



An econometric analysis of imported timber demand in Turkey

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Abstract

This paper attempts to understand and explain determinants of Turkish demand for foreign timber imported to Turkey. Explanatory variables in the propounded model include price of imported timber, price of domestically-produced sawlog as an imperfect substitute, income per capita, country population, and capacity utilization rates (CUR's) and industrial production indices (IPI's) of forest industry sectors. For empirical purpose we used a time series data covering the 15-year period between 1995 and 2009. The econometric model set for there appears to be able to explain more than 96% of the variation in demand for imported timber, with all of the parameter estimates, except for population parameter, being statistically significant. Estimation results confirm the existence of the price elasticity and substitute cross-price elasticity of demand for imported timber. Results also imply that the Turkish firms importing timber tend to consider domestic sawlog prices as much as, even more than, the price of foreign timber. The hypothesized effects of production changes in wood products and furniture industries on imported timber demand do not appear to be substantiated by this study, which can partly be attributed to the partial method of measuring CUR's and IPI's. Meanwhile, possible effects of income, population and exchange rate index of the Turkish currency on the imported timber demand of the country are not evidenced by the empirical findings of this research. Finally, our model forecasts, *ceteris paribus*, that by 2016 the level of Turkish demand for imported timber demand can reasonably be expected to exceed 2 million m³/year. This corresponds to the level of timber import observed in the years preceding the global economic crisis in 2009.

Key words: Industrial roundwood, roundwood demand, forest sector, econometric model, regression analysis, timber market, demand forecast, Turkish forestry.

Introduction

True efforts to reach a real open economy in Turkey date back nearly three decades. Parallel to this fact, foreign trade in timber did really not started until late 1980's. Relatively low timber productivity of national (i.e. state-owned) forest lands, despite vast lands under forest regime, and boosting domestic demand for wood products can be said to have caused the country to be by far a net timber importer. Within the past two decades, annual import of industrial roundwood has amounted to 25 to 65% of annual domestic production of sawlog, and 10 to 24% of all industrial roundwood production from national forests that comprise virtually whole forest base of the country. Export of timber, however, has been minuscule.

The vast majority (often more than 90%) of timber imported to Turkey is of industrial roundwood nature, and is traded under HS (Harmonised Commodity Description and Coding System) commodity code of 4403 used in international trade. Furthermore, vast majority of annual Turkish import under HS code 4403 and its subheadings has steadily comprised sawlogs ever since the beginning of timber foreign trade of the country. Table 1 presents the further annual statistics of Turkish foreign trade in timber by

HS code 4403, i.e., "wood in the rough, whether or not stripped of bark or sapwood, or roughly squared", covering the 15-year period between 1995 and 2009.

As observed in Table 1, Turkish import of timber (i.e., industrial roundwood) added up to almost 20 million m³ and more than 2 billion dollars in the 15-year period between 1995 and 2009. This imported timber can be grouped mainly in four: treated, softwood or coniferous, tropical, and hardwood. Yet about three quarters of the timber imported in that period to the country under HS 4403 were of coniferous species, mostly of *Pinus sylvestris* L., or Scots pine, although the corresponding share tends to be somewhat less dominant in value (Table 2). This softwood-dominant timber import profile of the country has been more or less similar on annual basis as well.

Despite the relative importance of timber import in Turkey, studies on determinants of demand for imported timber in Turkey have been essentially limited to official reports ^{2,3}, descriptive investigations ⁴, professional observations and speculations ⁵. Moreover, Turkish import of timber has been tackled to a limited extent by certain internationally generic studies ^{6,7}. Although such

studies bear notable value, scarceness of econometric research on Turkish demand for foreign timber stands apparent. This paper has an aim to contribute to fill the mentioned research gap as a primary study focusing on the Turkish demand for imported timber, while it can also be seen as a contribution to the literature on international trade of forest products.

Materials and Methods

The data: This study made use of times series data sets that cover the period between 1995 and 2009. Furthermore, all the data used for this study is of secondary nature, i.e., data previously collected by other entities. The major source of data was The Turkish Statistical Institute (TurkStat) through its online databases as well as formal request of specific data. Statistics provided by TurkStat include timber foreign trade quantities and values, income (GDP) per capita and mid-year country population. Also provided by TurkStat are the data sets as to capacity utilization rates (CUR's)* and industrial production indices (IPI's)† of wood products, paper products, and furniture industries.

Meanwhile, one important set of data as to the prices of domestic sawlog sold from national forests was provided the Management and Marketing Department of GDF (General Directorate of Forests);

Table 1. Timber (HS 4403) foreign trade of Turkey by quantity, value and import/export ratio, 1995-2009¹.

Year	Import (1000 m ³)	Import (1000 US\$)	Export (1000 m ³)	Export (1000 US\$)	Imp./Exp by quantity (%)	Imp./Exp by value (%)
1995	891	118,198	57	3,502	6.4	3.0
1996	1,192	138,296	21	5,101	1.8	3.7
1997	900	123,829	20	6,871	2.3	5.5
1998	1,048	123,388	16	7,766	1.5	6.3
1999	1,302	104,122	18	5,169	1.3	5.0
2000	1,653	121,938	15	4,443	0.9	3.6
2001	832	66,509	21	3,633	2.5	5.5
2002	836	78,530	31	4,288	3.7	5.5
2003	1,133	100,732	11	2,781	0.9	2.8
2004	1,869	172,825	8	2,162	0.4	1.3
2005	1,989	208,316	10	2,822	0.5	1.4
2006	2,068	229,455	16	5,419	0.8	2.4
2007	1,846	254,091	13	4,260	0.7	1.7
2008	1,239	210,506	5	1,658	0.4	0.8
2009	928	113,160	6	1,557	0.6	1.4
15-year	19,729	2,163,896	268	61,431	1.4	2.8
Aver.	1,315	144,260	18	4,095	N/A	N/A

Table 2. Timber (HS-4403) import of Turkey by commodity type, quantity and value, aggregate of the period between 1995-2009¹.

HS Code	Description	Quantity (1000 m ³)	Value (1000 US\$)
440310	W.I.R. *, <u>treated</u> with paint, stains, creosote or other preservatives)	843	116,683
440320	W.I.R., <u>softwood/coniferous</u> (<i>Pinus sylvestris</i> L., <i>Picea abies</i> etc.)	14,483	1,204,202
440341	W.I.R., <u>tropical</u> (meranti, sapelli, okoumé, iroko, sipo etc.)	2,061	574,095
440391440392440399	W.I.R., <u>hardwood</u> (<i>Quercus</i> spp., <i>Fagus</i> spp., poplar, eucalyptus, birch etc.)	2,342	268,916
Total		19,729	2,163,896

*W.I.R.: Wood in the rough, whether or not stripped of bark or sapwood, or roughly squared.

* Capacity utilization rate represents the percentage at which potential output levels are being met or used by a given sector.

† Industrial production index measures the changes in industrial production of a given sector.

this set comprises annual nation-wide prices being the sales-weighted annual averages of sawlog sales in 27 forest regions in the country. Lastly, time series of effective exchange rate indices of Turkish Lira was obtained from the electronic data delivery system (EDDS) of the Turkish Central Bank. All pecuniary data used in this study were converted into real values.

The model: The following equation is proposed as a base model of national demand for imported timber in Turkey:

$$Q_{mt} = \beta_0 P_{mt}^{\beta_1} P_{dcl}^{\beta_2} I^{\beta_3} N^{\beta_4} e^{\beta_5 CUR_{op}} e^{\beta_6 CUR_{tur}} e^{\beta_7 IPI_{op}} e^{\beta_8 IPI_{tur}} e^{\beta_9 ERI} e^{u_i} \quad (1)$$

Variables of the above-proposed econometric model are defined in Table 3. Also, given in the rightmost column of the same table are the signs of the parameter estimates which can be expected in light of economic theory, production technology and practice. Meanwhile, β 's in the above equation represent respective model parameters and u_i stands for the disturbance term of the econometric model.. Lastly, e is the natural logarithm base approximately equal to 2.71828.

Concerning the expected signs, there is no economic or practical ground to expect the imported timber demand in Turkey would violate the law of demand. Accordingly, we would expect a negative price elasticity estimate, i.e., negative sign for the estimated parameter for the price of imported timber.

As mentioned in the preceding section, vast majority of the timber imported to Turkey under the HS-4403 comprises sawlogs. Inasmuch as sawlogs of the same or close species, with the exception of tropical timber, are also supplied by GDF from the State forests, domestically-produced sawlog can be perceived as an imperfect substitute for the timber imported under HS-4403 code. In this study we hypothesize such a substitution relationship, hence expect a positive sign of parameter estimate for variable of domestic sawlog price, i.e., a positive cross elasticity estimate.

As regards possible income effect on demand for imported timber, we expect a positive sign of the corresponding parameter estimate inasmuch as the imported timber is assumed to be a normal good. Furthermore, economic theory tells, in principle, a direct relationship between demand and population growth, hence a positive expected sign of estimated parameter for population variable.

Timber imported to Turkey is raw material in essence which is used as input by wood products and furniture industries within the country. Therefore, we conceivably hypothesize direct relationship of imported timber demand with aggregate CUR and IPI of domestic manufacturers of wood products and furniture, hence a positive expected sign of the parameters for the CUR and IPI variables. Finally, ERI variable is expected to have a parameter with a positive sign since this variable represent the strength of Turkish currency against a set of foreign currencies.

Table 3. Explanations and expectations as to the components of the model for imported timber demand in Turkey.

Symbol	Definition	Expected sign of parameter estimate
Q_{mt}	Quantity, in cubic meters, of timber imported to Turkey, under the 4-level HS code of 4403.	N/A
P_{mt}	Real C.I.F. price of timber imported to Turkey under the HS-4403, in Turkish Liras (TRY's)	-
P_{dsl}	Real price of domestically-produced sawlog, in TRY, as weighted average of sales prices that had occurred in 27 State forest regions in Turkey.	+
I	Real income, as measured by real gross domestic product per capita, in TRY	+
N	Number of mid-year population living in the country	+
CUR_{wp}	Capacity utilization rate of wood products industry in the country	+
CUR_{fur}	Capacity utilization rate of furniture industry in the country	+
IPI_{wp}	Industrial production index of wood products industry in the country	+
IPI_{fur}	Industrial production index of furniture industry in the country	+
ERI	Exchange rate index of Turkish currency	+

Our proposed sawlog demand model is in multiplicative form because of the ease of observation and interpretation of demand elasticities. Subsequently, the original form of the model is transformed into a double-log linear model as follows:

$$\ln Q_{mt} = \ln \beta_0 + \beta_1 \ln P_{mt} + \beta_2 \ln P_{dsl} + \beta_3 \ln I + \beta_4 \ln N + \beta_5 \ln CUR_{wp} + \beta_6 \ln CUR_{fur} + \beta_7 \ln IPI_{wp} + \beta_8 \ln IPI_{fur} + \beta_9 \ln ERI + u_i \quad (2)$$

Yet due to the stochastic trend, or nonstationarity, at level observed on many of the logarithmic variables, we took the first difference of the above model and all variables at first difference turned out to be stationary based upon the ADF unit root tests. Thus the final model is as follows:

$$\Delta \ln Q_{mt} = \ln \beta_0 + \beta_1 \Delta \ln P_{mt} + \beta_2 \Delta \ln P_{dsl} + \beta_3 \Delta \ln I + \beta_4 \Delta \ln N + \beta_5 \Delta \ln CUR_{wp} + \beta_6 \Delta \ln CUR_{fur} + \beta_7 \Delta \ln IPI_{wp} + \beta_8 \Delta \ln IPI_{fur} + \beta_9 \Delta \ln ERI + \varepsilon_i \quad (3)$$

where delta Δ represents the difference between the values in year t and the value in year $t-1$, ε is the stochastic error term of the first difference model. Lastly, method of ordinary least squares (OLS) was applied for parameter estimation of our proposed model, and Eviews 7 was used for econometric calculations and tests.

Results and Discussion

Model findings: The results of parameter estimation of the proposed econometric model for imported timber demand in Turkey are given in Table 4. Effectively, the model stands to be able to explain more than 96% of the variation in demand for imported timber. Moreover, all of the parameter estimates, except for population parameter, appear to be statistically significant.

As for the individual parameter estimates, price elasticity of demand for imported timber is found to be negative, as it was expected, with an absolute value of 1.282. This proves conformity of imported timber demand to the law of demand. Moreover, the hypothesized substitution relationship (cross-elasticity) of imported timber with the domestically-produced sawlog turns out to hold in view of the positive parameter estimate of domestic sawlog price (1.416).

Parameter estimate of income variable appears to have negative sign, which is contrary to our expectation. However, this estimated parameter has a very low absolute value (0.07) notwithstanding its statistical significance. In view of these findings, considerable effect of income on demand for imported timber can hardly be deemed substantive. Meanwhile, estimated parameter for population variable turns out to have no statistical significance, hence the hypothesized relationship between country population and imported timber demand is not substantiated by the results.

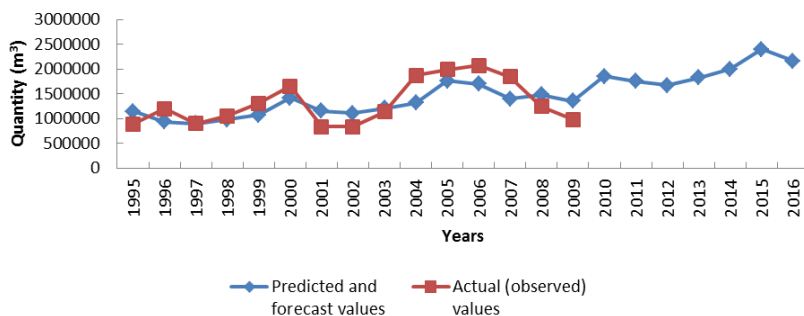
In accord with the expectation, forest industry capacity utilization rates and industrial production indices appear to hold positive sign of parameter estimates, with an exception of CUR of wood

products. Nevertheless the parameters have extremely small in absolute value. Even the highest of CUR and IPI parameters, CUR of furniture sector, implies that a one percent increase in capacity utilization rate of furniture industry can stimulate imported timber demand merely by one twentieth of one percent! The virtually lacking relationship of imported timber demand with forest industry CUR's and IPI's is admittedly intriguing. This situation may

Table 4. Results of parameter estimation as to the Turkish national demand for imported timber (Harmonised System code 4403).

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.321443	46.10097	-0.028664	0.9785
$\Delta \ln P_{mt}$	-1.282141***	0.190550	-6.728628	0.0025
$\Delta \ln P_{dsl}$	1.416260**	0.445005	3.182570	0.0335
$\Delta \ln I$	-0.074442**	0.023260	-3.200466	0.0329
$\Delta \ln N$	0.925372	4.194702	0.220605	0.8362
ΔCUR_{wp}	-0.013525*	0.005867	-2.305283	0.0825
ΔCUR_{fur}	0.020422**	0.004919	4.151527	0.0142
ΔIPI_{wp}	0.010768**	0.003201	3.364258	0.0282
ΔIPI_{fur}	0.003176*	0.001429	2.222811	0.0903
ΔERI	-0.018538*	0.007486	-2.476498	0.0685
R-squared	0.989383	Mean dependent var	7.109968	
Adjusted R-squared	0.965493	S.D. dependent var	0.334313	
S.E. of regression	0.062102	Sum squared resid	0.015426	
F-statistic	41.41554	Prob. (F-statistic)	0.001361	
Serial Correlation LM Test		F statistic: 1.5594 (Prob. 0.3907)		
Breusch-Pagan-Godfrey		F statistic: 2.3499 (Prob. 0.2131)		

Note 1: The symbols *, ** and *** represent the significance levels of 0.10, 0.05 and 0.01, respectively.
 Note 2: Optimal lag length was selected as 2 in serial correlation LM test.



evidenced empirically by the findings of this research.

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Figure 1. Actual, predicted and forecast national demand for imported timber (HS-4403).

defensibly be attributed to the scope of CUR and IPI in Turkey which are based upon surveys on workplaces employing 20 or more persons. Nonetheless employment of less than 20 persons among forest industry firms being mostly small or medium sized enterprises is known to be far from rarity.

Forecasts: Fig. 1 shows the graphical representation of forecasts and (backward) predictions juxtaposed with actually observed levels of timber import. By and large, backward prediction by our model appears to be in accord with the actually observed demand pattern. For instance, national economic crisis and devaluation in 2001 as well as global economic crisis in 2009 appear to be fairly reflected by the backward prediction.

Notwithstanding fluctuations to some extent, Turkish demand for imported timber can be said to have shown somewhat upward trend on the whole. In fact, level of annual timber import that was observed to be below 1 million cubic meters in 1995 had topped 2 million cubic meters just before the 2009 crisis. Our model forecasts, *ceteris paribus*, that this demand level can be expected to exceed 2 million m³/year again by 2016.

Conclusions

This paper can be perceived a primary attempt towards understanding and explaining determinants of Turkish demand for imported timber. The econometric model propounded herein stands to hold a high explanatory power which, in turn, confirms the demand forecasts made thereby.

As the first conclusion, Turkish demand for imported timber (industrial roundwood) is mostly determined by the import price as well as domestically-produced sawlog. In other words, the demand in question is price-elastic and has substitution cross-elasticity with domestic sawlog. Intriguingly, cross elasticity of the demand stands to be somewhat higher than its price elasticity, which may imply that the Turkish firms importing timber tend to consider domestic sawlog prices as much as, even more than, the cost of foreign timber.

We cannot assert that the effects of production changes in wood products and furniture industries on imported timber demand do not seem to be noteworthy in this study. As discussed in the previous section, this is partly due to current method of measuring capacity utilization rates (CUR's) and industrial production indices (IPI's). Researchers may be able to show more concrete and significant relationship of timber with forestry industries' productive capacities when a small and medium sized enterprises are included in a more inclusive measurement of CUR's and IPI's. Finally, possible effects of income, population and exchange rate index of the Turkish currency on the imported timber demand of the country are not

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