The causality of dollarisation, interest rate and exchange rate: evidence from Laos

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Abstract: In this paper, we examine the causality among the dollarisation, the interest rate differential, and the exchange rate risk in Laos. We use an ARDL approach to cointegration and a Granger causality test in a VECM for this purpose. We find that no long-term causality exists from the interest rate differential and the exchange rate risk to the dollarisation. But, we do find a unidirectional causality from the real interest rate differential to the dollarisation and the exchange rate risk short term. This finding implies that the interest rate differential reduces the dollarisation in the short term only.

Keywords: dollarisation; ARDL approach; Granger causality test; Laos.

1 Introduction

Laos has achieved high economic growth in the past decade along with a remarkable poverty reduction. However, Laos still faces various economic problems. Laos faces chronic twin deficits in government and trade balances. The financing deficits come from the foreign direct investment (FDI) and foreign grants. Moreover, the Laos’ economy highly depends on its resource sectors, this dependence will have a negative long-term impact on manufacturing and agriculture sector, known as the ‘Dutch disease’ (Kyophilavong and Toyoda, 2008; Kyophilavong, 2016).

A high degree of dollarisation exists in Laos. The ratio of foreign currency deposits (FCD) to total deposits was about 50% in 2008 (Kyophilavong, 2010). Of course, this dollarisation has benefits and costs for Laos. However, the costs of this dollarisation appear to be higher than the benefits (Menon, 2006). Therefore, reducing the dollarisation is an important policy decision of the Bank of Lao PDR (hereafter BOL). Therefore, monetary authority has tried to reduce the dollarisation by interference in the exchange rate market by promoting and campaigning for the use of local currency (kip).

The dollarisation in Laos was the main historical source of its macroeconomic instability (Kyophilavong, 2010; Keovongvichith, 2007). Even though Laos has achieved macroeconomic stability since 2000, the dollarisation is still high. Therefore, the question that arises is: what are the factors that determine the dollarisation in Laos? The study of determinants of dollarisation mostly conducted in East European and Latin American. However, only few studies focus on Laos (Menon, 2006, 2008; Ra, 2008; Kyophilavong,
The causality of dollarisation, interest rate and exchange rate 2010; Keovongvichith, 2007; Furukawa, 2002). In addition, most of these studies provide discussion and descriptive analysis which was not based on econometric analysis. Except in the studies by Sinxayvoravong (2005), and Ra (2008), they use an econometric model to analyse the dollarisation phenomenon in Laos.

The main objective of this study is to investigate the causality of dollarisation and its determinants in Laos by using an ARDL approach and a Granger causality test in a VECM. This study contributes to the literature in three ways. Firstly, the paper is a pioneering effort because it investigates the relation between the dollarisation and its determinants in Laos by using an econometric model. Secondly, we apply a unit root test with a structural break. Thirdly, we apply the relatively new method of an ARDL bounds testing approach with structure break to cointegration that was developed in Pesaran et al. (2001).

The remainder of this paper is organised as follows: Section 2 presents the theoretical framework and the empirical modelling. Section 3 comprises the empirical results. And Section 4 is conclusion.

2 Empirical model

We use the following empirical model as found in Ramirez-Rojas (1985), Rojas-Suarez (1992), and Clements and Schwartz (1993). The model is defined as

\[ \text{LnFC}_t = \alpha_0 + \alpha_{\text{Di}} \text{LnDi}_t + \alpha_{\text{Me}} \text{LnMe}_t + DDF + \mu_t \] (1)

where \( \text{FC}_t \) is the dollarisation, \( \text{Di}_t \) is the real rate differential, \( \text{Me}_t \) is the exchange rate risk, and DDF is a dummy variable. All of the series are converted into natural logarithms. We use the autoregressive distributed lag (ARDL) approach to cointegration (Pesaran and Shin, 1999; Pesaran et al., 2001) that has some advantages over other approaches. Furthermore, a dynamic unrestricted error correction model (UECM) can be derived from the ARDL bounds testing approach through a linear transformation. The UECM integrates the short-term dynamics with the long-term equilibrium without losing any long-term information. The equation for the UECM is as follows:

\[ \Delta \text{LnFC}_t = \alpha_0 + \alpha_{\text{FC}} \Delta \text{LnFC}_{t-1} + \alpha_{\text{Di}} \Delta \text{Di}_{t-1} + \alpha_{\text{Me}} \Delta \text{Me}_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta \text{LnFC}_{t-i} + \sum_{j=0}^{q} \alpha_j \Delta \text{Di}_{t-j} + \sum_{k=0}^{r} \alpha_k \Delta \text{Me}_{t-k} + \alpha_{\text{DF}} \text{DF} + \mu_t \] (2)

where the \( \Delta \) is the first difference operator, and the \( \mu_t \) is the error term assumed to be independently and identically distributed. The DDF is a set of dummy variables that result from the unit root test with structural break.

The ARDL bounds testing approach has two steps. Step one uses an F-test for the joint significance of the lagged level variables. The null hypothesis for no long-term relation between the variables is denoted by \( H_0: \alpha_{\text{FC}} = \alpha_{\text{Di}} = \alpha_{\text{Me}} = 0 \) against \( H_1: \alpha_{\text{FC}} \neq \alpha_{\text{Di}} \neq \alpha_{\text{Me}} \neq 0 \). To test for cointegration, two asymptotic critical bounds are used. A lower bound is applied if the regressors are I(0), and an upper critical bound is used for I(1). If the F-statistic exceeds the upper critical bound, a long-term relation exists. If the F-statistic falls below the lower critical bound, the null hypothesis of no cointegration is
accepted. The next step is the estimation of the short-term parameters using an Error Correction Model. To get the convergence of the dynamics to the long-term equilibrium, the sign of the coefficient for the lagged error correction term \(ECM_{t-1}\) must be negative and statistically significant. Further, the diagnostic tests look for the serial correlation, the functional form, the normality, and the heteroskedasticity (Pesaran and Pesaran, 2009).

After investigating the long-term relation between the variables, we use the Granger causality test to determine the causality among the variables. If there is cointegration among the series, then the VECM can be developed as follows:

\[
(1 - L) \begin{bmatrix}
    LnFC_t \\
    LnDI_t \\
    LnME_t
\end{bmatrix} = \begin{bmatrix}
    \phi_1 \\
    \phi_2 \\
    \phi_3
\end{bmatrix} + \sum_{i=1}^{2} (1 - L) \begin{bmatrix}
    a_{i1} & a_{i2} & a_{i3} \\
    b_{i1} & b_{i2} & b_{i3} \\
    c_{i1} & c_{i2} & c_{i3}
\end{bmatrix} + \begin{bmatrix}
    \xi_1 \\
    \xi_2 \\
    \xi_3
\end{bmatrix}
\]

\[
\times \begin{bmatrix}
    LnFC_{t-1} \\
    LnDI_{t-1} \\
    LnME_{t-1}
\end{bmatrix} + \begin{bmatrix}
    \mu_{i1} \\
    \mu_{i2} \\
    \mu_{i3}
\end{bmatrix},
\]

where the difference operator is \((1 - L)\), and the \(ECM_{t-1}\) is the lagged error correction term, generated from the long-term equation. The long-term causality is disclosed by using the \(t\)-test statistic to gain the significance of the coefficient for the \(ECM_{t-1}\). The existence of a significant relation in the first differences of the variables provides evidence on the direction of the short-term causality.

We use quarterly data from 1993Q1 to 2013Q4 from the Bank of Lao PDR. The definition of the dollarisation (FC) is the ratio of the FCD to the broad money (M2). In this study, we follow the previous studies (Us, 2003; Samreth, 2011). We do not consider the foreign currency cash outside of the bank in our model. We assume that the foreign cash holdings move proportionately to FCD. The foreign cash outside of the bank is not available in the Bank of Lao PDR, and it is difficult to estimate for this study. The real interest rate differential (DI) is the real rate differential between the domestic and foreign currencies. The exchange rate risk (ME) is defined as the exchange rate misalignment.

### 3 Empirical results

The statistical summary of all variables in our analysis is shown in Appendix. Before conducting the bounds test for cointegration, we use a unit-root test to ensure that our variables are not integrated at order 2-I(2). The F-test will be spurious if the variables are I(2) because the critical value (CV) of the F-statistics is computed using the assumption that the variables are I(0) or I(1) (Pesaran et al., 2001; Narayan, 2005). Because the traditional unit root tests (Dickey and Fuller, 1979; Phillips and Perron, 1988; Kwiatkowski, et al., 1992; Elliott, et al., 1996) have lower power in the presence of a structural break (Perron, 1989; Lee et al., 1997); we apply the unit root test from Perron (1997) for one structural break.
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Table 1

Perron’s unit root test with one break

<table>
<thead>
<tr>
<th></th>
<th>A – intercept</th>
<th></th>
<th>B – both</th>
<th></th>
<th>C – trend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T-stat Break</td>
<td></td>
<td>T-stat Break</td>
<td></td>
<td>T-stat Break</td>
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<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
<td>(0)</td>
<td></td>
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<td></td>
<td>(4)</td>
<td>(4)</td>
<td>(4)</td>
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<td></td>
<td>(1)</td>
<td>(1)</td>
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<td></td>
<td>(0)</td>
<td>(0)</td>
<td>(0)</td>
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<td></td>
<td>(2)</td>
<td>(2)</td>
<td>(2)</td>
<td></td>
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<tr>
<td></td>
<td>(3)</td>
<td>(3)</td>
<td>(3)</td>
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</tr>
</tbody>
</table>

Notes: *, **, and *** represent significance at the 1, 5, and 10% levels of significance.

Source: Authors’ estimation

The results of Perron’s unit root test (Table 1) with one structural break show that the series is in different forms in the intercept, the trend, or both. This result implies that our variables have an order of integration as I(1) that confirms our variables are not I(2) and that the F-test is applicable. The F-test results are sensitive to the number of lags set for each first-difference variable in the equation (Bahmani-Oskooee and Nasir, 2004). Therefore, we select the optimal lag length based on the Schwarz Bayesian criterion (SBC) (Narayan, 2004; Pesaran and Shin, 1999). The result indicates that four is the optimal lag order. In order to account for the fact that we have a relatively small sample size, we produce new CVs for the F-tests that are computed by using stochastic simulations with 20,000 replications.

Table 2

Results of the ARDL cointegration test with one break

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>LnFC_t</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistics</td>
<td>4.462**</td>
</tr>
<tr>
<td>Time break</td>
<td>1997Q2</td>
</tr>
<tr>
<td>Critical values</td>
<td></td>
</tr>
<tr>
<td>5% level</td>
<td></td>
</tr>
<tr>
<td>10% level</td>
<td></td>
</tr>
<tr>
<td>Lower bounds</td>
<td>3.965</td>
</tr>
<tr>
<td>Upper bounds</td>
<td>5.091</td>
</tr>
<tr>
<td></td>
<td>4.274</td>
</tr>
</tbody>
</table>

Notes: *, and ** show the significance at 5% and 10% levels respectively.

Source: Authors’ estimation

The calculated F-statistics exceed the upper bound of the CVs as shown in Table 2. When the FC_t is the dependent variable, then the calculated F-statistic with one structure break is $F(LnFC_t/LnDI_t, LnME_t) = 4.462$ and F-statistic with two structure breaks is 13.822.
These are greater than the upper critical bound at the 10% level of significance. This statistic suggests that cointegration exists between the $\text{LnFC}_t$ and its determinants in the case of Laos.

Table 3  
Short- and long-term equations

<table>
<thead>
<tr>
<th>Dependent variable = $\text{LnFC}_t$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Long-term results</strong></td>
</tr>
<tr>
<td><strong>Variable</strong></td>
</tr>
<tr>
<td>Constant</td>
</tr>
<tr>
<td>$\text{LnDI}$</td>
</tr>
<tr>
<td>$\text{LnME}$</td>
</tr>
<tr>
<td>$\text{DDF}$</td>
</tr>
<tr>
<td><strong>Short-term results</strong></td>
</tr>
<tr>
<td>Constant</td>
</tr>
<tr>
<td>$\Delta\text{LnDI}$</td>
</tr>
<tr>
<td>$\Delta\text{LnME}$</td>
</tr>
<tr>
<td>$\text{DDF}$</td>
</tr>
<tr>
<td>$\text{ECM}_{t-1}$</td>
</tr>
</tbody>
</table>

Notes: *, ** and *** show the significance at 1%, 5% and 10% levels respectively.

Source: Authors’ estimation

Table 3 shows the long-term and short-term equations. In the long term, the real interest rate differential and the exchange rate risk are statistically significant for the $\text{LnFC}_t$. In the short term, the empirical evidence shows that the $\text{LnME}$, has an impact that is positive and statistically significant for the $\text{LnFC}_t$ at the 1% level, and the $\text{LnDI}$, has an impact that is negative and statistically significant for the $\text{LnFC}_t$ at the 10% level. These findings imply that the exchange rate risk leads the $\text{LnFC}_t$, and the real interest rate differential determines the $\text{LnFC}_t$ in the short term. However, the estimate of the $\text{ECM}_{t-1}$ is statistically insignificant. This significance shows that the long-term relation between the $\text{LnFC}_t$ and its determinants do not exist. The diagnostic tests are also applied for the adequacy of the specification in the model (Table 4). The diagnostic tests suggest that the estimates are free from serial correlation, misspecification in the short-term model, and heteroskedasticity.

Table 4  
Diagnostic tests for the $\text{LnFC}_t$ as the dependent variable

<table>
<thead>
<tr>
<th><strong>F-version</strong></th>
<th><strong>LM-version</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Statistics</strong></td>
<td><strong>P-value</strong></td>
</tr>
<tr>
<td>A Serial correlation</td>
<td>F(4.63) = 1.899</td>
</tr>
<tr>
<td>B Functional form</td>
<td>F(1.66) = 0.016</td>
</tr>
<tr>
<td>C Normality</td>
<td>N/A</td>
</tr>
<tr>
<td>D Heteroskedasticity</td>
<td>F(1.58) = 0.174</td>
</tr>
</tbody>
</table>

Source: Authors’ estimation
estimates of the $ECM_{t-1}$ are not statistically significant when the $\Delta LnFC_t$ is the independent variable. The statistical insignificance of the $ECM_{t-1}$ indicates that no long-term causality exists among the $\Delta LnFC_t$ and its determinants. However, when the $\Delta LnME_t$ is the independent variable, then the estimates of the $ECM_{t-1}$ are statistically significant with a negative sign at the 5% level. This significance suggests that unidirectional causality exists that runs from the dollarisation and the real interest rate differential to the exchange rate risk in the long term. However, unidirectional causality exists that runs from the $\Delta LnDi_t$ to the $\Delta LnFC_t$ and that runs from the $\Delta LnDi_t$ to the $\Delta LnME_t$ in the short term. These findings suggest that the real interest rate differential causes the dollarisation and the exchange rate risk in the short term.

Arguments exist that there are some limitations to the Granger causality approach. Some scholar says that this causality test cannot capture the relative strength of the causal relation between the variables beyond the selected time period. In order to capture how the series responds when there is a shock in one of the variables beyond the selected time span, we use the generalised impulse response analysis with a vector autoregressive (VAR). This generalised impulse response analysis was developed by Pesaran and Shin (1998). Several scholars argue that with the VAR framework, the generalised impulse response analysis produces better results than other traditional approaches (Engle and Granger, 1987; Ibrahim, 2005). The primary advantage of this approach as compared to the orthogonalised impulse response analysis is that it is not sensitive to the ordering of the variables because the ordering is uniquely determined by the VAR system. Further, the generalised impulse response analysis estimates simultaneous shock affects.

Figure 1 shows the impulse response function that indicates how long and to what extent the dependent variable reacts to the shock of forcing the variables. The figure shows a negative response of the real exchange rate differential at the second time horizon and a positive response at the fourth time horizon. These responses are because of a one standard deviation shock to the dollarisation that decreases and then dies out at the sixth time horizon. Hence, the impulse response function supports the unidirectional causality running from the real interest rate differential to the dollarisation.

There is a positive response from the exchange rate risk at the third time horizon and a positive response at the fifth time horizon because of a one standard deviation shock to the dollarisation that dies out after the fifth time horizon. This result implies that the exchange rate risk has a negative response to the dollarisation in the short term.
Figure 1  The plots of the impulse response function (see online version for colours)

Response to Generalized One S.D. Innovations ± 2 S.E.

Response of DI to FC

Response of ME to FC

Source: Authors’ estimation

4 Conclusions

Reducing the dollarisation is the main priority of the monetary authority in Laos. In order to decide the most effective policy to reduce the dollarisation, it is important to investigate the causality between the dollarisation and its determinants in the short and long term. In order to respond to this objective, we use an ARDL approach to cointegration and the Granger causality test. The empirical result indicates that no causality exists between the dollarisation and the real interest rate differential, the exchange rate risk, and the dollarisation in the long term. However, unidirectional causality does exist that runs from the real interest rate differential to the dollarisation in the short term. This finding might imply that the real interest rate differential could reduce the dollarisation in the short term. Therefore, in order to reduce dollarisation, the direct control of the dollarisation and the promotion of the local currency might be an important policy option for Laos in order to reduce dollarisation in Laos.

In addition, we also added a paragraph of limitation of this study (there might be other factors that cause the dollarisation problem) as follows: this paper is attempting to find the relationship between dollarisation, interest rate and exchange rate using ARDL approach and Causality test. However, due to short sample, this analysis only includes key variables of determinants of dollarisation from the literature, but there are more variables, including the FDI, foreign grants, and remittance is also important variables in the case of Laos.

Moreover, there are some constraints related to the institution, regulatory, and human resources to deal with dollarisation in Laos (Kyophilavong, 2010). Therefore, the strengthening the institution, law enforcement, and human resources are also important elements to reduce dollarisation in the short and long run. Moreover, it is crucial to increase the market confidence on government policy and macroeconomic management (Kyophilavong, 2010).
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References


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Notes
1 Dollarisation is the substitution of foreign currency for domestic in its function as a means of payment, unit of accounts, and store of value (e.g., Cuddington, 1983; Menon, 2007).
2 For the cost of dollarisation, it has hindered the authority to conduct effective monetary and exchange rate policies. Secondly, the government loses the benefit of seigniorage (Kyophilavong, 2010). In addition, the empirical result shows that dollarisation makes the economy more vulnerable to inflation and an increase in the volatility of the exchange rate (Calvo and Vegh, 1996; Calvo et al., 1999; Berg and Borensztein, 2000). For the benefits of dollarisation, it helps to prevent capital flight from the domestic economy and the repatriation of funds is encouraged because residents can hold foreign currency assets in domestic banks. It also can increase bank intermediation and facilitate transactions (Kyophilavong, 2010).
3 The log-linear specification provides more efficient results than a simple specification (Layson, 1983; Shahbaz, 2010).
4 This approach is more advantageous than the Johansen cointegration technique (Johansen and Juselius, 1990). Firstly, it requires a smaller sample size (Ghatak and Siddiki, 2001). Secondly, Johansen’s technique requires the integration of the variables at the same order. The ARDL approach does not have this requirement. It can be applied whether the variables are purely I(0), I(1), or mutually cointegrated. Thirdly, the ARDL approach provides unbiased long-term estimates and valid t statistics despite some of the model regressors being endogenous (Narayan, 2005). Fourthly, this approach provides a method for assessing the short-term and long-term effects of one variable on the other simultaneously, and it also separates these effects (Bentzen and Engsted, 2001).
5 The exchange rate risk (ME) is defined as the deviations in the real exchange rate from the trend following Ramirez-Rojas (1985).
6 We set the maximum lag order up to six to ensure a sufficient degree of freedom for the econometric analysis because our sample size is quite small. In order to save space, the results are not presented but are available on request.

Appendix

Table A1  Statistical summary of variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dollarisation (FC)</td>
<td>56.67</td>
<td>14.38</td>
<td>29.20</td>
<td>83.66</td>
</tr>
<tr>
<td>Real interest rate differential (DI)</td>
<td>9.03</td>
<td>5.71</td>
<td>1.85</td>
<td>21.15</td>
</tr>
<tr>
<td>Exchange rate risk (ME)</td>
<td>0.03</td>
<td>0.25</td>
<td>-0.31</td>
<td>0.52</td>
</tr>
</tbody>
</table>

Source: Authors’ calculation