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Budget Deficit and Real Exchange Rate: Further Evidence from Cointegration and Causality Test for in the Lao PDR

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Abstract: Laos is resource booms economy and might be affected by the Dutch disease. One of important factors for appreciation of real exchange rate is increasing government spending from resources sector. However, the relationship between government spending and real exchange rate appreciation is not clear. Therefore, the purpose of this paper is to investigate the dynamic relation between budget deficit and the real exchange rate in the Lao PDR from 1980 to 2010. The empirical analysis applies ARDL Cointegration methodology in conjunction with the VAR as well as the structural VAR (SVAR) analysis to provide evidence for both the long and short run dynamics between the variables. We found that there is no long run relationship between budget deficit and real exchange rate in the case of Laos. In addition, we also found that there is no Granger causality between budget deficit and real exchange rate in Laos.

JEL classification: C22, C23, H10, H50
Key words: Budget deficit · The real exchange rate · ARDL Bounds Testing · SVAR model

INTRODUCTION

The question about causality between the government budget balance and real exchange rate is important to investigate and is a dominant theme of discussion in economic policy circles. This theme is certainly not new although the debate on the relation between budget deficit and real exchange rates has a long and distinguished intellectual history. The studies focus on the relationship between the budget deficit and exchange rate and argue that budget deficit may appreciate or depreciate the exchange rate, depending on the relative importance of wealth effects and relative asset substitution effects.

Since the New Economic Mechanism[1] (NEM), was introduced in 1986, Laos has been in transition from a centrally planned economy to a more market-oriented economy. As a result, with the exception of a period of negative growth following the Asia financial crisis of 1997, Laos had generally been achieving high rates of economy growth with low inflation. Average economic growth was about 7 % during 2000-2010. Inflation has been maintained below double digits since 2005, about 4.5 % in 2007 [1]. The exchange rate has also stabilized since 2000. The kip depreciated against the dollar by 4.9% in 2003 but experienced only marginal depreciation in the next 2 years. In 2006, the kip began to strengthen against the dollar, rising 9.2% in 2006, 2.8% in 2007 and 6.6% in

[1]Laos has implemented various reforms under NEM, which includes vital components; (a) promotion of private production through improved incentives; (b) institutional infrastructure to improve market economy operation; (c) the strengthening of Lao comparative advantages through trade liberalization and future specialization; and (d) the establishment of price stability through macroeconomic policy measures.

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2008. Even though Laos has been maintaining high economic growth with low inflation and a stable exchange rate, there are still serious macroeconomic issues to overcome. Laos is basically facing chronic twin deficits in both government fiscal and international trade. During last three decades Budget deficit to GDP was over 5% and slightly improved during 2000 onward. In fiscal year 2006-2007, budget deficit to GDP was 2.7% compared to 6.5% in fiscal year 1997-1998. The government deficit is financed mostly through government revenue and international development assistance. In addition, the government revenues are largely dependent on natural resources. The fiscal revenues from this sector went from 3% in 2001 to around 18% of total revenues in 2008. The contribution from the mining and energy sectors to the GDP in particular went from approximately 2.5% before 1997 to 12% in 2008. Thus, natural resources contributed more than one-fifth of the total economic growth over that period. Current account balance had moved the same pattern as budget deficit during last three decades. Recently, in 2011 current account balance was at negative 1.8 to GDP [1].

The purpose of this paper is to examine the relation between budget deficit and the real exchange rate and its implication. In order to examine the long-run relation between two variables, we apply the ARDL bounds testing approach to cointegration and the VAR Granger causality as well as the structural VAR framework. This study uses annual time series data and covers the period of 1980 to 2010. This study contributes to the literature as follows: firstly, this study is a pioneering effort by investigating the causality between budget deficit and current account and the real exchange rate in the Lao PDR. Second, we use the ARDL bounds testing approach to cointegration that was developed by Pesaran, Shin and Smith [2] and lastly we use VAR and the structural VAR that was used by Narayan, Narayan and Prasad [3].

Following the introduction in Section 1, this paper is organized as follows: Section 2 discusses the literature and evidence from the empirical findings. Section 3 provides the modeling and empirical strategy. Section 4 provides the empirical results and the last section concludes the paper.

Literature Review: It is generally accepted that cutting budget deficit will result in a decrease in interest rates but its real effects on exchange rate is not clear cut. Some argued the exchange rate would be strenghthened by deficit reduction, while others argued it would be weakened. Deficit reduction has different effects on the exchange rate, with some effects leading to a stronger exchange rate and other effects leading to a weaker exchange rate. Budget deficit reduction may have an effect on interest rates and exchange rates both directly and indirectly. Direct effects decrease the exchange rates, while indirect effects increase the exchange rates.

Deficit reduction can give rise to a weaker exchange rate. Deficit reduction directly influences interest rates and exchange rates because it decreases the demand for loanable funds leading to the interest rates to shrink. With the decline of domestic interest rates, exchange rates will decrease accordingly. If domestic assets pay lower yields, investors would incline to sell lower yielding domestic securities and buy higher yielding foreign securities. When an investor tends to buy a foreign security in lieu of a domestic one, he does not really exchange a domestic security for a foreign security. In this case, the investor sells domestic security for domestic currency, buys foreign currency by using domestic currency and lastly uses the foreign currency to buy the foreign security. Consequently, a fall in domestic interest rates diminishes the demand for the national currency giving rise to the depreciation of the exchange rate.

Deficit reduction may also indirectly lead to an increase in demand for loanable funds by private investors. The increase in demand for funds may originate from one of three effects; a) lower expected inflation rate, b) lower foreign exchange risk premium and finally c) higher expected rate of return on domestic assets.

Firstly, budget deficit reduction may lead to a decrease in expected inflation. When the government decreases budget deficits, its need for printing money or monetizing the deficit will diminish, leading to a fall in expected rate of inflation. Since nominal interest rate includes expected inflation as definition, when long-term expected inflation falls, nominal interest rates will decrease correspondingly. A fall in long-term inflation expectations leads to a decrease in nominal long-term interest rates, whereas it leads to an increase in real interest rates. As the real interest rates increase, investors will find domestic securities more appealing, leading to a rise in the demand for national currency. In other words, when expected inflation falls appreciation of the exchange rate takes place ultimately.

Secondly, reduction of budget deficits may give rise to a fall in the riskiness of domestic securities in comparison with foreign securities. When budget deficits decrease, government borrowings decrease, leading to a fall in the stock of domestic government securities, which in turn gives rise to the foreign exchange risk premium to decrease. When the foreign exchange risk premium falls, demand for domestic securities tend to increase and the appreciation of the exchange rate occurs. Beside these facts, when the government reduces budget deficits, risk of default decreases and foreign exchange risk premium falls.

Thirdly, deficit reduction may affect the expected rate of return on domestic securities. Government can decrease budget deficits either by cutting spendings or by increasing taxes. These two ways of cutting budget deficits may have individual effects over the expected rate of return of domestic assets. When the government cuts spendings, it also directs resources toward private sector. The use of resources by private sector leads to a rise in private investments, which in turn causes an increase in economic growth. As a result of this situation, the expected rate of return of domestic assets might also increase, hence leading to a higher demand for domestic assets and domestic currency, resulting in the appreciation of the exchange rate in the end.

Many studies have focused on the interaction of deficits with interest rates but there have been conflicting and inconsistent empirical findings about the relationship between budget deficits and interest rates. Evans [4, 5, 6] and Barro [7] found no causal relationship between budget deficits and interest rates in the US. On the other hand, Hoelscher [8] and Cebula and Koch [9], found that federal budget deficits have contributed to higher levels of interest rate yields. Wijnbergen [10] have shown that in Canada higher budget deficits have led to higher interest rates and, therefore, to an appreciation of the Canadian dollar. Knoester and Mak [11] showed that only in Germany (among eight OECD economies) does the government budget deficit contribute significantly to the explanation of higher interest rates.

There is some literature on relationship between current account deficit and government deficit. Large budget deficits contributed to a worse performance by the trade deficit. Several researchers have examined the Feldstein hypothesis of the "twin deficits" [12]. According to this hypothesis, the current account deficit was caused by large public deficits. The explanation lies in the story behind budget deficits. Higher interest rates comparative to their foreign counterparts, drive up the value of the domestic currency internationally, since they attract capital from the rest of the world and through this channel, they contribute to the deterioration in trade. Darrat [13]; Miller and Russek [14]; and Alse and Bahmani-Oskooee [15] have demonstrated this perverse relation via empirical analysis. Sachs [16] and Krugman [17] argued that lower budget deficit lowers the value of the dollar.

Many researchers have interpreted this issue in many contrary views. Fleming [18]; Smyth and Hsing [19] has argued that government deficits may cause trade deficits through different channels. For example, it is argued that an increase in the budget deficit would induce upward pressure on interest rates, causing capital inflows and an appreciation of the exchange rate that will increase the current account deficit. The Keynesian absorption theory suggests that an increase in the budget deficit would induce domestic absorption and thus, import expansion, causing a current account deficit. Another contrary view is provided by Barro [20], known as the Ricardian Equivalence Hypothesis (REH). He states that shifts between taxes and budget deficits do not matter for the real interest rate, the quantity of investment, or the current account balance. In other words, theoretically, REH negates any relationship between the two deficits.

Moreover, Feldstein [12], Melvin, Schlagenhauf and Talu [21] and Oskooee and Payesteh [22] showed that higher budget deficits have been followed by an appreciation of the dollar and vice versa. Bernheim [23], Abell [24] and Zietz and Pemberton, [25] has demonstrated that a rise in budget deficit associated with lower savings tends to appreciate the exchange rate as a result of capital inflows.

Evans [5] argues that higher budget deficits tend to raise domestic consumption. Higher consumption falls on both domestic and imported goods, which in turn leads to higher domestic interest rates with respect to their counterparts abroad. Then, capital inflows are induced, which tend to be prevented by an appreciation in the exchange rate sufficient to motivate traders to hold the existing stock of assets. If the budget deficit contributes to aggregate demand, this might lead to higher price levels and, therefore, to a depreciated currency.

There have been other studies on the impact of budget deficits on other macroeconomic variables such as inflation and money supply. McMillin [26] find evidence

that budget deficits cause inflation. Other studies refute this finding and suggest that budget deficits do not contribute significantly to higher inflation [27]. It has also been stated that depending on the degree of independence the Central bank enjoys, it may resort to monetize the deficit in the current period or in future periods [28]. Turnovsky and Wohar [29] have argued that the empirical results depend on the exchange rate regime under which the economies operate. In terms of the relationship between budget deficits and money supply, some studies have found evidence in favor of the debt monetisation hypothesis [30], while others have reached the opposite results [31]. Inflationary conditions could be made worse through printing more money; crowding out effect[2], which tends to and excessive issue of government bonds, since they constitute a substantial part of money supply. Therefore, higher budget deficits could aggravate the inflationary conditions in the economy, contributing to the presence of a depreciated domestic currency.

These variety results arise due to the different data set, alternative econometric methodologies and different countries' characteristics. Despite the fact that the relationship between government budget and exchange rate issues is important to evaluate how to address their imbalances, empirical research on this issue in the Lao PDR is scarce as there has been no published research in the case of the Lao PDR. Nevertheless, earlier study on Kyopilavong and Toyoda, [32] used macroeconomic model to examine exchange rate policy on Lao economy. On one hand, macroeconomic stability in term of prudent fiscal balance and controlling inflation is one of the most priorities for fiscal and monetary authority[3] [33, 34]. Therefore, it is very importance to deeply examine the causality of these two variables.

Modeling, Empirical Strategy and Data Collection: Following literatures, the dynamic relationship between government budget deficit and real exchange rate is investigated. The relation is specified as follows:

$$\text{Ln BD}_t = \alpha_1 + \alpha_2 \ln \text{REX}_t + \mu_t \quad (1)$$

$$\text{Ln REX}_t = \beta_1 + \beta_2 \ln \text{BD}_t + \mu_t \quad (2)$$

where, BD and REX denote the government budget deficit and real exchange rate respectively. μ is an error term. We expect that α_2 and $\beta_2 > 0$. Government budget deficit was defined as the ratio government budget deficit to GDP and the real exchange rate of the Lao PDR. To examine the long-run relationship between two variables, ARDL bounds testing approach to cointegration is used. This approach is sequentially developed by Pesaran and Pesaran [35], Pesaran and Shin [36] and Pesaran *et al*. [2]. There are a number of comparative advantages to the ARDL method, which makes it more useful than others. First, with a small sample size, as is the case with ours, this method is more efficient than other techniques. Secondly, the ARDL bounds testing is flexible regarding the integrating order of variables whether variables are found to be stationary at I(1) or I(0). A dynamic unrestricted error model (UECM) can derived from the ARDL bound testing through a simple linear transformation The UECM integrates the short run dynamics with the long run equilibrium without losing any information for long run. The empirical formula of the ARDL bounds testing approach to cointegration is given below:

$$\Delta \ln \text{BD}_t = c_1 + \pi_1 \ln \text{BD}_{t-1} + \pi_2 \ln \text{REX}_{t-1} + \sum_{i=1}^{p} \theta_i \Delta \ln \text{BD}_{t-i} + \sum_{i=1}^{p} \xi_i \Delta \ln \text{REX}_{t-i} + u_{1t} \quad (4)$$

$$\Delta \ln \text{REX}_t = c_2 + \pi_1 \text{REX}_{t-1} + \pi_2 \ln \text{BD}_{t-1} + \sum_{i=1}^{p} \theta_i \Delta \ln \text{REX}_{t-i} + \sum_{i=1}^{p} \phi_i \Delta \ln \text{BD}_{t-i} + u_{2t} \quad (5)$$

Here, Δ is the first difference logarithm operator. c_1 and c_2 are constants and π_1 and π_2 are the coefficients on the lagged level dependent and independent variables respectively. θ_i and Φ_i are the coefficients on the lagged dependent and independent variables respectively. u_{1t} and u_{2t} are the error terms. P signifies the maximum lag length, which is decided by the user.

The procedure of the ARDL bounds testing approach has two steps. The first step is dealt with F-test for the joint significance of lagged level variables. The null hypothesis of the non-existence of a long-run relationship is H_o: $\pi_1 = \pi_2 = 0$ against (H_a: $\pi_1 \neq \pi_2$). Pesaran *et al*. [2] generated lower and upper critical bounds for F-test, lower bound critical values assume all variables are I(0) while upper bound critical values assume all variable are I(1). If the calculated F-statistic exceeds upper critical bound, the null hypothesis of no cointegration among

[2]Results in reduced real capital stock in the economy, in turn, a lower growth rate of output, and thereby, with a given money supply, to higher prices.

[3]Lao has induced managed-floating exchange rate system in 1986. Monetary authority has management exchange rate in order to stabilize macro-economy.

variables may be rejected. If the calculated F-statistic falls below lower bound, the null hypothesis of no long-run relationship is accepted[4].

Further, we use VAR and structural VAR (SVAR) approaches to analyze the dynamic of the relationship between BD and REX. SVAR is used to see the sensitivity of the results of VAR model. The SVAR is superior to the VAR in the sense that the reduced form of VAR does not consider the structural relationship among the variables unless some identification restrictions are assumed. In this sense, SVAR analysis is an attempt to solve the traditional identification problem. Therefore, the SVAR can be used to predict the effects of specific policy actions or of important changes in the economy [3].

We define a vector of variables in SVAR as follows:

$$x_t = [BD_t, REX_t]' \quad (6)$$

The infinite order vector moving average (VMA) represent as follows:

$$\Delta x_t = C(L)\, \xi_t \quad (7)$$

where L is a lag operator, Δ is a difference operator and $\xi_t = [\xi_{a,t}, \xi_{b,t}]$ is a (2 x 1) vector for the covariance matrix of the structure shocks Σ. The error term can be interpreted as relative budget deficit shocks and real exchange rate shocks respectively. We assume that structural shocks have no contemporaneous correlation or autocorrelation. This implies that Σ is a lower diagonal matrix.

Next, we estimate the following finite-order VAR model:

$$[I - \Psi(L)]\, \Delta x_t = u_t \quad (8)$$

where Ø(L) is a finite-order matrix polynomial in the lag operator and u_t is a vector of disturbance. If the stationary condition is satisfied, we can transfer equation (8) to the VMA form:

$$\Delta x_t = A(L)\, u_t \quad (9)$$

where A(L) is a lag polynomial. Equation (7) and (9) imply a linear relationship between $\hat{\imath}_t$ and u_t as follows:

$$u_t = C_0\, \xi_t \quad (10)$$

In equation (10), C_0 is a 2 x 2 matrix that defines the contemporaneous structural relationship among the variables. Addition, we have to identify for the vector of structure shocks so that it can be recovered from the estimated disturbance vector. We require 4 parameters to convert the residual from the estimated VAR into the original shocks that drive the behavior of the endogenous variables.

The long-run of equation (8) can be written as follows:

$$\begin{bmatrix} BD_t \\ REX_t \end{bmatrix} = \begin{bmatrix} C_{11}(1)\, C_{12}(1) \\ C_{21}(1)\, C_{22}(1) \end{bmatrix} \begin{bmatrix} \xi_{1,t} \\ \xi_{2,t} \end{bmatrix} \quad (11)$$

where $C(1) = C_0 + C_1 + C_2 + \ldots 0$ are long-run multiplier in SVAR model (long-run effect of Δx_t). We worked with a lower triangular matrix. In next step, we construct a SVAR and plot the impulse response functions (IRFs) of variables in the model. Lag-length to be incorporated in analysis of SVAR model is determined based on Akaike Information Criteria (AIC) because of its better performance in small sample [38].

Empirical Results: We apply the ARDL to find the long-run link between budget deficit and real exchange rate in the Lao PDR. To ensure that the variables are not stationary at I(2),we use the augmented Dickey-Fuller (ADF) [39, 40] and PP tests [41]. The unit root test shows that the BD and the REX are stationary in their different forms with the intercept. This finding implies that our variables have an order of integration that is I(1).

We select the optimal lag length by using the Schwarz Bayesian Criterion (SBC). The result indicates that one is the optimal lag order[5]. To account for a relatively small sample size, we produce new critical values (CVs) for the F-test computed by stochastic simulations with 20,000 replications. Table 2 reports the computed F-statistic for cointegration. When the dependent variable is $\ln BD_t$, then the calculated F-statistic ($F(\ln BD_t / \ln REX_t) = 0.948$) is smaller than the lower critical bound at the 10% significance level. Further, when the dependent variable is $\ln REX_t$, then the calculated F-statistic ($F(\ln REX_t / \ln BD_t = 0.683$) is smaller than the lower critical bound at the 5% significance level. These results suggest that no cointegration exists between budget and real exchange in Laos.

[4]If the calculated F-statistics falls between the lower and upper bounds, it is inclusive. The significance and negative lagged error-correction term has been used for the investigation of cointegration [37].

[5]We also set the maximum lag order up to five due to the small sample size. The results are available upon request.

Table 1: Results of Unit root test

	ADF test				PP test			
	Level		Difference		Level		Difference	
	Intercept	With trend	Intercept	With trend	Intercept	With trend	Intercept	With trend
lnBD	-1.3190 (2)	-5.2437* (0)	-6.1904* (1)	-6.1077* (1)	-1.6030 (6)	-5.2976* (2)	-20.6424* (21)	-22.8625* (20)
lnREX	-1.2057 (1)	-0.6903 (0)	-3.2061** (0)	-3.2357 (0)	-0.9619 (2)	-0.9665 (1)	-3.1616** (2)	-3.1667 (3)

Note: * and ** show the significance at 1% and 5% level respectively. ( ) Denote the Lag Length for ADF test or the Bandwidth for PP test.

Table 2: Results of ARDL Cointegration Test

Variable	$lnBD_t$	$lnREX_t$
F-statistics	0.9485	0.6835
Cittical values	5% level	10% level
Lower bounds	5.6928	4.4607
Upper bounds	6.6165	5.2536
Diagnostic tests		
R^2	0.6064	0.7566
Adj-R^2	0.5671	0.7323
Durbin-Watson	2.7815	1.2494

Note: *, ** and *** show the significance at 1%, 5% and 10% level respectively.

Table 3: VAR Engle-Granger causality analysis

VAR Granger Causality/Block Exogeneity Wald Test					
Sample: 1980 2010					
Dependent variable: BD			Dependent variable: REX		
Excluded	Chi-sq	Prob	Excluded	Chi-sq	Prob
DLREX	2.132696	0.3443	DLBD	2.278898	0.3200
All	2.132696	0.3443	All	2.278898	0.3200

Note: *, ** and *** show the significance at 1%, 5% and 10% level respectively

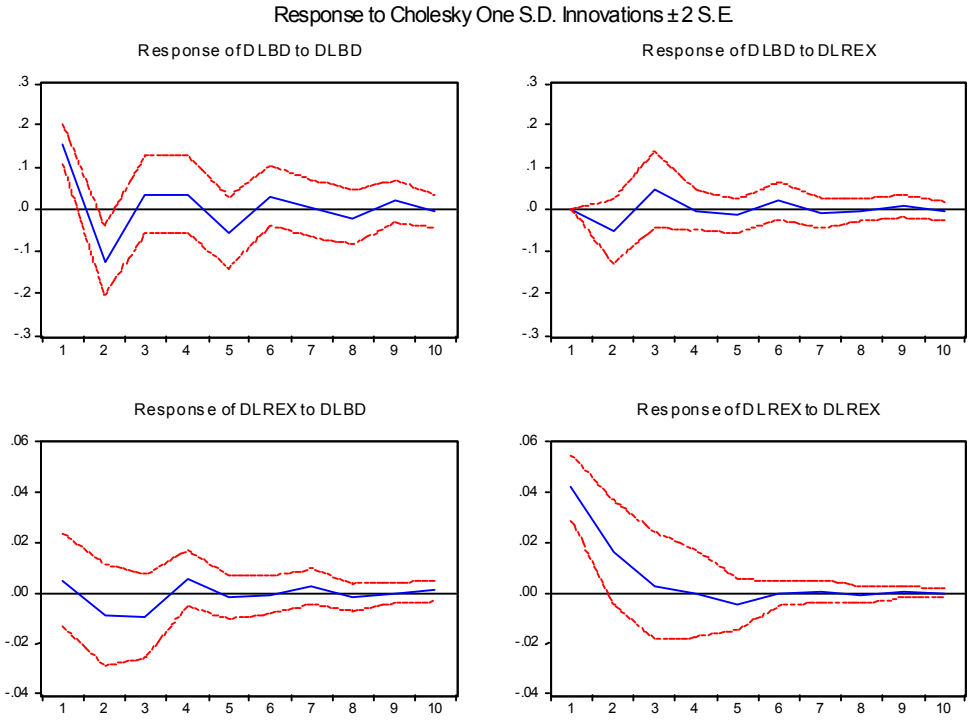

Fig. 1: IRF of VAR analysis

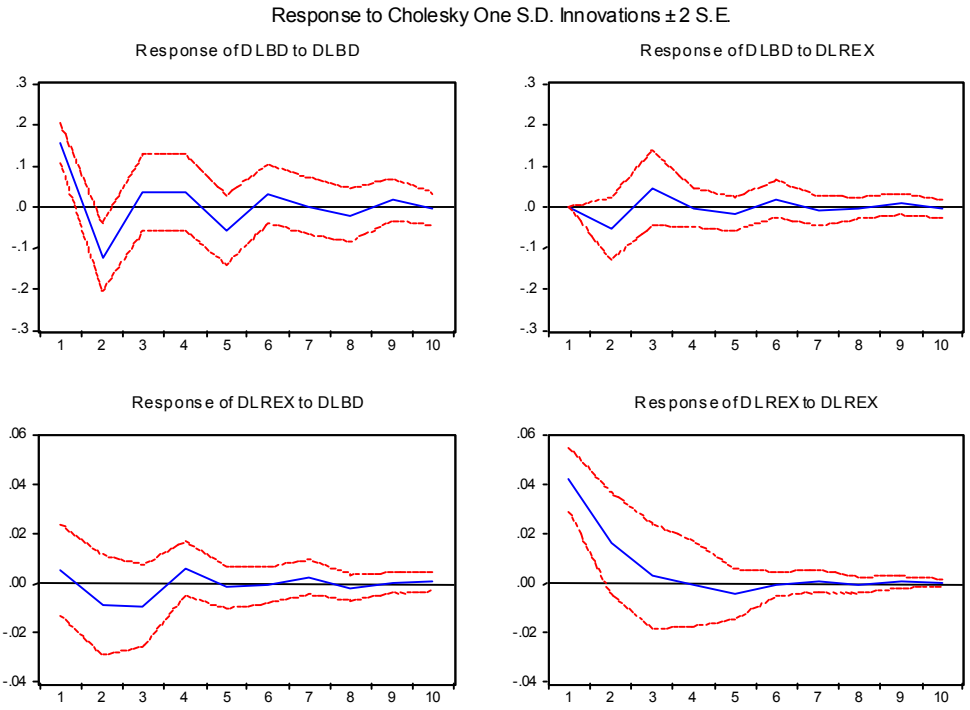

Fig. 2: IRFs in SVAR model

In order to obtain better results we analyzed the VAR-based Granger causality test and reported the results in Table 3. It is evident from Table 3 that there is no causal relationship between BD and REX.

Further, to analyze the accumulated dynamic among these variables we calculated IRFs with 10,000 Monte Carlo simulation standard errors following Benkwitz, Lütkepohl and Wolters [42], who suggest that for a small sample, the properties of bootstrap confidence intervals are better in comparison with other asymptotic methodologies, as we have a sample size which is not large enough. In the following Figure 1 shows the impulse response function (IRF) of the VAR.

It is evidence from Figure 1 shows that the response of BD to one SD shock in REX is negative and positive, while the response of REX to one SD shock in BD is also positive and negative. After analyzing the VAR model and IRFs derived from the VAR model, in the next step we analyzed the SVAR model and presented the IRFs plots in Figure 2.

Figure 2 shows that the accumulated response of BD to one SD shock in BD itself is positive and negative, whereas the response of BD to SD shock in REX is negative and positive. The accumulated response of REX to one SD shock in REX itself is positive in 4 years and tern to negative in 5 years, whereas the response of REX to SD shock in BD is positive and negative. The results of FEVDs (forecast error variance decompositions) for VAR and SAVR are presented in appendix 1 and 2.

CONCLUSION

This study examined an important subject between government budget balance and real exchange rate by employed the ARDL bounds testing approach and Granger causality in SVAR framework to examine the interrelationship between two variables by using annual date from 1980 to 2010. We have examined the causality of budget deficit and real exchange rate in structural VAR (SVAR) framework that is superior to the VAR analysis in term of addressing the traditional identification problem and is well suited to predict the effects of specific policy actions or important changes in the economy.

The results reveal that there is no long run relationship between budget deficit and real exchange rate. There is no Granger causality between two variables. However, the impulse response results in SVAR model indicate that budget deficit has a positive and negative impact over the real exchange rate. The variance decomposition analysis of budget deficit could explain about 10% in real exchange rate. Nevertheless, the study found that budget deficit has not directly caused an

Appendix I: Variance decomposition in VAR

Variance Decomposition of DLBD:				Variance Decomposition of DLREX:			
Period	S.E.	DLBD	DLREX	Period	S.E.	DLBD	DLREX
1	0.16	100.00	0.00	1.00	0.04	1.56	98.44
2	0.21	93.22	6.78	2.00	0.05	4.85	95.15
3	0.21	89.09	10.91	3.00	0.05	8.43	91.57
4	0.22	89.36	10.64	4.00	0.05	9.91	90.09
5	0.22	89.56	10.44	5.00	0.05	9.93	90.07
6	0.23	89.13	10.87	6.00	0.05	9.95	90.05
7	0.23	88.99	11.01	7.00	0.05	10.21	89.79
8	0.23	89.05	10.95	8.00	0.05	10.33	89.67
9	0.23	89.02	10.98	9.00	0.05	10.33	89.67
10	0.23	88.97	11.03	10.00	0.05	10.35	89.65

Appendix II: Variance decomposition in SVAR

Variance Decomposition of DLBD:				Variance Decomposition of DLREX:			
Period	S.E.	DLBD	DLREX	Period	S.E.	DLBD	DLREX
1	0.16	100.00	0.00	1	0.04	1.56	98.44
2	0.21	93.22	6.78	2	0.05	4.85	95.15
3	0.21	89.09	10.91	3	0.05	8.43	91.57
4	0.22	89.36	10.64	4	0.05	9.91	90.09
5	0.22	89.56	10.44	5	0.05	9.93	90.07
6	0.23	89.13	10.87	6	0.05	9.95	90.05
7	0.23	88.99	11.01	7	0.05	10.21	89.79
8	0.23	89.05	10.95	8	0.05	10.33	89.67
9	0.23	89.02	10.98	9	0.05	10.33	89.67
10	0.23	88.97	11.03	10	0.05	10.35	89.65

appreciation of real exchange rate in Laos. But there is a sign to have moving forward to the Dutch disease phenomena. In order to prevent Dutch disease, it is important to reduce budget deficits.

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