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Sustainable Forest Management Practices and West Malaysian Log Market

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Abstract

The global demand for timber products will continue to grow in line with increasing population and economic development especially in many developing countries. Simultaneously, forest ecosystem plays important roles in the environmental services such as carbon sequestration, recreational, water catchments, wildlife reserve and soil protection. Therefore, Malaysia is committed in implementing Sustainable Forest Management (SFM). The forest are harvested in a sustainable manner by adopting the method of reduce impact logging practices. This resulted to diminishing supply of logs to downstream timber industry. The West Malaysian log supply is in deficit since 1995. This has significant impact on major timber products. They have moved from resources surplus to one of deficit in Malaysia. Therefore, it is interesting to know the behaviour of West Malaysian log market with the implementation of SFM policy. The results indicate that full adoption of SFM could lead to substantial reduction of supply. Furthermore, a sustained price increase in the long run does not seem to have significant impact on the demand side. In conclusion, the ongoing adaptation of West Malaysian forestry to the standards of the SFM certification programs could have substantial effects only on the log supply. This will probably influence the scheme of forest plantation establishment in sustaining the West Malaysian forest sector.

Keywords: Sustainable Forest Management (SFM), Supply and demand of logs, Autoregressive Distribution Lag (ARDL)

1. Introduction

Malaysia has committed to achieving the International Tropical Timber Organization (ITTO) Year 2000 Target of Sustainable Forest Management (SFM). One of the targets is to practice timber certification where Malaysia is committed to managing its natural production forests in a sustainable manner. It is to ensure continuous timber production, maintain forest multiple functions, conserve biodiversity and control environmental impact (Anon, 1994 and 1996). To achieve some of these aims substantial information and better understanding of the stand growth and stand ecological are required. It is essential in cutting regime management to adopt the practice that best suits the forest stand, site, environment, cutting cycle and expected timber output (Anon, 1994). The sustainable management definition and objectives required maintenance of the forest stand re-generation not only for timber production, also for environmental stability, biodiversity conservation, but recreational values preservation and other forest products and forest components conservation.

Motivated by ITTO target, National Committee Sustainable Forest Management was established in 1994 under the Ministry of Primary Industries. This committee has formulated a total of 92 activities, based on 5 criteria and 27 indicators to implement the ITTO criteria at the national level (Thang, 2002). SFM has led to greater planning and monitoring of the environment. In term of economic, there are indications to incur incremental costs. This is due to additional forest management activities to comply with SFM. Furthermore, in the social aspect, forest concessionaires have an obligation to take into consideration the interest of local residents who are referred as The Orang Asli (or Indigenous Peoples).

To achieve SFM, Malaysia has committed to maintain at least 50 per cent of the land area under forest cover (Woon & Norini, 2002). Furthermore, SFM is typically implemented in the forest which is categorised under Permanent Forest Reserve (PFE). The Malaysian Government has imposed limits on the opening of annual PFE for harvesting, which is normally called annual coupe. This is part of the conservation strategy to ensure sustainable timber production (Mohd Shahwahid & Awang Noor, 2002). In the PFE designated as Production Forests, commercial logging is undertaken on a rotational cycle, under a sustained yield management system. Only mature trees with a ratio (7 to 12, trees per hectare) are marked for felling at each harvesting cycle. This allow the logging area time for recovery and regeneration before subsequent cycle (Thang, 2002). Under this selective logging system, Malaysian forests have the ability to maintain the eco-balance, thereby allowing for better biological functioning of the forests.

In compliance to SFM, the supply of logs has keep on reducing and this scenario has become worse since 1995 when the demand of logs greater than supply. The supply of logs increased gradually with a slight fluctuation from 6.5 million m^3 in 1970 to 13.0 million m^3 in 1992 with an average growth rate of 4.5 percent per year. However, it was decreased to 4.4 million m^3 in 2005 with an average growth rate of -5.1 percent per year (Figure 1). This decline in log production was mainly due to the reduction of annual coupes resulting from the Rio Convention and Malaysia's need to achieve ITTO objectives 2000 and international certification standard in attaining SFM (Lim *et. al.* 2002).

Therefore, the objective of this study is to analyse the log market in moving towards complying with SFM in West Malaysia. This is due to decrease in harvesting level are likely to affect the log production in connection with the implementation of SFM (Schwarzbauer & Rametsteiner 2001). To this consideration, it should be added the potential of a change in the supply and demand of logs through sustainably produced.

From the objective of study, it will help the industries to design strategies in facing the various impacts of SFM practices particularly in log market. Moreover, wood is an essential raw material for local industries such as those manufacturing furniture and building-frame structures, which are heavily concentrated in West Malaysia.

2. A Review of Related Literature

In Malaysia, supply of raw material became a serious problem after 1995, when the wood-based industry moved from producing products such as sawlogs, sawntimber and plywood/veneer to manufacturing high value-added products like furniture, joinery/mouldings and rubberwood products in late 1990s (Norini, 2003). This has worsened the supply of primary wood products being the raw materials in meeting the demand of the local factories.

With regards to SFM practices, Schwarzbauer & Rametsteiner (2001) have analysed the potential impacts of SFM certification on forest products markets using a simulation model of the Western European forest sector. The empirical evidence shows that rather modest changes are to be expected from SFM certification in forest products markets. The market impact of timber supply reduction from certified forest would be more distinct than the impact of chain of custody costs. That means, a decrease of harvesting levels in certified forest will affect forest products markets more than the increase costs related to the installation and maintenance of SFM certification in the forest sector.

On the other hand, Eriksson, Sallnass & Stahl (2007) studied the forest certification and wood supply in Sweden with the objective of assessing the likely effect of Forest Stewardship Council (FSC) certification on short and long term supply of roundwood in Sweden. The results indicated that full adoption of the FSC standard on the entire land base, compared to adherence only to the Forestry Act, could result in a substantial reduction in supply. In contrast this could induce a price increase in situation where supplied quantity is maintained at current level. Furthermore, a sustained price increase that used to compensate for lost volume today does not seem to prevail in the long run.

3. Methodology and Data

In dealing with the time series analysis, there is a large number of the empirical studies utilised the unrestricted reduced-form model in the Vector Autoregression (VAR) context to investigate the effect on forest-related policy of forest products (Nanang, 2000; Stodal & Nyrud, 2003; Laaksonen *et al.* 1997; and Hanninen 1998). VARs are dynamic systems of equations that examined the interrelationship between economic variables, using minimal assumptions about the underlying structure of the economy. Since the right-hand side of the models consists only predetermined variables and the error terms are the ordinary least square (OLS) method in estimating the VAR model, it is well known from the literature on simultaneous equation estimation that the OLS method yield efficient estimates of the VAR coefficients.

The cointegration techniques like Engle & Granger (1987) or Johansen types cointegration procedures; for example, Johansen (1988) and Johansen & Juselius (1990) are commonly used in the empirical economics to study the existence of long-run equilibrium relationship in levels between variables. These methods involve a pre-testing step for unit roots in order to determine the order of integration of the variables in the model. In particular, they require all the variables under study to be integrated in the same order of one, that is I(1). In practice, however, not all variables have a unit root. Some variables are stationary in level, I(0), while others might have two unit roots, I(2), or stationary in second differences. If the orders of integration of the variable under study are different, it will cast doubt on the accuracy and validity of the estimation results obtained from the above cointegration testing procedures.

Engle & Granger (1987) highlighted that if the time series is non-stationary, one can include lagged dependent and independent variables using a sufficiently complex dynamic specification such as an Autoregressive Distributed Lag (ARDL) model to ensure the residual stationary. As such, in this study, ARDL bounds testing approach proposed by Pesaran *et. al.* (2001) is used to allow the regressors to have different order of integration, either I(1) or I(0), in estimating the functions. The bound test which is based on the estimation of an Unrestricted Error Correction Model (UECM) is applicable irrespective of whether the underlying regressors are purely I(0), I(1) or mutually cointegrated. By evaluating the long-run elasticity and short-run causality as well as examining economic factors that contributed to log supply, we hope that our results could provide some useful insights in the implementation of such forest-related policy.

Macroeconomic variables used in this study are: the quantity of log supply (lnLOGSS), the quantity of log demand (lnLOGDD), weighted price of logs (lnLOGWP), the annual logging area (lnLOGAREA), industrial production index (lnIPI) and the royalty of log (lnLOGROY) in natural logarithmic form. We obtained weighted price of logs via summation of price of log by species multiply with ratio of log quantity by species at particular year. Both functions of the analysis are as follows:

$$\begin{aligned}\Delta \text{lnLOGSS}_t = {} & \beta_0 + \beta_1 \text{lnLOGSS}_{t-1} + \beta_2 \text{lnLOGWP}_{t-1} + \beta_3 \text{lnLOGAREA}_{t-1} + \\ & \beta_4 \text{lnLOGROY}_{t-1} + \sum_{i=0}^{p} \alpha_5 \, \Delta \text{lnLOGSS}_{t-i} + \sum_{i=0}^{p} \theta_6 \, \Delta \text{lnLOGWP}_{t-i} + \\ & \sum_{i=0}^{p} \delta_7 \, \Delta \text{lnLOGAREA}_{t-i} + \sum_{i=0}^{p} \varphi_8 \, \Delta \text{lnLOGROY}_{t-i} + \varepsilon_t\end{aligned} \tag{1}$$

$$\begin{aligned}\Delta \text{lnLOGDD}_t = {} & \beta_0 + \beta_1 \text{lnLOGDD}_{t-1} + \beta_2 \text{lnLOGWP}_{t-1} + \beta_3 \text{lnIPI}_{t-1} \\ & + \sum_{i=0}^{p} \alpha_4 \, \Delta \text{lnLOGDD}_{t-i} + \sum_{i=0}^{p} \theta_5 \, \Delta \text{lnLOGWP}_{t-i} + \\ & \sum_{i=0}^{p} \delta_6 \, \Delta \text{lnIPI}_{t-i} + \varepsilon_t\end{aligned} \tag{2}$$

where Δ denotes a first difference operator; *ln* represents natural logarithmic transformation; β_0 is intercept and ε_t is a white noise error term.

There are two steps in testing the cointegration relationship. First, the model above is estimated by OLS technique. Second, the null hypothesis of no-cointegration is tested against the alternative by the means of *F*-test. Two sets of critical value bounds for the *F*-statistics are generated by Pesaran *et.al.* (2001). If the computed *F*-statistic fall below the power bound critical value, the null hypothesis of no-cointegration cannot be rejected. Contrary, if the computed *F*-statistic lies above the upper bound critical value, the null hypothesis is rejected. This implies implying that there is a long-run cointegration relationship amongst the variables in the model. Nevertheless, if the calculated value falls within the bounds, inference is inconclusive.

The general-to-specific procedure by Hendry & Ericson (1991) can be used to obtain a parsimonious UECM by dropping sequentially the insignificant first difference variables. The long-run elasticity of the independent variable is then calculated over the estimated coefficient of one-lagged level of the variable. Whereas, for the short-run elasticity of the independent variable, it is captured by the estimated coefficients of the first differenced variable in ARDL model above. In addition, we can detect the short-run causality through the error correction representation for selected ARDL model.

This study intends to evaluate the impact of SFM on West Malaysian log market using annual data from 1970 to 2005. Publish data on log supply, weighted price of logs, logging area and royalty were made available by the Forest Department of Peninsular Malaysia, the Ministry of Primary Industry publications and Department of Statistics. The MASKAYU provides monthly data on domestic log prices. We used weighted price of logs instead of the average price of logs by species. This is due to the availability of price of logs in various species and to enhance accuracy.

4. Results

The ARDL approach in this analysis involves several steps (see Pesaran & Pesaran (1997) for more detail). For the data analysis, it involves econometric software namely MICROFIT 4. The second step is to estimate the determinant of log market model in West Malaysia. The third step is to estimate the long run coefficient of log supply and lastly to estimate the short run error correction representation for the selected ARDL model of log supply.

4.1 ARDL Bounds Testing

The methods adopted in the literature in previous years mainly concentrated on cases in which the underlying variables are integrated of order I(1) (Pesaran *et al.*, 2001). The ARDL approach has some advantages over other approaches. First, the series used do not have to be I(1) (Pesaran & Pesaran 1997). Second, even with small samples more efficient cointegration relationships can be determined (Ghatak & Siddiki, 2001). Finally, Laurenceson & Chai (2003) stated that the ARDL approach overcomes the problems resulting from non-stationary time series data which led to spurious regression coefficient that are biased towards zero (Stock & Watson, 2003).

Table 1 shows the diagnostic test of the log supply and log demand function. Base on the goodness of fit of the ARDL model, both Panel A and B are well fitted as it passes all the diagnostic tests. The diagnostic tests reveal no evidence of misspecification. In addition, we find no evidence of autocorrelation was found. To test for structural stability, we utilised the cumulative sum of recursive residuals (CUSUM) and CUSUM of square stability test and it indicate that the estimated coefficient of the model are stable.

The computation of *F*-statistics for supply and demand functions are 3.6218 and 3.608 respectively. Both of the computed *F*-statistics are greater than the upper bound critical value at 10% level of significance (Table 2). Hence, there is an evidence of cointegrating relationship on supply and demand functions. This shows the existence of the relationships between the supply of logs with the price of logs, area with open for harvesting and that with royalty. Similarly, the relationship between the demand of logs with price of logs and that with industrial production index are also present.

The estimated coefficients of the long run relationships for these models are explained in Table 3. The lag lengths are determined by Schwartz Bayesian Criteria (SBC) criterion following the suggestion of Pesaran & Pesaran (1997). Panel A reveals only the price of logs is negatively (-0.9067) and significantly (at level 10%) related to log supply. This implies that as price of logs increases, the log supply decrease. It is due to the continuous restriction of annual allowable cutting rate by Malaysian government. Base on the information disclosed by the Forest Department Peninsular Malaysia (FDPM), the annual allowable cutting rate has decline from 71,200 ha in Fifth Malaysia Plan to 36,940 ha in Nine Malaysia Plan. This restriction of production affects the cost of harvesting. Therefore, log supply will drop in the long run even though the price increases. In other words, the production of logs is controlled by the government. This conclusion is derived based on West Malaysian log market only and not on Malaysia log market as a whole. Hence, the result of this analysis cannot represent the full picture of Malaysia log market as West Malaysia log supply covers only 30% of the whole Malaysia log supply (FDPM, 2005). We expect to derive a different result if we take into account the log market from Sabah and Sarawak.

In the context of demand function, Panel B (Table 3) illustrates all variables follow the expected sign. The coefficient of price of logs and Industrial Production Index (IPI) are -0.2920 and 1.2331 respectively. However, they are not significant in explaining the demand of logs. This means, price and IPI do not play an important role in determining the demand of logs in the long run. This is consistent with the studies by Mohd Shahwahid (1993) and Ahmad Fauzi (2005).

Lastly, the result in Table 4 reveals the error correction representation for selected ARDL model of log supply. This is also known as the short run dynamic coefficient estimation. Similar with long run estimation, Panel A shows only the price of logs is significantly related to log supply in the short run. However, the coefficient (0.2602) is positive at 10 percent significance level. This implies that in the short run, an increase in price of logs will lead to an increase in the log supply. In other words, producers may increase their production in the short run when the price increases but not in the long run as mentioned earlier. This result is consistent with the theory of supply where the rise in price will increase the supply of products (Parkin, 2003)

Panel B (Table 4) explains the short run demand function of logs. It shows that the price of logs is significantly related to log demand in the short run. The coefficient (-2.0921) is negatively significant at 10 percent level. The sign is consistent with the long run estimation and the theory of demand (refer Parkin, 2003). This implies that in the short run, an increase in price of logs will lead to decrease in the log demand. The error correction term (denoted ecm (-1) in Table 5) is found to be negative and statistically significant for both models. This term indicates the speed of adjustment process to restore equilibrium following a disturbance in the long run equilibrium relationship. A negative and significant error correction term implies how quickly variables return to equilibrium. For instance, the model of log supply and log demand implies 21% and 23% of the disequilibrium of the previous year's shocks able to readjust to the long run equilibrium in the current year respectively. This means both models are cointegrated with their own explanatory variables.

5. Policy Implications

This study has identified several economic instruments and policies that could improve the West Malaysia log market performance. For example State Governments should give preference to meet the domestic need for logs over that for exports. State Governments also further enhance Federal Government's financial assistance for forest plantation establishment by allocating adequate land with attractive terms to encourage private sector participation. In addition, the Government may provide incentives to encourage overseas sourcing of raw materials to help ease local supply constraints. Thus, State Government through their subsidiary companies and the support from the State Forestry Departments should be actively involved in reforestation programs. Subsequently, it can easily exclude the poor and unproductive state lands or degraded and severely damaged forest reserves for commercial forest plantations. Meanwhile, the essential of industry in assisting and give an element of confidence in planning for the future to ensure the supply of raw materials sustained. Two major categories of raw material are identified as log from forest plantation and rubber plantation.

At the international scene, markets have to be created for timber produced from SFM practices or known as sustainable managed forest. The element of price premium could only be fetched when there is market demand that willing to pay extra for logs that come from forest with sustainable managed. As SFM practices would be maintaining and escalating capabilities to sequester carbon, the element of carbon credit has to see as another incentive of complying with SFM. To this end, Malaysian Timber Certification Council (MTCC) and ITTO have a role to play to promote such incentives. Therefore, it would encourage more producers and land owners to manage their forests with sustainable manner.

6. Conclusions

In this study, we have examined the long-run and short-run relationships of both supply and demand models. An ARDL bound testing analysis is carried out to identify the cointegration of the model. The results show that both models are cointegrated by 10 percent significant level. The short run analysis reveals that log supply will increase as price of logs increases. However, the long run analysis indicates that by complying with SFM criteria, it will lead to substantial reduction in the log supply. This is because when the price of logs increase, the log supply tends to decrease due to controlled production by Government. Furthermore, in the long-run, an increase in domestic price of logs would help to compensate for the lost volumes these days. Annual area for logging and royalty show that they are not significant factors to log supply either in the long run or short run. This is due to the fact that SFM practices play an important role in controlling and monitoring the forest utilisation.

On the other hand, the demand side is only significantly influenced by the price of logs in the short run but not in the long run. This implies that, by complying with SFM, the price of logs is no longer an important determinant for the demand of logs. For the IPI, it is not significant in determining the demand of log for both short run and long run.

The total revenue from log harvests is referred to the government revenue from royalty paid by logger companies. In general the reduction in government revenue has been indicated by the shrinking of log supply. In conclusion, the ongoing adaptation of West Malaysian forestry to the standards of the certification programs could have substantial effects on the timber supply. This will probably influence the scheme of forest plantation establishment in order to sustain the West Malaysian forest sector.

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Table 1. Diagnostic test for West Malaysia log market

Panel A: Diagnostic Tests for Supply Function			
R^2	0.9234	Durbin Watson-*d*	1.9268
$\bar{R}^2$	0.9097	Serial Correlation	0.850
Functional Form	0.1970	CUSUM	Stable
Heteroscedasticity	0.9840	$CUSUM^2$	Stable
Panel B: Diagnostic Tests for Demand Function			
R^2	0.7031	Durbin Watson-*d*	2.1839
$\bar{R}^2$	0.6734	Serial Correlation	0.4460
Functional Form	0.3360	CUSUM	Stable
Heteroscedasticity	0.7790	$CUSUM^2$	Stable

Table 2. Cointegration result of bounds test for West Malaysia log market

Computed *F*-statistic for supply of logs function: 3.6218*	Critical Value	
Computed *F*-statistic for demand of logs function: 3.608*	Lower-bound	Upper-bound
10% significant level	2.618	3.532
5% significant level	3.164	4.194
1% significant level	4.428	5.816

Notes: The bounds critical values are obtained from Narayan et al. (2000), Appendix: Critical values for the bounds test: Case II: restricted intercept and no trend (k = 3); *Significant at 10 percent.

Table 3. Estimated long run coefficient using the ARDL approach of log market

Panel A : Supply Function				
Variable	Coefficient	Standard Error	*t*-statistic	*p*-value
lnLWP	-0.9067	0.41431	-2.1885**	0.0370
lnLOGAREA	-0.4148	0.62693	-0.6617	0.5140

lnLOGROY	-0.0919	0.67759	-1.1357	0.8930
C	26.2757	11.5754	2.2700**	0.0310
Panel B : Demand Function				
Variable	Coefficient	Standard Error	*t*-statistic	*p*-value
lnLOGP	-0.2920	0.1934	-1.5095	0.1420
lnIPI	1.2331	1.0799	1.1419	0.2630
C	12.6313	4.2054	3.0036***	0.0050

Notes: ***Significant at 1 percent, **Significant at 5 percent and *Significant at 10 percent

Table 4. Error correction representation for the selected ARDL model of log Market

Panel A : Supply Function				
Variable	Coefficient	Standard Error	*t*-statistic	*p*-value
dlnLOGWP	0.26023	0.14093	1.8465*	0.075
dlnLOGAREA	-0.08626	0.13961	-0.6179	0.541
dlnLOGROY	-0.01912	0.14351	-0.1333	0.895
dC	5.4637	3.4024	1.6059	0.119
Ecm(-1)	-0.2079	0.075857	-2.7412**	0.010
Panel B : Demand Function				
Variable	Coefficient	Standard Error	*t*-statistic	*p*-value
dlnLOGP	-0.0681	0.0325	-2.0921**	0.0450
dlnIPI	0.2875	0.2276	1.2633	0.2160
dC	2.9447	1.7182	1.7138*	0.0970
Ecm(-1)	-0.2331	0.0936	-2.4902**	0.0190

Notes: ***Significant at 1 percent, **Significant at 5 percent and * Significant at 10 percent

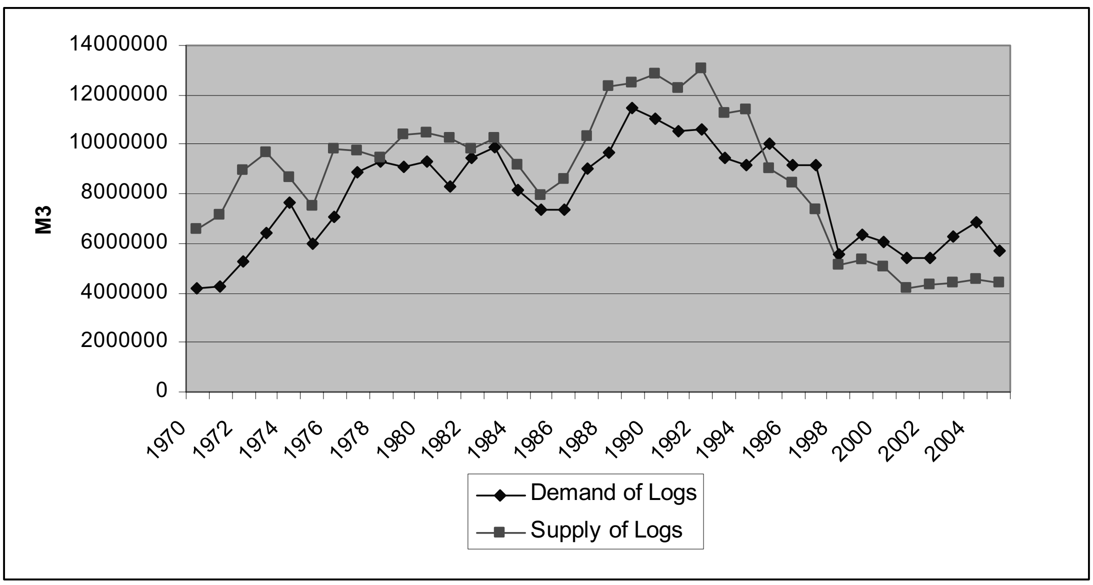

Figure 1. Supply and demand of logs in West Malaysia (1970 – 2005)

Source: Forestry Department of Peninsular Malaysia (Various Issues)