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Supply of Rubber Wood Log in Malaysia

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Abstract

Issue on shortage of raw material for wood processing solved by discovery of rubber wood log as one of the substitutes the natural log. This paper examines the supply of rubber wood log in Malaysia. We employ ARDL Bound Approach Test and time series data from 1980 to 2010 which represented the whole Malaysia are used to achieve the established objectives. The result shown, in the long run harvested area and wages have 1% and 10% significant level respectively. While in the short run, there was only harvested area having an impact with 1% significant level. This result indicates that, the harvested area become the most impact towards supply of rubber wood log either in short run or in the long run. While wages as input cost gave less impact in another word it become unburden to the producers.

Keywords: ARDL bound test approach, rubber wood log & latex

Introduction

Rubber trees with species (Hevea brasiliensis) were planted in Malaysia since centuries ago.

Historically, Sir Henry Wickham brought some seeds to the Kew Garden, United Kingdom from Brazil in 1876 (Hilton, 1955). Some of the seedlings were then transported to Singapore Botanical Garden through Ceylon (now known as Sri Lanka) in the same year before transfer to Malaysia.

Based on archive records showed that the initial cultivation of rubber in Malaysia began in Kuala Kangsar in 1879 (Ratnasingam, 2000). Today, Malaysian recognizes him as the father of the rubber industry in Malaysia as appreciation of his contribution.

Initially, the rubber trees serve as the main rubber producers in Malaysia. Just not only Malaysia the rubber trees are now widely planted in 20 countries around the world for the production of latex or natural rubber (Teoh *et al.*, 2011).

According to Shigematsu *et al*. (2011), more than 80% of total rubber plantation areas in the world are in Asia, with Malaysia, Indonesia and Thailand covering almost 70% of the total rubber cultivation.

Malaysia was the largest producer of rubber in the world until the late 1980's (Balsiger *et al.*, 2000).

Indonesia then took over as the biggest rubber cultivator in the world followed by Thailand. Malaysia is currently the 3rd most

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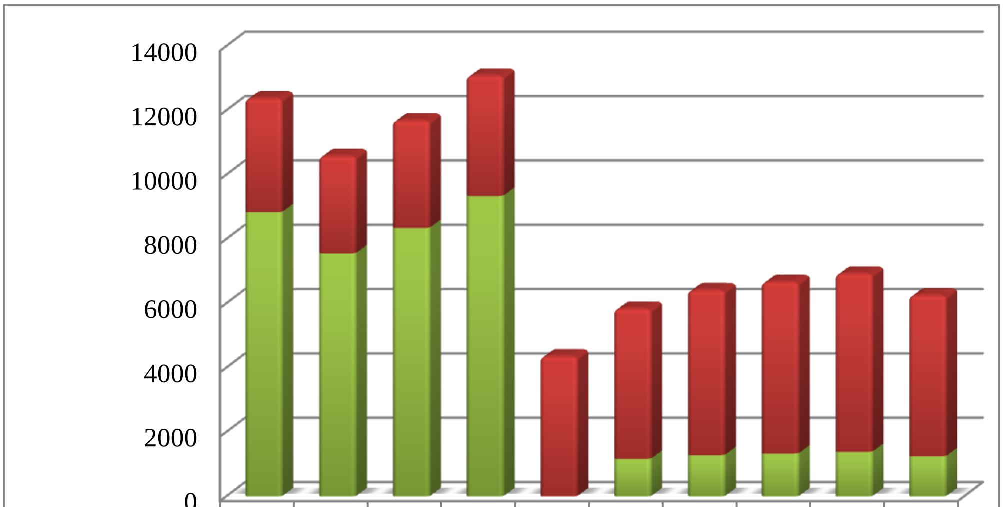
important country in the world for rubber cultivation (Shigematsu *et al.*, 2011).

But, when Malaysian government imposed restricted logging activities in the natural forests in the mid-1980s, the wood-based industry in Malaysia forced to find other raw material instead of natural forest timber.

Resulting on inadequacy of raw material, rubber wood log has emerged as the most important wood raw material in the country and be promoted as an alternative source of wood raw material for the wood industry. Since then, Malaysia start using rubber wood tree as substitute to natural timber and this decision embark a successful action.

According to Hong (1994), the turning point here was the fact that Malaysia was the first country to be successful in the export of rubber wood sawn timber in the late 1970s.

Based on the Figure 1, it is proven when the rubber wood log becomes a successful substitute to the wooden from natural timber in making furniture.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Rubberwood	3535	3023	3339	3736	4351	4665	5127	5332	5537	4999
Wooden	8838	7557	8349	9344	0	1167	1282	1333	1384	1250

Figure 1: The total export of rubber wood furniture and wooden furniture
Source: Malaysian Timber Council (2011)

There are a lot of indicator contribute to the successful of rubber wood furniture in world market.

According to Shukari, (1994) and Balsiger *et al.* (2000) the physical and mechanical properties of rubber wood log is almost comparable with the other commercial timbers such as Dark Red Meranti (Shorea platyclados), Sepetir (Sindora coriacea), Nyatoh (Palaquium gutta) and Ramin (Gonystylus bancanus). Furthermore, rubber wood log have good machining properties, acceptable durability, pleasant appearance and ease in finishing (Anonymous, 1993).

However, year to years, total rubber plantation keep decreasing due to other crops more profitability than rubber wood. Rubber wood estate owner willing shifted to mainly oil palm plantation. According to Ratnasinggam (2000), the planters claimed less profit in the rubber industry, due to low latex price in world market. As a result, the large plantation groups in Malaysia, which consist of Guthrie, Golden Hope and Kuala Lumpur Kepong, have been slowly converting their land to oil palm plantation.

Furthermore, the issues of declining of labor become constraint in rubber plantation (Ratnasinggam, 2011). According to the Department of Statistic (2010), the total number of workers in rubber plantations in 2000 was 24,193, and showed reduction of 61.40% in 2009. It was believed due to low rate of wages. As noted by Chang and Ong (2000), a rubber tapper needs to tap at least 30-40kg of latex in order to earn 7.85 USD-9.42USD per day. In addition, the annual total wages obtained by the estate worker declined by 34% from 2000 to 2009.

In addition, the fluctuation of the price of latex for certain years making the rubber planter makes decision in order to increase their yield (Ratnasinggan, 2011). When the price of latex decreased in 1990s, most rubber planters shifted to oil palm plantation. But, from 2002s onward, the annual average of natural rubber price (SMR 20) shown upward trend each year (Figure 2).

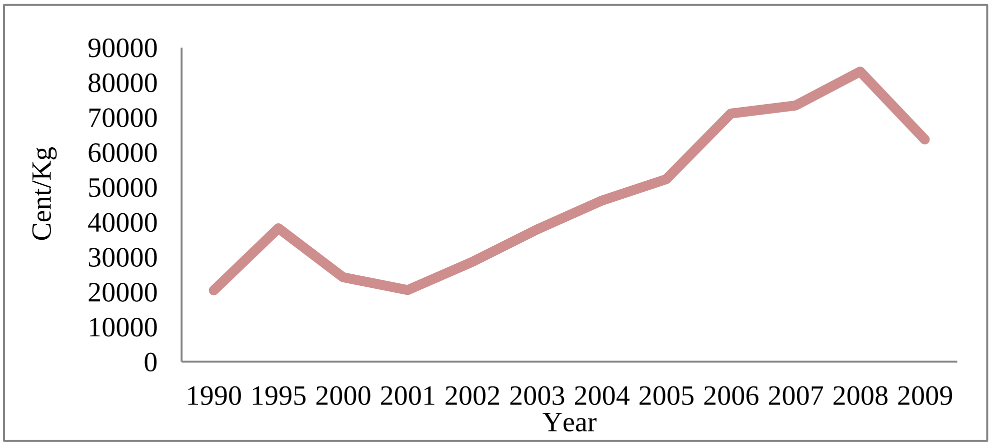


Figure 2: The annual average F.O.B price of natural rubber (cent/kg)
Notes: SMR 20-standard Malaysian rubber-medium grade produced from field coagulation but may contain some RSS.
Source: Department of statistics (2011).

The rubber planters delay in the replanting of rubber occurred as a consequence of the high price of latex, although the yield as lower. According to Shahwahid and Abdul Rahim (2009), the curb in felling the rubber trees have resulted in the shortage of rubber wood logs supply to the wood industries. Due to the reason above, the study on economic impact on supply of rubber wood log is crucial particularly to investigate the future direction of rubber wood log industry in Malaysia.

Methodology and data

To construct the supply function of rubber wood log, the model was deriving from Cobb-Douglas supply function. Cobb-Douglas has been chosen as the supply function type for this study since it satisfies the conformity of the assumed model with traditional economic theory. The supply function has assumed the following form:

$$Y = A\,K^{\alpha}N^{\beta} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where Y is total supply level of industry, K as capital stock for industry, N as employment of industry, A is total factor productivity and α+β as positive fraction. Some of the major properties of Cobb-Douglas supply function deserve nothing:

1. It is homogenous of degree (α+β).
2. In the special case where (α+β) =1, it is linearly homogenous. (or it is homogenous of the first degree)
   Economic meaning of this property is that it implies the condition of constant returns to scale.
3. Its isoquants are convex toward the origin and they negatively sloped throughout.

Rewriting (Eq. 1) in more general way, we obtain the following supply for rubber wood log:

$$TR = f(P, HA, W) \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

where (TR) refers to total supply of rubber wood log, (P) is price of rubber wood log in meter cubic (m^3) and (W) as total wages for plantation workers. While, HA referred to harvested area in rubber wood plantation. The development of the supply of rubber wood log market model is based on the theoretical framework of the supply model of log from natural forest. Based on the previous researchers Kumar (1981, 1983), Daniels and Hyde (1986), Kinus (1992), Shahwahid (1995), Ismariah (2001), Abdul Rahim and Shahwahid (2009), they have attempted to develop this model. Based on the economic theory and practical knowledge, the supply of rubber wood log equations are specified as follows:

Supply of rubber wood log = f (price of rubber wood log, harvested area, input cost)……………………………………. (3)

Then, the supply of rubber wood log is specified as follows:

$$TR_t = \alpha_0 + \beta_1 P_t + \beta_2 HA_t + \beta_3 W_t + \varepsilon_t \ldots. \ (4)$$

Where TR_t as supply of rubber wood log in Malaysia at time t, HA_t as harvested area in rubber wood plantation area at time t, P_t as the price of rubber wood log at time t, W_t as input cost incurred at time t in the supply which is total wages and ε_t error term. After that, all variables in Equation 3 were transformed into the log form (Equation 4) in order to ensure variance in every random error term is homoscedasticity.

$$InTR_t=\alpha_0+\beta_1\ InP_t+\beta_2\ InHA_t+\beta_3\ InW_t+\varepsilon_t \ldots (5)$$

The coefficient of price of rubber wood log, β_1 will give positive sign. Similarly, expected that coefficient in harvested area; β_2 is expected to be positively related to the total supply of rubber wood log.

An increase in harvested area would increase the supply for Malaysian rubber wood log and vice versa.

It is an important variable in determining the quantity of supply of rubber wood log. On the other hand, the coefficient of input cost (β_3) generally expected to be negative as if the cost of producing increase, the total supply of rubber wood log decreases and vice versa.

In this study, we employ ARDL bound test approaches introduced by Pesaran *et al.* (1996). Refer to Pesaran and Pesaran (1997) and Pesaran *et al.* (2001), the construction of the ARDL model are written as follows:

$$InTR_t = \alpha_0 + \beta_1 InTR_{t-1} + \beta_2\ InHA_{t-1} + \beta_3 InP_{t-1} + \beta_4 InW_{t-1} + \sum_{i=1}^{k} \varphi_1\ InTR_{t-i} \sum_{i=1}^{k} \varphi_2\ InHA_{t-i} + \sum_{i=1}^{k} \varphi_3\ InP_{t-i} + \sum_{i=1}^{k} \varphi_4\ InW_{t-1} + \varepsilon_t \ldots\ldots (6)$$

There are two steps in testing the cointegration relationship between variables. First, the model above is estimated by OLS technique.

Second, the null hypothesis of no-cointegration H_0=φ_1=φ_2=φ_3=φ_4= 0 is tested against the alternatives of H_A=φ_1≠φ_2≠φ_3≠φ_4≠ 0 by the means of F-test. Two sets of critical value bounds for the F-values are generated by Pesaran *et al.* (2001).

According to Pesaran *et al.* (2001), if the F-statistic lies between lower bound I(0) and upper bound I(1) values, this will indicate inconclusive decision. While, if F-statistic lies below lower bound I(0), it reveals that there is no cointegration relationship among the variables in the long run. Nevertheless, if the calculated values fall within the bounds, inference is inconclusive.

If there is an evidence of long-run cointegration relationship between variable, the next step is to estimate the long-run cointegration model, however if it is not cointegrated then other methods should be used and do not continue the following steps. So that is represented long-run cointegration model as following equation:

$$InTR_t = \alpha_0 + \sum_{i=1}^{k} \varphi_1\, InTR_{t-i} \sum_{i=0}^{k} \varphi_2\, InHA_{t-i} + \sum_{i=0}^{k} \varphi_3\, InP_{t-i} + \sum_{i=0}^{k} \varphi_4\, InW_{t-1} + \varepsilon_t \;\ldots\ldots\ldots \quad (7)$$

The dependent variable of Equation (7) start from lags one and independent variables start from zero because it has priori shows that long-run cointegration relationships exist among the variable in Equation (6).

After generating the long-run coefficient model, now can proceed to estimate the short run regression with ECT model as below:

$$InTR_t = \alpha_0 + ect_{t-1} + \sum_{i=1}^{k-1} \varphi_1\, InTR_{t-i} \sum_{i=0}^{k-1} \varphi_2\, InHA_{t-i} + \sum_{i=0}^{k-1} \varphi_3\, InP_{t-i} + \sum_{i=0}^{k-1} \varphi_4\, InW_{t-1} + \varepsilon_t \quad \ldots\ldots. (8)$$

Where k is the lag based on the selected lag length in the long-run equation, ect_t is the error correction term. It presents the potential effects of departures from the long-run equilibrium (Baharumshah *et al.*, 2009). The ECT coefficient should be negative and significant in order to confirm the cointegration relationship.

Data description

The secondary data which represented the whole Malaysia are used to achieve the established objectives. The time series data from 1980 to 2010 has been obtained.

Data for harvested was obtained by Rubber Industry Smallholders Development Authority, price of rubber wood log by Forestry Department Peninsular Malaysia and wages of plantation workers by the Department of Statistic, Malaysia.

These values are expressed in terms of Ringgit Malaysia (RM), metric cubic (m^3) and hectare (ha). For the data analysis, it involves econometric software namely EVIEW 7 and Microfit 4.0.

Result and discussion

Pre-testing the level of stationary

Before estimating the Bound Test-ARDL, the requirement to test for unit root test is needed. Even though ARDL approach does not required to conduct the unit root test, but we have to ensure that the variables are not integrated of order 2 [I(2)]. In fact, the F-test would be spurious in the presence of I(2) because both the critical values of the F-statistics computed by Pesaran *et al.* (2001) and Narayan (2005) are based on the assumption that the variables are I(0) or I(1). Based on Table 1, the result found that all variables are stationary at first difference. Automatically, the result of I (2) do not need to carry out because all variables are integrated at I (0) and I (1). If, there are not integrated at I (0) and I (1), then it is necessary to analyse the unit root test at I(2) level.

Table 1: Unit root test

Variables	ADF test statistics (with Trend and intercept)		PP test statistics (with trend and intercept)	
	Level	First difference	Level	First
LTR	-2.737996 (0)	-6.618241*** (0)	-2.335126 [29]	-7.654367*** [12]
LP	-3.264263* (0)	-4.918503*** (0)	-3.380484* [11]	-4.896466*** [8]
LHA	-2.809452 (0)	-6.619939*** (2)	-2.480714 [29]	-7.383990*** [12]
LW	-0.204832 (0)	-4.324263*** (1)	0.049796 [6]	-4.448498*** [12]

Notes: *** and ** denotes significant at 1%, and 5% significance level, respectively. The figure in parenthesis (…) represents optimum lag length selected based on Akaike Info Critirion. The figure in bracket […] represents the Bandwidth used in the KPSS test selected based on Newey-West Bandwidth Critirion.

Long-run co integration relationship

The next step is to test for the existence of long-run co integration relationship between the variables. The null hypothesis of no co integration H_0=β_1=β_2=β_3=β_4= 0 in Equation (7) is tested against the alternative hypothesis H_A=β_1≠β_2≠β_3≠β_4≠ 0. This process accomplished when the F-statistic lies on upper bound or I (1). It indicates that, we reject the null hypothesis or there is long-run co integration relationship between dependent variable (total supply of rubber wood log) and independent variables (harvested area, price and wages). Based on the result depicted in Table 2, the F-statistic is computed 5.1013 which fall on upper bound mcritical value with 1% significant level. It means that, the model have long-run co integration model between them.

Table 2: Co integration result of bounds test-ARDL for supply of rubber wood log

Variables: InTRlnPlnHAlnW		
Computed F- statistic: 5.1013**	Critical value	
	Lower bound	Upper bound
1% significant level	5.333	7.063
5% significant level	3.710	5.018
10% significant level	3.008	4.150

Notes: The bounds critical values are obtained from Narayan (2005), Appendix: Critical values for the bounds test: Case III: restricted intercept and no trend (k=2).

Estimation of long-run relationship coefficient

After confirming that there is co integration relationship among the dependent and independent variables, then we proceed with the estimation of long run co integration model (refer to Equation 7). Based on Table 3, as expected, the sign of the estimate variables are consistent with the theory. The result shows that the sign of the price of log, harvested area and wages are positive, positive and negative respectively. The t-ratio shows that, harvested area is highly significant at 1% level followed by wages at 10% significant level while price shows insignificant toward the total supply of rubber wood logs.

Table 3: Estimated ARDL model based on supply of rubber wood log

Dependant variable: InTR		
Regressors	Coefficient	T-ratio
InP	0.027817	1.5881
InHA	1.0599	27.8177***
InW	-0.048617	-1.7557*
InPT	5.0049	9.6991***
R-Squared	0.99544	
R-Bar-Squared	0.99392	
Durbin Watson Statistic	2.2604	
Diagnostic Test		
Test Statistics	LM Version	F Version
Serial Correlation	0.037992	0.028860
Functional Form	3.9520**	3.4711*
Normality	2.6614	Not applicable
Heteroscedasticity	0.091621	0.085572

Notes: *** and ** denotes significant at 1%, and 5% significance level, respectively

Based on the estimation, (W) is inelastic and it suggests that an increase 10% in wage of plantation workers ceteris paribus, supply of rubber wood log would decrease only by 0.5%. It clearly shows that, the input cost become unburden towards producers due to inelastic in input cost (wages) as it gives weak impact towards total supply of rubber wood log.

It means that the input cost is unburdened to the rubber wood log producers. In other words, the incremental amount of wages is needed among plantation workers especially to those who are working at the rubber estate plantation.

According to Chang and Ong (2000), in a case of smallholders, a rubber tapper needs to tap at least 30-40kg of latex in order to earn RM 25-RM 30 per day.

Furthermore, the annual total wages obtained by the estate workers declined by 34% from 2000 to 2009.

Therefore, workers do attract to work at the oil palm plantation which is known as more lucrative than being a rubber tapper since oil palm oil plantation could give more income than working at the rubber wood plantation (Teoh *et al.*, 2011).

As reported by the Department of Statistic, Malaysia, (2013), annual total of rubber estates worker was declined 52% from 2000 to 2012 while annual total of oil palm estate worker was increase 73% from 2000 to 2012.

On the other hand, the result for harvested area (Inha) is highly significant at 1% significant level and elastic.

This means that a 10% decrease of harvested area, ceteris paribus total supply of rubber wood log would decrease by 10.6%. It was believed due to direct impact of harvesting area on rubber wood log supply.

The scenario has been shown during 1990, when it was reported that the area under rubber cultivation has shrunk from 1.93 million hectares to almost 1.0 million hectares in 2010 (Ratnasingam and Jones, 2011).

The main cause of this trend is believed due to less profit in the rubber industry as price of latex always low in the world market (Ratnasingam, 2000).

As a result, many rubber wood plantations were converted to more profitability crops particularly oil palm plantation (Teoh *et al.*, 2011).

The inadequacy of rubber wood log forces some furniture mills used imported rubber wood log for sustaining their production. It is noted that, during 2009, Malaysian timber industry board (MTIB) has imported 73,000 cubic meter of rubber wood log worth RM80 million (Puasa *et al.*, 2010).

From January till May 2010, Malaysia has imported a total of 30,000 cubic meters of rubber wood log, mainly from Thailand (Puasa *et al.*, 2010).

Validation of rubber wood log supply

The R-Squared represent the overall fit of the equation between explanatory variables and dependent variable and this become an important criterion in evaluating the quality of regression.

Based on the Table 3, it shows that R-Squared is 0.99. This implies that 99 percent of the variation in rubber wood supply can be explained by the explanatory variables in the model.

Based on the diagnostic tests, the model is free from serial correlation problem, heterocedasticity and normality but has misspecification problem (see Table 3).

Although, the model is failed to pass the misspecification problem, since majority of the tests were passed, it is still considered that the model is acceptable reported. In addition, the result of Durbin Watson Statistic is also passed the autocorrelation test.

For the long-run stability test, the Ramsey RESET test proven that the model is stable (Refer Figure 3).

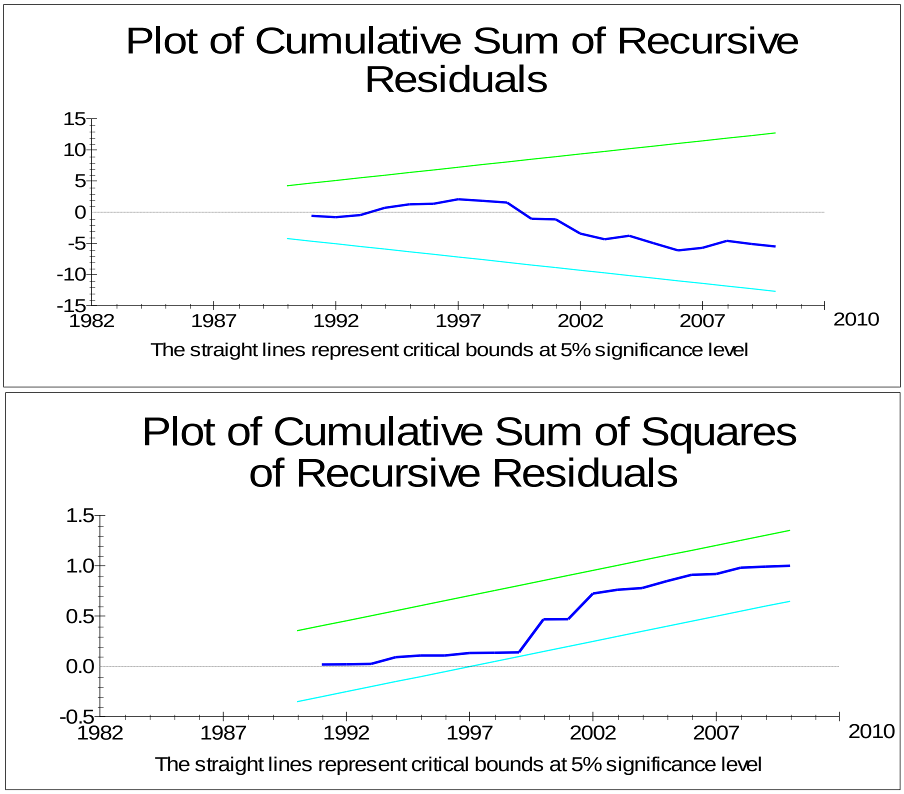


Figure 3(a) and figure 3(b): Ramsey RESET Test

Short-run ECM model

Table 4 reveals the results for error correction representation for selected ARDL model. This is also known as the short-run dynamic coefficient estimation. The error correction term denotes ECM (-1) should be negative and statistically significant. This term indicates the speed of adjustment process to restore equilibrium following a disturbance in the long-run equilibrium relationship. A negative and significance error corrections term implies how quickly variables can return to equilibrium.

Table 4: Error Correction Model (ECM) representation for the ARDL

Dependant variable: InTR		
Regressors	Coefficient	T-ratio
InP	-0.0247	-1.2056
InHA	1.0371	55.6262***
InW	-0.0288	-1.5583
InPT	2.9595	2.8193***
ECM(-1)	-0.5914	-3.1085***

Notes: *** and ** denotes significant at 1%, and 5% significance level, respectively.

ECM value for supply of rubber wood log in Malaysia is 0.5914. This suggests that the speed of adjustment to the long-run equilibrium for independent variables (i.e. harvested area, price of log and input cost) is 0.5914 or 59.1 percent and convergence to equilibrium after a shock in supply of rubber wood log would take about 10 Months 7 Days.

Conclusion

By using ARDL Bound test with annual time series data from 1980 to 2010, the study has estimated and analyzed the supply of rubber wood log in Malaysia. It is found that, the variables in supply function are cointegrated by 5% significant level.

The sign of price of rubber wood log, harvested area and wage of plantation workers were consistent with the theory. In the long-run and short-run, harvested area in rubber wood plantation becomes highly significant at 1% level.

Every changes in harvested area either for short- or long-run period would give highly impact towards supply of rubber wood log. On the other hand, as wages is inelastic and only significant at 10% level, it means that, wages is not a burden towards rubber wood log producers. This finding was confirmed by Schwarzbauer and Rametsteiner (2001) who found that a decrease in harvested levels gave immerse impact on the forest products market than an increase in the operational costs.

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