THE EFFECT OF CENTRAL BANK INDEPENDENCE ON PRICE STABILITY: THE CASE OF INDONESIA

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Abstract

This paper investigates the relationship between central bank independence (CBI) and inflation in Indonesia during 1970-2006. Using partial adjustment Ordinary Least Square (OLS) and Engel Granger Error Correction Model, the result shows that legal CBI index inversely affect the inflation, while the turnover of governor is not significant. This result emphasizesBank Indonesia to strengthen its independency in order to achieve his inflation target.

Keywords: Central bank independency, Inflation, Error Correction Model.
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I. INTRODUCITON

Indonesia had been severely affected by Asian economic crisis in 1997. At that time, Indonesia experienced multidimensional economic problems including large current account deficit and exchange rate depreciation. An increase in uncertainty pushed the capital out, followed by liquidity problem in many banks. As the lender of last resort, Bank Indonesia provided liquidity borrowing for the banks, nevertheless, these led to increase in money supply and trigger hyperinflation.

One possible source of the crisis in 1997 is that the central bank was not independent. In previous political regime (*Order Lama*), the central bank always financed the government budget deficit by printing money. During the new regime (*Order Baru*), the central bank was mandated to support the government's goals to sustain economic growth and to reduce unemployment. Accordingly, it was very difficult for the Bank Indonesia to pursue price stability as its main objective. Later in 1999, Bank Indonesia became legally independent, along with the rising awareness and also theoretical and empirical evidencethat independent central bank is required to achieve price stability. This was also a recommendation of the IMF for economic recovery after the crisis. Through Law No.23/1999 the central bank responsibility hadbeen more focus from multiple objectives to single objective of price stability.

The basic theory of the central bank independence is inflation bias theory. Inflationary bias reflects price instability that will determine the basic prices of all economic activities. It will affect the economy through the purchasing power of the national currency. With unstable prices, people worry about the real value of their money being discounted by inflation. Furthermore, unstable price will increase uncertainty and create economic instability.

However, appointing a conservative central banker to pursue the price stability is debatable since many researchers find different results. Some researchers suggest that the central bank independence can create low inflation, while the other found no correlation between Central Bank Independence (CBI) and inflation. Generally, a negative correlation between legal CBI index and inflation is found in the industrial countries while in the developing countries, it is not significant. On the other hand, the governor turnover of central bank as informal indicator of CBI is generally positively correlated to inflation in the developing countries but it is not significant in the industrial or developed countries.

The purpose of this research is to investigate the relationship between CBI and inflation in Indonesia using annual data from 1970 to 2006. This research uses two indicators of CBI; legal index and TOR constructed by Cukierman, Webb and Neyapty (CWN) (1995). We use two models; Ordinary Least Square (OLS) by using partial adjustment model and Engel Granger Error Correction Model (EGECM) to identify the impact of CBI on inflation, and to investigate the long-run equilibrium of inflation.

The reminder of the paper is structured as follows. Section I is theoretical adjustment for central bank independent. In section II, the research presents previous empirical evidence of

the central bank independence effect on price stability. Section III discusses the result found in Indonesia. The last section is conclusion and policy implication.

II. THEORY

2.1. Basic Model of Central Bank Independency

Inflation bias occurs under discretionary monetary policy where central bank is controlled or at least intervened by government. Within this condition, if central bank knows public expectations, he tends to create inflation surprise to increase seignorage income and to push real economic activity; employment and output. However, in the next period people will no longer believe the central bank and set higher expectations. Inflation will be higher than it should have been as inflation is a function of expected inflation. In this case, the central bank is perceived to not be credible, hence it will be more difficult to manage inflation.

There are three reasons why central banks should be independent; first, public choice theory explains that central banks get political pressure from a government to finance the government budget deficit through easy money policy (Eijffinger 1997). Second, when fiscal authority is dominant, monetary authorities will not be able to control government budget deficit, hence the supply of money become endogenous. This condition is possible when the central bank is not independent (Sargent and Wallace, 1981 cited in Eijffinger 1997). Third, there is a 'time inconsistency' problem, where the policy is no longer optimal to respond the original plan (Kydland and Prescott, 1977; Barro and Gordon, 1983; Rogoff, 1985).

One solutionfor the inflation bias is to delegate monetary policy to an independent 'conservative' central banker (Rogoff, 1985; Barro and Gordon, 1984; Walsh, 2003). Central bank is independent when he is free from political pressure or government intervention, including free from the government's temptation to increase seignorage by increasing money supply, (Alesina andSummers (1993). Moreover, independent central bank should only has single objective; price stability, which implies that central banks focus more on inflation than output growth. Within this framework, the central bank can formulate monetary policy to achieve price stability, independent from any political interference (Ahsan, 2006; Pollard, 1993).

The central bank is also not allowed to buy government's obligation in primary market. This means the government is not permitted to borrow money from the central bank. The government should choose ways within his authorities such as raising taxes, issuing bills, or borrowing from conventional banks to finance its expenditure rather than borrowing from the central bank.

Before looking at the various result of empirical evidence, this paper provides basic model of inflation bias and CBI.We use Rogoff model (1985) as starting point. This model compares the loss function between discretionary monetary policy and conservative central banker (by

rule). Inflation under the discretionary monetary policy is analyzed by Barro and Gordon (1983) adopting the Lucas-Island supply function.

$$y_t = yn + a(\pi_t - \pi_t^e) + \varepsilon_t \tag{1}$$

where y_t is output; yn is natural rate of output; π_t isinflation; π_t^e is expected inflation; and ε_t isreal shock.

Output in this model is a function of labor and capital (Cobb Douglas). When actual inflation is greater than expected inflation, the real wages will drop since the expected real wage is lower and the firm will absorb employees. On the other hand, whenever actual inflation is less than expected one, the real wages will increase and firm will reduce employees.

Under discretionary monetary policy, the central bank minimizes the following social loss function:

$$L = \frac{1}{2}\pi_t^2 + \frac{\lambda}{2}(y_t - yn - k)^2 \tag{2}$$

Where λ is society's preference for output, and kis constant. Parameter k is imperative in this model. Under discretionary monetary policy, on stabilizing output and inflation, the central bank will set the output to be around $yn+k$, while inflation will fluctuate around zero.

A simple relationship between inflation and the actual policy instrument adopted by policy maker gives:

$$\pi = \Delta m + v \tag{3}$$

where Δm is the growth rate of money supply (first difference of the log nominal supply of money), and V is the velocity shock. In setting Δm, this model assumes that expected inflation is given, supply shock (ε_t) is observable by central bank but not velocity shock (v_t); and also ε_t and v_t are uncorrelated.

Initially, private sector set wages based on expected inflation. The private agent must commit to the nominal wage contract before the central bank set the growth rate of nominal money supply. Under discretionary monetary policy, the central bank care about output and tries to reduce output variation by choosing inflation. In this case, the central bank has the opportunity to create inflation different from private agent's expectation.

The effect of discretionary policy on inflation rate is obtained by substituting equation (1) and (3) into the central bank loss function (2), then take first order condition with respect to money growth:

$$V = \frac{1}{2}\lambda \left[a\left(\Delta m + v - \pi^e\right) + e - k \right] + \frac{1}{2}\left(\Delta m + v\right)^2$$

$$0 = \lambda \left[a\left(\Delta m + -\pi^e\right) + e - k \right] + \left(\Delta m\right)$$

$$\Delta m = \frac{a^2\lambda\pi^e + a\lambda(k - e)}{1 + a^2\lambda} \tag{4}$$

Equation (4) shows that aggregate supply shock occurs since the central bank wants to minimize output variability (λ) around its target and then result in high inflation. There is a tradeoff between inflation and output variability. The more a central bank wants to minimize output variability (λ), the greater inflation will be (Δm). Private sectors will use this equation as their expectation. Therefore, optimal policy depends on expected inflation of private agent's. The expected inflation is formed from observing the aggregate supply shock (ε) as follows:

$$\pi^e = E[\Delta m] = \frac{a^2\lambda\pi^e + a\lambda k}{1 + a^2\lambda}$$

$\pi^e = a\lambda k > 0$, substitute this into (3) and use (4) to get equilibrium rate of inflation under discretionary policy:

$$\pi^d = \Delta m + v = a\lambda k - \left(\frac{a\lambda}{1 + a^2\lambda}\right)e + v \tag{5}$$

Equation 5 shows that positive average inflation rate equals to $a\lambda k$. The determinant of inflation bias is distortion (k), the effect of money supply on output (a) and the weight of central bank to pursue output objective (λ). When private agents are able to anticipate this rate completely, it will have no effect on output.

If monetary policy is delegated to an independent central bank (conservative), central bank puts weight on inflation, and inflation will be:

$$\pi^d(\delta) = \Delta m + v = \frac{a\lambda k}{1 + \delta} a\lambda k - \left(\frac{a\lambda}{1 + \delta + a^2\lambda}\right)e + v \tag{6}$$

This equation implies that inflation bias will be lower since $1 + \delta > 1$ or $\delta > 0$, and this tends to reduce the loss function. However, the coefficient of aggregate supply shock (ε) is also lower, implying the central bank does not respond sufficiently to aggregate supply shock (ε). In other words, when the central bank cares more about inflation than output stabilization, inflation

bias will be lower.Yet, this will lower output stabilization. Based on this result, many researchers conclude that lower average inflation can be achieved by assigning a conservative independent central bank; however at the cost of lower output stabilization. Thus, a trade-off between lower average inflation and high output variability is expected to occur.

Berger, Haan and Eijffinger (2001) use another simple equation to explain the theory of central bank independency (see equation 7). This model adopts the same loss function equation and Lucas-Island supply function, and also inflation under rational expectation as in Barro and Gordon model. Under discretionary policy type of central bank, inflation is:

$$\pi_t = \chi y_t^* - \frac{\chi}{\chi+1}\mu_t \tag{7}$$

The first right hand side term is inflationary bias. When a country has high inflationary bias, it implies that a government pushes big surprise on inflation. The second term is the degree of stabilization of output shock that will affect inflation. Loss function becomes:

$$L^{cb} = \frac{1+\varepsilon}{2}\pi_t^2 + \frac{\lambda}{2}(y_t - y_t^*)^2 \tag{8}$$

However, when a central bank is independent or conservative, inflation will be:

$$\pi_t = \frac{\chi}{1+\gamma\varepsilon}y_t^* - \frac{\chi}{1+\gamma\varepsilon+\chi}\mu_t \tag{9}$$

Comparing inflation rate under discretionary policy in equation (7) and conservative (independent) central bank in equation (9) shows that inflation can be lower under independent central bank than discretionary policy. The key parameter is γ and ε. When both values are positive, inflation rate will be lower. This means that by delegating monetary policy to a conservative central banker will create positive value of γ and ε, thus inflation will be lower. Conversely, when γ or ε is equal to zero, the central bank has the same preference of inflation aversion as the government, implying independency of central bank does not matter. This is in line with Eijffinger and Hoebericht (1998):

$$M_t = \gamma L^{cb} + (1-\gamma)L^G,$$

where γ is the degree of CBI, and as $\gamma=1$, the central bank is fully independent.

However, a conservative central banker alone is not sufficient to achieve price stability since it provides too little response on the shock. Lohmann (1992) argues that appointing a central banker to fight inflation is better idea, but discharges him when the shock is too large. This way, the central banker will stay responsive to output stabilization. Walsh (1995) provides

alternative solution for inflation bias problem which is known as '*Optimal Walsh Contracts*'. He suggestsproviding bonus for the central banker when inflation is successfully reduced, instead of appointing a central banker. This approach is more contractual than institutional solution.

2.2. Empirical Evidence

Empirically, whether higher degree of CBI is associated with the lower inflation is still controversial among economists. The empirical evidence shows that there is a negative relationship between the degree of CBI and average inflation such as Grilli et al (1991), Cukierman et.al. (1992), Alesina and Summer (1993), Berger (2000) Jacome (2007), Hayo and Voigt (2005), Hicks (2004), Eijffinger et.al., (1998).

The correlation between CBI and inflation is described in Figure 1. Switzerland and Germany with a high CBI degree have low inflation. In Japan, Canada and Netherlands, their moderate CBI degree is associated with average inflation. Similarly, New Zealand with low CBI has high inflation. Thus, the higher degree of CBI is associated with lower inflation rate, vice versa.

Index of Central Bank Independence

Average Inflation

Source: Alesina and Summer (1993)

Figure 1
Relationship between CBI and Average Inflation
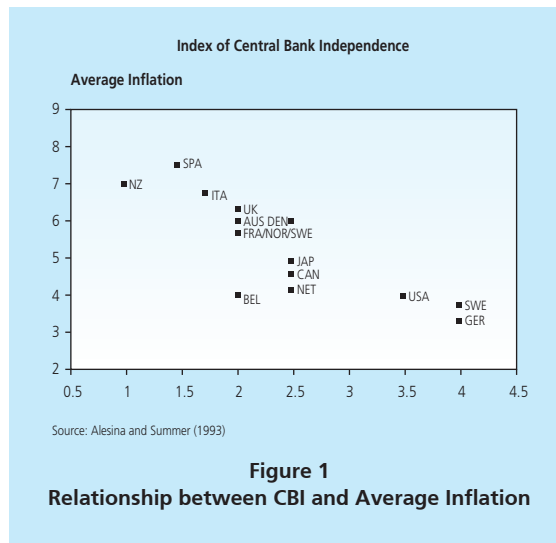
Nonetheless, Luna (2003)claims that there is no correlation between CBI and inflation. Using cross-country panel data among 23 OECD countries, he suggests that low inflation can be achieved without delegating monetary policy to an independent central bank. A low inflation is more related to exchange rate target rather than a conservative central bank. Using institutional reform as a proxy for CBI, he detects that price stability was achieved after the implementation of independence reform only for Spain, Greece, New Zealand, Portugal and Italy.

In contrast to Luna, Jong (2002) result finds a negative correlation between CBI and inflation in OECD countries. He suggests that the negative correlation appears because of cultural factors where people do not like uncertainty. An unclear correlation is found by Campilo and Miron (1996) but their result contrast with Luna (2003). Their panel regression across countries shows that exchange rate regime is not important to determine inflation. The more important factors are economic fundamentals such as openness and optimal tax.

Pollard (1993) has the same result but finds that an independent central bank will harm economic growth. He argues that an independent central bank can increase policy conflict with a government since they have difference preferences; and if this is evident, the economic growth will be lower.

Economists not only focus on whether CBI promotes price stability, but also whether it responds to economic performance. Waud (1995) points out that CBI will improve the trade-off between inflation and economic performance as assumed in Philip curve. An independent central bank can create low inflation and low growth as well. However, Fisher (cited in Eijffinger (1997)) argues that the tradeoff occurs only in the short term. In the long term, the Philip curve is vertical, implying monetary policy will only influence inflation; hence there is no clear correlation between CBI and output.

Those various outcomesmay be originated from different measures of CBI. Seminal work of Bade and Parkin's (1988) measures the relationship between the central bank and government as 'budgetary'. They create an index based on the institutional relationship between central bank and government.

Grilli, Masciandaro and Tabellini (1991) presented another index known as the GMT Index, based on political and economic independence measures. Using government deficit that financed by central bank, they found negative correlation between CBI and inflation.

Cukierman, Webb and Neyapti (1992) introduce the CWN index. They divide the measurement into two categories; Central Bank Independence (CBI) legal index and the rate of turnover of the central bank governor (TOR). The legal CBI index is significantly negative correlated with inflation in developed countries, but is insignificant for developing countries. TOR is positively correlated in less developed countries but uncorrelated in industrial countries.

The measurement of CBI adopted in many empirical studies has augmented the diversity of the substantial result to explain the effect of CBI on inflation.Alesina and Summer (1982) and Jacome (2001, 2007) adopting the expansion index of GMT and CWN results a negative correlation between the CBI and inflation. Panagiotidis (2005) confirms the same result using the CWN index for the case of Greece.

Voig (2005) adopts the degree of de facto of central bank as measurement of CBI and finds negative correlation between CBI and inflation. However, TOR as an informal proxy for CBI provides a positive correlation.

Campilo and Miron (1997) actually found the same result as Cukierman (1992) but reached a different conclusion. They claim there is no correlation between CBI and inflation because they find that CWN index was negatively significant only in high income countries and positively insignificant in developing countries. When they pooled the sample together, the result is unclear. This is similar with Cukierman (1992) who found the index is only significant in developed countries.

The other reason why empirical evidence provides different results is different exchange rate regime. A country with fixed exchange rate regimewill lose its independence; conversely, strong effect of CBI on inflation can be found on a country under the floating exchange rate (Cukierman 2001).

Empirical model and estimation technique are other possible source for different result.. Many previous studies find there is a positive or no correlation between CBI and inflation because they use an econometric methodology that does not account for error in the proxies of index. Consequently, the results show spurious estimation. For example Campilo and Miron (1997) and Ismihan and Ozkan (2004) estimate inflation directly on the proxy of CBI using ordinary least square (OLS) without calculating the error on the CBI index. They find there is no significant relationship between CBI and inflation.

Brum (2002, 2006) suggests that the problem in such estimations can be solved by analysis of the covariance structure. This method calculates an error in CBI index. Thus, the estimation will produce an unbiased estimator. Based on the empirical evidence, Brum (2002) uses this method to estimate Campilo and Morin (1997) and Ismihan and Ozkan (2003) model, and find CBI is significant negatively correlated with inflation even in developing countries sample. Hicks (2004) uses the ARIMA process and produces a negative correlation between CBI and inflation.

III. METHODOLOGY

3.1. Variable and Data

The dependent variable (inflation) is proxied with Consumer Price Index (CPI). Independent variables contain of legal index of central bank independence (legal CBI), turnover of central bank governor (TOR), money supply (M1), exchange rate (ER) and lag CPI;the latter three are control variables. All data are annual from 1970 to 2006.

The inflation rate was measured as the log of annual percentage in Consumer Price Index (CPI). The CPI data were taken from International Financial Statistic (IFS) based on CPI for 17 capital cities from 1970 to 2006 by using the base year of 1993.

The independence index covers both low (close to zero) and high degree of independence (close to one). This way, this research is able to include all data from 1970 until 2006 without

having to divide them in two categories before and after independence law (Law No. 23/1999) was released.

(Scales)

←——→

0.0   0.5   1.0
Too dependence   *Too independence*

The legal index of central bank independence for Indonesia was formulated by Cukiermen, Webb and Neyapty (CWN Index). This index is measured based on 16 characteristics, generated from the relationship between the Bank Indonesia and the government. The characteristics are categorized into four main clusters; first is Chief Executive Officer (CEO), which contains proxies for governing period and dismissal of the central bank governor, who appoints the governor, and his/her capability to hold another office. Second is the policy formulation variable; contains proxies for who formulate policies, final decision involvement, and the degree of the central bank's participation in formulating the government budget. The third is central bank objective variable; contains question whether central bank has single objective (price stability) or multiple objectives (price stability, growth, unemployment). The fourth is the limitation of central bank's lending to government; contains proxies for advances and securitizes lending, the authority of central bank to regulate the term of maturity of lending, the potential borrowers from central bank, the type of lending limitation, the maturity of loan, interest rate of the loan, and prohibition of central bank to buy government securities in primary market.

Using these 16 variables, the index of CBI is calculated with scaling method. The scale lies between 0 (zero) and 1 (one)[2]. For the period of 1970 to 1998, we use index calculated by Cukiermen, Webb and Neyapty (1995) for some developed and developing countries including Indonesia.Legal CBI index from 1999 to 2006 were primary data, collected through survey in Bank Indonesia. The set of questions are the same as in CWN index.

Another indicator used in this research as the measurement of independence is turnover of central bank governor (TOR). CWN suggest turnover of central bank governor as an informal indicator to measure independence. This idea based on the assumption that the higher governor turnover, the greater the possibility of central bank's dependence on the political authority.This assumption occurs only in developing countries, and not in countries with stable authoritarian government such as Denmark and United Kingdom, (Cukiermen 1995).

The turnover of the central bank governor (TOR) is measure based on the average change of the governor in years. More specifically, Cukiermen (1995) noted the formula as:

$$\text{Average Annual Turnover of central bank governor} = \frac{\text{Number of years}}{\text{Number of governor changes}}$$

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2   The calculation is available on the author upon request.

The critical value of average annual TOR lies between 0.2 and 0.5. This is due to the electoral cycle in every four or five years. If electoral cycle is less than four years, the probability of the threshold is higher than 0.5; conversely, it will be lower than 0.2 when the electoral cycle is more than five years. For Indonesia case, the threshold of turnover rate before 1970 was unstable, hence lies probably between 0 and 0.6. After 1970, the critical range is probably between 0 and 0.2.

The first control variable used in this research is narrow money as proxy for money supply. The second control variable is an exchange rate variable which is predicted also has a significant correlation with inflation. Both money supply and exchange rate data are gathered from International Financial Statistic (IFS). Another variable is inflation expectation, proxied with lag of log CPI, which is expected to have a positive correlation with current inflation.

3.2. Estimation Technique

Initially we identify the correlation between two indicators of central bank independence included in the model using Spearman's correlation. Gujarati (1995) suggests that all explanatory variables should be independent each other or they have low correlation. If they are strongly correlated, they are not be able used as independent variables together. Conversely, if they are weakly correlated, we can put them together as independent variables. The next step is estimating the equation using Ordinary Least Square (OLS):

$$PI = c + \alpha_1 LegalCBI + \alpha_2 TOR + \alpha_3 Log(m1) + \alpha_4 Log(er) \tag{10}$$

Panagiotidis (2005) estimates transformation inflation on indicators of CBI (Legal CBI and TOR) and dummy (capturing different regimes such as Bretton Wood System, Flexible Exchange Rate mechanism and Maastricht regime). On the other hand, this paper estimated inflation on both indicators of CBI and money supply and exchange rate as control variables.

Estimating equation (10) using OLS probably subject to spurious estimation when the included variables have unit root. Following Enders (2004), the alternative is first-difference form. Furthermore, to anticipate the autocorrelation issue, we put lag of inflation to see correlation of change in previous inflation on change in current inflation. Lag of inflation is reasonable theoretically, since we can see the relationship between expected inflation and inflation. These considerations will lead us to the following empirical model:

$$\begin{aligned} dPI_t = c + \alpha_1 d(PI(-1)) + \alpha_2 d(LegalCBI)_t + \alpha_3 d(TOR)_t \\ + \alpha_4 d(Log(m1))_t + \alpha_5 d(Log(er))_t + \varepsilon_t \end{aligned} \tag{11}$$

Based on Gujarati (1995) and Wooldridge (2006), we can use this model as long as there is no serial correlation, heteroscedasticity and multicollinearity problem. Although $d(PI(-1))$ depends on ε_{t-1} and all previous disturbance terms, it is not correlated to the current error term ε_t. Therefore, as long as ε_t is serially independent, $d(PI(-1))$ will also independent or uncorrelated to ε_t.

The model satisfies the OLS assumption especially for nocorrelation between explanatory variables and stochastic disturbance term. We check the serial correlation problem with Godfrey- Breusch Test known as the LM-test. We use white heteroscedasticity test for the heteroscedasticity problem and see the correlation test for the multicollinearity problem.

Further stationarity check on the error of equation (12) is important to find out whether the variables in equation are cointegrated, meaning there is a long run relationship among the variables on the model, (Enders, 2004). There are two types of ECM we can use; Engel Granger Error Correction Model (EGECM) and Wickens-Breusch Error Correction Model, as explained below.

For the Engel Granger ECM, first we estimate the residual error term: $\varepsilon_t = y_t - \alpha_1 - \alpha_2 x_1$ and, $\Delta \hat{\varepsilon}_t = \beta_1 \hat{\varepsilon}_{t-1}$ then a simple ECM can be formulated as $\Delta y_t = \alpha_1 + \alpha_2 \Delta x_t + \alpha_3 \hat{\varepsilon}_{t-1} + u_t$. If we assume Autoregressive Distributed Lag (1):

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \beta_0 x_t + \beta_1 x_{t-1} + \varepsilon_t \tag{12a}$$

$$y_t - y_{t-1} = \alpha_0 + \alpha_1 y_{t-1} - y_{t-1} + \beta_0 x_t + \beta_1 x_{t-1} + \varepsilon_t \tag{12b}$$

$$dy_t = \alpha_0 + (\alpha_1 - 1)y_{t-1} + \beta_0 (x_t - x_{t-1}) + \beta_0 x_{t-1} + \beta_1 x_{t-1} + \varepsilon_t \tag{12c}$$

$$dy_t = \alpha_0 + (\alpha_1 - 1)y_{t-1} + \beta_0 dx_t + (\beta_0 + \beta_1)x_{t-1} + \varepsilon_t \tag{12d}$$

$$dy_t = \alpha_0 + \beta_0 dx_t - (\alpha_1 - 1)\left[y_{t-1} - \left(\frac{\beta_0 + \beta_1}{\alpha_1 - 1} \right) x_{t-1} \right] + \varepsilon_t \tag{12e}$$

$$dy_t = \alpha_0 + \beta_0 dx_t - \lambda EC_{t-1} + \varepsilon_t \tag{13}$$

The equation (13) is the typical Engel Granger Error Correction Model, where $-\lambda EC_{t-1}$ is known as error correction term and λ is speed of adjustment parameter. The larger value of λ, the greater the adjustment of previous deviation to the long run equilibrium; conversely, the lower value of λ imply small short-run adjustment of deviation back to equilibrium. Following above procedure, we can specify our empirical model of Engel Granger ECM as:

$$d(PI)_t = \alpha_0 + \beta_0 d(CBI)_t + \beta_0 d(TOR)_t + \beta_1 d(\log(m1))_t + \beta_2 d(\log(er))_t$$
$$+ \lambda EC_{t-1} + \varepsilon_t \tag{14}$$

The second error correction specification is Winkens-Breusch Error Correction model. This model can explain long-run relationship between dependent and independent variable, and furthermore provide alternative valid way to test misspecification of presumed model. Recalling equation (13b):

$$y_t - y_{t-1} = \alpha_0 + \alpha_1 y_{t-1} - y_{t-1} + \beta_0 x_t + \beta_1 x_{t-1} + \varepsilon_t$$

$$y_t - \alpha_1 y_t = \alpha_0 + \alpha_1 y_{t-1} - \alpha_1 y_t + \beta_0 x_t - \beta_1 x_t + \beta_1 x_t + \beta_1 x_{t-1} + \varepsilon_t$$

$$(1 - \alpha_1) y_t = \alpha_0 - \alpha_1 dy_t + (\beta_0 + \beta_1) x_t - \beta_1 dx_t) + \varepsilon_t$$

$$y_t = \frac{\alpha_0}{1-\alpha_1} - \frac{\alpha_1}{1-\alpha_1} dy_t + \frac{\beta_0 + \beta_1}{1-\alpha_1} x_t - \frac{\beta_1}{1-\alpha_1} dx_t + \varepsilon_t$$

$$y_t = \lambda_0 - \lambda_1 dy_t + \lambda_2 x_t - \lambda_3 dx_t + \varepsilon_t \tag{15}$$

Following this equation, the empirical model of Winkens-Breusch is specified as:

$$PI_t = \lambda_0 + \lambda_1 d(PI)_t + \lambda_2 d(CBI)_t + \lambda_3 d(TOR)_t + \lambda_4 d(\log(m1))_t + \lambda_5 d(\log(er))_t$$
$$\lambda_6 (CBI)_t + \lambda_7 (TOR)_t + \lambda_8 (\log(m1))_t + \lambda_9 (\log(er))_t + \varepsilon_t \tag{16}$$

Since there is endogeneity problem in the model, we need to use Two Stage Least Square (TSLS); hence a set of instrumental variables (IV).

IV. RESULT AND ANALYSIS

Preliminary inspection shows all variables in first difference (inflation, central bank independence index, governor turnover, money supply and the exchange rate) are stationary. The residual of the model is also stationary, which confirm the presence of cointegration among the variables. We also test the correlation between legal CBI index and TOR (turnover of central bank governor) by using Spearman's correlation test. The result shows both indicators are weakly correlated (0.28).

The estimation result is presented below.We have checked the model is free from serial correlation problem using Breusch-Godfrey Serial Correlation LM Test (F-statistic = 0.632533 and p = 0.538934). The hypothesis of there is no serial correlation in the model cannot be rejected at 5 percent level tested by using Breusch-Godfrey Serial Correlation LM Test (see table 3). Using correlogram Q-statistics and White's test, we also confirm the model is free from heteroscedasticity problem.

Most of the variables are statistically significant at 5 percent level except TOR and the lag of inflation. The value of indicates that the variation of independent variables can explain 88.16 percent of the dependent variable's variation.

Table 1 Estimation Result of Standard Model				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-0.084955	0.027666	-3.070776	0.0046
D(PI(-1))	-0.124883	0.080302	-1.555153	0.1308
D(CBI)	-0.844977	0.146587	-5.764348	0.0000
D(TOR)	0.244953	0.207011	1.183286	0.2463
D(LOG(M1))	0.255763	0.125883	2.031749	0.0514
D(LOG(ER))	0.524653	0.055112	9.519822	0.0000
R-squared	0.881640	Mean dependent var		0.000686
Adjusted R-squared	0.861233	S.D. dependent var		0.188990
S.E. of regression	0.070402	Akaike info criterion		-2.314395
Sum squared resid	0.143735	Schwarz criterion		-2.047764
Log likelihood	46.50191	F-statistic		43.20299
Durbin-Watson stat	1.673317	Prob(F-statistic)		0.000000

Dependent Variable: D(PI)
Note: Method Least Square, 35 included observations from 1972 - 2006.

The estimation result shows the legal central bank independence (CBI) inversely related to inflation, which is typically a characteristic of developed countries. This is the opposite of common findings; where for developing countries, the correlation between legal CBI and inflation is insignificantly negative. We obtain similar result when using Engel Granger Error correction model; both indices of central bank independence are also negative and significant, with similar magnitude (minus 0.78).

| Table 2 — Estimation Result: Engel Granger Error Correction Model				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.087866	0.025741	-3.413459	0.0019
D(CBI)	-0.784542	0.126515	-6.201202	0.0000
D(TOR)	0.256597	0.192545	1.332657	0.1927
D(LOG(M1))	0.254733	0.116107	2.193959	0.0361
D(LOG(ER))	0.511670	0.051436	9.947756	0.0000
RESOLS(-1)	-0.366300	0.121117	-3.024357	0.0051
R-squared	0.894532	Mean dependent var		-0.001933
Adjusted R-squared	0.876954	S.D. dependent var		0.186933
S.E. of regression	0.065572	Akaike info criterion		-2.460323
Sum squared resid	0.128991	Schwarz criterion		-2.196403
Log likelihood	50.28582	F-statistic		50.88936
Durbin-Watson stat	1.970609	Prob(F-statistic)		0.000000

Dependent Variable: D(PI)
Note: Method Least Square, 36 included observations from 1971 - 2006.

The negative coefficient of CBI shows the lower independency, the higher inflation will be. The lower the degree of independence is, the weaker the central bank to refuse government intervention. On this situation, the Central Bank simply implements policy set by the government. Fiscal authority is more dominant than monetary authority. Based on Sargent and Wallace (1981) if the fiscal authority is dominant, the monetary authority will be forced to work under the government instruction. Thus, inflation will be higher since the government focuses more output or unemployment. Before Central Bank Independence Act No 23/1999, this is evident for the case of Indonesia.

Prior the implementation of this law, Bank Indonesia (BI) institutionally and practically depended on government. Bank Indonesia also hadother target such as promoting economic growth and reducing unemployment beside its core target on stabilizing price and Rupiah. Because of these many objectives, Bank Indonesia functioned as government's cashier or a part of government, including as agent of development. With this twin functions, BI was more difficult to realize its target, thus, the inflation was high. For example in period 1970-1984 the average inflation rate was 18 percent annually. Indeed, in 1972 until 1973, inflation was 25.80, 30.63 and 41.03 percent respectively (IFS, 2008).

Figure 2 shows the co-movement of inflation and interest rate from 1974 to 2006. In 1970s, the inflation rate was still high and the government took tight money policy. The result is inflation reduced below the level of 1960s but still above 10 percent. In 1974, inflation rate was 41.03 percent, mainly due to multi objective of central bank; stabilizing price and as agent of development, which provide unlimited liquidity for the government.

Inflation and Interest Rate in Indonesia

Percentage

Figure 2
Inflation and Interest rate in Indonesia
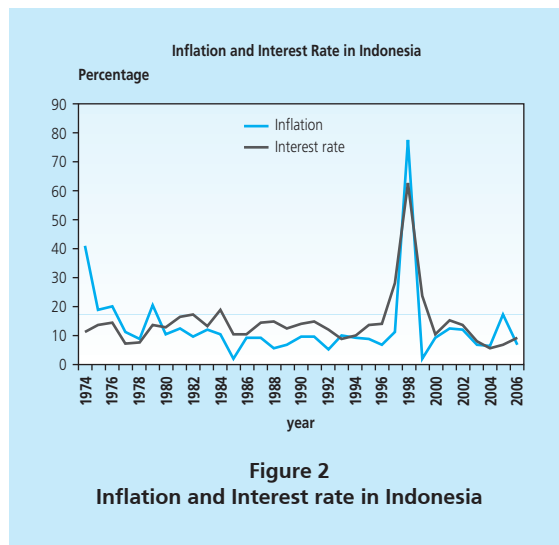
In 1980s the inflation performance was stable with inflation below 10 percentand interest rate of around 15 percent. This achievement was obtained through stabilization and rehabilitation program, followed by financial deregulation and the monetary program such as enabling conventional banks to set their own interest rate. In 1988, government issued a deregulation packet known as 'Pakto'88', providingeasier procedures to set up new bank and eventually lead to large increase number of banks.

Before 1999, there are several evident of the non-independency of Bank Indonesia. One of them is the weakening of Bank Indonesia's power when the government formed the monetary council, comprising the governor of the Bank of Indonesia, the minister of trade and the minister of finance (Raharjo 2002). This will restrict the flexibility of Bank Indonesia to formulate its own monetary policy, and also reflecting the non-independency on formulating its target. Within this framework, Bank Indonesia as the monetary authority was allowed to have various monetary policies; however the implemented policy is subject to government agreement(Bank Indonesian report, 1966-1984).

Another case was in October 1996 and April 1997, when the Chief Executive Officer (CEO) of BI advised the governing President Suharto to liquidate some banks, but refused (Aris Munandar 2004). The government argued this bank liquidation would create economic instability due to the start of election, and eventually Bank Indonesia gave dispensation to those banks to operate. One year ahead, 1997, the Asian financial crisis occurred.

Beside external factor, the source of economic crisis in 1997 is the government budget deficit financed by foreign debt. As part of the government, Bank Indonesia always signed every debt contract for the government (Sitorus 2007). The amount of debt (private and official loan) increased every year (seeTable 3), and when the Rupiah depreciated, Indonesia suffer

from a sudden increase of foreign debt. The effect of foreign debt to inflation is similar with the effect of moneyprinting. Theoretically, financing deficit through foreign debt will reinforce inflation in the long term, particularly under fixed exchange rate regime(Harkness, Uriarte 1985; Budina, 2001). Without independency, Bank Indonesia will not be able to control the government budget deficit.

Table 3 Composition of Indonesian Debt (US$ Billion)										
Year	1970	1980	1990	1992	1993	1994	1995	1996	1997	1998
Total	-	20.938	69.872	88.172	89.172	107.824	124.398	128.941	136.173	150.875
Official	2487	15021	47982	53664	57156	63926	65309	60016	55869	66944
Private	461	3142	10261	16281	14029	24441	33123	36694	44469	54728

Source: The World Bank, World debt table, Washington D. C, USA, 2000, (cited in Hafild (2000)

Trough law No 23/1999, BI is independent. Under this regulation, appoint and dismissal of central bank chief executive officer is decided by the discretion of central bank board of governor. Under this law, Bank Indonesia is prohibited to buy the government securities in the primary market to avoid an increase in the money supply. Moreover, this act also guarantee the target independency of Bank Indonesia; single objective of price stability.

Post this legal independence, the inflation rate decreased. The Bank of Indonesia exercised tight money policy and successfully reduce inflation rate from 77.63 percent in 1998 to 2.1 percent in 1999. Average of inflation was around 8 percent from 1999 to 2004. In 2005, the economy suffered from high inflation (17.11 percent), due to the oil price increase. This was the highest inflation rate during the post crisis period 1997/1998. In 2006 Bank Indonesia implemented Inflation Targeting Framework (ITF), and successfully reduced inflationclose to its target of 6 percent and the exchange rate was Rp 8500 per USD. Nevertheless, this level of inflation was still higher than other developing countries such as Malaysia and Thailand of only around 2 percent.

Many attempts had been made by Bank Indonesia to provide better policy conduct. First is switching the government spending from non-budgetary to budgetary side. Second is converting interest rate subsidy for liquidity credit into government budget (Djiwandono, 2001) and third is directly intervening the foreign exchange market to stabilize Rupiah. The latter is also exercised by Monetary Authority of Singapore (MAS) and Government of Singapore Investment Corporation (GSIC). The result is the appreciation of Rupiah (Achjar, 2001).

The second measure of central bank independency is the governor turnover. AS presented earlier, the coefficient of central bank turnover (TOR) is statistically insignificant, which contradict

to initial hypothesis, even has correct positive sign. Generally, the higher frequent of central bank governor turnover, the lower degree of independence and the higher inflation will be (Cukiermen, Webb and Neyapty, 1995). A positive correlation between TOR and inflation is because political instability affects the central bank instability as well, since the election of central bank's governor is affected by political transition. The indicator TOR is relatively stable before the crisis, 1997. The election cycle of 5 years for the central bank is similar with the cycle of government election. During the transition process (reformation, 1998-1999), the position of a central bank governor was major concern of political party; as when Suharto was replaced by B. J Habibie, J. Soedradjad Djiwandonowas also replaced by Syahril Sabirin (Sabirin 2008) at the same time.

Worth to mention that even the central bank independence exist by law, Bank Indonesia needs de-facto independence;the government intervention made by Abdurahman Wahid (the fourth president of Indonesia) to replace the elected Governor Shahril Sabirin in 2000 is one of the sample. Such intervention will lead to political instability and weakenthe Indonesian currency. The governing period of 5 years is too short the central bank to form long-term policies in order to achieve price stability (Panagiotidis, 2005). A possible option for Indonesia is to run the governor election in every 10 years as in Federal Reserve of United States, or every 7 years as Deutsche Bundesbank in Germany.

As presented on Table 2, the Engel Granger Error Correction model confirms the long-run relationship among inflation, exchange rate, money supply and the central bank independence. The speed adjustment coefficient is 0.37, showing a quite fast correction of inflation deviation to its long long-run equilibrium. As in standard model, the Engel Granger ECM also explains the legal CBI index inversely affect inflation while TOR is positive insignificant. The short-run change in both control variables are also significant in affecting inflation; a short run increase of money supply will increase inflation significantly, while short-run depreciation of Rupiah will raise inflation.

Even though the result of estimated model is different from common findings in developing country, but we can find similar result in Greece, where legal CBI is negatively and significantly correlated to inflation,(Panagiotidis, 2005). He also found that TOR is also positively correlated to inflation in lower significant level.

V. CONCLUSION

This research analyzes the relationship between the central bank independence (CBI) and inflation in Indonesia by using two indicators; legal CBI index and turnover of central bank governor (TOR). The conclusion of this paper is the central bank independencyinversely affects the inflation. The implication is straightforward for the Bank Indonesia to strengthen its independency to achieve low targeted inflation.

There are several limitations of this paper;first, it is important to internalize the Central Bank Independence Act No.23, 1999, directly into the model and find out how the implementation of this law affect the marginal effect of CBI on inflation; second, related to estimation technique, it is important to apply other method such as Wickens-Breusch model, which believed can work better.

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