



## A regression analysis of fiberboard production, import and export amounts in Turkey, with projections to 2021

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**Abstract:** That the foreign trade enjoys an important place in the industrialization policies shows the need to develop fiberboard 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 fiberboard industry in Turkey over time. And hence in this study, models are established and projections are developed for production, import and export of Turkish fiberboard industry by econometric method. As a result of regression analysis performed, it is seen that fiberboard production of 2 million m<sup>3</sup> in 2006 shall increase 1.5 times in the year 2021, reaching to 3.4 million m<sup>3</sup>, and the fiberboard export around 200 thousands m<sup>3</sup> in 2004-2006 shall reach to 330 thousands m<sup>3</sup> and import of 500 thousands m<sup>3</sup> to 900 m<sup>3</sup> thousands in 2021.

**Keywords:** Fiberboard trade, Production, Import, Export, Regression analysis

## Türkiye’de liflevha üretimi, ithalat ve ihracat değerlerine ilişkin regresyon analizi ve 2021 yılına kadar tahmini

**Özet:** Sanayileşme politikalarında dış ticaretin önemli bir yerinin olması liflevha endüstrisinin geliştirilmesini ve bu sektöre önem verilmesi gereğini ortaya koymaktadır. Bu nedenle, Türkiye’nin liflevha endüstri üretim ve dış ticaret yapısının zaman içinde meydana gelecek değişmelerinin incelenmesi son derece önemli duruma gelmiştir. Bu çalışmada, Türkiye liflevha endüstrisinin üretim, ithalat ve ihracatının ekonometrik yöntemle modelleri kurulmuş ve tahminleri geliştirilmiştir. Yapılan regresyon analizi sonucunda 2006 yılı itibarıyla 2 milyon m<sup>3</sup> olan liflevha üretiminin 2021 yılında yaklaşık 1,5 kat artarak 3,4 milyon m<sup>3</sup> olacağı, 2004-2006 yıllarında yaklaşık 200 bin m<sup>3</sup> olan liflevha ihracatının ise 330 bin m<sup>3</sup>’e, 500 bin m<sup>3</sup> olan ithalatın ise 2021 yılında 900 bin m<sup>3</sup>’e ulaşacağı görülmektedir.

**Anahtar kelimeler:** Liflevha ticaret, Üretim, İthalat, İhracat, Regresyon analizi

### 1. Introduction

The first fiberboard plant was established in Izmir, Turkey in 1968. After that Sumerbank Istanbul and Bolu plants and Artvin ORUS plants making the total production capacity of about 85,000 m<sup>3</sup>/year. From the year of 1995, 4 new MDF plants were established and the total capacity reached to 550,000 m<sup>3</sup>/year. In those years capacity usage ratio was 86%, the share of wood based panels in foreign trade of forest products was 5% in export and 5.8% in import (Tank et al. 1998).

According to 2011 reports, there were 40 plants in operation in terms of board production. And, 24 of them were particleboard and 16 of them were fiberboard manufacturing facilities. The total production capacity of both of these sectors is 9 million m<sup>3</sup> and production amount reached to 5.5 million m<sup>3</sup>. Most of the fiberboard plants are operated by using dry system. Wet system plants are only producing high density fiberboards (HDF), but dry system plants produce both HDF and medium density fiberboards (MDF) (Sakarya and Canli 2011; TOBB 2012).

As it can be seen in Table 1, the average fiberboard production between the years of 1982 to 1991 was about 70,000 m<sup>3</sup>, between 1992 and 1994 it was 100,000 m<sup>3</sup>, between 1995 and 2001 it was 350,000 m<sup>3</sup>, in 2002 it was 600,000 m<sup>3</sup>, 2003-2004 it was 900,000 m<sup>3</sup> and between 2005 and 2006 it was 1,900,000 m<sup>3</sup>. Between the years of 1982 and 1991 import and export values were zero, however it can be understood that foreign trade was started in 1992. The export was around 10,000 m<sup>3</sup> between 1992 and 2000, but it reached to 85,000 m<sup>3</sup> between 2001 and 2002, 175,000 m<sup>3</sup> between 2003 and 2005, and 343,000 m<sup>3</sup> in 2006. The import numbers were higher in comparison for the matching years. It was 40,000 m<sup>3</sup> until 2000 and it was 21,000 between 2000 and 2004, 727,000 m<sup>3</sup> in 2005 and it was down to 549,000 m<sup>3</sup> in 2006.

Table 1 and Fig. 1 shows that the lowest production level was seen between 1982 and 1991 and the highest level was seen in 2006. The production was 70,000 m<sup>3</sup> in 1991 and it was increased by 720% in 1997 reaching to 574,000 m<sup>3</sup>. Similarly, the production level was 810,000 m<sup>3</sup> in 2003 and it was increased by 159.26% in 2006 reaching to 2,100,000 m<sup>3</sup>.

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1415 m<sup>3</sup> export level was the starting point in 1992 when the export began and it was increased by 12,341% (125 times) reaching to 176,049 m<sup>3</sup> and it was increasing up till 2006 and reached to 343,000 m<sup>3</sup>. At the same time the import amount was 20,413 m<sup>3</sup> in 1992 and it was increased by 1242% and reached to 274,000 m<sup>3</sup> in 2000. It was decreased to 88,000 m<sup>3</sup> in 2001. However it was increased again by 726% for the later years reaching 727,000 m<sup>3</sup> in 2005. In 2006 it was decreased by 24.5% down to 549,000 m<sup>3</sup>.

## 2. Materials and methods

### 2.1. Materials

In the study, a 25-years data set between the years of 1982-2006 was used for the variables included in each product and model. The data in question were obtained either by direct access to or via websites of Turkish Statistics Institute (TUIK, 2008), Undersecretariat of Foreign Trade (DTM, 2008), State Planning Organization (DPT, 2008), Export Development Center, Ministry of Industry and Trade (IGEME, 2008), World Agricultural organization (FAO, 2008), Forest Certification Council (FSCC, 2008), and General Directorate of Forestry (OGM, 2008). Furthermore, some information and document of the organizations operating in the sector, the records of Turkish Association of Chambers and Exchanges (TOBB, 2007) and Chipboard Industrialists Society and websites of the organizations and enterprises having direct or indirect relation to the subject of the study were all used.

For establishment of the most appropriate regression models for the projection operations, while the fiberboard production, import and export were dealt with as dependant variables, the industrial wood sales by General Directorate of Forestry (m<sup>3</sup>), gross national product per capita (GNP), population, building area (m<sup>2</sup>) as per occupancy permit, construction materials price index, economic growth, consumer price index (CPI), producer price index (PPI) and foreign exchange 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.

25-years (1982-2006) data on the aforementioned independent and dependant variables are organized in (Tables 2-3-4) 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 1982-1991 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.

### 2.2. Methods

Basic econometric method used in this study is multiple regression modeling. In this method, the aim is 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.

Making the study or building the most appropriate regression models was achieved by using SPSS statistical package program. For this purpose, Stepwise Regression method was used. At first, different number of variables and period combinations as well as the most appropriate variable and period were determined and then different regression models (logarithmic, exponential, quadratic, linear, etc.) were also tried in the selection of the most accurate regression model used in the projection operation. This method was found to be the most appropriate one for the subject of the study in that theoretically it aims at determining the independent variables that may affect Y-dependant variable and selecting from them those that are not interrelated with each other and affect the dependant variable most.

Table 1. The production, export and import amounts of fiberboard panels in Turkey (m<sup>3</sup>; FAO, 2008)

| Years | Production | Export  | Import  |
|-------|------------|---------|---------|
| 1982  | 70,000     | 0       | 0       |
| 1983  | 85,000     | 0       | 0       |
| 1984  | 70,000     | 0       | 0       |
| 1985  | 70,000     | 0       | 0       |
| 1986  | 70,000     | 0       | 0       |
| 1987  | 70,000     | 0       | 0       |
| 1988  | 70,000     | 0       | 0       |
| 1989  | 70,000     | 0       | 0       |
| 1990  | 70,000     | 0       | 0       |
| 1991  | 70,000     | 0       | 0       |
| 1992  | 100,000    | 1,415   | 20,413  |
| 1993  | 95,000     | 1,767   | 16,174  |
| 1994  | 120,000    | 500     | 4,400   |
| 1995  | 131,000    | 2,100   | 16,900  |
| 1996  | 301,000    | 8,200   | 51,000  |
| 1997  | 574,000    | 7,000   | 49,000  |
| 1998  | 357,000    | 10,000  | 83,000  |
| 1999  | 348,000    | 14,000  | 45,000  |
| 2000  | 422,000    | 19,000  | 274,000 |
| 2001  | 386,000    | 82,000  | 88,000  |
| 2002  | 600,000    | 90,000  | 227,000 |
| 2003  | 810,000    | 176,049 | 247,261 |
| 2004  | 1,003,000  | 184,648 | 369,000 |
| 2005  | 1,742,000  | 183,267 | 727,355 |
| 2006  | 2,100,000  | 343,000 | 549,000 |

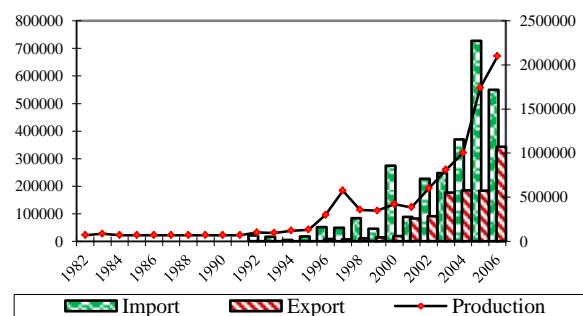


Fig. 1. The production, export and import amounts of fiberboard panels in Turkey

As independent variables with significant effect on Y are included in the model one by one starting from the strongest one, overloading of the model and waste of time shall be eliminated, making the projection calculation more practical.

Calculation results given in the variance table of the regression model were compared with the coefficients of regression equation, statistical values F and t and table values of F and T statistical values at the significance level of  $\alpha=0.05$  and test was performed to find out whether the model is valid and the selected independent variables may be used satisfactorily or not.

### 3. Results and Discussion

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

#### 3.1. Regression analysis results of fiberboard industry (production-import- export)

##### 3.1.1. Fiberboard production

As it may be seen from the summary table (Table 5), all regression models, with one independent variable (CPI), two independent variables (CPI, FOREIGN EXCHANGE \$), three independent (CPI, FOREIGN EXCHANGE \$, BUILDING AREA) and four independent variables (CPI, FOREIGN EXCHANGE \$, BUILDING AREA, NUMBER OF BUILDINGS) are valid and significant, that is, usable for projection. The reason is that it indicates that the coefficient of determination (R Square,  $r^2$ ) is quite high is high in four regression models and F statistical values are significant when the models are valid or when the relationship between the dependant variables and independent variables is significant at  $\alpha = 0.05$ . However, in this case of projection, the regression model with three independent variables (CPI, FOREIGN EXCHANGE \$, BUILDING AREA) shall be used. The reason is that the difference between the  $r^2 = 0.972$  value of the model represented by four independent variables and  $r^2 = 0.951$  value of the model represented by three independent variable is at a negligible level. Another reason is that, use of three independent variables in the projection makes the operation easy. Furthermore here,  $r^2 = 0.951$  is a very high coefficient of determination. This figure indicates that the selected independent variables express the fiberboard production around 95%, demonstrating that structure of the linear model is appropriate. Below other results of the solution, ANOVA (Table 6), Coefficients (Table 7) and dispersion graphic (Fig. 2) of the model are given.

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

| Years | Population | Per Capita    | GNP   | Per Capita    | GDP   |
|-------|------------|---------------|-------|---------------|-------|
|       | (1000)     | TL            | \$    | TL            | \$    |
| 1982  | 46,688     | 227,293       | 1,375 | 224,730       | 1,360 |
| 1983  | 47,864     | 291,096       | 1,264 | 290,528       | 1,261 |
| 1984  | 49,070     | 451,758       | 1,204 | 448,281       | 1,195 |
| 1985  | 50,306     | 702,706       | 1,330 | 697,640       | 1,320 |
| 1986  | 51,433     | 995,174       | 1,462 | 993,124       | 1,459 |
| 1987  | 52,561     | 1,427,282     | 1,636 | 1,421,623     | 1,629 |
| 1988  | 53,715     | 2,404,824     | 1,684 | 2,405,743     | 1,685 |
| 1989  | 54,893     | 4,196,709     | 1,959 | 4,141,220     | 1,933 |
| 1990  | 56,203     | 7,066,839     | 2,682 | 6,993,580     | 2,655 |
| 1991  | 57,305     | 11,070,462    | 2,621 | 10,995,846    | 2,603 |
| 1992  | 58,401     | 18,897,021    | 2,708 | 18,721,735    | 2,682 |
| 1993  | 59,491     | 33,573,525    | 3,004 | 33,313,730    | 2,981 |
| 1994  | 60,576     | 64,182,233    | 2,184 | 63,860,757    | 2,173 |
| 1995  | 61,644     | 127,423,385   | 2,759 | 125,923,952   | 2,727 |
| 1996  | 62,697     | 238,896,076   | 2,928 | 235,611,117   | 2,888 |
| 1997  | 62,480     | 470,442,977   | 3,079 | 461,522,054   | 3,021 |
| 1998  | 63,459     | 843,358,573   | 3,255 | 822,976,986   | 3,176 |
| 1999  | 64,345     | 1,216,609,421 | 2,879 | 1,203,124,428 | 2,847 |
| 2000  | 67,461     | 1,861,759,072 | 2,965 | 1,846,747,873 | 2,941 |
| 2001  | 68,618     | 2,571,977,513 | 2,123 | 2,600,082,172 | 2,146 |
| 2002  | 69,626     | 3,950,138,827 | 2,598 | 3,986,643,746 | 2,622 |
| 2003  | 70,712     | 5,044,135,199 | 3,383 | 5,087,720,980 | 3,412 |
| 2004  | 71,789     | 5,974,903,440 | 4,172 | 5,996,900,319 | 4,187 |
| 2005  | 72,065     | 6,749,476,615 | 5,008 | 6,760,596,160 | 5,016 |
| 2006  | 72,974     | 7,890,261,766 | 5,477 | 7,897,637,938 | 5,482 |

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)

| Years | Log                | Industrial                 | Buildings          | Permits     | Annual              |
|-------|--------------------|----------------------------|--------------------|-------------|---------------------|
|       | 1000m <sup>3</sup> | Wood (1000m <sup>3</sup> ) | Number of building | Area        | Exchange Rates (\$) |
| 1982  | 4,066              | 5,821                      | *45,995            | 22,945,123  | 164.07              |
| 1983  | 3,945              | 6,665                      | 58,968             | 25,554,984  | 228.14              |
| 1984  | 4,078              | 7,596                      | 63,153             | 28,887,793  | 369.75              |
| 1985  | 3,892              | 7,407                      | 71,844             | 37,251,360  | 522.91              |
| 1986  | 3,746              | 7,570                      | 102,888            | 55,624,440  | 676.56              |
| 1987  | 3,687              | 7,251                      | 138,155            | 70,912,137  | 866.08              |
| 1988  | 3,572              | 7,447                      | 139,995            | 67,861,304  | 1,448.46            |
| 1989  | 3,393              | 7,460                      | 136,015            | 62,923,939  | 2,137.81            |
| 1990  | 3,310              | 6,581                      | 123,304            | 60,083,035  | 2,634.47            |
| 1991  | 3,159              | 6,513                      | 121,486            | 61,447,817  | 4,264.53            |
| 1992  | 3,353              | 6,897                      | 137,990            | 73,062,016  | 6,994.97            |
| 1993  | 3,199              | 7,010                      | 147,033            | 85,080,806  | 11,193.6            |
| 1994  | 2,939              | 6,712                      | 143,281            | 81,715,801  | 30,266.88           |
| 1995  | 3,578              | 8,046                      | 137,905            | 83,956,863  | 46,558.58           |
| 1996  | 3,172              | 7,528                      | 126,722            | 78,477,686  | 83,043.91           |
| 1997  | 2,845              | 6,974                      | 126,956            | 83,388,824  | 165,170.83          |
| 1998  | 2,817              | 7,051                      | 116,235            | 78,568,789  | 264,183.08          |
| 1999  | 2,833              | 7,066                      | 92,469             | 62,761,914  | 427,202.08          |
| 2000  | 3,007              | 7,329                      | 79,140             | 61,694,941  | 628,804.5           |
| 2001  | 2,738              | 6,778                      | 77,430             | 57,449,494  | 1,245,609.58        |
| 2002  | 3,297              | 8,005                      | 47,242             | 36,187,021  | 1,517,018.41        |
| 2003  | 2,827              | 7,320                      | 53,843             | 45,516,030  | 1,493,827.91        |
| 2004  | 3,065              | 8,253                      | 75,495             | 69,719,611  | 1,421,467.33        |
| 2005  | 2,936              | 8,100                      | 114,254            | 106,424,587 | **1,344,966.66      |
| 2006  | 3,480              | 9,299                      | 114,204            | 122,909,886 | **1,433,958.33      |

\* 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)

| Years | The base year 1978<br>CPI (%) | The base year 1981<br>PPI (%) | Economic Growth<br>Rate (%)<br>Constant Prices | Economic Growth<br>Rate (%)<br>Current Prices | Construction Materials<br>Price Index<br>(1968=100) |
|-------|-------------------------------|-------------------------------|--|---|---|
| 1982  | 410.29                        | 127.05                        | 0.6  | 29.0  | 3,882   |
| 1983  | 539.00                        | 165.68                        | 1.7  | 28.1  | 5,441   |
| 1984  | 799.95                        | 249.13                        | 4.5  | 55.2  | 7,878   |
| 1985  | 1,159.63                      | 356.79                        | 1.7  | 55.5  | 12,525  |
| 1986  | 1,560.98                      | 462.25                        | 4.4  | 41.6  | 16,916  |
| 1987  | 2,167.51                      | 610.40                        | 7.5  | 43.4  | 23,075  |
| 1988  | 3,800.95                      | 1,027.30                      | -0.7   | 68.5  | 38,744  |
| 1989  | 6,447.44                      | 1,741.99                      | -0.6   | 74.5  | 62,699  |
| 1990  | 10,547.15                     | 2,741.10                      | 6.8  | 68.4  | 91,729  |
| 1991  | 17,503.32                     | 4,260.36                      | -1.6   | 56.7  | 152,580   |
| 1992  | 30,052.64                     | 7,051.58                      | 4.4  | 70.7  | 246,594   |
| 1993  | 50,392.45                     | 11,545.97                     | 6.2  | 77.7  | 406,756   |
| 1994  | 106,102.03                    | 25,212.55                     | -7.8   | 91.2  | 887,488   |
| 1995  | 206,323.49                    | 47,528.46                     | 6.1  | 98.5  | 1,511,717   |
| 1996  | 366,475.34                    | 84,934.70                     | 5.3  | 87.5  | 2,765,327   |
| 1997  | 672,724.15                    | 153,300.04                    | 8.7  | 96.9  | 5,104,892   |
| 1998  | 1,225,733.19                  | 260,825.50                    | 2.3  | 79.3  | 8,538,854   |
| 1999  | 1,943,577.71                  | 398,121.90                    | -7.4   | 44.3  | 12,277,603  |
| 2000  | 2,960,721.26                  | 600,952.65                    | 1.4  | 53.0  | 18,851,834  |
| 2001  | 4545,059.66                   | 998,582.63                    | -11.1  | 38.1  | 31,567,385  |
| 2002  | 6,733,431.01                  | 1,510,984.00                  | 6.4  | 53.6  | 45,494,981  |
| 2003  | 8,506,320.48                  | 1,871,847.92                  | 4.2  | 27.7  | **56,359,182  |
| 2004  | 9,208,409.60                  | 2,099,693.40                  | 8.2  | 18.5  | **63,218,094  |
| 2005  | 10,136,772.60                 | 2,260,856.62                  | 7.2  | 13.0  | **68,066,921  |
| 2006  | *11,657,288.49                | *2,599,985.11                 | 4.6  | 16.9  | **78,276,959  |

\*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,%15) respectively.

Table 5. Model summary(e)

| Model | R        | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|----------|----------|-------------------|----------------------------|
| 1     | 0.922(a) | 0.850    | 0.843             | 209,437.59902              |
| 2     | 0.964(b) | 0.929    | 0.923             | 147,035.01392              |
| 3     | 0.975(c) | 0.951    | 0.944             | 125,420.63667              |
| 4     | 0.986(d) | 0.972    | 0.966             | 97,294.804830              |

a Predictors: (Constant), CPI

b Predictors: (Constant), CPI, EXCHANGES

c Predictors: (Constant), CPI, EXCHANGES, BUILDAREA

d Predictors: (Constant), CPI, EXCHANGES, BUILDAREA, NUMBERBUILD

e Dependent Variable: FIBERPRODUCT

Table 6. ANOVA(e)

| Model |            | Sum of Squares        | df | Mean Square           | F       | Sig.     |
|-------|------------|-----------------------|----|-----------------------|---------|----------|
| 1     | Regression | 5,710,682,878,696.730 | 1  | 5,710,682,878,696.730 | 130.190 | 0.000(a) |
|       | Residual   | 1,008,874,481,303.265 | 23 | 43,864,107,882.751    |         |          |
|       | Total      | 6,719,557,360,000.000 | 24 |                       |         |          |
| 2     | Regression | 6,243,932,863,024.130 | 2  | 3,121,966,431,512.065 | 144.406 | 0.000(b) |
|       | Residual   | 475,624,496,975.871   | 22 | 216,19,295,317.085    |         |          |
|       | Total      | 6,719,557,360,000.000 | 24 |                       |         |          |
| 3     | Regression | 6,389,220,301,841.730 | 3  | 2,129,740,100,613.912 | 135.391 | 0.000(c) |
|       | Residual   | 330,337,058,158.267   | 21 | 15,730,336,102.775    |         |          |
|       | Total      | 6,719,557,360,000.000 | 24 |                       |         |          |
| 4     | Regression | 6,530,231,779,051.290 | 4  | 1,632,557,944,762.824 | 172.460 | 0.000(d) |
|       | Residual   | 189,325,580,948.705   | 20 | 9,466,279,047.435     |         |          |
|       | Total      | 6,719,557,360,000.000 | 24 |                       |         |          |

a Predictors: (Constant), CPI

b Predictors: (Constant), CPI, EXCHANGES

c Predictors: (Constant), CPI, EXCHANGES, BUILDAREA

d Predictors: (Constant), CPI, EXCHANGES, BUILDAREA, NUMBERBUILD

e Dependent Variable: FIBERPRODUCT

As it may be seen from the coefficients (a) (Table 7), regression equation for the fiberboard production shall be as follows (model 3)  $Y = 119,108.553 + 0.210 \text{ CONSUMER PRICE INDEX (CPI)} - 0.593 \text{ FOREIGN EXCHANGE \$} + 0,004 \text{ BUILDING AREA}$ .

3.1.2. Fiberboard import

As it may be seen in the summary table (Table 8), both regression models, one built with one independent variable (CPI), and the other with two independent variables (CPI,

GNP\$) are valid and significant, that is, usable for projection. However, in this case of projection, the regression model with two independent variables (CPI, GNP\$) shall be used. Here,  $r^2 = 0.880$  is a very high coefficient of determination. This figure indicates that the selected independent variables express the fiberboard import around 88%, demonstrating that structure of the linear model is appropriate. Below other results of the solution, ANOVA (Table 9), Coefficients (Table 10) and dispersion graphic (Fig. 3) of the model are given.

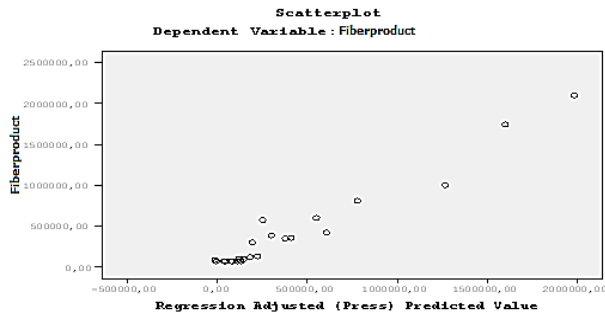


Fig.2. The scatter diagram of fiberboard production

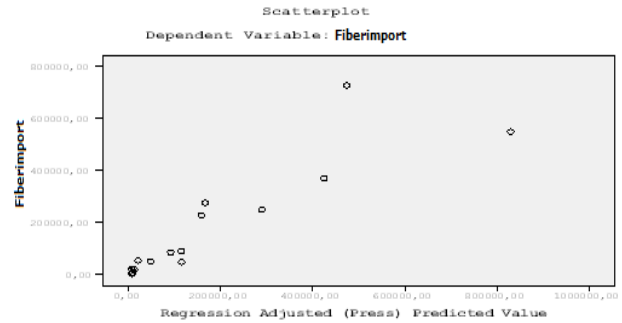


Fig. 3. The scatter diagram of fiberboard import

Table 7. Coefficients(a)

| Model |             | Unstandardized Coefficients |            | Standardized Coefficients |   | t      | Sig.  |
|-------|-------------|-----------------------------|------------|---------------------------|---|--------|-------|
|       |             | B                           | Std. Error | Beta                      | B |        |       |
| 1     | (Constant)  | 89,484.217                  | 49,580.708 |                           |   | 1.805  | 0.084 |
|       | CPI         | 0.130                       | 0.011      | 0.922                     |   | 11.410 | .000  |
| 2     | (Constant)  | 133,123.273                 | 35,899.908 |                           |   | 3.708  | 0.001 |
|       | CPI         | 0.258                       | 0.027      | 1.836                     |   | 9.534  | .000  |
|       | EXCHANGE\$  | -0.848                      | 0.171      | -0.956                    |   | -4.966 | .000  |
| 3     | (Constant)  | -119,108.553                | 88,464.706 |                           |   | -1.346 | 0.193 |
|       | CPI         | 0.210                       | 0.028      | 1.495                     |   | 7.521  | .000  |
|       | EXCHANGE\$  | -0.593                      | 0.168      | -0.669                    |   | -3.529 | 0.002 |
|       | BUILDAREA   | 0.004                       | 0.001      | 0.182                     |   | 3.039  | 0.006 |
| 4     | (Constant)  | 87,188.921                  | 86,986.132 |                           |   | 1.002  | 0.328 |
|       | CPI         | 0.162                       | 0.025      | 1.153                     |   | 6.483  | .000  |
|       | EXCHANGE\$  | -0.559                      | 0.131      | -0.63                     |   | -4.275 | .000  |
|       | BUILDAREA   | 0.014                       | 0.003      | 0.619                     |   | 5.058  | .000  |
|       | NUMBERBUILD | -7.081                      | 1.835      | -0.452                    |   | -3.860 | 0.001 |

<sup>a</sup>Dependent Variable: FIBER PRODUCT.

Table 8. Model summary(c)

| Model | R        | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|----------|----------|-------------------|----------------------------|
| 1     | 0.891(a) | 0.795    | 0.779             | 102,601.59496              |
| 2     | 0.938(b) | 0.880    | 0.860             | 81,604.73207               |

a Predictors: (Constant), CPI,

b Predictors: (Constant), CPI, GNP\$

c Dependent Variable: FIBERIMPORT

Table 9. ANOVA (c)

| Model |            | Sum of Squares      | df | Mean Square         | F      | Sig.     |
|-------|------------|---------------------|----|---------------------|--------|----------|
| 1     | Regression | 529,536,565,249.674 | 1  | 529,536,565,249.674 | 50.302 | 0.000(a) |
|       | Residual   | 136,852,134,740.726 | 13 | 10,527,087,287.748  |        |          |
|       | Total      | 666,388,699,990.400 | 14 |                     |        |          |
| 2     | Regression | 586,476,712,430.898 | 2  | 293,238,356,215.449 | 44.034 | 0.000(b) |
|       | Residual   | 79,911,987,559.502  | 12 | 6,659,332,296.625   |        |          |
|       | Total      | 666,388,699,990.400 | 14 |                     |        |          |

<sup>a</sup>Predictors: (Constant), CPI., <sup>b</sup>Predictors: (Constant), CPI, GNP\$., <sup>c</sup>Dependent Variable: FIBERIMPORT.

As it may be seen from the coefficients (a) (Table 10), regression equation for the fiberboard import shall be as follows (model 2)  $Y = -259,153.982 + 0.028 \text{ CONSUMER PRICE INDEX (CPI)} + 102.962 \text{ GNP\$}$ .

3.1.3. Fiberboard export

As it may be seen in the summary Table 11, both regression models, one built with one independent variable (PPI), and the other with two independent variables (PPI, BUILDING AREA) are valid and significant, that is, usable for projection. The reason is that it indicates that the coefficient of determination (R Square,  $r^2$ ) is quite high is 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  $\alpha=0.05$ . Here,  $r^2 = 0.946$  is a very high coefficient of determination. This figure indicates that the selected independent variables express the fiberboard export around 95%, demonstrating that structure of the linear model is appropriate. Below other results of the solution, ANOVA (Table 12), Coefficients (Table 13) and dispersion graphic (Fig. 4) of the model are given.

As it may be seen from the coefficients (a) Table 13, regression equation for the fiberboard export shall be as follows (model 2)  $Y = -84,828.788 + 0.100 \text{ PPI} + 0.001 \text{ BUILDING AREA}$ .

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

In the estimated values of the independent variables (Tables 14-17), 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 1982-2006 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).

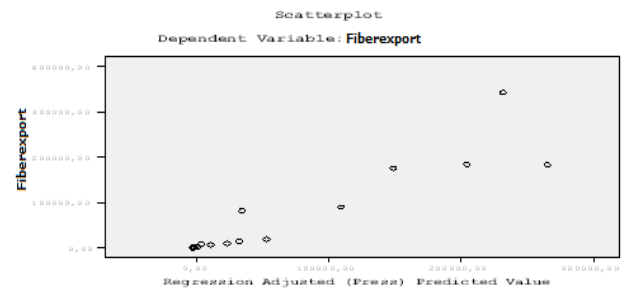


Fig. 4. The scatter diagram of fiberboard export

Table 10. Coefficients (a)

| Model |            | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig.  |
|-------|------------|-----------------------------|------------|---------------------------|--------|-------|
|       |            | B                           | Std. Error | Beta                      |        |       |
| 1     | (Constant) | 5,295.19                    | 36,609.217 |                           | 0.145  | 0.887 |
|       | CPI        | 0.046                       | 0.006      | 0.891                     | 7.092  | .000  |
| 2     | (Constant) | -259,153.98                 | 95,009.21  |                           | -2.728 | 0.018 |
|       | CPI        | 0.028                       | 0.008      | 0.550                     | 3.58   | 0.004 |
|       | GNP\$      | 102.962                     | 35.211     | 0.449                     | 2.924  | 0.013 |

<sup>a</sup>Dependent Variable: FIBERIMPORT.

Table 11. Model Summary(c)

| Model | R        | R Square | Adjusted R Square | Standard Error of the Estimate |
|-------|----------|----------|-------------------|--------------------------------|
| 1     | 0.951(a) | 0.904    | 0.897             | 33,015.51093                   |
| 2     | 0.973(b) | 0.946    | 0.937             | 25,730.61147                   |

a Predictors: (Constant), PPI., b Predictors: (Constant), PPI, BUILDAREA., c Dependent Variable: FIBEREXPORT.,

Table 12. ANOVA(c)

| Model |            | Sum of Squares      | df | Mean Square         | F       | Sig.     |
|-------|------------|---------------------|----|---------------------|---------|----------|
| 1     | Regression | 133,693,459,344.881 | 1  | 133,693,459,344.881 | 122.652 | 0.000(a) |
|       | Residual   | 14,170,311,502.052  | 13 | 1,090,023,961.696   |         |          |
|       | Total      | 147,863,770,846.933 | 14 |                     |         |          |
| 2     | Regression | 139,918,998,446.938 | 2  | 69,959,499,223.469  | 105.669 | 0.000(b) |
|       | Residual   | 7,944,772,399.995   | 12 | 662,064,366.666     |         |          |
|       | Total      | 147,863,770,846.933 | 14 |                     |         |          |

<sup>a</sup>Predictors: (Constant), PPI., <sup>b</sup>Predictors: (Constant), PPI, BUILDAREA., <sup>c</sup>Dependent Variable: FIBEREXPORT.

Table 13. Coefficients(a)

| Model |            | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig.       |
|-------|------------|-----------------------------|------------|---------------------------|--------|------------|
|       |            | B                           | Std. Error | Beta                      | B      | Std. Error |
| 1     | (Constant) | -14,160.376                 | 11,716.802 |                           | -1.209 | 0.248      |
|       | PPI        | 0.103                       | 0.009      | 0.951                     | 11.075 | 0.000      |
| 2     | (Constant) | -84,828.788                 | 24,788.727 |                           | -3.422 | 0.005      |
|       | PPI        | 0.100                       | 0.007      | 0.921                     | 13.616 | 0.000      |
|       | BUILDAREA  | 0.001                       | 0.000      | 0.207                     | 3.066  | 0.010      |

<sup>a</sup>Dependent Variable: FIBER EXPORT.

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

| Years | Population (000)person | OGM Wood Sales (m <sup>3</sup> ) | Foreign Exchange (USD\$) |
|-------|------------------------|----------------------------------|--------------------------|
| 2007  | 74,609.64              | 7,970.756                        | 1,286,324.672            |
| 2008  | 75,713.84              | 8,021.802                        | 1,354,092.479            |
| 2009  | 76,818.04              | 8,072.848                        | 1,421,860.286            |
| 2010  | 77,922.24              | 8,123.894                        | 1,489,628.093            |
| 2011  | 79,026.44              | 8,174.940                        | 1,557,395.900            |
| 2012  | 80,130.64              | 8,225.986                        | 1,625,163.707            |
| 2013  | 81,234.84              | 8,277.032                        | 1,692,931.514            |
| 2014  | 82,339.04              | 8,328.078                        | 1,760,699.321            |
| 2015  | 83,443.24              | 8,379.124                        | 1,828,467.128            |
| 2016  | 84,547.44              | 8,430.170                        | 1,896,234.935            |
| 2017  | 85,651.64              | 8,481.216                        | 1,964,002.742            |
| 2018  | 86,755.84              | 8,532.262                        | 2,031,770.549            |
| 2019  | 87,860.04              | 8,583.308                        | 2,099,538.356            |
| 2020  | 88,964.24              | 8,634.354                        | 2,167,306.163            |
| 2021  | 90,068.44              | 8,685.400                        | 2,235,073.970            |

Table 15. The estimated values of the independent variables between the years of 2007-2021 (CPI, PPI, Price Index)

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

Table 16. The estimated values of the independent variables between the years of 2007-2021 (Building Area, Number of Building, GNP)

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

Table 17. The estimated values of the independent variables between the years of 2007-2021 (Economic Growth %)

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

3.3. Fiberboard production, export and import projection values in Turkey

In Table 19, Turkish fiberboard production, export and import projection values are given for the period of 2007-2021. 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 2007-2021 in the equation found as a result of regression analysis conducted for the fiberboard production, export and import values previously for the period of 1982-2006. In the projection, the following regression models were used with the results below:

For fiberboard production;  $Y = 119,108.553 + 0.210 \text{ CPI} - 0.593 \text{ FOREIGN EXCH.} + 0.004 \text{ BUILD. AREA}$

For fiberboard import;  $Y = -259,153.982 + 0.028 \text{ CPI} + 102.962 \text{ GNPS}$

For fiberboard export;  $Y = -84,828.788 + 0.100 \text{ PPI} + 0.001 \text{ BUILDING AREA}$ ,

3.4. Observed and projected values of fiberboard production, export and import in Turkey

In Figure-5, the projected and observed values of fiberboard production of Turkey between the years of 2007-2013 were presented. The projected and observed values are very close, especially in the 2007-2010 it can be seen that they were very close to real values.

Turkey's projected and observed import figures between the years of 2007-2013 are given in Figure 6. The projected values were determined a little higher than the real values, and the predicted values is almost the same with values realized in 2012 and 2013.



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

|                            |                                      |                            |                                   |
|----------------------------|--------------------------------------|----------------------------|-----------------------------------|
| $Y_{\text{Population}}$    | $= 45,900.440 + 1,104.200.x$         | $Y_{\text{CPI}}$           | $= 3,071,639.325 + 415,954.780.x$ |
| $Y_{\text{OGM}}$           | $= 6,643.560 + 51.046.x$             | $Y_{\text{PPI}}$           | $= -684,537.362 + 92,481.844.x$   |
| $Y_{\text{Pricet Indx}}$   | $= -2E+007 + 2,800,423.762.x$        | $Y_{\text{E.Growth}}$      | $= 64.462 - 0.688.x$              |
| $Y_{\text{B.Area}}$        | $= 40,478,545.270 + 1,872,130.982.x$ | $Y_{\text{GNP}}$           | $= 957.470 + 128.622.x$           |
| $Y_{\text{Number Build.}}$ | $= 104,765.760 - 83.514.x$           | $Y_{\text{Foreign Exch.}}$ | $= -475,638.310 + 67,767.807.x$   |

Table 19. Fiberboard production, export and import projection values in Turkey (m<sup>3</sup>)

| Years | Production | Export  | Import  |
|-------|------------|---------|---------|
| 2007  | 2,629,091  | 176,324 | 572,573 |
| 2008  | 2,683,744  | 187,445 | 597,463 |
| 2009  | 2,738,397  | 198,565 | 622,353 |
| 2010  | 2,793,049  | 209,685 | 647,242 |
| 2011  | 2,847,702  | 220,806 | 672,132 |
| 2012  | 2,902,355  | 231,926 | 697,022 |
| 2013  | 2,957,007  | 243,046 | 721,912 |
| 2014  | 3,011,660  | 254,166 | 746,802 |
| 2015  | 3,066,313  | 265,287 | 771,692 |
| 2016  | 3,120,966  | 276,407 | 796,582 |
| 2017  | 3,175,618  | 287,528 | 821,472 |
| 2018  | 3,230,271  | 298,648 | 846,362 |
| 2019  | 3,284,924  | 309,768 | 871,252 |
| 2020  | 3,339,577  | 320,888 | 896,142 |
| 2021  | 3,394,229  | 332,009 | 921,031 |

According to Turkey's projected and observed export values between the years of 2007-2013 (Figure-7), the observed values were found higher than projected values. This situation proves that Turkey's fiberboard export values have been improved beyond expectations.

#### 4. Conclusion and recommendations

An indispensable part of human life, the forest industrial products occupy a great place in the world economy. Considering that value of the forest industrial products is close to iron-steel, textile and chemical products in the world trade, it is clearly seen how important this industrial branch is. Products produced in the forest products industry and launched to the market are products with which people encounter in all environments of life such as working, resting, etc. in direct interaction. For this reason, in addition to direct contribution of this industrial branch to total production, they have a great number of important, but indirect contributions not possible to express by numbers.

Investments through production of fiberboard production being one of the most important inputs in furniture industry have been growing rapidly in Turkey along with foreign trade (Koç ve Aksu,1999).

In the regression analyses performed for projection of fiberboard production, import and export, the nine independent variables used include round timber and industrial wood sales by the General Directorate of Forestry (m<sup>3</sup>), gross national product per capita (thousand person), building area as per the occupancy permit (m<sup>2</sup>), inflation rate, exchange rates, economic growth and construction materials price index. All possible models for fiberboard production, import and export projections and their combinations were tried and the most appropriate regression models were searched and thus regression models were formed.

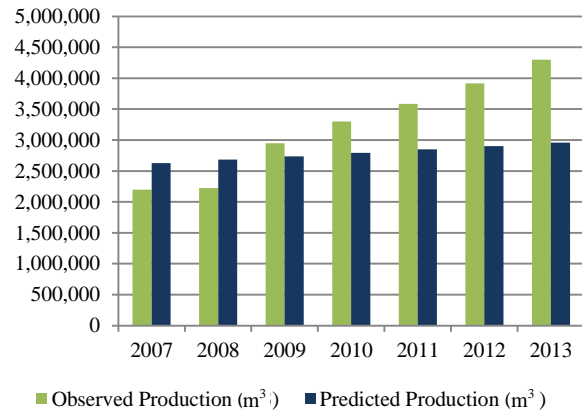


Fig.5. 2007-2013 Observed and projected values of fiberboard production in Turkey

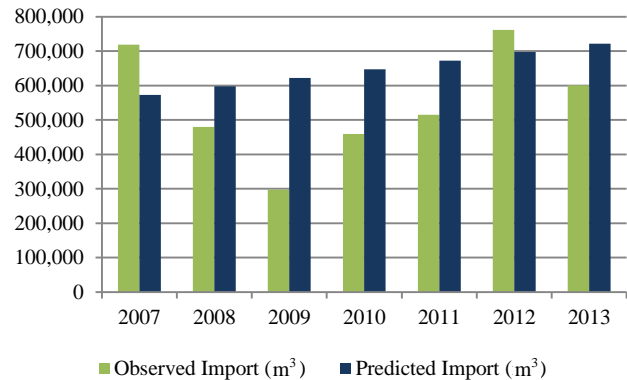


Fig.6. 2007-2013 Observed and projected values of fiberboard import in Turkey

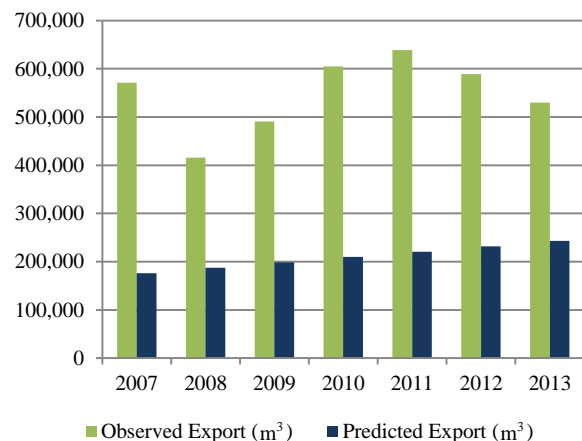


Fig.7. 2007-2013 Observed and projected values of fiberboard export in Turkey



As period up to the year 2021 was target in the projection of fiberboard production, import and export quantities made, the estimated values of the independent variables significant and valid for the models built were calculated by a separate regression analysis, proceeding to the projection operation.

In this study made for the said purposes, the following results were obtained and evaluations made:

As a result of different regression model trials, the independent variables of CPI, Foreign Exchange and Building Area As Per The Occupancy Permit ( $m^2$ ), have provided sufficient explanation ( $r^2 = 0.951$ ) for the fiberboard production and used as estimation tool for the projection of fiberboard production.

Similar operations in the fiberboard import projection were performed by using same data and changes in the period. It is seen from the results of the regression analysis that CPI and GNP as significant and independent variables provides explanation ( $r^2 = 0.880$ ), and that the variables PPI and Building Area As Per The Occupancy Permit ( $m^2$ ) in the fiberboard export projection provide explanation as significant variable ( $r^2 = 0.946$ ) and can be used as projection tool.

When examining the fiberboard export and import estimated figures, the following results appear:

As a result of regression analysis performed, it is seen that fiberboard production of 2 million  $m^3$  in 2006 shall increase 1.5 times in the year 2021, reaching to 3.4 million  $m^3$ ; and the fiberboard export around 200 thousands  $m^3$  in 2004-2006 shall reach to 330 thousands  $m^3$  and import of 500 thousands  $m^3$  to 900  $m^3$  in 2021.

Comparing the actual values and predicted ones belonging to 2013, it can be said that especially production and import values are very close to estimated values. It can be seen that the difference between realized values of production and estimates has gone down to 7.2% for some of the years and for import it was 8.5%. However, the difference in export values was found as 54% as it is very high (FAO 2014). In order to improve the export projections new variables can be determined and different models can be established.

And hence this study has been a very new, important and comprehensive one in filling the gap of search mentioned above with the production, import and export projections for the fiberboard industry with a confidence level and acceptable error extent. By this study, the relations explaining production and foreign trade of the fiberboard industry in Turkey have been set forth and projection data were obtained by scientific data.

## Acknowledgement

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## References

- DTM, 2008. Undersecretariat of The Prime Ministry For Foreign Trade of Turkey, <http://www.dtm.gov.tr/dtmweb/index.cfm>, Accessed: 23.12.2008.
- FAO, 2008. Food and Agriculture Organization of The United Nations, <http://faostat.fao.org/site/626/default.aspx#ancor>, Accessed: 30.11.2008.
- FAO, 2014. Food and Agriculture Organization of The United Nations, <http://faostat.fao.org/site/626/default.aspx#ancor>, Accessed: 10.08.2014.
- FSCC, 2008. Forest Certification Council, <http://www.fsc.org/>, Accessed: 25.11.2008.
- IGEME, 2008. Export Development Center, Ministry of Industry and Trade, <http://www.igeme.org.tr/>, Accessed: 13.11.2008.
- Koç, H., Aksu, B., 1999. Türkiye liflevha dış ticareti. Laminant Mobilya Dekorasyon Sanat Tasarım Dergisi, 3: 82-85.
- OGM, 2008. General Directorate of Forestry, Forestry Statistics, <http://www.ogm.gov.tr/>, Accessed: 29.11.2008.
- Sakarya, S., Canli, Ş., 2011. Orta Anadolu Ağaç Mamulleri ve Orman Ürünleri İhracatçıları Birliği, Levha Sanayi Raporu, 17 s.
- Tank, T., Göker, Y., Kurtoğlu, A., Erdin, N., 1998. Türkiye’de orman ürünleri endüstrisindeki gelişmeler. Cumhuriyetimizin 75. Yılında Ormancılığımız Sempozyumu, Bildiri Kitabı, s. 471-475, İstanbul.
- TOBB, 2007. Union of Chambers and Commodity Exchanges of Turkey, Industry Database, [www.tobb.org.tr](http://www.tobb.org.tr), Accessed: 11.09.2007.
- TOBB, 2012. Union of Chambers and Commodity Exchanges of Turkey, 2011 Turkey Forest Products Sector Council, 49 s.
- TUIK, 2008. Turkish Statistics Institute, <http://www.tuik.gov.tr/VeriBilgi>, Accessed: 30.12.2008.