INFLATION TARGETING, EXCHANGE RATE PASS-THROUGH, AND MONETARY POLICY RULE IN INDONESIA

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ABSTRACT

The purpose of this paper is twofold: (1) to investigate whether the degree of exchange rate pass-through (ERPT) becomes lower in the inflation targeting (IT) frameworks and (2) to identify whether the ERPT is reflected in the monetary policy reaction function. To test those hypotheses, we use monthly data in the case of Indonesia over the period 2003(1)-2013(12). By applying ARDL model, the results prove the complete ERPT exists only for import and producer prices. The ERPT tends to remain unchanged both in the pre- and post-IT periods. We also find that the exchange rate fluctuations fail to explain the interest rate policy. Given those results, we conclude that IT in Indonesia puts too much emphasize on stabilizing the domestic currency mainly based on the consumer price index. She loses ERPT import and producer price indices thus leading to benign neglect of stabilizing its external value in term of exchange rate. Furthermore, to achieve simultaneously both the domestic and external price shocks stabilization, the central bank credibility plays an important role in conducting IT policy which operates primarily through a signaling effect.

Keywords: Inflation Targeting, Interest Rate Policy, Exchange Rate Pass-Through, Monetary Reaction Function, ARDL

Introduction

Since adopted in New Zealand, Canada, the United Kingdom, Sweden, and Australia for the first time in 1990, inflation targeting (IT) has been becoming a standard operating procedure for central banks not only in advanced countries but also in emerging market. At present, there are 32 countries around the world that have already adopted IT as the monetary policy frameworks (Scott, 2010; Gill, 2011).

Despite its popularity, there is substantial controversy and mixed empirical evidence in the evaluation of the inflation targeting framework. The main challenge is how to assess the impact of exchange rate shocks on domestic prices and to forecast its determinants (see: Taylor, 2000, and Gagnon and Ihrig, 2004 for developed economies, and Choudhri and Hakura, 2006 and Ca'Zorzi *et al*., 2007 for emerging markets).

A key channel for the international transmission of inflation and economic cycles is from exchange rate movements to domestic prices, known as exchange rate pass-through (ERPT). The ERPT into inflation can be defined as the change in local currency domestic prices resulting from 1 percent change in the exchange rate (Goldberg and Knetter, 1997). In such a case, understanding how import prices adjust to exchange rates helps anticipating inflation effects and monetary policy responses.
In a broader scope, the inability of monetary authorities in forecasting inflation that could be in the presence of high ERPT into domestic prices, the exchange rate movements also change the current account position which in turn affects aggregate demand (Woo, 1984). In addition, a high degree of ERPT is often a reason for a country to 'fear' floating exchange rate and is thus a given rationale for the intervention in the foreign exchange market (Ball and Reyes, 2008; Junior, 2006).

However, many studies suggest the inclusion of exchange rate term in the policy reaction function. In one hand, exchange rate plays an improving role in the performances of monetary policy rules and enhances higher welfare of agents (for examples Ball 1999; Batini *et al*., 2001; and Senay, 2001). Exchange rate contributes to the demand channel through the effects of relative price and creates the direct exchange rate channel through the convert of domestic currency prices of foreign produced goods.

While exchange rate affects the aggregate demand for domestic goods, there are opinions which against this view. The central banks should concern the effects of exchange rate fluctuations on inflation and output gap rather than giving an independence role for the exchange rate in the policy reaction (Mishkin and Schmidt-Hebbel, 2002). The exchange rate already has the indirect effects on inflation and output in the policy reaction function so giving a direct role to exchange rate in the Taylor rule may add volatility to the monetary policy (Taylor, 2001).

Indonesia provides a unique opportunity to assess the nature of prices, output, and exchange rates stabilization. Experiences of the sky-rocketing inflation rate, dropped economic growth, and followed by dramatic depreciation in accordance with Asian financial crisis in 1997/98 have directed the monetary authority to focus on the economic recovery and stabilization. Accordingly, since 1999, Indonesia has been implementing a new law for the central bank. By Act No. 23/1999, the central bank of Indonesia has to be independent from interventions of government and political pressure in conducting monetary policy.

Also, refer to Act No. 3/2004, since July 2005 the central bank of Indonesia has been officially adopting IT in the monetary policy frameworks. In this circumstance, the central bank of Indonesia operationally relies on BI Rate to control inflation rate replacing money stock as short-term monetary base target as implied by the older regulation. Then in 2008, fully backed up by the fiscal policy, the central bank of Indonesia attempted to revive economic activity through various monetary action measures to face the adverse impacts of global financial crisis.

All of them are subjected to achieve the single goal, i.e. domestic currency (Rupiah) stabilization both in terms of inflation and exchange rate. After that, gradually Indonesia in 2010s is one of the largest developing countries to implement various economic liberalization reforms that produce strong economic growth (Hur *et al*., 2010). Therefore, lessons from Indonesia will be useful to develop a better exchange rate stabilization policy design for developing countries.

This paper enriches the literature on monetary policy in the context of exchange rate stabilization in Indonesia. The motivation for this approach associates to the fact that Indonesia is a small-open economy in the international context so the impact of external shocks on the domestic economic condition remains high. Moreover, Indonesia under IT monetary policy frameworks consistently conducts some prudent macroeconomic policies to anticipate possible high inflation rate in the short- and medium-terms so it would be suboptimal to deliberate exchange rate to make more room for speculative attacks. Hence, implementing IT regime in the free floating exchange rate system is likely to require a decrease in the degree of the ERPT. The article is organized as follows. In the next section, we briefly present the literature and previous empirical researches both in developed countries and developing countries including Indonesia. The third section describes the dataset and empirical techniques used. Then, we present the results of the empirical tests. In the end, we conclude with a summary of key findings.

Literature Review

The discussion regarding the importance of ERPT test lays in the three interconnected issues (see: Choudhri and Hakura, 2006). These issues are (1) ERPT and the role of exchange rate as shock absorber; (2) exchange rate volatility and IT; and (3) exchange rate and policy reaction function. Those basically emphasize the role of exchange rate in the monetary policy.

In relation to the first, the role of exchange rate as a shock absorber can be illustrated by distinguishing the pass-through of exchange rate changes into the price of non-tradable and tradable goods. A high pass-through for non-tradable goods will reduce the effectiveness of the nominal exchange rate while a high pass-through for tradable goods will enhance its effectiveness. Thus, exchange rate will act as an effective shock absorber if pass-through into domestic prices leads to depreciation in real exchange rates.

With regard to the second issue, the co-existence of ERPT and exchange rate fluctuation is a consequence of IT regime. In an economy with free mobility of capital flows, the monetary policy cannot coexist with pegged exchange rate. Accordingly, an ideal IT regime should have an inflation target as its primary objective and, therefore, should not simultaneously pursue an exchange rate goal (Obstfeld *et al*., 2005).

The two issues above implicitly argue that ERPT might be incomplete and less than unity. There are three prominent explanations of why. First, Krugman (1989) formalizes the idea of pricing to market. He suggests that following a depreciation of an importer's currency, the foreign exporters might decide to cut his domestic currency export prices or profit margin instead of increasing the price of imports.

Second, exporters can invoice in their own home currency (producer currency pricing), in the currency of their importer (local currency pricing), or in a third-party currency (vehicle currency pricing). When exporters set the prices in local currency pricing, these prices do not fluctuate quite frequently with the exchange rate, at least in the short run. Thus invoicing in local currency pricing reduces the pass-through (Goldberg and Tille, 2008).

Third, the cross-border production leads to lower pass-through when production costs are denominated in different currencies (Mishkin, 2008). If production occurs in several stages in a number of different countries, then production costs are incurred in different currencies. The ERPT can be lower as long as all the currencies do not experience the same appreciation or depreciation against the currency of the exporter (Marazzi and Sheets, 2007).

Furthermore, based on the concept of ERPT, the third issue, it is important to distinguish whether the exchange rate matters to the extent that it is relevant for domestic inflation, or monetary authorities care about the exchange rate for reasons other than inflation. Calvo and Reinhart (2002) argue that IT regime induces lower pass-through due to strong commitment to achieve price stability. The lower ERPT, in turn, stimulates low inflationary impulse. Similarly, Adolfson (2007) finds that the lack of credibility of monetary authority may lead to exchange rate volatility problem.

The empirical literature on the behavior of ERPT in IT regime provides some differing results. The global disinflation since 1990s has caused the absence of ERPT and thus made it difficult to identifying any role of IT. The globalization and higher competition have contributed to the little transmission of exchange rate shocks to domestic prices in addition to monetary policy since the 1990s (Chen *et al*., 2004).

Campa and Goldberg (2005) observe that while there is evidence that pass-through rates have been declining over time in some countries, this pattern of pass-through decline has not been a common or robust feature of all OECD countries. Ca'Zorzi *et al.*

(2007) suggest considerable differences in the ERPT across countries implying relevance of examination of the issue in country specific perspective.

The relationship between IT regime and exchange rate regime has led some analysts to conclude that one of the costs of IT adoption is the increase in exchange rate volatility. Yet, some studies show that the adoption of a free-floating exchange rate does not necessarily implies more effective of nominal and real exchange rate floating. Edwards (2006) points out that IT would lead to higher exchange rate volatility.

Those authors argue that many emerging countries that officially announce themselves to be free floaters are in fact managed exchange rate regimes. This problem is known as fear of floating. The reason is they are reluctant to allow their currencies to float. Under those circumstances, the monetary authority is likely to place additional constraint on emerging market countries' monetary policy by smoothing the exchange rate floating.

However, based on the study in Chile, Hausmann *et al*. (2004) indicate that the volatility of nominal exchange rates of IT countries does not increase compare to other countries with floating exchange rate regimes. The recent study by Choudhri and Hakura (2006) on seven countries with some extensions to Chile shows that IT does not result in an increase in exchange rate volatility. The authors emphasize that IT helps reducing unexpected shocks by making monetary policy transparent and predictable.

The role of exchange rate in the design of monetary policy rules is another way to study the relationship of exchange rate and monetary policy (Sek and Ooi, 2012). Eichengreen and Hausmann (2005) discuss the reasons for monetary policy to react to exchange rate: (1) monetary policy rule with the exchange rate term may affect the total effects of policy adjustment on economy; (2) this augmented rule improves the effectiveness in the adjustment of interest rate and exchange rate effects on inflationary impulse; (3) it helps stabilizing the effects of real shocks which led by the exchange rate misalignment.

On the other hand, some economists and researchers have different views about the role of exchange rate in the formation of monetary policy rule particularly in emerging economies. According to Calvo and Reinhart (2002), exchange rate has an indirect impact on inflation and output in the policy reaction function and there is no need to include the exchange rate term in the policy reaction function.

In contrast, empirical findings report quite different results. For instance, Gali and Monacelli (2005) in their study on six Central and Eastern European countries find that during the fixed exchange rate regimes periods, exchange rate plays an important role in the monetary policy. However, the influence disappears after these countries have moved to the flexible regimes. Contrary view, Mishkin (2004) in his study on three Asian IT countries finds no evidence of monetary policy responds to the exchange rate.

In the case of Indonesia, Taguchi and Sohn (2014) obtain that under IT adoption, Indonesia takes an inflation-responsive rule in the backward-looking manner. They also found that Indonesia loses the inflation-responsive rule under IT adoption, thereby showing the unclear linkage between the loss of inflation-responsive rule and the pass-through. Similarly, Prasertnukul *et al.* (2010) find that adopting IT is less clear to help reducing pass-through. Pontines and Siregar (2012) point out that for various reasons it is possible that the degree of exchange rate flexibility will be significantly higher on one side of the market. It tends to adopt a form of asymmetrical exchange rate behavior, wherein appreciation pressures are restrained more substantially than depreciation pressures.

In the context of wider macroeconomic policy, Zams and Cooray (2007) examine the links between the exchange rate channel and a proper monetary policy rule toward an inflation targeting framework. Their paper employed a small macro-econometric model based on the IS-LM-Philips Curve type. Their finding is that the exchange rate in Indonesia is becoming less volatile, but both the magnitude changes in the Rupiah as well as depreciation are quite high. Unfortunately, they fail to identify that the presence of exchange rate movements in the monetary policy will have a better value of loss function.

Kuncoro and Sebayang (2013) show the response of monetary policy to exchange rate was marginal. Also, Juoro (2013) finds that there was no bi-direction causal relationship between exchange rate and inflation rate. Moreover, Adenan (2014) presents that changes in exchange rate did not significantly affect on the inflation rate. Therefore, he suggests enlarging alternative reaction function model of monetary policy incorporating the exchange rate movements. Those conflicting findings highlight the importance of more research to identify the linkage between inflation and exchange rates for developing countries including Indonesia.

In fact, they have different strengths and weaknesses in addressing the challenge of methodological issues. First, the ERPT is sensitive to the price index specification, i.e. consumer, producer, and import prices index (Bailliu and Fujii, 2004). Second is non linearity associated with the lag-length used explicitly in the equations (Junior, 2007) either backward- or forward-looking models (Taguchi and Sohn, 2014). Third is time period to be covered. The ERPT and Taylor rule at the beginning periods of IT regime will tend to yield overestimate (Zams and Cooray, 2007). Finally, the treatment of appreciation and depreciation exchange rates will determine the role of exchange rate in monetary policy reaction function (Pontines and Siregar, 2012).

We contribute to the empirics of the linkages between IT and exchange rate in emerging economies particularly Indonesia in some aspects. To get further insights into the linkages between IT and exchange rate, we compare them in the pre- and post-IT

adoption. Second, we identify them not only in the context of ERPT but also monetary policy reaction function. Third, we elaborate them by testing forward- and backward-looking behavior of central bank to conduct IT framework.

Research Method

The theoretical foundation on which the relationship between prices and exchange rate is based on evolves from the doctrine of purchasing power parity (PPP) and offshoot of the law of one price (LOOP) (Goldberg and Knetter, 1997). With the assumptions that there are no trade barriers and transport cost (or at least a constant exporter's marginal cost, α), we begin our analysis by considering PPP relation in logarithmic form:

$$\log(p_t) = \alpha + \lambda \log(er_t) + \varphi \log(y_t) + \varepsilon_t \quad (1)$$

where *p* is domestic import price at time *t*, *er* is the nominal (bilateral) exchange rate expressed in domestic currency given the tradable output (*y*), and ε is the stochastic term.

The LOOP implies that $\lambda = 1$ in which case changes in the exchange rate completely pass-through to the domestic price of the traded good. This simple expression forms the basis of analyzing the long run pattern of ERPT. In the short-term relationship, we prefer to use the restricted ARDL (auto-regressive distributed lag) model to accommodate some adjustments.

The use of the ARDL model is justified by the fact that it makes possible to easily assess the relative change in *p* both in the short-run and in the long-run. Another advantage of this specification is the consistency and efficiency of estimates in the presence of endogenous regressors. Moreover, bearing in mind that standard unit root tests are susceptible to misleading results, Pesaran and Shin (1999) and further extended by Pesaran *et al*. (2001) show that ARDL models yield consistent estimates of the coefficients irrespective of whether the underlying regressors are *I*(1) or *I*(0), as the Johansen framework, thus providing robustness to the results. The model takes the unrestricted form as follows:

$$\Delta \log(p_t) = \alpha + \beta_1 \Delta \log(er_t) + \beta_2 \Delta \log(er_{t-1}) + \beta_3 \Delta \log(y_t) + \beta_4 \Delta \log(y_{t-1}) + \beta_5 \Delta \log(p_{t-1}) + e_t \quad (2)$$

To investigate the presence of long-run relationships among the log(*p*), log(*er*), and log(*y*), bound testing under Pesaran *et al.* (2001) procedure is used. The bounds test method co-integration has certain econometric advantages in comparison to other methods of co-integration which are the following: (1) all variables of the model are assumed to be endogenous; (2) bounds test method for co-integration is being applied irrespectively the order of integration of the variable; and (3) the short-run and long-run coefficients of the model are estimated simultaneously.

The bound testing procedure is based on the F-test. The F-test is actually a test of the hypothesis of no co-integration among the variables against the existence or presence of co-integration among the variables, denoted as:

Ho: $\beta_2 = \beta_4 = \beta_5 = 0$ (3a)

i.e., there is no co-integration among the variables.

Ha: $\beta_2 \neq \beta_4 \neq \beta_5 \neq 0$ (3b)

i.e., there is co-integration among the variables.

The ARDL bound test is based on the Wald-test (F-statistic). The asymptotic distribution of the Wald-test is non-standard under the null hypothesis of no co-integration among the variables. Two critical values are given by Pesaran *et al*. (2001) for the co-integration test. The lower critical bound assumes all the variables are *I*(0) meaning that there is no co-integration relationship between the examined variables. The upper bound assumes that all the variables are *I*(1) meaning that there is co-integration among the variables. When the computed F-statistic is greater than the upper bound critical value, then the Ho is rejected (the variables are co-integrated). If the F-statistic is below the lower bound critical value, then the Ho cannot be rejected (there is no co-integration among the variables). When the computed F-statistics falls between the lower and upper bound, then the results are inconclusive.

The ARDL has been chosen since it can be applied for a small sample size as it happens in this study. Also, it can estimate the short- and long-run dynamic relationships in ERPT simultaneously. The ARDL methodology is relieved of the burden of establishing the order of integration amongst the variables. Furthermore, it can distinguish dependent and explanatory variables, and allows testing for the existence of relationship between the variables. Finally, with the ARDL it is possible that different variables have differing optimal number of lags.

In empirical practice, ERPT is defined as the coefficient of the lagged exchange rate change. The short-run effect is the increase in prices following a depreciation episode that happened in no more than one lagged month. The long-run effect, or static solution, corresponds to the expected value after all the dynamic adjustment has taken place. We can think of the coefficients as short-run and long-run multipliers. Generally, both in the short-run and the long-run, the coefficients of the exchange rate are expected to be positive. In contrast, the coefficient of real output growth would have a negative sign. The coefficient of lagged dependent variable is expected to be positive and measures the speed of adjustment towards the equilibrium in the long-run.
The ERPT enters in the monetary policy reaction function through inflation rate. Regarding to the monetary policy reaction function estimation, we basically follow the estimation model of Clarida *et al*. (2000), and such subsequent studies as Gagnon and Ihrig (2004), Kim and Park (2006), and Siregar and Goo (2008). Since the central bank of Indonesia is responsible primarily

on the currency value, we focus on the inflation rate deviation from its target. We estimate three kinds of Taylor-type monetary policy rules using: standard model, a backward-looking specification, and forward-looking one in the following ARDL equation:

$$IRP_t = c_1 + \theta_2 (INF_t - IT_t) + \theta_3 (INF_{t-1} - IT_{t-1}) + \theta_4 (INF_{t+1} - IT_{t+1}) + \theta_5 \Delta \log(y_t) + \theta_6 \Delta \log(y_{t-1}) + \theta_7 \Delta \log(er_t) + \theta_8 \Delta \log(er_{t-1}) + \phi IRP_{t-1} + e_t \quad (4)$$

where IRP is interest rate policy, INF is the annualized inflation rate, and IT represents the targeted inflation rate for each year. The standard model holds if $\theta_3 = \theta_4 = 0$. The backward-looking specification exists when $\theta_4 = 0$. Eventually, the forward-looking behavior occurs if $\theta_3 = 0$. If the complete ERPT exists, θ_7 and θ_8 should be statistically insignificant. The conventional F and χ^2 statistics are used to ensure which one the fittest model is. Again, the bound test procedure as (3) is applied to ensure the existence or absence of co-integration among the variables.

We employ the following indicators: interest rate policy, exchange rate, prices index, inflation rate, and output growth. As noted in the introductory section, the interest rate policy is represented by BI Rate as the main operational target in the short-run. The exchange rate is the price of US Dollar against Rupiah stated in the mid value. Regarding the ERPT, we use three types of price index, monthly consumer prices index (*cpi*), import prices index (*pm*), and wholesales industrial prices index (*ppi*) in 2010 base year. The annualized CPI inflation rate is only used in the monetary reaction function model in order to be comparable to the targeted inflation rate. The industrial production index is used as a proxy for the real GDP growth.

We analyze the behavior of interest rate policy in relation to business cycle referring to actual output gap instead of potential output gap (i.e. output is below its potential). Generally, many researchers (Taguchi and Sohn, 2014; among others) used Hodrick-Prescott (HP) filter procedure to estimate the potential output. The potential output gap is then calculated by differencing between the actual output and the HP-filtered output.

The motivation for our approach relates to the fact that measuring potential output in developing countries including Indonesia is difficult. The major reason for this is most likely due to the limited availability of reliable, long, and high frequency data quality. As a consequence, it is not easy to discuss business cycles or cyclicality per se. Therefore, we alternatively employ actual output gap (i.e. output growth; the difference between outputs in the current period from outputs in the previous one by assuming that the latter are the potential one).

The sample periods chosen for this study extend from 2003(M1) to 2013(M12). The total observation operationally is 132 sample points. We divide them into two sub-samples, with sample break dates chosen is based on the official adoption of IT by the central banks. Most of the monthly data are taken from the central bank of Indonesia (www.bi.go.id). Other data are obtained from Central Board of Statistics (www.bps.go.id).

The models will be estimated by OLS (ordinary least squares) because there is no simultaneous relationship among the variables. We use a general-to-specific approach to select variables in the regression equation in order to obtain the 'best' model. In relation to ARDL model, we used the same approach to determine the lag length of the variables. Before executing the models above, as usual, the descriptive statistical analysis and standard time series properties of the data are done. Most of the results are calculated in econometric program Eviews 8.

Result And Discussion

Table 1 presents the elementary statistics of all variables of interest covering mean, median, and extreme (maximum and minimum) values. Each the median value is not too far from the respective mean (an exception for output growth, $\Delta\log(y)$). The closeness of median to the mean value preliminary indicates that all of the variables of interest are normally distributed.

The symmetric distribution of almost variables is confirmed by the moderate value of skewness. Skewness measures the symmetric or normal distribution which the value is expected to be zero. The skewness values of $\Delta\log(ppi)$ is slightly greater than 0 which indicates that the series are normally distributed. Two series, $\Delta\log(pm)$ and $\Delta\log(y)$, have a negative value of skewness. Other series are skewed to the right. The upper tail of the distribution is thicker than the lower tail.

Furthermore, the range (distance from minimum to maximum) values vary. The range value of targeted inflation rate (IT) is the lowest. In contrast, the range value of $\Delta\log(y)$ and $\Delta\log(er)$ are the two highest. They are consistent with the configuration of standard deviation and consequently those of CV (coefficient of variance, standard deviation to its mean ratio).

$\Delta\log(cpi)$ has the greatest value of kurtosis followed by $\Delta\log(ppi)$ and $\Delta\log(pm)$. The kurtosis measures the peakedness or flatness of the distribution with an expected value of 3.0. The result shows that only BI Rate and actual inflation rate (INF) satisfy the condition. It implies that the tails of the distribution of other series are thicker than the normal (indicated by the kurtosis coefficient much greater than 3, i.e. leptokurtic).

Table 1: Descriptive Statistics

	Month-on-Month (x100)					Year-on-Year		
	Δlog(cpi)	Δlog(pm)	Δlog(ppi)	Δlog(er)	Δlog(y)	BI Rate	INF	IT
Mean	0.58	0.77	0.76	0.24	0.29	7.87	7.44	5.35
Median	0.45	0.84	0.64	0.11	0.71	7.13	6.30	5.00
Max.	8.35	7.10	8.65	15.91	15.23	12.75	18.38	8.00
Min.	-0.35	-11.98	-6.79	-10.41	-21.85	5.75	2.41	4.50
Std. Dev.	0.87	2.31	1.48	2.94	4.99	2.04	3.94	1.10
CV	1.51	3.00	1.94	12.14	17.11	0.26	0.53	0.21
Skewness	5.74	-1.27	0.60	1.12	-1.18	1.08	1.25	1.52
Kurtosis	49.87	9.72	13.60	10.03	7.77	3.24	3.75	4.17
N	131	131	131	131	131	102	102	102

Figure 1 visualizes the three types of price index and exchange rate dynamics. It seems that there is no clear synchronized pattern between CPI inflation and domestic currency depreciation rates as the main hypothesis in the ERPT theory. Correlation of the two variables is weak either in the pre- or post-IT regime. The coefficient correlation of ER depreciation and CPI inflation rates in all period of observation is quite low, -0.01.

In contrast, the *ppi* and *pm* inflation rates are closely related to the US$-Rupiah depreciation rate. The coefficient of correlation of rates of change in *pm* and *ppi* is 0.76. While the correlation of those inflation and depreciation rates is 0.33 and 0.25 respectively. At this point, we can say that Δlog(*er*) has a little effect on CPI inflation rate and its contributions to Δlog(*pm*) is higher than that to Δlog(*ppi*).

Figure 1: CPI, PM, and PPI Inflation and Depreciation Rates

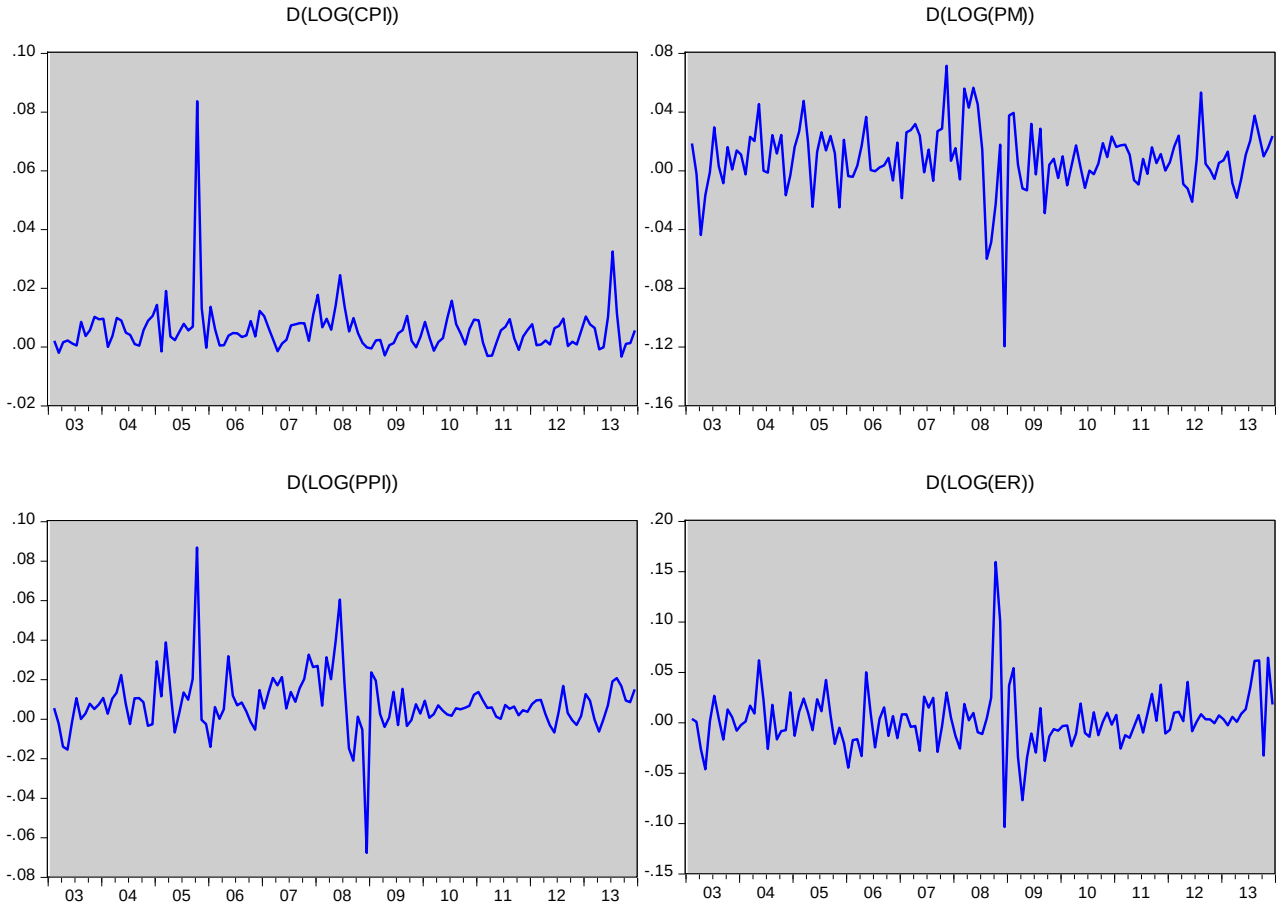

Figure 2: Inflation Targeting Policy and Exchange Rate Depreciation

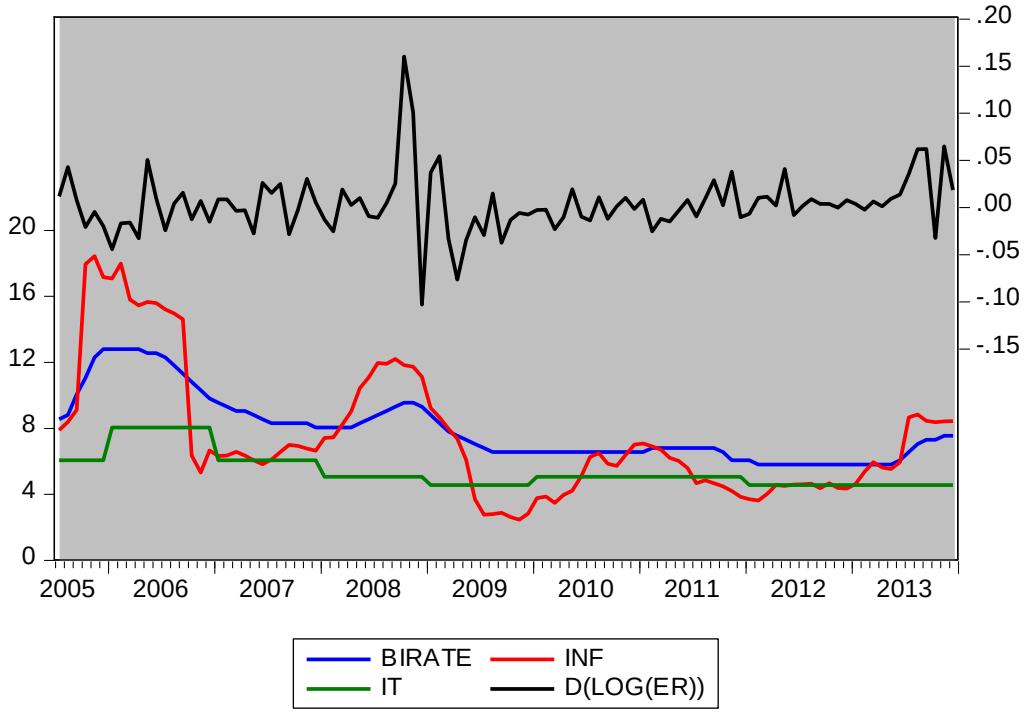

Figure 2 report the dynamics of monetary policy stance (BI Rate), actual annualized inflation rate (INF), targeted inflation rate (IT), and then related them to the depreciation rate (Δlog(*er*)). It is observable that there is a strong co-movement among BI Rate, INF, and IT. As implied by Taylor's rule mechanism, the central bank of Indonesia will normally raise the BI Rate if the future inflation is forecasted ahead of the established inflation target. Conversely, the central bank of Indonesia will lower the BI Rate if future inflation is predicted below the inflation target.

Conversely, there is unsynchronized pattern between the relative changes in exchange rate and the other variables. The coefficient of correlation of depreciation and BI Rate is -0.04 while that of depreciation and inflation rates is 0.03. When we divide the sample into pre- and post-global financial crisis in 2008, the correlation does not change substantially. Given that, we preliminary conclude that the changes in exchange rate has a little impact on monetary policy. We shall check it again later more rigorously using econometric tools.

To prove our hypothesis, we estimate first the unrestricted ARDL model as equations (2) and (4). The results show that the coefficients of lagged independent variables do not entirely present statistically significant. But the coefficient of lagged dependent variable is highly significant for each equation. These preliminary perform the presence of co-integration. To ensure the presence of co-integration, then we test the possibility of co-integration by implementing the bound test. The result is presented in Table 2.

The Wald test (F and χ^2 statistics) is computed to test the null hypothesis, Ho: there is no co-integration against the alternative hypothesis, Ha: there is co-integration for the corresponding models. The test for log(*cpi*) equation fails to be co-integrated. The other results of the Wald test values fall outside the upper bound in the lower probability value. It means that the null hypothesis of no co-integration is rejected suggesting the presence of co-integrating relation. In other words, all of those variables in each model are said to be co-integrated and, consequently, those series tend to move towards the equilibrium relationship in the long-run.

Table 2: Bound Test of Co-integration

Equation	Test	Value	df	Prob.	Conclusion
log(cpi)	F-stat	1.5077	(3, 124)	0.215	Not Co-integrated
	χ^2	4.5231	3	0.210	
log(pm)	F-stat	5.4819	(3, 124)	0.001	Co-integrated
	χ^2	16.4457	3	0.000	
log(ppi)	F-stat	8.5865	(3, 124)	0.000	Co-integrated
	χ^2	25.7595	3	0.000	
BI Rate	F-stat	994.729	(5, 91)	0.000	Co-integrated
	χ^2	4973.645	5	0.000	

Table 3 reports the OLS estimation results of two regression models as specified equation (4) in the previous section after conducting general-to-specific approach. As a result, we use 1 lag length and drop some insignificant variables. Compared to the complete model, the current result has the similar coefficient of determination (R^2), standard error of estimate, and F-statistic values respectively.

We also have tried to estimating the ERPT model using CPI inflation rate. Unfortunately, the result is not good enough. None explanatory variable is statistically significant consistent with the result of bound test. This also supports to the visual inspection onto Figure 1 that $\Delta\log(er)$ has a little synchronized pattern with CPI inflation rate. Juoro (2013) obtained the same yield in the context of causality. Hence, it seems that ERPT mechanism operates in the context of import and producer price indices.

In the pre-IT period, there is only depreciation rate that significantly affects to the inflation rate both based on *pm* and *ppi* indices. The lagged dependent variable is insignificant suggesting dynamic instability. Moreover, both magnitudes are quite different, 0.61 and 0.15 respectively. As observed by Bailliu and Fujii (2004), it may reflect the different composition of these indices. Producer price indices are driven mainly by prices of tradable goods, whereas import price indices have a more ample distribution between tradable and non-tradable goods.

In the post-IT and total periods, most all of variables (either lagged or contemporaneous variables) including constant are found to be statistically significant. The lagged *er* and the lagged dependent variable are significant respectively. However, the output growth is insignificant for all sub-samples. This result indicates that the movement of exchange rates is not perfectly associated with output exchange in the real sector implying the possibility of dollarization or 'money commodity' phenomenon in the financial sector, i.e. ERPT takes places due to shocks in money market in line with speculative motives.

It is noticeable that the degree of ERPT tends to decrease both in the case of *pm* and *ppi*. A depreciation of, say, 10 percent would lead in the short-run to an inflation of around 6 and 3 percent for both the import and the producer prices inflation. After IT a currency depreciation of 10 percent would lead to 3 percent inflation in import prices, and 1.5 percent inflation in producer prices respectively.

Table 3: Estimation Results of Exchange Rate Pass-Through

Dep. Var:	Δlog(pm)			Δlog(ppi)		
Period:	Pre-IT	Post-IT	Total	Pre-IT	Post-IT	Total
Constant	0.0062**	0.0052**	0.0050**	0.0053*	0.0052*	0.0048*
Δlog(er)	0.6079*	0.2958*	0.3240*	0.2821*	0.1480*	0.1561*
$\Delta\log(er_{(-1)})$	-	-0.2080*	-0.2089*	-	-0.1321*	-0.1147*
Lag	-	0.3009*	0.2999*	-	0.3624*	0.3620*
R^2	0.4137	0.1907	0.2132	0.2702	0.2011	0.2011
R^2-adj	0.3920	0.1660	0.1944	0.2432	0.1767	0.1821
SEE	0.0155	0.0220	0.0208	0.0099	0.0142	0.0135
F	19.0549	7.6998	11.3780	9.9970	8.2254	10.5722
DW	1.8015	2.1397	2.0996	1.7268	2.0059	2.0258
N	29	102	130	29	102	130
Test of ERPT	-2.8153*	-9.7103*	-10.5750*	-8.0482*	-18.4977*	-20.6585*

Note: (*) and (**) represent significant at 1 and 5 percent confidence levels respectively

Overall, the domestic currency depreciation of 10 percent in the short-run is followed by 3.4 and 1.6 percent with respect to *pm* and *ppi* inflation rates. This is consistent with Ca'Zorzi *et al*. (2006) that presented evidence of a similar ERPT for developed economies and emerging markets with moderate rates of inflation. This may due to the same use of import and producer price indices to assess the existence of ERPT.

However, we find evidence of complete ERPT both in the short- and the long-run. This result also holds both in sub-samples before and after IT adoption which is in the opposite with the finding of Prasertnukul *et al*. (2010). The conventional t-test statistic presents that the null hypothesis ERPT = 1 at 1 percent confidence level could not be rejected implying that the changes in exchange rate are completely represented by the *pm* and *ppi* inflation rates. Therefore, it is not easy for the central bank of Indonesia to formulate monetary policy in handling prices stabilization.

Table 4 delivers the estimation results of monetary policy reaction function regarding to the response of dynamics of inflation rate. Before advancing our analysis further, it is important to understand that for the inflation target to be reached; monetary policy is implemented with lag instead of contemporaneously or instantaneously. It means that any change in the monetary policy stance is undertaken after evaluating whether future developments in inflation are on track with the established inflation target.

The future developments in inflation can be formulated by the past and current values in the manner of backward looking approach. In contrast, the expected inflation in the future is based on the current and future available information in the way of forward-looking approach. Therefore, it is interesting to check which one more applicable is and what the policy implication is. In doing so, we use 1 lag and 1 lead as suggested by lag length criteria and general-to-specific approach.

Table 4: Estimation Results of Monetary Policy Reaction Function

Dep. Var.: BI Rate	A	B	C
Constant	0.4517*	0.5215*	0.4512*
INF – IT	0.1125*	-0.0154	0.0135
$INF_{(-1)} - IT_{(-1)}$	-0.0531*	-	-0.0305***
$INF_{(+1)} - IT_{(+1)}$	-	0.0932*	0.0868*
$\Delta log(y)$	-1.4685**	-1.2566**	-1.4364*
$\Delta log(y_{(-1)})$	-0.6936	-0.9719***	-1.0343**
Lag	0.9261*	0.9126*	0.9236*
R^2	0.9888	0.9917	0.9920
R^2-adj	0.9882	0.9912	0.9915
SEE	0.2226	0.1925	0.1897
F	1672.6270	2240.9240	1923.5760
N	101	100	100

Note: (*), (**), and (***) represent significant at 1, 5, and 10 percent confidence levels

Panel A performs the result of the backward-looking approach. Except lagged output growth, all of the coefficients are significant at 5 or even 1 percent confidence levels. The interest rate policy tends to increase 11 basis points to respond 1 percent out of targeted inflation rate. On the other hand, the output gap -- as expected -- significantly reduces the interest rate policy in the short-run.

The result of the forward-looking approach is presented in panel B. Compared to Panel A, Panel B has a better result. The central bank considers the future inflation rate gap relative to the current gap of inflation rate. There is a long-run impact of output growth on interest rate policy indicated by significance of the lagged log(*y*). It means that the central bank implicitly in the long-run has a responsibility on economic growth as an additional task.

The synthesis model is presented in Panel C. Basically, the result equals to the two previous models in term of magnitudes and signs. Also, the exchange rate can be dropped in all of the three models because of insignificance as found by Miskhin (2004), Kuncoro and Sebayang (2013), and Adenan (2014). In short, the central bank has been trying to smooth any change in interest rate policy. This in indicated by the high coefficient of lagged dependent variable. In other words, there is a low adjustment to reach the desired interest rate implying the high degree of persistence.

Table 5 offers the test result confronting backward- and forward-looking behavior of the central bank in formulating interest rate policy. The t-stat, analysis of variance, and chi-square tests show that forward-looking model in parsimony relative to backward-looking one. The probability to accept the null hypothesis (there is an existence of forward-looking behavior) is at 5.4 percent much higher than to reject it. This result, in fact, does not confirm to the study of Taguchi and Sohn (2014).

Tables 4 and 5 clearly show that the complete ERPT as found in Table 3 could be represented by (INF-IT) even though INF (CPI based) does not perfectly represent the fluctuation of exchange rate. Given that, we can say that the significantly positive existence of pass-through in the post-IT indicates mixed outcomes. The combination of the existence and loss of pass-through in the post-IT period differs depending on the specifications of pass-through equations, i.e. those for exchange rate and consumer prices. In contrast, Indonesia experiences the pass-through of import and producer prices.

Table 5: Backward- versus Forward-Looking Behavior Tests

Null Hypothesis	Test	Value	df	Prob.	Conclusion
Forward-Looking Behavior: Coefficient of $(INF_{(t-1)} - IT_{(t-1)}) = 0$	t-stat	-1.9478	93	0.0545	Ho accepted
	F-stat	3.7940	(1, 93)	0.0545	
	χ^2	3.7940	1	0.0514	
Backward-Looking Behavior: Coefficient of $(INF_{(t+1)} - IT_{(t+1)}) = 0$	t-stat	6.1034	93	0.0000	Ho rejected
	F-stat	37.2513	(1, 93)	0.0000	
	χ^2	37.2513	1	0.0000	

We can then summarize the implications of estimation results combining those for monetary policy reaction function and those for pass-through rates as follows. As noted earlier, the simple macro model of Gagnon and Ihrig (2004) showed that when the monetary authorities focus on stabilizing inflation, there is less pass-through of external price shocks into consumer prices. We could successfully identify this linkage, i.e. the one between the loss of pass-through effect and the inflation-responsive rule which was proven to take a forward-looking policy rule.

The outcomes were consistent with Gagnon and Ihrig (2004), since their macro model presumes the forward-looking type of monetary policy rules for monetary authorities' behavior. As noted by Taguchi and Sohn (2014), the difference in pass-through effects may come from the difference between the way that the private sector forms expectations on inflation under forward- and backward-looking policy rules: the forward-looking rule of the central bank makes it easier for private agents to form their expectations consistent with the targeted inflation, by sharing reliable inflation-forecasting information presented by the central bank.

Under the backward-looking rule, accompanied often with lack of reliable inflation forecasting, private agents cannot recognize the intent of the central bank (see: Eichengreen, 2002) regarding on what grounds and criteria the central bank has set an inflation target to certain level, which makes it difficult for them to believe in targeted inflation. The lack of credibility of targeted inflation, then, may render expectations on inflation subject to transitory external price shocks, thereby leading to high pass-through structure of economies. The difference in policy rules, thus may, create the difference in the way to form expectations on inflation, and so the difference in pass-through effects against external price shocks.

Concluding remarks

This paper analyzed the role of exchange rate in monetary policy in emerging country with focus on Indonesia. First, we observed the ERPT in the pre- and post-periods of IT adoption. Second, we estimate the monetary reaction function taking into account the ERPT. The motivation of this paper is triggered by the fact that many empirical studies regarding the related issues in Indonesia are inconclusive. The study employed secondary data published by formal institutions focusing on the exchange rate, interest rate policy, consumer, import, and producer price indices, and output growth. We used monthly data over the period 2003(1)-2013(12) relying on the ARDL model.

We found the existence of ERPT both in the pre- and post-IT adoption. The ERPT holds both in import and producer prices. Conversely, the ERPT does not occur in the consumer prices. Surprisingly, the complete ERPT is found to be consistent both in the pre- and post-IT adoption. The high degree of ERPT makes difficulties for the central bank to formulate the monetary policy to control the inflation rate, i.e. foreign inflation will become domestic inflation. Consequently, adding the exchange rate fluctuation in the Taylor rule does not improve the monetary policy reaction function. The exchange rate fluctuation seems to be perfectly represented in the deviation of actual inflation rate from the targeted inflation rate. This probably is associated with the forward-looking behavior of the central bank to forecast the future inflation rate which mainly based on the CPI. Therefore, the monetary policy reaction function is less pass-through of external price shocks into consumer prices instead of import and producer prices. Regardless the ERPT comes from; the use of 'exchange rate into policy' rule does yield a better value of loss function.

Refer to those findings, this paper concludes that IT in Indonesia puts too much emphasize on stabilizing the domestic currency thus leading to benign neglect of stabilizing its external value, ultimately resulting in increased exchange rate fluctuation. It challenges to the conventional wisdom that IT adoption, if conducted in a forward-looking manner, can be a resisting power against external price shocks. Accordingly, the monetary policy would not be optimal without taking exchange rate movements into consideration. Under these non-technical circumstances, those findings suggest that central bank credibility plays an important role in conducting IT policy which operates primarily through a signaling effect to achieve simultaneously both the two goals.

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