(REFEREED RESEARCH)

THE PREDICTION OF TURKEY'S DENIM TROUSERS EXPORT TO GERMANY WITH ANN MODELS

YSA MODELLERİYLE TÜRKİYE'NİN ALMANYA'YA DENİM PANTOLON İHRACATININ ÖNGÖRÜLEBİLİRLİĞİ

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ABSTRACT

In this study, Turkey's denim trousers export to Germany was predicted using ANN models. ANN models were composed of the import of denim trousers, the minimum wage, the price of cotton, electricity, and water, the value of TRY against USD, the credit usage of ready-made clothing enterprises, export credits, the real effective exchange rate, brands of denim trousers, the denim trouser Balasa Index, Germany Denim Trousers import, Germany's Quota Application to Turkey, Income Per Capita in Germany, Population in Germany, Unemployment in Germany and Inflation in Germany. It is observed that the best prediction is provided by ELMAN.

Key Words: Artificial neural networks, Prediction, Export, Denim trousers.

ÖZET

Bu çalışmada; Türkiye'nin Almanya'ya denim pantolon ihracatı YSA modelleriyle öngörüldü. YSA modelleri; denim pantolon ithalatı, asgari ücret, pamuk, elektirik ve su fiyatı, TL'nin ABD Doları karşısındaki değeri, hazır giyim sektöründeki kredi kullanımı, ihracat kredileri, reel efektif döviz kuru, denim pantolon markaları, denim pantolon Balasa İndeksi, Almanya'nın denim pantolon ithalatı, Almanya'nın Türkiye'ye kota uygulaması, Almanya'da kişi başına düşen gelir, Almanya nüfusu, Almanya'daki işsizlik ve enflasyondan oluştu. En iyi öngörü performansını ELMAN ağı gerçekleştirmiştir.

Anahtar Kelimeler: Yapay sinir ağları, Öngörü, İhracat, Denim pantolon.

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1. INTRODUCTION

Export, having provider effects on exchange input on the international arena and increasing effects on domestic tax incomes and employment, provides great contributions to the domestic economy; therefore, countries support their export sectors. According to the comparative advantage theory, if a country imports its competitive resources while exporting its non-competitive ones, it could be said that the world's resources are used efficiently and effectively. With its cotton, cotton textile industry and worldwide known denim brands, Turkey is one of the world's most important denim trouser manufacturers. All these characteristics make denim trousers a strategic product for Turkey. Germany is the second biggest denim trousers importer. Germany's denim trousers import directly effects Turkish denim trousers export. Therefore, prediction of Turkey's denim trousers export to Germany can bring lots of benefits, in the form of support for denim trouser manufacturers and exporter merchants, as well as sector on-time investments and the determination of cotton requirements etc.

Koutroumanidis et al. used the Autoregressive Integrated Moving Average (ARIMA), & Artificial Neural Networks (ANN) models as well as a hybrid one (ARIMA-ANN) to predict future prices of fuel wood in Greece. After completing the study, they concluded that the hybrid ARIMA-ANN model can make beter predictions of future prices (1).

In order to estimate the energy demand of South Korea, Geem and Roper used the ANN model, Linear Regression Model, and Exponential Model together with the Gross Domestic Product (GDP), population, and import and export amounts as independent variables. They concluded that with the ANN model the energy demand had been better estimated than the other two methods (2).

Karaali and Ülengin determined factors that affect unemployment using the cognitive mapping method. Using these factors, they forecasted unemployment with ANN (3).

Co and Boosarawongse examined the network architecture of ANN in forecasting rice exports from Thailand and compared the performance of ANN with the Holt-Winters additive exponential smoothing model and the Box-Jenkins ARIMA model. They concluded that ANN model had produced better predictive accuracies since they are non-linear mapping systems (4).

Usta used Backpropagation ANN, VAR (Vector Autoregression) and Box-Jenkins (ARIMA) modeling techniques for prediction of the Producer Price Index (PPI). It was concluded that the ANN had a beter prediction performance than the other methods (5).

Zou et al. used ANN, ARIMA and the combined model in forecasting the wheat price of the China Zhengzhou Grain Wholesale Market. Consequently they found that the ANN model could perform as well as or even outperform ARIMA and the combined model (6).

Ertuğrul et al. used single-layered feedforward ANN and Regression models. They concluded that the ANN provided better predictions, and the performance increased when appropriate parameters were used (7).

In the study realized by Bayır; independent variables considered having affects on prediction of production industry monthly export values are determined as monthly average value of USA dollar, total industry sector industry production index per month, domestic industrial index closing rates, industrial manufacturing partial productivity index per month. Prediction has been realized in established models and it is seen that the ANN model produces much better solutions, both in modelling and in prediction of realized values, than multiple linear regression model (8).

In this work, the prediction of Turkey's denim trousers export to Germany is examined, and the results are compared with Elman Network and MLP Network models.

The factors that influence denim trousers export are analyzed in the following section.

a. Cost of Denim Trousers: Cost is one of the most important factors that effects export. As the export goods' prices increase, the demand for high-priced goods of an exporter country decreases. This situation causes decrease in total export amount (9). The quality of ready-made goods across the world becomes similar as the technology develops and spreads. The customers' choice of good to buy depends on the price (10). International competition of ready-made goods is determined by labour cost (intense nature of sewing process), financing of auxiliary products, transportation, communication and energy costs and therefore it is effected by international competition (11),(12). Labour cost causes increase in production costs and therefore switches the production to the countries where low-cost labor force is used (9). Mobility on cotton prices effects all cotton-made products. Electricity cost is also another element which effects the product cost (12).

b. Export Support in Exporter Countries: Generally, export support measures include all measures that make the export profitable by decreasing costs or increasing incomes (13). Financing export means providing necessary funds which an exporter needs for exportation in any step of the process. In every stage of this process, from manufacturing the exported product to delivering it to the importer, the exporter needs financing (14). For an increase of export, it is important to support the exporter's and/or consignor's credit and/or insurance methods before and/or after the dispatch (15). Any type of credit which can be provided in any stage of export such as investment, production and collecting export cost with low interest rate, short term or long term is classified as export credit (13).

c. Exporter Countries' Brands: Enterprises use brand to be able to set different prices from their rivals, to differentiate products, to take legally under control by registering officially, to increase loyal customer number, to provide a consistency to product demand, to increase profits and to advertise (16). Brand brings cost and responsibility, it guarantees sustainable sale (11). Brand prevents tendency to buy cheaper products when not differentiate and makes the product more qualified and more appealing to customers (17).

d. Exchange Rates of Exporter Countries: The real exchange rate measures how much and to which direction a country's international competitive strength develops compared to its business associates and rivals (18). A country's short term competitive situation effects real rate's level. The value of that country's money against that of foreign countries influences competitive capacity, even though it is not considered as a production cost (11). While foreign trade prices effect directly real exchange rates directly, they can have a direct influences on the import price index and an indirectly effect on the export price index through the import price index. The fact that real rate of exchange movements and the import – export price index have an important relationship with each other, weakens the role of exchange rates in foreign trade productivity (19). The alternation in the exchange rate (ups and downs) can increase the cost of exported products in a price competitive environment. If a country's exchange rate increases instantly, the export desired from such a country can shift to another (9).

e. Comparative Advantages Situation of Exporter Countries: Balassa Index is an experimental device to determine countries' powerful and weak exporter sectors (20). The comparative Advantages of exporter countries is given as follows;

$$RCA_{ij} = \frac{(x_{ij} / X_j)}{(x_{iw} / X_w)} \qquad (1)$$

The RCA_{ij} shows explained comparative advantages index of country j. x_{ij}, X_j, x_{iw} and X_w in order shows the export of product i of country j, the total export of country j, the world-wide export of product i and the total world-wide export. If the index takes a value of greater than 1, it means that country j has comparative advantages on product i. In other words, country's total export share of that product is greater than its world-wide trade share. An index value smaller than 1 means a comparative disadvantage for that product (21).

f. Germany's Denim Trousers Import: Concentration of industrialization in

more technological areas of developed countries such as USA, Britain, Japan, France, Italy and Germany caused traditionally powerful textile and clothing sectors to become narrower. These manufacturers decrease employment and investments in the sector while they are leaning to design, technical developments, product development and production of high quality goods and they seek to provide their simple textile and clothing needs by importation. Import amounts of those countries became significant to determine export amount of exporter countries (22).

In Table 1, biggest denim trousers importers of the world and their importation amounts are ranked. According to this table, USA is the biggest denim trousers importer and Germany is ranked as the second biggest importer country.

g. Germany's Quota and Tax Applications to Turkey: Importer countries sometimes apply special policies like quotas and importation tariffs in order to protect their local textile and clothing industries (22). Quota is the limitation realized by governments of the imported goods' volume as amount or value (24). Along with loose of advantage of entering the market without restrictions, quotas also cause delay problems in delivering process due to exceeding quota when taking orders. This situation can cause the shifting of product facilities of exporter countries to the other countries where no quota application is applied or no quota limit is exceeded. The only good part of the quota agreements is that they guarantee importation at the rate of applied quota (25). Quotas are abolished with the ATC (Agreement of Textile and Clothing) agreement which went in effect in 2005. The fact that the quotas are abolished doesn't mean that importation shares of supplier countries or companies will broaden. For instance, while Bangladesh shows success in EU market, it underachieves in USA market (26).

In Table **2**, world's top five denim trousers importer countries and their quota applications to Turkey for denim trousers are given. Custom tariffs are the taxes taken from imported goods and are the most common means of protectionism. They include a wide application area of off-tariff restraints, export bans, import quotas and technical standards of imported goods. Using custom tariffs and off-tariff restraints, the local market becomes attractive. In long term, local industry is protected and scale economy is profited (27).

Export taxes create shortage in international markets and increase prices. They reduce local prices of importable good while custom taxes increase prices of exportable goods. Those two methods provide lower prices for exportable goods in comparison to importable goods for local manufacturers and customers (13).

Custom tax rate has a negative effect on import demand. A study which is realized for USA market showed that the reduction of the taxes implemented on clothing import caused an increase in the import. As a result of the studies realized in textile and ready-made clothing industries of USA, EU and Canada, it should be stated that if quotas are abolished while import taxes remain the same, the developed countries' access to foreign markets becomes more difficult (9).

Table 1. Denim trousers importer countries

	2008	2007	2006	2005	2004	2003	2002
Countries	**(1000$)**	**(1000$)**	**(1000$)**	**(1000$)**	**(1000$)**	**(1000$)**	**(1000$)**
USA	4.185.603	3.894.157	4.090.697	4.516.319	3.972.171	3.685.293	3.603.328
Germany	1.983.344	1.622.525	1.503.814	1.441.413	1.247.175	1.082.110	1.022.660
France	1.017.710	878.286	805.249	856.920	752.694	596.855	503.013
Britain	914.965	801.897	788.005	780.956	687.262	577.442	539.802
Italy	790.117	581.490	587.148	424.480	308.144	304.695	276.031

Source: (31).

Table 2. Quotas applied to Turkey's denim trousers export

	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995
USA	-	-	-	-	+	+	+	+	+	+	+	+	+	+
Germany	-	-	-	-	-	-	-	-	-	-	-	-	-	+
France	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Britain	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Italy	-	-	-	-	-	-	-	-	-	-	-	-	-	+

Source: İTKİB (+) = quota applied (-) = quota not applied

Table 3. Tax rates applied to Turkey's denim trousers export (%)

	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995
USA	16,6	16,6	16,6	16,6	16,6	16,7	16,8	16,9	17,0	17,2	17,3	17,4	17,5	17,6
Germany	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
France	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Britain	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Italy	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Source: (31).

In Table 3, tax rates applied to Turkey's exported denim trousers are shown. It is seen that the highest import taxes are applied by USA. Other countries are EU countries and according to Custom Union Agreement they don't apply import taxes to Turkey.

h. Income Per Capita in Germany: When income per capita in a country increases, demand on both locally manufactured and exported goods increase as well. High income per capita leads to high prices for locally manufactured goods and to relatively low prices for exported goods. In this case, demand on exported goods increases (10). Income per capita is one of the factors which effects denim clothing import. When denim trousers importer countries are analyzed, it is seen that income per capita in these countries is high. The fact that countries such as USA, Germany, France, Britain and Italy are on the top of the list of denim trousers importers should be thought as a proof of this (22).

In Table IV, income per capita in world's biggest denim trousers importers are shown. These countries have a very high income per capita when compared to world's average.

j. Population in Germany: One of the factors which can increase denim trousers sales is the growth of population. But in developed countries, the rate of population growth is not high. So it seems more advantageous to focus on developing countries for denim clothing sales where this rate is greater. Denim trousers sales in developed countries constitute 70% of the world market. These countries compose only 14% of the world population. Calculations show that every one person out of three buys a denim trousers every year (23).

In Table 5, population in denim trousers importer countries is shown. It is clear that there is no trend of increasing population. This situation shows that denim trousers imports in these countries can be reduced in the future.

2. MATERIAL AND METHOD

2.1. Material

Turkey's denim trousers export is anticipated with a model consisting of 29 input variables and 1 output variable. The input variables are shown below:

1. Years, (1995–2008), 2. Months, (from the first month of 1995 to the last month of 2008), 3. Turkey's Denim Trousers Import, 4. Minimum Wage in Turkey, 5. Cotton Price in Izmir Stock-Market, 6. Electricity Prices in Turkey Industry, 7. Water Prices in Turkey Industry, 8. TL/USA($), 9. Credit Usage of Ready-Made Clothing and Confection Sector, 10. Export Credit Prior Consignment (TL), 11. Foreign Trade Enterprise Credit (TL), 12. Export Credit (TL), 13. Transport, TL, 14. Export Credit SME TL, 15. Export Credit Prior Consignment, (foreign currency), 16. Foreign Trade Enterprise Credit (foreign currency), 17. Export Credit (foreign currency), 18. Pre-consignment Rediscount Credit - DISCOUNT, 19. Transport Shipping Marketing Credit, 20. Export Credit SME (foreign currency), 21. Manufacturer Price Index Based Real Effective Exchange Rate, 22. Denim Trousers Brand Registration No, 23. Denim Trousers Balasa Index, 24. Germany's Denim Trousers Import, 25. Germany's Quota Application to Turkey, 26. Income Per Capita in Germany, 27. Population in Germany, 28. Unemployment in Germany and 29. Inflation in Germany. Turkey's Denim Trousers Export is used as the output variable. Every data used is part of the time series of 168 data between January 1995 and December 2008.

2.2. Method

Artificial neural networks (ANNs) have been applied to a large number of problems because of their non-linear system modelling capacity. ANNs are designed to mimic the characteristics of biological neurons in the human brain and nervous system. With given sample vectors, ANNs are able to map the relationship between input and output; they "learn" this relationship, and store it in their parameters. The training algorithm adjusts the connection weights (synapses) iteratively, and learning typically occurs through training. When the network is adequately trained, it is able to generalise relevant output for a set of input data. The prediction of Turkey's denim trousers export to Germany was realised using Multi layer perceptron (MLP) and Elman Recurrent Neural Networks (ERNN) models.

MLP: A typical MLP network is arranged in layers of neurons, where each neuron in a layer computes the sum of its inputs and passes this sum through an activation function (*f*). The architecture of an MLP type ANN is presented in ***Figure 1***. To train to MLP with back-propagation, the first step is propagating the inputs towards the forward layers through the network. For a three-layer feed-forward network, the training process is initiated from the input layer (29):

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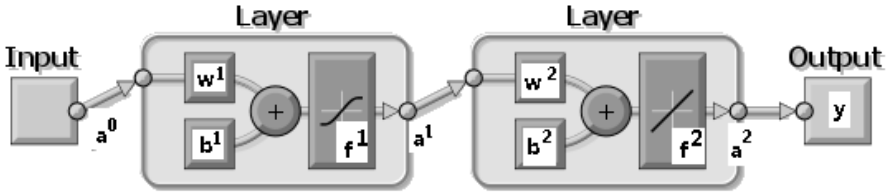

Figure 1. MLP type ANN architecture (28)

For train to MLP with back-propagation, the first step is propagating the inputs towards the forward layers through the network. For a three-layer feed-forward network, training process is initiated from the input layer: (29).

$$a^0 = u$$

$$a^{m+1} = f^{m+1}(W^{m+1}a^m + b^{m+1}), \quad m = 0, 1 \tag{2}$$

$$y = a^3$$

Where **y** output vector, **u** is input vector, **f(.)** is the activation function, **W** is weighting coefficients matrices, **b** is bias factor vector and m is the layer index. These matrices defined as ;

$$\mathbf{W^1} = \begin{bmatrix} w_{1,1} & w_{1,2} & \cdots & w_{1,S0} \\ w_{2,1} & w_{2,2} & \cdots & . \\ . & . & \cdots & w_{2,S0} \\ w_{S1,1} & w_{S1,2} & \cdots & w_{S1,S0} \end{bmatrix},$$

$$\mathbf{W^2} = [w_{1,1}\ w_{1,2} \ldots w_{1,S1}],\ b^1 = [b_1\ b_2\ .\ .\ b_{S1}]^T,\ b^2 = [b_1]$$

In this study, sigmoid tangent activation functions are used in the hidden layer and linear activation function is used in the output layer respectively. These functions are defined as follows;

$$f^1 = \frac{(exp^n - exp^{-n})}{(exp^n + exp^{-n})}, \quad f^2 = n \tag{3}$$

The total network output is ;

$$n_i^m = \sum_{j=1}^{s^{m-1}} w_{i,j}^m a_j^{m-1} + b_i^m \tag{4}$$

Second step is propagating the sensibility s (d) from the last layer to the first layer through the network: d^3, d^2, d^1. The error (e) calculated for output neurons is propagated to the backward through the weighting factors of the network. It can be expressed in matrix form as follows:

$$d^3 = -2\dot{F}^3(n^3)(e)$$

$$d^m = \dot{F}^m(n^m)(W^{m+1})^T d^{m+1} \quad \text{for} \quad m = 2, 1 \tag{5}$$

$\dot{F}^m(n^m)$ is Jacobian matrix;

$$\dot{F}^m(n^m) = \begin{bmatrix} \frac{\partial f^m(n_1^m)}{\partial n_1^m} & 0 & 0 \\ 0 & \frac{\partial f^m(n_2^m)}{\partial n_2^m} & 0 \\ 0 & 0 & \frac{\partial f^m(n_{s^3}^m)}{\partial n_{s^3}^m} \end{bmatrix} \tag{6}$$

e is mean square error,

$$e = \frac{1}{2}\sum_{\gamma=1}^{q} (y^\gamma - \hat{y}^\gamma)^2 \tag{7}$$

Where γ is the sample in dimension q .

The last step in back-propagation is updating the weighting coefficients. The state of the network always changes in such a way that the output follows the error curve of the network towards down.

$$W^m(k+1) = W^m(k) - \alpha d^m (a^{m-1})^T$$
$$b^m(k+1) = b^m(k) - \alpha d^m \quad (8)$$

where α represents the training rate, k represents the epoch number. By the algorithmic approach known as gradient descent algorithm using approximate steepest descent rule, the error is decreased repeatedly.

ERNN: ERNN (also known partially recurrent neural network) are a subclass of recurrent networks. It is MLP network augmented with additional context layers (W0), storing output values ($\mathbf{y}$), of one of the layers delayed (z-1) by one-step and used for activating this other layer in the next time (t) step (30).

$$\mathbf{y}_{(t+1)} = f^1(\mathbf{W}^1\mathbf{x} + \mathbf{b}^1) + \mathbf{y}_{(t)}\mathbf{W}^0 \quad (9)$$

While ERNN use identical training algorithm as MLP, context layer weight (W0) is not updated as in equation 6.

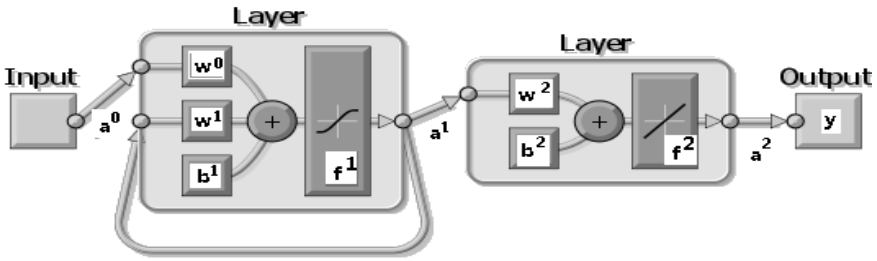

Figure 2. ERNN Type ANN Architecture. (28)

Selecting the Best Network Architecture: The number of hidden layer and neurons in the hidden layer(s) play very important roles for ANNs and choice of these numbers depends on the application. Influenced by theoretical works proved that single hidden layer is sufficient for ANNs to approximate any complex nonlinear function with any desired accuracy. In addition, determining the optimal number of hidden neurons is still a question to deal with. Although there is no theoretical basis for selecting these parameters, a few systematic approaches are reported but the most common way of determining the number of hidden neurons is still trial and error approach. Designed MLP and ERNN are trained with back propagation learning algorithms, which are described above. Once trained, the network can be used for predicting the output for any input vector from the input space. This is called the "generalization property" of the network. To show this property of trained networks, the same experiment is done with testing data set that are not involved in training data set. At the end of the training and testing experiments, the obtained root mean square error (RMSE) values and correlation coefficients (R) are compared. MATLAB with Neural network toolbox is used for all ANN application (28).

Prediction with MLP Model: Testings realized with MLP model and their results are given in Table 6.

Table 6. Test Results with MLP

Test Order	Test Name	Hidden Layer Neuron No.		Training (1995-2006)		Test (1995-2006)		Predicition (2007-2008)	
		1.	2.	RMSE	R	RMSE	R	RMSE	R
1	1_5	5		0,0012	0,996	0,0501	0,8817		0,202
2	1_15	15		2.0505e-26	1,000	0,0714	0,8287	0,1248	0,417
3	2_10_5	10	5	4.3595e-04	0,998	0,0643	0,9088	0,0956	0,640
4	2_20_35	20	35	1.1668e-30	1	0,0787	0,8069	0,0612	0,633
5	2_25_25	25	25	1.1389e-30	1	0,1094	0,8421	0,0601	0,651
6	2_25_40	25	40	2.9012e-30	1	0,0580	0,8481	0,0740	0,701
7	2_30_25	30	25	1.0960e-04	0,999	0,0584	0,8988	0,0722	0,731
8	2_30_40	30	40	1.8064e-30	1	0,0810	0,7711	0,0443	0,797
9	2_35_35	35	35	9.7009e-31	1	0,0522	0,8813	0,0326	0,889
10	2_40_40	40	40	1.2601e-30	1	0,0500	0,8103	0,0195	0,896

As a result of testing realized with the MLP Model, the model with no 2_40_40 was seen to be the best one which modeled Turkey's denim trousers export to Germany. It has two hidden layers. There are 40 neurons in both first and second hidden layers. Testing realized with this model and its results are shown below. When regression curves of the model is analyzed, in Figure 3 it is seen that the R value in training data series is 1. This data shows the full realization of the training.

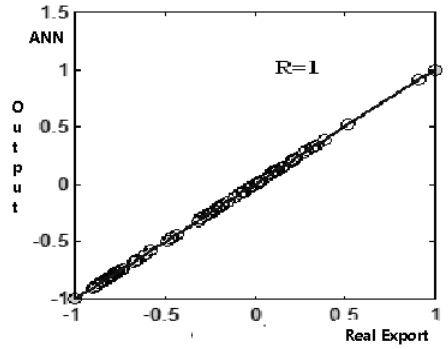

Figure 3. 2_40_40 Model's training reg.

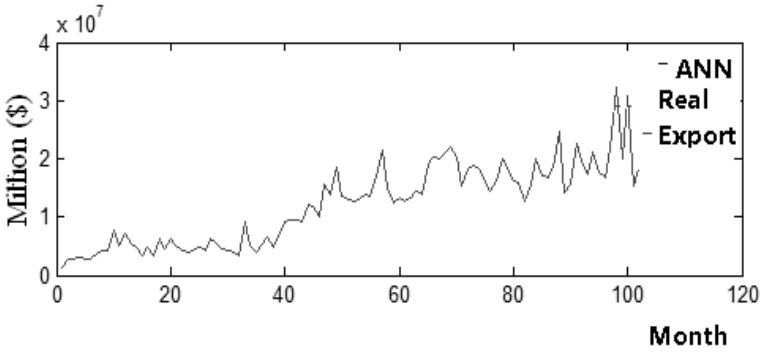

Figure 4. 2_40_40 Model's training graph

In order to see the results more detailed, in Figure 4, ANN and output values in training process are given. It is clearly seen that a full modeling is provided in training process. In Figure 5, it is occurred that the R value is 0,810 in model's testing process. This shows that the test is not completely successful but aim values and output values approach each other.

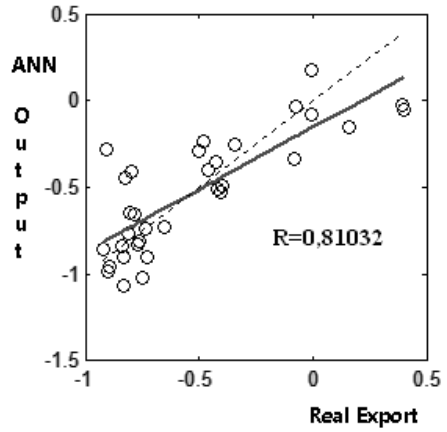

Figure 5. 2_40_40 Model's test reg.

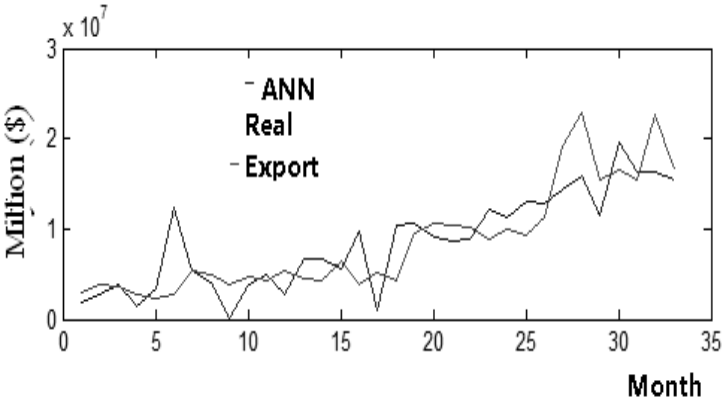

Figure 6. 2_40_40 Model's test graph

n Figure 5, model's output values in testing process are given. In the first months there is a coherence between ANN output and the real output. But, this coherence is sometimes corrupted. A prediction is realized in order to see how this obtained model can foresee 2007-2008 values. The regression value of the prediction is seen in Figure 7. The correlation coefficient is a high value as 0,896.

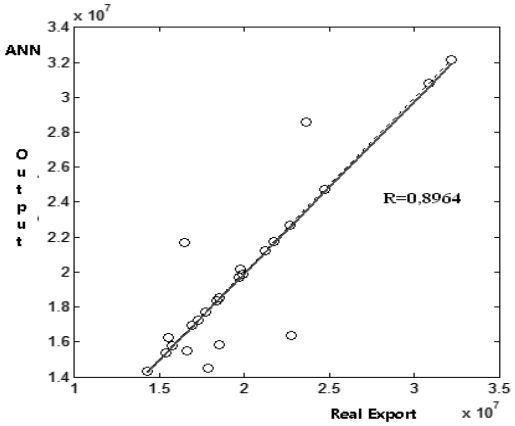

Figure 7. 2_40_40 Model's prediction reg.

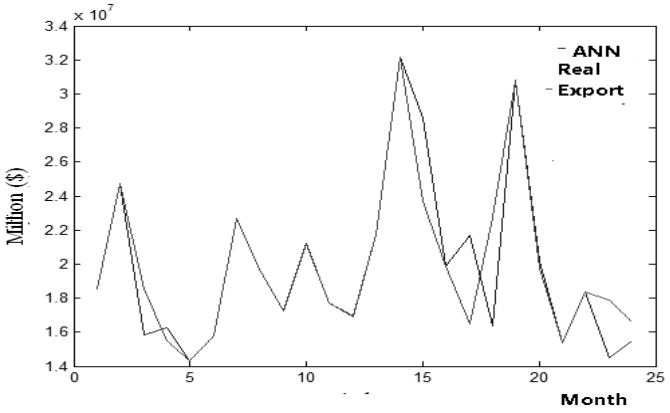

Figure 8. 2_40_40 Model's prediction graph

This prediction of years 2007-2008 is shown more detailed in Figure 8. As seen in Figure 8, ANN and output values of 2007-2008 are very coherent. When the regression curve in Figure 7 and the prediction graph of the model are analyzed, it is concluded that this ANN model can be used to predict Turkey's denim trousers export.

Prediction with the Elman Network: Testing realized with the Elman model and their results are shown in the table below.

Table 7. Test results of the model with the Elman Network

Test Order	Test Name	Hidden Layer Neuron No.		Training (1995-2006)		Test (1995-2006)		Prediction (2007-2008)	
		1.	2.	RMSE	R	RMSE	R	RMSE	R
1	1_5	5		0,0012	0,996	0,0501	0,9158	0,0924	0,202
2	1_10	10		0,0007	0,998	0,0223	0,931	0,0835	0,236
3	1_15	15		1.1087e-26	1	0,0755	0,798	0,0717	0,747
4	1_20	20		6.5275e-31	1	0,0777	0,839	0,0415	0,786
5	1_25	25		4.0749e-31	1	0,0278	0,908	0,0321	0,833
6	1_30	30		1.0917e-27	1	0,0645	0,8834	0,0256	0,849
7	2_5_25	5	25	0,0026	1	0,0261	0,8564	0,0476	0,865
8	2_10_10	10	10	0,0011	0,997	0,0298	0,9135	0,0258	0,872
9	2_10_15	10	15	3.5942e-14	1	0,0459	0,8416	0,0149	0,940
10	2_25_20	25	20	8.3983e-31	1	0,0348	0,924	0,0142	0,917

According to the test results in Table 7, the best Elman model that gives the best result is model number 2_10_15. This model has got two hidden layers. In the first hidden layer there are 10 neurons and 15 in the second hidden layer. Testing realized with that model and the results are shown below. When model's regression curves are analyzed, in Figure 9, it is seen that the R value in training data series is 1. This shows the full realization of the training.

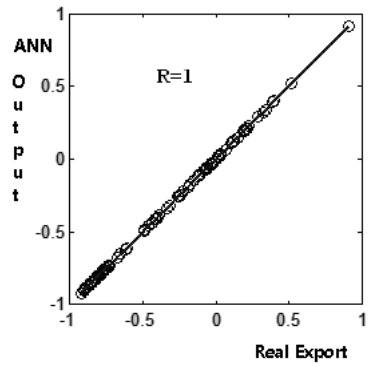

Figure 9. 2_10_15 Model's training reg.

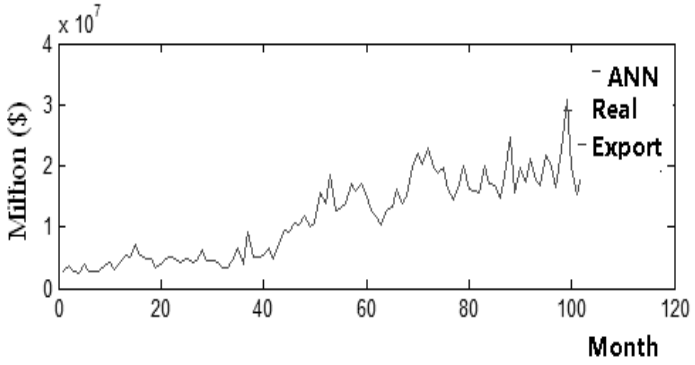

Figure 10. 2_10_15 Model's training graph

In order to see the results more detailed, ANN and output values in training process are given in Figure 10. It is clearly seen that in training process a full modeling is supplied. In Figure 11, the R value in testing process is 0,841. This shows that the test is not completely successful but aim values and output values approach each other.

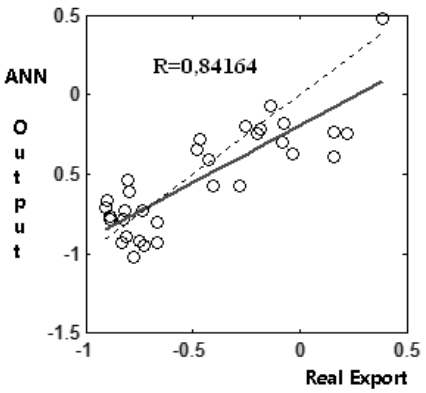

Figure 11: 2_10_15 Model's test reg.

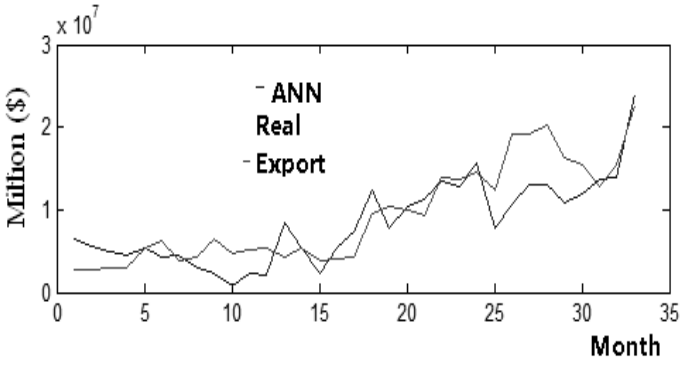

Figure 12. 2_10_15 Model's test graph

In Figure 12, output values in testing process are given. In the first months there is a coherence between ANN output and the real output. But, this coherence is sometimes corrupted. An prediction is realized in order to see how this obtained model can foresee 2007-2008 values. The regression value of the prediction is seen in Figure 13. The correlation coefficient is a high value as 0,940.

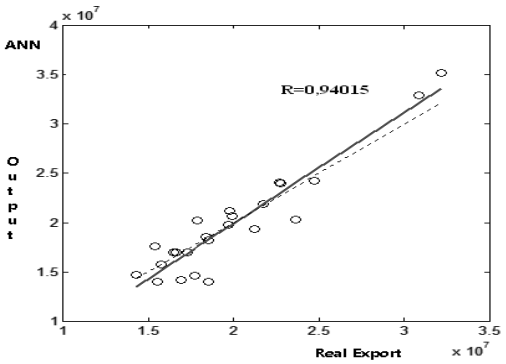

Figure 13. 2_10_15 Model's prediction reg.

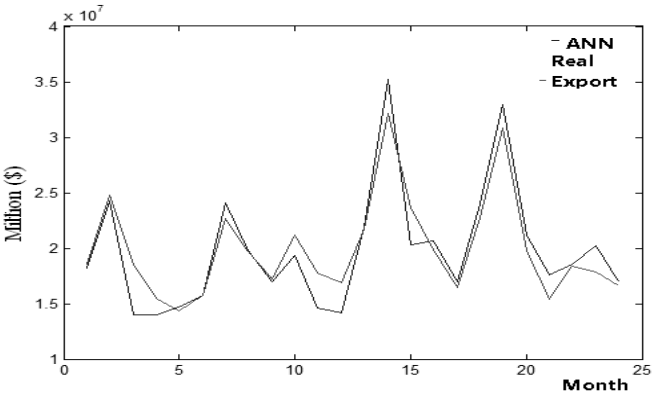

Figure 14. 2_10_15 Model's prediction graph

This prediction is given more detailed in Figure 14. As seen in Figure 14, ANN and real output values of years 2007-2008 are very coherent. We concluded that this ANN model that we developed from the graph in Figure 14 and the regression curve in Figure 13, can be used to anticipate Turkey's Denim Trousers export.

3. CONCLUSION

As a result of developed model on Turkey's denim trousers export to Germany, it is concluded that both models used give successful results in terms of prediction and can be used in prediction of denim trousers export. It is determined that the Elman Network has better prediction performance than MLP Network. When data other than used in these prediction models are considered, it can be said that this study can be used and similar studies can be made by using different input values; thus foreseeing imports can be a very important subject for countries future exports.

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