



## **Influences of Government Interventions on Increasing Value-Added Wood Product Exports from Ghana**

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**Louisiana Forest Products Development Center  
Working Paper #77**

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July 13, 2006

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### **Abstract**

Most tropical developing countries with a forest sector are transitioning away from exporting raw materials such as lumber to exporting processed or value-added wood products. In the mid-1990s the government of Ghana began instituting a number of regulations and initiatives to achieve this goal. This study examines the three primary actions taken since that time and examines their influence on increasing value-added exports. These actions are: 1) the imposition of a levy on air-dried lumber exports, 2) a decrease in the country's annual allowable cut and 3) establishment of the Woodworking Sector Development Project. Export records from the Timber Industry Development Division of the Forestry Commission were used to develop time series of volumes of 10 major value-added products exported from Ghana for the period 1992 to 2001 in order to estimate the effect of these government interventions. Autoregressive Integrated Moving Average (ARIMA) modeling was used to model these effects. Results indicate that the air-dried lumber export levy and the decrease in annual allowable cut had the most impact on increasing value-added wood product exports. The Woodworking Sector Development Project did not influence exports of processed wood products, most likely because this initiative was started only two years before this study was conducted.

## Introduction

Ghana timber industry exports can be categorized into three major groups: *lumber and/or timbers, panels* and *machined products*. In spite of a broad product mix, the industry has been commodity-based, selling mostly lumber, timber-sized products and veneer.

In January 1996, the Ghana Ministry of Lands and Forestry directed that Ghana's annual allowable cut (AAC) be reduced from 1.2 million to 1.0 million cubic meters. The motive was to curb excessive exploitation of the natural forest which had reached an alarming level at the time. To be able to cover costs and make a profit, the industry had to consider adding value to limited raw materials.

A further directive given to the Forest Products Inspection Bureau was to place a levy ranging from 10-30 percent FOB depending on species rarity on nine popular species, if exported as air-dried lumber. This took effect in the beginning of March 1996. These species account for over 80 percent of total export volume. The Ministry's rationale for the levy was that continued use of air-dried, limited popular species for lumber production was gradually decimating the value-adding industry by siphoning off basic raw materials on which it depends. Added to the two strategies was the inception of the Woodworking Sector Development Project (WSDP) in January 1999 to promote value-addition and increased use of lesser-used species.

As part of the foundation of the International Tropical Timber Organization (ITTO) Year 2000 Objective, which was the main driving force for these government actions, these policies are considered to be effective in relieving pressure on natural forests and increasing further processing in tropical producing countries. However, the industry in Ghana became outraged by these directives and has since been pressuring the government for a reversal of the decisions. Nearly a decade after implementation, the government claims success, but, according to industry associations, the exercise is a failure and they have called for an independent evaluation of the policy effects and immediate withdrawal of the measures.

This study explores some possible direct outcomes of the Ministry's decisions, that is, whether there is a significant impact on further processing after the interventions were instituted. Findings from the study could lead to recommendations that may help to determine the future direction of the industry in Ghana as well as offering guidance to other tropical countries yet to implement similar measures.

## Reducing the Annual Allowable Cut (AAC)

Forest management, especially in the tropics, faces a number of dilemmas including:

- Popular endemic species, which are under intense pressure, have difficulty growing artificially. For example, *phytolya* insects attack seedlings and young plants of *Milicia excelsa* (Cobbinah 1986) and the juvenile *Terminalia ivorensis* species dieback in Ghana (FORIG).
- In recent years forest fires have ravaged many tropical forests.
- FAO reports have pointed out the subsistence nature of agriculture (shifting cultivation) among forest communities and increase of urbanization in the tropics. Both of these lead to increased clearing of forest areas.

Because of these challenges, continuous adjustment of the AAC has become a tool to slow depletion of forests. However, reductions in AAC for ensuring sustainable management of forests have come under intense attack. Reports suggest that reductions have not yielded the desired results (Majidcooke 1995). Hyde et al. (1996) recommend that direct policies and those

with negative spillover effects that limits land tenure, have high stumpage fees and reduce annual allowable cut need to be reconsidered. They suggest that more reasonable and effective approaches are value-adding technology for forest products and research directed towards plantations and community well-being.

### **The Need for Kiln-drying Wood**

Moisture accounts for at least 75 percent of wood-manufacturing problems; therefore, reduction of wood-related problems correlates with a reduction in moisture content (MC) (Wengert 2001).

According to the Northern Hardwood Initiative (NHI) (2001), increasing the value of lumber requires improving utility and minimizing quality loss. Utility can be increased through drying by improving:

- Resistance to biological attack by insects, bacteria, and fungus
- Volume/weight ratio
- Appearance
- Gluing properties
- Finishing properties
- Machining and assembly properties
- Phytosanitary acceptability
- Stability for storage and shipping

### **Application of Levies in Forest Products Trade**

Levies and charges in the forest product sector may come in many forms but can generally be classified as developmental, environmental, countervailing, and anti-dumping levies or duties.

Developmental levies are usually arrived at through a consensus to help in funding activities such as research and development (R&D), marketing and promotion, residue testing, and animal health programs (AFFA 1999). In Australia, a developmental levy ranging from 3.5 cents to 29 cents per cubic meter, depending on type, is imposed on logs delivered to a processing plant or exported and on certain imported forest products to support their Forest and Wood Products Research and Development Corporation.

The remaining types of levies are usually imposed for punitive purposes to deter illegal activities or to steer the industry in a policy-driven direction. Private sector activities may in one way or the other impinge on the environment, which need government intervention to protect the interests of the larger public. The government therefore uses various instruments such as environmental levies to mitigate undesirable activities. In this situation, levy assessment often focuses on the relationship between taxes levied and consumption because levying products with inelastic demand may not improve the situation unless proceeds are channeled into correcting the problem (ESCAP 1998).

In Ghana the forest product industry is continuously battling the government over an air-dry levy that many consider to be environmentally driven as proceeds are used to fund reforestation.

## **Considerations for Downstream Wood Processing**

### *Direction of the Global Industry*

A report on progress towards the ITTO Year 2000 Objective has argued the need to develop timber industries in countries with forest resources. During the past decade, most producing countries have steadily increased their downstream processing. However, according to the ITTO pre-project study 25/99(1) carried out by UNCTAD/WTO, Africa has lagged other regions, accounting for only 1 percent of the total trade in furniture, builders' joinery and profile boards from ITTO producer countries. This production was mainly from Ghana and Cote d'Ivoire. Asia accounted for 83 percent with Malaysia and Indonesia as the major players. Latin America's portion of 16 percent was due almost completely from Brazil, which alone contributed 83 percent of the region's performance.

Although there is a predicted growth in the furniture and other further processed wood products, there is concern that those countries without a significant processing industry will be unable to bridge that gap without support (Tissari 2001).

### *Industry Readiness*

Vlosky et al. (1998) suggest that forest-sector development goes beyond simply examining forest resources, current industry capabilities and the market in creating economic development through the growth of value-added processing. Added components include an analysis of regional economic effects of value-added industry growth, socio-economic and demographic reasons, work readiness of the potential employee base, needed employee skills, and employee training program development.

In Africa, socio-economic, demographic and skill development problems remain unsolved. The irony is that places like Ghana and Cote d'Ivoire, which rank highest in forest sector development, are among the least endowed with forest resources. Ghana and Cote d'Ivoire have per capita forest areas of 0.5 and 0.4 ha, respectively, compared to Gabon (13.5), the Central African Republic (9.0) and the Congo (7.5) (FAO 1999).

In Ghana, efforts to address these issues include establishment of the Wood Sector Development Project, and a Wood Industry Training Center. The creation of "Wood Villages" as shared facilities is also underway. Kozak and Hatridge (2000) recommend shared facilities as a means of developing a value-added industry. However, they caution that without guidance, leadership and regional interest, a shared facility could be an expensive waste of valuable resources.

### *Assessment of Industry Needs*

Developing a value-added industry is an expensive venture; therefore, implementation should come after needs assessment has taken place. There should also be a deliberate effort to set up well-coordinated aiding structures for ensuring success. Vlosky and Chance (1996) outline the approaches adopted by six states in the U.S. in developing their value-added wood products sectors. Programs included marketing, forest management, industry loans, industry grants, tax incentives, resource analysis, export support, labor training, management training and product development. The government, specialized institutions, universities and nonprofit organizations helped in these programs. In their research, twelve goals were judged by development agencies involved in the forest product industry. The top six priorities were to increase employment, attract new value-added industry, support rural economic development, increase market share, increase export opportunities and attract new industry in general.

### *Technological Considerations*

Tissari (2001) identifies five categories of processing technologies. These are (1) users of basic portable tools and universal woodworking machines, (2) users of basic woodworking machines to produce in small batches, (3) users of basic woodworking machines to produce larger batches using low-cost mechanization and jigs suitable for serial production, (4) users of special-purpose machines, and (6) users of integrated machining lines. Targeting millers in the third category for support could boost further processing in slow producing areas (Tissari 2001).

## THE STUDY

### **Hypothesis**

The study examined the following hypotheses:

H<sub>1</sub>: Promotion of value-addition (that is, inception of WSDP) will increase the export of value-added products significantly.

H<sub>2a</sub>: Introduction of the air-dry levy will increase the export of value-added products significantly.

H<sub>2b</sub>: Introduction of the air-dry levy will decrease the export of air-dried lumber significantly.

H<sub>3a</sub>: Reduced raw material level will increase the export of value-added products significantly.

H<sub>3b</sub>: Reduced raw material level will decrease the export of air-dried lumber significantly.

### **Data**

Information on Ghana forest products industry used in this study came from the export records of TIDD. It is comprised of monthly data on volume of ten major forest products exported from 1992 to 2001. The products include air-dried and kiln-dried lumber, panels (plywood, rotary and sliced veneers) and machined products (processed lumber molding, profile board, furniture parts, dowels and flooring). There are 120 monthly data cases.

### **Analysis**

The goal of the study is to find out whether interventions under consideration had any contribution to changes in patterns rather than to develop a model for forecasting performance of any of the dependent variables. A model for forecasting would not need the pre-intervention data since it has probably lost influence on trends in the trade. Hence its inclusion may amplify the noise component.

The SPSS Decision Time 1.0 package using Autoregressive Integrated Moving Average (ARIMA) modeling will be used in this analysis.

The ARIMA model in this study follows those of Bowerman and O'Connell (1993) and Box and Tiao (1975) discussing transfer function and intervention models. Using notations representing variables in this study, the combined model can be written as:

$$z_t = \mu + [C_R \omega_R(B) / \delta(B)] B^b z_t^{(R)} + [C_L \omega_L(B) / 1 - \delta(B)] B^b z_t^{(L)} + [C_W \omega_W(B) / 1 - \delta(B)] B^b z_t^{(W)} + N_t$$

The noise component of the model,  $N_t$  is modeled using Autoregressive (AR) and Moving Average (MA) processes. Generally, after Box and Tiao 1975:

$$N_t = [\theta(B)/\phi(B)]a_t$$

Where,  $\theta(B) = 1 - \theta_1 B - \theta_2 B^2 - \dots - \theta_q B^q$  are moving average polynomials in  $B$  of degrees  $q$   
 $\phi(B) = 1 - \phi_1 B - \phi_2 B^2 - \dots - \phi_p B^p$  are autoregressive polynomials in  $B$  of degrees  $p$   
 $a_t$  = white noise

For seasonal data:

$$\theta(B) = \theta_1(B) \theta_2(B^s), \text{ where } s = 12 \text{ for the monthly data}$$

$$\phi(B) = \phi_1(B) \phi_2(B^s)$$

The transfer function component with stationary raw material series,  $z_t^{(R)}$  is used to model the impact that changes in raw material level might have on export volume of a major forest product from Ghana,  $V_t$  where:

where,  $z_t$  = stationary  $V_t$  (volume of a major product exported)  
 $\mu$  = a constant (usually excluded unless significant, i.e., unless  $t$ -value  $> 2$ ).  
 $C$  = unknown scale parameter.  
 $b$  = # of periods before  $z_t^{(R)}$  begins to affect  $z_t$ .  
 $B$  = backshift operator, where  $BV_t = V_{t-1}$   
 $\omega(B) = (1 - \omega_1 B - \omega_2 B^2 - \dots - \omega_s B^s)$ , estimating numerator effects over  $s$  lags of  $z_t^{(R)}$  that are significant in predicting  $z_t$ .  
 $\delta(B) = (1 - \delta_1 B - \delta_2 B^2 - \dots - \delta_r B^r)$ , estimating denominator effects over  $r$  lags of  $z_t$  itself that are significant in predicting  $z_t$ .

To model the impact air-dry levy might have on export volume of a major forest product,  $z_t$  from Ghana, a dummy step variable,  $z_t^{(L)}$  is used. Since  $z_t^{(L)}$  is expected to have a gradual start and permanent effect on  $z_t$  then;

$$z_t = \phi(B)V_t \text{ and } z_t^{(L)} = \phi(B)S_t, \text{ where } S_t = 0 \text{ or } 1 \text{ (for pre- and post-intervention respectively); } \omega(B) = 1; \delta(B) = 0 \text{ and } b = 0.$$

The dummy variable,  $z_t^{(W)}$  (defined as in  $z_t^{(L)}$ ) captures the impact of the inception of WSDP (i.e., the effect promotion of value addition and lesser-used species might have on volume exported of a given product).

Four variables were included in modeling analysis: volumes of product exported,  $V$  (dependent), raw material level,  $R$  (metric predictor), air-dry levy,  $L$  (dummy predictor) and inception of WSDP,  $W$  (dummy predictor).

A caution with intervention analysis is getting correct dates of the interventions. There may be a 'dead time' or a delayed response to the date of intervention or a period where the system responded before the known date. Choosing an inappropriate date could mask a possible effect of an intervention.

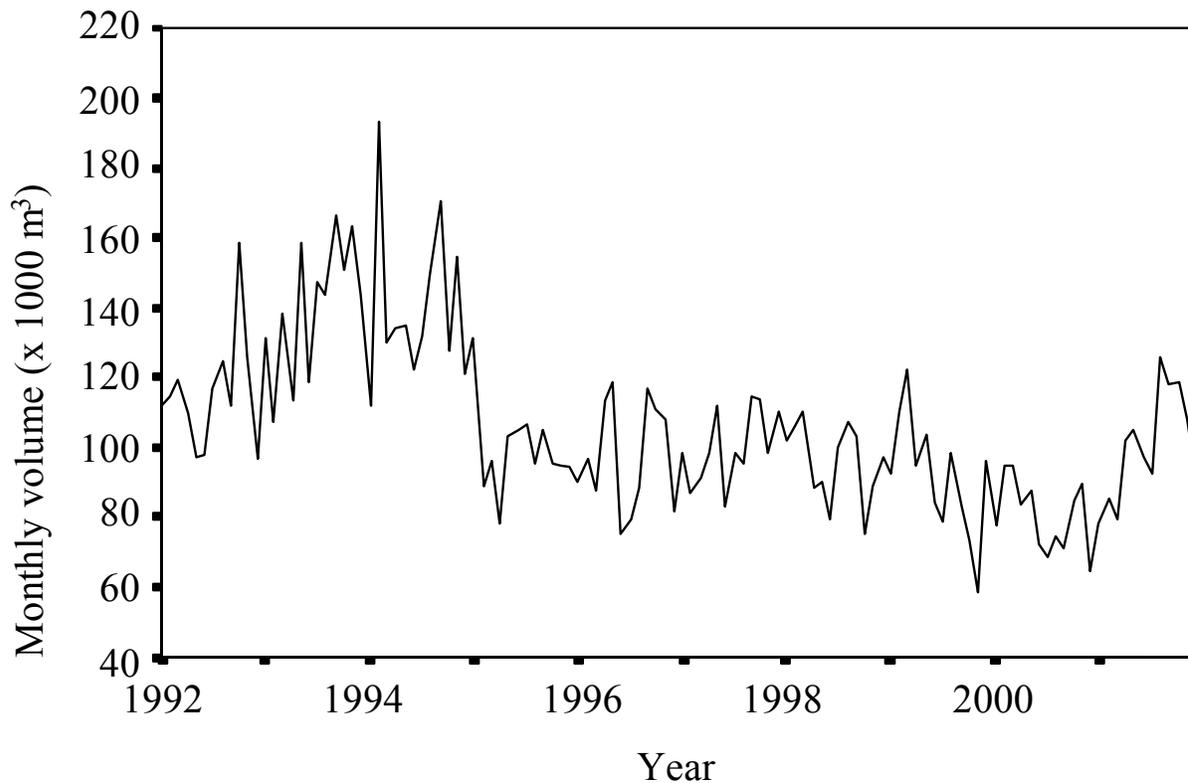
An exploratory examination of the data revealed that the value-added producers responded late to the introduction of the air-dry levy. This is because value-adding equipment requires capital investment which took time for industry to buy and install. A sensitivity analysis of gradually shifting the date from March 1996 revealed late response of nearly a year, that is, until January 1997.

A downward trend in the volume of air-dried lumber and a rise in value-added products were expected during the post-intervention period. This would differ from the trend in the two series in the pre-intervention era. Also expected was a systematic change in the behavior of the time series after the introduction of the intervention.

## Results

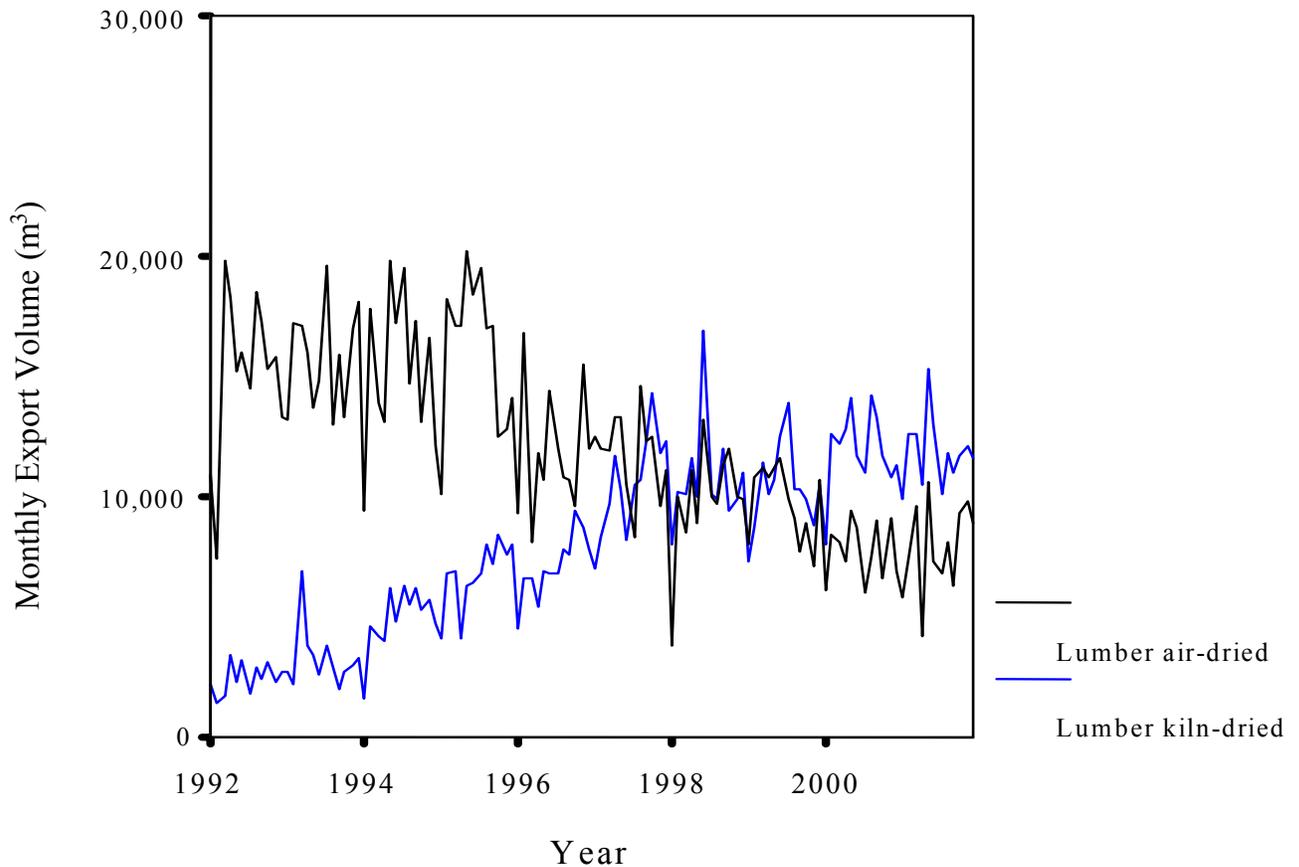
### *Time Series*

Raw material levels stayed within the annual allowable cut (AAC) of 1.2 million cubic meters (about 100,000 m<sup>3</sup> per month) until 1992, when export of logs, mainly those of lesser-used species, gained market access to Asia. Then the level almost doubled by early 1994. When log exports were suspended in late 1995, the new level of AAC of 1.0 million cubic meters immediately followed. Since then, raw material levels have been under strict monitoring to avoid going beyond the current AAC. **Figure 1** shows the raw material flow pattern of the timber industry from 1992 – 2001.



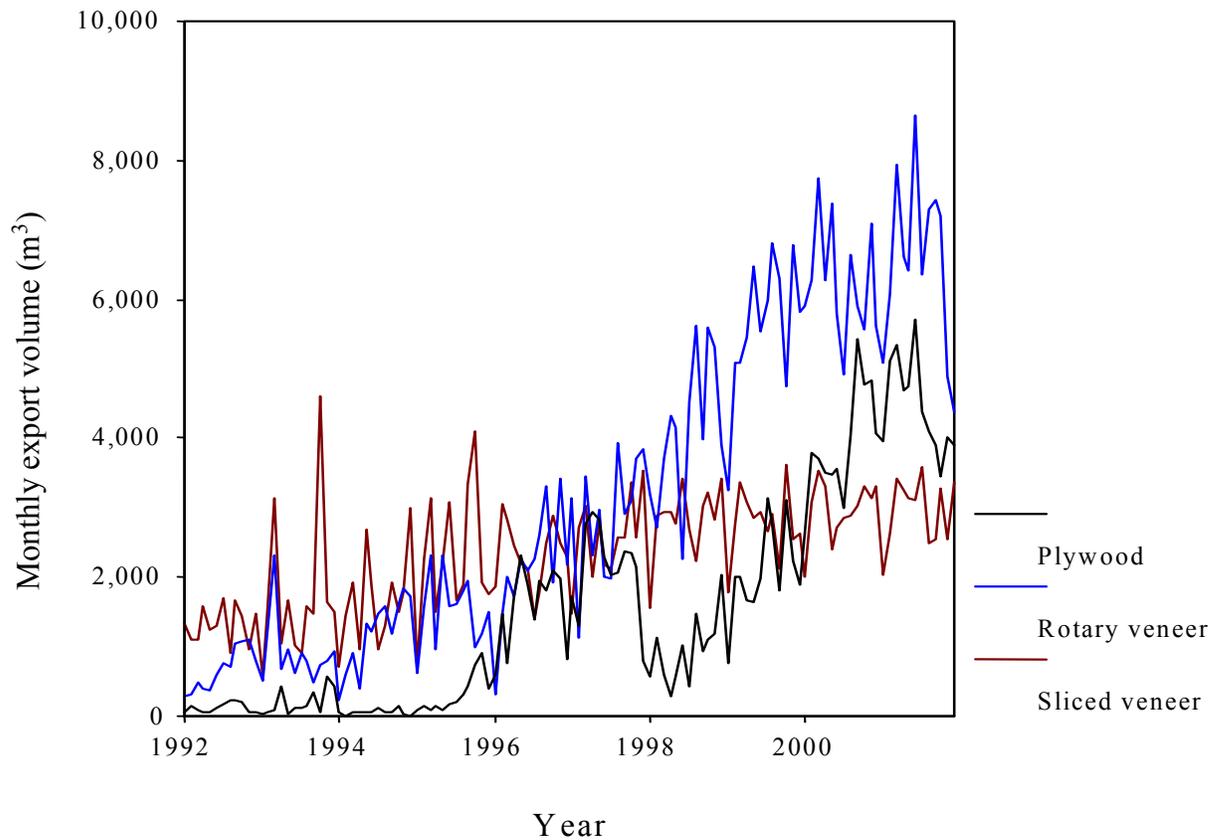
**Figure 1. Monthly Volume of Raw Material Harvested from Ghana's Forests (January 1992 – December 2001)**

An initial plot of time series for forest product exports shows changes in trends in air- and kiln-dried lumber. **Figure 2** shows air-dried lumber exports immediately falling after implementation of the interventions, while for kiln-dried lumber, there was a large increase about a year after implementation. After three years, exportation of kiln-dried (value-added) surpassed air-dried lumber.



**Figure 2. Volume of Air- and Kiln-dried Lumber Exported from Ghana (January 1992 – December 2001)**

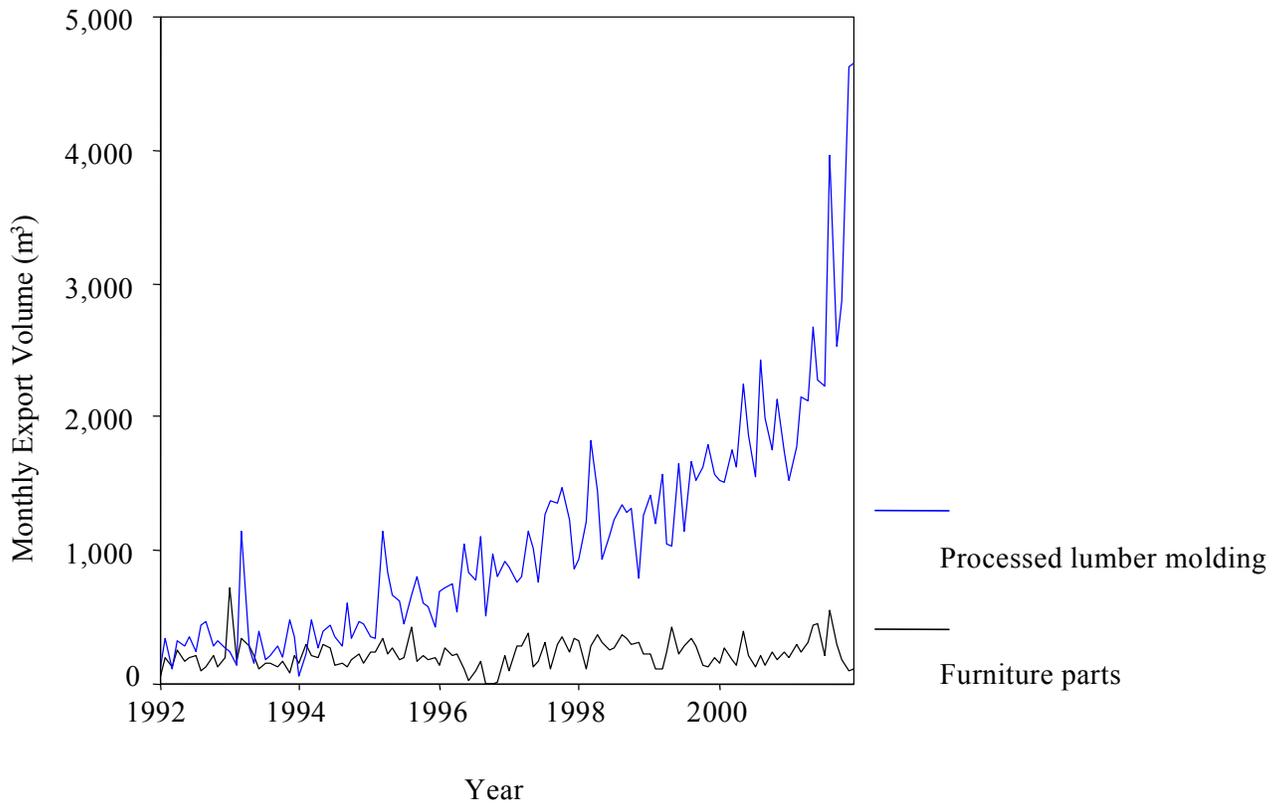
**Figure 3** displays a plot of time series for export volumes of major wood panel products including plywood, sliced and rotary veneers. Examination of the plots shows that increasing trends exist for all three products. Plywood exports from Ghana increased after the 1995 measures were implemented in the industry but plummeted with the Far Eastern economic crises in 1997. Exports picked up again in early 1999, mainly to Australia, and continued with entry into the U.S. market in 2000. Slice veneer exports, mainly to Italy, have maintained a gradual rise within the period under study. Rotary veneer followed troughs and crests in the pre-intervention era, but sales of peeled ‘ceiba’ as plywood core-stock to the U.S. market created an upward trend in the post-intervention period.



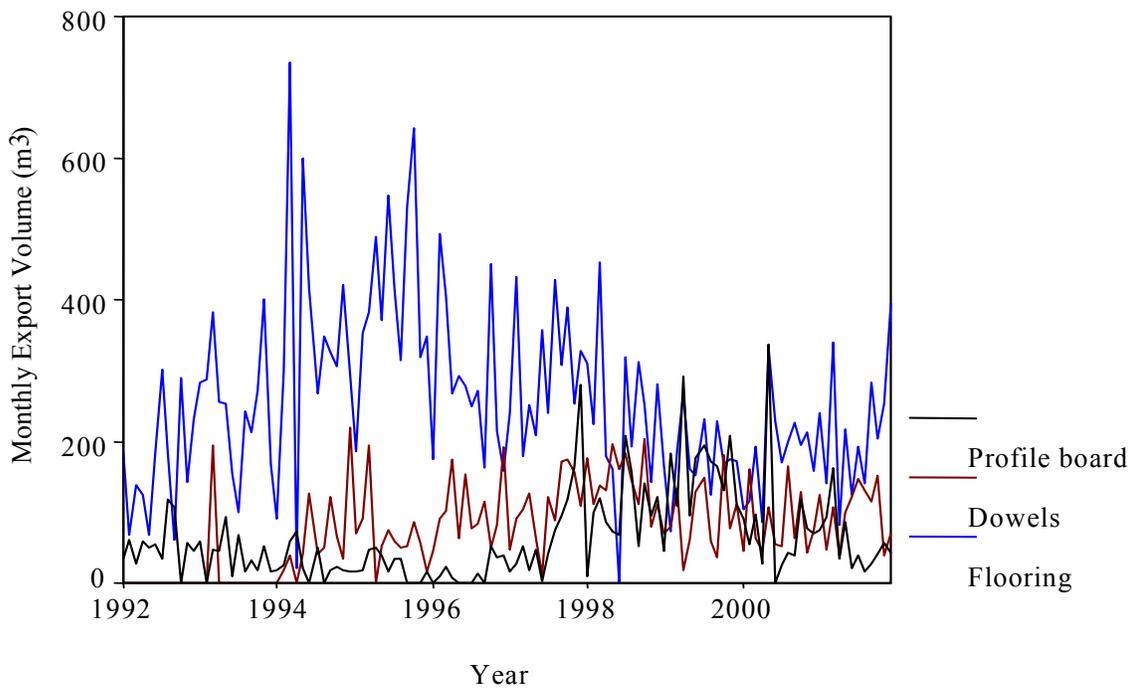
**Figure 3. Volume of Plywood, Rotary and Sliced Veneers Exported from Ghana (January 1992 – December 2001)**

**Figures 4a and 4b** show export time series for machined products. Figure 4a shows trends for furniture parts to the U.K. market (increasing) and processed lumber moldings to France (somewhat stable), whereas Figure 4b displays time series for flooring and profile boards to Italy, and dowels to U.K. The demand for flooring and profile boards appears to be declining.

(a)



(b)



**Figures 4a, 4b. Volume of Furniture Parts, Processed Lumber Molding, Dowel, Flooring and Profile Board Exported from Ghana (January 1992 – December 2001)**

### Influences of Government Intervention

To estimate effects from government intervention predictor variables, transfer function and intervention ARIMA modeling methods were applied. Using the model to establish the relationships between air-dried lumber and the government interventions, a good-fit model for the series was ARIMA (0,1,1)(1,0,1) model and only the air-dry levy intervention appeared to be useful as a predictor for inclusion in the model. Examination of the model parameters showed that the air-dry levy related to a decrease in the average monthly export of air-dried lumber in the post-intervention period. **Table 1** summarizes the results of the analysis.

Dependent Variables (m <sup>3</sup> )	Estimates of Independent Variables		
	Reduced AAC	Air-dry Levy	WSDP
1. Air-dried Lumber	ns	-3968	ns
2. Log (Kiln-dried Lumber)	-0.3790 (@ lag 0) 0.2514 (@ lag 4)	0.3218	ns
3. Sliced Veneer	ns	713	ns
4. Log (Processed molding)	-0.3636	ns	ns
5. Furniture Parts	ns	59	ns

Note: All estimates have  $t > 2.0$ ; ns – Not significant

**Table 1. Parameter Estimates of Raw Material Level and Air-dry Levy as Predictors for Air- and Kiln-dried lumber, Moldings, Furniture Parts and Sliced Veneer.**

**Table 1** indicates that the air-dry levy intervention correlated to an average monthly decrease in air-dried lumber export by about 4,000 m<sup>3</sup>. The decrease as indicated by a t-value of -3.658 was highly significant. From **Figure 1**, the pre-intervention average monthly shipment of air-dry lumber was about 16,000 m<sup>3</sup>, a decrease of about 25 percent.

For kiln-dried lumber (**Table 1**), an ARIMA (1,1,0)(0,1,0) model emerged as the best fit to the series, with both the air-dry levy and raw material levels accepted in the model as predictors of volume of kiln-dried lumber exported. **Table 1** suggests that the air-dry levy increased the average monthly volume of kiln-dried lumber exports by 32 percent. However, in the case of raw material levels, both negative and positive relationships with kiln-dried exports were significant with an overall increase of 13 percent.

An average monthly rise of 36 percent in export volume of processed lumber moldings was associated with changes in raw material levels but the air-dry levy did not influence shipments of this product.

The raw material level did not impact export of furniture parts. Although the air-dry levy accounted for an average monthly increase of about 60 m<sup>3</sup> in the post-intervention era, the variance explained by the model (that is,  $R^2 = 0.07$ ) is too low to be considered reliable.

Among the panel products, only sliced veneer had any association with the intervention strategies despite the increases observed in plywood and rotary veneer from the initial plots. The role of raw material levels in sliced veneer shipments was not significant. However, the air-dry levy was responsible for an average monthly increase of about 700 m<sup>3</sup>, which is a 50 percent increase compared to the pre-intervention monthly average of about 1,400 m<sup>3</sup>.

## **DISCUSSION**

### **Raw Material Level Reductions**

Raw material level modifications had no discernable influence on air-dried lumber exports. As a result of the log export ban in 1995, logs destined for export were made available to the domestic industry. More lesser-used species (LUS) logs being converted to air-dried lumber and panel production may have distorted any effect raw material level changes might have had on these two products. The unexpected positive association of kiln-dried lumber exports to raw material levels was probably a result of the Far East crisis in 1997. The crisis reduced exports in most products aside from the severely affected panel products during that period. Since raw material levels, too, was also on a downward trend, the relationship with kiln-dried lumber indicate a positive relationship. Considering the overall effect in 2001 however, there was a 13 percent ( $0.2514 + [-0.3790] = -0.1276$ ) increase in kiln-dried lumber due to a decrease in raw material levels. Producers of kiln-dried lumber might have thought it wise to add value in the wake of reduced raw material availability.

In the panel group, a reason why raw material levels did not show a significant impact may be because rotary veneer and plywood are produced primarily from relatively abundant lesser-used species (LUS) which were not affected by the AAC reduction. Moreover, there could have been increased availability of LUS due to the log export ban. It is also possible that decorative (sliced) veneer, which uses popular species, was not be affected significantly by the AAC reduction due to increased availability of logs that were shifted away from production of air-dried lumber (as a result of the levy).

The machined products group was mostly unaffected by raw material level changes, except in the case of processed lumber molding. This group of products relies on factors other than raw material levels (e.g., advanced machinery and skills, etc.), which are not readily available in the industry. Therefore, variation in raw material levels did not significantly shift export trends in the machined products category, especially in more downstream products. However, in processed lumber molding, which is basically an S4S kiln-dried lumber (that is, planed all four sides), the raw material level reduction was responsible for a 36 percent increase.

### **Air-dry Levy**

Introduction of the air-dry levy impacted the nine most popular species that formed the backbone of air-dried lumber exports, thus creating a strong negative relationship between air-dried lumber and the air-dry levy. Subsequently, kiln-dried lumber producers took advantage of the release of those popular species and increased production, resulting in a significant positive relationship with the air-dry levy.

In the panel group, the nine popular species being driven by the air-dry levy have limited roles in production of rotary veneer and plywood. As a result, the increasing levels in these two products did not show a significant relationship to the introduction of the air-dry levy. On the other hand, sliced veneer, which depends on the nine popular species because of its decorative use, was highly significantly related to the air-dry levy.

The machined product category, as in the case of raw material level, remained unresponsive to the air-dry levy, hence confirming the group's independence in relation to the intervention strategies.

## **Woodworking Sector Development Project (WSDP)**

The WSDP had been implemented for only two years when this assessment was conducted, a probable reason for an insignificant relationship to exports of all product groups.

### **Influences Due to Past Trends**

The past influences amount to the noise component in the model, which captures several factors that might affect patterns of the time series. For example, price, supply and demand cycles, quality levels, market crisis, competition and, more importantly marketing strategies, could be major underlying factors contributing to the noise component in the model. Therefore, the patterns of export trends in the panel products were possibly dictated by dominant suppliers in the global market such as Indonesia. In such situations, whatever regulatory measures are applied to the domestic industry without due regard to market influences may not be effective.

## **CONCLUSIONS AND RECOMMENDATIONS**

This research indicates that a reduction in air-dried lumber production significantly and negatively related to imposition of the air-dry levy but had no significant relationship with raw material levels. Both the air-dry levy and raw material levels had significant influences on air-dried lumber, kiln-dried lumber, sliced veneer and processed lumber molding out of the ten major products studied. It was observed that products that are processed further downstream (profile boards, dowels, flooring and furniture parts), as well as rotary and plywood production, could not be significantly affected by the strategies. The Woodworking Sector Development Project (WSDP) had not shown any significant impact at the time of this assessment.

The reduction in raw material levels influenced the increase in kiln drying and processed lumber molding. The air-dry levy is observed to be working well as a disincentive to primary processing by reducing air-dried lumber and increasing kiln-dried lumber and sliced veneer production. However, the two strategies seem to be limited in driving the industry to the ultimate goal of increased exportation of high-end value-added products.

If support could be given to the industry to acquire appropriate machinery and skills, the intervention strategies could create a more efficient transformation process to the desired goal of optimum value-addition.

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