Open Journal of Forestry, 2014, 4, 431-438
Published Online October 2014 in SciRes. http://www.scirp.org/journal/ojf
http://dx.doi.org/10.4236/ojf.2014.45048

Analyzing the Relation between Greek Paper and Paperboard Imports and Exports with Macroeconomic Variables

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Received 6 June 2014; revised 20 July 2014; accepted 4 August 2014

Abstract

This paper describes the relation between Greek imports and exports of paper and paperboard and a number of major macroeconomic variables, such as population, gross domestic product, the industrial production index and domestic round wood production. The Pearson correlation coefficient and multiple regression analysis were employed in the analysis of the data. The study shows that there is no significant relation between paper and paperboard imports as a dependent variable and population, gross domestic product and domestic round wood production as independent variables. Despite this, an acceptable model is constructed using only gross domestic product as an independent variable. The study also shows that there is a significant relation between the export of paper and paperboard and gross domestic product, the industrial production index and round wood production. The results indicate that gross domestic product as an independent variable has the greatest effect on wood imports and exports in Greece during the period studied. Using these models is confirmed that the use of socioeconomic variables and the construction of future scenarios for the Greek forest sector is very efficient considering the special characteristics of the Greek economy. These models could help the establishment of economic growth, the reduction of the financial and ecological deficit, the implementation of economic reforms and to increase new investments.

Keywords

Greek Forest Sector, Paper Imports Exports, Forecasts, Macroeconomic Variables

1. Introduction

It is known worldwide that Greece is not a major producer of wood and wood products. Domestic production is

small and aims to cover the country's needs, but the country spends a considerable amount on importing large quantities of wood and wood products such as paper. The primary reason is that geophysical and climate factors do not support the large-scale production of timber. Koulelis (2009) placed Greece among low-productivity European Union counties, such as Belgium and Luxembourg (counted together because of their low levels of production), Portugal, Austria, Denmark, the Netherlands, Ireland, the United Kingdom, Slovenia, Cyprus, the Czech Republic, Estonia, Slovakia, Lithuania and Latvia; all have natural ecosystems that do not support significant timber production. Greece has a small share in world production and makes a small contribution to the determination of wood prices. Nonetheless, the Food and Agriculture Organization of the United Nations (FAO, 2001) reported that most Greek forests can be used for wood supply and that more than three quarters of forestry and other wooded land is publicly owned, with the remainder being owned by private individuals and institutions. In addition, the collection of fuel wood, honey, resin and other non-wood products is important for the livelihood of the local population (FAO, 2001). The FAO (2005) also investigated important forest sector characteristics and reported historical trends and forecasts for European countries, including Greece.

There are few published studies on the development of the Greek forestry industry and none on the paper and paperboard sector. There are some studies concerning wood products consumed or produced in Greece. Thus, Arabatzis and Klonaris (2009) stressed that the study of wood and wood product imports is important to the national economy and could provide a useful guide for forest farms, the wood industry and wood firms. Klonaris and Arabatzis (2009) also pointed out that in Greece and internationally roundwood is one of the most important forest products as it is used widely in the construction and building sector. In this study, the process of wholesale long-length (>2 m) roundwood price determination is depicted in the form of an inverse demand system. According to Koulelis (2011), Greek wood product imports have been increasing rapidly over the years with combined economic and ecological implications. Although a high level of imports indicates robust domestic demand and a growing economy, too many imports in relation to exports can distort a nation's balance of trade. It's preferable if these imports are mainly productive assets like machinery and modern equipment, since they will improve productivity over the long run. On the other hand, due to that the level of national demand on wood is over the ability of country's natural capital to produce the quantity of wood products that population use, an ecological deficit is created.

Despite the general economic recession and the economic problems in Greece (large national debt, etc.), the state could promote national programs for the development of the small-scale wood elaboration and wood-selling industrial units.

In contrast to Greece, there are many studies worldwide related to the forest sector generally and paper and paperboard sector specifically. Ince (2001) summarized the analysis, key assumptions, and key findings related to projected fiber supply and demand in the U.S. pulp and paper sector. He reported that continued growth and the sustainable development of fiber supply in the U.S. pulp and paper sector appear to be assured for decades to come because of ongoing improvements in forest management, together with projected shifts in product markets, international trade, and production technology. Hseu and Shang (2005) measured the productivity of the pulp and paper industry in OECD countries over the period 1991-2000. Using the Malmquist productivity index, they reported changes in productivity, for example a small reduction (0.9%) for Switzerland and an increase of 2.4% for Japan over the sampled period. Ince and Buongiorno (2007) developed the North American pulp & paper (NAPAP) model to project pulp and paper market trade flows for forest policy development. Lundmark (2010) investigated the European trade in forest products and fuels using an adopted model. He suggested a direct relationship between a country's trade, forest endowments and income. McCarthy and Lei (2010) examined the pulp and paper industry globally and pointed to dramatic changes during the past several decades with large variations in world regional market shares of production capacity and consumption patterns. Limaei et al. (2011) studied the import and export of wood in Iran and determined the relation with major macroeconomic variables, such as population, gross domestic product (GDP), the world oil price, and the amount of domestic wood production. They underlined that the prediction of wood imports and exports is a tool for production and consumption planning. In regards to other projections models of the forest sector, the EFSOS (European Forest Sector Outlook Study) presents projections about the forest sector including paper and paperboard about Europe (Kangas and Baudin 2003). Additionally the Buongiorno et al. (2012) report provides an outlook for 2030-2060 based on the Global Forest Products Model GFPM (Buongiorno et al., 2003, updated in Buongiorno and Zhu 2011). The scenarios in this study address changes in world population, GDP, energy use, land use and resource availability. Equivalent models of forest sector projections are presented in the EFSOS II (UNECE, FAO 2011),

FAO Global Forest Products Outlook Study (Zhu et al. 1998) and ETTS V (Baudin and Brooks 1995).

The primary aim of this research was to study the relation between paper and paperboard import and export in Greece with major macroeconomic variables, such as population, GDP, industrial production index (IPI) and the amount of roundwood production, determined using time series data covering a period 1970-2010. In addition, it investigated the contribution of these variables to explain forest sector parameters in terms of the special economic characteristics of Greece.

2. Data and Methods

The data on Greek paper and paperboard imports and exports and roundwood production were drawn from the FAOSTAT database for the period 1970-2010 (FAO, 2010). The independent variables were roundwood production and macroeconomic data such as population and GDP (in millions of constant 2000 US$) collected from the World Bank database (World Bank, 2012) and the IPI (2005 = 100) collected from the Eurostat database (Eurostat, 2012) for the same period. For the analysis of the data SPSS (ver. 22) statistical software was used (Norusis, 1997). The time series of data used were not transformed from their original form and sorted to SPSS worksheets in chronological order.

In order to analyze the data, the Pearson correlation coefficient and multiple regression analysis were employed. Correlation measures the degree of affinity-interaction between two or more variables. In practice, the Pearson correlation coefficient provides an understanding of how strong or weak the correlation is between two variables. However, it is important to emphasize that a good correlation coefficient (around 1 or −1) does not necessarily show that there is a function between the variables. This is determined by using regression analysis, more specifically multiple regression analysis. Multiple linear regression estimates the coefficients of the linear equation, involving more than one independent variables that best predict the value of the dependent variable. Multiple regression analysis is a flexible method of data analysis that can be used when the dependent variable is studied in isolation or in relation to independent variables (Cohen & Cohen 1983). In addition, it can be used as a dynamic and precise data analysis tool. Regression provides all the essential mechanisms for statistical hypothesis testing, estimates and dynamic analyses (Cohen & Cohen 1983). The multiple linear regression method has also made a significant contribution to the development of prediction models (Draper & Smith, 1981). After the construction of the equation, the accuracy of the process was tested using the basic statistical tests of regression, including the adjusted R^2, standard error of estimate (SEE) and significance ($P > 0.05$). One simple and important diagnostic test of multicollinearity is the variance inflation factor VIF; (Matis, 2004). When the VIF value is greater than 10, there are redundant variables in the regression model and the parameter estimates may be unreliable.

3. Results

3.1. Relation between Paper and Paperboard Import and Macroeconomic Variables

Correlation analysis based on Pearson's r (**Table 1**) showed that there is a strong relation between Greek paper and paperboard imports and macroeconomic variables. This was positive for population, GDP and the IPI, and negative for round wood production. The Pearson correlation coefficient ranged from −0.719 for round wood production to 0.919 for GDP. Thus, GDP is the variable that correlates most strongly with paper and paperboard imports.

The extension of linear regression model to the case where there is more than one explanatory variable is multiple regression analysis. This analysis was undertaken based on the following equation.

$$Y = b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 \ldots b_n x_n \quad (1)$$

where Y is the depended variable and $x_1, x_2, \ldots, x_n$ are the explanatory variables and $b_0, b_1, \ldots, b_n$ are their coefficients.

Table 2 presents the statistically significant ($P = 0.05$) factors, the coefficient of determination (adjusted R^2) and the regression equation parameters during the period 1970-2010.

Analyzing the results shown in this table, it is evident that the variables "industrial production index" and "roundwood production" cannot explain the dependent variable "paper and paperboard imports" as they both have a P value greater than 0.05. It is common practice to conclude that the independent variable contributes to predicting the dependent variable when $P < 0.05$, i.e., the smaller the P value, the greater the probability that the

Table 1. Pearson Product Moment Correlation for paper and paperboard imports.

	Population	GDP	Industrial production index	Roundwood production
Imports paper paperboard (r)	0.874	0.919	0.817	−0.791

Table 2. Imports paper and paperboard Multiple Regression model parameters.

Imports Paper Paperboard = $-(267575.925 + 6.446\ \text{GDP}) + (890.972\ \text{Ind Prod Index}) - (0.0499\ \text{Round wood production})$				
Standard Error of Estimate = 98105.826				
Adj Rsqr = 0.835	Coefficient	Std. Error	*P*	VIF
Constant	−267575.925	221970.728	0.236	
GDP	6.446	1.472	<0.001	7.723
Industrial production index	890.972	2039.275	0.665	4.543
Roundwood production	−0.0499	0.0563	0.381	3.293

variables are correlated. The socioeconomic variable "population" was eliminated from the independent variables because it created multicollinearity among the independent variables (VIF = 14.318). It is also important to note that the adjusted R^2 for the equation was 0.835, which is acceptable.

After the elimination of the macroeconomic variables that were not acceptable (IPI, round wood production and population), a new model was constructed using only the socioeconomic variable that could explain the dependent variable. **Table 3** presents the results of the iteration of the procedure and the model parameters that were calculated.

According to **Table 3**, it may be possible to predict imports by using only the macroeconomic variable GDP, employing the above function with model parameters adjusted R^2 = 0.840 and $P < 0.001$. Also according to **Figure 1** the resulting plot is approximately linear so the error terms are normally distributed.

3.2. Relation between Paper and Paperboard Exports and Macroeconomic Variables

Correlation analysis based on Pearson's r (**Table 4**) showed that there is a strong relation between Greek paper and paperboard exports and macroeconomic variables. This is positive for population, GDP and the IPI, and negative for roundwood production. The Pearson correlation coefficient ranged from −0.680 for roundwood production to 0.901 for GDP. Thus, GDP is again the variable that correlates most strongly with the export of paper and paperboard.

Multiple regression analysis was undertaken based on Equation (1). **Table 5** presents the statistically significant (P = 0.05) factors, the coefficient of determination (adjusted R^2) and the regression equation parameters during the period 1970-2010.

Analyzing the results of **Table 5**, it can be seen that all the independent variables could explain the dependent variable "paper and paperboard exports" because they have a P value less than 0.05. Again, the macroeconomic variable "population" was eliminated from the independent variables due to multicollinearity problems (VIF = 14.318). Also according to **Figure 2** the resulting plot is approximately linear so the error terms are normally distributed. The adjusted R^2 was calculated as 0.836, which is acceptable. Therefore, the model provides the basis for the possible prediction of exports.

4. Conclusion and Discussion

This research was carried out in order to study paper and paperboard imports and exports in Greece and investigate the relation with certain macroeconomic variables, such as population, GDP, the IPI and domestic roundwood production for the period 1970-2010. The results showed no significant relation between paper and paperboard imports as a dependent variable and population, GDP or domestic roundwood production as independent variables. However, an acceptable model was constructed using only GDP as the independent variable. Also, the study demonstrates that there is a significant relation between the export of paper and paperboard and GDP, the IPI and round wood production. The results indicate that GDP as an independent variable has the greatest effect on wood imports and exports in Greece during the studied period. The basic idea in economic projections is to combine information from the past with current knowledge and judgement to make statements

Table 3. Imports paper and paperboard Regression model parameters.

Imports Paper Paperboard = −433410.217 + (7.586 GDP)			
Standard Error of Estimate = 96675.579			
Adj Rsqr = 0.840	Coefficient	Std. Error	*P*
Constant	−433410.21	57723.461	<0.001
GDP	7.586	0.522	<0.001

Table 4. Pearson Product Moment Correlation for paper and paperboard exports.

	Population	GDP	Industrial production index	Round wood production
Exports paper paperboard (r)	0.783	0.901	0.731	−0.680

Table 5. Exports paper and paperboard Multiple Regression model parameters.

Exports Paper Paperboard = −112046.611 + (1.560 GDP) − (646.839 Industrial Prod Index) + (0.0170 Round wood Production)				
Standard Error of Estimate = 13211,971				
Adj Rsqr = 0.836	Coefficient	Std. Error	*P*	VIF
Constant	−112046.611	29892.932	<0.001	
GDP	1.560	0.198	<0.001	7.723
Industrial production index	−646.839	274.630	0.024	4.543
Roundwood production	0.0170	0.00758	0.031	3.293

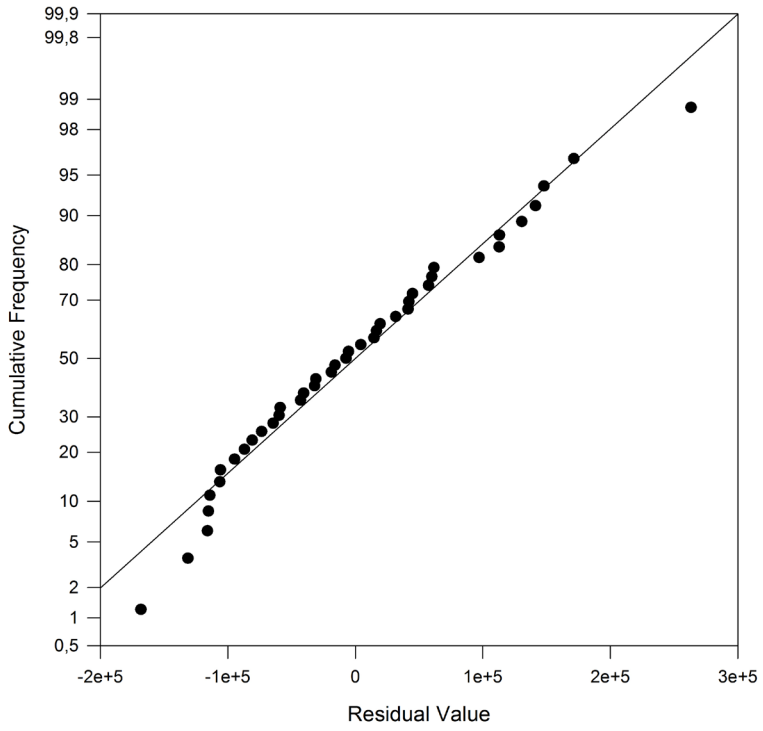

Figure 1. Normal probability plot for the imports of paper and paperboard imports model.

about likely developments in the future (Kangas & Baudin 2003). The projection models presented here are prepared based on the idea that basic forest sector topics like production, trade and consumption could be possibly explained by socioeconomic variables like GDP, population etc. The use of this kind of variables is very

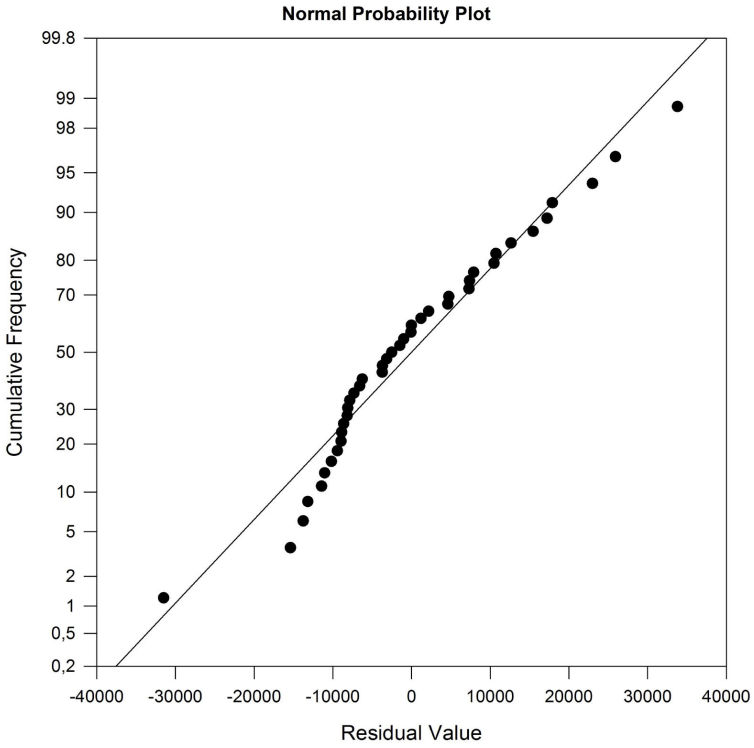

Figure 2. Normal probability plot for the paper and paperboard exports model.

common to the forest sector projections like the studies that mentioned above. For example EFSOS (European Forest Sector Outlook Study) model, Kangas and Baudin (2003) and EFSOS II (UNECE, FAO 2012) use GDP as the best reflecting variable for economic growth in order to make projections about forest products demand, supply and trade in Europe. This study confirms that the usage of socioeconomic variables and the construction of future scenarios for this propose are very efficient. Decision makers generally are encouraged to reflect upon these kinds of studies and to consider them when taking possible future policy actions. All the above studies also project increasing trends in paper and paperboard consumption and trade for Greece until 2020. One important issue is that these studies relate the above increase to an increasing GDP for the same period (i.e. GDP growth rate 2.20) and to stable prices of the commodities. The truth was that GDP of Greece after 2008 (233 billion euros) started to decline due to the economic crisis. In 2013 according to EUROSTAT, the Greek GDP was 193 billion $ and continues to shrink. The real GDP growth rate at 2013 was −3.9 (EUROSTAT, 2014). Instead IMF (IMF, 2014) projects that after 2014 the GDP will have an increase reaching the levels of 333 billion $ in current prices in 2019. Overall it is easy to conclude that it is quite risky to make a projection about Greece because of the current uncertain economic situation. It is crucial to underline that there is no guarantee of the accuracy of the prediction models in this paper. This is especially the case for Greece, which still faces some long-term financial challenges; the country is in the grip of a major recession and is experiencing a general economic crisis. The predictions are valuable in particular circumstances, such as the establishment of economic growth, the reduction of the financial and ecological deficit, the implementation of economic reforms and an increase in new investments. Also, this kind of models can be used only under some limitations like absence of major socioeconomic transitions; prices (in this case of wood products) remain generally stable, and technological changes during production are not too extensive. Perhaps these models are useful in order to guide the decision makers in constructing a healthy Greek economy where both exports and imports are growing, since this typically indicates economic strength and a sustainable trade surplus or deficit.

Acknowledgements

This project has received funding from the European Union's Seventh Programme for research, technological

development and demonstration under grant agreement No. 282887.

References

Arabatzis, G., & Klonaris, S. (2009). An Analysis of Greek Wood and Wood Product Imports: Evidence from the Linear Quadratic Aids. *Forest Policy and Economics, 11*, 266-270. http://dx.doi.org/10.1016/j.forpol.2009.04.002

Baudin, A., & Brooks, D. (1995). Projections of Forest Products Demand, Supply and Trade in ETTS V. UNECE/FAO Timber and Forest Discussion Papers, ETTS V Working Paper, ECE/TIM/DP/6.

Buongiorno, J., & Zhu, S. (2011). Calibrating and Updating the Global Forest Products Model (GFPM Version 2010). Staff Paper Series #70, Department of Forest and Wildlife Ecology, University of Wisconsin Madison, Madison.

Buongiorno, J., Zhu, S., Raunikar, R., and Jeffrey, P., & Prestemon, J.P. (2012). Outlook to 2060 for World Forests and Forest Industries: A Technical Document Supporting the Forest Service 2010 RPA Assessment. Gen. Tech. Rep. SRS-151. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station, 119 p.

Buongiorno, J., Zhu, S., Zhang, D. et al. (2003). *The Global Forest Products Model: Structure, Estimation, and Applications*. San Diego: Academic Press/Elsevier.

Cohen, J., & Cohen, P. (1983). *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences* (2nd ed.). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Draper, N. R., & Smith, H. (1981). *Applied Regression Analysis*. New York: John Wiley and Sons, Inc.

Eurostat (2012). Production in Industry—Total (Excluding Construction). http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&language=en&pcode=teiis080

EUROSTAT (2014). ©European Union, 1995-2014.

FAO (2001). FAO Forestry Country Information. Food and Agriculture Organization of the United Nations. http://www.fao.org/forestry/country/en/

FAO (2005). *Microfinance and Forest-Based Small Scale Enterprises. Forestry Paper 146*. Rome: Food and Agriculture Organization of the United Nations.

FAO (2010). FAOSTAT, Forestry Database, 2010. Rome: Food and Agriculture Organization of the United Nations. http://faostat.fao.org/site/626/default.aspx#ancor

Hseu, J. S., & Shang, J. K. (2005). Productivity Changes of Pulp and Paper Industry in OECD Countries, 1991-2000: A Non-Parametric Malmquist Approach. *Forest Policy and Economics, 7*, 411-422. http://dx.doi.org/10.1016/j.forpol.2003.07.002

IMF (2014). April 2014 World Economic Outlook Database. http://www.imf.org/

Ince, P. (2001). Outlook for Sustainable Fiber Supply through Forest Management and Other Developments in the US Pulp and Paper Sector. *Proceedings of TAPPI 2001 International Environmental, Health and Safety Conference*, Charlotte, 22-25 April 2001, 11. www.tappi.org

Ince, P. J., & Buongiorno, J. (2007). North American Pulp & Paper Model (NAPAP). In D. M. Adams, & R. W. Haynes, (Eds.), *Resource and Market Projections for Forest Policy Development: Twenty-Five Years of Experience with the US RPA Timber Assessment* (pp. 99-174). Dordrecht: Springer.

Kangas, K., & Baudin, A. (2003). Modelling and Projections of Forest Products Demand, Supply and Trade in Europe. A Study Prepared for the European Forest Sector Outlook Study (EFSOS) Geneva Timber and Forest Discussion Papers. United Nations, New York and Geneva.

Klonaris, S., & Arabatzis, G. (2009). Empirical Demand Analysis of Long-Length Roundwood (Sawlogs) in Greece. *New Medit, 8*, 54-62.

Koulelis, P. (2009). Cluster Analysis in Primary Roundwood Production of 25 Countries of European Union. *Annals of Forest Research, 52,* 163-168.

Koulelis, P. (2011). Greek Timber Industries and Wood Product Markets over the Last Century: Development Constraints and Future Directions. *Annals of Forest Research, 54,* 229-240.

Limaei, M. S., Heybatiana, R., Vaezinb, S. M. H., & Torkmana, J. (2011). Wood Import and Export and Its Relation to Major Macroeconomics Variables in Iran. *Forest Policy and Economics, 13*, 303-307. http://dx.doi.org/10.1016/j.forpol.2011.03.001

Lundmark, R. (2010). European Trade in Forest Products and Fuels. *Journal of Forest Economics, 16*, 235-251. http://dx.doi.org/10.1016/j.jfe.2009.11.007

Matis, K. (2004). *Introduction to Regression*. Thessaloniki: Pigasos Press.

McCarthy, P. & Lei, L. (2010). Regional Demands for Pulp and Paper Products. *Journal of Forest Economics, 16*, 127-144.

http://dx.doi.org/10.1016/j.jfe.2009.11.001

Norusis, M. J. (1997). SPSS Professional Statistics. Chicago, IL: SPSS Inc., 376 p.

UNECE/FAO (2011). The European Forest Sector Outlook Study II 2010-2030. EFSOS II. Geneva: United Nations Publication.

World Bank (2012). World Data Bank. http://databank.worldbank.org/ddp/home.do?Step=2&id=4&hActiveDimensionId=WDI_Ctry

Zhu, S., Tomberlin, D., & Buongiorno, J. (1998). Global Forest Products Consumption, Production, Trade and Prices: Global Forest Products Model Projections to 2010. Global Forest Products Outlook Study Working Paper No: GFPOS/WP/01. Rome: Forestry Policy and Planning Division, Food and Agriculture Organization.

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