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FISCAL AND MONETARY POLICY INTERACTIONS IN INDONESIA DURING PERIODS OF ECONOMIC TURMOIL IN THE US: 2001Q1-2014Q4

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ABSTRACT

This study investigates the formation of the interaction between monetary and fiscal policies in Indonesia during periods of economic turmoil in the US (external shock) based on the Hybrid New Keynesian (HNK) model. The study estimates the HNK model using the Full Information Maximum Likelihood and time-series data over the period 2001Q1-2014Q4. The result reveals the form of coordination is a monetary-led policy mix between active monetary policy and passive fiscal policy. The degree of coordination is down when external shock increases.

Keywords: Central bank policy; Fiscal policy; Policy coordination; External shock.
JEL Classifications: E520; E62; E63; E6; E371.

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I. INTRODUCTION

Despite the existing literature on monetary-fiscal interaction in Indonesia (see Mochtar, 2004; Simorangkir, 2007; Hermawan and Munro, 2008; Simorangkir and Adamanti, 2010; Rahutami, 2011; Santoso, 2011; Kuncoro *et al*., 2013; and Yunanto and Medyawati, 2013), the study of the interaction of the policies facing global shock is relatively rare. The study is essential since the coordination determines the effectiveness of the fiscal and monetary policies reduce the negative impact of the external crisis. This research focuses on investigating how the fiscal and monetary policies are arranged to deal with the contraction of the US economy in the period 2001Q1-2014Q4. We use the 2001-2014 period because there were two crises in the US, namely the 2001 and 2008-2009 crises, which put significant pressure on the US and world economies.

The research uses the US economy since its expansion and contraction influences the global economy, including Indonesia's (see Nezky, 2013). The interaction of the monetary and fiscal policies in Indonesia has become more attractive because shortly before the US economic contraction, through the Central Bank Act of 1999 (Law no. 23/1999), *Bank Indonesia* (central bank of Indonesia) was independent of the cabinet and focused on inflation. Indonesia's central bank, Bank Indonesia (BI), introduced and socialized the Inflation Targeting Framework (ITF) in 2001 and fully implemented it in July 2005 (see Alamsyah *et al*., 2001: 316; Warjiyo, 2002: 4; BI, 2009: 6). The study investigates whether the independence of the central bank after 1999 caused difficulties in synergizing fiscal and monetary policies in the face of crises from abroad. The study examines the form of interaction (or coordination) and whether the external shock change the degree of coordination between fiscal and monetary policy.

There are two frameworks that are usually employed for policy interaction in the background literature. Game theory is the basis of the first framework in which the policymakers maximize pay-off from interactions (e.g. Bennett and Loayza, 2000, Lambertini and Rovelli, 2003, Simorangkir, 2007, Stawska *et al*., 2021). The second framework assumes a general equilibrium relationship among economic variables (e.g. Muscatelli *et al*., 2004, and Bianchi and Melosi, 2019). This study uses a second framework. Furthermore, the majority of previous studies in many countries as well as Indonesia show the coordination is better than when they isolate each other (see Hall and Mankiw, 1994; Woodford, 2001; Auerbach, 2003 and Favero and Monacelli, 2005; Drazen, 1985; Bruno and Fisher, 1990; Blinder, 1982; Tabellini, 1986; Alesina and Tabellini, 1987 and also see Mochtar, 2004; Simorangkir, 2007; Hermawan and Munro, 2008; Simorangkir and Adamanti, 2010; Rahutami, 2011; Santoso, 2011; Kuncoro *et al*., 2013; and Yunanto and Medyawati, 2013).

In this study, a model was developed based on the model previously introduced by Muscatelli *et al*. (2004 a,b), that uses a macroeconomic equilibrium approach, with the Hybrid New Keynesian (HNK) framework by incorporating backward-looking and forward-looking elements into the model. We argue that the economic agent in Indonesia consists of both, partially backward and partially forward behavior. Muscatelli *et al*. (2004 a,b) use a system of equations consisting of 5 equations, the goods market equilibrium (IS), the Monetary Policy reaction function (MP), the Phillips Curve (PC), the government expenditure reaction function (FP-G), and

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the tax revenue reaction function (FP-T). We modify their model from a closed economy model to an open economy and introduce the impact of foreign shocks on the pattern of policy interactions. A system of equations is better than a single equation in estimating a macroeconomic model since a single equation potentially produces a biased estimator (Linde 2005). Furthermore, following Linde, we use the Full Information Maximum Likelihood (FIML) method in the estimation. He states that FIML produces more precise and unbiased estimates than GMM, which is usually used to estimate the Hybrid New Keynesian Model.

Bianchi and Melosi (2019) provide an idea that contributes to a better understanding of the interaction between the two policies. We apply their ideas to analyze the estimation results of the model. They have introduce four patterns of interaction, namely (i) A *monetary-led policy mix* (monetary policy active but fiscal policy passive-AM/PF,(ii) *A fiscally-led policy mix* (fiscal policy active and passive monetary policy-PM/AF), (iii) *active fiscal and monetary policy-AM/AF and* (iv) *passive fiscal and monetary policy-PM/PF (see also* Bianchi and Ilut 2017; Bianchi *et al*. 2020; and Liu *et al*. 2021). Leeper (1991) argues that only AM/PF or PM/AF makes the policy mix effective. Furthermore, the AM/PF is suitable to be applied when the economy rises above its potential. In contrast, PM/AF is more appropriate when output is below the potential output level.

Many studies define contraction in the US narrowly by viewing the US turmoil as a financial crisis. Some studies only look at the effect of quantitative easing by the FED during the contraction period on various countries' capital and financial markets. They argue that the Quantitative Easing (QE) increases the capital inflows, which causes real output growth, and equity returns to rise, the exchange rate appreciates, and the lending rate decreases (see Kiendrebeogo, 2016; Anaya *et al*., 2017; Apostolou and Beirne, 2019; Balcilar *et al*., 2020, Chen *et al*., 2016; Yang and Hamori 2014; Tran *et al*., 2020, Insukindro dan Pritadrajati 2019). In this study, we define the US contraction in a broader sense, namely economic conditions in the US compared to previous and future situations (expectations). We use the Consumer Sentiment Index (CSI) as the indicator of economic conditions. The sentiment index contains information about the current and future states of the economy. Furthermore, CSI is suitable for the HNK since the model that assumes the economic agents base their decision on past economic conditions (backward-looking) and forecasts of future economic expectations (forward-looking). Barsky and Sims (2012) find a relationship between consumer confidence and subsequent macroeconomic activity. Likewise, the studies of Lahiri and Zhao (2016) and Ahmed and Steven (2016) show the relationship between economic output in the US and the consumer confidence index.

Since we need to capture the movement of the US economic output during and after the crisis, we do not use dummy variables (dummy of crisis). Another index, like the St. Louis Fed Financial Stress Index (FSI), neither describes the movement, nor does it meet our research objective (see Figure 1).

There are two contributions from this study. It is the first study that analyzes the changes in interaction patterns due to external shocks in Indonesia. It contributes an empirical model to investigate the equilibrium policy mix, policy interaction, and the effect of the external shock. The results imply that policy coordination is a collective decision of two independent authorities. The study finds fiscal policy

accommodates monetary policy, and the form of policy interaction is AM/PF. The US contraction weakens the degree of coordination even if it does not change the AM/PF.

II. DATA AND METHODOLOGY

A. Data

This study uses quarterly macroeconomic data of the Indonesian period of 2001Q1-2014Q4 at the constant price (2015=100). We use government expenditure (g), tax (τ), output (y), and wage (w). Government expenditure is the central government expenditure, excluding interest rate and payment of debt. The government tax revenue is revenue from domestic personal tax. Furthermore, the change in government debt (d) is the value of budget deficit financing for each period. The wages are the average wage of labor in the industrial sector below the supervisor. Furthermore, employment (n) is the number of workers (15 years old or older). The data of n are semi-annual in the period 2005-2014 and annual before 2005. We change the series to quarterly. The interest rate (i) is the central bank's interest rate (*Bank Indonesia*) at the end of the period of March, June, September, and December. Likewise, inflation (π) is year-on-year inflation that measures the percentage change of the Consumer Price Index (CPI) compared to the same period in the previous year. We use data from CPI at the end of March, June, September, and December. We use the Michigan Consumer Sentiment Index (CSI) to measure external economic conditions. The CSI indicates the consumer perception about the economic situation in the last six months, at present, and over the next six months, so a low CSI suggests the economic contraction. However, we use the negative value of CSI named Z in the estimation, so the increase of Z shows the increase in economic contraction. The data is obtained from Bank Indonesia (BI), the Indonesian Ministry of Finance (MoF), the Indonesian National Bureau of Statistics (BPS), and the Federal Reserve of the United States (FED).

In the estimation we use the percentage deviation from the steady-state or named fluctuation. We employ the following equation to estimate the percentage deviation from the steady state (fluctuation).

$$\hat{x} = \frac{(x - x^*)}{x^*} \tag{1}$$

where $\hat{x}$ is the fluctuation of the variable, x is the actual value of the variable, and x^* is the equilibrium value of the variable or steady-state. The value of x^* is estimated using the Hodrick Prescott filter (HP filter). Table 1 shows the definition of variables.

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Table 1.
Data Description

Labor share is the value of fluctuation of wages, employment, minus output, $\hat{s}=\hat{w}_t+\hat{n}_t-\hat{y}_t$ (see Muscatelli *et al*., 2004a). The frequency of all variables is Quarterly 2001Q1-2014Q4. Fluctuation is percentage deviation from a steady state (or equilibrium).

Variable	Description	Source
g	Central government expenditure (Billion Rp, constant 2015 price).	MoF
$\hat{g}$	Fluctuation of g. Percentage deviation from equilibrium government expenditure	Author's computation
τ	Central government tax revenue (Billion Rp, constant 2015 price)	MoF
$\hat{\tau}$	Fluctuation of τ.	Author's computation
y	GDP real (Billion Rp, constant 2015 price)	BPS
$\hat{y}$	Fluctuation of output (output gap).	Author's computation
i	Monetary policy interest rate	BI
$\hat{\imath}$	Fluctuation of i.	Author's computation
i^{US}	US monetary policy. Average Federal Fund rate	FED
CSI	Michigan consumer sentiment index	FED
Z	External crisis indicator. Negative value of Michigan Consumer Sentiment Index	Author's computation
π	Year on year inflation	BPS
$\hat{\pi}$	Fluctuation of π.	Author's computation
π^F	Year on year US inflation	FED
π-π^F	The inflation differences (domestic inflation minus US inflation).	Author's computation
$\widehat{(\pi-\pi^F)}$	Fluctuation of (π-π^F).	Author's computation
er	er = Rp/USD.	BI
$\widehat{er}$	Fluctuation of er	Author's computation
d	The change of debt (measured by the value of deficit financing).	MoF
$\hat{d}$	Fluctuation of d.	Author's computation
w	Real value of wage (Rp, constant 2015 price).	BPS
$\hat{w}$	Fluctuation of w.	Author's computation
n	Number of workers. Data is sourced in semi-annual and annual frequency and has been converted into quarterly.	BPS
$\hat{n}_t$	Fluctuation n.	Author's computation
$\hat{s}_t$	Labor income share. $\hat{s}_t=\hat{w}_t+\hat{n}_t-\hat{y}_t$	Author's computation

B. Methodology

Gali *et al*. (2001) introduce the simple Hybrid New Keynesian (HNK) model developed by Muscatelli *et al*. (2004, a, b) by adding fiscal variables to the model. Muscatelli *et al*. (2004 a,b) build the function based on the fiscal reaction function (FP) of Clarida *et al*. (1998 and 2000), Giannoni and Woodford (2003, a, b), Muscatelli *et al.* (2004, a,b) and Favero (2004). We combine the FP version of Muscatelli *et al*. (2004 a,b) with the FP which was developed by Wyplosz (1999), Melitz (2000), Blanchard and Perotti (2002), Rezabek (2002), Perotti (2005), Favero and Giavazzi (2007), Caldara and Kamps (2008), and Kappel and Janku (2014) and built our version of FP. Our model has the advantage over others since it uses open economy assumptions and adopts a simple approach to looking at the foreign

impact on policy interaction. The system consists of five equations: equilibrium in goods market (IS), Hybrid New Keynesian Phillips Curve (HNKPC), Monetary Policy reaction function (MP), and two fiscal reaction functions (government expenditure, FP-G, and tax revenue, FP-T). The macroeconomic model can be formulated as:

$$\hat{y}_t = \beta_{11}\hat{y}_{t-1} + \beta_{12}E_t\hat{y}_{t+1} + \beta_{13}\hat{\imath}_t + \beta_{14}E\hat{\pi}_{t+1} + \beta_{15}\hat{g}_{t-1} + \beta_{16}\hat{g}_t + \beta_{17}E_t\hat{g}_{t+1}$$

$$+\beta_{18}\widehat{(\pi - \pi^F)}_t + \beta_{19}E\hat{g}Z_{t-1} + u_{1t}$$

$$\hat{\pi}_t = \beta_{21}\hat{\pi}_{t-1} + \beta_{22}E\hat{\pi}_{t+1} + \beta_{23}\hat{s}_t + u_{2t}$$

$$\hat{\imath}_t = \beta_{30} + \beta_{31}E\hat{\pi}_{t+1} + \beta_{32}\hat{y}_t + \beta_{33}\hat{\imath}_{t-1} + \beta_{34}\widehat{er} + \beta_{35}\hat{g}_{t-1} + \beta_{36}\hat{g}Z_{t-1} + u_{3t}$$

$$\hat{g}_t = \beta_{40} + \beta_{41}\hat{g}_{t-4} + \beta_{42}\hat{y}_t + \beta_{43}\hat{y}_{t+1} + \beta_{44}\hat{d}_{t-1} + \beta_{45}\hat{\imath}_{t-2} + \beta_{46}\hat{\imath}Z_{t-1} + u_{4t}$$

$$\hat{\tau}_t = \beta_{50} + \beta_{51}\hat{\tau}_{t-2} + \beta_{52}\hat{y}_{t-1} + \beta_{53}\hat{d}_{t-1} + \beta_{54}\hat{\imath}_{t-1} + \beta_{55}\hat{\imath}Z_{t-1} + u_{5t} \quad (2)$$

where 'hatted' variables represent percentage deviation from steady-state or fluctuation of the variables, it will be called *fluctuation* in this study. Initially, the HNK model by Muscateli *et al*. (2004, a b) is a closed model economy. We modify the model to an open economy. We add an external factor using the fluctuation of difference between domestic and foreign (US) inflation, $(\widehat{\pi - \pi^F})$, in the IS equation to find the effect of foreign demand on net exports. We modify the IS model by replacing the fluctuation of real interest rate $\hat{r}_t$ with a fluctuation of nominal interest rate $\hat{\imath}_t$ and fluctuation of expected inflation $E\hat{\pi}_{t+1}$.[1] We modify the government expenditure reaction function by adding a lag of monetary variable $\hat{\imath}_{t-1}$ to measure fiscal policy's responses to the monetary change. We also add a lag of fiscal variable, lag of government expenditure $\hat{g}t$-1, to the monetary policy reaction function to find the monetary policy response to changes in fiscal policy. We assume the monetary policy is affected by government expenditure but not by tax revenue. However, the government expenditure and tax policies respond to monetary policy[2].

Furthermore, the Hybrid New Keynesian Phillips Curve (HNKPC) is the same as the PC version by Gali and Gertler (1999) that is developed based on Fischer (1997), Taylor (1980), Calvo (1983). Gali and Gertler (1999) simplifies the HNKPC

$$\pi_t = \vartheta\hat{s}_t + \beta_b\pi_{t-1} + \beta_f E_t\{\pi_{t+1}\} \quad (3)$$

where β_b is *backward-looking* and β_f is *forward-looking* coefficients. The $\hat{s}_t$ is the percentage change from steady state or the labour income share (see Muscatelli *et al*. 2004a). Furthermore, we developed the reaction function of monetary policy

[1] rt=it-t+1

[2] Utama (2021, 90-91) argues that the effect of government spending on monetary policy is sufficient to measure the impact of fiscal policy on monetary policy. There are two reasons for the argument: 1) the relation among tax revenue, government expenditure, and government budget confirms that the tax revenue is used to finance government spending; 2) government spending is used as a primary instrument in countercyclical fiscal policy.

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reaction and fiscal policy based on models by Muscatelli *et al*. (2004a) and Clarida *et al*. (1998) (see also Clarida *et al*., 2000; Muscatelli *et al*., 2002; and Giannoni and Woodford, 2003a,b; Favero, 2004).

Furthermore, we add the external shock variable, represented by the negative value of the Michigan Sentiment Index (CSI), Z, into the system of the equation to measure the effect of external shock (US economic contraction) on the domestic economy[3]. The higher Z, the smaller the CSI value, implying a worse US economy or increased external shock. Furthermore, in system equation (2), the interaction variable between government spending and Z, $\hat{g}Z$, shows the government expenditure adaptation when external shock worsens. Meanwhile, the variable interaction between the interest rate and Z, $\hat{\imath}Z$ shows monetary policy adoption when external shock worsens. In the fiscal policy reaction function, the coefficients of the variables $\hat{\imath}Z_{t-1}$ in FP-G and FP-T (β_{46} and β_{55}) indicate the change in the response of fiscal policy to monetary policy when the degree of external shock increases. Meanwhile the coefficient of $\hat{g}Z_{t-1}$ (β_{36}) on the monetary policy reaction function indicates the change in the monetary policy response to fiscal policy when the degree of external shock increases.

III. MAIN FINDING

A. Preliminary Result

The National Bureau of Economic Research [NBER]) declared during 2001-2014 that there were two crises in the US namely the 2001 recession (April-November 2001) and the 2007-2009 recession (January 2008-June 2009). Furthermore, the St. Louis Fed Financial Stress Index (FSI) also indicates the financial crisis during the 2008-2009 crisis. The effect of the crisis on the US economy is not only felt during the crisis period but also until several years later. The effect is indicated by the Unemployment Rate (UR), which shows the rise of the US unemployment rate from 3.9% in December 2000 to 5.7% in December 2001. After the unemployment rate fell back to 4.4% in December 2006, it increased to 5% in December 2007 and rose sharply to 10% in October 2009. However, it was still 9.3%, 8.5%, 7.9%, 6.7%, and 5.6% in December 0f 2010, 2011, 2012, 2013, and 2014 respectively. Figure 1 displays FSI and UR and the shaded gray area which is the crisis period according to the NBER Recession Indicator. Figure 1 shows that the CSI condition worsened from 2001 to the end of 2014. Figure 1(a) also shows the Michigan Consumer Sentiment Index (CSI), which declined after the 2001 crisis and continued to decline in the 2008-2009 crisis.

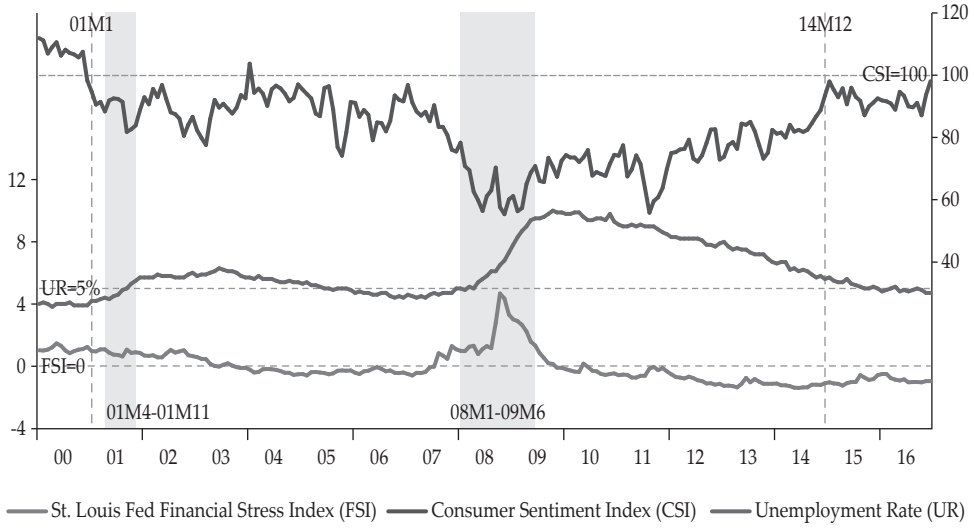
Figure 1(a) shows that CSI and UR describe the long-term effect of the economic contraction better than the FSI. The CSI and UR show that the 2008-2009 crisis took longer to recover than in 2001. Figure 1(a) shows that CSI is the right indicator to explain degrees of the US economy's contraction during 2001-2014. Figure 1(b) shows the reaction of the Federal Reserve (FED) to shock by lowering the Federal Fund Rate (FFR) a few years after the shock. The FED started dropping the Federal Fund Rate (FFR) in September 2007. At the end of 2008, the FFR was near zero. Bank Indonesia reacted by slowly lowering interest rates caused the difference between Indonesia's interest rates and the FFR to widen.

[3] Z=CSI×(-1)

Figure 1.
Economic Condition of US (2000-2016) as Well as US and Indonesia Monetary Policy

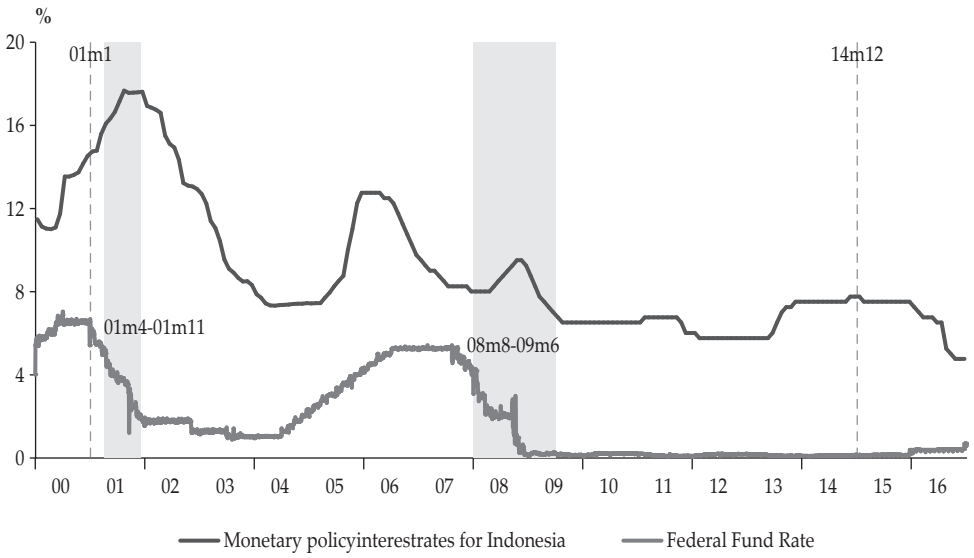
The shaded area is crisis period which arranged based on NBER Recession Indicators

(a)



Sources: FED, Bank Indonesia, 2021

(b)



Sources: FED, Bank Indonesia, 2021

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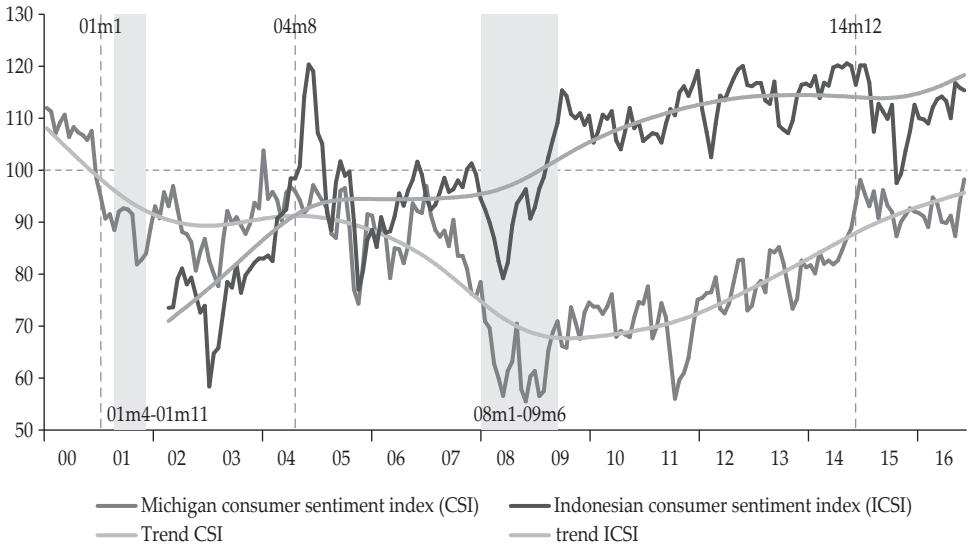
Figure 2 explains how the Indonesian economy reacted to US contraction. Starting in October 2004, there is the opposite movement of CSI and ICSI (Indonesian Consumer Sentiment Index), CSI went down but ICSI went up. The result indicates the negative co-movement between the US and Indonesian confidence in the domestic economy. Likewise, when the crisis was present around 2007-2010, ICSI was getting better, but CSI was getting worse. Figure 2 supports research conducted by Kiendrebeogo (2016), Chen *et al*. (2016), Anaya *et al*. (2017), Apostolou and Beirne (2019), Balcilar *et al*. (2020), and Tran *et al*. (2020) which mention that the financial crisis in 2008-2009 causes positive effects on emerging economies.

Figure 2.
Consumer Sentiment Index of Indonesia and US



Sources: Federal Reserve and Bank Indonesia, 2020

B. Statistical Feature of the Data

A crucial issue in the time series analysis is the problem of stationarity. The study used the unit root test to determine whether the data are stationary or not. We employ the Augmented Dickey-Fuller (ADF) unit root test with interceptions. The test indicates that all variables are stationary.

Table 2.
Unit Root Test Result

This table reports the results for the ADF unit root test. The ADF unit root test examines the null hypothesis of "unit root." We examine the ADF test using the Schwartz Information with a maximum of 10 lags length.

Variable	*t*-statistic	ADF Unit Root Test Lag Length	*P*-value
$\hat{y}_t$	-3.2964	0	0.0198
$\hat{g}_t$	-3.5233	3	0.0111
$(\pi\text{-}\pi^F)$	-9.0948	0	0.0000
$\widehat{er}$	-3.2448	1	0.0027
$\hat{g}Z$	-4.0156	3	0.0028
$\hat{i}Z$	-3.8175	1	0.0048
$\hat{\pi}$	-5.1280	3	0.0001
$\hat{\imath}$	-3.9332	1	0.0035
$\hat{d}$	-8.18892	0	0.0000
$\hat{s}$	-4.1206	0	0.0020
$\hat{t}$	-4.6353	1	0.0004

C. Main Result

C.I. Empirical Verification

Before discussing the policy interaction, it is crucial to verify whether the relationships among variables in Indonesia in the period 2001Q1-2014Q4 are appropriate for the prediction of HNK. The verification is essential since the result of the interaction is not robust if the basic theoretical framework that underlies it is not applied in Indonesia. The results of IS estimation in Table 3 show that the previous and expected output fluctuation ($\hat{y}_{t-1}$ and $E_t\hat{y}_{t+1}$) positively influence the current output fluctuation. Although fluctuation of interest rates, $\hat{\imath}_t$, does not significantly affect the output fluctuation, the negative sign β_{13} supports the theory. Furthermore, the coefficient fluctuation of inflation expectations, $E_t\{\hat{\pi}_{t+1}\}$, implies that the increase of expected inflation significantly increases the economy's output. The positive coefficient of $(\widehat{\pi - \pi^F})_t$ suggests that if the domestic inflation fluctuations are higher than the fluctuation of foreign inflation, then output fluctuations will decrease since the net export decreases. The results are different from the theory of Purchasing Power Parity (PPP), although many studies find the PPP puzzling (example Rogoff, 1996 and Murray and Papell, 2005). The effect of past fluctuation of government expenditure, g_{t-1}, and current fluctuation of government expenditure, g_t, statistically does not affect output fluctuations significantly. Conversely, the expectation of fluctuation of government spending, $E_t\hat{g}_{t+1}$, is positively significant and confirms the theory's prediction that government expenditure will contribute to the output expansion.

Table 3.
Result of System of Equation

Variable	Coefficient		*P*-Value	Variable	Coefficient		*P*-Value
	Symbol	Value			Symbol	Value	
Dependent Variable: $\hat{y}_t$							
$\hat{y}_{t-1}$	β_{11}	0.4124	0.0000	$\hat{g}_t$	β_{16}	-0.0021	0.1447
$E_t\hat{y}_{t+1}$	β_{12}	0.5511	0.0000	$E_t\hat{g}_{t+1}$	β_{17}	0.0324	0.0001
$\hat{i}_t$	β_{13}	-0.0023	0.5267	$(\widehat{\pi-\pi^T})_t$	β_{18}	-0.0003	0.0039
$E_t\{\hat{\pi}_{t+1}\}$	β_{14}	0.0054	0.0094	$(\hat{g}Z)_{t-1}$	β_{19}	-0.0004	0.0001
$\hat{g}_{t-1}$	β_{15}	-0.0006	0.5667				
Adj. R^2	0.6686						
Dependent Variable: $\hat{\pi}_t$							
$\hat{\pi}_{t-1}$	β_{21}	0.5660	0.0000	$\hat{s}_t$	β_{23}	-0.0911	0.8333
$E_t\{\hat{\pi}_{t+1}\}$	β_{22}	0.4723	0.0000				
Adj. R^2	0.7499						
Dependent Variable: $\hat{i}_t$							
Constant	β_{30}	-0.0946	0.0000	$\widehat{er}$	β_{34}	0.4340	0.0013
$E_t\hat{\pi}_{t+1}$	β_{31}	0.0309	0.0000	$\hat{g}_{t-1}$	β_{35}	-0.0047	0.6766
$\hat{y}_t$	β_{32}	2.4818	0.0042	$\hat{g}Z_{t-1}$	β_{36}	0.0005	0.0093
$\hat{i}_{t-1}$	β_{33}	0.7729	0.0000				
Adj. R^2	0.8542						
Dependent Variable: $\hat{g}_t$							
Constant	β_{40}	-0.0229	0.3212	$\hat{d}_{t-1}$	β_{44}	-0.0287	0.2161
$\hat{g}_{t-4}$	β_{41}	0.8301	0.0000	$\hat{i}_{t-2}$	β_{45}	-0.5932	0.0634
$\hat{y}_t$	β_{42}	10.941	0.0447	$\hat{i}Z_{t-1}$	β_{46}	0.0022	0.5128
$\hat{y}_{t+1}$	β_{43}	-8.3166	0.0625				
Adj. R^2	0.7213						
Dependent Variable: $\hat{\tau}_t$							
Constant	β_{50}	-0.0030	0.5609	$\hat{d}_{t-1}$	β_{53}	0.0104	0.0140
$\hat{\tau}t$-2	β_{51}	0.2793	0.0002	$\hat{i}_{t-1}$	β_{54}	0.1752	0.6946
$\hat{y}t$-1	β_{52}	0.8167	0.1558	$\hat{i}Z_{t-1}$	β_{55}	-0.0015	0.7544
Adj. R^2	0.031						
Log likelihood			357.4253	Akaike info criterion			-12.7618
Avg. log likelihood			1.401668	Schwarz criterion			-11.5497
Determinant residual covariance			5.95E-13	Hannan-Quinn criter.			-12.2986

The Phillips Curve (PC) estimation shows a positive and significant value of the backward-looking, $\hat{\pi}_{t-1}$, and forward-looking, $E_t\{\hat{\pi}_{t+1}\}$, variables supporting the theory's predictions. However, the negative value of the labor share $\hat{s}_t$ is not compatible with the predictions of the PC. Even so, the negative estimation results confirm the studies conducted by Lawless and Whelan (2011) in Europe (1970-2005) and the US (1959-1996).

Table 3 shows the result of the monetary policy reaction function and the fiscal policy reaction functions. Monetary policy emerges as a stabilizing policy by having a positive reaction of fluctuation of interest rate $\hat{i}_t$ to output gap $\hat{y}_t$ and

expected inflation $E_t\hat{\pi}_{t+1}$. The study confirms previous research by Wyplosz (1999), Clarida *et al*. (1998), and Kappel and Janku (2014). Furthermore, the past fluctuation of interest rate $\hat{\imath}_{t-1}$ positively affects the $\hat{\imath}_t$, implying the consistency of the central bank's policy or policy credibility. The positive and significant exchange rate fluctuation $\widehat{er}$ on $\hat{\imath}_t$ indicates that the monetary policy responds to the exchange rate. If the Rupiah (IDR) depreciates more than its equilibrium value, BI will raise the policy interest rate.

The result of fiscal policy reaction functions indicates that the expenditure and the tax reaction function (FP-G and FP-T) respond to the fluctuation of the change of debt or deficit financing $\hat{d}_{t-1}$. The government reduces the fluctuation of expenditure $\hat{g}_t$ when $\hat{d}_{t-1}$ rises. Furthermore, the the government increases the fluctuation of the tax $\hat{\tau}_t$ when t $\hat{d}_{t-1}$ rise. The estimation result indicates that the government manages the debt to make the budget sustainable by controlling government expenditure and revenue. The result confirms the study about fiscal sustainability in Indonesia by Insukindro (2018).

The negative and significant effect of the expected output gap $\hat{y}_{t+1}$ implies that the government uses expenditure for procyclical policy by stabilizing future output. The estimation of FP-T also shows the output fluctuation did not affect tax significantly. The result in table 3 verifies whether the HNK framework is applied in Indonesia. The relation among variables is appropriate to the theory.

C.II. Policy Interaction

The sign of fiscal and monetary policy interaction coefficients shows the coordination exists. The negative effect of government expenditure fluctuation $\hat{g}_{t-1}$ on interest rate fluctuation $\hat{\imath}_t$, the negative effect of $\hat{\imath}_{t-2}$ on $\hat{g}_t$, and the positive effect $\hat{\imath}_{t-1}$ on tax revenue fluctuation $\hat{\tau}_t$ indicate policy coordination (β_{35} is negative, β_{45} is negative, and β_{54} is positive). Furthermore, there is evidence that the form of the coordination is *a monetary-led policy mix* since only β_{45} is statistically significant. The policy mix shows that fiscal policy adjusts the expenditure when monetary policy changes. If fiscal policy changes, monetary authority will not adjust interest rates significantly. This result indicates the form of policy mix can produce effective policies. (see Bianchi and Melosi, 2019 and Leeper, 1991).

Furthermore, to see the effect of shock from the US on the interaction, the impact of the interaction variable $\hat{g}Z_{t-1}$ on the monetary reaction function (MP) and the effect of the interaction variable $\hat{\imath}Z_{t-1}$ on the government spending reaction function (FP-G) and tax revenue reaction function (FP-T) or fiscal reaction functions. The interaction increases when the shock increases (US economic conditions worsen) if the coefficient of β_{36} on MP is negative, β_{46} on FP-G is negative, and β_{55} on FP-T is positive.

The results show when the value of Z increases (US economy down), then the coordination between monetary policy and government expenditure policy decreases (the values of β_{36} and β_{46} are positive). Furthermore, the result shows the coordination between monetary policy and tax revenue policy decreases when the US economy decreases (Z increase). The significant value of β_{36} also indicates a substantial decrease in the effect of fiscal policy on monetary policy when external shocks increase.

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The results of the study show a foreign shock decrease in coordination. If the foreign shock is too big, the policy mix may turn into a *passive fiscal and monetary policy*-PM/PF or even an *active fiscal and monetary policy*-AM/AF, which results in an ineffective policy mix. In preparing the foreign policy framework, this condition must be watched out for by both the fiscal and monetary authorities.

C. III. Test for Residual of System Equation

We perform several residual tests on the system of equations. Table 4 describes the normality test of the residual of each equation and system of equations. The Jarque-Bera (JB) test indicates that residuals have a joint-normal distribution. The result will provide that if the likelihood function is specified correctly, then FIML is fully efficient.

We use the System Residual Portmanteau to test the presence of autocorrelation. In Table 6, both the *Q*-statistics and the adjusted *Q*-statistics (with a minor sample correction). Based on the null hypothesis of no serial correlation up to lag 8, the results show that the null hypothesis is accepted so the autocorrelation is absent. Likewise, the stationarity test for residuals, the ADF shows the residual of each equation, and the system of the equation is stationary. Based on the test of normality, autocorrelation, and stationarity tested on a residual system of equations, we conclude that the estimated system equation (2) is efficient.

Table 4.
Residual Test for HNK System of Equations

System Residual Normality Tests: Orthogonalization: Residual Correlation (Doornik-Hansen). Null hypothesis: residuals are multivariate normal; b) System Residual Portmanteau Tests for Autocorrelations: Null Hypothesis: no residual autocorrelations up to lag h. c) The ADF unit root test examines the null hypothesis of "unit root." We examine the ADF test using the Schwartz Information with a maximum of 10 lags length.

System Residual Normality Tests				
Component	**Skewness**	**Kurtosis**	**Jarque-Bera (JB)**	**JB-Prob.**
1	0.804	6.155	15.468	0.000
2	-0.342	4.383	7.482	0.024
3	0.128	3.163	1.126	0.570
4	0.586	3.383	3.274	0.195
5	2.670	16.072	31.581	0.000
Joint			58.931	0.999
System Residual Portmanteau Tests for Autocorrelations				
Lags	***Q*-Stat**	**Prob.**	**Adj *Q*-Stat**	**Prob.**
1	33.080	0.129	33.742	0.114
2	47.890	0.559	49.156	0.507
3	70.846	0.614	73.547	0.526
4	104.782	0.352	110.371	0.225
5	125.605	0.468	133.458	0.286
6	146.978	0.555	157.680	0.318
7	172.115	0.548	186.817	0.257
8	199.987	0.487	219.874	0.160

Table 4.
Residual Test for HNK System of Equations (Continued)

Stationary Test for Residual			
Equation	***t*-statistic**	**ADF Unit Root Test Lag Length**	***P*-value**
Equation 1	-9.767	0	0.000
Equation 2	-5.564	8	0.000
Equation 3	-5.845	0	0.000
Equation 4	-7.467	0	0.000
Equation 5	-7.326	0	0.000
All	-6.736	0	0.000

IV. ROBUSTNESS CHECK

We determine whether the system of equations is robust using two approaches. The first is by investigating the consistency of the coefficient by checking the sign of coefficients in four models (system of equations). The first system of equations is the basic macroeconomic model with households and firms without a government in a closed economy. The second model is the three economic sectors: households, firms, and government in a closed economy. The third is the open economy version of second model. Finally, the fourth model is the augmented version of the third model (full version or system equation (2)). Table 5 shows that a coefficients' sign (positive or negative), ranging from a simple to a complete model, is consistent.

Table 5.
Consistency Check of the Model

		System 1		System 2		System 3		System 4	
Variable	**Sign**	**Coef.**	***P*-Value**	**Coef.**	***P*-Value**	**Coef.**	***P*-Value**	**Coef.**	***P*-Value**
Dependent variable: $\hat{y}_t$									
$\hat{y}_{t-1}$	β_{11}	0.456	0.002	0.421	0.229	0.449	0.391	0.412	0.000
$E_t\hat{y}_{t+1}$	β_{12}	0.514	0.015	0.519	0.219	0.525	0.313	0.552	0.000
$\hat{\imath}_t$	β_{13}	-0.003	0.832	-0.009	0.791	-0.004	0.950	-0.002	0.527
$E_t\{\hat{\pi}_{t+1}\}$	β_{14}	0.004	0.606	0.006	0.664	0.005	0.857	0.005	0.009
$\hat{g}_{t-1}$	β_{15}			-0.001	0.919	0.000	0.990	-0.001	0.567
$\hat{g}_t$	β_{16}			-0.001	0.941	-0.002	0.931	-0.002	0.145
$E_t\hat{g}_{t+1}$	β_{17}			0.000	0.953	0.001	0.939	0.032	0.000
$(\widehat{\pi-\pi^F})_t$	β_{18}					-0.0001	0.961	-0.0003	0.004
$\hat{g}Z_{t-1}$	β_{19}							-0.0004	0.000
Dependent variable: $\hat{\pi}_t$									
$\hat{\pi}_{t-1}$	β_{21}	0.550	0.000	0.556	0.005	0.566	0.087	0.566	0.000
$E_t\{\hat{\pi}_{t+1}\}$	β_{22}	0.465	0.000	0.482	0.095	0.476	0.108	0.472	0.000
$\hat{s}_t$	β_{23}	-0.038	0.965	-0.010	0.995	-0.101	0.947	-0.091	0.833
Dependent variable: $\hat{\imath}_t$									
Constant	β_{30}	-0.122	0.000	-0.104	0.049	-0.107	0.179	-0.095	0.000
$E_t\hat{\pi}_{t+1}$	β_{31}	0.038	0.000	0.033	0.079	0.034	0.204	0.031	0.000
$\hat{y}_t$	β_{32}	0.520	0.645	2.319	0.441	2.028	0.576	2.482	0.004
$\hat{\imath}_{t-1}$	β_{33}	0.772	0.000	0.771	0.002	0.755	0.038	0.773	0.000

Table 5.
Consistency Check of the Model (Continued)

		System 1		System 2		System 3		System 4	
Variable	**Sign**	**Coef.**	***P*-Value**	**Coef.**	***P*-Value**	**Coef.**	***P*-Value**	**Coef.**	***P*-Value**
$\widehat{er}$	β_{34}			0.417	0.487	0.418	0.667	0.434	0.001
$\hat{g}_{t-1}$	β_{35}					-0.016	0.793	-0.005	0.677
$\hat{g}Z_{t-1}$	β_{36}							0.001	0.009
Dependent variable: $\hat{g}_t$									
Constant	β_{40}			-0.020	0.831	-0.024	0.838	-0.023	0.321
$\hat{g}_{t-4}$	β_{41}			0.813	0.003	0.821	0.007	0.830	0.000
$\hat{y}_t$	β_{42}			14.025	0.553	11.478	0.745	10.941	0.045
$\hat{y}_{t+1}$	β_{43}			-9.386	0.650	-8.722	0.774	-8.317	0.063
$\hat{d}_{t-1}$	β_{45}			-0.017	0.849	-0.023	0.888	-0.029	0.216
$\hat{i}_{t-2}$	β_{46}					-0.378	0.781	-0.593	0.063
$\hat{i}Z_{t-1}$	β_{47}							0.002	0.513
Dependent variable: $\hat{\tau}_t$									
Constant	β_{50}			-0.003	0.915	-0.003	0.954	-0.003	0.561
$\hat{\tau}_{t-2}$	β_{51}			0.319	0.590	0.293	0.693	0.279	0.000
$\hat{y}_{t-1}$	β_{52}			0.684	0.836	0.731	0.891	0.817	0.156
$\hat{d}_{t-1}$	β_{53}					0.011	0.824	0.010	0.014
$\hat{i}_{t-1}$	β_{54}					0.035	0.900	0.175	0.695
$\hat{i}Z_{t-1}$	β_{55}							-0.002	0.754
Log likelihood			298.6271	350.911		353.3799		357.4253	
Avg. log likelihood			1.843377	1.376121		1.385804		1.401668	
Determinant residual cova.			3.17E-09	7.85E-13		6.95E-13		5.95E-13	
Akaike info criterion			-1.0E+01	-1.28E+01		-1.28E+01		-12.7618	
Schwarz criterion			-10.2477	-11.9109		-11.6994		-11.5497	
Hannan-Quinn criter.			-10.4966	-12.4727		-12.3547		-12.2986	

The second approach is to examine whether the sign of the coefficient (positive or negative) matches the predictions of the HNK theory. The verification of the model indicates that the HNK applies in Indonesia in the period of the study. Based on these two approaches, we can state that the model is robust.

V. CONCLUSIONS

The study investigates that the coordination relationship between government expenditure and interest rate policy. The study does not find a significant coordination relationship between interest rates and the government tax policy. In the period under investigation, it appears that there is an indication that the form of coordination is a monetary-led policy mix, or active monetary policy and passive fiscal policy. Based on Bianchi and Melosi (2009), this policy mix can produce effective policies.

This study has found the decrease in coordination as the US economy worsened. The monetary policy response to changes in fiscal policy is down significantly as

the US economy contracts. However, even if the level of coordination has changed, the results indicate the policy took the form of a *monetary-led policy mix*.

The study shows that HNK applies in Indonesia so that based on the theoretical framework, the model used is valid. This study also shows that the shock in the US had a positive impact on Indonesia, so it is reasonable to apply the AM/PF policy mix to achieve an effective policy mix. This indication confirms the study that finds the US crises, especially 2008-2009, have a positive impact on emerging countries (see Kiendrebeogo, 2016; Chen *et al*., 2016; Anaya *et al*., 2017; Apostolou and Beirne, 2019; Balcilar *et al*., 2020; and Tran *et al*., 2020).

This study encourages the fiscal and monetary authorities to increase their cooperation in dealing with turmoil from abroad. The two authorities must develop a common policy framework to deal with external shocks so that policy coordination can be maintained even when major crises occur abroad.

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