\sigma(s_t)$ is the logarithm of the standard error of the regression in each regime. $p_{ij}$ and $d$ are the transition probabilities and the expected duration of regimes, respectively. The variables are government expenditure ($g_t$), output gap ($y_t - y'_t$), inflation ($\pi_t$), tax revenue ($\tau_t$), debt ($d_t$), and short rate ($l_t$). $\Delta$ denotes first difference. The sample period is from 2000Q1 to 2019Q1.
### Appendix
#### Table A1: Data description and sources

This table shows each variable, its calculation (where applicable) and its source. These variables are used to examine the interaction of monetary and fiscal policies in our paper.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>$l_t$</td>
<td>Short-term Interest rate (%). This is based on the Bank Indonesia Certificate 1 months &amp; pasar uang antar bank 30 days)</td>
<td>Bank Indonesia</td>
</tr>
<tr>
<td>$\pi_t$</td>
<td>Inflation rate. It is computed as the first difference of logarithm of the consumer price index.</td>
<td>Global Financial Database</td>
</tr>
<tr>
<td>$\tau_t$</td>
<td>Tax ratio (%). It is calculated as tax revenue (US$ billion) by GDP (US$ billion).</td>
<td>Bank Indonesia</td>
</tr>
<tr>
<td>$g_t$</td>
<td>Govt Expenditures to GDP ratio (%). It is calculated as government expenditure (US$ billion) by GDP (US$ billion).</td>
<td>Bank Indonesia and Badan Pusat Statistik Indonesia</td>
</tr>
<tr>
<td>$y_t$</td>
<td>Real output. It is the logarithm of real GDP (US$ billion).</td>
<td>Organisation for Economic Co-operation and Development, Badan Pusat Statistik Indonesia, and CEIC Data</td>
</tr>
<tr>
<td>$e_t$</td>
<td>Exchange rate. It is rupiah per US$ rate.</td>
<td>International Monetary Fund</td>
</tr>
<tr>
<td>$d_t$</td>
<td>Debt to GDP ratio (%). It is the total debt (US$ billion) by GDP (US$ billion)</td>
<td>Ministry of Finance, Indonesia</td>
</tr>
</tbody>
</table>