

Defence Expenditure and Economic Growth in Malaysia: An Application of Toda-Yamamoto Dynamic Granger Causality Test 1980-2014

Muhammed Aminu Umar¹ and Abu Sufian Abu Bakar²

¹ Nigerian Army School of Education (NASE) Ilorin, Nigeria & School of Economics, Finance and Banking, University Utara Malaysia

² School of Economics, Finance and Banking, University Utara Malaysia

Using Toda-Yamamoto augmented causality approach, this paper examines the causal relationship between defence expenditure and economic growth in Malaysia. The study takes into account the recent development in econometric techniques. The dynamic Granger causality test is based on the Vector Autoregressive VAR framework, it is simple at the same time interesting procedure in estimation of augmented VAR. The framework guarantees asymptotic distribution, because the process is more robust to cointegration and integration. The purpose of this paper is to verify the relevance of the Keynesian and Wagner's Law of a long-run relationship between defence expenditure and economic growth in Malaysia between 1980-2014. The empirical findings reveal bidirectional causality between defence expenditure and economic growth. By implication both Wagner's and Keynesian hypothesis hold in the case of Malaysia and that any policy formulated on any of the variables will influence the other variable.

Keywords: Toda-Yamamoto, Defence expenditure, Economic growth Arms importations.

INTRODUCTION

Defence expenditure can affect economic growth either negatively, through a crowding out of investment or positively through an expansion of aggregate demand. In a case defence expenditure precedes growth, the simplest interpretations are: for the positive causal relationship, the aggregate demand impact is dominant. On the other hand, if the impact is negative, the crowding out is the main effect. Moreover, if causation runs from economic growth to defence expenditures and it is found positive, the country is trying to protect itself against internal and external aggressions. It can also be perceived that a country is at a stage of development where defence expenditure is seen as a positive social good. The early work on defence expenditure and economic growth by Benoit's (1973,1978) which establishes positive impact of defence expenditure on economic growth attracts questions. The study led to criticisms and interests among researchers. Subsequently large number of studies are being conducted employing range of advance econometric models and diversified theories. The previous works use different specifications, estimators, samples of cross-sections, panel and time-series analyses. The diversity in the previous results steered also the arguments for case studies of individual country Dunne (1996). The economic impact and relationship of defence expenditures on economic

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growth has been a subject of empirical and theoretical revision. There is no clear-cut regarding the direction of causation between defence expenditures and economic growth. It has been established in the literature that defence spending may retards economic growth via what is called "crowding-out" phenomenon (a diversion of equal amount from the productive sector to the unproductive sector). On the contrary, it has been established that defence spending may also stimulate economic growth through what is called Keynesian multiplier effects. Like other public expenditures, if there is spare capacity utilization, an increase in defence expenditure may leads to an increase in capacity utilisation, which will reduce unemployment of resources. In the same vein, defence expenditure may result to spin-off effects as a result externality effects. Such as the creation of socioeconomic structures conducive to economic growth (Deger, 1986).

According to In Masih, et al. (2004), using Granger causality, the relationship between defence expenditure and economic growth cannot be generalised across nations. The actual relationship differs between countries as a result of a variety of factors. The importance of determining the causality between defence expenditure and growth is that because policy inferences can be derived from the understanding of the direction and the magnitude of the causation.

However, when examining the methodology used in testing a long-term cointegration among series. The cointegration tests performed by Engle-Granger (1987), Johansen (1988) and, Johansen and Juselius (1990) are widely used. The condition required is, series should not be stationary at a level, but rather they should become stationary when the same difference is taken. When one or more of the series becomes stationary at the level I (0), the cointegration relationship cannot be examined with these tests. Further, Bound Test approach developed by Pesaran et al. (2001) eliminates this problem. Base on this approach, the existence of causal relationship

can be examined regardless of whether the series are integrated at level or first difference (I(0) or I(1)).

The aim of this paper is to re-examine the causal relationship between defence expenditure and economic growth in Malaysia, using a more advance technique. The paper is divided into five sections. Section 2 of this paper deals with the literature review, it comprises both the theoretical and the empirical literature. Section 3 discusses the model specification. Section 4 presents the results and finally section 5, concludes the paper.

LITERATURE REVIEW

This paper discusses the relationship between defence expenditure and economic growth in Malaysia. It has been argued that defence expenditure like other public expenditure can stimulate economic activities. On the other hand, it is also argued that defence expenditure is a non-productive activity, it, therefore, drains economic resources from the productive sector of the economy such as education and health. After the works of Benoit 1973, and 1978, many researchers get involved in defence expenditure and economic growth relationship. Despite the enormous efforts, this relationship is still inconclusive. The relationship between defence expenditure and economic growth established in the literature is in three folds: First, bi-directional (feedback), Second, unidirectional (one-way causality) and third non causation at all.

The studies that establish bi-directional causation between defence and economic growth in Malaysia and elsewhere include; (Chowdhury: 1991; Chor Foon 2008; Tsangyao et al., 2001; Ozun 2014; Al-jarrah; 2005; Tiwari et al. 2012; Ayey; 2014; Hou & Chen 2014;). These studies applied cointegration test Granger causality on using different models.

However, Tsangyao et al. (2001) examined the causal relationship between defence expenditure and economic growth in Taiwan and Mainland China.

Using cointegration analysis and a VAR model, the Granger-causality tests confirmed bidirectional Granger causality (feedback) between defence expenditure and economic growth in the two countries. Bidirectional causality was also found in Ozun (2014), on NATO countries. Using the Toda-Yamamoto approach to Granger causality, Bidirectional relationship was confirmed in Turkey. In Al-jarrah, (2005) causal relationship between economic growths in oil-rich countries and non-oil rich countries was examined with defence expenditure in Saudi Arabia from 1970-2003. The study used real growth rate as a proxy for economic growth while defence expenditure as independent variables. The result revealed the presence of the cointegration between defence expenditure and real growth. It also shows the existence of bidirectional causality between growth and defence expenditure. Tiwari et al. (2012) also examined the relationship between defence expenditure and economic growth in India, using Granger-causality test framework. The study found bi-directional causality between GDP and defence expenditure. Moreover Ayey (2014) found evidence of bidirectional Granger causality in South Africa, when he re-examined previous literature on the milex-growth nexus, on South Africa.

On the contrary (Masoud et al. 2014) revisited the relationship between military expenditure and economic growth in China, using ARDL approach Granger causality techniques. The study shows unidirectional relationship running from GDP to military spending in China. Similarly, Tsangyao et al. (2001) uses Vector Autoregressive (VAR) model in the study conducted in China and Taiwan. The Granger causality result suggests unidirectional causality running from economic growth to defence expenditure. Aligned with the above finding is the study carried out by Masih et al. (2004), in the mainland China. Using VAR modelling. The study revealed a unidirectional causality from defence spending to economic growth. Moreover, Frederickson (1991) in his study observes that a causal relationship between defence expenditure

and economic growth runs from economic growth to defence expenditure in Malaysia. Tang (2008) in his study while reassessing the causal relationship between defence expenditure and economic growth in Malaysia using Wald test confirmed unidirectional causality in Malaysia.

Another way, of viewing the relationship between defence expenditure and economic growth, is seeing it as the inconclusive relationship. In Oriavwote & Eshenake, (2013) using a VAR model the result shows that shocks in expenditure on defence did not significantly clarify changes in the level of economic growth. The same result was found in Masoud et al. (2014) in China using ARDL approach to cointegration; the result shows that the long-run relationship is inconclusive between defence expenditure and economic growth in China. Lastly, in Paul, (2007), using a VAR model and Granger causality test shows that the relationship between the unemployment rate, defence and non-defence spending is not uniform across countries. Chowdhury (1991) analyses of 55 developing countries, found that conclusion cannot be made regarding causality between defence expenditure and economic growth across countries. The study concluded that the actual relationship varies from country to country as a result of the sample period, social structure and types of government. Regarding Malaysia specifically the study confirms the absence of causality between defence expenditure and economic growth. Same is confirmed in Himassa et al. (2009) that no well-established or meaningful relationship was established between defence expenditure and economic growth in Malaysia.

Joerding (1986) maintained that growth may be causally prior to defence expenditure. For example, a country with high growth rates may wish to strengthen itself against foreign or domestic threats by increasing defence expenditure. On contrast, it is equally conceivable that countries with high economic growth rates may divert resources from defence to other productive uses (Kollias, 1997).

Theoretical Framework

Defence expenditure constitutes a large share of world resources, but in spite its significant size, its impact is just recently been a topic of discussion in economic theory. The theoretical analysis of defence expenditure becomes difficult because it is not purely economic but a mixture of economic and political activity. Economic theories do not provide an explicit role for defence expenditure as a unique economic activity. Notwithstanding, there exist two basic theoretical approaches used in explaining causations between defence expenditure and economic growth from different points of view, these are Keynesian and Wagners approaches (Dunne & Nikolaidou 2012).

In the Keynesians view, the state appears to be proactive and interventionist. It uses defence expenditure to increase output through multiplier effects if aggregate demand is not sufficient (Dunne, 1996). If aggregate demand is inadequate to supply, an increase in defence expenditure can stimulate capacity utilisation, profit, investment and economic growth (Faini, Annez and Taylor 1984). By implication therefore defence expenditure like other government expenditures can be used to stimulate economic activities. The causality is expected from defence spending to economic growth.

On the other hand, Adolph Wagner's (1890) Law of increasing state activities has been used in the literature in establishing causation between economic growth and defence expenditure. Wagner's law is based on the historical facts from Germany. According to Wagner's there is a functional relationship between economic growth and government expenditure. According to this law, there is a long-run propensity for the public expenditure to increase with higher levels of economic growth (Lindhauer and Velenchik, 1992). Therefore, it hypothesised, public spending to increase over time with the increase in economic growth. It expects causations running from economic growth to defence expenditure.

METHODOLOGY

Data

The three variables used in this paper are: gross domestic product (GDP) a proxy for economic growth, defence expenditure and arms import expenditure. The study employs time-series data for the period 1980-2014. The data are obtained from different sources. The data on the GDP is collected from World Development Indicator (WID). The data on Military expenditures and arms importation is retrieved from Stockholm International Peace Research Institute (SIPRI).

Test Procedure

The paper starts with an examination of the unit root test for the variables employed. This is essential to avoid spurious regression in a case the data is not stationary. These models include the Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1979, and the Phillips-Perron (PP) (Phillips and Perron, 1988) unit root tests.

The causality analysis

The traditional path of testing causality between two series is by using Granger Causality as proposed by Granger (1969). The process is done using simple vector autoregressive (VAR) model as shown below:

$$Z_t = \sum_{i=1}^n \alpha_i Z_{t-i} + \sum_{j=1}^n \alpha_j K_{t-j} + \varepsilon_{1t} \quad [1]$$

$$K_t = \sum_{i=1}^n \lambda_i K_{t-i} + \sum_{j=1}^n \lambda_j Z_{t-j} + \varepsilon_{2t} \quad [2]$$

In the above Equations 1&2 β_1 and β_2 represent uncorrelated error terms. Equation 1 shows that variable Z is influenced by the lag of variable K and Z. The same thing does the Equation 2. By Granger-Causality, it means the Z variables is influenced by the lag of significantly in equation 1 and lagged K influence Y in Equation 2. If the test jointly reject the null hypothesis that the errors are not different from zero,

then causality between Z and K are confirmed. The Granger-Causality itself has its limitations. The test of granger causality without considering the other variables due to their effect has been considered a source of possible specification bias. It has been established in the literature that causality test is very sensitive to model specification and lags Gujarati (1995). Toda-Yamamoto (1995) employed simple at the same time interesting procedure in estimation of augmented VAR that guarantees the asymptotic distribution, because the process is more robust to cointegration and integration.

Toda-Yamamoto Causality Test

For the causal relationship between defence expenditure and economic growth in Malaysia, this paper employs Toda and Yamamoto (1995) dynamic Granger causality test. It is based on the Vector Autoregressive VAR (p+dmax) framework.

It has been established in the literature that if cointegration occurs between series after taken the same difference, the Vector error correction (VEC) model by Engle and Granger (1987) is used. In VEC limited WALD model, F test is used for testing the causality. Moreover, if the variables are cointegrated, traditional F test statistics used for testing the Granger causality might not be valid since it does not fit into the standard distribution (Toda and Yamamoto, 1995). The issue of cointegration between series in the causality test to be performed with modified WALD method by Toda-Yamamoto (1995), is not that vital. The approach is enough to determine the right model and to know the maximum cointegration level of the variables in the model Ozun (2014).

In the Toda and Yamamoto (1995) it is specified that WALD hypothesis test can be performed by counting the extra lag to WALD model. In line with this the maximum cointegrating variables should have chi-square () distribution. This approach fits into a standard WALD test model at level variable are first difference for Granger causality tests. Accordingly it reduces the risks resulting from the

possibility of wrong detection of cointegration among the series (Mavrotas and Kelly, 2001).

The study employs the following Toda-Yamamoto (1995) statistics based on the augmented Vector Autoregressive VAR (p+d max) framework as shown in equation 3.

$$y_t = \alpha_0 + \alpha_1 + \dots + \alpha_d t^d + \eta_t \quad [3]$$

Where β is k^{th} order of VAR further define as I (d) is the lag length in the equation. Then

$$y_t = \gamma_0 + \gamma_1 t + \dots + \gamma_q t^q + \sum_k y_{t-k} + \varepsilon \quad [4]$$

Where Y_t and β are vectors of variables and error terms respectively. The hypothesis will be tested based on the estimated equation:

$$y_t = \gamma_0 + \gamma_1 t + \dots + \gamma_q t^q + \sum_k y_{t-k} + \sum_p y_{t-p} + \varepsilon_t \quad [5]$$

Where Y_t is a vector for defence expenditure, economic growth, while d denotes the Lag length more than the exact lag length k . The additional lag parameters are spared unrestricted in the null hypothesis. This is to maintain the asymptotic chi-square values for the fulfilment of the VAR model (Toda & Yamamoto, 1995). From now on, the equation is given as:

$$y_t = \Gamma \tau^t + \Theta x^t + \varpi z_t + \varepsilon_t \quad [6]$$

From the above equation, unrestricted regression is estimated to get estimated vector of residual out of which variance-covariance matrix for the residual is calculated. Equally, the null hypothesis is tested using the constructed Wald statistics for the Granger causality test.

This study used WALD test with three variables which comprise of Gross Domestic Product (as proxy for economic growth), Military Expenditures (as defence expenditure) and arms importation have been formed as follows:

$$DE_t = \alpha + \sum_{i=1}^{k+d} \beta_1 DE_{t-i} + \sum_{i=1}^{k+d} \beta_2 GDP_{t-i} + \sum_{i=1}^{k+d} \beta_3 AI_{t-i} + \varepsilon_t \quad [7]$$

$$GDP_t = \alpha + \sum_{i=1}^{k+d} \beta_1 GDP_{t-i} + \sum_{i=1}^{k+d} \beta_2 DE_{t-i} + \sum_{i=1}^{k+d} \beta_3 AI_{t-i} + \varepsilon_t \quad [8]$$

Here, DE = defence expenditure/Military expenditure. GDP= Gross Domestic Product. Where d = maximum order of integration of the system series. k = is the optimal lag length of GDP, DE, and Arms importation β = denotes error term, which is assumed to be white noise, having zero mean, constant variance with no autocorrelation.

EMPIRICAL RESULT

The Unit root test result of the series is investigated using Augmented Dickey Fuller (ADF) and Phillip Perron (PP). The result is shown below:

Table 1: Unit root Analysis				
Series	ADP		PP	
	Level	First difference	Level	First difference
LGDP	-3.084 (0.116)	-7.274*** (0.000)	-2.018 (0.585)	-7.124*** (0.000)
LDE	-3.070 (0.119)	-3.685*** (0.028)	-2.156 (0.509)	-7.136*** (0.000)
LARM	-3.333** (0.016)	-	-3172** (0.025)	-

Values above are the t statistics used in testing the null hypothesis that the series is nonstationary. The figures in parenthesis represent the probability values. While ** & *** denotes significance at 5% and 01% levels.

Source: Eviews 8.0

Table 1 indicates that the economic growth and defence expenditure variables only stationary after 1st difference whereas, the log of Arm importation variables was stationary at level. The pp test also confirmed the ADF test results. The table indicates that the maximum order of the integration in determining to be one. Therefore, the lag augmentation in the VAR framework is estimated as one.

Table 2: Lag Length Selection Criteria		
VAR Lag selection based on lag AICC		
Lag	0	13295.0685
"	1	12373.9325
"	2	12330.7836*
"	3	12346.8620
Lag	4	12354.7850

Source: RATs 8.0

*Denotes lag order selected by the appropriate criterion

From table 2 above the paper reports the optimal lag length to be employed in the study. The lag length is selected based on the Akaike Information criterion. The optimal lag length selected by the AICC is shown as 2. This shows that the lag length prior to augmentation is determined as 2 where used the appropriate lag of the model in three due to the condition of VAR (P+dmax)

Table 3: Toda-Yamamoto/Granger causality (modified WALD) Test Result			
Null hypothesis	Granger Causality	MWALD test statistics	MWALD P. value
MEX β > GDP	0.75494 (0.6856)	3.27374	0.0704
GDP β > MEX	1.53084 (0.4651)	13.18916	0.00028

Source: RATs 8.0 & Eviews 8.0

1. *, ** & *** represent a rejection of the null hypothesis at 1%, 5% and 10 % level of significance respectively with reference to MWALD p. value.
2. Symbol \neq > represent non-Granger causality.
3. The numbers in parenthesis represent the p. values of Granger non-causality hypothesis.

The above Table 3 depicts the estimated Toda-Yamamoto result of the Granger Causality with MWALD test statistics. The results of non-Granger causality hypothesis between MEX to GDP and GDP to MEX are rejected at 10% & 1% respectively. By implication, the alternative hypothesis of the existence of causality between MEX to GDP and from GDP to MEX in Malaysia is established. The established causality tests indicate bidirectional causality (feedback) between defence expenditure and economic growth in Malaysia. It implies defence

expenditure like all other public expenditure can be used as a policy instrument for regulating economic growth. As observed in Tsangyo et al.(2001), Ozun, & Erbaykal, (2011) and Tiwari et al. (2012) that defence expenditure can be used to stimulate market activities, hence facilitates market through multiplier effects, this is in line with the Keynesian demand-side argument. On the other hand, economic growth is a cause of defence expenditure in Malaysia, which can be interpreted as the Malaysian economy progresses government spends more to provide security both internally and externally. This is in line with the Wagner's propositions that as an economy develops more, the government need to spend more to ensure security, law and order and to deter any internal and external aggression against a state. However the ordinary, Granger causality in the second column does not establish causality between the two variables. Therefore, the previous studies conducted using only two variables with no control variables might have suffered the same problems of size distortion and nuisance parameters estimates. As argued by Dunne 2004 analysis for the defence expenditure and economic growth need to be done with a more robust econometric model to achieve much-desired and reliable result. The use of more robust econometric methods of estimations in economics and another field of studies have paved way for establishing more reliable results in various research.

CONCLUSIONS

This study re-examined the relationship between defence expenditure and economic growth to test the relevance of Keynesian and Wagner's hypotheses in Malaysia. The study examines if defence expenditure causes economic growth or economic growth causes defence expenditure in Malaysia. The findings confirm the existence of bidirectional causality between defence expenditure and economic growth in Malaysia. It is comforting to say that defence expenditure in Malaysia has been used as a policy instrument in stimulating economic

activities, just like all other public expenditure. In the same vein, the study also establishes that the Malaysian government has been financing its defence to secure its economy, territory against internal and external threats. Therefore, both Wagner's and Keynesian hypotheses are valid and applicable in Malaysia. By and large, any policy formulated on the variables will influence the other variable.

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BRIEF PROFILE OF THE AUTHORS

Muhammed Aminu Umar is currently undergoing his PhD research in Economics at University Utara Malaysia. He obtained his first and second degree from Usmanu Danfodiyo University Sokoto and Ahmadu Bello University Zaria respectively in Nigeria. The researcher has experience on security issues, currently working with the Nigeria Ministry of Defence (MoD) for ten years and doing research as well as reading current issues on security. Mohammed's research publications appeared in the reputable journals such as *Actual Problems of Economics*, *International Business Management* and *Amity Business Review* among others. His research interests are in the area of Defence Economics and Public Finance.

Abu Sufian, PhD, is presently a senior lecturer at University Utara Malaysia. Abu Sufian has been a lecturer in the School of Economics Finance and Banking for about twenty years. He had publications in many international Journals, such as *Actual Problem of Economics*, *International Business Management* and *Amity Business Review* among others. He is an expert in economic modelling and entrepreneurship.