【Article】

Foreign Direct Investment, Real Exchange Rate Misalignment, and Export Performance of Lao PDR

Vatthanamixay CHANSOMPHOU
Graduate Student, Graduate School for International Development and Cooperation
Hiroshima University
1-5-1 Kagamiyama, Higashi-Hiroshima, Hiroshima, 739-8529, Japan
email: vatthanamixay@hiroshima-u.ac.jp

Masaru ICHIHASHI
Professor, Graduate School for International Development and Cooperation
and Faculty of Integrated Arts and Sciences
Hiroshima University
1-5-1 Kagamiyama, Higashi-Hiroshima, Hiroshima, 739-8529, Japan
Phone: +81-82-424-6935(or 6404) / email: ichi@hiroshima-u.ac.jp

Abstract

It is widely recognized that foreign direct investment (FDI) has its paradoxical aspects. On one hand, it contributes to economic development; on the other hand, the surge of foreign capital inflows might cause adverse effects, especially the appreciation of real exchange rate that might hamper the economic performance of the recipient countries. In this paper, we investigate the net impact of FDI on the export performance of Lao PDR, during the period 1981-2008. A single equation of the equilibrium real exchange rate model is adopted and is estimated using cointegration techniques. We then compute a misalignment index using the information of actual and equilibrium real exchange rate. The net contribution of FDI on export is calculated by comparing the magnitude of FDI and the misalignment coefficients obtained from the regression of the export function. The analysis indicates that although FDI is a source of real exchange rate misalignment – the factor that deteriorates the export performance – its direct contribution on export performance is positively significant and higher than that of the real exchange rate misalignment. Our finding indicates that FDI has a net positive effect on the export performance of Lao PDR.

1. Introduction

Foreign direct investment (FDI) involves the transfer of capital, technology and skills from one country to another. However, the costs and benefits associated with this form of transfer have been of interest in the study of development economics and globalization. There is no clear and agreeable evidence on whether the benefits associated with this transfer offset its costs or vice versa. The pro-FDI arguments believe that FDI contributes to filling the gaps of domestic savings, foreign exchange, and skills necessary to achieve the growth and development target of developing countries. It is also believed that FDI can help boost the economy through trade improvement. These arguments are supported by some facts that some developing countries during the 1980s can improve export performance via FDI promotion (i.e. Singapore, Malaysia, Thailand and the Philippines). Nevertheless, there are also concerns that large FDI inflows will bring about adverse effects. This can be found in the vast literature of real exchange rate misalignment, which stems from the studies of Dutch disease effects associated with large foreign capital inflows (Corden and Neary, 1982; Wijnbergen, 1986).

Real exchange rate misalignment refers to the deviation of actual real exchange rate from its desired equilibrium that maintains stable economic growth. Persistent misalignments of the real exchange rate could lead to serious macroeconomic imbalances and would affect the stability of the economy (Edwards, 1989). In addition, the persistent overvaluation of an economy is a precursor to economic crisis (Jongwanich, 2009). In theory, the forces driving real exchange rate away from its equilibrium include both monetary and real factors (Branson, 1988; Edwards, 1989; and Hinkle and Montiel, 1999). Among which, one of the most prominent factors that bring about the real exchange rate misalignment is foreign capital inflows. According to Athukoral and Rajapatirana (2003), a country that relies on foreign capital to finance high level of domestic absorption tends to have real exchange rate appreciation regardless of the exchange rate regime.

In most literature, the positive and negative effects of FDI are examined separately, and the simultaneous studies of both effects are rare. In this study, we examine an aspect of the net impact of FDI on export performance of Lao PDR, by investigating the direct impact of FDI on the export performance with the inclusion of real exchange rate misalignment. This paper is organized as follow: Section 2 provides brief information of FDI in Lao PDR, the trends of FDI-GDP ratio, real effective exchange rate and export.-GDP ratio. Section 3 provides the theoretical background of equilibrium real exchange rate, the empirical model and the empirical results. Section 4 discusses the real exchange rate misalignment. Section 5 provides the analysis of the impact of FDI and real exchange rate misalignment on the export performance. Section 6 is conclusion.

2. Trends of foreign direct investment, real exchange rate, and export

2.1 Foreign direct investment in Lao PDR

Lao PDR is a country that has long experienced a chronic trade deficit. In its economic history, this deficit has been mostly financed by foreign capital (mostly foreign aid). In the first decade after the revolution in 1975, the Lao economy had been managed under the centrally-planned economic system. The government imposed restrictions on price, private transaction and international trade. In 1986, the Lao government introduced New Economic Mechanism (NEM) and open door economic policies to improve its economic condition. Under this new regime, Lao PDR has seen a large increase of external financial assistance and foreign direct investment. Figure 1 shows that major contributors of net foreign capital inflows, throughout the period of study, are foreign aid, foreign direct investment, and other capital inflows, respectively.

Initially, the amount of FDI inflow to Lao PDR was rather small. During 1988-1992, the value of actual FDI inflows was only about 3 million US dollars per annum on average. Then it started to increase to US$ 96 million (in constant 2000 price) in 1996, but continuously decreased after the Asian financial crisis in 1997. Having seen a declining trend of FDI inflows in the beginning of 2000s, the Lao government took another step in amending the FDI promotion law in 2004 and sought for a Normal Trade Relation (NTR) with the United States (which was granted in 2005). In 2006, the actual amount of FDI inflows jumped to US$ 137 million, which was about 6 times higher than the amount in 2005, and the amount of FDI inflows remains higher than US$ 100 million ever since. The surge of FDI inflows since 2005 has been attributed to the increase of the investment in mining sector and large hydro-power projects (Bank of Lao PDR, 2009).

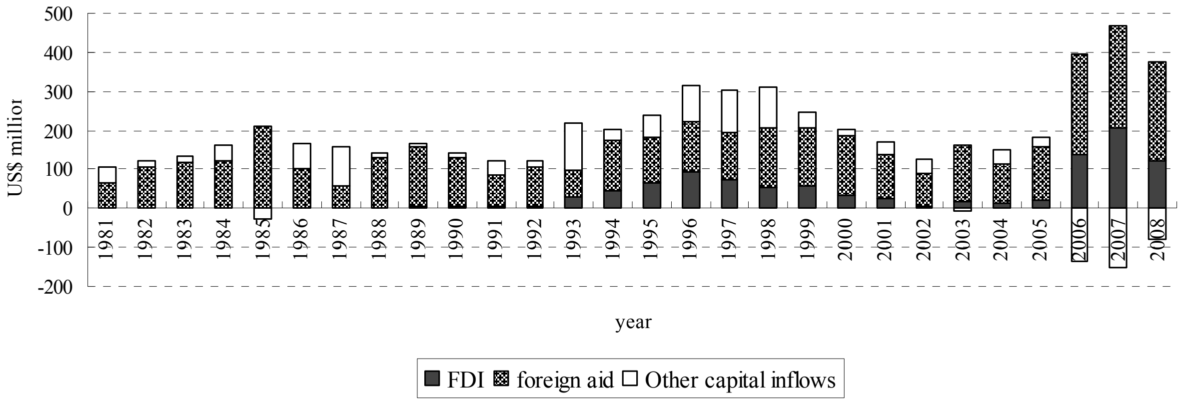

Figure 1: Net foreign capital inflows to Lao PDR

Note: value is in constant 2000 price
Source: Balance of payment of Lao PDR provided by ADB (1999, 2002, 2007), Bank of Lao PDR (2009)

2.2 Foreign direct investment, real effective exchange rate, and export of Lao PDR

The real effective exchange rate (REER)[1] of Lao PDR shows a cyclical trend. During 1981 to 1986, the REER had appreciated. In this period the only major capital inflows were foreign aid. However, the trend of aid-GDP ratio does not seem to plays a significant role in the appreciation of REER (see Figure 2). The appreciation of REER in this period seems to be due to inflation (see Appendix E for the trend of inflation). After 1988, it can be noted that the cyclical trend of REER seems to move reversely with the trend of FDI-GDP ratio. Therefore, FDI might have some influence on the movement of REER. This inference seems to be reasonable, since the inflation rate is relatively stable during 1988 and 2008 (except in 1989, when there was a soar of price level due to a natural disaster; and in 1998, when Asian financial crisis erupted). However, by the visual observation, we cannot make an inference between the relationship of foreign aid and the REER.

Figure 3 shows the trend of FDI-GDP ratio, export-GDP ratio and the REER. It can be noted that the vertical movement of export always has an opposite direction with that of the REER. Between 1981 and 1986, export-GDP ratio had been quite stable at around 5%. However, after the introduction of open market policy of the government, export-GDP ratio increased significantly.

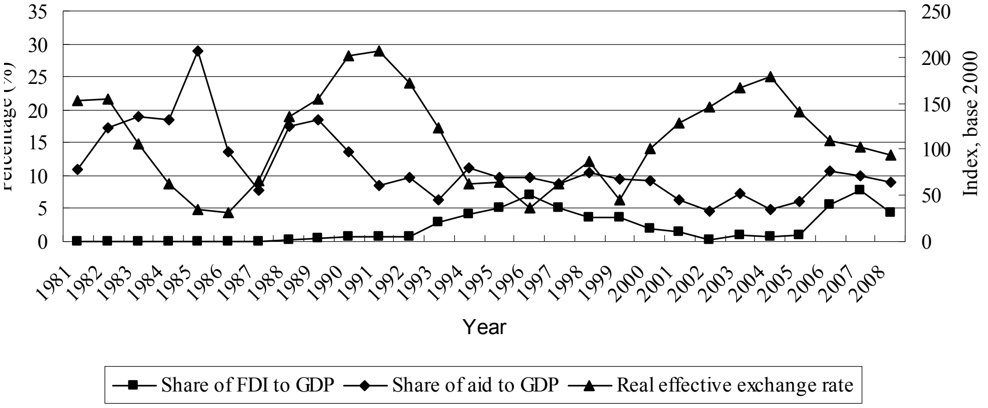

Figure 2: Trends of FDI-GDP ratio, aid-GDP ratio, and real effective exchange rate of Lao PDR

Note: The left axis is the percentage share of FDI and aid to GDP. The right axis is the indexed value of real effective exchange rate, with year 2000 as based year.
Source: Authors computed from UN (2010), ADB (1999, 2002, 2007), Bank of Lao PDR (2009)

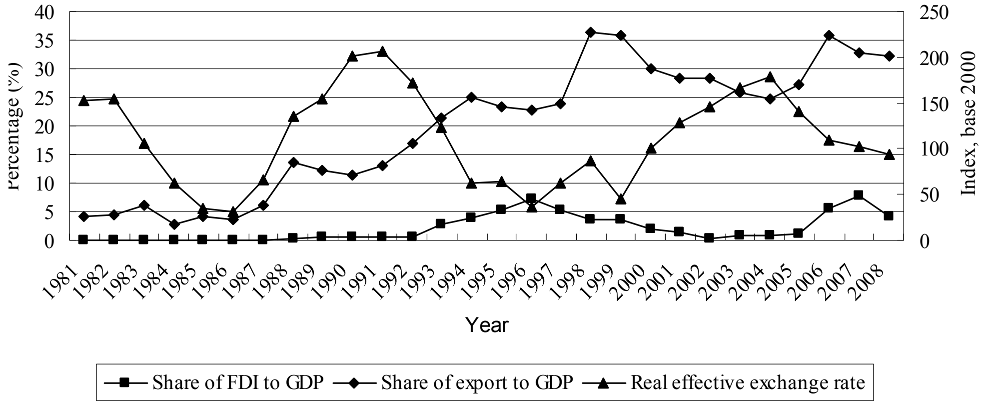

Figure 3: Trends of FDI-GDP ratio, export-GDP ratio, and real effective exchange rate of Lao PDR

Note: The left axis is the percentage share of FDI and aid to GDP. The right axis is the indexed value of real effective exchange rate, with year 2000 as based year.
Source: Authors computed from UN (2010), ADB (1999, 2002, 2007), Bank of Lao PDR (2009)

3. Equilibrium real exchange rate estimation

3.1 Equilibrium real exchange rate theories

Although there exists a number of theories and approaches employed to estimate the equilibrium real exchange rate[2], we follow a method that is in line with the studies of Edwards (1988, 1989), and Montiel (1999). Edwards considers a three-goods economy (exportable, importable, and non-tradable goods). The equilibrium condition is determined by considering the behavior of portfolio decisions, demand side and supply side of the three goods, the government sector and the external sector. Montiel takes a different approach from Edward, by considering the production side of the economy, household behavior and the public sector. Nevertheless, the equilibrium condition is determined in a similar manner as that of Edwards's study.

Following them, the equilibrium real exchange rate is attainable when the *internal* and *external* balance holds simultaneously.

The internal balance holds when the non-tradable goods clear.

$$Y_N(e) = C_N + G_N = (1-\theta)\cdot e\cdot C + G_N, \qquad \frac{\partial Y_N}{\partial e} < 0 \tag{1}$$

where e is the real exchange rate, Y_N is the supply of non-tradable goods, C_N and G_N are private and government spending on non-tradable goods. C is total private spending (eC is total private spending measured in terms of tradable goods). θ is the share of total private spending on tradable goods. This equation implies that a rise in public and private spending on non-tradable goods (G_N and eC) creates an excess demand for these goods. Therefore, the real appreciation of real exchange rate is required to restore the equilibrium condition.

The *external balance* is attained when, at the steady state, the change of net foreign asset is zero.

$$\dot{F} = B + Z + rF = Y_T(e) - G_T - C_T + Z + rF, \tag{2.1}$$

$$\text{Or,}\quad \dot{F} = B + Z + rF = Y_T(e) - G_T - \theta\cdot C + Z + rF, \qquad \frac{\partial Y_T}{\partial e} > 0 \tag{2.2}$$

where F is net foreign asset ($\dot{F}$ is the change in net foreign asset), B is the trade balance, Z is the net foreign capital inflow, and r is the rate of return of foreign-asset holdings (rF is real yield in net foreign asset, measured in tradable goods). The trade balance is the difference between supply of tradable goods (Y_T) and the sum of government (G_T) and private ($C_T = \theta C$) spending on these goods. Equation (2) implies that, at steady state ($\dot{F}=0$), a rise in public or private spending for tradable goods (G_T and C_T) causes a current account deficit; therefore, it requires the real exchange rate to depreciate to switch demand towards non-tradable goods and supply towards tradable goods. Many studies show that simultaneous attainment of *internal* and *external* balance can be obtained by solving equation (1) and (2). For the purpose of our study, in the following section, we follow Elbadawi (1994) to show a clearer process of deriving the empirical model for the equilibrium real exchange rate.

3.2 Empirical model of equilibrium exchange rate

We assume a small-opened economy with three-goods sectors (importable, exportable and non-tradable goods). The economy has the following identity of domestic absorption, A:

$$A = G + C, \text{ and } G = g\cdot Y \tag{3}$$

where G is total government spending, C is total private spending, Y is GDP, and g is the ratio of G to GDP.

On one hand, assume that the government spending on non-tradable goods, G_N, is a ratio to total government spending, G:

$$G_N = \bar{g}_N \cdot G, \text{ thus } \quad G_N = \bar{g}_N \cdot g\cdot Y \tag{4}$$

On the other hand, assume that $1-\theta = \frac{C_N}{C}$ (the ratio of private spending on non-tradable goods to total private spending) is endogenously determined by export price (P_X), import price (P_M), and non-tradable goods' price (P_N); therefore we can write:

$$C_N = (1-\theta)_{(P_X,P_M,P_N)} \cdot C = (1-\theta)_{(P_X,P_M,P_N)} \cdot [A-G] = (1-\theta)_{(P_X,P_M,P_N)} \cdot [A - g \cdot Y] \quad (5)$$

Combining (4) and (5), we can express the demand-side of non-tradable goods as, D_N:

$D_N = g_N \cdot g \cdot Y + (1-\theta)_{(P_X,P_M,P_N)} \cdot [A - g \cdot Y]$, or we write

$$d_N = \frac{D_N}{Y} = (1-\theta)_{(P_X,P_M,P_N)} \cdot [\frac{A}{Y} - g \cdot] + g_N \cdot g \quad (6)$$

On the supply side, we assume also that the ratio of supply of non-tradable goods (Y_N) to GDP (Y) is also determined by export price (P_X), import price (P_M), and non-tradable goods' price (P_N):

$$s_N = \frac{Y_N}{Y} = \sigma_{(P_X,P_M,P_N)} \quad (7)$$

Equalize (6) and (7), when *internal balance* is attained, we have:

$$s_N = d_N$$

$$\sigma_{(P_X,P_M,P_N)} = (1-\theta)_{(P_X,P_M,P_N)} \cdot [\frac{A}{Y} - g \cdot] + g_N \cdot g \quad (8)$$

From (8), it is possible to write the inverse demand function in abstract form as:

$$(P_X, P_M, P_N) = f(\frac{A}{Y}, g, g_N) \quad (9)$$

Then define the real exchange rate as

$$e = E \cdot \frac{P_T}{P_N} \quad (10)$$

where E is nominal exchange rate, P_T is the price of tradable goods, and P_N is the price of non-tradable goods.

Define $P_T = \alpha \cdot P_X^* + (1-\alpha) \cdot P_M^*$, and $P_X = E(1-t_X)P_X^*$; $P_M = E(1+t_M)P_M^*$

where t_X and t_M are export and import tax rates; and P_X^* and P_M^* are foreign prices of exportable goods and importable goods, P_X and P_M are domestic prices of exportable and importable goods, respectively.

Therefore, we can write:

$$e = \frac{\alpha \cdot P_X /(1-t_X) + (1-\alpha) \cdot P_M /(1+t_M)}{P_N} \quad (11)$$

Substitute (9) to (11), we can define a real exchange rate function when *internal balance* is attained.

$$e = f(\frac{A}{Y}, g, g_N, t_X, t_M, \frac{P_X}{P_M})$$

For the empirical purpose, we write the function of real exchange rate in log-linear form:

$$\log(e) = \alpha_0 + \alpha_1 \log(\frac{A}{Y}) + \alpha_2 \log(g) + \alpha_3 \log(g_N) + \alpha_4 \log(t_X, t_M) \quad (12)$$

Equation (12) cannot be called the function of equilibrium real exchange rate unless the *external balance* condition is met. From this equation, $\frac{A}{Y}$ is endogenous and the *external balance* can be attained through this variable. External balance can be attained when the sustainable current account deficit condition is met. This condition can be fulfilled through the linkage of domestic absorption and the sustainable level of net capital inflows (*NKI*).

We simplify Elbadawi's (1994) assumption, by assuming that domestic absorption is a function of only net foreign capital[3].

$$\frac{A}{Y} = f(\frac{NKI}{Y}), \qquad \frac{\partial(A/Y)}{\partial(NKI/Y)} > 0$$

and

$$\log(\frac{A}{Y}) = \beta_0 + \beta_1 \log(\frac{NKI}{Y}) \tag{13}$$

By disaggregating *NKI* to foreign direct investment (FDI), foreign aid (AID) and other foreign capital inflows (OI), we can write (13) as:

$$\log(\frac{A}{Y}) = \beta_0 + \beta_1 \log(\frac{FDI}{Y}, \frac{AID}{Y}, \frac{OI}{Y})$$

By using first-order Taylor approximation to approximate around a constant mean of $\frac{A}{Y}$, the logarithm function can be written as a linear relation of variables, thus:

$$\log(\frac{A}{Y}) = \beta_0^{'} + \beta_1^{'}(\frac{FDI}{Y}) + \beta_2^{'}(\frac{AID}{Y}) + \beta_3^{'}(\frac{OI}{Y}) \tag{14}$$

Substituting (14) to (12), the equilibrium real exchange rate can be defined as:

$$\log(e) = \alpha_0 + \beta_0^{'} + \beta_1^{'}(\frac{FDI}{Y}) + \beta_2^{'}(\frac{AID}{Y}) + \beta_3^{'}(\frac{OI}{Y}) + \alpha_2 \log(g) + \alpha_3 \log(g_N) + \alpha_4 \log(t_X, t_M) \tag{15}$$

For the purpose of the empirical analysis, we write the empirical model of equilibrium real exchange rate as:

$$\begin{aligned} \log ERER_t = \theta_0 &+ \underset{(-)}{\theta_1 (FDIY)_t} + \underset{(-)}{\theta_2 (GIY)_t} + \underset{(-)}{\theta_3 (OIY)_t} + \underset{(-)}{\theta_5 \log(GCY)_t} + \underset{(+)}{\theta_6 \log(OPEN)_t} \\ &\underset{(+/-)}{\theta_7 \log(TOT)_t} + \underset{(-)}{\theta_8 \log(PROD)_t} + u_t \end{aligned} \tag{16}$$

where *ERER* is the equilibrium real exchange rate; *FDIY* is FDI-GDP ratio; *GIY* is the ratio of public investment to GDP (we replace aid-GDP ratio by this ratio due to most aid finances public investment, see Figure 5 in appendix E)[4]; *OIY* is the ratio of other capital inflows (net foreign capital inflows less FDI and aid) to GDP; *GCY* is the ratio of government consumption to GDP (it is used as a proxy of government consumption of non-tradable goods)[5]; *OPEN* is the trade openness index (the ratio of sum of import and export to GDP), used as a proxy of the trade policy (this proxy is used due to the difficulty to obtain import and export tax data); TOT is the terms of trade (we use the ratio of export value index to import value index as a proxy of this terms of trade); *PROD* is the productivity differential, it is the ratio of Lao PDR's GDP per capita to weighted average of trading partners' GDP per capita. It is used as a proxy of technological progress which captures the Balassa-Samuelson effect[6], *u* is the long-run error term; and the subscript *t* represents time.

3.2 Estimation methods

According to Edwards (1989) and Elbadawi (1994), the equilibrium real exchange rate (ERER) is unobservable. Nevertheless, Elbadawi shows that the ERER can be estimated using cointegration techniques. This is consistent with the econometric theory of co-integration that the long-run equilibrium can be measured by the cointegration techniques. Therefore, to find the ERER, we find the existence of long-run relationship between the interested variables. In order to have the most reliable results of estimating the existence of long-run relationship between variables, we employ two cointegration approaches, including: the 2-step cointegration technique of Engle and Granger (1987), and the bounds testing approach to cointegration of Pesaran, Shin, and Smith (2001). However, in theory the estimation using Engle and Granger approach will be biased with small sample size (Harris and Sollis, 2003). The advantage of the bounds testing approach is that it is applicable irrespective of whether the regressors in the model are purely I(0) (stationary), purely I(1) (integrated of order 1) or mutually cointegrated; and it is appropriate for small sample-size data (Pesaran and Shin, 1999; Pesaran, Shin, and Smith, 2001). We also estimate with the vector error correction model (VECM) of Johansen (1988) and Johansen and Juselius (1992) as well, but the results are not reported here. However, it is warned that when including many variables with the small sample size in the estimation, the VECM tends to deteriorate significantly (Hargreaves, 1994). This seems to be true in our case, as there are contradicting results of cointegration test and error correction terms in VECM. While cointegration test reports the existence of cointegration, the error correction terms in error correction models are insignificant.

3.3. REER creation and data source

Real effective exchange rate is defined as follows:

$$REER = \prod_{i=1}^{n} \frac{(NER_i \times CPI_{i,partners})^{Wi}}{CPI_{Lao}} \tag{17}$$

where *REER* is real effective exchange rate; *NER* is bilateral nominal exchange rate of Lao PDR's currency per one unit of major trading partners' currency (see Appendix F for the list of major trading partners); $CPI_{i,partners}$ is major trading partners' consumer price index; CPI_{Lao} is Lao PDR's consumer price index; i (i=1,…..,n) is number of major trading partners; W_i is the trade weight (it is the trade share of Lao PDR's major trading partner), $\sum_{i=1}^{n} W_i = 1$ The *REER* in equation (17) is then transformed to index number by deflating by the *REER* of year 2000 (using the original value of *REER* and the index do not change the results in general).

The data used in this study are annual data from 1981 to 2008 (28 years). They are taken from different sources. FDI, foreign aid, public investment, and net capital inflows data are from ADB (1999, 2002, and 2007) and the Bank of Lao PDR (2009). Nominal exchange rates of each country are from World Development Indicators of the World Bank (2009). The data of GDP, import, export and government consumption of Lao PDR are from United Nations (2010). Trading partners' and Lao PDR's GDP per capita, nominal exchange rate, and Lao PDR's import and export value index are taken from World Development Indicators (World Bank, 2010). Consumer price index (CPI) of Lao PDR and trading partners are taken from World Economic Outlook of the IMF (2010b). The annual amount of trade between Lao PDR and trading partners is the sum of total values of export to and import from major trading partners. The data of trade direction using in computing trade weight are from Direction of Trade database of IMF (2010a).

3.4. Empirical results

Prior to estimating equation (16), we test for unit root in the series to check for their order of integration. The results are reported in Table A.1 and A2, in Appendix A. The Augmented Dickey-Fuller test reports that logarithm of REER is stationary at 10%; while, the Phillips-Perron test reports non-stationary at level. For the rest of the variables, both tests report that they are non-stationary at level, but are stationary at first difference. Therefore, the use of the bounds testing approach to cointegration is the most preferable choice. The choice of lag length of variables to use in the error correction form of the bounds testing approach is determined by Akaike Information Criteria (AIC) and Schwarz Information Criteria (SC). The test results suggest using zero lag for the logarithm of REER, and one-year lag for the rest of the variables. The cointegration results of the bounds testing approach are shown in Appendix B. They indicate that there exists a long-run relationship among variables, after excluding the ratio of other capital inflows to GDP. This may be due to the way this variable is created, which is other capital inflow equals net foreign capital inflows less FDI and less foreign aid. Thus, this may lead to the strong multicollinearity of this variable with FDI and aid. The long-run relationship coefficients are reported in Table 1. In this study, we base our analysis on the results of the bounds testing approach (as it is more appropriate with our sample size and the stationary condition of the variables). Nevertheless, we report the estimation results of OLS for the comparative purpose. All variables have expected sign and are significant, except the productivity differential. These results are in line with those of Edwards (1988, 1989), Elbadawi (1994), Baffes *et al*. (1997), and Jongwanich (2009), among others. The results indicate that the increase of FDI, public investment, and government consumption tends to appreciate the REER. This implies that they have some influence on the consumption of non-tradable goods (as discussed in section 3.1). However, the impact of FDI seems to be stronger than that of public investment. The positive sign of trade openness implies the effects of reduction in tariffs of Lao PDR. This reduction leads to a decline in domestic prices of imported goods, which reduces the domestic demand of non-tradable goods. The negative impact of the proxy of terms of trade implies that the income effect of terms of trade improvement plays a prominent impact relative to the substitution effect. This means that the improvement of terms of trade leads to the increase in demand of non-tradable goods in Lao PDR. The improvement of productivity differential also shows negative relationship with REER, but not significant.

Table 1: Long-run equilibrium real exchange rate model

Dependent variable: *log(REER)*

Variables	Estimated by OLS	Estimated by Bounds testing approach
Intercept	5.536**	15.269***
	(2.503)	(3.577)
FDIY	- 0.125***	- 0.214***
	(-3.239)	(-3.325)
GIY	- 0.036**	- 0.105***
	(-2.163)	(-4.012)
log(GCY)	-1.666**	- 2.117*
	(-2.342)	(-1.987)
log(OPEN)	0.620*	1.235**
	(1.993)	(2.503)
log(TOT)	1.252	- 4.478**
	(1.114)	(-2.735)
log(PROD)	-1.031***	- 0.373
	(-3.430)	(-0.624)
Adjusted R^2	0.637	
Durbin-Watson stat	1.089	

Note: The figures in parentheses are t-statistics. The critical t-statistics for 28 samples are employed.. Asterisks (*), (**), (***) indicate significant at 10% , 5%, and 1% respectively. The t-statistics of coefficients estimated by bounds testing approach are obtained by using Bardsen transformation.

Table 2: Short-run error correction of real exchange rate model

Dependent variable: △ *log(REER)*

Variables	Estimated by Engle-Granger approach	Estimated by Bounds testing approach
Intercept	- 0.009	0.067
	(-0.145)	(0.981)
△ *FDIY*	- 0.083**	- 0.105***
	(-2.213)	(-3.115)
△ *GIY*	- 0.010	- 0.017
	(-0.560)	(-1.089)
△ GIY_{t-1}	- 0.024	- 0.011
	(-1.555)	(-0.767)
△ *log(GCY)*	- 1.372	- 1.343*
	(-1.651)	(-1.825)
△ $log(GCY)_{t-1}$	- 0.295	-0.108
	(-0.288)	(-0.117)
△ *log(OPEN)*	0.148	0.209
	(0.417)	(0.673)
△ $log(OPEN)_{t-1}$	0.475	0.362
	(1.416)	(0.673)
△ *log(TOT)*	1.221	- 0.086
	(1.458)	(-0.105)
△ *log(PROD)*	- 1.080***	- 1.029***
	(-3.383)	(-3.633)
EC_{t-1}	- 0.408**	- 0.424***
	(-2.073)	(-3.036)
Adjusted R^2	0.655	0.725
Durbin-Watson stat	1.893	2.226
Serial correlation test (LM)	F(2,13) = 0.08 [4.494]	F(2,13) = 0.76 [4.494]
Heteroskedasticity (ARCH) test	F(1,23) = 0.243 [4.279]	F(1,23) = 0.135 [4.279]
Specification error (RESET) test	F(1,14) = 0.934 [4.494]	F(1,14) = 0.368 [4.494]
Normality (Jarque-Bera) test	$\chi^2(2)$ = 0.059 [5.99]	$\chi^2(2)$ = 3.691 [5.99]

Note: The figures in parentheses under each coefficient are t-statistics. The critical t-statistics for 28 samples are employed. Asterisks (*), (**), (***) indicate significant at 10% , 5%, and 1% respectively. The figures in [ ] of diagnostic tests are the critical value of each test.

The results of short-run dynamic impact of the estimated fundamentals of real exchange rate, estimated by the two cointegration techniques, are reported in Table 2. These results are of parsimonious models (by eliminating some insignificant variables). Error correction model (ECM) allows us to eliminating some insignificant variables in order to increase the degree of freedom and the performance of the estimation (Harris and Sollis, 2003). In our case, we eliminate the lag of FDI-GDP ratio and the lag of first difference of terms of trade and the productivity differential. The validity of the model can be checked by the Adjusted R squared, Durbin-Watson statistics and diagnostic tests. In both estimation approaches, the adjusted R squared is relatively high, and the Durbin-Watson statistics are closed to 2 implying no serial correlation. The diagnostic tests also show that all F-statistics are less than the critical values (the figures in squared brackets), thus the models are well specified.

The coefficients in the short-run error correction model of the real exchange rate have correct signs (except the terms of trade estimated by Engle-Granger approach). Both estimations indicate that there is an instantaneous negative effect of FDI on REER, while the immediate impact of public investment does not exist. The increase of government consumption also seems to appreciate the REER in the short run (but weakly significant). The trade liberalization and the improvement of terms of trade do not have a significant impact in the short run. However, the increasing productivity of Lao PDR relative to the trading partners has a strong immediate impact in the short run. The lag effects of some variables have the same impact as instantaneous effects indicating that their impact (if significant) will persist over years. The coefficients of the error correction terms have correct signs (negative) and have proper magnitudes (the absolute value is between 0 and 1) and are highly significant, indicating that there is an adjustment to the equilibrium level overtime. This also reconfirms the existence of long-run relationship of variables.

4. Real exchange rate misalignment and export performance

4.1 Real exchange rate misalignment

After being able to estimate the equilibrium path of the real exchange rate, it is important to know by how much the actual real exchange rate deviates from its equilibrium. We follow Elbadawi (1994), Jongwanich (2009), among others, in defining real exchange rate misalignment. We use the results of the long-run relationship obtained by the bounds testing approach to calculate the real exchange rate misalignment. It should be noted that prior to computing the misalignment we smooth the REER by Hodrick-Prescott filter in order to obtain the real equilibrium path of the REER. The following figures show the real exchange rate misalignment computed from equilibrium real exchange rate model. The index of misalignment is defined as:

$$\text{Misalignment index} = \frac{REER - ERER_{HP}}{ERER_{HP}} \times 100 \qquad (18)$$

where $ERER_{HP}$ is the equilibrium real effective exchange rate after smoothing by Hodrick-Prescott (HP) filter.

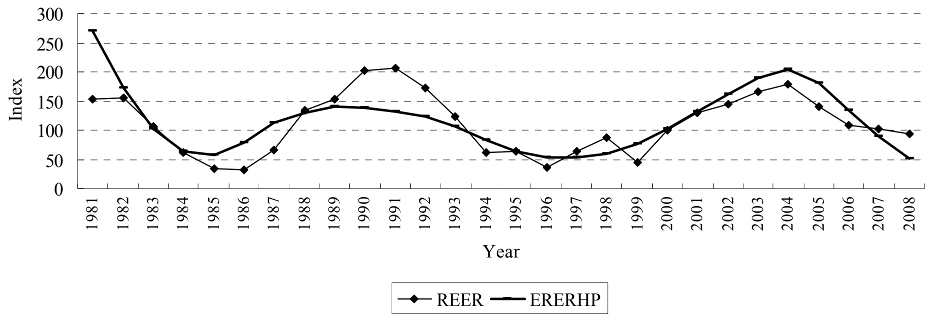

Figure 3: Actual and equilibrium real exchange rates computed from equation (2)

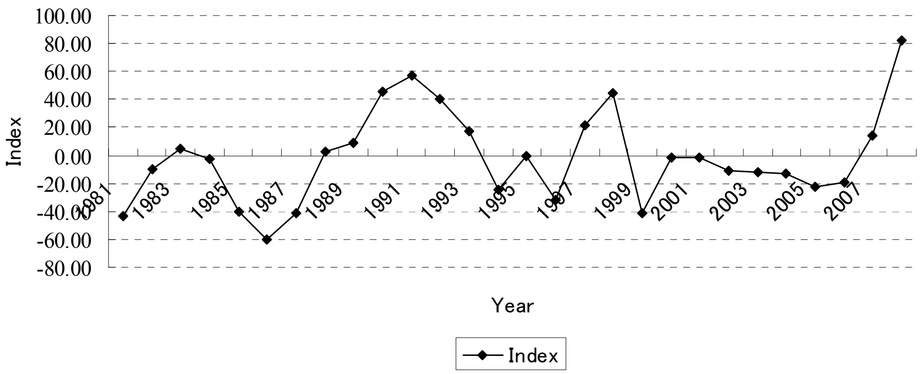

Figure 4: Misalignment of real exchange rates computed from equation (2)

4.2 Misalignment and export performance

After determining the value of real exchange rate misalignment, in this section, we carry out our ultimate goal of examining the net impact of FDI on export performance. We do this by checking by how much FDI and the real exchange rate misalignment affect the export performance during the study period. We adapt the reduced form of the export function of Goldstein and Khan (1978), which includes the effects of both demand and supply side. Following Goldstein and Khan, the reduced form of the export model is specified as:

$$\log X_t = \varphi_0 + \varphi_1 \log PXW_t + \varphi_2 \log YW_t + \varphi_3 \log Y_t^* + \varphi_4 \log P_t \tag{19}$$

where X is export, PXW is weighted average of export prices of the country's trading partners, YW is weighted average of the real incomes of the country's trading partners, Y^* is the domestic capacity, P is the domestic price index.

To make equation (19) consistent with the model of section 3, we express the real variables by the ratio to domestic GDP. Therefore, equation (19) can be rewritten as:

$$\log(\frac{X}{Y})_t = \varphi_0 + \varphi_1 \log(PXW)_t + \varphi_2 \log(\frac{YW}{Y})_t + \varphi_3 \log(\frac{Y^*}{Y}) + \varphi_4 \log P_t \tag{20}$$

We then assume that the domestic capacity is a function of FDI, public investment, and private domestic investment, thus we write:

$$\log(\frac{Y^*}{Y}) = a_0 + a_1 \log(\frac{FDI}{Y}, \frac{PDI}{Y}) \tag{21}$$

We approximate equation (21) around a constant mean of $\frac{Y^*}{Y}$ using the first-order Taylor approximation, we can write (21) as:

$$\log(\frac{Y^*}{Y}) = b_0 + b_1(\frac{FDI}{Y}) + b_2(\frac{PDIY}{Y}) \tag{22}$$

We do not include the ratio of public investment to GDP in the function of domestic capacity, because public investment does not enter the production activity directly; rather this type of investment is spent with the purpose to facilitate the production sector. In addition, the trend of ratio of public investment to GDP seems to decrease overtime, which moves reversely to that of export-GDP ratio. The interpretation that public investment causes the reduction of export seems to be misleading. This phenomenon can be intuitively understandable in that when the accumulation of public capital increases, there is no incentive for the government to increase more public investment. Another aspect to understand this phenomenon is that when the rate of growth of export is greater than the rate of growth of public investment, the reverse relationship when express in terms of the ratio to GDP seems to be natural.

Substitute (22) to (20), we yield:

$$\log(\frac{X}{Y})_t = c_0 + c_1 \log(PXW)_t + c_2 \log(\frac{YW}{Y})_t + c_3(\frac{FDI}{Y})_t + c_4(\frac{PDI}{Y})_t + c_5 \log P_t \tag{23}$$

To yield our ultimate goal, we include the misalignment variable in (23), and rewrite the equation as:

$$\begin{aligned}\log(EXY) = \rho_0 &+ \underset{(+)}{\rho_1 \log(PXW)_t} + \underset{(+)}{\rho_2 \log(YWY)_t} + \underset{(+)}{\rho_3 (FDIY)_t} + \underset{(+)}{\rho_4 (PDIY)_t} + \underset{(-)}{\rho_5 \log LCPI_t} \\ &+ \rho_6 MISALIGN_t\end{aligned} \tag{24}$$

where *EXY* is export-GDP ratio, *PXW* is weighted average of export prices of the country's trading partners, *YWY* is ratio of weighted average of the real incomes of the country's trading partners to domestic *GDP* (it is used to measure the relative income of trading partners to the domestic income), *FDIY* is the FDI-GDP ratio, *PDIY* is the ratio of private domestic investment to GDP, *LCPI* is the Lao consumer price index. *MISALIGN* is the misalignment index of (18).

4.2.1 Estimation approach and data source

We use the same cointegration tests as in section 3 (Engle-Granger and the bounds testing approaches) to estimate the long-run relationship of the variables in the export model.

Since the data of export prices are not available, we create the proxy of export price index by computing the ratio of real export value in constant 2000 US$ to export value in current US$. The data of private domestic investment are also created by using domestic capital formation less FDI and less public investment. The data of major trading partners' exports, GDP of trading partners, and GDP of Lao PDR are taken from World Development Indicators of The World Bank (2009). The data of domestic capital formation are from United Nations (2010) statistic department. The data of the rests are as describe in section 3.

4.2.2 Estimation results of export equations

Prior to estimating equation (24), we check for the stationarity of the series using Augmented Dickey-Fuller and Phillips-Perron unit root tests. The unit test results are reported in Appendix C. The results indicate that all variables are not stationary at level, but are stationary after taking first difference. We then proceed with the check of cointegration using bounds testing approach. The choice of lag length of variables to use in the error correction form of the Engle-Granger and bounds testing approach is determined by Akaike Information Criteria (AIC) and Schwarz Information Criteria (SC). The criteria suggest one lag for the logarithm of the relative income of trading partners to the domestic income, and suggest zero lag for the rest of the variables. The estimation of cointegration is shown in Appendix D. It suggests that there exists a long-run relationship among variables (Lao consumer price index variable is dropped, due to its high correlation with other variables). The coefficients of long-run model are reported in Table 3. It is noteworthy that the OLS estimates and the estimates of bounds testing indicate different effects of the variables. However, the Engle-Granger approach indicates no long-run relationship among variables, due to the error correction term in the short-run model is insignificant (in addition, the error term of OLS estimation is not stationary at level). Therefore, the results of bounds testing are more reliable. The bounds testing approach reports that all variables have expected signs, but most of them, except FDI-GDP ratio and misalignment index, are insignificant. This long-run result contains very important information of our analysis, that is FDI-GDP ratio has a strong positive impact on export performance and the magnitude is higher than that of misalignment index.

The short-run error correction model of bounds testing approach confirms its reliability in that many variables are significant. Although the estimation does not have very high R-squared, the Durbin-Watson statistics and the diagnostic tests indicate the validity of the model. Also, the error correction term of the bounds testing shows correct sign and has an appropriate magnitude (-0.574), indicating that there is an adjustment to the long run of the variables and confirming the existence of long-run relationship. In the short-run model, the relative income of trading partners has a positive influence on export performance. However, FDI and private domestic investment show a negative relationship but not significant. The misalignment index shows a strong negative effect on export performance as well. The dummy variable used to capture the opened-door policy and the promotion of FDI indicates that policy has strong a influence on export performance.

Table 3: Long-run relationship of variables in export equation

Dependent variable: *log(EXY)*

Variables	Estimated by OLS	Estimated by Bounds testing approach
Intercept	6.887**	- 2.687
	(2.110)	(-0.521)
Log(PXW)	0.373	0.647
	(0.404)	(0.723)
log(YWY)	- 0.929***	0.202
	(-2.968)	(0.425)
FDIY	0.047	0.141**
	(0.710)	(2.102)
PDIY	- 0.002	0.019
	(-0.124)	(1.105)
MISALIGN	0.049*	- 0.09**
	(1.717)	(-2.623)
Adjusted R^2	0.753	
Durbin-Watson stat	1.020	

Note: The figures in parentheses are t-statistics. The critical t-statistics for 28 samples are employed.. Asterisks (*), (**), (***) indicate significant at 10% , 5%, and 1% respectively. The t-statistics of coefficients estimated by bounds testing approach are obtained by using Bardsen transformation.

Table 4: Short-run error correction of export model

Dependent variable: △*log(EXY)*

Variables	Estimated by Engle-Granger approach	Estimated by Bounds testing approach
Intercept	0.059	0.045
	(-0.391)	(0.534)
△*Log(PXW)*	0.113	- 0.153
	(0.221)	(-0.407)
△*log(YWY)*	0.301	0.824***
	(0.750)	(3.499)

$\triangle FDIY$	0.021	- 0.013
	(0.494)	(-0.414)
$\triangle PDIY$	- 0.011	- 0.002
	(-0.785)	(-0.233)
$\triangle MISALIGN$	- 0.006	- 0.071***
	(-0.272)	(-3.341)
$D_{1988\text{-}2008}$	0.212	0.800***
	(1.225)	(4.232)
EC_{t-1}	- 0.325	- 0.574***
	(-1.217)	(-4.465)
Adjusted R2	0.01	0.475
Durbin-Watson stat	1.387	1.92
Serial correlation test (LM)	F(2,17) = 2.377 [4.494]	F(2,17) = 0.286 [4.494]
Heteroskedasticity (ARCH) test	F(1,24) = 0.734 [4.279]	F(1,24) = 0.369 [4.279]
Specification error (RESET) test	F(1,18) = 0.031 [4.494]	F(1,18) = 0.001 [4.494]
Normality (Jarque-Bera) test	$\chi^2(2)$ = 5.785 [5.99]	$\chi^2(2)$ = 1.217 [5.99]

Note: The figures in parentheses under each coefficient are t-statistics. The critical t-statistics for 28 samples are employed. Asterisks (*), (**), (***) indicate significant at 10% , 5%, and 1% respectively. The figures in [ ] of diagnostic tests are the critical value of each test. $D_{1988\text{-}2008}$ is a dummy that captures the FDI promotion policy of Lao PDR. It takes the value of 1 after 1988 and 0 elsewhere.

4.2.3 Comparing the results with other studies

In this section, we compare our findings of net impact of FDI on export performance with some other studies.

The comparison in Table 5 shows that in many countries such as India, Indonesia, Malaysia, and Thailand, although FDI has a positive impact on export performance, the negative effect of real exchange rate misalignment is much stronger. In the case of the study in MENA countries by Nabli and Varoudakis (2002), the net effect of total investment (not FDI) is bigger. Therefore, we might infer that FDI performs better in promoting export in Lao PDR.

Table 5: Compare the results with some selected studies

Study	Country	Effects on export performance in the long run	
		RER Misalignment	FDI
Jongwanich (2009)	India	-2.76*	0.02
	Indonesia	-1.34**	0.25**
	Malaysia	0.45	0.007
	Thailand	-0.96**	0.10***
Nabli and Varoudakis (2002)	MENA countries	-0.10***	0.30***[a]
This study	Lao PDR	-0.09**	0.14**

Note: Asterisks (*), (**), (***) indicate significant at 10% , 5%, and 1% respectively. [a] this effect is of total investment, not FDI.

5. Conclusion

This paper examines the net impact of foreign direct investment on the export performance of Lao PDR over the period 1981-2008. The net impact is carried out by comparing the magnitude of the coefficient of FDI-GDP ratio and the coefficient of misalignment index.

The analysis is carried out by using cointegration techniques including the 2-step Engle-Granger approach and the bounds testing approach to cointegration. The results of the analysis reconfirm the widely shared view that FDI leads to the appreciation of real exchange rate. In addition, other forms of government spending also have a significant influence in appreciating real exchange rate, but relatively smaller than that of FDI's effect. This finding contrasts with that of Athukorala and Rajapatirana (2003) in which FDI has less impact than other forms of capital inflows and government expenditures. The impact of FDI on export performance is explored. It is noteworthy that FDI has a strong positive influence on export performance in the long run, while the real exchange rate misalignment index (in which FDI plays a significant role) has a strong negative impact on export performance in the long run. Nevertheless, the net contribution of FDI to the export performance is positive. We close our analysis by comparing our results with other studies; it is found that FDI to Lao PDR performs better in terms of promoting export performance.

In conclusion, the results of our investigation show that although foreign direct investment have some negative impact on the stability of real exchange rate, its effect on export performance is stronger. Therefore, Lao PDR can still embrace the inflows of FDI for contributing to its development process. Nevertheless, in this study, only some aspects reflecting the impact of FDI on export are analyzed, many other aspects have still been left for the further research.

Notes

[1] In this paper, the increase of real effective exchange rate refers to depreciation, and the decrease is appreciation. See section 3 for the definition of real effective exchange rate.

[2] See MacDonald (2007), for a comprehensive review of many other approaches of equilibrium real exchange rate estimation.

[3] Elbadawi (1994) assumes that domestic absorption is determined by net foreign capital inflows, world interest rate, share of non-tradable goods in consumption and the expected rate of real exchange rate depreciation; however relaxing this assumption does not alter our empirical results. In addition, many studies in this area do not include the latter variables due to the difficulty to obtaining data and the model derivation becomes more complicated.

[4] The preference of *GIY* to *AIY* is that including *GIY* provides a strong co-integration among variables in the model. The form of the variables (with or without log) does not change the general results.

[5] This assumption seems to be reasonable, since most government consumption expenditures go to government's service sector.

[6] Due to the difficulty in measuring technological progress, some studies (i.e., Jongwanich, 2009) used this ratio as the proxy. It captures the productivity improvement of the host country relative to its trading partners.

Acknowledgements

We would like to thank the participants of the 12th International Convention of East Asian Economic Association held in Seoul, Korea; and two anonymous referees for very helpful comments on an earlier draft.

References

ADB, (1999), *Key Indicators of Developing Asian and Pacific Countries,* Asian Development Bank, Manila.

ADB, (2002), *Key Indicators of Developing Asian and Pacific Countries,* Asian Development Bank, Manila.

ADB, (2007), *Key Indicators of Developing Asian and Pacific Countries,* Asian Development Bank, Manila.

Athukorala, P., and Rajapatirana, S. (2003), Capital inflows and the real exchange rate: A comparative study of Asia and

Latin America. *The World Economy*, 26, 613-637.

Bank of the Lao PDR, (2009), *Annual Report 2009*, Vientiane, Pakpasak.

Clark, P. B., and MacDonald, R. (1998), Exchange rates and economic fundamentals: A methodological comparison of BEERs and FEERs, *IMF Working Paper WP/98/67*, International Monetary Fund, Washington, DC.

Corden, W. M., and Neary, J. P. (1982), Booming sector and deindustrialization in a small open economy, *The Economic Journal*, 92, 825-848.

Edwards, S. (1988), Real and monetary determinants of real exchange rate behavior, *Journal of Development Economics*, 29, 311-341.

Edwards, S. (1989), *Real exchange rate, devaluation and adjustment: Exchange rate policy in Developing countries*, MIT Press, Cambridge.

Elbadawi, I. (1994), Estimating long-run equilibrium real exchange rates, J. Williamson, eds., *Estimating equilibrium real exchange rates*, Institute for International Economics.

Goldstein, M., and Khan, M. (1978), The supply and demand for exports: A simultaneous approach, *The review of economics and statistics*, 60, 275-286.

Goldstein, M., and Khan, M. (1978), Income and price effects in foreign trade, R.Jones and P. Kenen eds., *Handbook of International Economics Vol. 2* , Elsevier, Amsterdam.

Harris, R., and Sollis, R. (2003), *Applied time series modeling and forecasting*, John Wiley & Sons Ltd, Sussex.

Hargreaves, C. (1994), A review of methods of estimating cointegrating realationships, C.Hargreaves eds., *Nonstationary time series Analysis and cointegration*, Oxford University Press, New York.

Hinkle, L. E., and Montiel, P. J. (1999), *Exchange rate misalignment: Concept and measurement for developing countries*, Oxford, Oxford University Press.

IMF, (2010a), *Direction of trade statistics*, International Monetary Fund, Washington, D.C. [Online cited 2010], available from URL: http://www2.imfstatistics.org/DOT/

IMF, (2010b), *World Economic Outlook: Recovery, risk and rebalancing*, International Monetary Fund, Washington, D.C. [Online cited 2010], available from URL: http://www.imf.org/external/pubs/ft/weo/2010/02/index.htm

Jongwanich, J. (2009), Equilibrium real exchange rate, misalignment, and export performance in Developing Asia, *Asian Development Bank Economics Working Paper 151*, Asian Development Bank, Manila.

Johansen, S. (1988), Statistical analysis of cointegration vectors, *Journal of Economic Dynamic and Control*, 12, 231-254.

Johansen, S., and Juselius, K. (1992), Testing structural hypotheses in a multivariate cointegration analysis of the PPP and the UIP for UK, *Journal of Econometrics*, 53, 211-244.

MacDonald, R. (2007), *Exchange rate economics: Theories and evidence*, Routledge.

Montiel, P. (1999), Determinants of the long-run real exchange rate: an analytical model, L.E. Hinkle and P. Montiel eds., *Exchange rate misalignment: Concepts and measurement for developing countries*, Oxford University Press, New York.

Nabli, M. K., and Varoudakis, M. A. (2002), Exchange rate regime and competitiveness of manufactured export, *World Bank Working paper Series 27*, Washington, DC.

Pesaran. M. H., and Shin, Y. (1999), An autoregressive distributed lag modeling approach to cointegration analysis, S. Strom eds., *Econometrics and Economic theory in the 20th Century: The Ragnar Frisch centennial symposium*, Cambridge University Press, Cambridge.

Pesaran, M. H., et al. (2001), Bounds testing approach to the analysis of level relationships, *Journal of Applied Econometrics*, 16, 289-326.

Stein, J. et al. (1995), *Fundamental determinants of exchange rates*, Clarendon Press, Oxford.
van Wijnbergen, S. (1986), Macroeconomic aspects of the effectiveness of foreign aid: On the two-gap model, home goods disequilibrium and real exchange rate misalignment, *Journal of International Economics*, 21, 123-136.
Williamson, J. (1983), *The exchange rate system*, Institute for international economics, Washington, DC.
United Nations. (2010), *GDP by type of expenditure*, United nations Statistic Division, [Online cited 2010], available from URL: http://data.un.org/Data.aspx?d=SNAAMA &f=grID%3a1013bcurrID%3aUSD %3bpcFlag%3a0
World Bank, (2009), *World Development Indicators 2009*, CD-ROM, Washington, DC.

Appendices

Appendix A

Table A.1: Unit root test of series in equilibrium real exchange rate model at level

	ADF Test		Phillips-Peron Test	
Variable	Computed t-statistics	5% critical value	Computed t-statistics	5% critical value
log(REER)	-2.855*	-2.981	-2.413	-2.981
FDIY	-2.483	-2.981	-1.672	-2.981
GIYY	-1.723	-2.981	-2.117	-2.981
OIY	-3.458***	-2.981	-3.464***	-2.981
log(GCY)	-2.394	-2.981	-1.869	-2.981
log(OPEN)	-1.219	-2.981	-1.556	-2.981
log(TOT)	-1.885	-2.981	-1.935	-2.981
log(PROD)	-1.647	-2.981	-1.521	-2.981

Note: Asterisks (*), (**), (***) indicate significant at 10% , 5%, and 1% respectively. Critical values are from McKinnon (1996). Lag length are chosen using Akaikei Information Criteria (AIC) and Schwarz Information Criteria (SIC).

Table A.2: Unit root test of series in equilibrium real exchange rate model at first difference

	ADF Test		Phillips-Peron Test	
Variable	Computed t-statistics	5% critical value	Computed t-statistics	5% critical value
△*log(REER)*	-4.034***	-2.981	-4.034***	-2.981
△*FDIY*	-3.543***	-2.981	-3.145***	-2.981
△*GIY*	-6.584***	-2.981	-8.636***	-2.981
△*OIY*	-7.172***	-2.981	-13.917***	-2.981
△*log(GCY)*	-7.155***	-2.981	-7.155***	-2.981
△*log(OPEN)*	-3.731***	-2.981	-5.719***	-2.981
△*log(TOT)*	-5.619***	-2.981	-15.210***	-2.981
△*log(PROD)*	-6.182***	-2.981	-12.648***	-2.981

Note: Asterisks (*), (**), (***) indicate significant at 10% , 5%, and 1% respectively. I(1) indicates stationary after first difference. Critical values are from McKinnon (1996). Lag length are chosen using Akaike Information Criterion (AIC) and Schwarz Information Criteria (SIC). ADF test refers to Augmented Dickey-Fuller test.

Appendix B: Cointegration test of equilibrium real exchange rate model using bounds testing approach to cointegration

Table B.1 t-statistics for testing the existence of long-run relation of REER equation

Variable	Coefficient	Computed t-statistics	Critical t-statistics at 5% significant level for unrestricted intercept and no trend, *k*=6	
			Lower bound	Upper bound
$log(REER)_{t-1}$	- 0.808	- 4.951**	-2.86	-4.38
$(FDIY)_{t-1}$	- 0.172	- 3.410		
$(GIY)_{t-1}$	- 0.084	- 4.438		
$log(GCY)_{t-1}$	- 1.713	- 2.097		
$log(OPEN)_{t-1}$	0.999	2.895		
$log(TOT)_{t-1}$	3.623	- 3.078		
$log(PROD)_{t-1}$	- 0.301	- 0.744		

Note: Asterisks (*), (**), (***) indicate significant at 10% , 5%, and 1% respectively. *k* is the number of exogenous variables in the long-run equation. OIY is dropped since it deteriorates the cointegration estimation.

Table B.2: F-statistics for testing the existence of long-run relation of REER equation

Model	Estimated F-statistics	Critical F-statistics at 5% significant level, for unrestricted intercept and no trend, *k*=6	
		Lower bound	Upper bound
Equation (16)	5.749***	2.45	3.61

Note: Asterisks (*), (**), (***) indicate significant at 10% , 5%, and 1% respectively. *k* is the number of exogenous variables in the long-run equation.

Appendix C: Unit root test of series for export equation

Table C.1: Unit root test of series in export model at level

	ADF Test		Phillips-Peron Test	
Variable	Computed t-statistics	5% critical value	Computed t-statistics	5% critical value
log(EXY)	-2.495	-2.981	-1.386	-2.981
log(PXW)	-1.455	-2.981	-1.260	-2.981
log(YWY)	-1.524	-2.981	-0.637	-2.981
FDIY	-2.483	-2.981	-1.672	-2.981
PDIY	-0.360	-2.981	-0.373	-2.981
log(LCPI)	-2.145	-2.981	-1.997	-2.981
MISALIGN	-2.554	-2.981	-2.554	-2.981

Note: Asterisks (*), (**), (***) indicate significant at 10% , 5%, and 1% respectively. Critical values are from McKinnon (1996). Lag length are chosen using Akaikei Information Criteria (AIC) and Schwarz Information Criteria (SIC).

Table C.2: Unit root test of series in export model at first difference

	ADF Test		Phillips-Peron Test	
Variable	Computed t-statistics	5% critical value	Computed t-statistics	5% critical value
△*log(EXY)*	-3.792***	-2.981	-5.605***	-2.981
△*log(PXW)*	-5.456***	-2.981	-5.816***	-2.981
△*log(YWY)*	-1.786	-2.981	-7.670***	-2.981
△*FDIY*	-3.543***	-2.981	-3.145***	-2.981
△*PDIY*	-4.897***	-2.981	-5.229***	-2.981
△*log(LCPI)*	-3.717***	-2.981	-3.695***	-2.981
△*MISALIGN*	-4.888***	-2.981	-4.866***	-2.981

Note: Asterisks (*), (**), (***) indicate significant at 10% , 5%, and 1% respectively. I(1) indicates stationary after first difference. Critical values are from McKinnon (1996). Lag length are chosen using Akaike Information Criteria (AIC) and Schwarz Information Criteria (SIC). ADF test refers to Augmented Dickey-Fuller test.

Appendix D

Table D.1: t-statistics for testing the existence of long-run relation of export equation

Variable	Coefficient	Computed t-statistics	Critical t-statistics at 5% significant level for unrestricted intercept and no trend, k=5	
			Lower bound	Upper bound
$log(EXY)_{t-1}$	-0.689	-4.540**	-2.86	-4.19
$log(PXW)_{t-1}$	0.446	0.963		
$log(YWY)_{t-1}$	0.139	0.457		
$(FDIY)_{t-1}$	0.097	2.114		
$(PDIY)_{t-1}$	0.013	1.227		
$(MISALIGN)_{t-1}$	0.06	-2.785		

Note: Asterisks (*), (**), (***) indicate significant at 10% , 5%, and 1% respectively. *k* is the number of exogenous variables in the long-run equation.

Table D.2: F-statistics for testing the existence of long-run relation of export equation

Model	Estimated F-statistics	Critical F-statistics at 5% significant level, for unrestricted intercept and no trend, *k*=5	
		Lower bound	Upper bound
Equation (24)	6.791***	2.62	3.79

Note: Asterisks (*), (**), (***) indicate significant at 10% , 5%, and 1% respectively. *k* is the number of exogenous variables in the long-run equation.

Appendix E

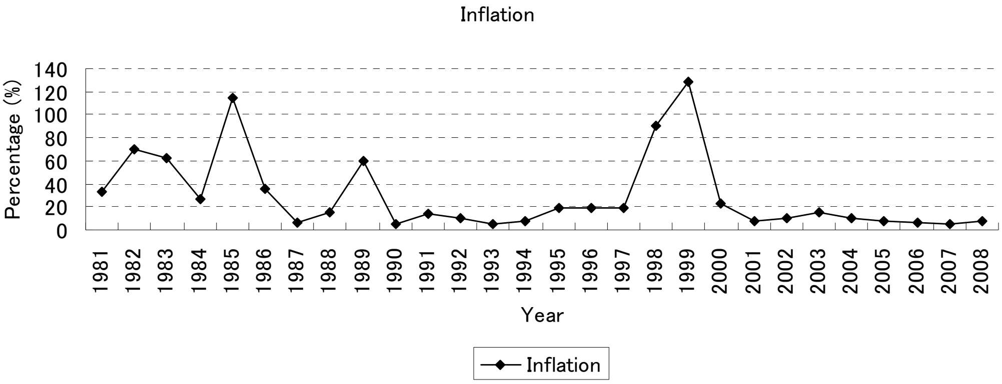

Figure 4: Inflation rate

Source: IMF, 2010b

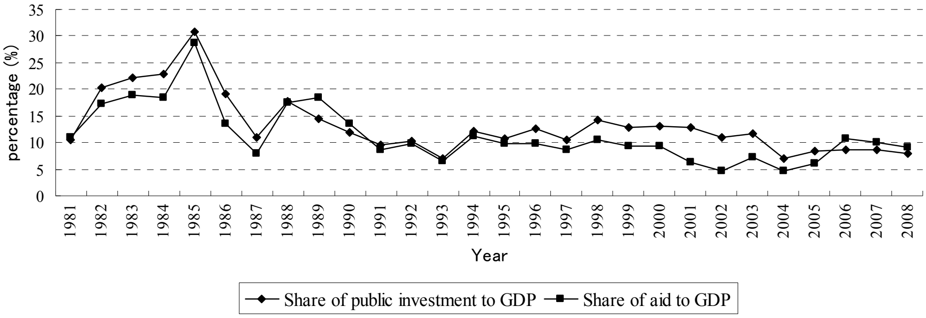

Figure 5: Trends of share of public investment to GDP and share of aid to GDP

Source: ADB (1999, 2002, 2007), Bank of Lao PDR (2009)

Appendix F

Table F: Lao PDR's major trading partners

1.Thailand	(0.5647)	13.Netherlands	(0.0065)	25.Norway	(0.0016)
2.Vietnam	(0.1206)	14.Malaysia	(0.006)	26.Indonesia	(0.0015)
3.China,P.R	(0.0925)	15.Italy	(0.006)	27.Ireland	(0.0014)
4.Japan	(0.0359)	16.Sweden	(0.0033)	28.South Africa	(0.0012)
5.France	(0.0251)	17.Russia	(0.0032)	29.Ukraine	(0.0010)
6.Germany	(0.0228)	18.Canada	(0.002)	30.Cambodia	(0.0008)
7.Singapore	(0.0200)	19.Poland	(0.0023)	31.Pakistan	(0.0005)
8.Korea	(0.015)	20.India	(0.0023)	32.Czech Republic	(0.0004)
9.UnitedStates	(0.0123)	21.Spain	(0.0020)	33.Austria	(0.0004)
10.Belgium	(0.0104)	22.Finland	(0.0018)	34.New Zealand	(0.0003)
11.Australia	(0.0077)	23.Switzerland	(0.0017)	35.Portugal	(0.0003)
12.Hong Kong	(0.0073)	24.Turkey	(0.0017)		

Note: the figure in parentheses is the total trade share over the study period. In the estimation, we use the trade share in respective year.