

## THE DETERMINANT OF INFLATION IN INDONESIA: PARTIAL ADJUSTMENT MODEL APPROACH

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**Abstract:** Inflation is one of the economic issues that always being targeted by the government, particularly central bank because it could adversely influence the economy. For the past view years, the inflation targeting framework as the part of monetary policy has been successfully implemented where the interest rate is the operational target. In view of past investigations, there are fundamental factors that affect inflation, for example, interest rate, exchange rate, and money supply. This study aims to evaluate the impact of those factors on inflation both in the short and long run. The estimation uses monthly data from January 2013 to November 2017, which was obtained from Indonesian Banking Statistics. The use of Partial Adjustment Model illustrates how interest rates, exchange rate, and money supply negatively and significantly affect inflation on both short and long run. This regression result is consistent with the finding of previous studies which strengthen the evidence that the government should maintain the inflation rate through those variables.

**Keywords:** Inflation, Monetary Policy, PAM

**JEL Classification:** E31, E52, C22

### INTRODUCTION

Inflation is an economic problem which could affect the negative impact on a country economic. Thus, inflation is often target in government policy. High inflation will affect negatively the economy because it leads to such unrest condition, high unemployment, and slow economic growth. All in all, those will result in low economic growth. (Suparmoko, 1992). Theoretically, inflation is a condition in which the increasing price of goods and services continuously in a certain period. If the process doesn't occur at the same time but with the same percentage, it doesn't call as inflation (Nopirin, 1987).

Monetary authority published the monetary policy to anticipate the high inflation rate or to decide the macro policy. Monetary policy can be done by interest rate, open market policy, cash ratio, or foreign exchange policy (Mizaroh, 2014).

**Table 1. Inflation Rate in Indonesia from 2008-2016**

Year	Inflation Target	Realization
2013	4.5%	8.38%
2014	4.5%	8.36%
2015	4.0%	3.35%
2016	4.0%	3.02%
2017	4.0%	3.30%

Source: Bureau Labour of Statistics, 2013

Based on table 1, the growth of the inflation rate can be seen to reach the highest rate in 2013 with 8,38%, much below the government target at 4.5%. The main reason was that the fuel price which increased to Rp6.500/litre for premium and Rp5.500/litre for solar. It affects the inflation for 1,17%. The increasing price of subsidized fuel affects to the other prices such as transportation within cities. The transportation gives 1,75%, red onion 0,38%, electricity 0,38%, red pepper 1,31%, fish 0,3%, rice 0,2%, cigarettes 0,19%, airfare 0,19%, workers 0,16%, home assistant wage 0,1% (LPI, 2014).

In 2014, the inflation rate is 8,38%. This was because of the pressure of the price from the previous year. In 2015 onward the inflation rate can be handled below the government target.

Central Bank of Indonesia as the monetary authority that holds the monetary policy to handle the national economy is the one that decides money flow with interest rate. Interest rate affects the individual decision on deciding either to spend or to save money in deposit (Suhaedi, 2000).

Externally, when rupiah appreciates toward USD can be caused by the government external debt or private external debt. In result, the exported goods become much cheaper. The cheap price effects the increasing volume of goods. It is related to the demand law when the price is low, the demand will increase. The increasing output can reduce the inflation rate and decrease the price. Hendrawan (2016) and Perlambang (2012) state that exchange rate shows the balance between supply and demand toward foreign exchange rate. Rupiah appreciation reflects the society demand on rupiah and the increasing demand on forex as an international currency. Rupiah depreciation makes imported goods become much more expensive and exported goods become much cheaper. This condition needs to look at because it leads to inflation.

Generally, inflation gives some social price bear by society. First, the income distribution will get affected. A low class society with fixed income will bear the condition with their low purchasing power. On the other hand, upper-middle-class society will protect their saving and deposit so their purchasing power still stays the same. Both inflations give a negative impact on the economy.

High inflation effects the instability of economic, high unemployment, slow economic growth on the country. On this research, we would explain the 3-month-deposit effect on the conventional bank, exchange rate, and money supply toward inflation in Indonesia from January 2013-November 2017.

## RESEARCH METHOD

### Type and Data Source

The type of data used in this research is secondary monthly data period January 2013 – November 2017, including:

1. Inflation period January 2013 – November 2017 taken from Indonesia Bureau of Statistics on percentage.
2. Interest rate represented by 3-month-deposit in conventional bank period January 2013 – November 2017 from Statistic of Indonesian Banking on percentage.
3. Rupiah exchange rate on USD from January 2013 – November 2017 in Rupiah.
4. Money supply from January 2013 – November 2017 taken from Indonesian Financial Statistic (SEKI).

### Statistical Test

#### Significance Test

The hypothesis that will be tested in this research is related to the significance of independent variables (deposit interest rate, exchange rate, and money supply) toward the dependent variable (inflation) partially or simultaneously.

#### 1. F Test

F Test aims to know whether all independent variables tested significantly affected the dependent variable. The test is done through ANOVA test with 95% degree, with the requirements:

- a. If  $F_{test} < F_{table}$ ,  $H_0$  is not rejected
- b. If  $F_{test} >> F_{table}$ ,  $H_0$  is rejected

#### 2. t Test

Partial hypothesis test aims to know the affect and significance of each independent variable to the dependent variable. This done through t-test with 95% degree, with the requirement:

- a.  $H_0$  : if  $p\text{-value} > 0,05$ ,  $H_0$  is not rejected
- b.  $H_0$  : if  $p\text{-value} < 0,05$ ,  $H_0$  is rejected

### Adjusted R Square

The closer it gets to 0, the less impact of independent variables might give to the dependent variable. However, if it closer to 1, the higher impact of independent variables might give to the dependent variable.

### Autocorrelation Test

The test aims whether there is a disturbing correlation on the multiple linear regressions model on t period with previous t period. If there is a problem, we called it autocorrelation. We can go through Durbin Watson (DW Test).

### Heteroskedasticity Test

This classic test aims to see whether on regression model exist the inconsistency variances from one residue to the other. If there is a problem then we call it as heteroskedasticity. A good model should never be having heteroskedasticity. We can see from scatterplot from the expected value of Y with residue value where the predictions are scattered. Another way is to do a Part test by comparing t-test and t table. If  $t\text{-test} < t\text{-table}$  then there will be no heteroskedasticity.

### Multicollinearity Test

This aims to know whether there is a correlation among independent variables. A good model should never correlate among each other (Ghozali, 2009). We can go through a variance factor (VIF) test. The prevalent cut off value is used to show multicollinearity is tolerance value with  $\leq 0.10$  or the same with  $VIF \geq 10$  (Ghozali, 2009)

### Analysis Method

In analyzing interest rate, exchange rate, and money supply toward inflation in Indonesia, we will use Partial Adjustment Model estimation. It is one of the simple models used to estimate the relationship between the independent and dependent variable with lag (Gujarati, 1995).

This model assumes the expected dependent variable in t period ( $Y_t^*$ ) depends on actual independent variables. Written as below:

$$INF = f(SB, NT, JUB) \dots\dots\dots 3.1$$

The short-term PAM estimation:

$$INF_t = b_0 + b_1SB_t + b_2NT_t + b_3JUB_t + b_4Y_{t-1} + e \dots\dots\dots 3.2$$

The long-term PAM estimation:

$$\begin{aligned} \text{Constant} &= b_0 / (1-b_4) \\ \text{Coefficient SB} &= b_1 / (1-b_4) \\ \text{Coefficient NT} &= b_2 / (1-b_4) \\ \text{Coefficient JUB} &= b_3 / (1-b_4) \end{aligned}$$

Notes:

- INF = Inflation (%)
- SB = Interest rate (%)
- NT = Rupiah Exchange Rate (on Natural Log)
- JUB = Money Supply M1 (on Natural Log)
- e = Disturbance Variable

## RESULT AND DISCUSSION

Interest rate fluctuation in Indonesia can be caused by a number of factors, thus it is hard to control inflation. The government should be aware of the initial factors that can form inflation. In Indonesia, inflation is not only a short-term inflation, as said on Keynes's theory, but also it is a long-term condition (Baasir, 2003). Inflation rate can be reduced or even can be prevented. To reach the inflation rate below government target, all parties need to work all together either from the Central Bank or the private sector.

Monetary policy is one of the policies can be done by the government. It aims to balance the internal balance and external balance. Internal balance can be shown by high economic growth, price stability, and equality development. While external balance can be shown by the balance of payment, high employment rate, and balance of international payment (Insukindro, 1993).

Central Bank of Indonesia using Monetary policy to control Rupiah value as the repre-

sentative of the stable inflation rate. The main instrument used is BI rate to influence the economic activities with the goal of the inflation rate. To reach one certain inflation rate, the interest rate policy should go through the long transmission.

Based on graphic 1, we can see that target inflation can be reached only 3 times. The inflation trend fluctuates because several inflation rates show bad economic activity. The inflation realization can be seen in Figure 1.

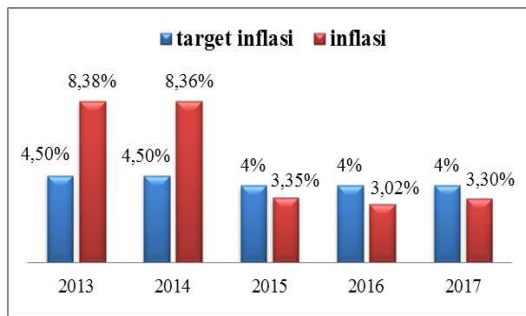


Figure 1. Inflation Target and Realization

Source: Indonesia Banking Statistics 2013-2017

The result from Partial Adjustment Model can be seen at table 2.

Table 2. The result of Regression Analysis

Variabel	Coefficient	t-statistic	Probabilities
C	4.956845	2.302072	0.0253
SB	-0.214892	-2.398663	0.0200
NT	-0.801375	-2.547670	0.0138
JUB	-0.712997	-2.580804	0.0127
Y(t-1)	0.969124	19.01613	0.0000
<i>Adjusted-Squared</i>			0.869362
<b>F-statistic</b>			95.82999
<b>Probabilities (F-statistic)</b>			0.000000

Source: Attachment 1

Based on table 2, the short term PAM model equation is at the below:

$$Y = 4.9568 - 0.2148SB - 0.8013NT - 0.7129JUB + 0.9691Y(t-1)$$

Thus, the long term equation is :

$$Y = 16.475 - 6.9614SB - 25.9320NT - 23.0711JUB$$

## Statistic Test

### t-Test and F-Test

t-test aims to know whether independent variables partially has significant impact to dependent variable. T-test by using  $\alpha=5\%$ ,  $df=n-k= 59-4 = 55$  is 1.671. If t-statistic < t-table  $H_0$  is accepted, and if t-statistic > t-table  $H_0$  is rejected.

F-test aims to know whether generally the model can be trusted with certain degree. F-test is used to simultaneously know the affect of interest rate, exchange rate and money supply on inflation. Because F-test is  $(95.82999) > F\text{-table}$  (2.76) and significancy value  $0.000000 < 0.05$ , thus  $H_0$  is rejected and  $H_a$  is accepted, so all variables are affected inflation.

### Test on Adjusted R<sup>2</sup> Coefficient

$R^2 = 0.869362$  or 86% means the fluctuation on inflation in Indonesia can be described by interest rate, exchange rate, and money supply. The rest of 14% can be described by other factors not in the model.

### Classical Assumption Test

Classical assumption test aims to know the problem of autocorrelation, heterokedasticity or multicollinearity in the model. Because if the model can't pass the test, f-test and t-test is invalid and the final result is rejected.

### Normality Test

The test is done to know the residu from the estimation is normally distributed. Based on regression result, the Jarque\_Bere probability value is  $0.10 > \text{probabilitas statistik}$  ( $\alpha = 5\%$ ), so it is normally distributed

Table 3. Normality Test

Jarque_Bere Value	4.485210
Probability	0.106182

Source: Attachment 2

### Autocorrelation Test

Autocorrelation test is the comparison between the value of Obs\*R-squared with the value of Chi Square table. If Obs\*R-squared < value of Chi Square table, there is no autocorrelation existed and vice versa. According to the estimation result, *Obs\*R-squared* 5.192133 < value of Chi Square table 7.815 so there is no autocorrelation. The result is on the table 4.

**Table 4. Langrange Multiplier Test (LM)**

Obs*R-squared	5.192133
Probability	0.0746

Source: Attachment 3

### Heteroskedastisity Test

Table 5 shows the value of Obs\*R-squared and White Heteroskedasticity is 0.782230 and Chi Square table df ( $k-1 = 4-1=3$ ) with  $\alpha=5\%$  is 7.815. If *Obs\*R-squared* is 0.884633 < value of *Chi Square tabel* 7,815 so there is no heteroskedasticity exist on the model. See the result on table 5.

**Table 5. White Heteroskedasticity Test**

Obs*R-squared	0.884633
Probability	0.9268

Source : Attachment 4

### Linearity Test

Linearity test can be done to detect the empirical model whether a new variable applies is relevant with the empirical model. Based on the result  $F_{test}$  is 2.07 < value of  $F_{table}$  is 2.76. So the empirical model is a linear function.

$$\begin{aligned} F_{-table} &= (\alpha= 0.05 : k-1; n - k) \\ &= (\alpha= 0.05 : 4-1; 59 - 4) \\ &= (\alpha= 0.05 : 3; 55) (2.76). \end{aligned}$$

**Tabel 6. Linearity Test**

F-Statistik	2.073192
Probability	0.1363

Source : Attachment 5

### Multicollinearity Test

The test result is on the below:

**Table 7. Multicollinearity Test**

<b>R<sup>2</sup> INF</b>	0,8785
<b>R<sup>1</sup> SB</b>	0,0663
<b>R<sup>2</sup> NT</b>	0,0616
<b>R<sup>3</sup> JUB</b>	0,0183

Source: Attachment 6

Table 8 shows R-Squared from the PAM estimation> R-Squared value of interest rate, exchange rate and money supply so there is no multicollinearity exists.

Based on the hypothesis test, we can conclude that interest rate has negative affect on inflation. The regression coefficient in short term is 0.21. When interest rate increases by 1 %, inflation decreases by 0.21% in short term. In long term, regression coefficient is -6.95%. When interest increases by 1%, inflation decreases by 6.95%. This is linked with the hypothesis because during January 2013 - November 2017, the interest rate is one of the main reasons why people save or deposit their money in bank. This is in tune with the result from the previous research by Rahmawati (2011).

Exchange rate has negative affect on inflation. The regression coefficient is -0.80. It means, if exchange rate increases by 1%, inflation will decrease to 0.80% in short term. While in long term, the regression coefficient is -25.93%. In other words, when exchange rate increases by 1%, the inflation rate will decrease by 25.93%. On January 2013-November 2017, when rupiah depreciates in USD, so the imported goods become much more expensive and exported goods become much cheaper. It is in the contrary with the research from Nugroho, et.al (2012) states that exchange rate does not influence on inflation.

This matches with the research from Fadel (2013) proves that exchange rate influence inflation rate positively during 1981–2011. The depreciation of Rupiah makes inflation rate higher, and vice versa. This implicates the theory from parity purchasing power when domestic currency is related positively with the domestic inflation and foreign currency. So, the government should proactively make strategic decision to strengthen its currency to reduce inflation.

Money supply has negative relationship on inflation. The regression coefficient in short term is -0.71% .This shows when money supply increases by 1%, inflation will decrease by 0.71%. In long term, however, the regression coefficient is -23.07%. This is not what the hypothesis stated in first place. This can be caused money supply that hold by society is not only for consumptive buying but also for productive buying. The increasing money supply leads the real sector to produce goods and services exceeding the demand so can reduce the price. This is the same with the research by Nugroho, et al. (2012) where high money supply will not sufficient enough to influence inflation.

## CONCLUSION

Based on the analysis from the previous chapters, the effect of interest rate, exchange rate and money supply in Indonesia from 2013 – 2017 can be described below :

1. Interest rate in short and long term has negative affect on inflation. The high interest rate will be responded by the society by saving or depositing their money in bank.
2. Exchange rate in short and long term has negative affect on inflation. This is because the exchange rate depreciation cause high production cost.
3. Money supply in short and long term has negative affect on inflation. This is because people tend to buy on productive goods.

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## ATTACHMENT

### Attachment 1

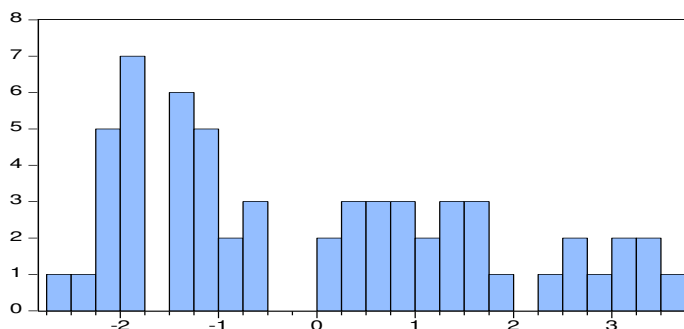
#### Partial Adjustment Model (PAM)

Dependent Variable: INF  
 Method: Least Squares  
 Date: 18/03/18 Time: 12:17  
 Sample (adjusted): 2013M02 2017M11  
 Included observations: 58 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.956845	2.153210	2.302072	0.0253
SB	-0.214892	0.089588	-2.398663	0.0200
NT	-0.801375	0.314552	-2.547670	0.0138
JUB	-0.712997	0.276269	-2.580804	0.0127
INF(-1)	0.969124	0.050963	19.01613	0.0000
R-squared	0.878530	Mean dependent var		5.464138
Adjusted R-squared	0.869362	S.D. dependent var		1.851307
S.E. of regression	0.669134	Akaike info criterion		2.116599
Sum squared resid	23.73026	Schwarz criterion		2.294223
Log likelihood	-56.38136	Hannan-Quinn criter.		2.185787
F-statistic	95.82999	Durbin-Watson stat		1.456726
Prob(F-statistic)	0.000000			

### Attachment 2

#### Normality Test



Series: Residuals Sample 2013M01 2017M11 Observations 59	
Mean	-2.52e-15
Median	-0.648934
Maximum	3.537607
Minimum	-2.631770
Std. Dev.	1.793471
Skewness	0.415367
Kurtosis	1.934931
Jarque-Bera Probability	4.485210 0.106182

**Attachment 3****Autocorrelation Test**

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.507190	Prob. F(2,51)	0.0915
Obs*R-squared	5.192133	Prob. Chi-Square(2)	0.0746

Test Equation:

Dependent Variable: RESID

Method: Least Squares

Date: 18/03/18 Time: 12:20

Sample: 2013M02 2017M11

Included observations: 58

Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.914678	2.190552	0.417556	0.6780
SB	0.015121	0.087624	0.172571	0.8637
NT	0.058795	0.307102	0.191451	0.8489
JUB	-0.100064	0.279145	-0.358467	0.7215
INF(-1)	-0.036262	0.057155	-0.634444	0.5286
RESID(-1)	0.329759	0.147626	2.233745	0.0299
RESID(-2)	-0.060107	0.150858	-0.398432	0.6920
R-squared	0.089520	Mean dependent var		-7.12E-16
Adjusted R-squared	-0.017596	S.D. dependent var		0.645229
S.E. of regression	0.650881	Akaike info criterion		2.091781
Sum squared resid	21.60593	Schwarz criterion		2.340456
Log likelihood	-53.66166	Hannan-Quinn criter.		2.188645
F-statistic	0.835730	Durbin-Watson stat		2.011340
Prob(F-statistic)	0.548096			

**Attachment 4****Heteroskedasticity Test**

Heteroskedasticity Test: White

F-statistic	0.205223	Prob. F(4,53)	0.9344
Obs*R-squared	0.884633	Prob. Chi-Square(4)	0.9268
Scaled explained SS	2.052931	Prob. Chi-Square(4)	0.7260

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 18/03/18 Time: 12:22

Sample: 2013M02 2017M11

Included observations: 58

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.614740	1.618741	0.997528	0.3230
SB^2	0.001529	0.008276	0.184748	0.8541
NT^2	-0.026698	0.146754	-0.181923	0.8563
JUB^2	-0.022800	0.027366	-0.833149	0.4085
INF(-1)^2	-0.001028	0.006674	-0.154065	0.8781
R-squared	0.015252	Mean dependent var		0.409142
Adjusted R-squared	-0.059068	S.D. dependent var		0.973024
S.E. of regression	1.001350	Akaike info criterion		2.922837
Sum squared resid	53.14315	Schwarz criterion		3.100461
Log likelihood	-79.76228	Hannan-Quinn criter.		2.992025
F-statistic	0.205223	Durbin-Watson stat		1.596788
Prob(F-statistic)	0.934408			



**Attachment 5****Linearity Test**

Ramsey RESET Test:

<b>F-statistic</b>	<b>2.073192</b>	<b>Prob. F(2,51)</b>	<b>0.1363</b>
Log likelihood ratio	4.533602	Prob. Chi-Square(2)	0.1036

Test Equation:

Dependent Variable: INF

Method: Least Squares

Date: 25/05/18 Time: 11:46

Sample: 2013M02 2017M11

Included observations: 58

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.036025	6.791992	-0.594233	0.5550
SB	0.361528	0.456854	0.791342	0.4324
NT	1.666435	1.869836	0.891220	0.3770
JUB	1.404019	1.586489	0.884985	0.3803
INF(-1)	-2.008959	2.160715	-0.929766	0.3569
FITTED^2	0.590539	0.390656	1.511662	0.1368
FITTED^3	-0.035530	0.021838	-1.626982	0.1099

R-squared	0.887663	Mean dependent var	5.464138
Adjusted R-squared	0.874447	S.D. dependent var	1.851307
S.E. of regression	0.655983	Akaike info criterion	2.107399
Sum squared resid	21.94601	Schwarz criterion	2.356073
Log likelihood	-54.11456	Hannan-Quinn criter.	2.204262
F-statistic	67.16500	Durbin-Watson stat	1.272383
Prob(F-statistic)	0.000000		

**Attachment 6****Multicolleniarity Test  
Multicolleniarity Test SB**

Dependent Variable: SB

Method: Least Squares

Date: 18/03/18 Time: 12:24

Sample (adjusted): 2013M02 2017M11

Included observations: 58 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.185508	3.121091	2.302243	0.0252
NT	-0.406991	0.474577	-0.857586	0.3949
JUB	-0.071178	0.419535	-0.169658	0.8659
INF(-1)	0.140837	0.075002	1.877771	0.0658

R-squared	0.066378	Mean dependent var	8.472931
Adjusted R-squared	0.014510	S.D. dependent var	1.023856
S.E. of regression	1.016401	Akaike info criterion	2.936884
Sum squared resid	55.78579	Schwarz criterion	3.078984
Log likelihood	-81.16964	Hannan-Quinn criter.	2.992235
F-statistic	1.279749	Durbin-Watson stat	0.268492
Prob(F-statistic)	0.290611		

### Multicolleniarity Test NT

Dependent Variable: NT

Method: Least Squares

Date: 18/03/18 Time: 12:25

Sample (adjusted): 2013M02 2017M11

Included observations: 58 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.717013	0.901750	-1.904091	0.0622
SB	-0.033014	0.038497	-0.857586	0.3949
JUB	-0.096614	0.118795	-0.813281	0.4196
INF(-1)	0.033725	0.021565	1.563868	0.1237
R-squared	0.061676	Mean dependent var		-2.486724
Adjusted R-squared	0.009547	S.D. dependent var		0.290875
S.E. of regression	0.289483	Akaike info criterion		0.425034
Sum squared resid	4.525233	Schwarz criterion		0.567134
Log likelihood	-8.325992	Hannan-Quinn criter.		0.480385
F-statistic	1.183143	Durbin-Watson stat		1.790620
Prob(F-statistic)	0.324796			

### Multicolleniarity Test Money Supply

Dependent Variable: JUB

Method: Least Squares

Date: 18/03/18 Time: 12:26

Sample (adjusted): 2013M02 2017M11

Included observations: 58 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.788260	0.521112	13.02648	0.0000
SB	-0.007485	0.044117	-0.169658	0.8659
NT	-0.125245	0.154000	-0.813281	0.4196
INF(-1)	-0.009067	0.025073	-0.361608	0.7191
R-squared	0.018316	Mean dependent var		6.986552
Adjusted R-squared	-0.036222	S.D. dependent var		0.323785
S.E. of regression	0.329597	Akaike info criterion		0.684583
Sum squared resid	5.866262	Schwarz criterion		0.826682
Log likelihood	-15.85290	Hannan-Quinn criter.		0.739933
F-statistic	0.335831	Durbin-Watson stat		2.076906
Prob(F-statistic)	0.799469			