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Effects of log export ban policy and dynamics of global tropical wood markets on the growth of timber industry in Ghana

M. Amoah*, G. Becker, L. Nutto

Institute of Wood Utilisation and Work Science of the University of Freiburg, Werthmannstr. 6, 79085 Freiburg, Germany

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Abstract

The effects of log export ban (LEB) policy and dynamics of global tropical timber markets on the growth of Ghanaian timber industry were studied. The purpose was to follow the trend in the growth of timber industry from 1984 to 2005 using Fisher index and semi-log regression analysis. The study showed that the volume of plywood, veneer, and processed wood exported before the period of 1984–1995 and during the LEB policy (1996–2005) was, respectively, 6% and 46% of the total exports during those periods. On the contrary, the aggregate price index of all products exported before the LEB policy was up by 129% compared to −3.9% for the period during the LEB policy. A further decline in prices of the most products exported during the LEB policy was found by the study. Thus even though an LEB policy could increase volume share of value-added products, it cannot guarantee growth in prices of wood products.

JEL classification: Q23; Q27

Keywords: Export-led growth; Log export ban; Ghana; Growth rate; Wood industry

*Corresponding author at: Faculty of Technology Education, University of Education, P.O. Box 1277, Kumasi, Ghana. Tel.: +4997612033808.
E-mail address: martin.amoah@fobawi.uni-freiburg.de (M. Amoah).

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Introduction

Export-led growth (ELG) refers generally to an economic development strategy which seeks to encourage and support production for exports (Asian Development Outlook, 2005). This economic strategy is based on the axiom that the overall growth of a country can be generated not only by increasing the amounts of labour and capital within the economy, but also by expanding exports (Medina-Smith, 2001). Proponents of this development strategy have the conviction that export is the engine of growth, in the sense that it can contribute to a more efficient allocation of resources within countries as well as transmit growth across countries and regions.

Several benefits have been associated with ELG. Exports, and export policies are considered as stimulants for growth. Through international price-quality competition, ELG affords a country the opportunity to accumulate physical and human capital and serves as a channel for learning and technological advancement through global transmission of production methods and product design. Moreover, export growth has the potential for generating employment. In the opinion of classical economists, trade is welfare improving because it leads to an efficient use of resources in each country, in the sense that countries would produce and export the products in which they have a comparative advantage, and import the products in which they have a comparative disadvantage. Furthermore, ELG may help a country to overcome the ex-ante saving–investment gap by providing the necessary foreign exchange for development. Moreover, countries engaged in trade are thought to be more able to respond to and to be less vulnerable to external shocks than those following the inward-looking developing strategy.

As a developing country, Ghana is striving to achieve a modest economic growth and employment generation. In a bid to achieve these goals, the Government of Ghana, over a decade ago, embarked on vigorous economic development policies aimed at placing a high priority on processing of secondary and tertiary wood products for export. The implementation of these policies gave birth to a ban on log exports in the mid-1990s. The wisdom behind the ban was to stimulate growth in the secondary and tertiary sectors of wood processing firms so that more revenue could be generated from exports of timber products. Moreover, the log export ban (LEB) policy was aimed at reducing the rate of exploitation of forest resources. However, different opinions have been expressed about the environmental and economic advantages of an LEB policy. At best an LEB policy is considered a second-best policy. Several authors are of the view that trade restrictions are not solutions for environmental conservation and economic growth, but rather have more detrimental effects on environment and economy.

However, in recent times the market trends for tropical timber and wood products have been shaped by multifaceted factors such as global economic climate, shortage of supply of wood raw materials, consumer confidence and demand. Other factors that might have influenced the market trends of timber products include events such as September 11, 2001 disaster and more recently hurricane Katrina. The growth of the Ghanaian timber industry under the influence of the LEB policy and the dynamics of global tropical timber products is of particular interest to policy makers,

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researchers and the timber industry. A report on the timber industry in Ghana by the Bank of Ghana advocates that the total ban on exports of logs should be maintained in order to ensure the survival of the industry (Bank of Ghana, 2004). Recently, however, there have been moves by the government to lift the ban on log exports. Reasons cited included low domestic log prices, low efficiency and low returns to landowners and state (Ministry of Lands and Forestry, 2003). The question that has so far not been answered is what impacts the LEB policy and global wood products market have on the growth of the timber industry in Ghana. To date no study has been conducted to assess the effects of LEB policy and the dynamics of global tropical timber products market on the growth or performance of timber industry in Ghana using a time-series data. With the depletion rate of tropical forests in Ghana at all time high coupled with the high costs of log inputs, the timber industry is confronted with decisions to allocate log raw material to product options that would generate the highest value. It is also of economic interest for the industry to know the trends of growth of various wood products so that managers could have informed decisions on resource allocation.

The log export ban (LEB) policy

LEB policy has attracted a lot of attention from foresters, environmentalists and economists. Different opinions have been expressed on the environmental and economic wisdom of an LEB policy. A wide array of issues has also been discussed on an LEB policy and Resosudarmo and Arief (2006) have categorised them into resource-based industrialisation, employment generation, balance of payment and fiscal implication. For the purpose of this paper, only resource-based industrialisation is discussed.

Resource-based industrialisation

Value addition or down stream processing is a desired processing option in any industrial setup. Apart from having a high value–volume ratio and for that matter low material input, down stream processing has the potential of reducing the rate at which forest is visited for exploitation. Several studies have linked LEB to the promotion of downstream processing. In the view of Von Amsberg (1994), log export ban (LEB) is considered as a policy tool aimed at promoting domestic processing and increasing the export of higher valued wood products or manufactured goods. The development of downstream processing is expected to be boosted when the sale of logs is restricted only to domestic processing mills (Resosudarmo and Arief, 2006). In addition, by promoting export-oriented, natural resource-processing downstream industries, countries could focus more attention on value-added products (Kishor et al., 2004). The potential of an LEB policy to induce the production of value-added products has therefore been used as a justification for

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implementing the LEB policy. Even though welfare is lost through the ban on log exports, the welfare gained by producing value-added products is far larger than the welfare loss in logging industry (Resosudarmo and Arief, 2006).

Several empirical studies, however, do not support the idea that there is a net gain in welfare in an LEB policy. These studies have demonstrated the perversity of the LEB policy, even though they agree in principle that the policy could promote the development of locally based wood industries (Resosudarmo and Arief, 2006). LEB tends to lower the prices of logs in the exporting countries (Von Amsberg, 1994) and this could lead to inefficient logging and processing techniques (Repetto and Gillis, 1988). Von Amsberg (1994) claimed that as a result of log export ban in Costa Rica, domestic log prices fell to 20–60% of the international price levels. Gillis (1988) studied the LEB in Indonesia during the 1980s and predicted that, on account of the inefficiency in processing value-added products from logs, there was a loss of $15 for every $100 of log input. In analysing the implementation of the LEB policy in Malaysia, the Philippines and Indonesia, Boscolo and Vincent (2000) also found that even though processing capacity occurred during the LEB policy, it was in fact established at the expense of the economy. These countries paid an economic price in the form of subsidy and inefficiency. The authors concluded that, for example, for every cubic metre of plywood that was produced, between 15% and 20% more trees had to be felled than it would have been the case if the logs had been processed by more efficient milling plants in Asian countries. Others are of the view that an LEB policy has the potential of reducing a country's export revenue from forest and wood products (Lindsay, 1989; Manurung and Buongiorno, 1997). Several authors have therefore advocated the removal of the LEB policy so as to increase the revenue generated from the forest sector (APEC, 2000; Gillis, 1988; Kishor et al., 2004). Even though short-term growths may be stimulated through the LEB policy, with the passage of time, the policy tends to result in undervaluing of logs, losses in value-added and resource rents, processing overcapacity and inefficient production practices (FAO, 1995).

Dynamics of global markets for timber products

The Ghanaian major trading partners in wood products in the 1990s were the EU and the United States of America. The trade in wood products at the beginning of the millennium has, however, witnessed a great diversity with the emerging economies in the East Asia now playing a significant role. The shape of the economies in those trading partners could affect the growth and performance of the timber industry.

The western market economies registered significant growth in 1997 with the GDP for western Europe and North America averaged 3.3%, the best year for GDP growth since 1989 (Timber Bulletin, 1998). The economic situation in East Asia around the same time was, however, different. Following the economic crisis in Asia in 1997, the Japanese economy deteriorated significantly during the first half of 1998.

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The collapse of some important financial institutions in East Asia culminated in the loss of consumer and business confidence.

The globalisation of forest products markets became evident in 1997, as the economic and political crises in Asia took its toll on the trade of world forest products. Housing construction in Japan experienced a decline in both 1997 and 1998 whilst domestic production which depended on imported wood materials reduced significantly (Timber Bulletin, 1998).

During 1999 and 2000 the global tropical forest products recovered slightly from the downturn of 1997 and 1998. Many tropical timber producing countries shifted their focus to secondary processed wood products to bolster their forest products recovery as, unlike the primary products, these products were less vulnerable to the sharp price fluctuations. The policy to shift emphasis from exports of primary products to secondary processed products became evident in 2001, as the exports of processed wood timber products from Africa exceeded log exports for the first time in 2001 (FAO, 2002).

The terrorist attacks in the United States on September 11 2001 masked the global economic progress. The biggest economies, United States, Japan and Germany went into recession in the second half of 2001 culminating in the decline of the growth of the global economy from 4.7% in 2000 to 2.5% in 2001. This development resulted in weak demand for international commodity and decline of prices (FAO, 2002).

The global output (real GDP) grew from 4% in 2003 to 5.1% in 2004. The healthy growth of US economy in 2004 coupled with rising consumption and tax cuts boosted export growth (ITTO, 2005). Following changes in China's housing policy to encourage private ownership and the expansion of her economy in both 2004 and 2005 housing starts and demand for wood increased. It is reported that since 1999 annualised sales of residential homes in China have increased by 40–50% (ITTO, 2005).

The objective of the study is twofold: first, to assess the effects of log export ban (LEB) policy enacted in 1995 and the dynamics of the global markets for tropical timber products on the growth and performance of the timber industry in Ghana; and second, to assess the growth trends of the timber industry on the basis of products so that relevant information could be provided for the industry in order for them to make economic decision on resource allocation.

Methodology

Data

The source of data for the study was from the annual report on exports of wood products as prepared by timber industry development division (TIDD) of Forestry Commission of Ghana. TIDD is the responsible agency which compiles data on exports of wood products. Two sets of data were used in this study. In the first data set volume and value of export wood products from 1984 to 2005 were categorised

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into log, sawnwood, veneer, plywood and processed wood. The second data set was a more comprehensive one where volume and value of export products and prices have been compiled from 1995 to 2005 on products basis and ,therefore, allowed for the assessment of trends in the growth of prices of individual wood export products. The wood products used to study the trends in the growth of prices were sawnwood (air- and kiln-dried), plywood, rotary veneer, flooring and moulding.

There have been some minor changes in TIDD data reporting that should be clarified. Between 1995 and 1997 the major trading currency in Ghana wood export products was the Deutsche Mark (DM). From 1998 to 2000, the trading currency changed to the US Dollar and finally from 2001 to date the major currency is Euro. For easy comparison, the export value for all the years were based on the US dollar.

Data analysis

Descriptive and inferential statistics were used in this study. Price indexes were used to investigate the trends in the growth of prices of export wood products. Published price indexes have been used exclusively as value deflators to create quantity index number and the most widely used value deflator is producer price index (PPI) (Ahn and Abt, 2006). Two important indexes, the consumer price index (the CPI) and the producer price index (the PPI) are both Laspeyres indexes (Bowerman et al., 2001, p. 657). Other commonly used index formulas include Paasche, Fisher and Törnqvist formulas.

In this study, Laspeyres and Paasche price index numbers were not used because they depict two extremes in constructing weights in formulas (Ahn and Abt, 2006). Laspeyres price index emphasises the quantities of base period and when dramatic price changes occur the index can be misleading (Bowerman et al., 2001, p. 657). Paasche price index emphasises the quantities of current period and takes into account both changes in prices and quantities. Fisher index, which is a geometric mean of the Laspeyres and Paasche indexes, was used in this study. Diewert (1976) demonstrated that the Fisher index numbers provide a good approximation even when the form of utility function is unknown. Diewert (1992) further used a test to discover that Fisher index numbers satisfied more tests than other any index numbers and recommended the use of Fisher index number in productivity growth.

The export price data for wood and wood products as compiled by TIDD are expressed in nominal prices. These are the actual or observed prices in the world market at a given time and include the effects of inflation. To eliminate inflation effects, the nominal prices were converted to real prices using the producer price index (PPI).

The PPI of the prices of the wood products was calculated by using *Fisher index numbers* as expressed in

$$P^{F} = \left[P^{L} \times P^{P}\right]^{1/2} \tag{1}$$

where P^{F} is the Fisher price index, P^{L} the Laspeyres index and P^{P} the Paashe index.

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The nominal prices of wood products (measured in dollars) were converted to real prices by using Fisher index numbers as shown in Eq. (2).

Real price of a wood product exported in year t = nominal price of the wood product exported in year

$$t/P_{\mathrm{t}}^{\mathrm{F}} \tag{2}$$

where $P_{\mathrm{t}}^{\mathrm{F}}$ is the Fisher price index of the wood product in year t.

To investigate the annualised rate of change of export prices for all products, a semi-log-linear regression equation was used (Howard and Chase, 1995; Linehan and Jacobson, 2005; Remington and Dennis, 1986; Sendak and McEvoy, 1989; Wagner and Sendak, 2005; Zhang and Nagubadi, 2006). Linear regression was preferred to compound growth model because it uses more information and is therefore more likely to provide better estimates of rates of change and more valuable predictions of future prices and volume than compound growth model (Howard and Chase, 1995).

A response that exhibits exponential growth can be transformed to one that exhibits linear growth by taking its logarithm. The wood and wood product prices at any time t (p_{t}) can be estimated by Eq. (3) if the continuous rate of change for wood and wood product price (β_1) is known (Wagner and Sendak, 2005):

$$p_t = \beta_0 \mathrm{e}^{\beta_1 t} \tag{3}$$

where β_0 is the product price at time 0 (base year = 1984) and e is the exponential function.

To be able to estimate the continuous rate of change in wood product prices using linear regression, natural logarithm was taken on both sides of Eq. (3) and the resulting equation is shown in

$$\ln(p_t) = \beta_0 + \beta_1 t + \varepsilon_t \tag{4}$$

where $\ln(p_t)$ is the natural logarithm of p_t and ε_t is the regression error.

The annual continuous growth rates of the wood products were estimated by

$$\alpha = (\mathrm{e}^{\beta_1} - 1) \times 100 \tag{5}$$

Regression models were developed for both nominal and real prices for the first and second data sets. To determine if there was a change in annual continuous growth rate for the period between 1984 and 2005, the data were divided into subdata sets. In 1995, log export ban (LEB) policy was enacted (with the exception of exportation of teak logs) in Ghana. Again, Europe and USA are Ghana's major trading partners in wood products and September 11, 2001 disaster might have influenced the prices of wood products. The regression models were therefore developed for three time intervals for the first set of data as follows:

1984–1995 (the immediate period before the LEB policy),
1996–2001(the first period during the LEB policy) and
2002–2005 (the recent period during the LEB policy).

The second data were used to assess the growth rates of the selected wood products during the LEB policy. Time interval used in the regression analyses was 1995–2005.

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Statistical evaluation

The assumption of the linear regression in Eq. (4) is that the errors or residuals of each observation are independent. However, when time-series data are analysed, this basic assumption is often violated since the residuals of adjacent data points have a tendency to be similar, a condition known as autocorrelation (Bowerman et al., 2001, p. 636; Linehan and Jacobson, 2005). Positive autocorrelation is the most common in time-series data (Berenson et al., 1983). In the first-order autocorrelation, the error terms of any one point are correlated with the previous period's error. Several methods have been used for correcting the autocorrelation. In forecasting hardwood stumpage price trends in Pennsylvania, Linehan and Jacobson (2005) employed a generalised least squares procedure to correct autocorrelation. Wagner and Sendak (2005) assessed the annual increase of northeastern regional timber prices and used a maximum likelihood (ML) to correct first- or second-order autocorrelation. Durbin–Watson statistic can be used to check first-order autocorrelation (Bowerman et al., 2001, p. 583). The Durbin–Watson statistic is always between 0 and 4. Small values and large values of the Durbin–Watson statistic indicate that there is positive and negative autocorrelation, respectively. In this study first-order autocorrelation was checked by using the Durbin–Watson statistic.

Results

Trends of volume and price of wood and wood products exported before and during the LEB

The volume of wood and wood products exported between 1984 and 2005 totalled about 10.1 million cm^3. Log and sawnwood were the most dominant export products, accounting for about 76% of the total wood products exported from 1984 to 2005 (Table 1). Plywood had the lowest export volume, contributing only 4.8% of the total volume. The total volume of wood products exported before the LEB policy (1984–1995) was about 5.7 million cm^3, representing about 56% of the total export volume from 1984 to 2005. Out of this percentage volume, log and sawnwood exports accounted for about 53% whilst veneer, plywood and processed wood combined contributed only about 3.0% (Table 1). This percentage volume is equivalent to about 6% of the total cubic volume exported during the period.

The total volume of wood products exported during the LEB policy (1996–2005) was about 4.5 million cm^3 and this represented about 44% of the total export volume from 1984 to 2005. Veneer, plywood and processed wood showed mild presence in the export market during the LEB policy. Out of this percentage volume, log and sawnwood exports accounted for about 24% whilst veneer, plywood and processed wood combined contributed one-fourth (20%) (Table 1). This percentage volume contribution by veneer, plywood and processed wood is equivalent to about 46% of

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Table 1. Export volume of wood products before and during the LEB policy

Period	Export volume (m^3)					
	Log	Sawnwood	Veneer	Plywood	Processed wood	Total
Before the LEB (1984–1995)	3,114,835 (30.7%)	2,202,854 (21.8%)	233,109 (2.3%)	22,446 (0.2%)	79,060 (0.8%)	5,652,304 (55.8%)
During the LEB (1996–2005)	5811 (0.1%)	2,407,563 (23.8%)	953,861 (9.4%)	468,202 (4.6%)	633,628 (6.3%)	4,469,065 (44.2%)
Total	3,120,646 (30.8%)	4,610,417 (45.6%)	1,186,970 (11.7%)	490,648 (4.8%)	712,688 (7.0%)	10,121,369 (100%)

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the total cubic volume exported during the period. The difference between the volume of wood products exported before and during the LEB policy was not statistically significant (Wilcoxon test = 137; p-value = 0.974).

Export prices generally increased from 1984 to 1995. Between 1995 and 2001, export prices, however, declined but have shown some gains in recent years (Fig. 1). The only exception was log export prices which were generally low until 1995 when they experienced a surge and peaked in 1998, but showed declines in the subsequent years. Among the products which recorded gains in export prices in recent years, processed wood had the highest whilst plywood had the lowest.

Table 2 displays the average volume and price of wood products exported before and during the log export ban policy. The corresponding p-values of Wilcoxon tests are also indicated in the table. All the value-added wood products showed substantial increases in volume during the LEB policy. Sawnwood had the highest average export volume whilst plywood had the lowest. The export volume of plywood before the LEB policy averaged $1900 \pm 2100\,m^3$, increasing to the average value of $46{,}800 \pm 2500\,m^3$ during the LEB policy. The average volume of processed wood also increased from $6600 \pm 3900\,m^3$ before the LEB policy to $63{,}400 \pm 20{,}300\,m^3$ during the LEB policy. It is evident that there were statistically significant differences between the average volume of wood products exported before and during the LEB policy. The average volume of veneer, plywood and processed wood was significantly higher (p-value = 0.001) during the LEB policy than before the LEB policy (Table 2).

The lowest average export price before the LEB policy was recorded by sawnwood (285US$/$m^3$) whilst processed wood had the highest average export price (788US$/$m^3$) during the same period. During the LEB policy, plywood and veneer had the lowest and highest export prices, respectively. For two out of four export products (sawnwood and processed wood), differences in export price before and

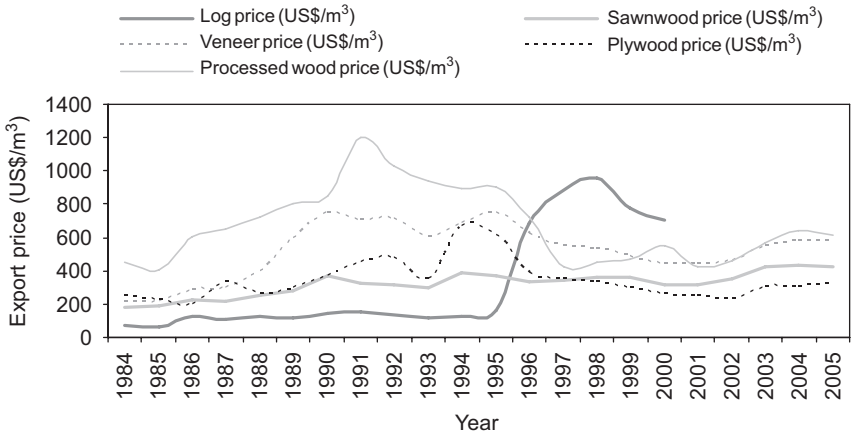

Fig. 1. Nominal prices for wood and wood export products. Only plantation Teak logs (*Tectona grandis*) were permitted for exports during the LEB policy.

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Table 2. Mean export volume and value before and during the LEB policy and the corresponding *p*-values of Wilcoxon test

Product	Mean export volume ($\times 10^3$ m^3)			Mean export price (US$/m^3)		
	Before LEB	During LEB	*p*-Values of Wilcoxon test	Before LEB	During LEB	*p*-values of Wilcoxon test
Sawnwood	183.6 (86.0)	240.8 (27.5)	0.048	285 (21)	366 (15)	0.014
Veneer	19.4 (6.6)	95.4 (21.3)	0.001	634 (148)	524 (20)	0.628
Plywood	1.9 (2.1)	46.8 (25.3)	0.001	376 (43)	306 (15)	0.418
Processed wood	6.6 (3.9)	63.4 (20.3)	0.001	788 (233)	518 (114)	0.009

Values in parentheses are the standard deviations.

during the LEB policy were statistically significant at the 0.01 level, whilst there was no statistically significant difference in export price of veneer and plywood during the two periods. In general, export prices were more stable during the LEB policy than before the LEB policy (Table 2).

Trends of export prices of wood product categories before and during the LEB policy

The aggregate wood export price index increased from 1.0 in 1984 to 2.2 in 2005, an indication of a growth of 120% in the timber industry during the past 21 years (Fig. 3). The aggregate price index between 1984 and 1995 (period before the LEB policy) was up by 129% compared to −3.9% for the period between 1995 and 2005 (period during the LEB policy). Among individual products, prices of veneer grew the fastest whilst those of plywood grew the slowest (Fig. 3). Veneer export price index grew from 1.0 in 1984 to 2.64 in 2005, a price growth of 164% whilst plywood price had a growth of 28% during the same period (Fig. 3). Between 1997 and 2000 there was a surge in export prices of logs (Fig. 2).

The estimates for β_1 in the regression model in Eq. (4) represent the continuous annual rate of change of export price for the wood products. Table 3 shows the results by-product category for the three time periods, 1984–1995, 1996–2001 and 2002–2005.

The following growth equations describe these trends:

For the period between 1984 and 1995,

$$\ln(p_t) = 0.080t - 153.924 \quad (6)$$

p-value $= 0.001$; $R^2 = 0.88$; F-stat $= 73.844(0.001)$; 95% CI $= 0.061-0.106$ Durbin–Watson $= 1.240$;

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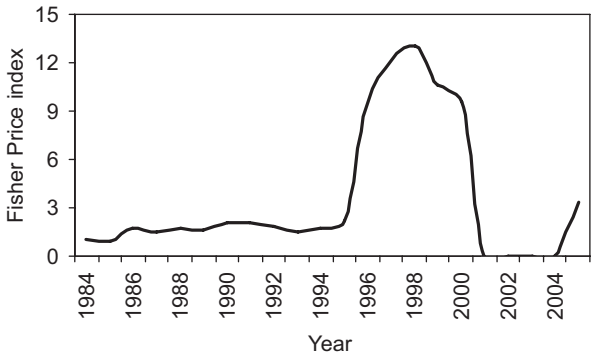

Fig. 2. Growth index for log export price.

Table 3. Continuous annual rate of change of export nominal prices of wood products

Product	Nominal price (1984–1995)			Nominal price (1996–2001)			Nominal price (2002–2005)		
	α	R^2	D–W	α	R^2	D–W	α	R^2	D–W
Log	5.3**	0.50	1.56	–	–	–	–	–	–
Sawnwood	6.7**	0.84	1.47	−1.3	0.19	1.38	6.0	0.60	2.12
Veneer	12.3**	0.81	0.62	−7.0**	0.95	2.65	7.7	0.78	2.12
Plywood	9.5**	0.79	2.66	−9.2**	0.97	2.60	9.1	0.74	2.52
Processed wood	7.6**	0.71	0.947	−5.3	0.24	2.08	10.1	0.75	2.01

D–W = Durbin – Watson statistic.
*p-Value $\leqslant 0.05$.
**p-Value $\leqslant 0.01$.

For the period between 1995 and 2005,

$$\ln(p_t) = 0.008t - 10.531 \quad (7)$$

p-value = 0.478; $R^2 = 0.057$; F-stat = 0.548(0.478); 95% CI = −0.017–0.034.

Eqs. (6) and (7) describe the growth trends of wood and wood products exported for the periods indicated. The p-values indicate the probabilities that the annual continuous growth rate is zero, while the F-statistics indicate the usefulness of the growth equations.

The nominal annual continuous rate of growth or price change for the aggregate wood and wood products exported between 1984 and 1995 was about 8.3% (Eq. (6)) and this was significantly different from zero (p-value = 0.001). For the period from 1995 to 2005, however, there was no growth (p-value = 0.478) (Eq. (7)).

For the period between 1984 and 1995, which represents the period before the LEB policy, all the wood products experienced positive growths (Table 3). The

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annual continuous growth rate of products ranged from 5.3% for log to 12.3% for veneer. Sawnwood, plywood and processed wood recorded annual price increase of 6.7, 9.5 and 7.6%, respectively. All the 1984–1995 period rates were statistically significant at 0.01 level and the coefficient of determination values ranged from 0.50 to 0.84 (Table 3).

For the period between 1996 and 2001, which represents the immediate period during the LEB policy, all prices of export products experienced declines. Plywood experienced the greatest decline (−9.2%; p-value = 0.01), whilst veneer declined at the annualised rate of −7.0% (p-value = 0.01). The r^2 values ranged from 0.19 to 0.97 (Table 3).

For the 2002–2005 period, which also represents the recent period during the LEB policy, positive growths were recorded for all the product categories but they were all not significant at 5% level (Table 3). In real terms, it was veneer only which showed positive annualised growth rate (5.5%) and was statistically significant at 1% level (Table 4).

Trends of nominal and real prices of individual wood products exported during the LEB policy (1995–2005)

Presented in Fig. 4 are the price indexes of eight main products exported during the LEB policy. In general, all indexes experienced declines from 1995 to 2005. An exception was flooring whose price index recorded steady growth from 2002 to 2005. The price index of aggregate products decreased from 1.0 in 1995 to 0.65 in 2005, indicating a 35% decline of price growth of eight main products exported between 1995 and 2005. Among individual products, the price index of flooring grew from 1.0 in 1995 to 1.17 (+17%) in 2005, whilst that of furniture parts declined from 1.0 in 1995 to 0.85 (−15%) in 2005. Processed mouldings had the highest decline in price growth, decreasing from 1.0 in 1995 to 0.44 (−56%) in 2005 (Fig. 4).

Table 5 indicates the summary statistics of the continuous annual rates of change of nominal and real prices for wood products exported from 1995 to 2005. For the

Table 4. Continuous annual rate of change of export real prices of wood products

Product	Real price (1984–1995)			Real price (1996–2001)			Real price (2002–2005)		
	α	R^2	D–W	α	R^2	D–W	α	R^2	D–W
Log	−1.7	0.31	1.88	–	–	–	–	–	–
Sawnwood	−0.3	0.03	1.90	10.1	0.54	1.82	−8.1	0.66	2.23
Veneer	5.5**	0.70	0.77	4.4	0.12	1.52	−6.4	0.60	2.34
Plywood	2.5	0.13	2.05	2.2	0.04	1.60	−5.0	0.51	2.02
Processed wood	0.6	0.03	1.78	6.1	0.15	1.30	−3.9	0.21	2.41

D–W = Durbin – Watson statistic.
*p-Value ⩽0.05.
**p-Value ⩽0.01.

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Table 5. Continuous annual rate of change of export nominal and real prices of wood products from 1995 to 2005

Product	Nominal price (1995–2005)			Real price (1995–2005)		
	α	R^2	D–W	α	R^2	D–W
Sawnwood AD	0.6	0.05	0.97	0.9**	0.54	1.73
Sawnwood KD	3.4*	0.52	0.94	0.2	0.31	1.14
Plywood	−3.1*	0.41	0.73	−0.1	0.04	2.24
Sliced veneer	0.7	0.08	1.01	−0.6**	0.60	0.61
Rotary veneer	−1.9	0.24	0.97	−0.6*	0.43	1.73
Furniture parts	2.6*	0.43	1.38	3.2*	0.36	2.35
Flooring	4.3**	0.59	2.01	1.4	0.14	1.21
Processed moulding	−2.2	0.17	0.56	0.3	0.33	1.56

AD = air-dried, KD = kiln-dried, D–W = Durbin – Watson statistic.
*p-Value$\leqslant$0.05.
**p-Value$\leqslant$0.01.

period between 1995 and 2005, the highest annualised growth rate in nominal and real prices was recorded by flooring (4.3%; p-value $\leqslant$0.01) and furniture parts (3.2%; p-value $\leqslant$0.05), respectively (Table 5). Of the eight wood export products, plywood had the highest negative annual growth rate in nominal terms (−3.1%; p-value$\leqslant$0.05).

Discussion

Export volume and value of wood products before and during LEB policy

The results showed that between 1984 and 2005 the timber industry in Ghana was heavily orientated towards exports of logs and sawnwood. Log and sawnwood accounted for about 77% of the total volume of wood products exported between 1984 and 2005. Veneer, plywood and processed wood showed substantial presence in the export market during the LEB policy. The volumes of these products exported during the LEB policy were significantly higher than their corresponding export volume before the LEB policy. This indicated that the LEB policy resulted in increases in export volume of value-added products. This result is in agreement with literature. The purpose of an LEB policy is to increase export of higher valued wood products (Von Amsberg, 1994). During the 1990s, tropical timber exporting countries focussed on exports of secondary processed wood products (FAO, 2001). This policy has been progressively gaining ground as 2004 export figures indicated a continuous rise in secondary processed wood products towards the level

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of primary tropical timber products (ITTO, 2005). The policy to increase exports of value-added wood products was motivated largely by increasing scarcity of raw materials. Strategies adopted to achieve this included log export restrictions, high export taxes on primary products and investment incentives (FAO, 2001).

Growth in export prices of wood products

During the past 21 years (1984–2005) the price of wood export products grew about 120% with veneer and plywood growing the fastest and slowest, respectively (Fig. 4). The trade in veneer appears to have benefited from the increasing preference of MDF and OSB to plywood for furniture production. Veneers are used to protect the exposed parts of MDF and OSB in furniture production. The period between 1984 and 1995 witnessed positive annualised growth rates in nominal prices for all wood export products (Table 3). Veneer had the highest annualised growth rate in nominal price (12.3%; p-value = 0.01). The annualised growth rate for all products during this period was 8.3% and this was statistically significant at 1% probability level (Eq. (6)). Decline in annualised growth of export nominal prices of all wood products in the period between 1996 and 2001 was evident (Table 3). Plywood had the highest negative growth of 9.2% and was statistically significant at 1% level. The growth rate for all products from 1995 to 2005 was flat (0.8%; p-value = 0.478; Eq. (7)).

These trends are consistent with the dynamics of global markets in wood products in recent years. The Asia crises in 1997 and 1998 coupled with the September 11, 2001 disaster in the United States (Timber Bulletin, 1998) possibly had negative effect on the growth of all products. The highest decline in export prices of plywood (Fig. 3) could be attributed to the increasing substitution of tropical plywood by softwood plywood and other panels such as thin MDF and OSB in furniture, millwork and mouldings (FAO, 2002). Another factor that might have contributed to the decline in the growth of plywood is the mounting competition from China (Ghana Gazette, 2006). It has been reported that China has changed from a major importer to a major exporter of plywood (FAO, 2002). China's booming plywood industry has been producing more panels for the domestic market and for export from imported and domestic log supplies and therefore needs to import less (FAO, 2007). Another factor that appears to have exacerbated the worsening plight of plywood exporters from tropical regions was the introduction of new and stricter quality and safety standards in 2003 by the two major markets for tropical plywood, Japan and the EU. Access to these markets has been very difficult. Mills had to pay for external, third-party, for quality and safety control which increased the cost of production (FAO, 2003). Export figures in 2005 indicated that plywood export from Ghana to overseas shrank by 37%, but the trade in the commodity survived as a result of a rise in overland shipment to neighbouring countries by 28% (Ghana Gazette, 2006).

The aggregate price index before the LEB policy (1984–1995) was up by 129% compared to that of −3.9% during the LEB policy (1995–2005) (Fig. 3).[1] A further

[1]These figures were based on all export wood products.

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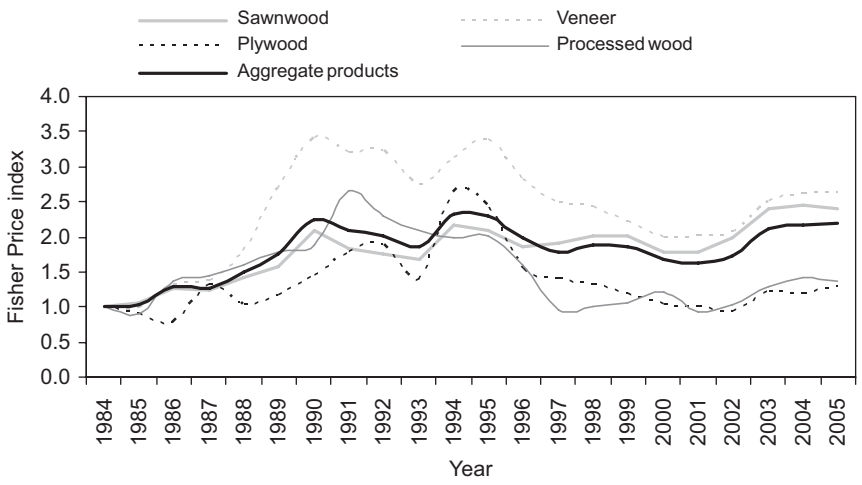

Fig. 3. Growth indexes for wood export prices (1984 = 1.0). Note that the price index for log is not shown in this graph.

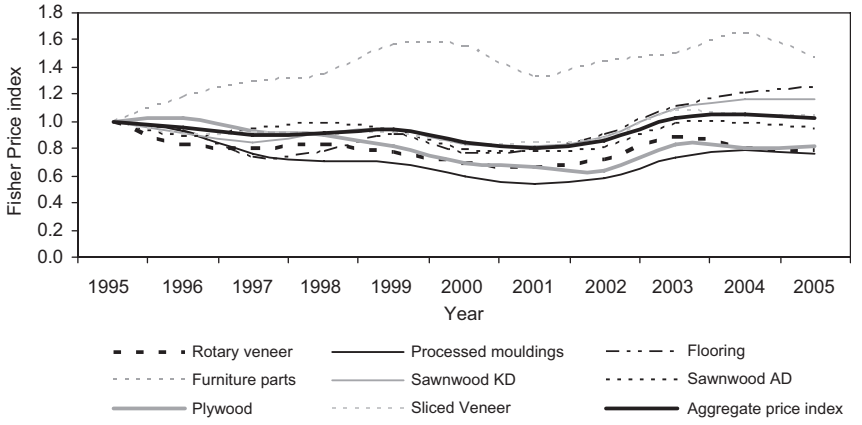

Fig. 4. Growth indexes for wood export prices during the LEB policy (1995 = 1.0).

decline in prices of the most wood products exported during the LEB policy (1995–2005) (Fig. 4) seems to support the view held by several authors (e.g. Lindsay, 1989; Manurung and Buongiorno, 1997) that an LEB policy tends to reduce a country's export revenue, *ceteres perabus*. These declines could, however, be attributed to the multifaceted factors rather than a single factor such as the LEB policy. The surge in the prices of Teak logs exported during the LEB policy (Fig. 2) was essentially due to strong demand for logs in Asia between 1997 and 1998.

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Conclusions

Although this study confirms the theory that an LEB policy increases value-added products (Von Amsberg, 1994), several other factors including shortage of raw materials, high export taxes on primary products and investment incentives might have contributed to increases in volume shares of value-added products.

The aggregate price index of wood products exported during the LEB policy declined by 3.9%, indicating that with the global market competition, an LEB policy might not be the best strategy to boost growth in the timber industry in Ghana. To be able to respond to the globalisation forces, product quality and environmental standards which are critical success factors should be given adequate attention.

With MDF and OSB gaining more market share than tropical plywood, producers of plywood should concentrate on the production of veneers whose market share may depend on the ever increasing market share of MDF and OSB. Plywood market appears to have lost competitiveness mainly due to the competition from China, but also increasing market share of MDF and OSB. Strengthening the subregional market and greater diversification of wood products, trading partners could also help stimulate the export trade in plywood.

Judging from the trends in the price indexes of eight main export products, more revenue could be generated if efforts are directed at the production of veneer, flooring and furniture parts.

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