



## Relationship between National Product and Malaysian Government Development Expenditure: Wagner's Law Validity Application

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### Abstract

The objective of the study is to see how far Wagner's law validity can be applied in the Malaysian government development expenditure. According to Wagner's law, fundamental economic growth is a determinant to the public sector growth. The public sector is said to be able to grow at a very high rate when compared to the product growth (income). Accordingly, it can be said that government expenditure behaves elastic with the national product and the interpretation of Wagner's law can provide important policy implications. Using a method known as the Autoregressive Distributed Lag model (ARDL) and the border test (bound test) introduced by Pesaran *et al.* (2001), this study found that four out of five version Wagner basic laws show an interrelationship between the national product and government development expenditure. The long-term analysis also showed that national product has a positive relationship and is significant in influencing government development expenditure. Therefore, it can be summarized that this Wagner's law is still relevant to be applied in Malaysia.

**Keywords:** Wagner's law, ARDL, Government development expenditure

### 1. Introduction

Strong economic growth is of paramount importance to a country to increase its people's standard of living and to ensure stability in the country. Economic growth also can be used as a gauge to evaluate the performance of the economic development of a country. The economic growth of a nation has to face a state of increase or decrease. Sometimes economic growth rises rapidly until it causes an increase in prices and at other times it experiences slow growth and causes a decline in prices which are below the previous level. To determine the economic growth rate achieved by a country, it is necessary to take into account the real national income, namely the Real Gross Domestic Product (RGDP) or the Real Gross National Product (RGNP). In this calculation, the national income and its components are stated at a fixed price which is the basic price of goods in the year.

Economic growth is closely related to the economic situation in the long term and reflects the occurrence of expansion in economy because of government expenditure. Rapid economic growth would be vital to increase income and job opportunities for the people. To enable economic growth to be maintained at a high-level, one of the important factors which need to be enhanced is government expenditure. As such, government expenditure is of paramount importance for the economic growth of a country and becomes an important component to restore the economy.

Government expenditure is one of the important tools which contribute to the economic growth of a nation including Malaysian. Government expenditure includes the allocation provided by the government to carry out various government projects with a desire to enhance the growth of the country's economy. Most of the government expenditures are funded by the tax revenue collected by then government.

Furthermore, development expenditure is an investment or capital to carry out economic development projects by the government which can enhance the socioeconomic status and promote economic growth. This development expenditure is lower than management expenditure because development expenditure is a long-term investment. This expenditure covers the capital expenditure on economic sectors such as social services, security and public administration.

Malaysia's economy experienced rapid growth until the occurrence of the financial crisis of 1997 and 11 September 2001 which somehow influenced the growth of the country's economy. These show that, any event which occurs in the world can provide a direct impact on the achievement of economic growth of a country. Hence, every country in this world should always be prepared to face various effects, which may arise due to some events, by planning various economic policies to overcome the effects.

Government expenditure is an important component in influencing the growth of the Malaysian economy. It must be handled systematically and wisely so that the expenditure which has been made is effective. However, there is a problem in government expenditure and one of them is the occurrence of haphazard leakage and non-systematic expenditure which could affect the government's financial position. The Malaysian budget is in deficit. If the size of the deficit is large and cannot be closed again in an average period, then it leads to more problems.

The study on government expenditure determination is began the 1880s. One of the famous theories which are related to economic growth and its relationship with government expenditure is Wagner's law (Wagner 1983, 1890). According the basic idea of Wagner's law, economic growth is the fundamental determinant to a growth of public sector. Therefore, the public sector is claimed to grow at a very fast rate when compared to the national product (income). If Wagner's law is applied in a country, the government in that country should increase the fiscal enlargement policy in order to augment of the economy. This law shows that the rate of government expenditure increases more rapidly than the growth of the economy. In connection with that, Wagner's law Version gives important policy implications. For instance, in recession time or in a financial crisis, fiscal enlargement policy should be practised.

This study contains five parts. The second part is the literature review of the explanation of journals which are related to government expenditures and economic expansion. The third part is about research methodology which consists of a theoretical framework, a hypothesis statement, the econometric model usage explanation, the research hypothesis, and the methodology in making decisions. The fourth part is an explanation of the result analysis on the effects of government expenditures towards economic augmentation and the last part is the conclusion of this research.

## 2. Literature Review

This part will discuss the studies that were raised by earlier investigators to prove that there is a connection between economic growth and the country's expenditure. Chang *et al.* (2004) examined Wagner's law in ten countries using the co-integration testing and the error correction model (ECM). They found that Wagner's law gave strong empirical support to advanced industrial countries such as South Korea, Taiwan, Japan, the United Kingdom (UK) and the United States of America (USA). The study also found that there was no co-integration relationship between economic growth and the country's expenditure for countries such as Australia, Canada, New Zealand, South Africa and Thailand.

Bose *et al.* (2003) stated that government expenditure for educational purposes is the essential element for economic prosperity. Limited economic resources are preferred for the purposes of the education sector. Expenditure during aggregate does not affect the growth, but capital aggregate expenditure offers a positive growth. Tax yield gives a negative effect on the growth whereas an increase in the deficit gives the country a significant negative effect. Financial increase will moderate the positive effect of education or outgoing capital.

Glomm (1997) examined the influence of productive government expenditure to the long-term economic growth with a focus on two types of government expenditure, namely the entry as an input into the expenditure function for the output end and the entry as an input in technology investment. He explained that other government expenditure can also give an impression of long-term growth. For example, expenditure on health can improve human life span and has a significant effect on private capital collection and cause growth.

Dawrick (1996) explained that a strong positive relationship between the two growth rates is influenced by the increased demand for public service which causes the validity of economic growth. He states that a negative relationship between cross-country and the actual size of the government and economic growth is more to show proportionate relationship compared to direct cause-effects relationships. It may react to the need of the public sector in the larger economy which is described by a clear market failure in the provision of goods for the general public. Negative relationship across the country between is economic growth and the government size is lost when the government service cost is controlled and the manipulation of the time series data panel to take into account the specific differences of the country which are not observed in the rate of growth.

According to Heitger (2001) if government expenditure is used to provide common goods, such as roads, it will give the impression of positive economic growth to the country and the negative effects of economic growth will exist if the government expenditure is used to provide private goods in the country. Faris (2002) used the dynamic model in explaining the relationship between government expenditure and economic growth. It proved that a positive relationship existed between them.

Dalamagas (2000) described that many economic development experts have been interested in the relationship between economic growth and government expenditure. He said the government expenditure was one of the tools that could

affect the GDP in a country. He explained that government activity will give a positive impression or vice versa on the economic growth of the country. This explains that through use or government expenditure in general public production, it can increase economic growth.

Kweka and Morrissery (2000) stated that government expenditure can be divided into two types which are a production that can lead to economic growth and non-production which can prevent economic growth. They had used time series data to study the effect of government expenditure on economic growth. A small sized government affect the input productivity capital where the situation can improve the economic growth.

### 3. Methodology and Data

Classic estimation method is based on the assumption that the mean and the variables are constant and free. In other words, the standard estimation method assumes that variables are static. Nevertheless previous studies failed to deal with the existence of non-stationary variables in a serial time data which are used in statistical test are not valid. In this study, we will apply co-integration method ARDL in proving existence and prove relevant Wagner's law is applied by the Malaysian government in deciding its development expenditure growth in keeping with growth in economic growth augmentation.

According Engle and Granger (1987), that two serial time data were not stationary, but the linear combination between the two of them was stationary, then the two of the time series are co-integrated. In the context of Wagner law, if co-integration between government development economic growth and expenditure existed, then Wagner's law is more suitable to be tested in error correction context where it will include short-term dynamic coordination which makes a correction on the existence of deviation in a long-run equilibrium and this can be shown by the Error Correction Mechanism (ECM).

Wagner's law states that when incomes increase per capita then part of the government expenditure on gross national product will increase. Generally, we adapted five different basic versions of Wagner's law as follows:

Version 1 - Peacock-Wiseman "traditional" -  $G = f(Y)$

Version 2 - Goffman -  $G = f(Y/N)$

Version 3 - Musgrave -  $G/Y = f(Y_R/N)$

Version 4 - Gupta/Michos -  $G/N = f(Y/N)$

Version 5 - Peacock-Wiseman "share" -  $G/Y = f(Y)$

where  $G$  is total government expenditure,  $Y$  is Gross Domestic Product (GDP),  $Y_R$  is Real Gross Domestic Product (RGDP), and  $N$  is total population size.

The first version was formed by Peacock and Wiseman (1961) and Goffman and Mahar (1971). The second version was suggested by Goffman (1968) and Mann (1980). The third version was used by Musgrave (1969), Murthy (1993), and Ram (1987). Gupta (1967) and Michos (1975) took into account the fourth version and the fifth version was nominated and tested by Mann (1980). All the above versions were formed to test Wagner's law.

We will use all five of Wagner basic is law versions to test how far Wagner's law can be applied in the Malaysian government's. The versions of Wagner's law are indicated by equation below:

$$1 \quad \text{Peacock-Wiseman "traditional"} \quad \ln G_t = \alpha_0 + \alpha_1 \ln Y_t + \varepsilon_t \quad (1)$$

$$2 \quad \text{Goffman} \quad \ln G_t = \alpha_0 + \alpha_1 \ln Y_t / N_t + \varepsilon_t \quad (2)$$

$$3 \quad \text{Musgrave} \quad \ln G_t / Y_t = \alpha_0 + \alpha_1 \ln Y_{R_t} + \varepsilon_t \quad (3)$$

$$4 \quad \text{Gupta/Michos} \quad \ln G_t / N_t = \alpha_0 + \alpha_1 \ln Y_t / N_t + \varepsilon_t \quad (4)$$

$$5 \quad \text{Peacock-Wiseman "share" Version} \quad \ln G_t / Y_t = \alpha_0 + \alpha_1 \ln Y_t + \varepsilon_t \quad (5)$$

For the fives versions above,  $G_t$  refers to the government development expenditure,  $Y_t$  refers to gross domestic product,  $Y_{R_t}$  refers to real gross domestic product, whereas  $Y_t / N_t$  refers to gross domestic product per residential population,  $G_t / Y_t$  refers to the government development expenditure per gross domestic product, and  $G_t / N_t$  refers to government development expenditure per residential population.  $\alpha_0$  and  $\alpha_1$  refer to coefficient estimates and  $\varepsilon_t$  is the random error. Coefficient  $\alpha_1$  can be valued positive or negative and depends on the phase of the economic development of the country. If the country is in early development and the government is role would be vital, then coefficient  $\alpha_1$  would be worth positive, while if the country achieves a fairly high production-level with the significant role of the private sector in economy, then coefficient  $\alpha_1$  would be worth negative.

Equations 1 to 5 as mentioned above clearly show that government development expenditure influences Gross Domestic Product (GDP). This situation demonstrates a closed economy where the external elements are considered as having no effect on the elasticity of government development expenditure.

**ARDL Co-integration version**

The versions in this study will be estimated by using the co-integration border test procedure (Autoregressive Distributed Lag, ARDL) which was introduced by Pesaran and Shin (1995) and Perasan, *et al.* (2001) for analysis purposes by long-term empirical relationship and dynamic interaction between the variable studied. To use the co-integration technique, we need to determine the co-integration rule for each variable. However, as stated in the previous research, different tests will give different outcomes of decision and they depend on pre-test unit cause. This ARDL procedure is applied because of three reasons. First, the border testing procedure is relatively easy. This is different with from various variation co-integration techniques such as Johansen and Juselius (1990) where co-integration relationship estimates the use of ordinary least square (OLS) when rank lapse for model is upheld. Second, the border testing procedure does not require a unit root pre-test for variables in studies such as that of Johansen. This test may be carried out whether regression in the model is I(0), I(1), or it is a jointly co-integrated. We calculated Wald's test (statistic-F) to see the long-term relationship between the variables. Wald's test can be done with restrictions on long-term coefficient expectation. Third, this test is relatively more efficient for miniaturized data sample such as for this case study. Nevertheless, no border testing procedure can be done if the serial is I(2).

According to Pesaran *et al.* (2001), this study applies border testing procedure through a long-term model equation (1 - 5) as a general model vector auto regression (VAR) for rank p in z.

$$z_t = c_c + \beta t + \sum_{i=1}^p \phi z_{t-i} + \varepsilon_t \quad t = 1, 2, 3, \dots, T \quad (6)$$

Referring to vector (k+1) of intercept and vector (k+1) coefficient trend, Pesaran *et al.* (2001) the issued a mechanism vector error correction model (VECM) based on similarity (6):

$$\Delta z_t = c_c + \beta t + \Pi z_{t-1} + \sum_{i=1}^p \Gamma z_{t-i} + \varepsilon_t \quad t = 1, 2, 3, \dots, T \quad (7)$$

Where (k+1) x (k+1) is a matrix for  $\Pi = I_{k+1} + \sum \Psi_i$  and  $\Gamma = \sum \Psi_j$ ,  $i = 1, 2, \dots, p-1$  which contain long-term coefficient and VECM's coefficient.  $z_t$  refers to vector variables  $y_t^1$  and  $x_t$  respectively.  $y_t$  refers to dependent variable I(1), which is  $G_t$  (or  $G/Y_t, G/N_t$ ) and  $x_t = Y_t$  (or  $Y/N_t, Y_{Rt}$ ) is a matrix vector of 'power' regression I(0) and I(1) has identified similar (*identical*) many variation and scatter free (i.i.d) zero mean vector error  $\varepsilon_t$  ( $\varepsilon_{1t}, \varepsilon_{2t}$ ), and homoscedastic process.

With an assumption of long-term unique relationship between variables, VECM's position (7) will become:

$$\Delta y_t = c_{y0} + \beta t + \delta_{yy} y_{t-1} + \delta_{xx} x_{t-1} + \sum_{i=1}^{p-1} \lambda \Delta y_{t-i} + \sum_{i=0}^p \xi \Delta x_{t-i} + \varepsilon_{yt} \quad t = 1, 2, 3, \dots, T \quad (8)$$

By using assumptions made by Pesaran *et al.* (2001) in Case III (unlimited intercept with no trend) and imposing the restriction of  $\lambda_{yx} = 0, \mu \neq 0$ , the interrelationship between dependent variable and independent variables in Equation (1) to Equation (5) are as follows.

$$\ln G_t = \beta_0 + \beta_1 \ln G_{t-1} + \beta_2 \ln Y_{t-1} + \beta_3, i \sum_{i=1}^p \Delta \ln G_{t-i} + \beta_{4,i} \sum_{i=1}^{q_1} \Delta \ln Y_{t-i} + \varepsilon_t \quad (9)$$

$$\ln G_t = \beta_0 + \beta_1 \ln G_{t-1} + \beta_2 \ln Y / N_{t-1} + \beta_3, i \sum_{i=1}^p \Delta \ln G_{t-i} + \beta_{4,i} \sum_{i=1}^{q_1} \Delta \ln Y / N_{t-i} + \varepsilon_t \quad (10)$$

$$\ln G / Y_t = \beta_0 + \beta_1 \ln G / Y_{t-1} + \beta_2 \ln Y_{Rt-1} + \beta_3, i \sum_{i=1}^p \Delta \ln G / Y_{t-i} + \beta_{4,i} \sum_{i=1}^{q_1} \Delta \ln Y_{Rt-i} + \varepsilon_t \quad (11)$$

$$\ln G / N_t = \beta_0 + \beta_1 \ln G / N_{t-1} + \beta_2 \ln Y / N_{t-1} + \beta_3, i \sum_{i=1}^p \Delta \ln G / N_{t-i} + \beta_{4,i} \sum_{i=1}^{q_1} \Delta \ln Y / N_{t-i} + \varepsilon_t \quad (12)$$

$$\ln G / Y_t = \beta_0 + \beta_1 \ln G / Y_{t-1} + \beta_2 \ln Y_{t-1} + \beta_3, i \sum_{i=1}^p \Delta \ln G / Y_{t-i} + \beta_{4,i} \sum_{i=1}^{q_1} \Delta \ln Y_{t-i} + \varepsilon_t \quad (13)$$

where  $\Delta$  is the first difference operator;  $\varepsilon_t$  is white disturbance error and all variables are expressed in logarithm. Equation (9) to Equation (13) can also be interpreted as an Autoregression Distributed Lag (ARDL) and model (p<sub>1</sub>q<sub>1</sub>). We will use Akaike's Information Criterion (AIC) for lag level selections for ARDL's model. From the unlimited error correction estimate model, long-term elasticity is a lag independent variable (multiplied with negative sign) divided by a lapse dependent variable.

We will estimate Equation (9) to Equation (13) with the use of ordinary least square (OLS) technique and then calculate statistic-F (Wald's Test) for existence of long-term relationships between variables. Null hypothesis and alternatives were built as follows:

$$H_0 : \beta_1 = 0 \quad \text{dan} \quad \beta_2 = \beta_3 = \dots = \beta_6 = 0 \quad (\text{No long-term level relationship})$$

$$H_A : \beta_1 \neq 0 \quad \text{dan} \quad \beta_2 \neq \beta_3 \neq \dots \neq \beta_6 \neq 0 \quad (\text{Long-term level relationship existed})$$

Third, we will follow border test approach [Table 3 CI(ii)] proposed by Pesaran *et al.* (2001) and when sample statistical tests are below lower critical value it means that we receive the null hypothesis at one level of significance as significant. This null hypothesis is accepted regardless of whether it follows the rule that government expenditure

co-integration of and economic growth showed be either  $I(0)$  or  $I(1)$ . According to Pesaran *et al.* (2001), lower boundary critical values that utilised variables, are integrated at zero, or  $I(0)$ , while critical values upper boundary assume that they are integrated at one order. Therefore, if statistic-F in our sample is calculated the statistical test exceeds upper boundary value which means we reject the alternative that a long term relationship exists between government expenditure and economic growth. On the other hand, if statistic-F is calculated from the statistical test sample will be smaller from lower boundary value, then we do not reject the null hypothesis and we summarise that economic growth and its determinants are not co-integrated. On the other hand, if statistic-F is calculated from the statistical sample which is between the lower boundary and the upper boundary, its decision is not known.

Finally, error correction model can be defined in ARDL's framework as follows:-

$$\ln G_t = \mu + \sum_{i=1}^p \phi_i \Delta \ln G_{t-i} + \sum_{j=1}^{q_1} \varphi_j \Delta \ln Y_{t-j} + vecm_{t-1} + \varepsilon_t \quad (14)$$

$$\ln G_t = \mu + \sum_{i=1}^{p-1} \phi_i \Delta \ln G_{t-i} + \sum_{j=1}^{q_1-1} \varphi_j \Delta \ln Y / N_{t-j} + vecm_{t-1} + \varepsilon_t \quad (15)$$

$$\ln G / Y_t = \mu + \sum_{i=1}^p \phi_i \Delta \ln G / Y_{t-i} + \sum_{j=1}^{q_1} \varphi_j \Delta \ln Y_{R_{t-j}} + vecm_{t-1} + \varepsilon_t \quad (16)$$

$$\ln G / N_t = \mu + \sum_{i=1}^{i-1} \phi_i \Delta \ln G / N_{t-i} + \sum_{j=1}^{j=q_1} \varphi_j \Delta \ln G / N_{t-j} + vecm_{t-1} + \varepsilon_t \quad (17)$$

$$\ln G / Y_t = \mu + \sum_{i=1}^{p-1} \phi_i \Delta \ln G / Y_{t-i} + \sum_{j=1}^{q_1-1} \varphi_j \Delta \ln Y_{t-j} + vecm_{t-1} + \varepsilon_t \quad (18)$$

Here ( $\phi$  and  $\varphi$ ) in Equation (14) to Equation (18) refer to short-term dynamic coefficient and *vecm* shows an adjustment speed.

The data set contains the Malaysian data series for 1970 - 2007. GDP's annual data, real GDP per capita, and government development expenditure can be divided into four sectors; namely social services, economy services, security, and general administration taken from the World Development Indicator, Asia Development Bank, and Government Finance Statistics.

#### 4. Empirical Result

To ensure having a long-term relationship between variables in this model, static formal test namely Augmented Dickey-Fuller unit's root test (ADF) was used in econometric analysis in all variables for Malaysia. If variables in Equation (1) to Equation (5) are found to have a similar static level namely  $I(1)$ , then there is a possibility of long relationship between variables in those equations and this is confirmed by doing the co-integration test. Existing co-integration means that regression results in Equation (1) to Equation (5) are false regressions and form the same resonance in the long run. If all variables are co-integrated, then this shows existence of long-term relationship, or long-run equilibrium between variables in that equation.

Table 1 show empirical results in which GDP's variable (Y) and real GDP ( $Y_R$ ) are stationary in both constant and constant + trend. ADF's test was conducted again in its first differentiation approach and the result showed that the entire serial was stationary at 1% level of significance.

The analysis cause unit in Table 1 shows that most variables are stationary in  $I(1)$  although there is a stationary variable in  $I(0)$ . Ambiguity in this variable integration rule better supports ARDL's approach in using the co-integration alternative test.

Border's tests for Version 1 to Version 5 are indicated in Table 2. Using asymptotic critical value accounting by Pesaran *et al.* (2001), all statistical tests are significant at 1% level of significance. This test result also drove us to reject the null hypothesis that there is no co- integration, regardless of whether variables in were  $I(1)$  or  $I(0)$  or in both. This test also showed the existence of legal long-term relationship between independent variables and dependent variables in Version 1 at a significant level of 1% and Version 3 at a significant level of 10%. Exceeding boundary critical values in Version 4 and Version 5 show the existence of long-term relationship in significant statistical test at the significant level of 5% exceeding upper boundary critical value. While Version 2 indicates there is no legal long-term relationship between the dependent variable and the independent variable.

To determine ARDL model's strength Equation (9) to Equation (13) which have are being estimated, have been shown through several diagnostic tests like those indicated in Table 3 and CUSUM and CUSUMSQ stability's test in diagram 1. The diagnostic tests conducted were LM BREUSCH-GODFREY serial correlation test, Jacque-Bera's normality test, Ramsey RESET stability tests and ARCH tests. Structural parameter stability test was undertaken through CUSUM and CUSUMQ. According to Pesaran and Pesaran (1997), stability estimation coefficient models should be empirically investigated. A delegation with CUSUM and CUSUMSQ's statistics is shown in Figure 1. Both CUSUM and CUSUMSQ plots are within the boundaries and as such this statistics confirms long-term stability in government development spending growth coefficient and economic growth in ARDL's model.

Long-term coefficients based on ARDL model's estimate for the period of 1970 to 2007 are listed in Table 4. The results showed that the national product variable in Version 1 and Version 3 to Version 5 with a significant level of 1% does affect the Malaysian government development expenditure.

Version 1 explains that a rise of 1% in the national product leads to an increase of 17.1% in government development expenditure. Version 3 to Version 5 shows that a rise in the national product will increase the government development expenditure by as much as 44.3% (Version 3), 23.4% (Version 4) and 11.9% (Version 5). Referring to the three Versions discussed above, Version 3 shows more effect on the influence of Real Gross Domestic Product per large residential population ( $Y_{Rt}/N$ ) to government development expenditure per residential population ( $G/N_t$ ). Version 2 shows no significant relationship between national products and government development expenditure.

To determine the long-term coefficient for each chosen ARDL's model, we obtained estimation for model error correction. As shown in Table 5, every model which was found to be an estimate error correction parameter is marked 'right' which is a negative sign. Generally, the error correction coefficient of all models is very significant, and shows a speed adjustment which is fairly fast towards equilibrium after a shock. It was found that between 69% - 78% inequilibrium had happened in last year's shock and it was corrected to the long-term equilibrium in the current year.

## 5. Conclusion

Wagner's law is a hot topic which is still being discussed by economists in relation to government expenditure since it was explored by Adolph Wagner in the 1880s. This Wagner's law had been discussed many times as theoretical and empirical studies in past researches. Nevertheless, most of the empirical retrieval study missing validity or quantitative technique introduced in the study is uncertain. Due to this, we tried to test Wagner law's of validity by the exploring new technique in time series data introduced by Pesaran *et al.* (2001). This technique, called border test approach, probably is able to resolve co-integration dependence test on integration rule.

Product growth rate is closely related to the economic situation in the long term and it is a measurement of a country's development performance. By testing its validity based on five (5) of Wagner's law Version, it has been found that four (4) border tests support Wagner's long-term relationship verification in Malaysia. In accordance with that, government activity or economic development can be considered in the long run. Each variable influences the co-integration tests which are suggested by Pesaran *et al.* (2001).

This study shows that long-term relationships exist between national products and government development expenditure. Overall, the estimation analysis of ARDL's model for Wagner's law shows that the national product factor is still relevant in influencing government development expenditure in Malaysia.

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Table 1. Augmented's Test Dickey-Fuller (ADF) for Cause Unit

	I(0)		I(1)	
	<u>Constant</u>	<u>Constant + Trend</u>	<u>Constant</u>	<u>Constant + Trend</u>
lnG	-1.954675	-1.384145	-4.051215*	-4.077510*
lnY	-0.421721	-2.800540**	-6.105847*	-6.009744*
lnY/N	-0.926803	-2.163649	-5.556977*	-5.541558*
lnG/Y	-0.341275	-1.896491	-2.520402**	-3.059059*
lnY <sub>R</sub>	-3.258235*	-3.271125*	-5.070569*	-5.233604*
lnG/N	-1.623778	-2.225336	-4.013469*	-4.154940*

Note: \*, \*\*, and \*\*\* Significant at 1%, 5%, and 10% significance level.

Table 2. Border's test for long-term relationship existence

	Lat AIC	Statistic-F	Probability	Result
G Version 1	1,0	5.907*	0.005	co-integration
Version 2	1,0	2.101	0.147	No co-integration
Version 3	1,0	3.446**	0.043	co-integration
Version 4	1,0	4.349**	0.037	co-integration
Version 5	1,0	4.346**	0.037	co-integration
Critical Value		Below	Above	
1% level of significance		3.15	4.43	
5% level of significance		2.45	3.61	
10% level of significance		2.12	3.23	

Note: Border critical value achieved from Pesaran et al. (2001), Table CI(iii) Case III: unlimited intercept and no trend. \*, \*\* and \*\*\* significant at 1%, 5% and 10% significance level.

Table 3. Diagnostic test for ARDL's model

	$G=f(Y)$	$G=f(Y/N)$	$G/Y=f(Y_R/N)$	$G/N=f(Y/N)$	$G/Y=f(Y)$
LM Test	0.631(0.434)	0.605 (0.443)	0.003 (0.956)	0.678(0.417)	0.0016 (0.969)
Jarque-Bera	5.396 (0.125)	7.920 (0.052)	5.166 (0.115)	4.420 (0.110)	1.172 (0.557)
Ramsey's RESET Test	0.571 (0.456)	0.392 (0.536)	1.180 (0.286)	0.762 (0.390)	0.054 (0.818)
ARCH	0.392 (0.984)	0.002 (0.962)	0.011 (0.916)	0.103 (0.750)	0.148 (0.702)

Note: Ramsey's Test RESET - refer to regression specification error test. ARCH - refer to test heteroschedasticity (Engle 1982); Jarque-Bera - refer to distribution test normal; LM test - refer to Breusch-Godfrey serial correlation's test (BG).

Table 4. Long-term Estimation Coefficient of ARDL's Approach

	C	Y	Y/N	$Y_R/N$
$G=f(Y)$	1.320 (2.091)**	0.171 (3.196)*	-	-
$G=f(Y/N)$	0.928 (1.511)	-	2.253(0.385)	-
$G/Y=f(Y_R/N)$	0.317 (2.776)**	-	-	0.443(3.035)*
$G/N=f(Y/N)$	0.175 (3.897)*	-	0.234(4.674)*	-
$G/Y=f(Y)$	0.286 (2.035)**	0.119 (3.227)*	-	-

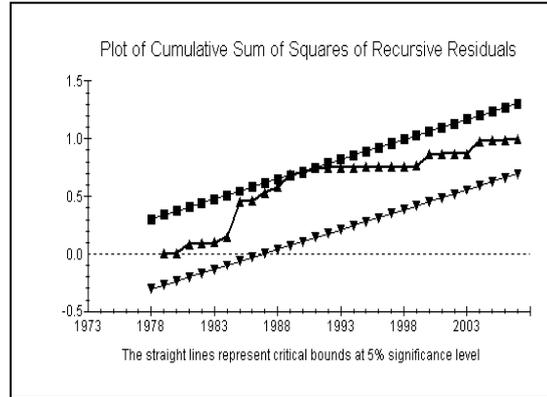
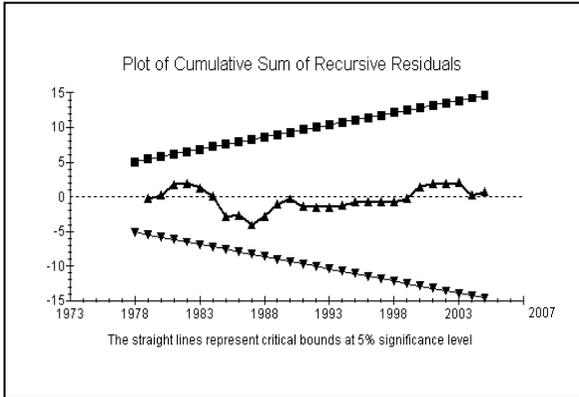
\*, \*\* and \*\*\* show significant at 1%, 5% and 10% significance level.

Table 5. ECM's model for ARDL's Model

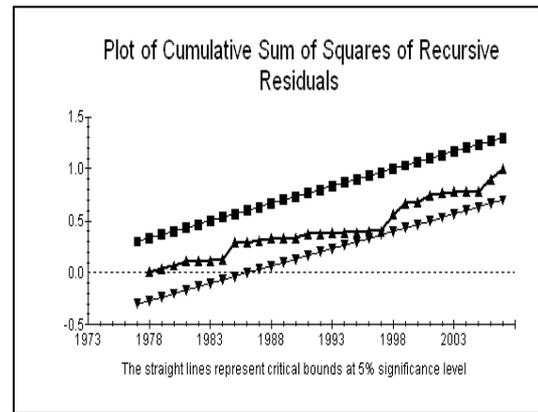
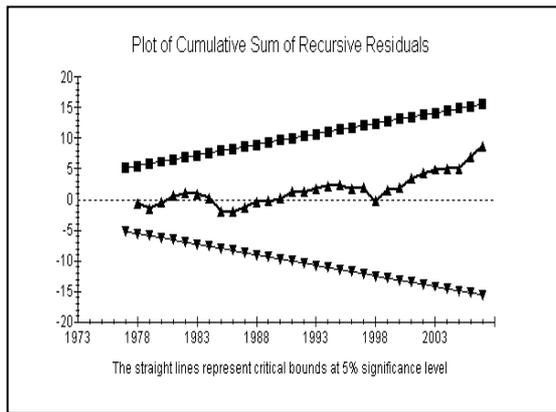
	$G=f(Y)$	$G=f(Y/N)$	$G/Y=f(Y_R/N)$	$G/N=f(Y/N)$	$G/Y=f(Y)$
C	0.914 (2.294)*	0.651 (1.492)	0.234 (2.132)**	0.055 (1.978)***	0.228 (2.313)**
Y	0.1492 (-2.194)**	-	-	-	0.095 (3.771)*
G(-1)	0.240 (2.727)*	-0.223 (-2.571)*	-	-	-
Y(-1)	0.146 (2.027)**	-	-	-	-0.005 (-1.464)
Y/N	-	-1.582 (-.379)	-	-0.174 (-0.663)	-
Y/N (-1)	-	2.557 (1.712)	-	0.103 (2.345)**	-
$Y_t/N$	-	-	0.327 (2.089)**	-	-
G/Y(-1)	-	-	-0.223 (-2.274)**	-	-
$Y_t/N(-1)$	-	-	-0.059 (-.609)	-	-
G/N(-1)	-	-	-	0.197 (2.187)**	0.179 (2.059)**
ecm(-1)	-0.692 (-4.171)*	-0.702 (-4.184)*	-0.738 (-4.304)*	-0.746 (-4.332)*	-0.798 (-5.651)*
R <sup>2</sup> -Adjusted	0.473	0.466	0.457	0.452	0.632
Stat.-DW	1.808	1.806	1.945	2.055	1.896
AIC	74.784	74.568	78.086	78.411	84.89

Note: ( ) refer to statistic-t; \*, \*\* and \*\*\* show significant at 1%, 5% and 10% significance level.

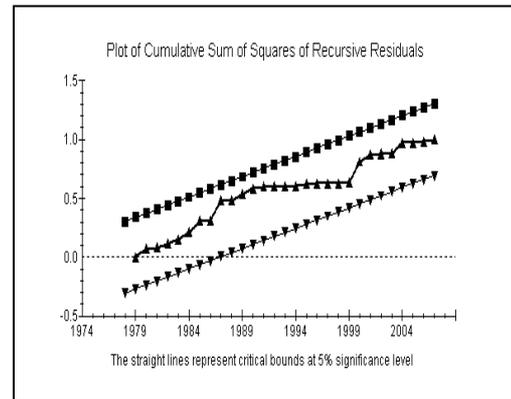
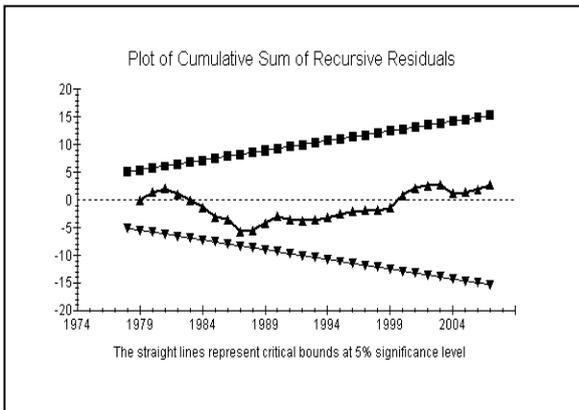
Version 1



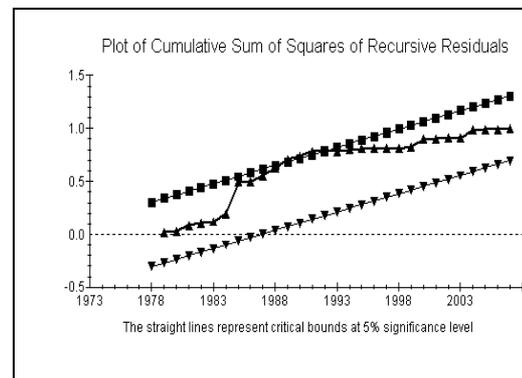
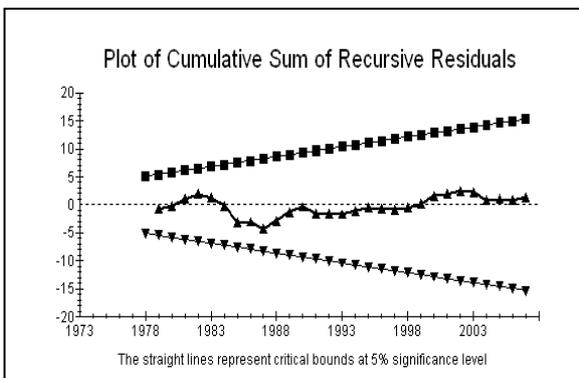
Version 2



Version 3



Version 4



Version 5

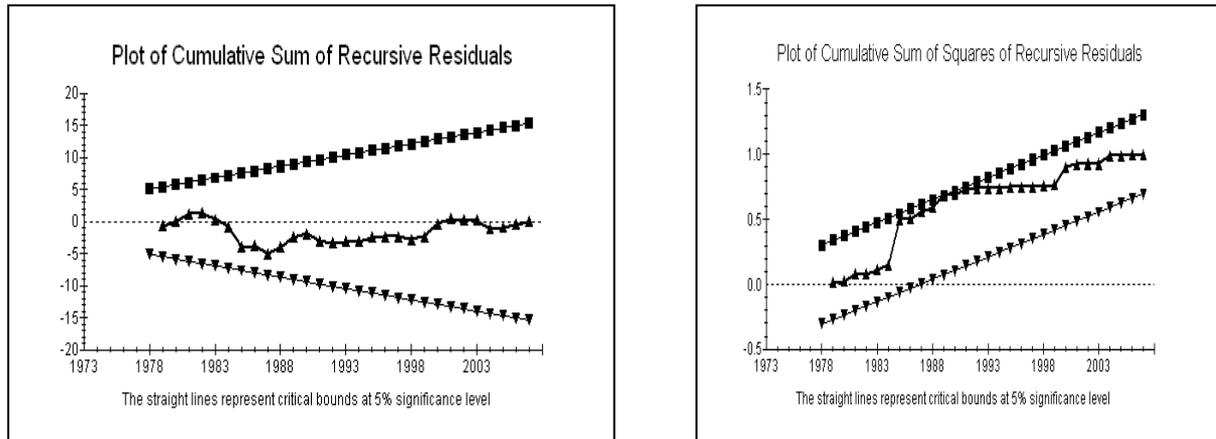


Figure 1. Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Squares of Recursive Residuals (CUSUMSQ)

Note: Straight line is a critical border in level of significance at 5% significance level.