STUDY ON THE CAUSALITY NEXUS BETWEEN MACRO-ECONOMIC VARIABLES USING VECTOR ERROR CORRECTION MODELING

ABSTRACT

The reason behind the execution of this research is to investigate the dynamic co-integration association of economic growth with its selected four determinants which include foreign direct investment (FDI), consumer price index (CPI), net export (NE) and personal remittances (PR) in Thailand, a developing economy. The paper examines empirically the association of economic growth with its determinants by employing Johansen Co-Integration Test, Granger Causality Test and Variance Decomposition between time-period of 1980-2013. Empirical results reveal the presence of co-integration among the considered variables whereby it is noticed that economic growth of Thailand is influenced by personal remittances and net exports. The Granger Causality Test supports unidirectional causality from LNE to LGDP (LNE→LGDP) and from LCPI to LNE (LCPI→LNE). Furthermore the study evidences feedback causality among LPR and LGDP. The variance decomposition results recommend that unsettling influences starting from LGDP incur most prominent variability of 69 percent followed by 31 percent of the variation explained by the remaining four variables.

Keywords: Gross Domestic Product, ARDL, Granger Causality, Net Export, VECM

JEL Classification: C32, C180, F43

RIASSUNTO

La relazione di causalità tra variabili macro-economiche tramite l’utilizzo di un modello Vector Error Correction

Il fine di questo studio è analizzare l’associazione di cointegrazione dinamica del tasso di crescita economica in Tailandia, con 4 determinanti: gli investimenti diretti esteri, l’indice dei prezzi al

1. INTRODUCTION

The GDP is one of the measures of national income and yield for a given nation’s economy. Economic development, doubtlessly, considered as the foundation of a nation’s advancement and its improvement stays one of the major key and strategy issues for the policymakers. Researchers, throughout the years, have investigated the economic development and its advancement; extraordinary accentuation has been laid upon the variables that impact the economic development. An immeasurable assemblage of literature has, exactly and hypothetically, explored the economic development and its determinants (Barro, 1990, 1997; Sachs and Warner 1997). These studies have distinguished a few variables, having exact and hypothetical support, which affect the economic development of a nation.

Each economy endeavors to accomplish the larger amount of economic development. There would be various macroeconomic variables that help towards the economic development of a country and they have additionally gotten much consideration recently, for example, PR, NE, FDI and so on. PR and net FDI inflows appear to rise as critical segments with the end goal of external financing for creating nations. FDI treated as an inflow of speculation displays an approach to get administration enthusiasm for an endeavor of any economy. It invigorates economic development essentially through work power and learning/innovative exchange impact as developing a number of studies demonstrates a favourable effect of foreign direct investment on the GDP of nations.

The relative development rate of GDP can be influenced by various elements, some of which
demonstrate a reverse relationship while other components demonstrate a direct relationship. This paper is committed to dissect the degree to which those components influence GDP development in creating nations. Alluding to prior studies led either in the rising or propelled economies on economic development, researchers hold diverse perspectives on the presence or heading of causality between economic development and its determinants (FDI, CPI, NE, and PR). Prior investigations looking into this area reported blended and uncertain results. This might be incomplete because of various reasons. Examining the economic development with diverse techniques, set of information, and sample of the study might prompt the conflicting findings. This study in this manner went for experimentally rethinking the short and long-run connections among GDP and its determinants (FDI, CPI, NE, and PR) in the Thailand economy during the period of 1980-2013 by embracing the most recent procedure, autoregressive distributed lag (ARDL) test, for validation of co-integration. Furthermore, the study likewise endeavors examination of the economic development of Thailand utilizing error correction mechanism taking into account VAR framework.

Although there are voluminous empirical studies on the effect of macroeconomic variables on economic growth, the majority of studies usually focused on developed economies, with relatively little attention paid to developing countries like Thailand. Accordingly, this paper will add to our understanding as to whether similar empirical results are observed in developing countries. In addition, these findings may have important policy implications because they could be crucial in areas which play an important role for decisions of economic policies. Results of the study may facilitate in identifying whether the movement of economic growth is the result of some macro-economic variables in Thailand economy; for example, long-term and unidirectional relationship between exports and economic growth is helpful for the government of Thailand to give more attention for stimulation of their exports. This motivates us to undertake the study of the effects of macroeconomic variables on economic growth in context to the economy of Thailand.

Looking at the literature review on the macro-economic variables nexus with economic growth, the studies have investigated both advanced and emerging stock markets using different approaches. However, none of them has investigated the dynamic interactions between macroeconomic variables and the economic growth adopting the ARDL in a small-open
economy like Thailand, which makes this study so important to fill this literature gap by examining the long-run stability between the macroeconomic variables and GDP.

2. Literature Review

The connection between the economic growth and its determinants has been a subject of considerable interest in the development of economic and finance literature in recent years. In this framework, FDI, CPI, NE, and PR are considered to be the principal input for economic growth.

Awokuse (2003) re-examined the export-led growth (ELG) hypothesis for Canada by testing for Granger causality from exports to national output growth using vector error correction models (VECM) and the augmented vector autoregressive (VAR) methodology developed in Toda and Yamamoto (1995). The empirical results suggested that a long-run steady state exists among the model’s six variables and that Granger causal flow is unidirectional from real exports to real GDP.

Erbaykal and Okuyan (2008) examined the relationship between the inflation and the economic growth in Turkey in the framework of data covering 1987:1-2006:2 periods. The existence of the long-term relationship between these two variables was examined using Bound Test developed by Pesaran et al. (2001), and the existence of a co-integration relationship between the two series was detected following the test result. Whereas no statistically significant long-term relationship was found with the formed ARDL models, a negative and statistically significant short-term relationship has been found. The causality relationship between the two series was examined in the framework of the causality test developed by Toda and Yamamoto (1995). Whereas no causality relationship was found from economic growth to inflation, a causality relationship was found from inflation to economic growth.

Jiranyakul (2007) identified the relationship between Government Expenditures and Economic Growth in Thailand and their main results show that aggregate government expenditures cause economic growth, but economic growth does not cause government expenditures to expand. Therefore, there is a unidirectional causality between government expenditures and economic growth. Further investigation using the least square method shows that government spending and its one-period lag variable impose a highly significant impact on economic growth which confirms the results from causality test.
Jatuporn and Thaipakdee (2011) investigate the causality between agriculture and economic growth in Thailand over the period 1961-2009. A Granger causality approach and the Wald ($\chi^2$) coefficient statistic are utilized to reveal a long-run causal relationship and impact transmission between the variables. Based on the time series analyses, a long-run relationship and size impact are detected running from agriculture to economic growth, and vice versa. These findings including the generalized variance decomposition show that agriculture exists in a long-term stable in economic growth while economic development encourages the growth of agriculture as a whole. As a conclusion, policy-makers should regard agriculture as an important supporter of Thai economy.

Kalaitzi (2013) examined the relationship between exports and economic growth in the United Arab Emirates over the period 1980-2010. The study applied the two-step Engle-Granger co-integration test and the Johansen co-integration technique in order to confirm or not the existence of a long-run relationship between the variables. Moreover, this study applied a Vector Auto regression Model in order to construct the Impulse Response Function and the Granger Causality Test to examine the causality between exports and economic growth. The findings of this study confirmed the existence of a long-run relationship between manufactured exports, primary exports, and economic growth. In addition, the Granger Causality Test showed unidirectional causality between manufactured exports and economic growth. Thus, a further increase in the degree of export diversification from oil could accelerate economic growth in UAE.

Makki and Somwaru (2004) in their study used the data from 66 countries classified in three decades (1971-80, 1981-90, 1991-2000). This study was an extended replication of Borenzstein’s (1998) analysis in a way to include 1990s as well. The results showed no significant differences between these two empirical studies. It has been found that FDIs affect economic growth to a large extent together with foreign trade, human capital and domestic capital and, finally, FDI has direct or indirect positive effects on economic growth.

Nyamongo et al. (2012) examined the impact of remittances and economic growth in 36 African countries during the period 1980–2009 by using panel regression and they found that remittances had a positive impact on economic growth. Ruba et al. (2014) studied to examine the causal relationship between economic growth and exports in Jordan using the Granger
methodology in order to determine the direction of the relationship between the two variables during the period 2000-2012. The study found that there is a causal relationship going from the economic growth to Export, and not vice versa. Based on the outcome of causality tests, the changes in the economic growth help explain the changes that occur in the Export.

Pradhan et al. (2008) examined the impact of remittances on economic growth in 39 developing countries during the period 1980-2004 by using panel regression and found that remittances had a positive effect on economic growth. Karagöz (2009) examined the impact of remittances on economic growth in Turkey during the period 1970-2005 by using Johansen co-integration and found that remittances had a negative impact on economic growth. On the other hand Nsiah and Fayissa (2011) also investigated the impact of remittances together with some macroeconomic variables on economic growth in 64 countries from Africa, Asia, and Latin America-Caribbean by using panel unit-root tests, co-integration tests, and panel fully modified ordinary least squares and found that remittances had positive impact on economic growth.

Tanna and Topaiboul (2005) investigated the causal links between human capital, openness through trade and FDI, and economic growth using quarterly data for Thailand over the period 1973:2-2000:4. A number of hypotheses are investigated including, in particular, FDI-led growth and export-led growth, as well as the reverse linkages from growth to FDI and exports. The importance of human capital is highlighted as complementary to trade and FDI inflows, underlying the importance of technology adoption. They found that, after controlling for domestic investment, government expenditure and imports, support for FDI-led growth is not as strong as export-led growth, although allowing for the joint interaction of FDI and human capital reveals a positive FDI effect above a minimum threshold of human capital, estimated to be around 4.5 years of average secondary schooling attainment. Extending their study using multivariate causality tests conducted within a vector error correction framework, they also found significant effects of domestic investment and trade openness, providing support for import-led growth, but direct support for FDI-led growth as well as growth-led FDI is again relatively weak, reinforcing the conclusion that trade openness has played a more significant role than FDI in influencing Thai economic growth. But the results reveal a subtle role for technology transfer through the complementary effect of trade on FDI, and FDI on government expenditure, which thereby influences human capital development with spillovers onto domestic investment and growth. This leads to an argument that there is a potential role for FDI
interacting with human capital in influencing the future development of the Thai economy, given its recently active policy of FDI promotion.

3. **RESEARCH FRAMEWORK**

3.1 **Data Source**

The causality relationship between macro-economic variables with particular emphasis on economic growth has stirred debates in academic circles and the controversy has arisen from the fact that the relationship between the macro-economic variables and economic growth is dynamic in nature. A majority of researches done in Thailand with regard to this area are mostly centered on the role of Agriculture, Government Expenditure, Human Capital and FDI in stimulating the economic growth, without taking into account other variables. This research work is an extension of the existing literature available from Thailand economy. An extended Model is developed as a conceptual framework to analyze the factors influencing the economic growth of Thailand. The model employed Consumer Price Index (CPI) and Personnel Remittances (PR) as extensions to the two existing constructs: Foreign Direct Investment (FDI) and Net Export (NE) to better reflect the economic growth parameters.

This research work is completed in context to the Thailand economy during the period 1980-2013 on the yearly premise containing 34 perceptions, which ought to be satisfactory to validate the association of co-integration among the variables used in the study. The information arrangement required includes GDP, FDI, CPI, NE, and PR. All the information utilized in this study are obtained from different sources of UNCTAD Organization and reports published by the Asian Development Bank. With respect to the economic development estimation, this research work utilizes real Gross Domestic Product (GDP). The variables incorporated in this exploration are GDP as a dependent variable and FDI, CPI, NE and PR as independent variables. All the variables used in the study are converted into the logged version for better results of time series analysis.

3.2 **Model Specification**

In the present research work, the short- and long-run progressive associations among GDP and its determinants is assessed with the help of utilizing ARDL Test, which was initially exhibited
by Pesaran et al. (1996). The ARDL approach gives vigorous results to a smaller sample size of co-integration investigation. Subsequent to the sample size of the present study as 34, this welcomes the appropriateness of ARDL model for the present study. The ARDL model utilized within this research is composed of as follows:

\[ \ln GDP_t = \beta_0 + \beta_1 \ln FDI_t + \beta_2 \ln CPI_t + \beta_3 \ln NE_t + \beta_4 \ln PR_t + e_t \]  

(1)

where \( \ln \) is Natural Logarithm, \( GDP_t \) is growth rate at time \( t \) for measuring economic growth, \( FDI_t \) as assessment of foreign investment flow, \( CPI_t \) is the inflation, \( NE_t \) is Net Export, \( PR_t \) represent personal remittances and \( e_t \) is an error term.

The variables in the Equation (1) could be reframed as follows by considering ARDL framework:

\[
\Delta \ln GDP = \delta_0 + \sum_{i=1}^{6} \epsilon_i \Delta \ln GDP_{t-1} + \sum_{i=1}^{5} \phi_i \Delta \ln FDI_{t-1} + \sum_{i=1}^{5} \psi_i \Delta \ln CPI_{t-1} + \sum_{i=1}^{5} \gamma_i \Delta \ln NE_{t-1} \\
+ \sum_{i=1}^{n} \delta_i \Delta \ln PR_{t-1} + \lambda_1 \ln GDP_{t-1} + \lambda_2 \ln FDI_{t-1} + \lambda_3 \ln CPI_{t-1} + \lambda_4 \ln NE_{t-1} + \lambda_5 \ln PR_{t-1} + \mu_t
\]  

(2)

4. RESULTS AND FINDINGS

4.1 Unit Root Tests

In order to check the stationary properties of the time-series used in the VECM model, two of the well-known stationary tests Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) were used by assuming that the null hypothesis supports the non-stationary properties of time series. So the rejection of the unit root hypothesis favours stationarity property. The findings are depicted in Table 1 and Table 2 in the form of t-test values along with their p-values for all five variables of the model. Both tests criteria indicate that all the dependent and independent variables used in the study have a tendency of non-stationary properties in time series when ADF and PP tests were executed at level.
When Augmented Dickey-Fuller Test is conducted with the Level of series, the computed T-statistics (with no trend and with trend) for LGDP (-0.67 & -2.67), LFDI (-2.50 & -2.86), LCPI (-2.15 & -1.75), LNE (-0.74 and -1.22) & LPR (-0.99 & -2.49) is larger than critical values of LGDP (-2.96 & -3.57), LFDI (-2.99 & -3.60), LCPI (-2.95 & -3.55), LNE (-2.95 & -3.55) & LPR (-2.95 & -3.55) respectively at the significance level of 5%. Results showed by Phillips-Perron test reveals that computed T-statistics (with no trend and with trend) for LGDP (-0.57 & -1.84), LFDI (-1.39 & -2.75), LCPI (-1.96 & -2.06), LNE (-0.71 and -1.64) & LPR (-0.99 & -2.60) is larger than critical values of LGDP (-2.95 & -3.55), LFDI (-2.95 & -3.55), LCPI (-2.95 & -3.55), LNE (-2.95 & -3.55) & LPR (-2.95 & -3.55) respectively at the 5% significance level. This means that the null hypothesis of unit root is accepted for all the five variables. All series have a unit root problem having non-stationary properties series at level of series. Hence ADF and P-P test have been conducted with first differences of each series in order to check the unit root problem.
When Augmented Dickey-Fuller Test is conducted at first difference of series, the computed value of T-statistics at significance level of 5% considering trend and no trend for LGDP (-3.64 & -3.58), LFDI (-3.50 & -3.75), LCPI (-5.38 & -5.23), LNE (-4.08 and -4.06), & LPR (-6.71 & -6.62) is smaller than critical values of LGDP (-2.96 & -3.56), LFDI (-2.99 & -3.61), LCPI (-2.96 & -3.56), LNE (-2.96 & -3.56), & LPR (-2.96 & -3.56) respectively. P-P unit root test at first difference of series also indicates that the computed T-statistics at significance level of 5% considering trend and no trend for LGDP (-3.64 & -3.58), LFDI (-7.29 & -7.77), LCPI (-5.32 & -5.19), LNE (-4.08 and -4.06) & LPR (-6.76 & -6.70) is smaller than critical values of LGDP (-2.96 & -3.56), LFDI (-2.96 & -3.56), LCPI (-2.96 & -3.56), LNE (-2.96 & -3.56) & LPR (-2.96 & -3.56) respectively at the 5% significance level. This means that the null hypothesis of unit root is rejected for all the five variables, which implies that the first difference series of LGDP, LFDI, LCPI, LNE, and LPR achieve stationarity. This is the pre-condition for co-integration test, that is, the variables are integrated of the same order. The study, therefore, proceeds to the co-integration test to obtain the number of co-integrating equation.

### 4.2 Johansen Co-Integration Test

Consequently, Johansen co-integration test is used to determine whether there are any long-term co-integration relationships between LGDP and other four variables (LFDI, LCPI & LNE)
in Thailand or not. In order to check the co-integration among the variables, Trace Statistics and Max Eigen Statistics have been tested by assuming the linear deterministic trend with lag of 1 to 4 for each time series. To determine the number of co-integration equation, this approach focuses on the rank of matrix S, the count for independent co-integrating vectors will represent the rank (the sum of its non-zero Eigen-values). The null hypothesis of having co-integration will be rejected if the calculated value exceeds the tabulated value.

**Table 3 - Johansen-Juselius Co-integration Test**

<table>
<thead>
<tr>
<th>Hypothesized No. of CE(s)</th>
<th>Trace Statistic</th>
<th>Max-Eigen Statistic</th>
<th>Critical Value (5%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Trace</td>
</tr>
<tr>
<td>r = 0</td>
<td>74.78155*</td>
<td>38.27830*</td>
<td>69.81889</td>
</tr>
<tr>
<td>r ≤ 1</td>
<td>37.50324</td>
<td>15.29136</td>
<td>47.85613</td>
</tr>
<tr>
<td>r ≤ 2</td>
<td>22.21188</td>
<td>12.77247</td>
<td>29.79707</td>
</tr>
<tr>
<td>r ≤ 3</td>
<td>9.439416</td>
<td>6.650768</td>
<td>15.49471</td>
</tr>
<tr>
<td>r ≤ 4</td>
<td>2.788649</td>
<td>2.788649</td>
<td>3.841466</td>
</tr>
</tbody>
</table>

*At Significance level of 5% hypothesis will be rejected.

Source: Data analysis.

Table 3 demonstrates the Johansen co-integration test results. It assures the long-term relationship between the selected variables. The result shows that the series is co-integrated, as both the trace and the maximum eigenvalue tests reject the null hypothesis of no co-integration (r=0) at 5% level. Table 3 reveals the trace statistics which indicate that there is at least one (1) co-integrating equation between LGDP and other four variables (LFDI, LCPI & LNE) in Thailand at 5%, meaning that they (the variables) move together in the long-run. Under the Max-Eigen statistics as shown in Table 3, it also indicates that there is at least one (1) co-integrating equation between LGDP and other four variables (LFDI, LCPI & LNE) in Thailand.

From the results both trace statistic and maximum Eigenvalue statistic indicated strong value 1 co-integrations (i.e., Trace Statistic 74.78155 is more than Critical Value 69.81889) at the 5% level of significance, suggesting that there is long-run relationship co-integrating relations between variables. When we talk about the Unrestricted Co-integration Rank Test here also
results are indicating a long-run relationship. Here our Max-Eigen Value (i.e., 38.27830) is more than Critical Value (i.e., 33.87687). Therefore, it may be concluded that there exists a stationary, long-run relationship among the variables.

### 4.3 Estimating a VEC Model

Presence of co-integration among variables under study offered to ascend to the estimation of VEC Model. The significance of the error correction term demonstrates the weight of smaller endogenous conformity (to the long-term pattern) to take the framework back to longer harmony. Up to a specific degree, causality fundamentally involves altogether of developments in the time series. After identifying the existence of co-integrating vector, VECM could be composed as:

\[
\Delta \ln \text{GDP}_t = \alpha_1 + \sum_{i=1}^{1} \Phi_1 \Delta \ln \text{FDI}_{t-1} + \sum_{m=1}^{2} \Omega_1 \Delta \ln \text{CPI}_{t-1} + \sum_{i=1}^{2} \gamma_1 \Delta \ln \text{NE}_{t-1} + \sum_{i=1}^{3} \omega_1 \Delta \ln \text{PR}_{t-1} + \\
\sum_{i=1}^{p} \zeta_1 \Delta \ln \text{GDP}_{t-1} + \Psi_1 \text{ECT}_{t-1} + \epsilon_{1t} \tag{3a}
\]

\[
\Delta \ln \text{FDI}_t = \alpha_2 + \sum_{i=1}^{1} \Phi_2 \Delta \ln \text{GDP}_{t-1} + \sum_{m=1}^{2} \Omega_2 \Delta \ln \text{CPI}_{t-1} + \sum_{i=1}^{2} \gamma_2 \Delta \ln \text{NE}_{t-1} + \sum_{i=1}^{3} \omega_2 \Delta \ln \text{PR}_{t-1} + \\
\sum_{i=1}^{p} \zeta_2 \Delta \ln \text{FDI}_{t-1} + \Psi_2 \text{ECT}_{t-1} + \epsilon_{2t} \tag{3b}
\]

\[
\Delta \ln \text{CPI}_t = \alpha_3 + \sum_{i=1}^{1} \Phi_3 \Delta \ln \text{GDP}_{t-1} + \sum_{m=1}^{2} \Omega_3 \Delta \ln \text{FDI}_{t-1} + \sum_{i=1}^{2} \gamma_3 \Delta \ln \text{NE}_{t-1} + \sum_{i=1}^{3} \omega_3 \Delta \ln \text{PR}_{t-1} + \\
\sum_{i=1}^{p} \zeta_3 \Delta \ln \text{CPI}_{t-1} + \Psi_3 \text{ECT}_{t-1} + \epsilon_{3t} \tag{3c}
\]

\[
\Delta \ln \text{NE}_t = \alpha_4 + \sum_{i=1}^{1} \Phi_4 \Delta \ln \text{GDP}_{t-1} + \sum_{m=1}^{2} \Omega_4 \Delta \ln \text{FDI}_{t-1} + \sum_{i=1}^{2} \gamma_4 \Delta \ln \text{CPI}_{t-1} + \sum_{i=1}^{3} \omega_4 \Delta \ln \text{PR}_{t-1} + \\
\sum_{i=1}^{p} \zeta_4 \Delta \ln \text{NE}_{t-1} + \Psi_4 \text{ECT}_{t-1} + \epsilon_{4t} \tag{3d}
\]

\[
\Delta \ln \text{PR}_t = \alpha_5 + \sum_{i=1}^{1} \Phi_5 \Delta \ln \text{GDP}_{t-1} + \sum_{m=1}^{2} \Omega_5 \Delta \ln \text{FDI}_{t-1} + \sum_{i=1}^{2} \gamma_5 \Delta \ln \text{CPI}_{t-1} + \sum_{i=1}^{3} \omega_5 \Delta \ln \text{NE}_{t-1} + \\
\sum_{i=1}^{p} \zeta_5 \Delta \ln \text{PR}_{t-1} + \Psi_5 \text{ECT}_{t-1} + \epsilon_{5t} \tag{3e}
\]
where $\varepsilon_{it}$ is serially uncorrelated random error terms. In this Vector Error correction model the ECT$_{t-1}$ coefficients $\Psi_1$ to $\Psi_5$ capture the adjustments of $\Delta \ln GDP$, $\Delta \ln FDI$, $\Delta \ln CPI$, $\Delta \ln NE$ and $\Delta \ln PR$. The outcomes of vector correction model (VECM) estimation results obtained from equations (3a) to (3e) are depicted in Table 4. Analysing the data of Granger Causality Test based on VECM, moving across through Equation No. (3a) horizontally the value of ECT$_{t-1}$ is showing statistically significant and negative at the level of significance of 5%. With this, the presence of long-run Granger causality moving from LFDI, LCPI, LNE, and LPR to economic growth is confirmed due to the negative sign of error correction term. The resulting analysis also reveals the short-run causality movements that show the Granger causality proceeding from LNE to LGDP and LPR to LGDP.

**TABLE 4 - Granger Causality Results based on VECM**

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Independent Variables</th>
<th>$\chi^2$ Statistics (Source of Causation)</th>
<th>ECT$_{t-1}$ Coefficient (T-Ratio)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eq.(3a)$\Delta$ LGDP</td>
<td>$\Delta$ LGDP</td>
<td>0.34</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>$\Delta$ LFDI</td>
<td>[0.562]</td>
<td>[0.365]</td>
</tr>
<tr>
<td>Eq.(3b)$\Delta$ LFDI</td>
<td>$\Delta$ LGDP</td>
<td>1.32</td>
<td>4.21**</td>
</tr>
<tr>
<td></td>
<td>[0.251]</td>
<td>[0.012]</td>
<td>[0.510]</td>
</tr>
<tr>
<td>Eq.(3c)$\Delta$ LCPI</td>
<td>$\Delta$ LGDP</td>
<td>0.08</td>
<td>3.28</td>
</tr>
<tr>
<td></td>
<td>[0.780]</td>
<td>[0.070]</td>
<td>[0.960]</td>
</tr>
<tr>
<td>Eq.(3d)$\Delta$ LNE</td>
<td>$\Delta$ LGDP</td>
<td>1.38</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>[0.241]</td>
<td>[0.326]</td>
<td>[0.054]</td>
</tr>
<tr>
<td>Eq.(3e)$\Delta$ LPR</td>
<td>$\Delta$ LGDP</td>
<td>4.23**</td>
<td>1.03</td>
</tr>
<tr>
<td></td>
<td>[0.040]</td>
<td>[0.309]</td>
<td>[0.750]</td>
</tr>
</tbody>
</table>

*Note:* *, ** significant at level of 1% and 5% respectively. [...] Represents p-value.

In aforesaid Table No. 4 horizontal row of Equation No.(3b) indicates that LFDI retort to long-run equilibrium because the negative value of ECT$_{t-1}$ at a significance level of 1% substantiate long-run causality moving from LGDP, LCPI, LNE and LPR to LFDI. In the same Equation No. (3b) Granger causality movement may be sense from the short-time perspective from LCPI to LFDI. Equation No.(3c) affirm the ubiquity of long-run Granger causality due to the presence of
significant and negative value of $ECT_{t-1}$ but the movement is at a low speed from LGDP, LFDI, LNE and LPR to LCPI. Moving on to the Equation No. (3d), it supports the presence of long-run equilibrium among the variables used in the model and the pace of movement followed is also high.

Furthermore, Equation No. (3d) also indicates the movement of Granger causality from LCPI to LNE. Moreover, taking a look at Equation No. (3e) indications of insignificant long-run equilibrium are supporting the results. On the other hand from a short-run perspective, Granger causality movement can be seen from LGDP to LPR. The outcome of the study also affirms the bi-directional causality between LPR and LGDP. Aforesaid determinations recommend that LPR, LNE, and LFDI matters a lot for sustainability in the economic growth of Thailand.

4.4 Variance Decomposition

The measurement of the percentage change (variation) in the economic growth of Thailand aroused by the shocks that emerge from its apt determinants is resolve by the variance decomposition. The approximation of the aforesaid has been listed below in Table 5. It covers a time period of 10 years. Now, let’s throw some light on the results drawn from the Table 5. There are five macro-economic variables in this study which are used for the model specification of VECM which includes LGDP, LFDI, LCPI, LNE, and LPR. As from the table, it indicates that the average of LGDP out of all the other four determinants is the greatest. This signifies that the disturbances emerging from the LGDP have imposed the highest variability to future economic growth in Thailand. The percentage of the variability contributed by the LGDP one year ahead is 50%. On the other hand, the percentage of the variability contributed by the LGDP 5 years ahead is 72% approx. Until 10 years the proportion of variance remains high i.e., 75%. So, to conclude we may visualize that LGDP confers 69 % (highest) variability. But, in spite of this 31% remains unexplained, which is further explained by other factors. Out of the four economic growth determinants which influence the economic growth of Thailand, net exports prove to be victorious. It accounts for approximately 81% of the total variance contributed by the four determinants (24.51% of the economic growth variance).

It indicates that in a developing country like Thailand the net export is one of the fundamental reasons for economic growth. On one hand, exports of goods and services produce income at home country and become a component of GDP. On the other hand, imports generate income
abroad, so it is subtracted from the export. Export also plays a vital role in achieving the socio-economic objectives of countries.

### Table 5 - Variance Decomposition of Economic Growth (GDP)

<table>
<thead>
<tr>
<th>Period</th>
<th>LGDP (%)</th>
<th>LFDI (%)</th>
<th>LCPI (%)</th>
<th>LNE (%)</th>
<th>LPR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>49.88</td>
<td>5.00</td>
<td>9.38</td>
<td>35.73</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>62.47</td>
<td>4.87</td>
<td>3.52</td>
<td>28.79</td>
<td>0.34</td>
</tr>
<tr>
<td>3</td>
<td>67.20</td>
<td>3.45</td>
<td>2.029</td>
<td>26.74</td>
<td>0.58</td>
</tr>
<tr>
<td>4</td>
<td>70.43</td>
<td>3.01</td>
<td>1.40</td>
<td>24.52</td>
<td>0.64</td>
</tr>
<tr>
<td>5</td>
<td>72.35</td>
<td>2.94</td>
<td>1.09</td>
<td>22.99</td>
<td>0.66</td>
</tr>
<tr>
<td>6</td>
<td>73.43</td>
<td>2.89</td>
<td>0.90</td>
<td>22.11</td>
<td>0.67</td>
</tr>
<tr>
<td>7</td>
<td>74.13</td>
<td>2.87</td>
<td>0.77</td>
<td>21.56</td>
<td>0.68</td>
</tr>
<tr>
<td>8</td>
<td>74.63</td>
<td>2.86</td>
<td>0.67</td>
<td>21.16</td>
<td>0.68</td>
</tr>
<tr>
<td>9</td>
<td>75.00</td>
<td>2.85</td>
<td>0.59</td>
<td>20.87</td>
<td>0.68</td>
</tr>
<tr>
<td>10</td>
<td>75.29</td>
<td>2.84</td>
<td>0.53</td>
<td>20.64</td>
<td>0.69</td>
</tr>
<tr>
<td>Average</td>
<td>69.48</td>
<td>3.36</td>
<td>2.09</td>
<td>24.51</td>
<td>0.56</td>
</tr>
</tbody>
</table>

*Source: Data Analysis.*

The LFDI is the other third largest source of the economic growth variance. It accounts for approximately 10% of the total variance that is contributed by the four determinants formerly mentioned. Thus, it admits the fact that foreign direct investment is a positive force for the economic growth of any country and export always enhances economic growth for small open economies. LCPI is the fourth largest source of the economic growth variance which contributes approximately 6% of the variance contributed by the four determinants accounted for the economic growth. This outcome has a very critical implication for the Thailand policy makers. Controlling the level of inflation is a must for maintaining the sustainability of the economic growth. Hence, the policy makers should be able to keep inflation rate at the low level. Apart
from these three determinants, the final remaining variable, personal remittances, contributes very less, approximately 3% of economic growth variance.

4.5 Impulse Response Functions

Impulse responsive function uses Vector Autoregressive to measure the responsiveness of a series when the shock is presented in one of the variables and exceeds the time period. Impulse Responsive functions give an indication of the system's dynamic behavior. This can be visualized through the fact that the variance decomposition cannot indicate whether the impact is positive/negative or whether it's is a temporary jump or long run persistence. Although economic growth of variance decomposition determined its determinants, Pesaran and Shin in 1998, proposed the generalized impulse response analysis. Comparing the VAR Framework with traditional (Engle and Granger, 1987) the economists found that there are two reasons that made VAR Framework superior to the latter. Very first, ordering of the variables is determined just by the VAR system. So, the variable ordering does not affect the results. Secondly, the simultaneous shock effects are computed by the generalized impulse analysis. Generalized impulse response functions (GIFRS) lying underneath in Figure 1, shows the response and impact of each and every macro-economic variable of VAR under study. In the VECM System, the GIRFs provides the support of causality status between economic growth and its' determinants.
Figure 1

Response to Cholesky One S.D. Innovations ± 2 S.E.
5. **Conclusion and Recommendation**

The study began by empirically examining the causal association among the selected macroeconomic variables (LFDI, LCPI, LNE, and LPR) with the economic growth (LGDP) in Thailand during the period 1980-2013. The study uses the multivariate VAR framework. The analysis started with stationary property examination of the underlying time series data. The estimated results confirmed that LGDP, LFDI, LCPI, LNE, and LPR are not stable under the confidence level of 5% but their first order difference terms are all stationary. Hence, they are integrated of order one. Results of study depict a long-run dynamic association of economic growth with its macroeconomic variables. The Johansen’s multivariate co-integration test evidence from the result suggests that the null hypothesis of no co-integration ($r = 0$) is rejected, which indicates that GDP and its determinants are co-integrated and thus exhibit a reliable long-run relationship. Having found co-integration among the variables we also carried out the Granger-causality by the mean of VAR. The result shows the existence of unidirectional causality between LNE and LGDP (LNE → LGDP) which is in consonance with the findings of Ruba et al. (2014) and Kalaitzi (2013) whereby both authors identify that there is a causal relationship between export and growth rate but in one direction, so that changes in the economic growth have effects on export but not vice versa. Furthermore, the study also results into unidirectional causality between LCPI and LNE (LCPI → LNE) which is very much similar to the study of Erbaykal and Okuyan (2008), where no causality relationship was found from economic growth to inflation but a causality relationship was found from inflation to economic growth. This study also confirms the presence of bilateral causality among LPR and LGDP which is consistent with the result of previous studies conducted by Pradhan et al. (2008) and Nyamongo et al. (2012), where the authors have found that remittances inflows affect economic growth positively. This study showed that there is no causal association between LFDI and LGDP which is inconsistent with the result of Makki and Somwaru (2004), which demonstrate a strong relationship between FDI and economic growth. This finding of the study related to having no relationship between FDI and economic growth is just opposite to the current literature.

For checking the source of instability and recognize the reactions from the macroeconomic variables of economic growth, study decomposes the variance of economic growth. The outcomes demonstrate that an aggravation beginning from LGDP itself actuates the
greatest variability to future economic development: it represents 50 percent of the variability one period ahead, roughly 72 percent five years ahead followed by 75 percent ten years ahead. The remaining fluctuation is represented by the remaining four variables. Among the four determinants Net Export contributed highest, i.e. 24.51 percent of the total economic growth variance, followed by foreign direct investment which is responsible for 3 percent movement in economic growth of Thailand. Further study also reveals that personal remittances and consumer price index play a very negligible role in the economic growth variance. Based on the findings of the present study the government of Thailand must focus on the liberalization of their economic policies, so that the boost in the industrial growth may help in the enhancement of net export which is one of the dominant factors for Thailand economy. Furthermore, the policies related to the foreign investments need to be focused which may attract the FDI flows.

The most important implication of our findings is a policy recommendation: if policy makers want to promote growth, then attention should be focused on long-run policies, for example, the enhancement of the existing export promotion schemes, liberal policies to invite FDI inflows, and the preservation of low rate of inflation. The government, therefore, needs to further enhance the banking sector and provide a conducive environment for foreign investors to allocate the assets. Apart from maintaining the low rate of inflation, the enhancement of financial and banking sector that promotes personnel remittances is among the important factors to be looked into by the government in order to speed up the economic growth.

The results have implications on domestic as well as foreign investors, stock market regulators, policy makers and stock market analysts. Investors and security analysts could forecast stock prices by analyzing the economic growth and earn profits. Policy makers should be acquainted with these macroeconomic effects on economic growth and make their decisions in a more efficient and precise manner. Since ambiguous research results were found in this study, it provides potential researchers ample opportunity for further research where a variety of other variables can also be taken into consideration which influences the economic growth of any developing economy.
REFERENCES


