



Determinants of MDF Exports: A Panel Data Analysis

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Abstract

This study analysed the factors influencing the exports of Medium Density Fibreboard (MDF) with the aid of the panel data approach procedures. The analysis was carried out with the data collected on MDF exports over 10 years (1996–2005) and across 28 countries all over the world using the panel data analysis in estimating the MDF exports with various factors. The result shows that the changes in export quantities of MDF are significantly determined by export price and exchange rate at 1 percent and 5 percent respectively. However, average world GDP is not significant in influencing exports demand of MDF. On the other hand, the Hausman test of the random effects and fixed effects specification give the evidence that the random effects specification is preferable in this model.

Keywords: MDF exports, Panel data, Panel OLS, Fixed effects, Random effects.

1. Introduction

Medium density fiberboard (MDF) is a non-structural wood-based panel that is composed of wood fibres bonded together with resin under the heat and pressure (Ropandi *et al.*, 2005). In Malaysia, most MDF plants depend on the supply of rubberwood as their feedstock. On the other hand, in other countries there are different types of raw material. Important raw materials for MDF include radiata pine (New Zealand), mixed tropical species (Japan), rubberwood (Thailand), bagasse (Pakistan, China and Thailand) and cotton stalks (India) (Wardworth, 1995). However, nowadays Malaysia for example not only used rubberwood as its raw material but started to use other source like Acacia, mixed tropical species and empty fruit branches. With the declining of raw material supply that has faced by some major exporting countries, the MDF industry has to search for a new fibre sources in order to sustain their operations in future. Hence, it is interesting to know the behaviour of MDF exports across among the exporting countries. Some of these countries seem to show that their MDF exports have kept on increasing despite the issue of raw material.

On the other hand, MDF has emerged as price competitive alternative to the more traditional products such as plywood, particleboard and hardboard. With similar characteristic to plywood products, their greatest advantage is that low quality and low value raw material (including non-wood fibres) can be turned into high value and high quality wood-panels. This clarifies why their production cost are about 50 percent lower (Adhar, 1996).

Table 1 shows the total volume of MDF exports in the world markets. There are 28 countries which are exporting the MDF product in the world. Based on the volume of their MDF export, there are several major exporting countries like Germany (3,335,900 m³), France (1,145,655 m³), Malaysia (1,065,000 m³), Canada (903,000 m³), New Zealand (646,000 m³) and Thailand (629,600 m³) in 2005. Hence, Germany was the largest of MDF export in 2005 with 3,335,900 m³ while Malaysia was the third largest behind France.

MDF is used mainly for partitions and interior décor work as well as for furniture-manufacturing. According to Anon (2006), Chinese MDF might be cheap compared to Malaysian boards but its low quality has resulted in poor market perception among both importer and end-users. However, the quality of Chinese MDF is reported to be improving. The export of MDF from Malaysia had grown steadily during the period 1996-2005. Similarly, in general, the global export demand of MDF is increasing rapidly during that period. In addition, Anon (2006) claimed that MDF capacity worldwide has increased significantly to 50 million m³ by the end of 2006.

On the other hand, in the literature on forest economics, lack of the study has been discussed on the specific forest products mainly on MDF product. Most studies mainly focused on the impacts of exchange rate changes on forest products trade volume or prices (Adams *et al.*, 1986; Buongiorno & Uusivuori, 1991; Sun & Zhang, 2003 and Bolkesjo & Buongiorno, 2006). For example, Adams *et al.*, (1986) use a structural econometric model (i.e., two-stage least squares) to analyse the role of exchange rate on the North American softwood lumber market. They concluded that an increase in exchange rate played a key role in the expansion of Canadian share of US market for the period of 1950-1983. Recently, Bolkesjo & Buongiorno (2006) adopt the vector autoregressive (VAR) model of panel data analysis to examine the short and the long run impacts of exchange rate changes on US trade in forest products throughout forty six countries with the quarterly time period from 1989 to 2004. They found that a change in the value of US dollar significantly affects forest products trade in both short and long run.

Relatively little attention has been paid to investigate the impact of exchange rate changes on the trade balance. The earlier study by Kaiser (1984) has investigated the effect of changes in exchange rate on US forest products trade balance. He found that, the depreciation of the US dollar is the most effective trade policies to increase US forest products exports and thus stabilises the US trade balance. Most recent study by Baek (2007) examined the dynamic effects of exchange rate changes on US trade balance in forest products. He used ARDL model to examine the various forest products such as softwood lumber, hardwood lumber, panel/plywood product, logs/chips product and does not include MDF product. From his study, it is found that real income (domestic and foreign country) and exchange rate are important determinants of the US forest products trade with Canada.

Hence, as to add into the forest-related literature of the forest products trade particularly on the MDF exports, the purpose of this study is to investigate the economic determinants on MDF exports with regards of 28 exporting countries in the world from 1996 to 2005 by using panel data analysis. From this analysis, we can see the export markets behaviour in general with respect to the major explanatory variables that will influence the export demand of MDF in the world.

2. Methodology

In this objective, panel data is more relevant because it contains the necessary mechanism to deal with both inter-temporal dynamic behaviour and the individualistic of the countries. For example, it allows controlling for *heterogeneity bias* due to the confounding effect of time-invariant variables omitted or hidden factors from the regression model. Besides, this longitudinal approach provides additional information and richer source of variation through utilisation of a large number of data points, in which increasing the degrees of freedom and reducing the collinearity among explanatory variables, thus improving the efficiency of econometric estimators (Hsiao, 1986). All these benefits may allow stronger conclusion than findings derived from use of static cross-sectional data or time series setting alone.

In addition, this objective would obtain the estimates of the parameters of the regression model using the standard pooled OLS technique. Then a few assumptions will be relaxed and simultaneously incorporate the countries fixed effects and time effects into the model. A diagnosis check will be carried out on the analysis to ensure that the basic OLS assumptions related to heteroscedasticity, autocorrelation and multicollinearity are not violated.

2.1 Pooled OLS Estimation

This study hypothesised that the explanatory variables have a linear relationship with the export and import of a country. Since this objective used panel data, it is not only enables to consider both time series and cross sectional characteristic of sample, but also it helps to identify the sources of possible mixed effects and the importance of each explanatory variable in influencing the export and import choice. At this initial stage, the regression model is assumed to have a constant intercept and slope coefficients. The relationship can be expressed as follows:

$$Y_{it} = \alpha + X_{it}\beta + \varepsilon_{it} \quad (1)$$

for $i = 1, 2, \dots, N$.

$t = 1, 2, \dots, T$.

where;

- i. Y_{it} is the dependent variable (leverage) pooling N cross sectional observations and T time series observations;
- ii. α is the intercept or constant;
- iii. Vector X_{it} contains K explanatory variable for country i in year t ;
- iv. Vector β contains K regression coefficients or parameters to be estimated;
- v. ε_{it} is the error term or disturbance term and by assumptions $E(\varepsilon_{it}) = 0$ and $\text{Var}(\varepsilon_{it}) = \sigma_{\varepsilon}^2$.

With the assumption that the disturbance terms ε_{it} are independent and identically distributed and have zero means, $E(\varepsilon_{it}) = 0$ and constant variances $\text{Var}(\varepsilon_{it}) = \sigma_{\varepsilon}^2$ and all the other classical assumptions hold. Equation (1) above can be directly estimated by usual pooled OLS approach. Under such conditions, the pooled OLS would yield an unbiased, consistent and efficient or Best Linear Unbiased Estimator (BLUE) estimator of β . It should be noted that this study will use the balance panel data. But for simplicity, it is assumed that T is the same for all countries to keep the formula notation clear and simple. This regression model consists two separate equations namely export and import equations. These equations can be expressed as follows:

$$\ln EX_{it} = \beta_0 + \beta_1 \ln XP_{it} + \beta_2 \ln AWGDP_{it} + \beta_3 \ln ER_{it} + \varepsilon_{it} \quad (2)$$

where EX_{it} denotes the export of MDF, XP_{it} export price of MDF, $AWGDP_{it}$ average world GDP, ER_{it} exchange rate, ε_{it} the disturbance, $\ln$ represents natural logarithmic transformation and β_0 is intercept. The indices i and t denote country and time respectively.

2.2 The Data

This study will use the annual data from 1996 to 2005 for the 28 countries as stated earlier in Table 1. The volume of exports for these countries of MDF product was obtained from Food Agriculture Organisation (FAO) compact disk. The real income for each of country and average world real income are measured as real GDP index (2000=100) and are taken from the International Financial Statistics (IFS) published by the International Monetary Fund (IMF). The exporting countries–United States (US) real exchange rate (ER) is gathered by the Economic Research Service (ERS) in the US Department of Agriculture (USDA). Since the exchange rate is expressed as domestic exporting countries currencies per US dollar, a decline in exchange rate indicates means a real depreciation of the US dollar. We selected the domestic currencies per US dollar exchange rate because typically the export of MDF product has quoted in US dollar. Finally, it is noted that, since all variables are converted to natural logarithms, the estimated coefficients can interpreted as elasticities.

3. Results of Analysis

Table 2 presents the panel OLS estimates of MDF exports with various explanatory variables and analyse their relationships. Besides, random effects and fixed effects estimated are also carried out and compare them with the panel OLS specification. At this point, we assume a static model in levels and test whether the structure of error term is adequate captured. Since, panel data typically exhibit serial correlation, cross-sectional correlation and groupwise heteroskedasticity (Greene, 2000: 592-608), we expect to find such a structural residuals.

The panel OLS in Table 2 reports the coefficient and the level of significant of the explanatory variables namely export price of MDF, average world GDP and exchange rate in determining export of MDF. The results reveal that export price of MDF and exchange rates are statistically significant at 1 percent and 5 percent respectively. Further, it shows expected sign with negative sign for export price and positive sign for exchange rate. This result suggests that as the export price of MDF increase the export demand of MDF will decrease. On the other hand, for the exchange rate, the result suggests that as the depreciation of the domestic currency, the export demand for MDF will increase. This implies that the exchange rate of the currency can influence the total volume of export demand. However, average world GDP is not significant in influencing MDF exports. This implies that the level of wealth of the nation is not considered as a significant factor.

An alternative approach is to estimate a random effects model, which is presented also in Table 2. This estimator is a weighted average of the within and between estimator and is based on two (related) assumptions: First, the intercepts are of no substantive relevance, which is the case in a large N , small T panel and second, the fixed effects and the regressors are uncorrelated (see Baltagi, 2001: 15). Hence, our result shows that we fail to reject random effects *a priori*

because of the large number cross sections. This implies that the Hausman (1978) test the random effects specification give the evidence that the random effects specification is preferable.

The choice between fixed effects and random effects estimators continues to generate a hot debate among econometricians (Baltagi *et. al.*, 2003). Mundalk (1978) argued that the random effects model assumes exogeneity of all the regressors and the random individual effects. In contrast, the fixed effects model allows for endogeneity of all the regressors and the individual effects. This all or nothing choice of correlation between the individual effects and the regressors prompted Hausman & Taylor (1981) to propose a model where some of the regressors are correlated with the individual effects. More specifically, the individual means of the strictly exogenous regressors are used as instruments for the time invariant regressors that are correlated with the individual effects, see Baltagi (2001). The choice of the strictly exogenous regressors is a testable hypothesis. Despite these debates, most applications in economics since the 1980s have made the choice between the random effects and fixed effects estimators based upon the standard Hausman test (Baltagi *et. al.*, 2003).

Owing to the diagnostic tests, the model is well fitted as it passes all the diagnostic tests. The diagnostic tests reveal no evidence of misspecification and additionally, we find no evidence of autocorrelation. The root mean square and Theil inequality test results have also given strong evidence that the equation is stable between the dependent and all independent variables (Figure 1).

4. Conclusion

The purpose of this study is to investigate the economic determinants of MDF exports with the export price, exchange rate and average world GDP for a panel of twenty eight countries over the sample period 1996-2005. The twenty eight countries considered in this study are known as exporting countries on MDF product. Our results indicate that the economics determinants of MDF export are export prices and domestic exchange rate. Of which the export price are most significant impact on export demand. However, the income variable in this study shown not significantly influences the export of MDF product. On the other hand, based on the Hausman test that carried out in this study, we can conclude that all the explanatory variables are exogenous and reflect variation across the twenty eight exporting countries and constant with time.

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Table 1. The MDF exporting countries in the world (volume in cubic meter)

Countries	1996	2000	2005
Argentina	50,900.00	46,000.00	346,000.00
Australia	89,700.00	297,000.00	461,000.00
Austria	35,100.00	138,000.00	48,000.00
Brazil	4,900.00	3,000.00	84,000.00
Canada	157,000.00	746,923.00	903,000.00
Chile	277,000.00	215,000.00	229,000.00
China	15,200.00	184,702.00	231,613.00
Czech Republic	47,400.00	58,000.00	38,000.00
Finland	4,000.00	2,000.00	1,665.00
France	316,000.00	500,704.00	1,143,655.00
Germany	300,000.00	1,999,000.00	3,335,900.00
Indonesia	9,400.00	158,000.00	300,000.00
Ireland	170,000.00	364,000.00	362,652.00
Italy	286,000.00	463,000.00	260,000.00
Japan	8,700.00	5,000.00	5,000.00
Korea, Republic of	16,000.00	33,000.00	15,000.00
Malaysia	368,000.00	458,000.00	1,065,000.00
Netherlands	48,000.00	47,000.00	118,700.00
New Zealand	341,000.00	598,000.00	646,000.00
Poland	100,400.00	180,800.00	513,600.00
Portugal	199,700.00	240,169.00	272,000.00
Romania	400.00	31,000.00	272,000.00
Singapore	4,200.00	5,000.00	12,800.00
Sweden	10,000.00	18,690.00	6,510.00
Thailand	3,500.00	340,000.00	629,600.00
Turkey	8,000.00	9,000.00	128,000.00
United Kingdom	53,000.00	76,000.00	137,465.00
United States of America	114,000.00	242,000.00	252,000.00

Source: FAO CD ROOM

Table 2. Regression results for the MDF exports markets model

Dependent Variable: MDF exports			
Explanatory variable	Panel OLS	Fixed Effects	Random Effects
Export price	-0.661*** (0.00)	-0.643*** (0.00)	-0.60*** (0.00)
Exchange rate	0.718** (0.02)	0.418 (0.20)	0.350 (0.28)
Average world GDP	1.137 (0.78)	5.041*** (0.00)	5.044*** (0.00)
Constant	-16.932 (0.88)	-121.24*** (0.00)	-120.86*** (0.00)
AR(1)	0.9397 (0.00)	-	-
R-squared	0.88	0.81	0.80
F-statistic	465.85 (0.00)	-	-
Durbin-Watson stat	2.0274	-	-
Hausman test	-	0.5116	

Notes: ***Significant at 1 percent, **Significant at 5 percent, *Significant at 10 percent. Parentheses are *p*-values.

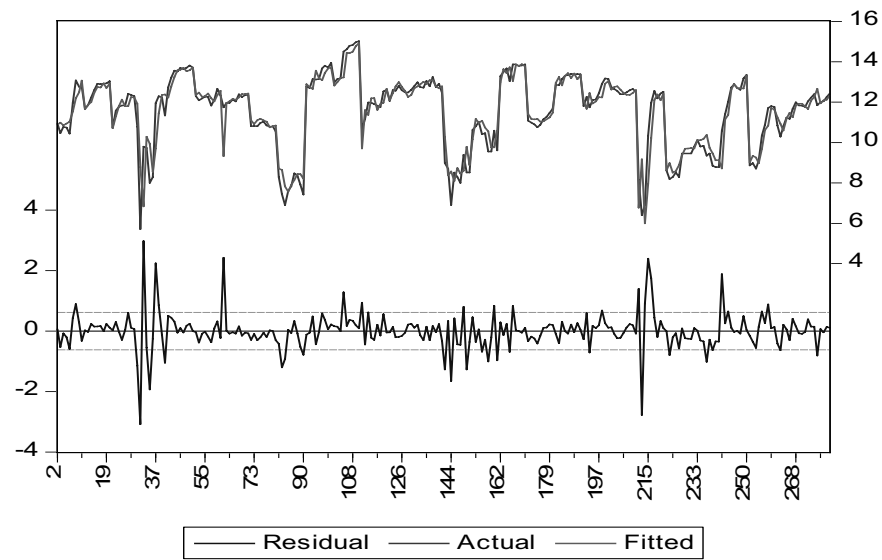


Figure 1. Actual, fitted and residual graph for MDF export demand