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J-Curve Effect and Thailand's Trade in Forest Products: ARDL Bounds Testing

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Abstract: This paper tried to check for J-curve existence in Thailand's trade in forest products with the rest of the world. An ARDL approach to cointegration has been employed to specify trade balance model from trade equation based on the theory. Prior to the test for J-curve existence, pre-testing for unit root and cointegration test ware conducted. The results show that all the variables became stationary at first difference and cointegration exists among them. We have also assessed both the short run and long run relationships between Thailand's trade balance and its various determinants stated in the equation. The result (both in the short run and long run) shows that sustainable forest management policy's coefficients gave the expected results; income coefficients also gave expected results while the exchange rate coefficients gave contrary results as against the expected. However, the result of the J-curve effect test indicates that there are no signs of its existence and hence we concluded that it does not exists in the case Thailand's trade in forest products.

Key words: J-curve effect · Trade balance · Short run · Long run · Autoregressive Distributed Lag Approach to Cointegration

INTRODUCTION

Thailand's logging ban on logging activities which exclude the coastal mangrove forest has dramatically reshaped the country's forest sector and timber processing industry as well as affect the forest products trade with other countries. As a result of this ban, the Thai wood processing sector needed to find a new strategy to procure natural forest wood which therefore led to the increase in forest products imports. However, Thai industries have developed an elaborate sourcing strategy that links a long list of countries (Malaysia, Myanmar, Laos and others). These firms add value to these raw or semi-processed timber resources and then the products are consumed nationally or re-exported to the global forest products market, namely china, EU and North America. The decline of domestic wood supply from natural forests has led to a clear domestic wood deficit for some economically-valuable species. The solution has been to import natural forest round logs and sawn wood from neighbouring Southeast Asian countries, particularly Myanmar, Cambodia, Lao PDR and Malaysia.

Nevertheless, Thailand is still described as the regional forest products manufacturing hub, competing with China and Vietnam while also sending large volumes of raw materials to these countries in the form of sawn rubber wood and eucalyptus wood chips as exports. Therefore, Thailand has become regional competitor in some industry segments and a regional supplier in others.

This paper aims to assess the long run and short run effects of sustainable forests management policies on the Thailand's trade balance in forests products with the rest of the world based the trade balance equation adopted by literature, as well as to test for the existence of J-curve effect. The study applies autoregressive distributive lag Model approach to cointegration (ARDL bounds testing) by [1]. Also, the error correction model version (ECMs) of the main ARDL has been employed to estimate the short run effects. The ARDL model has been chosen owing to

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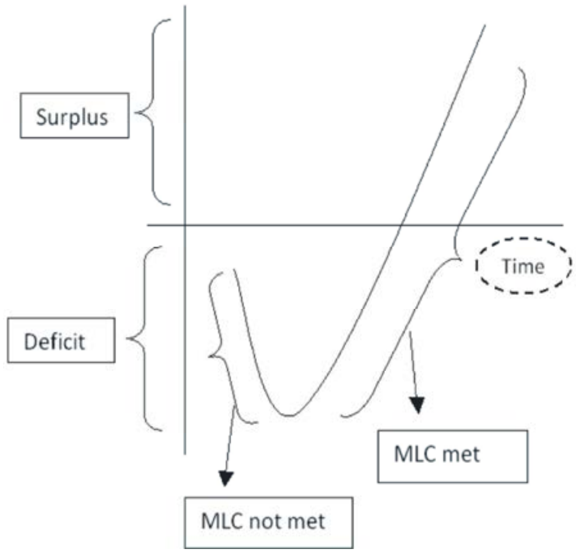

Fig. 1: The diagrammatical representation of the J-curve Theory.

its distinguishable features and econometric advantages when compare to standard co integration tests such as Engle and Granger 1987and Johansen 1995. For instance ARDL approach can be applied regardless of the variables' order of integration. More so, error correction model can be formed by a simple linear transformation from main ARDL model. Lastly, the ARDL model yields better results for both large and small sample size than other cointegration methods [2].

Theoretical Framework: This paper rests upon the conventional J-curve theory of international trade. According to the assumption of the theory, a country's balance of trade experiences J-curve effect when its currency is devalued. The theory postulates that at the initial stage, the country will experience trade deficit i.e. the imports exceed the exports resulting from currency devaluation. As trading activities continue over time, the nation's export prices will be reduced and consequently, the exports gradually start recovering. Hence, the theory concludes that such country will gradually move back to trade surplus region (Figure 1).

Trade balance is defined as difference between export revenue over cost of import including exports and imports of services.

i.e. $TB = P_x X - eP_m M$ (1)

where TB stand is balance of trade (in monetary value); P_x represents export price; P_m is the import prices; X, export quantity (in monetary value) and M, import quantity (in monetary value. while *e* represents the exchange rate expressed as a ratio of domestic currency to foreign currency.

Empirical Models and Data

Empirical Model: This study adopts the econometric ARDL model for estimation and analysis. To build our ARDL model, we need to firstly derive the original balance of trade model for forest products on the basis of theoretical framework developed by [3].

$$TB = X^s (Y^*, ER) - M^d (Y, ER) \quad (2)$$

That is the difference between the exports' value and imports' value.

where X^s is the home country's export; Y is the home country's income; Y* is the foreign country's income and M^d represents the import to the home country.

If we further reduce the equation, we have:

$$TB = TB (Y, Y^*, ER) \quad (3)$$

Constructing our ARDL model, we firstly specify equation (3) in log linear form:

$$\ln TB_t = \beta_0 + \beta_1 \ln Y_t^{THAI} + \beta_2 \ln Y_t^{RW} + \beta_3 \ln OER_t + \beta_4 DUM_t + U_t \quad (4)$$

where $lnTB_t$ is the Thailand's trade balance with the rest of the world expressed as trade deficit, *t* represents years covered by study; Y_t^{THAI} is the real Thailand income; Y_t^{RW} is the income of the world; OER_t is the official exchange rate; DUM_t is a dummy variable representing various policies on forest management in Thailand and U_t represents the error term.

The expected coefficients' sign in equation (4) are $\beta_1 > 0$ and $\beta_2 < 0$, $\beta_3 > 0$ since depreciation in Thailand's currency increase exports and at the same time decreases imports, hence improving balance of trade. Also, $\beta_4 < 0$ since sustainable forest management policy reduces the quantity of export which affects the trade balance negatively.

The approach of ARDL involves the estimation of error correction model version of the ARDL model for variables' estimation in the estimation process [1]. Therefore, from equation (4), the specified ARDL model becomes:

$$\Delta \ln TB_t = \beta_0 + \sum_{i=1}^{p} \lambda_i \Delta \ln TB_{t-i} + \sum_{i=0}^{p} \delta_i \Delta \ln Y_{t-i}^{THAI} + \sum_{i=0}^{p} \theta_i \Delta \ln Y_{t-i}^{RW} + \sum_{i=0}^{p} \eta_i \Delta \ln OER_{t-i} + \gamma_1 \ln TB_{t-1} + \gamma_2 \ln Y_{t-1}^{THAI} + \gamma_3 \ln Y_{t-1}^{RW} + \gamma_4 \ln OER_{t-1} + \gamma_5 DUM_t + \varepsilon_t \quad (5)$$

where Δ stands for the difference operator and disturbance term U_t is assumed to be serially uncorrelated. The parameters with summation signs (Σ) represent the short run dynamics between balance of trade and its determinants i.e. the J - curve effect. Also, the terms with γ's as coefficients in the second part of the equation represent the long run parameters which are jointly used to test for long run relationship. Two hypotheses are defined below for testing cointegration relation. The null hypothesis which is defined as: $H_0 : \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = 0$, indicating non existence of the long run relationship. While alternative hypothesis is defined as: $H_0 : \gamma_1 \neq \gamma_2 \neq \gamma_3 \neq \gamma_4 \neq \gamma_5 \neq 0$, indicating existence of long run relationship.

If cointegration relation exists among the variables, long run model would be estimated as specified below:

$$\ln TB_t = \beta_1 + \sum_{i=1}^{p} \lambda_{1i} \ln TB_{t-i} + \sum_{i=0}^{p} \delta_{1i} \ln Y_{t-i}^{THAI} + \sum_{i=0}^{p} \theta_{1i} \ln Y_{t-i}^{RW} + \sum_{i=0}^{p} \eta_{1i} \ln OER_{t-i} + \sum_{i=0}^{p} \rho_{1i} DUM_{t-i} + \nu_t \quad (6)$$

The lag orders of the ARDL model are selected mainly based on the Schwarz Bayesian Criterion (SBC) or Akaike Information Criterion(AIC) before proceeding to estimating the selected model by ordinary least squares method(OLS). The short run model can be constructed by specifying ECM model in this form:

$$\Delta \ln TB_t = \beta_2 + \sum_{i=1}^{p} \lambda_{2i} \Delta \ln TB_{t-i} + \sum_{i=0}^{p} \delta_{2i} \Delta \ln Y_{t-i}^{THAI} + \sum_{i=0}^{p} \theta_{2i} \Delta \ln Y_{t-i}^{RW} + \sum_{i=0}^{p} \eta_{2i} \Delta \ln OER_{t-i} + \sum_{i=0}^{p} \rho_{2i} DUM_{t-i} + \alpha ECM_{t-1} + \mu_t \quad (7)$$

where, ECM_t represents the error correction term which can be expressed as:

$$ECM_t = \ln TB_t - \beta_1 - \sum_{i=1}^{p} \lambda_{1i} \ln TB_{t-i} - \sum_{i=0}^{p} \delta_{1i} \ln Y_{t-i}^{THAI} - \sum_{i=0}^{p} \theta_{1i} \ln Y_{t-i}^{RW} - \sum_{i=0}^{p} \eta_{1i} \ln OER_{t-i} - \sum_{i=0}^{p} \rho_{1i} DUM_{t-i} \quad (8)$$

The short run's coefficients to be obtained from equation (8) are coefficients of the short run dynamics of the model's convergence to equilibrium in the long run and á denote the speed of the adjustment process.

Data: The series used include balance of trade expressed as *M/X ratio (TB_t),* official exchange rate *(OER_t),* world income in form of GDP *(Y_t^{RW})* and Thailand's income in form of GDP *(Y_t^{THAI})*. All these series are annual data collected for the period of 1970 – 2010 from the World Bank's official website and Food and Agricultural organization (FAO)'s website. However, since all the variables are converted into natural logarithms, the estimated coefficients can be interpreted as elasticities.

Empirical Results and Analysis: Prior to testing for cointegration relation, we have tested each variable for unit root using augmented Dickey Fuller (ADF) and Phillips Perron (PP) (see results in Table 1). Despite the fact that ARDL framework does not necessarily require that variables be tested for unit root as pre-requisite, but testing for the order of integration could be helpful in determining whether ARDL model should be applied or not as I(2) variables cannot be used in the model.

ARDL method commences with the determination of the appropriate and optimal lag length (*p*) in equation (5). However, since equation (5) is based on the assumption that U_t is serially uncorrelated, it is important to balance between choosing *p* sufficiently large to mitigate the residual correlation problems and sufficiently small to avoid over-parameterized, particularly in view of the limited time-series data which are available [1]. In this case, Akaike Information Criterion (AIC) and Lagrange Multiplier *(LM)* statistics are used for testing the null hypothesis of no serial correlation against order 1, 2 and 4 respectively (see results in Table 2). For instance, based on the AIC values, lag 2 (p=2) is the optimal and appropriate lag length for Thailand's forest products'

Table 1: Unit test using Augmented Dickey Fuller (ADF) and Phillips Perron (PP)

	Level		First Difference	
Variables	ADF Test stats.	PP Test stats.	ADF Test stats.	PP Test stats.
Balance of trade *[ln (TB)]*	-1.3903	-1.5604	-4.6219***	-4.5900***
	(0.848)	(0.790)	(0.003)	(0.003)
Thai-Income *[lnY^{THAI}]*	-1.5288	-0.9076	-3.3824**	-3.8018**
	(0.802)	(0.945)	(0.025)	(0.027)
World-Income *[lny^{RW}]*	-1.9692	-1.4188	-3.7592**	-3.7363**
	(0.599)	(0.840)	(0.029)	(0.031)
Exchange Rate *[lnOER]*	-1.4858	-1.9438	-4.6908***	-4.6290***
	(0.818)	(0.613)	(0.002)	(0.003)

Notes: ***Significance level at 1% level, **Significance at 5% level and *Significance level at 10%. Parentheses are the p-value.

Table 2: Summary statistics for lag selection and test for serial correlation

Model	Lag order	1 Lag	2 Lags	3 Lags	4 Lags
Trade Balance Model	AIC	-0.5882	-0.4580	-0.5592	-0.4822
	x^2sc (1)	2.4981	4.0702**	4.6789**	11.7983**
		(0.114)	(0.043)	(0.030)	(0.000)
	χ^2sc (2)	4.3398	5.4980	7.3727**	17.8502**
		(0.114)	(0.064)	(0.025)	(0.000)
	χ^2sc (4)	4.8772	6.8410	14.4121**	19.5623**
		(0.300)	(0.144)	(0.006)	(0.000)
	F -statistics	2.1279	4.4473	3.1839	3.2541

**Denotes level significance at 5%. AIC is the Akaike Information Criterion for a selected lag length. χ^2sc (1), χ^2sc (2) and χ^2sc (4) are the LM statistics for testing serial correlation against orders 1, 2 and 4 respectively and, parentheses are the p-value. The F-statistics critical value bounds for testing co integration relation at 5% are (2.962-4.338). These critical values are obtained from Table Case III by Narayan (2005).

trade given the lowest AIC value compare to other lags. Additionally, at lag 2, the LM test statistics indicate that the hypothesis of no serial correlation can be rejected in order of 1 but cannot be rejected in order of 2 and 4.

The next step is to conduct the bounds testing to check for the existence of cointegration. Contrary to the conventional vector autoregressive model, equation 5 contains the lagged level variables. The linear combination of these lagged level variables replace the lagged error term in the conventional ECM. Therefore, it becomes necessary to decide whether or not to retain the lagged level variables in the model (equation 5). If we need to retain them, then the variables are regarded as cointegrated. To confirm that, the null hypothesis of no cointegration ($H_0 : \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = 0$,) in equation (5) is tested against the alternative hypothesis ($H_0 : \gamma_1 \neq \gamma_2 \neq \gamma_3 \neq \gamma_4 \neq \gamma_5 \neq 0$) regardless of the order of integration of the regressors. This process could be accomplished by comparing the calculated F-statistics with the two sets of asymptotic critical values tabulated by [1] for large sample or [4] for small sample in which all the regressors are assumed to be all $I(0)$ or $I(1)$. If the F-statistics (computed) exceeds the upper bound, then cointegration exists and on the other hand if the F-statistics (computed) falls below the lower bound, then there is no cointegration. Furthermore, the F-statistics value lies in between the upper and the lower bound, then the result is said to be inconclusive.

The optimal lag, p =2 for Thailand's trade in forest products has F-statistics to be 4.4473 which exceeds the upper bound at 5% critical bounds (Table 2). Therefore, this result indicates the existence of cointegration between forest products' trade and its determinants. The result is in line with the result obtained by [5], where softwood lumber, logs and chips and other wood products' trade balances have been found to be cointegrated with its main determinants in US-Canada trade in forest products. So also, it concords with the findings of [6], who reports cointegration relation between Malaysia's trade balance and its determinants.

The long-run model could be estimated from the reduced form solution of equation (5) which is equation (6), when the entire first differenced variables jointly equal to zero. While the ECM is estimated by the ARDL method first estimates $(p + 1)^k$ number of regressions to obtain the lag length for variable, where p is the number of lag to be chosen using F-statistics and k is the number of variables in the equation. Furthermore, AIC is then used to select the optimal lag for ARDL specification. In this case, the optimal lag for trade balance equation is p =2 (p, p_1, p_2).

Table 3: The estimated long run coefficients of Thailand's forest products trade equation using ARDL approach

Independents Variables	Coefficients (Prob - value)
Thailand income *(Y_t^{THAI})*	2.5059
	(0.553)
World Income *(Y_t^{RW})*	-3.5771
	(0.676)
Official Exchange Rate *(OER_t)*	-1.5345
	(0.565)
Forest Policy *(DUM_t)*	-1.0233
	(0.445)
Constant	61.6091
	(0.749)

**Significance at 5% level. Parentheses are p-values.

Table 4: The Estimated Short run coefficients of Thailand's forest products trade equation using ARDL approach

Variables	Coefficients (Prob - values)
Thailand income	3.004**
(ΔY_t^{THAI})	(0.044)
World Income	-0.673
(ΔY_t^{RW}) Independents	(0.719)
Official Exchange Rate	-0.288
(ΔOER_t)	(0.529)
Forest Policy	-0.1925
(ΔDUM_t)	(0.512)
Constant	11.591
	(0.775)
EC_{t-1}	-0.1881**
	(0.042)

**Denotes significance level at 5%. *Denotes significance level at 10%. Parentheses are p-values.

Table 5: The determination of J-curve effect's existence based on the short run coefficients of exchange rate

Trade Balance	Coefficients
ΔOER_t	1.1011
	(0.435)
ΔOER_{t-1}	3.1948*
	(0.055)
ΔOER_{t-2}	4.3199**
	(0.019)
ΔOER_{t-3}	4.1163**
	(0.044)
ΔOER_{t-4}	0.2762
	(0.872)
EC_{t-1}	-0.6782***
	(0.005)

Note: OER_t is the official exchange rate. EC_{t-1} is the error correction term. Δ indicates the first difference of variable. *** denotes significance at 1% level. **Denotes significance at 5% level.*denotes significance at 10% level. Parentheses are p-values.

The long run Thailand's balance of trade model result shows that, all coefficients of income variables are having the expected signs even though statistically insignificant (Table 3). The finding is consistent with Keynesian monetary theories which state that an increase in domestic income will impact positively on country's trade balance. This substantiates the result obtained by [6], who found positive relationship between Malaysia's trade balance and domestic income. Also, the negative impact of the word income (foreign income) supports the findings of [5]. Whilst, the coefficient of the official exchange rate gives contradictory sign as against the expected (Table 3) and also statistically insignificant, which contradicts previous literatures that found positive relationship in the long run [5-7]. The negativity of the exchange rate could be as a result of exchange rate policy exercised by the government. The occasional intervention by government to maintain the target zone and also, the Asian financial crisis might have contributed to this outcome. Furthermore, the coefficient of sustainable forest management policy is negative as earlier expected but insignificant in determining the trade balance (Table 3). This proves that logging ban policy on logging activities has reduced the amount of exports from Thailand to other countries of the world at the expense of forest conservation.

More so, the Thailand's balance of trade negative long run relationship with official exchange rate for trading in forest products implies that, the depreciation of Thailand's currency does not improve the balance of trade in the long run. Rather, it will worsen it. This is against the expected as provided by the theory of J-curve. Some factors mentioned earlier might be responsible for that.

The results (Table 4) of the short run model (equation 7) are obtained from estimating the ECM model which shows that the coefficients of income variables – Thailand's income and world's income are statistically significant and insignificant respectively. However, both incomes are having the expected sign, which support the findings by [5] and [6]. The coefficient of exchange rate still gives negative sign which backs finding of [7] and the coefficient of sustainable forest management policy still conform to the expectation. The error correction term is negative and statistically significant, confirming the existence of long run relationship among the variables. However, both long run and short run coefficients exhibit the same signs though in the long run, Thailand income is insignificant but significant in the short run in determining balance of trade. It is worthy to note that both the long run and short run results justify the negative impact of sustainable forest management policy on the trade balance of Thailand's trade in forest products with rest of the world.

Lastly, the ECM is estimated by an ARDL approach to capture the short run dynamic effects of the depreciation on the trade balance or the J-curve effects (Table 5). The sign of the coefficients of exchange rate determines J-curve effect's existence. That is if an initial negative sign is followed by a positive one on the lag coefficients, then it is consistent with the J-curve theory. Otherwise, J-curve effect does not exist.

The results reveal that all the coefficients of the current and subsequent lagged exchange rates are positive though some significant and some insignificant. For instance coefficients of lag one, two and three are significant while the coefficients of current lag and lag four are insignificant. Therefore, the results does not follow the theory of J-curve, this means that J-curve does not exists in this case (Table 5). Therefore, the findings indicate absence of J-curve effect in Thailand's forest products trade. This finding substantiates other literatures that reported non existence of J-curve [3, 8-10]. On the other hand, it disputes those literatures which found J-curve existence [7, 11, 12].

CONCLUSION

Our paper checks the existence of J-curve effect in Thailand's trade in forest products with rest of the world. Prior to that, we have investigated the long run and short run impact of sustainable forest management policy on Thailand's trade balance based on the hypothesis of J-curve. An ARDL approach to cointegration has been used in estimating the annual trade data (1970 to 2010). However both long run and short run revealed that exchange rate has negative sign which means negative relationship with Thailand's trade balance. This result contradicts the theory developed under the elasticity approach of balance of trade. Despite that, the finding is in line with the findings of a study by [13], which revealed that the role of the exchange rate is rather insignificant in initiating changes in the trade balances in the case of Malaysia, Singapore, Thailand and the Philippines. We also found that sustainable forest management policy has negative but not significant impact on Thailand's trade in forest products with the rest of the world in both long run and short run which could be attributed to the restrictions imposed on logging activities in the Thailand' forest areas. The test for J- curve effect's existence reveals that, it does not exist as the theoretical provisions are not met. However, any attempt to devalue Thai currency in order to improve the forest products' trade balance may render it ineffective. Furthermore, the general findings of the paper provide some strong evidence that Thailand's income plays an important role in determining the short run behaviour of Thailand's balance of trade. This supports the finding of [6] in the case of Malaysia who reported that Malaysia's income impacts significantly on its trade balance compared to exchange rate. This might have been resulted from intervention by government to control and regulate exchange rate. Therefore, the policy implication here is that policies on income or growth in general could better be used to correct trade balance problem and not devaluation policy.

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