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Econometric modeling and projection of production, import and export of particle board industry in Turkey

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Although wood is one of the oldest materials used by humans, the production of wood-based panel products has a very short history. The production of panel products constitutes one of the most important developments in forest products industry. In this study, models are established and projections are developed for production, import and export of Turkish Particle board industry by econometric method. As a result of regression analysis performed, it is seen that the Particle board production above 2.5,000,000 m³ in 2006 shall exceed 4.5,000,000 m³ in 2021 and the export of around 175000 m³ shall exceed 250,000 m³ and import of 175,000 m³ shall reach 350000 m³.

Key words: Particle board trade, production, import, export, regression analysis.

INTRODUCTION

The first particle board plant was established in Istanbul in 1955 and the second one was integrated in a plant in Halkali in 1960. In 1972 another plant was built in Isparta for manufacturing three layer particle board from pine chips. From 1970, the building sector grew very rapidly and furniture demand increased significantly resulting in rapid developments in particle board industry and in 1982 the number of plants reached 27 and the production level was 1,600,000 m³. In 1993, the number of plants was 28 having annual capacity of 2,000,000 m³. In the later years as parallel to developments in the world, particle board industry in Turkey grew rapidly having 30 plants and 2,500,000 m³ annual capacities.

Four of the plants were previously owned by the state and they were privatized. The majority of the plants were using standard horizontal press method. These facilities were established according to Siempelkamp, Bison Böhre, Fahrni and Pagnomi machinery and systems. In addition, there is one plant established based on vertical extrusion machinery and system of OKAL type (DPT, 1995). In Turkey, there is also one OKAL type particle board plant, two particle-cement board plants and others

produce standard platen type particleboard. Almost all of the production is sold domestically. The major consumers are furniture manufacturers (70%), decorators (15%) and others (Akbulut, 2000).

In 1997, construction business was boomed and particle board production reached 1.7 million m³. But for 1998 and 1999 the demand for particle board decreased. Domestic sales were raised by 20% in 2000. Twenty-four percent of the export for the same year was carried out to Bulgaria, 17% to Macedonia, 15% to Northern Cyprus and 11% to Georgia. 55% of the total exported particleboards were laminated type (Yaman, 2002).

Particle board industry in Turkey has shown significant improvements in recent years, in parallel with the development and growth of especially the furniture industry. This development has been seen as improvement of much of the existing investments product structure in the form of expansion to bring new features in the sector rather than the formation of new investments. Presenting laminated particle board instead of similar products like medium density fiberboard (MDF) on the market brought significant ease of use for small and medium-sized businesses (Koc and Aksu, 1999).

As it can be seen in Table 1 and Figure 1, the average particle board production between the years of 1982 to 1983 was about 330,000 m³, between 1984 and 1991 it

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Table 1. The production, export and import amounts of Particle board panels in Turkey (m³) (FAO, 2008).

Year	Production	Export	Import	Year	Production	Export	Import
1982	330000	0	0	1995	1243000	51000	44000
1983	330000	0	0	1996	1193000	30000	17000
1984	546000	0	0	1997	1728000	31000	25000
1985	636000	0	0	1998	1525000	27000	19000
1986	636000	0	0	1999	1643000	30000	14000
1987	636000	0	0	2000	1884000	32000	219000
1988	636000	0	0	2001	1664000	64000	33000
1989	636000	0	0	2002	1999000	99000	77000
1990	636000	0	0	2003	2264000	111800	156000
1991	636000	0	0	2004	2700000	172419	272791
1992	947000	10954	10839	2005	2890000	284227	270736
1993	883000	3000	44300	2006	2750000	178000	179000
1994	898000	32600	64000				
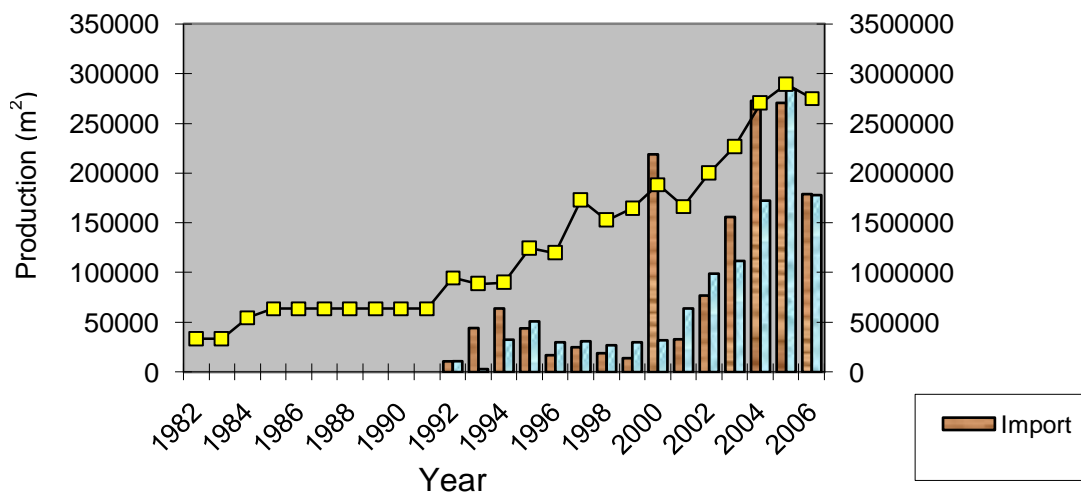
Figure 1. The production, export and import amounts of particle board panels in Turkey.

was 625,000 m³, between 1992 and 1994 it was 910,000 m³, between 1995 and 2001 it was 1,555,000 m³, in 2002 it was 2,000,000 m³ and 2003 to 2006 it was 2,650,000 m³. Exports began in 1992, and remained until year 2000 as 27,500 m³/year. In 2001, it was around 64,000 m³, from 2002 to 2003 it was 105,000 m³ and from 2004 to 2006 it was approximately 210,000 m³. In the same way, the average of 1992 to 1999 years imports was around 30,000 m³. In 2000 it went up to 219,000 m³ and in 2001 it fell to 33,000 m³. In 2003, it increased again and reached to 156,000 m³. Since 2004, import was, on average, 240,000 m³.

On the other hand, in 1982 particle board production amount was 330,000 m³ as the minimum, in 1992, there was an increase of 187% (2.87-fold) to 947,000 m³, 1,243,000 m³ in 1995, 82% (1.82-fold) increase in 2003 to 2,264,000 m³, and 21.5% increase in 2006 when reached 2,750,000 m³.

Exports started in 1992 as 10,954 m³, and in 2003, it was 111,800 m3 with 920% increase. In 2005, it reached 284,227 m³ with 154% (2.54-fold) increase. However, in 2006 the amount of export was realized as 178,000 m³ compared to 284,227 m³ in 2005 meaning 37.37% of decline. Similarly, in 1992, the amount of imports was 10,839 m³. In 2000, there was 1920% or about 20-fold increase as 219,000 m³. In 2003, it then decreased by 29%, or to 156,000 m³. The amount of imports increased to 272,791 m³ in 2004, and fell again in 2006; it was declined to 179,000 m³ (about 34.4%).

MATERIALS AND METHODS

Model building and regression analysis

Basic econometric method used in this study is multiple regression modeling. By applying this method in the present study, the aim is

Table 2. Population, GNP and GDP of Turkey (TUIK, 2008).

Year	Population (000)	Per capita (TL)	GNP ($)	Per capita (TL)	GDP ($)	Year	Population (000)	Per capita (TL)	GNP ($)	Per capita (TL)	GDP ($)
1982	46,688	227,293	1,375	224,730	1,360	1995	61,644	127,423,385	2,759	125,923,952	2,727
1983	47,864	291,096	1,264	290,528	1,261	1996	62,697	238,896,076	2,928	235,611,117	2,888
1984	49,070	451,758	1,204	448,281	1,195	1997	62,480	470,442,977	3,079	461,522,054	3,021
1985	50,306	702,706	1,330	697,640	1,320	1998	63,459	843,358,573	3,255	822,976,986	3,176
1986	51,433	995,174	1,462	993,124	1,459	1999	64,345	1,216,609,421	2,879	1,203,124,428	2,847
1987	52,561	1,427,282	1,636	1,421,623	1,629	2000	67,461	1,861,759,072	2,965	1,846,747,873	2,941
1988	53,715	2,404,824	1,684	2,405,743	1,685	2001	68,618	2,571,977,513	2,123	2,600,082,172	2,146
1989	54,893	4,196,709	1,959	4,141,220	1,933	2002	69,626	3,950,138,827	2,598	3,986,643,746	2,622
1990	56,203	7,066,839	2,682	6,993,580	2,655	2003	70,712	5,044,135,199	3,383	5,087,720,980	3,412
1991	57,305	11,070,462	2,621	10,995,846	2,603	2004	71,789	5,974,903,440	4,172	5,996,900,319	4,187
1992	58,401	18,897,021	2,708	18,721,735	2,682	2005	72,065	6,749,476,615	5,008	6,760,596,160	5,016
1993	59,491	33,573,525	3,004	33,313,730	2,981	2006	72,974	7,890,261,766	5,477	7,897,637,938	5,482
1994	60,576	64,182,233	2,184	63,860,757	2,173						

to show relationship of one dependant variable and multiple independent (explanatory) variables over some certain past period and, accordingly, to make projections on present and future quantity of a dependant variable at an acceptable confidence level.

For establishment of the most appropriate regression models for the projection operations, wherein the particle board production, import and export were dependant variables, and the industrial wood sales (m^3) from general directorate of forestry (OGM), gross national product per capita (TL and USD, separately), population, number of buildings by area (m^2) as per the occupancy permit; number of buildings constructed as per the occupancy permit, inflation rate (on annual consumer price index (CPI) and producer price index (PPI) basis), exchange rates (USD), economic growth rate, construction materials price index, gross domestic product (GDP) per capita, timber sales (m^3) by general directorate of forestry (TL and USD, separately) were used as independent variables, all of which are considered to be effective in the production, import and export quantities of the forest industry products. Parameters of the econometric modeling rest on time series of past 25-years and projection was made for the next 15 years around on basis of a variety of reasonable assumption and scenarios.

The data in question were obtained either by direct access to or via websites of Turkish Statistics Institute (TÜİK), Undersecretariat of Foreign Trade (DTM, 2008), state planning organization (DPT 2006), Export Development Center, Ministry of Industry and Trade (IGEME, 2008), World Food and Agricultural Organization (FAO), Forest Stewardship Council (FSC, 2008), and Turkish General Directorate of Forestry (OGM, 2008). Furthermore, some informations and documents of the organizations operating in the sector, the records of Turkish Association of Chambers and Exchanges (TOBB, 2001, 2007) and particle board Industrialists Society and websites of the organizations and enterprises having direct or indirect relation to the subject of the study were all used.

Twenty-five years (1982 to 2006) data on the aforementioned independent and dependant variables are organized in independent variables (Tables 2 to 4) and transferred to the computer environment for multiple regression analysis to be conducted at SPSS statistical package program. Information about calculations made for missing or unavailable data are given under the tables. It is seen that export and import figures for the years 1982 to 1991 given in Table 1 are zero. This situation does not mean that no data was found for the said years, but shows the real status. In other words, zero values for some years show that import and export of

Turkey was taken as zero as they are actually or very small or negligible level.

Furthermore, the economic growth rate (%), one of the independent variables given in Tables 2 and 4 has caused some difficulties with the fixed prices and gross national product (GNP) per capita (TL) in all models. It was considered that the reason is that both it causes multiple linear connection when the economic growth rate (%) that may replace these variables is used together with current prices and GNP per capita ($) and it is expressed by very high figures, thus the coefficients in the equations appear as zero. Consequently, when searching appropriate model, the said variables were not used together, but individually and the significant and valid variable out of them has taken its place in the model.

RESULTS AND DISCUSSION

After building the most appropriate regression models for projection (3 distinct models for particle board production, import and export), forecast values for independent variables applicable for each model for the next 15 years were obtained (year) based on the time series and projection values were calculated on basis of these figures.

Regression analysis results of particle board industry (production-import-export)

Particle board production

As it may be seen in the summary Table 5 given that both regression models, one built with one independent variable (Population), and the other with two independent variables (Population and CPI) are valid and significant, that is, usable for projections. The reason is that it indicates that the coefficient of determination r^2 is quite high in both regression models and F statistical values are significant when the models are valid or when the relationship between the dependant variable and

Table 3. The industrial wood and log sales by General Directorate of Forestry, number of buildings by area and number of buildings constructed as per the occupancy permit and exchange rates ($) of Turkey (OGM, 2008; TUIK, 2008).

Year	Log (000 m³)	Industrial Wood (000m³)	Buildings Number of building	Permits Area	Annual Exchange rates ($)	Year	Log (000m³)	Industrial Wood (000m³)	Buildings Number of building	Permits Area	Annual Exchange rates ($)
1982	4,066	5,821	*45,995	22,945,123	164.07	1995	3,578	8,046	137,905	83,956,863	46,558.58
1983	3,945	6,665	58,968	25,554,984	228.14	1996	3,172	7,528	126,722	78,477,686	83,043.91
1984	4,078	7,596	63,153	28,887,793	369.75	1997	2,845	6,974	126,956	83,388,824	165,170.83
1985	3,892	7,407	71,844	37,251,360	522.91	1998	2,817	7,051	116,235	78,568,789	264,183.08
1986	3,746	7,570	102,888	55,624,440	676.56	1999	2,833	7,066	92,469	62,761,914	427,202.08
1987	3,687	7,251	138,155	70,912,137	866.08	2000	3,007	7,329	79,140	61,694,941	628,804.5
1988	3,572	7,447	139,995	67,861,304	1,448.46	2001	2,738	6,778	77,430	57,449,494	1,245,609.58
1989	3,393	7,460	136,015	62,923,939	2,137.81	2002	3,297	8,005	47,242	36,187,021	1,517,018.41
1990	3,310	6,581	123,304	60,083,035	2,634.47	2003	2,827	7,320	53,843	45,516,030	1,493,827.91
1991	3,159	6,513	121,486	61,447,817	4,264.53	2004	3,065	8,253	75,495	69,719,611	1,421,467.33
1992	3,353	6,897	137,990	73,062,016	6,994.97	2005	2,936	8,100	114,254	106,424,587	**1,344,966.66
1993	3,199	7,010	147,033	85,080,806	11,193.6	2006	3,480	9,299	114,204	122,909,886	**1,433,958.33
1994	2,939	6,712	143,281	81,715,801	30,266.88						

*The calculation is based on 22% being the average of three year increase on the number of buildings. **, The US$ and Turkish Lira exchange rates were ignored for 2005-2006 US$ rates.

Table 4. Annual CPI, PPI, economic growth rate and construction materials price index of Turkey (TUIK, 2008).

Year	The base year 1978 CPI (%)	The base year 1981 PPI (%)	Economic growth rate (%) constant prices	Economic growth rate (%) current prices	Construction materials price index (1968=100)
1982	410.29	127.05	0.6	29.0	3882
1983	539.00	165.68	1.7	28.1	5441
1984	799.95	249.13	4.5	55.2	7878
1985	1159.63	356.79	1.7	55.5	12525
1986	1560.98	462.25	4.4	41.6	16916
1987	2167.51	610.40	7.5	43.4	23075
1988	3800.95	1027.30	-0.7	68.5	38744
1989	6447.44	1741.99	-0.6	74.5	62699
1990	10547.15	2741.10	6.8	68.4	91729
1991	17503.32	4260.36	-1.6	56.7	152580
1992	30052.64	7051.58	4.4	70.7	246594
1993	50392.45	11545.97	6.2	77.7	406756
1994	106102.03	25212.55	-7.8	91.2	887488
1995	206323.49	47528.46	6.1	98.5	1511717
1996	366475.34	84934.70	5.3	87.5	2765327
1997	672724.15	153300.04	8.7	96.9	5104892
1998	1225733.19	260825.50	2.3	79.3	8538854
1999	1943577.71	398121.90	-7.4	44.3	12277603
2000	2960721.26	600952.65	1.4	53.0	18851834
2001	4545059.66	998582.63	-11.1	38.1	31567385
2002	6733431.01	1510984.00	6.4	53.6	45494981
2003	8506320.48	1871847.92	4.2	27.7	56359182**
2004	9208409.60	2099693.40	8.2	18.5	63218094**
2005	10136772.60	2260856.62	7.2	13.0	68066921**
2006	11657288.49*	*2599985.11	4.6	16.9	78276959**

, The increase rate of the last three year was found as 15% and 2006 values were calculated according to this rate. **, PPI was calculated according to last four years increase rates (23.88, 12.17, 7.67 and 15%) respectively.

Table 5. Model summary[c].

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.941[a]	0.885	0.880	272344.38004
2	0.973[b]	0.948	0.943	187889.48198

[a], Predictors: (Constant), population. [b], Predictors: (Constant), population and CPI. [c], Dependent variable: particle product.

Table 6. ANOVA[c].

Model		Sum of squares	df	Mean square	F	Sig.
1	Regression	13123024949215.630	1	13123024949215.630		
	Residual	1705943610784.365	23	74171461338.451	176.928	0.000[a]
	Total	14828968559999.990	24			
2	Regression	14052314496387.000	2	7026157248193.500		
	Residual	776654063612.994	22	35302457436.954	199.027	0.000[b]
	Total	14828968559999.990	24			

[a]Predictors: (Constant), population. [b]Predictors: (Constant), population and CPI. [c]Dependent variable: particle product.

Table 7. Coefficients[a].

Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	Std. error	Beta	B	Std. error
1	(Constant)	-4194805.932	414793		-10.113	0.000
	Population	90.774	6.824	0.941	13.301	0.000
2	(Constant)	-2357852.321	458343.61		-5.144	0.000
	Population	56.790	8.126	0.589	6.988	0.000
	CPI	0.090	0.018	0.432	5.131	0.000

[a]Dependent variable: particle product.

independent variable is significant at α=0.05. However, in this case of projection, the regression model with two independent variables (Population and CPI) shall be used. Here, r^2=0.948 is a very high coefficient of determination. This figure indicates that the selected independent variables express the particle board production around 95%, demonstrating that the structure of the linear model is appropriate. Below other results of the regression model such as analysis of variance (analysis of variance) (Table 6), coefficients (Table 7) and dispersion graphic (Figure 2) are given.

As it may be seen from Table 7, regression equation for the particle board production would be as follows (Model 2):

Y = - 2357852.321 + 56.79 POPULATION + 0.090 CPI.

Particle board import

As it may be seen from the summary Table 8, the regression model with one independent variable (CPI) is valid and significant (Table 8). Other ten independent variables included in the model for the regression analysis were not included in the regression equation as a result of the operation. The reason is that here stepwise method was applied in the multiple regression analysis. Consequently, it is seen that with the method eliminating the multiple linear connection (a condition deteriorating the model caused by high correlation among the independent variables), the other independent variables remain outside the model without the variable(s) affecting the particle board import most and overloading the model. As a result, the resulting coefficient of determination r^2 is relatively high, and F statistical values show the model is valid and relationship between the dependant variable and independent variable is significant at significance level of α= 0.05. Here r^2 = 0.615 is a coefficient of determination which can be considered relatively high.

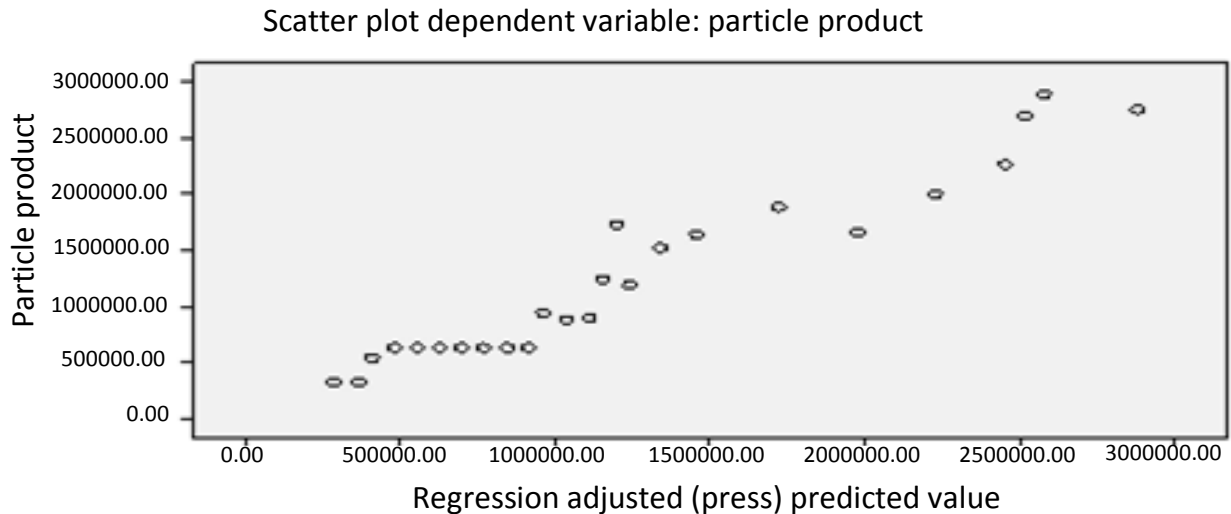Coefficient of correlation (R) of 0.78, as a measure of

Figure 2. The scatter diagram of particle board production.

Table 8. Model summary[b].

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.784[a]	0.615	0.586	61873.57933

[a], Predictors: (Constant), CPI. [b], Dependent variable: Particle import.

Table 9. ANOVA[b].

Model		Sum of squares	df	Mean square	F	Sig.
	Regression	79553455412.729	1	79553455412.729	20.78	0.001[a]
1	Residual	49768417648.204	13	3828339819.093		
	Total	129321873060.933	14			

[a], Predictors: (Constant), CPI. [b], Dependent variable: Particle import.

the linear relationship between the variables, is about the level 0.60 to 0.70 which is recognized in the literature. This figure indicates that the selected independent variable express particle board import around 62% and the structure of the linear model built is suitable. Subsequently, other results of the regression model such as ANOVA (Table 9), coefficients (Table 10) and dispersion graphic (Figure 3) are given. As it may be seen from Table 10, regression equation for the particle board import shall be as follows (Model 1): Y= 26918.227 + 0.018 CPI.

Particle board export

As it may be seen in the Table 11, both regression models, one built with one independent variable (PPI), and the other with two independent variables (PPI and number of building) are valid and significant, that is,

usable for projection. The reason is that it indicates that the coefficient of determination r^2 is quite high in both regression models and F statistical values are significant when the models are valid or when the relationship between the dependant variable and independent variable is significant at $\alpha=0.05$. However, in this case of projection, the regression model with one independent variable (PPI) shall be used.

Due to the fact that determination coefficient was found very low for projections for number of buildings. Therefore, it was excluded from the model. Here, r^2 =0.807 is a relatively high coefficient of determination. This figure indicates that the selected independent variables express the particle board export around 81%, demonstrating that structure of the linear model is appropriate. Subsequently, other results of the regression model such as ANOVA (Table 12), coefficients (Table 13) and dispersion graphic (Figure 4) are given. As it may be seen from Table 13, regression equation for the particle

Table 10. Coefficients[a].

Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	Std. Error	Beta	B	Std. error
1	(Constant)	26918.227	22077.077		1.219	0.244
	CPI	0.018	0.004	0.784	4.559	0.001

[a]Dependent variable: Partıcle ımport.
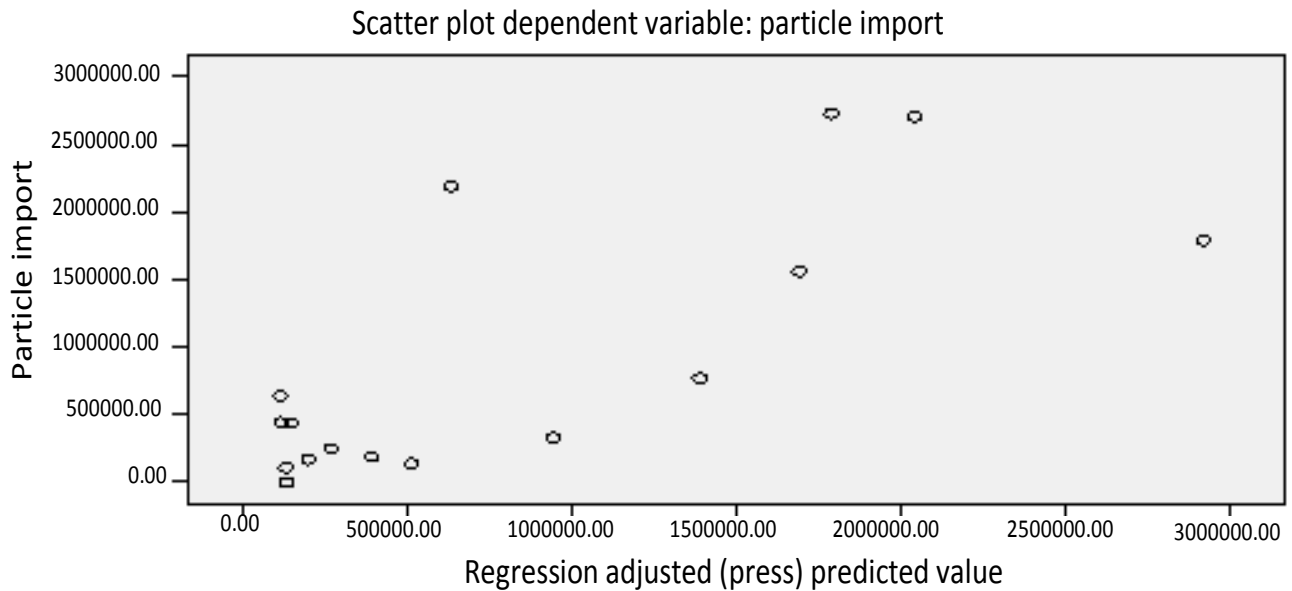
Figure 3. The scatter diagram of particle board import.

Table 11. Model summary[c].

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.898(a)	0.807	0.792	36095.25029
2	0.932(b)	0.869	0.847	30910.49550

[a], Predictors: (Constant), PPI. [b], Predictors: (Constant), PPI and number of buıldıng. [c,] Dependent variable: Partıcle export.

Table 12. ANOVA[c].

Model		Sum of squares	df	Mean square	F	Sig.
1	Regression	70719750322.554	1	70719750322.554	54.280	0.000[a]
	Residual	16937272216.779	13	1302867093.598		
	Total	87657022539.333	14			
2	Regression	76191517753.570	2	38095758876.785	39.872	0.000[b]
	Residual	11465504785.763	12	955458732.147		
	Total	87657022539.333	14			

[a], Predictors: (constant), PPI. [b], Predictors: (Constant), PPI and number of buıldıng. [c], Dependent variable: partıcle export.

Table 13. Coefficients[a].

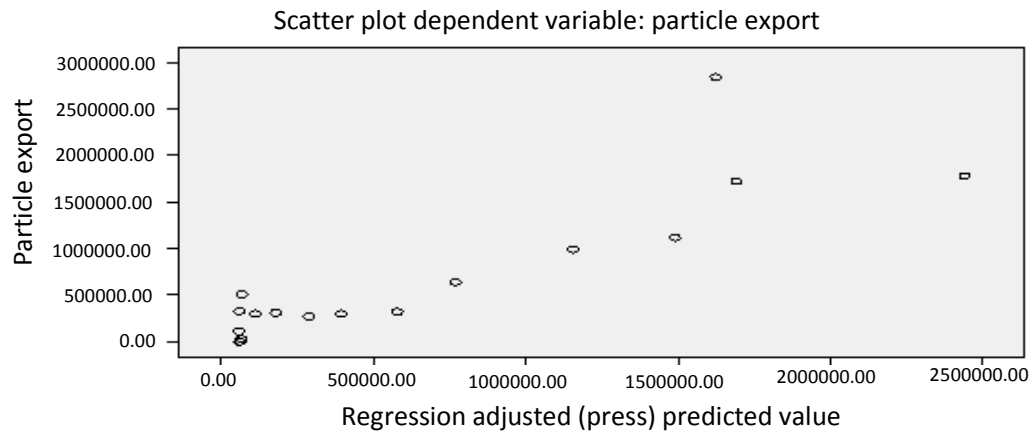| Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	Std. error	Beta	B	Std. error
1	(Constant)	12386.331	12809.764		.967	0.351
	PPI	0.075	0.010	0.898	7.368	0.000
2	(Constant)	-78442.205	39508.070		-1.985	0.070
	PPI	0.090	0.011	1.074	8.414	0.000
	Numberbuild	0.737	0.308	0.305	2.393	0.034

[a], Dependent variable: particle export.

Figure 4. The scatter diagram of particle board export.

Table 14. The estimated values of the independent variables between the years 2007 and 2021 (population, OGM wood sales, foreign exchange).

Year	Population (00) person	OGM wood sales (m^3)	Foreign exchange (USD$)	Year	Population (00) person	OGM wood sales (m^3)	Foreign exchange (USD$)
2007	74,609.64	7,970.756	1,286,324.672	2015	83,443.24	8,379.124	1,828,467.128
2008	75,713.84	8,021.802	1,354,092.479	2016	84,547.44	8,430.170	1,896,234.935
2009	76,818.04	8,072.848	1,421,860.286	2017	85,651.64	8,481.216	1,964,002.742
2010	77,922.24	8,123.894	1,489,628.093	2018	86,755.84	8,532.262	2,031,770.549
2011	79,026.44	8,174.940	1,557,395.900	2019	87,860.04	8,583.308	2,099,538.356
2012	80,130.64	8,225.986	1,625,163.707	2020	88,964.24	8,634.354	2,167,306.163
2013	81,234.84	8,277.032	1,692,931.514	2021	90,068.44	8,685.400	2,235,073.970
2014	82,339.04	8,328.078	1,760,699.321				

board export shall be as follows (Model 1):

Y= 12386,331 + 0.075 PPI.

Calculation of the estimated value of the independent variables in the projection models

In the estimated values of the independent variables

(Tables 14 to 17), the independent variables of Population, OGM wood sales, foreign exchange, CPI, PPI, price index, building area, number of buildings, GNP and economic growth are projected by years (x), using the data for the period of 1982 to 2006 by help of regression analysis. For the said projection, the following regression equations were found and these equations were used for the calculations (Table 18).

Table 15. The estimated values of the independent variables between the years of 2007-2021 (CPI, PPI, construction materials price index).

Year	CPI	PPI	Construction materials price index	Year	CPI	PPI	Construction materials price index
2007	13,886,464	1,719,991	52,165,111.15	2015	17,214,102	2,459,845	74,568,501.25
2008	14,302,418	1,812,472	54,965,534.91	2016	17,630,057	2,552,327	77,368,925.01
2009	14,718,373	1,904,954	57,765,958.68	2017	18,046,011	2,644,809	80,169,348.77
2010	15,134,328	1,997,436	60,566,382.44	2018	18,461,966	2,737,291	82,969,772.53
2011	15,550,283	2,089,918	63,366,806.20	2019	18,877,921	2,829,773	85,770,196.30
2012	15,966,238	2,182,400	66,167,229.96	2020	19,293,876	2,922,255	88,570,620.06
2013	16,382,192	2,274,882	68,967,653.72	2021	19,709,831	3,014,736	91,371,043.82
2014	16,798,147	2,367,363	71,768,077.49				

Table 16. The estimated values of the independent variables between the years of 2007 to 2021 (building area, number of building, GNP).

Year	Building area	Number of building	GNP	Year	Building area	Number of building	GNP
2007	89,153,950.80	102,594.396	4,301.642	2015	104,130,998.7	101,926.284	5,330.618
2008	91,026,081.78	102,510.882	4,430.264	2016	106,003,129.6	101,842.770	5,459.240
2009	92,898,212.77	102,427.368	4,558.886	2017	107,875,260.6	101,759.256	5,587.862
2010	94,770,343.75	102,343.854	4,687.508	2018	109,747,391.6	101,675.742	5,716.484
2011	96,642,474.73	102,260.340	4,816.130	2019	111,619,522.6	101,592.228	5,845.106
2012	98,514,605.71	102,176.826	4,944.752	2020	113,491,653.6	101,508.714	5,973.728
2013	100,386,736.7	102,093.312	5,073.374	2021	115,363,784.6	101,425.200	6,102.350
2014	102,258,867.7	102,009.798	5,201.996				

Table 17. The estimated values of the independent variables between the years of 2007 to 2021 (economic growth %).

Year	Economic growth (%) (current prices)	Year	Economic growth (%) (current prices)
2007	46.574	2015	41.070
2008	45.886	2016	40.382
2009	45.198	2017	39.694
2010	44.510	2018	39.006
2011	43.822	2019	38.318
2012	43.134	2020	37.630
2013	42.446	2021	36.942
2014	41.758		

Particle board production, export and import projection values in Turkey

In Table 19, Turkish particle board production, export and import projection values are given for the period of 2007 to 2021. These values were obtained by putting in place the estimated values of the valid and significant independent variables build for these equations for the period between 2007 to 2021 in the equation found as a result of regression analysis conducted for the particle board production, export and import values previously for

the period of 1982 to 2006. In the projection, the regression models were used and the results are shown in Table 19.

CONCLUSION AND RECOMMENDATIONS

There are more than 30 particle board plants having total annual production capacity close to 3 million m^3, each with average capacity around 75 thousands m^3 and capacity usage rate around 80%. Production in 1980,

Table 18. Regression equations used for the estimation of the independent variables.

$Y_{Population} = -2141520 + 1104.200.x$ $(r^2 = 0.99)$	$Y_{CPI} = -820934779 + 415954.780.x$ $(r^2 = 0.66)$
$Y_{OGM} = -94479 + 51.046.x$ $(r^2 = 0.29)$	$Y_{PPI} = -183891069 + 92481.844.x$ $(r^2 = 0.66)$
$Y_{Pricet\ Indx} = -5568285378 + 2800423.762.x$ $(r^2 = 0.66)$	$Y_{E.Growth} = 1428 - 0.688.x$ $(r^2 = 0.04)$
$Y_{B.Area} = -3668212931 + 1872130.982.x$ $(r^2 = 0.33)$	$Y_{GNP} = -253843 + 128.622.\ x$ $(r^2 = 0.74)$
$Y_{Number\ Build.} = 270207 - 84.x$ $(r^2 = 0)$	$Y_{Foreign\ exch.} = -134723663 + 67767.807.x$ $(r^2 = 0.7)$

Table 19. Particle board production, export and import projection values in Turkey (m^3).

Year	Production	Export	Import	Year	Production	Export	Import
2007	3,129,011	141,386	276,875	2015	3,930,158	196,875	336,772
2008	3,229,154	148,322	284,361	2016	4,030,302	203,811	344,259
2009	3,329,298	155,258	291,849	2017	4,130,445	210,747	351,746
2010	3,429,441	162,194	299,336	2018	4,230,589	217,683	359,234
2011	3,529,585	169,130	306,823	2019	4,330,732	224,619	366,721
2012	3,629,728	176,066	314,311	2020	4,430,876	231,555	374,208
2013	3,729,872	183,002	321,798	2021	4,531,019	238,492	381,695
2014	3,830,015	189,939	329,285				

around 300 thousands m^3, increased to 600 thousands m^3 between the years 1985 to 1990 and to around 900 thousands m^3 between the years 1990 to 1995, with an average increase of 300 thousands m^3 for each five years, resulting to 2 million 740 thousands m^3 in recent years. Although no significant difference is seen between import and export in the Turkish Particle board foreign trade, the import seems more weighted. Import and export quantities have realized above 150 thousands m^3 by 2003.

In this study, made for the said purposes, the following results were obtained and evaluations made: In the regression analyses performed for projection of particle board production, import and export, the nine independent variables used include round timber and industrial wood sales by the general directorate of forestry (m^3), gross national product per capita (thousand person), building area as per the occupancy permit (m^2), inflation rate, exchange rates, population, economic growth and construction materials price index.

All possible models for particle board production, import and export projections and their combinations were tried and the most appropriate regression models were searched and thus regression models were formed. As period up to the year 2021 was target in the projection of particle board production, import and export quantities made, the estimated values of the independent variables significant and valid for the models built ware calculated by a separate regression analysis, proceeding to the projection operation.

As a result of different regression model trials, the independent variables of population and CPI have provided sufficient explanation $(r^2 = 0.948)$ for the particle board production and were used as an estimation tool for the projection of particle board production.

Similar operations in the particle board import and export projection were performed by using same data and changes in the period. It is seen from the results of the regression analysis that CPI by itself as a significant and independent variable provides explanation $(r^2 = 0.615)$ for import, and that the variable PPI in the particle board export projection provide explanation as significant variable $(r^2 = 0.807)$ and can be used as projection tool for export.

When examining the particle board production, export and import estimated figures, the following results appear: From the regression analysis, it is seen that the particle board production above 2.5 million m^3 in 2006 shall exceed 4.5 million m^3 in 2021 and the export of around 175 thousands m^3 shall exceed 230 thousands m^3 and import of 175 thousand m^3 shall reach to 380 thousands m^3.

That the foreign trade enjoys an important place in the industrialization policies shows the need to develop particle board industry and give important to this sector. For this reason, it has become very important to examine changes to occur in the production and foreign trade structure of particle board industry in Turkey over time, determine short and long term development, strategy and policies for the particle board industry and perform realistic projections about production-import-export in future and hence this study has been a very new, important and comprehensive one in filing the gap of search mentioned above with the production, import and export projections for the particle board industry with a confidence level and acceptable error extent. By this

study, the relations explaining production and foreign trade of the particle board industry in Turkey have been set forth and projection data were obtained by scientific data.

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