Investigation of wood production and trading in Iran

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ABSTRACT: The relation between wood export and import of Iran and a number of major macroeconomic variables, such as oil price, gross domestic production, population, exchange rate, unemployment rate, inflation and domestic wood production during 1980–2014 were described. Pearson's correlation coefficient and multiple regression analysis were used for data analysis. The results showed that there is a significant relation at a significance level of 5% between wood export as a dependent variable and oil price, GDP, population, exchange rate and domestic wood production as independent variables. Meanwhile, there is also a significant relation between wood import and oil price, exchange rate and domestic wood production. The findings also indicate that oil price as an independent variable has the highest effect on wood import in Iran during the studied period.

Keywords: Iranian forest sector; timber market analysis; correlation; regression

Growing demand for wood has exerted a greater pressure on primary old-growth forests in the world (Bandara, Vlosky 2012). Therefore, many countries are considering secondary timber resources such as forest plantations. Other than the secondary timber resources, imports also play a key role in meeting the demand for timber and wood products in most countries (Index of Economic Freedom 2008, https://www.key4biz.it/files/000090/00009041.pdf). As a result of significant increases in demand for wood, the worldwide wood business is experiencing quick changes, putting significant and expanding weight on the world's remaining natural forests (Goldberg, Velicer 2006). The rapid increase of domestic wood demand has driven some nations into a state when they are insufficient with wood while forcing some countries to shift from being net exporters of wood to becoming net importers (e.g. China) (FAO 2006). These global developments have intensified the need for cross-boundary trade of wood products. Exports create foreign exchange and can generate employment. Although policy formulators tend to encourage exports, ideas on imports are diverse and conflicting. However, imports are also important to a country's economy in many ways. Imports can fulfil the accessible deficit of goods and services which are essential for the well-being of people while often facilitating the sustainable utilization of existing resources. The United Nations Environment Programme (2016, www.unep.org) encourages decision makers in government, local authorities and industry to develop and adopt policies, strategies and practices that are cleaner and safer, make efficient use of natural resources, ensure environmentally sound management of chemicals, and reduce pollution and risks for humans and the environment. In addition, imports generate employment in handling, transportation, marketing, and other segments of the value chain (Resource Conservation Alliance 2007). Metafore (2004) suggested that markets in tropical products such as plywood and wooden flooring will expand in the future. These market expansions provide opportunities for suppliers of tropical hardwood flooring products to increase sales. The above trend towards higher usage of pre-finished products will create an excellent prospect for suppliers that can deliver quality tropical species. Design and quality of timber products are increasingly being associated as a means of maintaining or increasing the market share. Iran's wood product manufacturing sector is characterized by low volume and high waste, but producing good quality products (FRWO 2013). Despite a sufficient forest resource base, this sector faces many obstacles for expansion. Lack of capital and technology, overdependence on a limited number of species, unorganized industrial structure, and legal constraints have restricted the growth of the industry. In order to derive maximum benefits from

these emerging global markets and opportunities, it is important to identify the current trade and development barriers that exist in Iran from wood product exporters' perspective. Identifying constraints in the export of the wood product industry would help policy makers to make necessary changes to facilitate development of a sustainable Iranian export sector. Iran has been endowed with ample natural resources to enrich and sustain the lives of its people (FRWO 2013). The forestry sector in Iran is composed of natural forests, forest plantations, home gardens, other non-forest tree resources, wood and wood based industries, non-wood forest products, and bioenergy (Yachkaschi et al. 2009). It is one of the sectors which has shown gradual improvement over the years and has a tremendous potential to grow. Wood-based exporting industries are considered as an emerging sector (Bahmani-Oskooee, Chakrabarti 2003). Private sector investments and involvement are the primary reasons for the expansion of the forestry sector including wood and wood-based industries. The FAO (2012) estimated that forest industries contribute more than 450 billion USD to national incomes, contributing nearly 1% of the global GDP in 2008 and providing formal employment to 0.4% of the global labour force. The economy of many countries (e.g. Sweden, Norway and Finland) is based on the proper utilization of forests (Howard, Westby 2009). At a glance, in Iran due to the existence of remnant natural forests, natural ecosystems and also plantations, all demonstrate the potential of this country for ecological capability (FRWO 2013). Due to differences in latitude and variation between the height above sea level and seasonal factors such as wind direction, sea and lakes and deserts, Iran has an altogether various climate, thus as a result, forests of Iran are ecologically different (FRWO 2013). The total GDP of Iran was 415.4 billion USD in 2010. The industrial sector, which includes mining, manufacturing and construction, employed 31% of the labour force in 2013. In 2012, the total unemployment of Iran was reported 15% of the nation's population (World Bank 2012). In light of the limitations of the previous development plans in Iran, the 5th National Development Program for the period 2010–2015 (http://www.wipo.int/wipolex/en/details.jsp?id=14565) focuses on socio-economic development through decentralization, encouraging private sector activities and the growth of cooperatives in construction, agriculture, animal husbandry, trade and services that enhance the economic development of the state and cooperatives. The plan is part of Vision 2025 – National Outlook of 2025 (http://www.shana.ir/en/newsagency/21864/Islamic-Republic-of-Irans-

20-Year-Outlook-to-2025), a strategy for long-term sustainable growth. The use of forest resources is abundant in the Caspian Hyrcanian landscape. The Caspian Hyrcanian forests are Iran's main source of commercial round wood timber. Trees are also felled for poles, firewood and charcoal, although the government strictly controls logging operations. Stricter regulations and increased enforcement resulted in wood extraction declining dramatically between 1991 and 2006: for example, timber production was reduced from 172,700 to 49,700 m^3, fuelwood declined from 718,800 to 294,900 m^3, charcoal production was reduced from 36,600 to 1,000 tons. A large portion of the country is mountainous with a central plateau comprising steppes, semi-steppes and saline deserts. In the northern Alborz Mountains and the southern Caspian Sea region of northern Iran, unique mild woodland spread constitutes a profitable common legacy, emphasizing rich biodiversity and hereditary variety (Yachkaschi et al. 2009). Hyrcanian forests are Iran's main source of commercial timber, so one of their generally noticeable utilizations is for timber extraction (Mohammadi Limaei et al. 2011). Almost 90% of the Iranian territory is situated on the Iranian Plateau. Out of a total of 1,648,194 km^2 of land in Iran, 54% is covered by mountain ranges, 21% deserts, 7% forests and woodlands and 1% inland waters, with a total of just 17% arable and residential land. Iran is a founding member of OPEC and Gas Exporting Countries Forum. Due to limited wood production in Iran and high domestic demand, exports are negligible. Each year, the Iranian Ministry of Trade publishes an imports and exports manual, which contains regulations regarding imports, exports, import duties, customs duties, tariff codes, and other conditions related to trade. Projection of wood import and export is a tool for production planning. The aim of this study was to assess the contribution of commercial forests of Iran to the economics of the country. For this purpose, wood import and export in Iran via the time series model was investigated during 35 years.

MATERIAL AND METHODS

Data collection. Data on wood raw material and wood products was gathered from the Iranian Customs Office and the Iranian Commercial Office during the period 1980–2014. Macroeconomic data such as population, unemployment rate, GDP, Iran oil price, exchange rate and inflation was collected from the Statistical Centre of Iran (2014, www.sci.org.ir, accessed August 10, 2014) and Islamic Re-

public of Iran Customs Administration (2014). The amount of domestic wood production was collected from FRWO (2013). Various types of wood and wood products have been classified into 3 bunches with a specific end goal to discover a strategy arranged to analyse the data. These groups include: raw material (industrial and pulpwood), wooden products (furniture, wooden instruments and parquets) and cellulose products (paper and liner, sanitary materials and wood pulp). Measuring and monetary estimations of the different groups were figured for a 35-year period. Thus, a database was created in order to perform the statistical analysis. The data reflect the effect of inflation. Therefore, data obtained for this variable does not show actual prices. In order to determine the real prices, consumer price index was employed. Therefore the following function was used to obtain adjusted prices (Eq. 1):

$$I_t = (P_t \times Y_0)/Y_t \tag{1}$$

where:
I_t – adjusted price in year t,
P_t – price in year t,
Y_0 – stock price in the base year,
Y_t – stock price in year t.

Fig. 1a shows the descriptive statistics of the total volume of wood export in Iran 1980–2014.
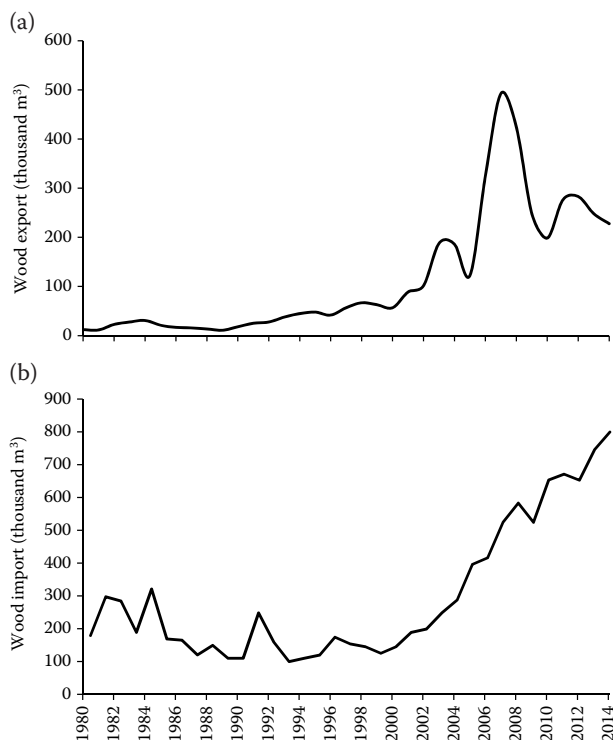

(a)

(b)

Fig. 1. Total volume of wood export (a) and import (b) in Iran in 1980–2014

Based on Fig. 1a, the highest amount of export was reported in 2008. Fig. 1b shows the descriptive statistics of the total volume of wood import in Iran 1980–2014. The highest amount of import was reported in 2014.

Data analysis. It was assumed that independent variables are the macroeconomic variables and domestic wood production from commercial forests of Iran and dependent variables are the amount of wood imported or exported. For the analysis of the data the SPSS statistical software (Version 20.0, 2011) was used (Norusis 1997). Pearson's correlation coefficient (r) and multiple regression analysis were employed. The multiple linear regression was used to estimate the coefficients of the linear equation. Regression provides all the essential mechanisms for statistical hypothesis testing, estimates and dynamic analyses (Cohen, Cohen 1983). After the construction of the equation, the accuracy of the process was tested applying the basic statistical tests of regression, including adjusted R^2, standard error of the estimate and significance ($P > 0.05$). One simple and important diagnostic test of multicollinearity is the variance inflation factor (Matis 2004). When the variance inflation factor value is higher than 10, there are redundant variables in the regression model and the parameter estimates may be unreliable. The following function was used to determine the relation between dependent and independent variables (Eq. 2):

$$Y = \alpha_0 + \alpha_1 x_1 + \alpha_2 x_2 + \alpha_3 x_3 + \ldots + \alpha_n x_n \tag{2}$$

where:
Y – dependent variable (e.g. amount of wood imported or exported),
$x_1, x_2, \ldots, x_n$ – explanatory variables (e.g. domestic wood production),
$\alpha_0, \alpha_1, \ldots, \alpha_n$ – coefficients of explanatory variables.

The hypothesis was if there is any significant relation between dependent variables and independent variables with significance level of 5% or confidence interval of 95%. Therefore, the one-sided t test with significance level of 0.5% was used to investigate significance between the variables.

RESULTS

Relation between wood export and macroeconomic variables

The correlation analysis based on r (Table 1) showed that there is a strong relation between wood export and macroeconomic variables. This

Table 1. Pearson's correlation coefficient (r) for wood exports

	Oil price	GDP	Population	Exchange rate	Domestic wood production
r	0.813	0.569	0.744	0.604	−0.613

Table 2. Multiple regression model parameters for wood exports (SEE = 53,891.89528, adjusted R^2 = 0.822)

	Coefficient of variables	SE	P-value	VIF
Constant	12,896.784	101,808.021	0.900	
Oil price	4,068.793	924.700	0.000	9.884
GDP	−46.638	15.385	0.005	5.652
Population	0.005	0.001	0.003	1.872
Exchange rate	−4.985	2.219	0.003	3.213
Domestic wood production	−0.143	0.045	0.032	3.112

SEE – standard error of the estimate, VIF – variance inflation factor

was positive for oil price, GDP, population, and exchange rate, and negative for domestic wood production. Pearson's correlation coefficient ranged from −0.613 for domestic wood production to 0.813 for oil price. Thus, oil price is the variable that correlates most strongly with wood export. It is also important to note that a stepwise method was applied, therefore the macroeconomic variables that were not statistically acceptable ($P > 0.05$) (e.g. unemployment rate and inflation) were eliminated automatically.

Table 2 presents statistically significant factors ($P = 0.05$), coefficient of determination (adjusted R^2) and regression equation parameters during the period 1980–2014. Analysing the results shown in this table, it is evident that the independent variables explain the dependent variable wood export ($P < 0.05$). The adjusted R^2 for the equation was 0.822, which is acceptable.

Regression model for wood export (W_E) in Iran in 1980–2014 (Eq. 3):

$$W_E = 12{,}896.784 + (4{,}068.793 \text{ oil price}) - (46.638 \text{ GDP})$$
$$+ (0.005 \text{ population}) - (4.985 \text{ exchange rate})$$
$$- (0.143 \text{ domestic wood production})$$

According to Table 2 and Eq. 3, it may be possible to predict wood exports using the macroeconomic variables oil price, GDP, population, exchange rate and domestic wood production.

Relation between wood imports and macroeconomics variables

The regression analysis was undertaken based on Eq. 2. The results show that there is a significant relation between wood import and macroeconomic variables as well as domestic wood production. Also the correlation analysis based on r (Table 3) showed that there is a strong relation between wood import and macroeconomic variables. This was positive for oil price and exchange rate, and negative for domestic wood production. Pearson's correlation coefficient ranged from −0.686 for domestic wood production to 0.962 for oil price. Thus, oil price is the variable that correlates most strongly with wood import. Again, a stepwise method was applied, therefore the macroeconomic variables that were not statistically acceptable ($P > 0.05$) (e.g. unemployment rate, inflation, GDP and population) were eliminated automatically.

Table 4 presents statistically significant factors ($P = 0.05$), coefficient of determination (adjusted R^2) and regression equation parameters during the period 1980–2014. Analysing the results shown in this table, it is evident that the independent variables explain the dependent variable wood import ($P < 0.05$). The adjusted R^2 for the equation was 0.941, which is considerably acceptable.

Regression model for wood import (W_I) in Iran in 1980–2014 (Eq. 4):

$$W_I = 2{,}085{,}442.529 + (4{,}068.793 \text{ oil price})$$
$$+ (49.103 \text{ exchange rate})$$
$$- (1.091 \text{ domestic wood production})$$

According to Table 4 and Eq. 4, it may be possible to predict wood imports by using the macroeconomic variables oil price, exchange rate and domestic wood production.

Table 3. Pearson's correlation coefficient (r) for wood imports

	Oil price	Exchange rate	Domestic wood production
r	0.962	0.788	−0.686

Table 4. Multiple regression model parameters for wood imports (SEE = 517,047.7152, adjusted R^2 = 0.941)

	Coefficient of variables	SE	*P*-value	VIF
Constant	2,085,442.529	609,050.919	0.002	
Oil price	4,068.793	5,172.145	0.000	3.359
Exchange rate	49.103	18.625	0.013	1.724
Domestic wood production	−1.091	0.412	0.013	2.382

SEE – standard error of the estimate, VIF – variance inflation factor

DISCUSSION

This research was carried out in order to study the contribution of commercial forests of Iran to the economics of the country and investigates its relation with some macroeconomic variables (e.g. population, GDP, world oil price, exchange rate, unemployment rate, inflation and the amount of domestic wood production during 1980–2014). Results showed that there is a significant relation between wood export as a dependent variable and oil price, GDP, population, exchange rate and domestic wood production as independent variables. Also, the study demonstrates that there is a significant relation between wood import as a dependent variable and oil price, exchange rate and domestic wood production as independent variables during the studied period. In fact, in our study and based on our data, we could not find any rational connection between the amount of domestic wood production and wood exports. Hence, the authors expected a positive relation between the above variables, but surprisingly Table 1 illustrates a negative variation of domestic wood production in relation to an increase of wood exports. Moreover, Eq. 3 confirms the coefficients of variables from Table 1. Contrastingly, Mohammadi Limaei et al. (2011) stated that there was also a significant relation between wood export and population, GDP, amount of domestic wood production, and world oil price. What can be learnt here is that wood exports in Iran are allocated to some particular wood products which have no clear association with the amount of domestic wood production (Bayat Kashkouli et. al. 2008). To disambiguate this issue, we suggest that in further researches the data of wood exports should be categorized in detail to assess any relationship between wood exports and domestic wood production. Zahmatkesh (1993) showed that there is a significant relation between population and wood import in Iran during 1980–1991. Ince and Buongiorno (2007) indicated that there is a relation between paper consumption and population, which is similar to this study. The basic idea in economic projections is to combine information from

the past with current knowledge and judgment to make statements 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 possibly be explained by socioeconomic variables like GDP, population etc. Mohammadi Limaei et al. (2011) announced that GDP as an independent socioeconomic variable had the highest effect on wood import in Iran during 1980–2009. Kangas and Baudin (2003) used GDP as the best reflecting variable for economic growth in order to make projections about forest product demand, supply and trade in Europe. This study confirms that the use of socioeconomic variables and the construction of future scenarios for this propose are very efficient. Decision makers are generally encouraged to reflect upon these kinds of studies and to consider them when taking possible future policy actions. Koulelis (2014) indicated that there is a significant relation between the export of paper and paperboard and GDP, the industrial production index and round wood production. The results of our research indicated that oil price as an independent variable had the highest effect on wood import in Iran during the studied period. Overall it is easy to conclude that it is quite risky to make a projection about a country because of the uncertain economic situation. It is crucial to underline that there is no guarantee of the accuracy of the prediction models in this research. The projections are valuable in particular circumstances, such as the establishment of economic growth, reduction of the financial and ecological deficit, implementation of economic reforms (e.g. new industrial policy, new trade policy, monetary reforms, capital market reforms and phasing out subsidies) and an increase in new investments.

CONCLUSIONS

There are many things that may affect the wood imports and exports which are not predictable and depend on socioeconomic conditions, consumer

behaviour, price of substitute commodities, etc. in the future. Perhaps these models are useful in order to guide the decision makers in constructing a resistive economy for the country where both exports and imports are growing, since this typically indicates economic strength and a sustainable trade surplus or deficit.

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