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THE ROLE OF INTEREST RATES AND PROVINCIAL MONETARY AGGREGATE IN MAINTAINING REGIONAL INFLATION IN INDONESIA

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ABSTRACT

In most countries, monetary policies are implemented in order to maintain economic stability. The policy may employ interest rate or money supply to derive the assigned national inflation target. Most studies investigate the relationship between monetary policy and inflation use national data. Based on the idea that inflation is a regional phenomenon, the application of provincial data might be more appropriate explaining the relationship between monetary policy and inflation. The study elaborate the impact of changes in provincial money supply, BI Rate (interest rates of central bank), and PUAB (money market interest rates) to regional inflation in the framework Hybrid New Keynesian Phillips Curve (HNKPC). The study employs Generalized Method of Moments (GMM) techniques on panel data of 32 provinces from 2005-III to 2014-IV. The data is classified into 4 groups, which are Jawa-Bali (W1), Sumatera (W2), Kalimantan-Sulawesi (W3), and Papua-Maluku-Nusa Tenggara (W4). The estimation result shows that provincial monetary aggregate influence inflation significantly only in Sumatera. Furthermore, inflation is also effect by BI Rate in Sumatera and Kalimantan-Sulawesi. The study also found that PUAB is significantly affecting inflation in almost all Indonesian regions, except Kalimantan-Sulawesi. This study concludes that interest rates, BI rate and PUAB, is more appropriate than change in provincial money supply to control provincial inflation.

Keywords: monetary policy, regional inflation, hybrid NKPC
JEL Classification Numbers: E31, E52, R19

1. INTRODUCTION

Inflation has become the main concern in monetary policies since it influences consumer purchasing power and business climate, which in turn will determine macroeconomic variables such as national output and unemployment. In Indonesia, Bank Indonesia(BI) has been granted an ultimate goal of achieving and maintaining the stability of rupiah toward the prices of goods and services, which are reflected in inflation (internal stability), and the exchange rate (external stability). In order to achieve the goal, BI implemented a monetary policy framework with inflation as its main target (Inflation Targeting Framework - ITF) and free floating as its exchange rate system. In ITFinflation target is publicly announced to the public and designed in a forward looking manner, meaning that changes in monetary policy stance is done through an evaluation whether the development of inflation is still in line with the inflation target.

In ITF, the inflation target, the operational monetary policy target, and the measurement of success are all engaged in national level indicator. However, the investigation only for national data is not enough since Indonesia has a considerably large territory with different economic structures and performances among its regions. The application of regional data in assessing inflation should be also investigated as alternative. This investigation is important since the aggregate national inflationdominated by only severalregionsinIndonesia.The inflation in Java represented 64.5% as well as in Java and Sumatra represented 84.3% in national inflation (BI 2009). It suggests that non-Java territory, which has 28 provinces and is appreciably larger in term of area, only has 35.5% of national inflation weight or only 15.7% of national inflation weight for all provinces outside Java and Sumatra. Moreover, if we investigate further we can find that the weight of Jakarta-Bogor-Depok-Tangerang-Bekasi (known as Jabodetabek), as the main business district in Indonesia, have covered 37.65% of national inflation (BI 2009). Hence, regarding this condition, if the inflation target, monetary adjustment, and policy evaluation are based on national inflation, they will dominantly be determined by the condition of Java-Sumatra or Java or particularly Jabodetabek.

The monetary stance in ITF is reflected in the determination of BI Rate, which is expected to influence interest rates in money market, banking deposit, and loan

market. The implementation of interest rate policy, including BI Rate and Pasar Uang Antar Bank (PUAB) or money market interest rates, reflect an effort to achieve the targeted inflation using operational target which is constructed nationally. In consequence, considering the different weighting in national indicator and idiosyncrasies of each region, questions arisen regarding whether the nationally-established operational target is capable of bringing about inflation fairly in every region in Indonesia? If not, is it more appropriate to regulate the money supply in each region to influence inflation? Furthermore this research applies the framework of Hybrid New Keynesian Phillips Curve (NKPC) to learn whether BI Rate, PUAB, or money supply is the most effective instrument in adjusting regional inflation. We will also identify the time lag of regional inflation responses monetary instruments.

2. LITERATURE SURVEY

Controlling inflation: Price based or quantity based?

Not only in Indonesia, monetary authority in various countries have justified the adoption of short-term interest rate as their operational target rather than monetary aggregate. Therefore, policy models started to set aside the relationship between money supply and inflation, and started to focus on the relationship between interest rate and inflation. This phenomenon was reviewed by MacCallum and Nelson (2010) who have shown that most publications which contributed to monetary handbook are minimizing the role of monetary aggregate in the theory and analysis of monetary policy.

Many have performed researches in order to identify the relationship between interest rate and inflation, one of them was Brzoza-Brzezina (2002). According to Humphrey (1993) in Brzoza-Brzezina (2002), the first approach which is applied in relating interest rate and inflation had been done by Wicksell (1898, 1907), but only a century after do Thornton and Joplin (1993) successfully clarify the economic process of central bank policy using interest rate to affect inflation. Latter publication by Woodford (2003), based on the idea from Wicksellian, discussed the process of real interest rate and natural rates of interest in influencing inflation. The next development, according to Goto and Torous (2003), the aggressive policy of anti-

inflation was pioneered by Taylor (1995) with his Taylor Rule. Taylor Rule explains that nominal short-term interest rate will move quicker than the expected inflation (move more than one-for-one) and yield a positive relationship between inflation and real value of interest rate. This view becomes the cornerstone of ITF implementation (Handa, 2009).

In contrast to Taylor, Fisher Hypothesis – which concern in the relation between interest rate and inflation – claimed the non-existent of more than one-for-one rule between inflation and interest rate. Moreover, Fisher Hypothesis also claims that there is no apparent relationship between expected inflation and real interest rate. This hypothesis is consistent with Mundell-Tobin Effects, which assert a negative impact of expected inflation to real interest rate (Shrestha et al. (2002) quoting: Mundell (1963), Tobin (1965), and Fama and Gibbons (1982)). Michell-Innes (2006) stated that important researches which studied the Fisher Hypothesis are also performed by Fama (1975), Mishkin (1992), Yuhn (1996), Crowder and Hoffman (1996), Dutt and Ghosh (1995), Hawtrey (1997), Koustas and Serletis (1999) and Mishkin and Simon (1995). Meanwhile, a research for developing country undertaken by Garcia (1993) in Brazil found that Fisher Hypothesis is occurring in the nation. Another researches are performed by Carneiro et al. (2002) and Phylaktis and Blake (1993) for Brazil, Mexico, and Argentina. While Phylaktis and Blake (1993) found that Fisher Effect is occurring in those three countries, Carneiro et al. (2002) only found the effect to be valid in Argentina and Brazil.

The relationship between interest rate and inflation in Fisher Hypothesis differs from Taylor Rule, which stated that changes in interest rate will determine the changes of inflation. In contrast, Fisher Effect stated that the simultaneous changes between interest rate and inflation are caused by the changes of money supply. Blanchard (2011) gave an example; a 10% increase in money supply will lead to 10% increase in inflation and interest rate.The hypothesis is supported by Handa (2009) and Mishkin (1992) who found that in long term, the relationship between money supply and interest rate is very high (with 0.7 or more as their correlation). Therefore, changes in money supply will determine the changes in interest rate and in turn will influence inflation. Monnet and Weber (2001) stated that the monetary authority is able to adjust the interest rate, but it will only change the controllable

instrument such as bank reserves. The instrument changes will influence money supply and then money market will react to the changes of money supply, reflected by the changes in interest rate. The view of Monnet and Weber (2001) shows that money supply is the key element which determine the interest rate.

There are also other researches which show that money supply has a direct influence on inflation. These researches are usually based on the quantity theory of money (QTM). MacCallum and Nelson (2010) stated that researches regarding this topic can be found in Hume (1752), Wicksell (1915/1935), Fisher (1913), Keynes (1936), Friedman (1956, 1987), Patinkin (1956, 1972), Samuelson (1967), Niehans (1978), and Lucas (1980)[1]. In QTM, there is a preposition: If the changes in money supply is determined by monetary authority, in long term it will change the price level in the same proportion as the proportion changes in money supply. This preposition, in turn, supports the argument of using monetary aggregate as the operational target in monetary policy.

Regional inflation and monetary policy

Monetary policy is designed structurally and purposely for an ultimate national goal – price stability. Yet, the impact of monetary policy may differ between regions in a country. The difference may be caused by regional industrial competition, financial structure, trading activities and relationship, and institutional environment. Indonesia is one of the best examples of a country with broad geographical territory and wide social and economic condition. Ridhwan et al. (2011) shows that, while tight monetary policy may be conducive for the economy of Java, it may have a destructive effect on the economy of non-Java regions.

Researches regarding the effectiveness of monetary policy are commonly performed using national-level data. Different from previous studies, this research exploits provincial data in order to identify the different responses between each region on monetary policy. Chaban and Voss (2012) assert that the success measure of ITF can be exhibitedby its capability to certainly determine the expected inflation to be strictly around the inflation target and that the deviation cannot be predicted. In

[1]Early researchers tend to focus their discussion on metallic money while the latters are on fiat money.

provincial-level, we can question the deviation of provincial-level inflation to its target. If there is a deviation, the nationally constructed inflation target is not equally successful in each region.

Some studies regarding the effectiveness of ITF in provincial level had been undertaken in China, Canada, and Peru. Mehrotra et al. (2007) found that in 1978-2004 there is a variation of inflation between China provinces. They also found that there are 22 out of 29 provinces where forward looking inflation component is statistically significant in determining the actual inflation. In ITF, the significance of forward looking inflation component will increase the effectiveness of monetary policy. Another research by Chaban and Voss (2012) found that there is inflation variation in 10 provinces in Canada. All of the provinces, besides Alberta, indicated the existence of anchored inflation expectation which supported the effectiveness of ITF.

Hybrid NKPC model

In this research, we estimate inflation using a theoretical framework developed by Gali and Gertler (1999) named Hybrid NKPC model. According to Gali and Gertler, every firm adjust their prices in every periods with the fixed probability of $(1-\theta)$. There are two types of firm, $(1-\omega)$are firms with forward-looking behavior as Calvo (1983) stated in his study while the rest, ω, are firms with backward-looking behavior. Based on this condition, aggregate price can be constructed as equation (1). If the price set by forward looking firm is p_t^f and backward looking firm is p_t^b , hence the new price is:

$$p_t* = (1-\omega)p_t^f + \omega p_t^b \tag{1}$$

Forward looking firms behave as Calvo's (1983) assertion, therefore p_t^f can be derived as

$$p_t^f = (1-\beta\theta)\sum_{k=0}^{\infty}(\beta\theta)^k E_t\{mc_{t+k}^n\} \tag{2}$$

While price in backward looking firm, p_t^b, equal to the average of adjusted price in the last period. The price can be denoted as

$$p_t^b = \overline{p}^*_{t-1} + \pi_{t-1} \tag{3}$$

Hence, the specification form of hybrid NKPC is

$$\pi_t = \lambda mc_t + \gamma_f E_t\{\pi_{t+1}\} + \gamma_b \pi_{t-1} \tag{4}$$

In empirical testing, equation (4) is estimated using non-linier instrumental variable (GMM) estimator. In their study, Gali and Gertler (1999) concluded some strong findings regarding inflation behavior. First, the real marginal cost is statistically significant and is an important determinant of inflation (in this study we used output gap). Second, the behavior of forward looking is crucial because most of the firms have this kind of behavior. They found that 60-80% of the firms have shown forward looking. Third, the behavior of backward looking is statistically significant, therefore even though forward looking behavior is plausible, pure forward looking model cannot be accepted. Last but not the least, it takes time for prices to change.

3. RESEARCH METHOD

In this research, we use quarterly panel data of 32 provinces in Indonesia covering the period of 2005-3 to 2013-3. Most of the data are obtained in quarterly report of Perkembangan Perekonomian Daerah (Pekda) and Kajian Ekonomi Regional (KER) which are published by Kantor Bank Indonesia (KBI) in provinces. Table 1 describes the definition of variable which are observed in this study.

We use year-on-year inflation to compare the development of inflation based on inflation in the previous year. Inflation is calculated using provincial consumer price index (CPI). Even though the original data of CPI is the general price in city, Pekda and KER have provided provincial CPI data. For Papua and Papua Barat, including Banten and Jakarta, the CPI data or inflation is compounded in a particular proportion based on Pekda and KER.

For economic output indicator, we use real PDRB (Product Domestic Regional Bruto) with year 2000 as its base year. Hodrick-Prescott Filter (HP Filter) is applied

in order to obtain potential output, y_{it}^{*}, based on the real PDRB data. The output gap, y_{it},is the reduction of actual output to potential output, divided by potential output, multiplied by 100%

Table 1: Definition of Variables

Variable	Sign	Measure	Explanation
Inflation	$\pi_{i,t}$	Percentage	Year-on-year inflation
Actual output	y_{it}^{a}	Trillion rupiah	Real regional output (base: year 2000)
Potential output	y_{it}^{*}	Trillion rupiah	Estimated using Hodric-Prescott Filter
Output gap	y_{it}	Percentage	$y_{it} = \frac{\left(y_{it}^{a} - y_{it}^{*}\right)}{y_{it}^{*}} \times 100\%$
Changes in real money supply	m_{it}	Trillion rupiah	m_{it} is the changes in real currency money (ΔK_{it}) added by real demand deposit (ΔG_{it}). ΔK_{it} is the net flow of currency in regional office central bank. ΔG_{it} is the changes in demand deposit in each province's banking.
BI Rate	$r1_t$	Percentage	Central bank interest rate; national data
PUAB	$r2_t$	Percentage	Money market interest rate; national data

Provincial money supplychanges, m_{it}, is used in this research caused by the unavailability of provincial money supply data, we use the net flow of currency in provincial central bank office (Kantor Bank Indonesia) as the proxy of currency changes. If the outflow is greater than inflow (net outflow), there is an increase of currency supply in the region, vice versa. We also use demand deposit changes in commercial bank (conventional and Islamic banking) as the proxy of provincial demand deposit changes. The sum of currency changes and demand deposit changes is utilized as the changes of money supply in each province.

For interest rate instruments, we use BI Rate, $r1_t$, and PUAB, $r2_t$. These variables are commonly used as the national monetary policy references. In contrast to m_{it}, which is a provincial level data, $r1_t$ and $r2_t$ is a national-level data therefore the value for these variables are identical for each period in every provinces.

To analyze the impact of policy variable toward provincial inflation we used Hybrid NKC framework developed by Gali and Gertler (1999).

$$\pi_{it} = \gamma_b \pi_{i,t-1} + \gamma_f \pi_{i,t+1} + \alpha_\lambda y_{it} + \varepsilon_{it} \quad (5)$$

We added policy variable, S_{it} ,on the basic form of Hybrid NKPC, and equation (5) therefor become:

$$\pi_{it} = \gamma_b \pi_{i,t-1} + \gamma_f \pi_{i,t+1} + \alpha_\lambda y_{it} + \delta_m S_{it} + \varepsilon_{it} \quad (6)$$

Where S_{it} may contain m_{it} , $r1_t$, or $r2_t$. Adapting Gali and Gertler (1999), we applied Generalized Method of Moments (GMM) as the estimation technique and employ $\pi_{i,t-2}$ and$\pi_{i,t-4}$ as the instrument variable. Estimating equation (6), we can identify the backward looking and forward looking behavior impacts by referring to γ_b and γ_f . We can also analyze the influence of output gap, y_{it} , on inflation. In order to assess the impact of policy variable on inflation, we can turn to δ_m .

Equation (6) is also used for the estimation of policies impact with, taking into account, regional aspect consideration. Since it is most likely that monetary policies need time lag in order to take effect on the economy, we try to determine the best time lag by repeating the estimation of equation (6) using different time lags. The criteria used in determining the best time lag are the conformity of the impact direction with the theory and policy objective, which are positive for $r1_t$ and $r2_t$, and negative for m_{it} , and the swiftness of effect. Based on equation (6) we construct an inflation model which takes into account the influence-differences between regions

$$\pi_{it} = \gamma_b \pi_{i,t-1} + \gamma_f \pi_{i,t+1} + \alpha_\lambda y_{it} + \delta_{m1} S_{it} + \delta_{m2} 2S_{it} d2_{it} + \delta_{m3} S_{it} d3_{it} + \delta_{m4} S_{it} d4_{it} + \varepsilon_{it} \quad (7)$$

Where d_2, d_3, andd_4, are dummy variables for Sumatera (W2), Kalimantan-Sulawesi (W3), and Papua-Maluku-Nusa Tenggara (W4). Furthermore, d_1, which represents Jawa-Bali region (W1), is not included in the model because of its role as the comparator. Table 2 explains the classification of regions and its provinces.

Based on equation (7), the impact of monetary instruments on inflation in Region 1, 2, 3, and 4 are consecutively δ_{m1}, ($\delta_{m1} + \delta_{m2}$), ($\delta_{m1} + \delta_{m3}$), and ($\delta_{m1} + \delta_{m4}$). In order to identify the significance of each policy impact coefficient, we run the Wald test. Using equation (7) we can identify the coefficient differences between Jawa-Bali region (W1) and the other regions by learning coefficient δ_{m2} , δ_{m3}, and δ_{m4} . However,

we can't identify the coefficient differences between regions except of using W1 as the comparator. For that purpose, we use Wald test in comparing the coefficient difference of each regions.

Table 2: Classification of Regions and Its Provinces[2]

	Provinces		
Region 1 (W1)	Banten and Jakarta	Jawa Tengah	Bali
	Jawa Barat	Yogyakarta	JawaTimur
Region 2 (W2)	Aceh	Sumatera Barat	Sumatera Selatan
	Sumatera Utara	Riau	Lampung
	Kepulauan Bangka Belitung	Jambi	
	Kepulauan Riau	Bengkulu	
Region 3 (W3)	Kalimantan Selatan	Kalimantan Tengah	Sulawesi Tenggara
	Kalimantan Timur	Sulawesi Utara	Sulawesi Tengah
	Kalimantan Barat	Sulawesi Selatan	Gorontalo
Region 4(W4)	Nusa Tenggara Barat	Maluku	
	Nusa Tenggara Timur	Maluku Utara	
	Papua and Papua Barat		

4. RESULT AND DISCUSSION

Estimation Result of Provincial Inflation Model

Table 3 displays the estimation result of three equations using Hybrid NKPC framework. Each equation has different policy variable, which are money supply, BI Rate, and PUAB. The results indicate the existence of backward looking and forward looking behavior in the determination of Indonesian inflation. Forward looking tends to be more dominant, suggested by its significance and coefficient level. In concordance with the theoretical prediction, output gap has also a significant role in the construction of inflation.

[2]Jakarta and Banten is reported in the same account, and so, in this research, they are combined for all period. So do Papua and Papua Barat. Moreover, although Indonesia has 34 provinces in 2013, Kalimantan Utara and Sulawesi Barat are not included as observations because the data for those provinces are not available in all observation period (Sulawesi Barat have just established in 5th October 2004, while Kalimantan Utara was established in 25th October 2012). Table 2 shows the provinces which are included as observations in this research.

Table 3: Estimation Result of Provincial Inflation Model

	π_{it}		π_{it}		π_{it}	
	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
$\pi_{i,t-1}$	0.4429	0.0000	0.0887	0.0000	0.3252	0.0000
$\pi_{i,t+1}$	0.6330	0.0000	0.2992	0.0000	0.6579	0.0000
y_{it}	0.2020	0.0000	0.0364	0.0011	0.1063	0.0000
$S_{it} = m_{it}$	-1.4E-07	0.0001				
$S_{it} = r1_{it}$			1.5515	0.0000		
$S_{it} = r2_{it}$					0.4736	0.0000
N		900		900		900
Instrument rank		30		30		30.0000
J-stat.		29.96381		29.85828		29.6851
prob.		0.269113		0.273524		0.2809

Table 3 also shows the significant role of money supply, BI Rate, and PUAB in determining the level of inflation. But there is a thing we should notice to be odd. The coefficients directions of policy variables in the estimation results contradict the theories. The result suggests that an increase in money supply will lower inflation, and the increase in interest rate will raise inflation. Supported by the probability value of J-statistic, which is greater than 10%, the estimation results have no over identification issues. Since the application of policy variables without time lag yield a conflictive result and that monetary policy need time to take effect on the economy, we try to re-estimate the model by adding time lag for the policy variables until we found each policy variable to be significant and having a corresponding effect as the policy objective.

For each equation in table 4, we add time lag in the policy variables. In concordance with the earlier result, the estimations show that backward looking and forward looking behavior have positive significant effects on inflation, with forward looking having greater influence. In accordance with the theory, output gap is also found to have a positive effect on inflation.By adding a time lag, worth one quarter,

the estimation results of monetary policies influence have changed. Money supply is shown to have insignificant effect on inflation, while BI Rate a controvert-than-expected effect. However, the estimation result on PUAB has shown the expected result. PUAB has a negative significant effect on the future inflation, with a time lag of one quarter. It suggests that, different with the other two policies, PUAB will become an effective policy in three months after its implementation. The value of J-statistic probability professes that there is no over identification in the model. Based on the estimation result on table 4, we will use 1 period lag to estimate the PUAB effects on each region observed.

Table 4: Estimation Result of Provincial Inflation Model with 1 Period Time Lag

	π_{it}		π_{it}		π_{it}	
	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
$\pi_{i,t-1}$	0.444342	0.0000	0.202718	0.0000	0.468151	0.0000
$\pi_{i,t+1}$	0.636456	0.0000	0.615281	0.0000	0.618738	0.0000
y_{it}	0.158972	0.0000	0.165596	0.0000	0.155991	0.0000
$S_{it} = m_{i,t-1}$	-4.9E-09	0.7151				
$S_{it} = r1_{i,t-1}$			0.683177	0.0000		
$S_{it} = r2_{i,t-1}$					-0.07558	0.0000
N		900		900		900
Instrument rank		30		30		30
J-stat.		29.8360		29.7515		29.8454
prob.		0.2745		0.2780		0.2741

We applied two quarter and three quarter periods of time lag in order to find the best time lag for BI Rate and money supply. All of the estimation results indicate that inflation level in Indonesia is significantly affected by backward looking and forward looking behavior. In contrast with the earlier results, these estimation suggest that backward looking behavior has a greater impact on inflation, meaning that societies take into account past inflation more considerably than expected future inflation in constructing their expectation regarding future inflation. In all estimation results in table 5, we also found that output gap has negative impact on inflation. We found that money supply and BI Rate need 3 periods of time lag (3 quarters) to

effectively influence the inflation. Based on this result, we will apply 3 periods time lag to assess the impact of money supply and BI Rate on regional inflation.

Table 5: Estimation Result of Provincial Inflation using 2 and 3 Lag

	π_{it}		π_{it}		π_{it}		π_{it}	
	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
$\pi_{i,t-1}$	0.5094	0.0000	0.5392	0.0000	0.4903	0.0000	0.5669	0.0000
$\pi_{i,t+1}$	0.4993	0.0000	0.5385	0.0000	0.5017	0.0000	0.5163	0.0000
y_{it}	-0.0582	0.0000	-0.0308	0.0369	-0.0036	0.6988	-0.0322	0.0063
$S_{it} = m_{i,t-2}$	-2E-07	0.0000						
$S_{it} = m_{i,t-3}$			2.1E-7	0.0000				
$S_{it} = r1_{i,t-2}$					0.0616	0.0000		
$S_{it} = r1_{i,t-3}$							0.12075	0.0000
N		870		840		870		840
Inst. Rank		30		30		30		
J-stat.		29.5054		29.6032		29.9087		29.4934
prob.		0.2886		0.2844		0.2714		0.2891

Inflation Model with Regional Consideration

In order to identify which monetary policy is better in maintaining regional inflation, we estimate each monetary policy's impact on each region. We started by assessing monetary aggregate, followed by BI Rate and PUAB sequentially. In order to identify differences in each region's response, we use dummy variable on monetary policy. Wald test is executed in order to evaluate the significance of monetary policy in each region and to diagnose if the policy effect is different.

Table 6 shows the estimation result of Hybrid NKPC model with regional consideration and monetary aggregate as the policy variable. W1 is used as the base comparator in this equation. The estimation result suggest that forward looking and backward looking behavior have significant roles in determining future inflation, with forward looking being a slightly greater determinant. Output gap is found to have no significant effect in determining inflation.

Table 6: Estimation Result with Monetary Aggregate and Regional Response

	π_{it}	
	Coef.	Prob.
$\pi_{i,t-1}$	0.5200	0.0000
$\pi_{i,t+1}$	0.5515	0.0000
y_{it}	0.0142	0.5505
$m_{i,t-3}$	9.02E-08	0.1444
$m_{i,t-3}d2_{i,t}$	1.43E-06	0.0000
$m_{i,t-3}d3_{it}$	-3.8E-07	0.1934
$m_{i,t-3}d4_{it}$	-1.1E-06	0.0029
N	840	
Instrument rank	30	
J-statistic	29.32421	
Prob(J-statistic)	0.1698	

Table 7 displays the effect of monetary aggregate on each region's inflation. The Wald Test result shows that money supply is only significantly affecting the inflation of W2 (Sumatera) and W4 (Papua-Maluku-Nusa Tenggara) regions. While it has a positive effect on W2's inflation, it turns out to have negative effect on W4's. It suggests that employing monetary aggregate as the monetary instrument will only be effective for managing inflation in W2 region.

Table 7: Wald Test: Effect of Monetary Aggregate on Each Region's Inflation

	Jawa-Bali	Sumatera	Kalimantan-sulawesi	Papua-Maluku-Nusa Tenggara
Coef.	9.02E-08	1.52E-06	-2.87E-07	-1.00E-06
F-statistic	2.1345	76.9455	1.0900	8.4129
Prob.	0.1444	0.0000	0.2968	0.0038

Table 8: Wald Test: Monetary Aggregate's Impact Differences Between Regions

		Jawa-Bali	Sumatera	Kalimantan-Sulawesi	Papua-Maluku-Nusa Tenggara
Jawa-Bali	F-Stat (Prob.)		75.3142 (0.0000)	1.6946 (0.1934)	8.9352 (0.0029)
Sumatra		75.3142 (0.0000)		30.1851 (0.0000)	40.8928 (0.0000)
Kal-Sul		1.6946 (0.1934)	30.1851 (0.0000)		4.3247 (0.0379)
Pap-Mal_Nusa		8.9352 (0.0029)	40.8928 (0.0000)	4.3247 (0.0379)	

Displayed by the estimation result in table 8, we found that money supply has no different impact on inflation in W1 and W3. The policy impact is especially unique in W2 and W4, where it is shown that there is no indifferent effect on other regions.

Table 9: Estimation Result with BI Rate and Regional Response

	π_{it}	
	Coef.	Prob.
$\pi_{i,t-1}$	0.5740	0.0000
$\pi_{i,t+1}$	0.5094	0.0000
y_{it}	-0.0463	0.0112
$r1_{i,t-3}$	1.3058	0.1258
$r1_{i,t-3}d2_{it}$	-1.6213	0.0396
$r1_{i,t-3}d3_{it}$	-2.1693	0.0722
$r1_{i,t-3}d4_{it}$	-1.4775	0.1761
N	840	
Instrument rank	30	
J-statistic	28.9268	
Prob. (J-statistic)	0.1827	

Moving to BI Rate policy, table 9 displays the estimation result of Hybrid NKPC model with BI Rate as the shock variable. Different from the previous estimation, while backward looking and forward looking behavior still significantly affecting inflation, it is found that backward looking behavior has a slightly greater role in

determining inflation. Contradicting the theory, we also found that an increase in output gap will lower inflation level.

Depicted in table 10, we found that BI Rate as a monetary instrument is only significantly affecting W2 region (Sumatera). Furthermore, Table 11 suggests that BI Rate has indifferent effect on W1 and W4. It is also found that W2 has the same responses as W3 and W4 on BI Rate changes. The impact of BI Rate on W3's inflation is also indifference to W4's. While it indicates that BI Rate may be a better and fairer policy in managing regional inflation, the result in table 11 suggest that BI Rate is only effective to be implemented in Sumatera regions.

Table 10: WaldTest: Effect of BI Rate on Each Region's Inflation

	Jawa-Bali	Sumatera	Kalimantan-sulawesi	Papua-Maluku-Nusa Tenggara
Coef.	1.3058	-0.3155	-0.8635	-0.1717
F-statistic	2.3485	3.8237	4.4681	0.1852
Prob.	0.1258	0.0509	0.0348	0.6671

Table 11: Wald Test: Diagnosis of BI Rate's Impact Differences between Regions

		Jawa-Bali	Sumatera	Kal-Sul	Papua-Maluku-Nusa Tenggara
Jawa-Bali	F Stat.		4.2467	3.2403	1.8336
	Prob.		0.0396	0.0722	0.1761
Sumatra		4.2467		1.1297	0.0741
		0.0396		0.2882	0.7855
Kal-Sul		3.2403	1.1297		2.0217
		0.0722	0.2882		0.1554
Pap-Mal_Nusa		1.8336	0.0741	2.0217	
		0.1761	0.7855	0.1554	

The other alternative for monetary policy operational target is PUAB. Table 12 shows the estimation result of Hybrid NKPC model with PUAB as the shock variable. In this estimation result, we found that backward looking and forward looking behavior is, still, significant in determining the level of inflation. We found forward looking behavior to be a greater determinant of inflation. It indicates that the expected future inflation has a bigger role in determining inflation than the inflation

track records. In this equation result, we also found that the output gap impact on inflation is in line with theory.

Table 12: Inflation Model with PUAB and Regional Response

	π_{it}	
	Coef.	Prob.
$\pi_{i,t-1}$	0.4697	0.0000
$\pi_{i,t+1}$	0.6145	0.0000
y_{it}	0.1463	0.0000
$r2_{i,t-1}$	-0.8723	0.0110
$r2_{i,t-1}d2_{it}$	0.6892	0.0555
$r2_{i,t-1}d3_{it}$	1.6945	0.0025
$r2_{i,t-1}d4_{it}$	0.2270	0.3969
N	900	
Instrument rank	30	
J-statistic	29.3568	
Prob(J-statistic)	0.1688	

Table 13presents the impact of PUAB on each observed region's inflation. We found that PUAB stands as the best monetary instruments compared to the two others in this study. PUAB has significant and in-line-with-objective effect on W1 (Jawa-Bali), W2 (Kalimantan-Sulawesi) and W4 (Papua-Maluku-Nusa Tenggara) regions. Still to be put in our concern, PUAB has a positive effect on W3 region (Kalimantan-Sulawesi) which contradict the policy objective.

Table 13: Wald Test: Effect of PUAN on Each Region's Inflation

	Jawa-Bali	Sumatera	Kalimantan-Sulawesi	Papua-Maluku-Nusa Tenggara
Coef.	-0.8723	-0.1830	0.8222	-0.6453
F-statistic	6.4851	11.4296	8.3421	4.7564
Prob.	0.0110	0.0008	0.0040	0.0295

Diagnosing the impact differences of PUAB between each region, we found that W1, W2, and W3 are having indifferent response toward the changes of PUAB (see table 14). On the other hand, we found that the impact of PUAB on inflation in W4 is

only indifferent with its impact on W3. Considering the result, we assert that PUAB is a fair monetary instrument in controlling inflation level across regions in Indonesia.

Table 14: Wald Test: Diagnosis of PUAB'S Impact Differences between Regions

		Jawa Bali	Sumatra	Kal-Sul	Pap-Mal-Nusa
Jawa-Bali	F-Stat		3.6769	9.2163	0.7184
	Prob.		0.0555	0.0025	0.3969
Sumatra		3.6769		12.8614	1.9798
		0.0555		0.0004	0.1598
Kal-Sul		9.2163	12.8614		7.0423
		0.0025	0.0004		0.0081
Pap-Mal_Nusa		0.7184	1.9798	7.0423	
		0.3969	0.1598	0.0081	

5. CONCLUDING REMARKS

Designing an effective and reliable monetary policy is a requirement to ensure national price stability. In order to achieve the expected level of inflation, monetary authority can engage quantity-based approach, which employs monetary aggregate as its instrument, or price-based approach, which make use of interest rate as it instrument. The utilization of interest rate as the monetary operational target may have its own advantages in directing national inflation, but then again interest rate is nationally-designed. Different from interest rate, money supply can be regulated in provincial level. Since inflation is a regional phenomenon, a detailed assessment of each region's idiosyncrasy is a necessity. Through this study, we found that each region in Indonesia have different responses on monetary policy instruments.

In general, the estimation result of Hybrid NKPC explains that backward looking and forward looking behavior have significant roles in determining inflation in Indonesia. Supporting Gali and Gertler (1999), we also find that forward looking behavior has a greater influence than backward looking. In accordance to the theory, output gap also has a positive impact on inflation.

Using provincial-level NKPC framework, we find that monetary policy, whether using money supply or interest rate as its instrument, need time to effectively influence inflation. We find that PUAB need the least time in order to influence

inflation. PUAB needs 1 quarter to effectively influence inflation while money supply and BI Rate needs 3 quarters. Furthermore, only the estimation using PUAB as the monetary instrument does yielding consistent backward and forward looking and output gap influence to provincial inflation.

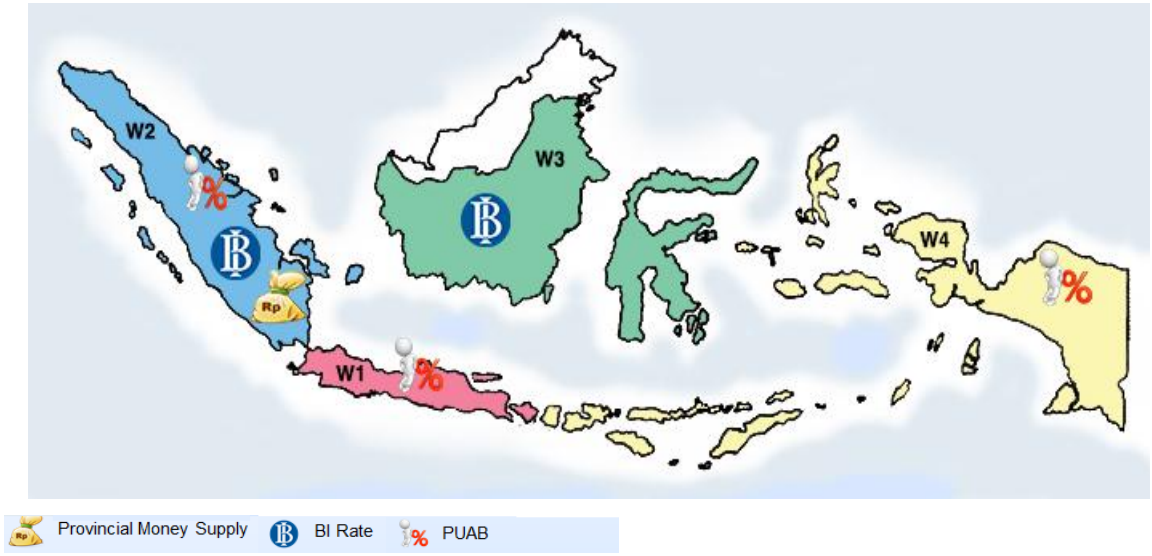
Taking into account regional aspects in the model, we find that money supply has a significant impact on inflation in Sumatera (W2) and Papua-Maluku-Nusa Tenggara (W4). We also find that this instrument is only effective in Sumatera region, since the estimation result suggests that it will have conflicting effect with theory in Papua-Maluku-Nusa Tenggara. The inflation responses toward money supply are also varying in each region.

Moving to the second instrument, we find BI Rate is an effective instrument in controlling the inflation of Sumatera (W2) and Kalimantan-Sulawesi (W3). We also find indifference impact of BI Rate to inflation in some regions in Indonesia, particularly in Sumatera (W2), Kalimantan-Sulawesi (W3), and Papua-Maluku-Nusa Tenggara (W4).

Lastly, we find that PUAB is the most favorable instrument in controlling inflation in Indonesia. PUAB has significant effects on every observed region. Based on the estimation result, we find that in three out of four observed regions, which are Jawa-Bali (W1), Sumatera (W2), and Papua-Maluku-Nusa Tenggara (W4), inflation can be effectively controlled by PUAB. In those regions, the influence of PUAB to inflation is in concordance with the policy objective. The impact of PUAB on inflation is also found to be uniform in Jawa-Bali (W1), Sumatera (W2), and Papua-Maluku-Nusa Tenggara (W4) regions. Figure 1 show most favorable instrument in controlling regional inflation in Indonesia.

We concluded that each region has their own favorable monetary instrument in controlling their inflation. In Jawa-Bali (W1) and Papua-Maluku-Nusa Tenggara (W4) inflation can only be managed using PUAB, while Kalimantan-Sulawesi's (W3) inflation can only be controlled using BI Rate. On the other hand, inflation in Sumatera (W2) can be effectively controlled using monetary aggregate, BI Rate, and/or PUAB.

Figure1: Most Favorable Instrument in Controlling Regional Inflation in Indonesia



While we find that provincial money supply can only be effective in controlling Sumatera region's inflation, monetary policy using PUAB, a nationally-constructed interest rate, can effectively control almost every region in Indonesia. Combining BI Rate and PUAB, monetary authority can also effectively control inflation in every region in Indonesia. Hence, we concluded that the implementation of interest rate as the monetary instrument in Indonesia is appropriate.

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