

Impact of Trade Policies on Wood Products Export in Ghana

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Abstract The purpose of the study was to apply Autoregressive Integrated Moving Average (ARIMA) with intervention model (also known as intervention analysis) to determine the impact of the review of the timber export levy from 3% to 1.5% in 2007 and the regulation of trade of *Pericopsis elata* (Afromosia) on the export of wood products in 2008. Monthly time series data on exports of wood products from January 1997 to May 2014 were extracted from monthly and annual reports on export of wood products published by the Timber Industry Development Division (TIDD) of the Forestry Commission of Ghana. The results showed that the reduction in the timber export levy significantly decreased the volume of wood products export by 23%. The introduction of the regulation of trade of *Pericopsis elata* resulted in a non-significant decrease of 11% in the volume of wood products export. Moreover, the results revealed a significant long-term gradual and permanent decrease in the volume of wood products export after the enactment of the policy on regulation of trade of *Pericopsis elata*. The results of this study are expected to inform policy makers on the outcome of their decisions.

Keywords Wood products export, Intervention analysis, Export levy, Trade policy measures

1. Introduction

Wood products export contributes significantly to Ghana's economy. In 2013, Ghana earned about 119.3 million Euros from the export of 271,772m³ of wood products [1]. The timber industry is the fourth largest foreign exchange earner after minerals, cocoa and oil exports [2] [3]. Timber export earned Ghana around 10% of the foreign exchange between 1990 and 2000 but there has been a considerable decline since 2005 from 8.1% to about 1.3% in 2011 [2]. Ghana's deforestation rate is 135,395 ha annually, resulting in a decrease in the forest cover from approximately 7.5 million ha in 1990 to 4.9 million ha in 2010 [4]. Over the years, the Government of Ghana has instituted policies, legislations and fiscal reforms in the forestry sector aimed at sustainable management and use of timber resources. Among the interventions was the Woodworking Sector Development Programme (WSDP) which was aimed at the promotion of value-added processing and increased utilization and marketing of Lesser-Used Species (LUS) by the timber industry. These promotions were aimed at promoting viable and efficient forest based industries in an effort to encourage sustainable use of the nation's forest resources. Another directive implemented in

1996 to improve efficient utilization of timber resource was the introduction of a levy by the Trees and Timber Amendment Act (Act 493) to promote the export of kiln-dried products. The rationale for the levy was to place a 10-30 percent free on board (FOB) mainly on selected rare species to discourage the export of air-dried lumber. Other interventions include the Forestry Development Master Plan which seeks to develop a competitive, innovative and technologically strong wood industry with a high value but low volume export content. These interventions are necessary because sustainability has become an essential factor employed by consumers in reaching a purchase decision for wood products. Moreover, the public procurement policies of many European Union (EU) Member States require timber products to come from sustainably managed forests. In this regard, Ghana's new Forest and Wildlife Policy of 2012 seeks to address emerging global issues such as Forest Law Enforcement, Governance and Trade (FLEGT)/Voluntary Partnership Agreement (VPA), Forest Certification, Reducing Emissions from Deforestation and Forest Degradation (REDD), all of which are aimed at promoting and supporting the long-term sustainability of forests.

In spite of these interventions, Ghana's timber industry is facing a number of challenges. The dwindling timber resources is forcing a number of processing firms especially those in the formal sector to close down. For example, about 60 companies out of 200 processing mills have collapsed in the last 10 years, leading to the loss of about 70,000 jobs in

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the last 10 years [5]. Companies that had managed to survive the turbulence in the industry are currently producing below 50 per cent capacity [6]. According to studies by [7], other challenges include distorted market; obsolete processing technology; inadequate infrastructure and logistics at the Forestry Commission; inadequate funding for research and illegal chainsaw harvesting.

The purpose of this paper is to apply the Autoregressive Integrated Moving Average (ARIMA) with intervention model (also referred to as intervention analysis), to determine the impact of the review of the timber export levy from 3% to 1.5% in 2007 and the regulation of trade of *Pericopsis elata* (Afromosia) on the export of wood products in 2008. *Pericopsis elata*, locally known as Kokrodua, Assamela or Afromosia, has been an important commercial species for over 60 years. The wood is an important export commodity and this has resulted in significant overharvesting and an “endangered” status on the International Union for Conservation of Nature (IUCN) Red List. It is highly valued on the international market as it is mainly used for furniture and as decorative veneer. Decades of exploitation have resulted in Ghana’s low levels of trade in this species. In 1966 Ghana exported 8600m³ of logs and 19,600 m³ of sawn wood [8]. We assume that the regulation of trade of *Pericopsis elata* would reduce the volume of wood products export but would the reduction be temporal or permanent? In addition, as the timber export levy is reduced we expect the volume of wood products export to increase.

This paper is organized into four (4) sections. The first section discusses the background and objectives of the study. Section 2 presents the methodology used to analyze the time series data. Data analysis and results are presented in section 3. In the final section, conclusion is presented.

2. Methods

2.1. ARIMA-Intervention Model

The ARIMA Intervention model was first suggested by [9] and has been successfully applied in a number of studies to examine the impact of external events on variables to be forecast [10]. An important early application of intervention analysis was undertaken by [9] who provided an analytical framework for examining the effect of two interventions in Los Angeles, namely the opening of the Golden State Freeway and the enforcement of a new law concerning oxidant data. However, this methodology has not been applied widely by researchers in the wood products export sector. Studies by [11] and [12] evaluated the impact of selected policy measures on forest products export trade. The studies examined the impacts on forest product export trade of the implementation of reforms in the Forestry Sector Development Master Plan—reduction in annual allowable cut from 1.2 to 1.0 million m³, introduction of air-dry levy, and promotion of value-addition and lesser-used species. An autoregressive integrated moving average (ARIMA) modeling approach was used to model these effects. The

results showed that the air-dried lumber export levy and the decrease in annual allowable cut increased value-added wood product exports. The policies also resulted in an increase in percent of lesser-used species exported.

Intervention analysis has been used to study the impact of external events, including natural disasters, policy changes, political or economic events, technological changes, enactment of new regulatory laws, strikes and many more [13-16]. In order to determine the impact of the reduction in the timber export levy from 3% to 1.5% as well as the regulation of trade of *Pericopsis elata* on the volume of wood products export, the time series data was analyzed by an adaptation of the model developed by [9]. The intervention analysis modeling approach mainly consists of two key components: the noise component which represents the pre-intervention period and an intervention component that incorporates the intervention events in the model. Symbolically, the intervention analysis model may be written as in equation (1):

$$Y_t = f(I_t) + N_t \quad (1)$$

where Y_t is the response series, $f(I_t)$ is the intervention component or dynamic component and N_t is the noise or ARIMA component.

2.2.1. The Noise Component (N_t)

The noise component was modeled using the Box-Jenkins three stage iterative process of model identification, estimation and diagnostic checking until a suitable model was found. In the identification stage, the series was first checked whether it was stationary or nonstationary by using the Correlogram, Augmented Dickey-Fuller (ADF) test and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. The data was transformed by taking a first difference of the non-seasonal component to remove trend. A tentative model was then determined by examining the autocorrelation function (ACF) and the partial autocorrelation function (PACF). In the estimation stage, the maximum likelihood and least squares were adopted for estimating the coefficients of the parameters. Diagnostic check was lastly employed by examining the residuals of the fitted model to see if the residuals is adequate and do not differ from white noise. White noise indicates that each value in the series has a mean of zero, a constant variance, and is serially uncorrelated [17]. The Ljung-Box Q statistic is used to test the adequacy of a model and is expressed as follows:

$$Q = n(n+2) \sum_{k=1}^h \frac{r_k^2}{(n-k)} \quad (2)$$

The test statistic (Q) is compared with a chi-square distribution written as $\chi^2_{\alpha, (h-p-q)}$.

Where α is taken to be 5% (0.05), h is the maximum lag being considered, and p and q are the order of the AR and MA processes respectively. The hypothesis of randomness is rejected if

$Q > \chi^2_{\alpha, (h-p-q)}$. If the residuals turn out to be white noise, the fitted model is accepted otherwise, the Box-Jenkins three stage process is repeated until a

satisfactory model is obtained.

2.2.2. Intervention Component (I_t)

After obtaining an adequate noise model for the pre-intervention data, a dichotomous intervention function is then added to the noise model to fit a full ARIMA-Intervention model. In contrast to the experimental construction of ARIMA model, specification of the intervention component should be executed based on *a priori* ideas [18]. Thus, because an intervention is considered an exogenous input time series with the pre-specified onset of an event that disturbs the dependent time series in a bivariate model approach, the function of I_t is called a transfer function which specifies the dynamic transference from the independent effect of the input series (I_t) on the dependent output series (Y_t).

A one-time event is usually modeled with a pulse function, whereas a reasonably lasting event is modeled with step function. A step intervention function (S_t) is coded as **0** for the absence of the intervention event and as **1** during the onset and the entire presence of the event.

$$I_t = S_t^{(T)} = \begin{cases} 1, & t \geq T \\ 0, & t < T \end{cases} \quad (3)$$

The pulse intervention function (P_t) is also coded as **1** for the onset of the intervention events and as **0** otherwise.

$$I_t = P_t^{(T)} = \begin{cases} 1, & t = T \\ 0, & t \neq T \end{cases} \quad (4)$$

The ARIMA-Intervention model would finally be deemed as an adequate fit for the response series if it has well-behaved residuals and do also passes the goodness of fit test. A concern with intervention analysis is getting correct dates of the interventions as there may be delayed response to the date of intervention or a period where the system responded before the known date. Hence, choosing an inappropriate date could mask a possible effect of an intervention.

2.2.3. Intervention Model Specification

The objectives of this study were to quantify the effects of the review of the timber export levy downwards and the regulation of trade of *Pericopsis elata*. The review of the timber export levy was initiated on 1st January 2007 while the regulation of trade of *Pericopsis elata* also started in July, 2008. These events were modeled with a step and pulse intervention functions due to their mode of occurrences. The hypothesized intervention model for this study is written as equation (5):

$$Y_t = c + w_0 I_{1t} + w_1 I_{2t} + \frac{\theta(B)}{\phi(B)} \varepsilon_t \quad (5)$$

where,

$$I_{1t} = S_t = \begin{cases} 1, & t \geq \text{July 2008} \\ 0, & t < \text{July 2008} \end{cases} \quad (6)$$

$$I_{2t} = P_t = \begin{cases} 1, & t = \text{January 2007} \\ 0, & t \neq \text{January 2007} \end{cases} \quad (7)$$

Y_t is the monthly increase or decrease of the volume of wood products export. I_{1t} represents a step function for the regulation of trade of *Pericopsis elata* and I_{2t} the review of the timber export levy from 3% to 1.5% and c is a constant term.

2.2.4. Estimation and Diagnostic Checking for the Impact Assessment Models

The strength and structure of an effect could be quantified in terms of its duration (temporary or permanent) and nature (gradual or immediate) depending on the duration of the intervention. Thus, the effects of the intervention was captured by the transfer function in equation (8),

$$\frac{wB}{(1-\delta B)} \quad (8)$$

where w is the parameter estimate of an intervention, δ is the decaying rate of the intervention and B is the backshift operator. The parameters of the full impact assessment model were then estimated based on the tentative ARIMA model identified. Diagnostic checks on the significance of the hypothesized parameters and the behaviour of the residuals were conducted on the tentative model. A t -test statistic was used to check the significance of all parameters reported from the estimated impact model. The examination of the residuals should verify whether it follows a white noise process or otherwise. When the residuals are tested to be white noise, then the adequacy of the impact or intervention model will be fully established.

3. Results and Discussion

3.1. Data

Two hundred and nine (209) monthly data on the volume (m^3) of wood products export from January 1997 to May 2014 were obtained from the monthly and annual reports on export of wood products by the Timber Industry Development Division (TIDD) of the Forestry Commission of Ghana. Primary data was also obtained through personal communication with the research and statistics unit of TIDD. The data was used to fit an ARIMA-Intervention model based on two interventions enacted by the Forestry Commission of Ghana. The R statistical package version 3.0.2 and Microsoft Excel 2007 were used for the analysis.

3.2. Pre-Intervention Model

The time series plot in Figure 1 shows the entire monthly series of the volume of wood products export from January 1997 to May 2014. Two hypothesized interventions were inserted into the time series plot. The red line indicates the period (January 2007) when the timber export levy was reviewed downwards from 3% to 1.5%. The blue line also indicates the period (July 2008) when there was a regulation of trade of *Pericopsis elata*. A preliminary calculation of the mean of the volume of wood products exported prior to the

intervention (January 1997 to December 2006) and after the interventions (January 2007 to May 2014) suggested a decrease in the mean level of the volume of wood products export. This change was found to be about 15%. However, to make a more statistically rigorous statement regarding the change in the mean level of the volume of wood products export an Intervention Model Analysis was developed. The pre-intervention observations before the first incident of an intervention (January 2007) was used to construct an ARIMA model. To check stationarity, the Correlogram, ADF and KPSS test were used. The KPSS test the null

hypothesis for a level stationary and a trend stationary against an alternative of a unit root whiles the ADF test the null hypothesis of a unit root against the alternative of a stationary series.

The Correlogram (Figure 2) indicates that the ACF shows positive spikes at lag 12 and lag 24 which then dies out to zero. The PACF also displays high positive spikes at lag 1, lag 11 and lag 12 (Figure 2) which indicates that the series is non stationary. This is confirmed by the unit root tests in Table 1.

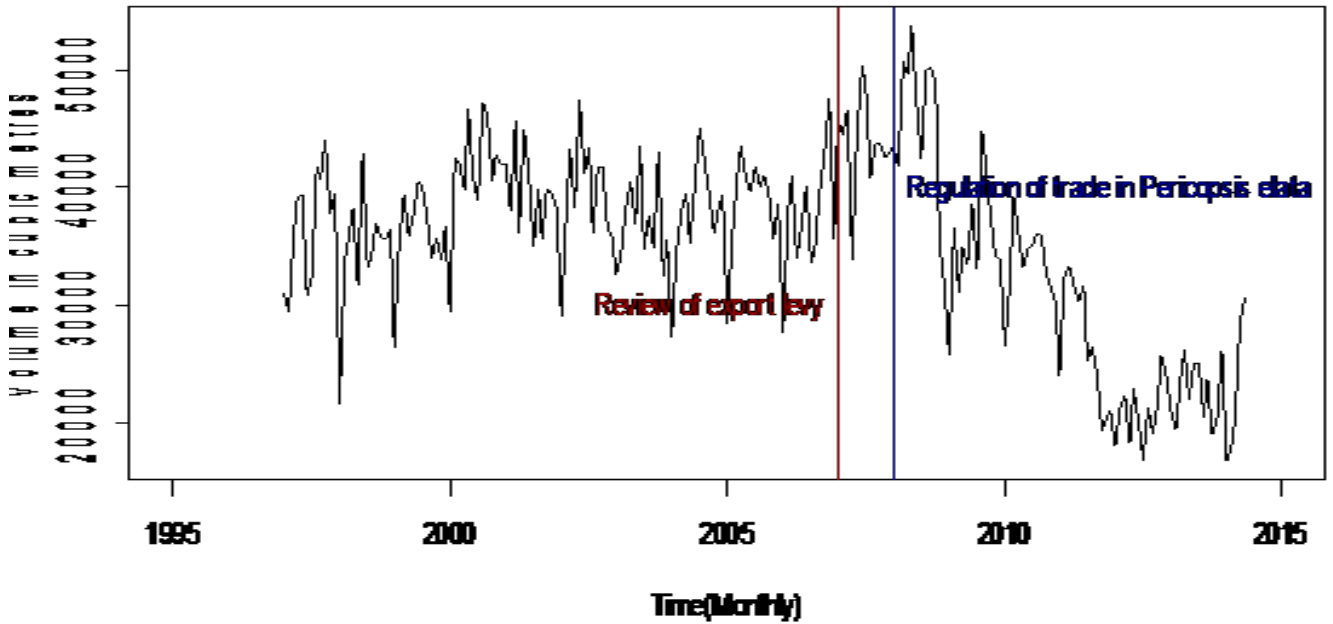


Figure 1. Time series plot from Jan 1997- May 2014 showing the review of export levy and regulation of trade of *Pericopsis elata* intervention

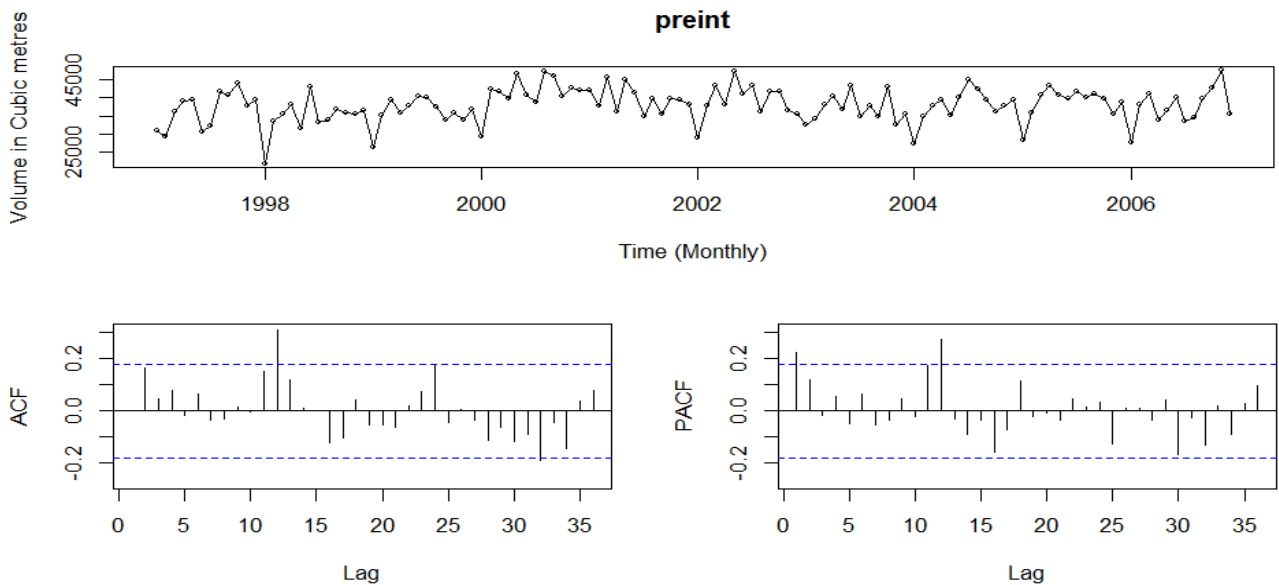


Figure 2. ACF and PACF plots of pre-intervention series

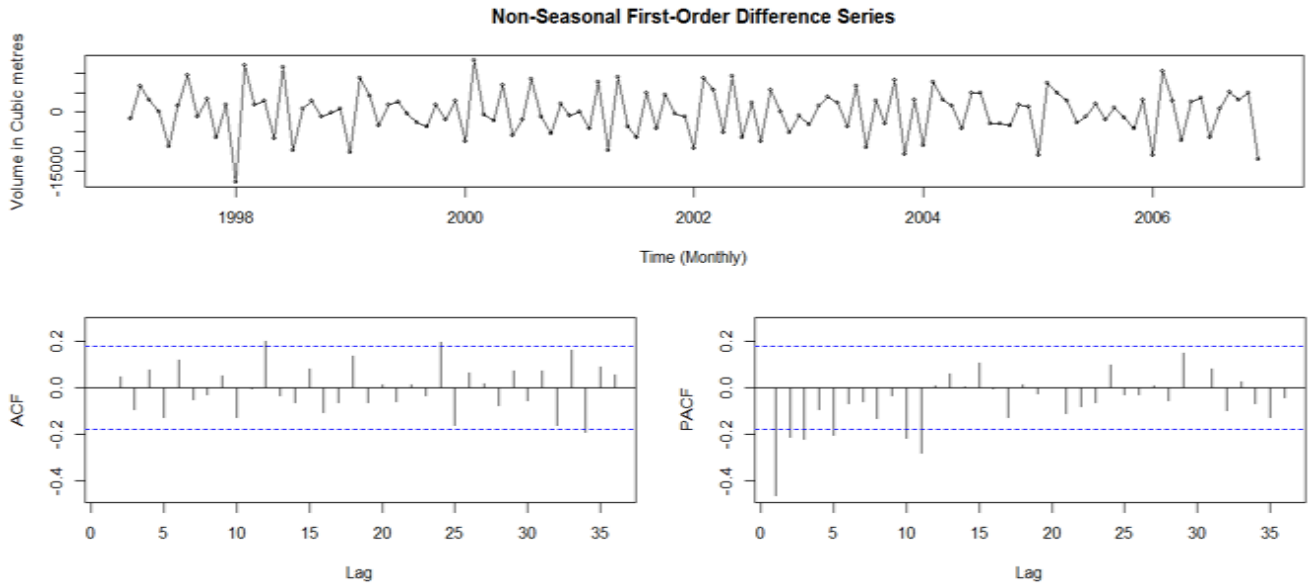


Figure 3. ACF and PACF of the differenced pre-intervention series

Table 1. Unit root test for pre-intervention series

Summary of Test Statistic			
Type of test	Test Statistic	Lag Order	P-value
KPSS (level)	0.3160	2	0.100
KPSS (Trend)	0.1783	2	0.024
ADF	-4.237	4	0.010

Table 2. Unit root test for seasonal and Non seasonal first order difference

Summary of Test Statistic				
1 st Difference	Type of test	Test Statistic	Lag Order	P-value
Seasonal Difference	KPSS (level)	0.1424	2	0.100
	KPSS (Trend)	0.0980	2	0.100
	ADF	-3.0635	4	0.134
Non seasonal difference	KPSS (level)	0.0264	2	0.100
	KPSS (Trend)	0.0136	2	0.100
	ADF	-7.4861	4	0.010

The KPSS test (level) statistic of 0.316 with p-value of 0.1 which is greater than the critical value of 0.05 as presented in Table 1 fails to reject the null hypothesis of having a level stationary series but the KPSS test for trend with p-value of 0.024 which is less than 0.05 rejects the null hypothesis of having a trend stationary series and therefore concludes that it has a unit root. The ADF test on the other hand rejects the null hypothesis of a unit root at 5% significance level, since its p-value of 0.01 is less than 0.05. It is clear from the objective tests that the series exhibits a trending pattern and has to be transformed or differenced to stabilize the series. Seasonal and non seasonal first order differencing were performed. The ADF test as well as both KPSS test for trend and level stationary indicates that after taking the first

difference of the non seasonal component the series was stationary (Table 2).

3.2.1. Model Identification

Figure 3 shows the Correlogram after taking the first difference of the non seasonal component. The following non seasonal and seasonal models were selected for investigation after examining the ACF and PACF of the Correlogram: ARIMA(3,1,0)(0,0,1)₁₂, ARIMA(4,1,0)(0,0,1)₁₂, ARIMA(3,1,0)(2,0,0)₁₂, ARIMA(3,1,0)(1,0,0)₁₂, ARIMA(2,1,0)(1,0,1)₁₂. The Akaike information criterion and the Schwartz Bayesian information criterion were used to select the most appropriate model among the several competing models reported in Table 3. Table 4 also indicates the model characteristics of the competing models.

3.2.2. Estimation of Model Parameters

ARIMA(2,1,0)(1,0,1)₁₂ was identified as the best noise model for the pre-intervention series since it has the least AIC, AICc and BIC. In addition, all the coefficients of the model parameters are significantly different from 0 at 5% significance level. The fitted model of the pre-intervention series is thus:

$$Y_t = \frac{(1-0.98B^{12})w_t}{(1-B)(1+0.66B+0.24B^2-0.99B^{12}-0.65B^{13}-0.24B^{14})} \quad (8)$$

Table 3. Values of AIC, AICc and BIC criteria for ARIMA models

Model	AIC	AICc	BIC
ARIMA(3,1,0)(0,0,1) ₁₂	2355.65	2356.18	2369.54
ARIMA(4,1,0)(0,0,1) ₁₂	2356.48	2357.23	2373.16
ARIMA(3,1,0)(2,0,0) ₁₂	2350.85	2351.60	2367.53
ARIMA(3,1,0)(1,0,0) ₁₂	2351.24	2351.77	2365.13
ARIMA(2,1,0)(1,0,1) ₁₂	2345.63	2346.16	2359.53

Table 4. Model characteristics of pre-intervention series

Model	Parameter	Parameter value	Standard Error	t-value
ARIMA (3,1,0)(0, 0,1) ₁₂	ϕ_1	-0.7003	0.0921	-7.6037
	ϕ_2	-0.3851	0.1049	-3.6711
	ϕ_3	-0.2795	0.0905	-3.0884
	Θ_1	0.3283	0.0915	3.5880
ARIMA (4,1,0)(0, 0,1) ₁₂	ϕ_1	-0.7271	0.0952	-7.6376
	ϕ_2	-0.4242	0.1106	-3.8354
	ϕ_3	-0.3531	0.1133	-3.1165
	ϕ_4	-0.1017	0.0940	-1.0819
	Θ_1	0.3310	0.0914	3.6214
ARIMA (3,1,0)(2, 0,0) ₁₂	ϕ_1	-0.6965	0.0906	-7.6876
	ϕ_2	-0.4254	0.1037	-4.1022
	ϕ_3	-0.3080	0.0903	-3.4109
	Φ_1	0.3319	0.1037	3.2006
	Φ_2	0.1742	0.1111	1.5680
ARIMA (3,1,0)(1, 0,0) ₁₂	ϕ_1	-0.7114	0.0905	-7.8608
	ϕ_2	-0.4112	0.1049	-3.9199
	ϕ_3	-0.3014	0.0903	-3.3378
	Φ_1	0.4120	0.0944	4.3644
ARIMA (2,1,0)(1, 0,1) ₁₂	ϕ_1	-0.6639	0.0917	-7.2399
	ϕ_2	-0.2405	0.0917	-2.6227
	Φ_1	0.9996	0.0020	499.800
	Θ_1	-0.9789	0.0511	-19.1566

3.2.3. Diagnostic Checking

The adequacy of the chosen noise model was checked

using the Ljung-Box test and the Shapiro Wilk test for normality. With a p-value of 0.5493 greater than 0.05 (Table 5), the Ljung-Box does not reject randomness of the error terms based on the first 24 autocorrelations of the residuals. This implies that the chosen noise model fits the pre-intervention data quite well.

Table 5. Test Statistic results for the test of normality and randomness

Summary of Test Statistic			
Type of test	Test Statistic	df	P-value
Shapiro-Wilk normality	0.9854		0.2230
Ljung-Box	22.5021	24	0.5493

In addition the Shapiro-Wilk test of normality (p-value=0.2230) at 5% significance level indicates that the model's residuals are normally distributed. This is confirmed from the normality plots shown in Figure 4. This signifies that the residuals of the chosen pre-intervention model follow a white noise process. It can therefore be concluded that the fitted pre-intervention model is appropriate.

3.3. ARIMA Intervention Model

After choosing an appropriate model for the pre-intervention data the Zivot and Andrews test was carried out to find potential breaks in the data. Table 6 reported a potential break point at position 142 in the series. This indicates that the regulation of trade of *Pericopsis elata* did not have an immediate impact on the volume of wood products export but took three months for the impact to be felt hence the significant structural break three months after the month of onset (July 2008).

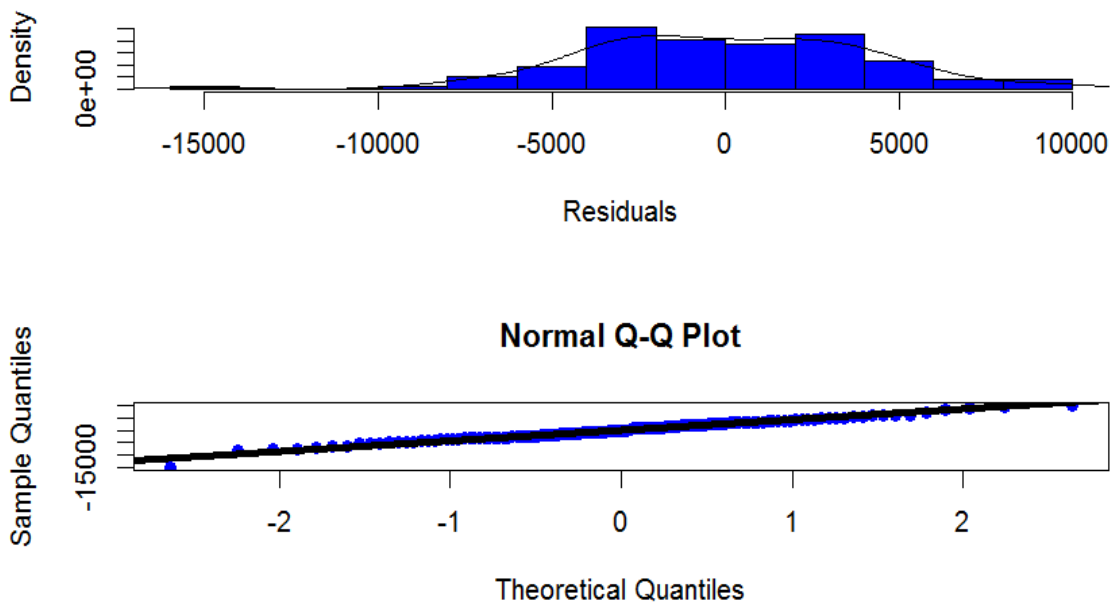


Figure 4. Normality plot for the selected noise model

Table 6. Zivot and Andrews test for potential break in data

Summary of Test Statistic			
Test type	Test statistic	P-value	Critical Values
Za	-9.9283	<0.00002	0.01 = - 5.57 0.05 = -5.08 0.10 = -4.82
Potential break point at position: 142			

The ARIMA(2,1,0)(1, 0,1)₁₂ model of the pre-intervention wood products series is now carried out together with the intervention functions. That is the review of the export levy and the regulation of trade of *Pericopsis elata*. The estimated parameters of the full intervention model are presented in Table 7. Almost all the estimated coefficients (Table 7), with the exception of the regulation of trade of *Pericopsis elata* were statistically different from zero. The ARIMA model with intervention provided a useful stochastic modeling tool to quantify the effects of the impact of the two interventions on the volume of wood products export in Ghana. The strength and structure of an effect could be quantified in terms of its duration (temporary or permanent) and nature (abrupt or gradual).

From Table 7 the estimate of the review of export levy parameter of -8,722.89 indicates the magnitude of the impact of the intervention event. Its negative sign indicates a reduction in the series as a result of the intervention effect. This means that the review of the timber export levy from 3% to 1.5% temporary reduced the monthly volume of timber products export by -8,722.89 m³. Its corresponding

t-value of -2.075 indicates that the reduction is statistically significant since it is greater than 2 in absolute value. From Figure 1, the pre-intervention average monthly export of wood products was about 37,965m³ a decrease of about 23%. Additionally, with a parameter estimate of -4,333.356, the regulation of trade of *Pericopsis elata* in 2008 had an impact on the volume of wood products export as it decreased exportation by 11% (4,333.356 m³) despite its non-significance. The decay or reduction component is however statistically significant since its corresponding t-value of 4.40077 is greater than 2 in absolute terms. The long term effect of the decay given by the relation in equation 10 is:

Table 7. Estimation results of the ARIMA-Intervention model

Model component	Parameter	Coefficient	Standard Error	t-value
	ϕ_1	0.6643	0.1328	5.00226
	ϕ_2	-0.2076	0.1239	-1.67554
	Φ_1	-0.4313	0.1279	-3.37217
	Θ_1	-0.8088	0.0759	-10.65613
Review of export levy in 2007	W_0	-8722.892	4201.892	-2.07594
Regulation in trade of <i>Pericopsis elata</i> in 2008	W_1	-4333.356	2447.403	-1.77059
	δ	0.3437	0.0781	4.40077

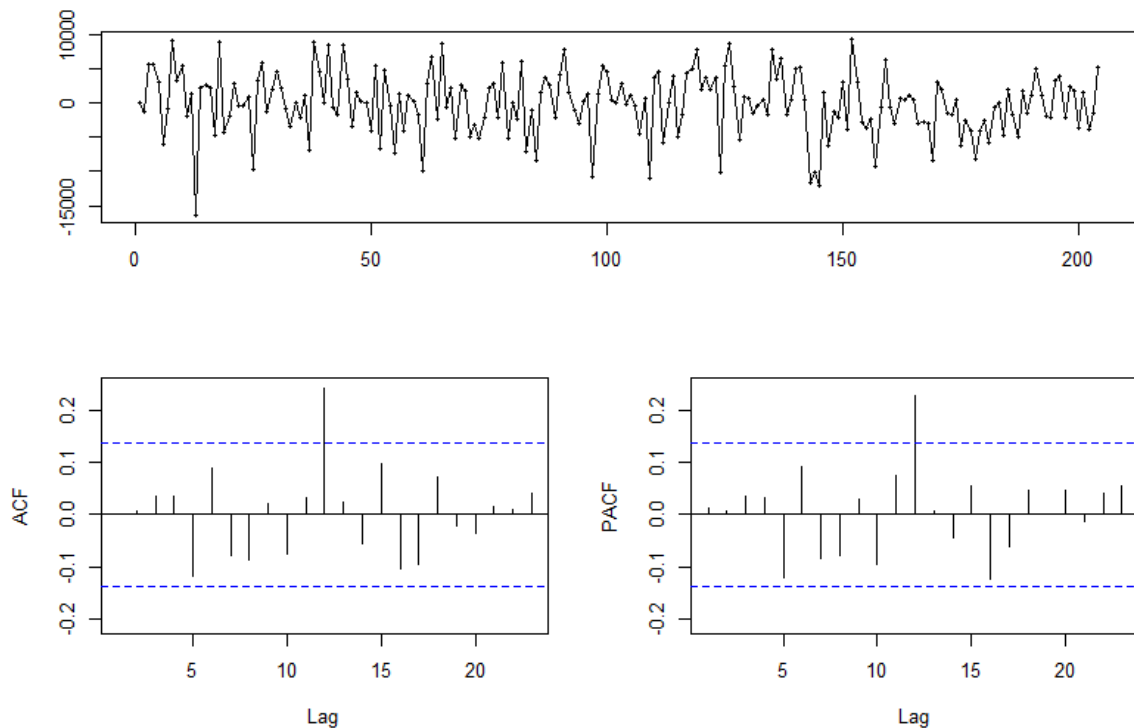


Figure 5. Residual ACF and PACF plots of the full Intervention model

$$\text{Longterm} = \frac{W_1}{1-\delta} \quad (10)$$

is $-6,602.716\text{m}^3$. This indicates that with the regulation of trade of *Pericopsis elata*, there is a gradual and permanent decrease in the volume of wood products export. The full intervention model could then be written as equation 11:

$$Y_t = \frac{-4333.36}{(1-0.3437B)} I_{1t-3} - 8722.89 I_{2t} + \frac{(1-0.98B^{12})w_t}{(1-B)(1+0.66B+0.24B^2-0.99B^{12}-0.65B^{13}-0.24B^{14})} \quad (11)$$

3.3.1. Diagnostic Checks for the Full Intervention Model

The residuals of the ARIMA-Intervention model were investigated based on residual plots (Figure 5) and Ljung-Box test statistic. The Ljung-Box test fails to reject the null hypothesis of white noise of residuals at 5% significant level since the p-value of 0.0502 is greater than the critical value of 0.05. The spikes of the residual correlogram in Figure 5 do not show much deviation from a white noise residual. This indicates that the ARIMA-Intervention model fits the data reasonably well.

4. Conclusions

This study identified both the significance and duration of two policies on the volume of wood products export in Ghana by employing an ARIMA-intervention analysis. The first policy was the reduction in timber export levy from 3% to 1.5% and the second was the regulation of trade of *Pericopsis elata*. Although it was expected that the downward review of the timber export levy would increase the volume of wood products export, it was realized that the reduction in the timber export levy resulted in a significant decrease in the volume of wood products export by 23% ($8,722.89 \text{ m}^3$). The results also indicated a non-significant decrease of 11% ($4,333.356\text{m}^3$) in the volume of wood products export when the regulation of trade of *Pericopsis elata* was introduced. In addition, the results showed a significant long-term gradual and permanent decrease in the volume of wood products export after the introduction of the regulation of trade of *Pericopsis elata*. This decrease did not take immediate effect when the policy was passed but took three months from the time of implementation before taking effect.

In conducting intervention analysis, other approaches such as comparing the changes in the means of the pre-intervention period to the post-intervention period could have been used but this does not give accurate results as no information on trends are incorporated into the calculations of the volume of wood products export. Alternatively, regression analysis which reports of significant intervention effects in most studies/cases could also have been used, but the diagnostic test statistics, and in particular the Q statistics and the goodness-of-fit R^2 measures are not satisfactory. This is because the regression errors are serially correlated and therefore the regression effects are not reliable.

Therefore intervention analysis based on simple regressions is not appropriate for seasonal time series such as for the volume of woods products export. This also applies to basic descriptive statistics for the mean changes before and after an intervention.

ARIMA intervention model takes into consideration all these effects and it is an effective approach in analyzing time series intervention designs. The use of ARIMA intervention analysis is thus very useful in explaining the dynamics of the impact of policy regulations in the wood products sector. Not only does it measure the significance of impacts on the export of wood products but also evaluate the form of decay of the impact, be it temporary, gradual or permanent. The findings of the study will inform policy makers on the outcome of their decisions and respond to the impact of the gradual decrease in the wood products export in Ghana.

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