Specifying main effective factors on domestic steel Price: Case study of Iran steel market

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Abstract.
Traditionally, production and consumption of steel are indicators of the development process in a society. In the world village, domestic and world indexes and prices highly affect each other. Differences between the supply and current demand are the main factors determining the steel price. In this paper, by an Artificial Neural Network we specify indispensable variable to identify the supply and demand for steel. Time of Contract, Expected Price, Volume of supply, Prior contract volume, Global Steel Price, Time between contract and transfer, Previous Price, Volume of Demand, Different Between Supply & Demand, Exchange Rate are specified as the main variables. Then, by a System Dynamics approach we analyze intricate system functioning against changing economic parameters in Iran.

Keywords: *System Dynamics, Iran, Artificial Neural Network, Delphi method*

1. Introduction

Today, forecasting of product prices of holding companies play a crucial role in both domestic and world markets. Steel with respect to oil is rank two in fundamental industries all over the world. Companies by predicting the price easily can alter their production plan. Steel market as an infrastructure industry plays an indispensible role both domestic and world market. Real estate market and automobile industry are two main markets which are based on steel market. During the last two years, economical Tsunami faces market with lots of adversity. Meanwhile, predicting the price and product planning show their necessity much more than before. Iran imports and also exports steel. Foolad mobarakeh as the main steel producer cannot satisfies all types of demanded steel in domestic market. It satisfies about 45 percent of domestic demand. In addition,

Mobarakeh produces more than domestic demand. Therefore, it exports extra production. Iran's special behavior as both importer and exporter intensifies indispensability of forecasting domestic steel price. Almost all imported steel come from China. China with the highest economic growth during the last decade and highest average economic growth during the last 25 years play an important role in world steel market. Furthermore, high share in this industry and rise of China to become world largest iron and steel producer and consumer since the late 1990s [9] and lower price in steel market highly affects other suppliers.

Total crude steel production for the 66 countries reporting to the World Steel Association in January 2010 was estimated to be 109.2 million tonnes, an increase of 25.9% on January 2009. In Asia, China, India, South Korea, and Taiwan are main producers. Iran produces about 1% of global demand. North America, Europe, Middle East are main markets of Iran's production. Selling strategy in Iran due to diversity of productions is based on demand. In other word, Iran's steel industry produce exclusively produce requested products. Domestic steel market is based on auction. Monthly contracts are usual in industry.

Domestic producer sells its product in auction. Ever month all demander request their proposed price and total amount of their need. Then based on these proposals, global steel price, marginal benefit, and cost make decision about its customers. Based on their prices domestic steel sells its product in the same order as prices order. More info about the structure of contacts can be obtained in Mobarakeh Steel Co. website [3].

In this paper, by a system Dynamics approach, we try to specific main factors which highly affect domestic steel market. The rest of this paper in organized as follows. In section 2, literature review and some work in this area presented. In section 3, we discuss about the main factor of steel pricing. Section 4 presents dynamics model. The conclusion and summary are described in section 5.

2. Literature review

There are wide varieties of different method to forecasting price. Time series, VARs techniques, Neural Networks, System Dynamics, Linear models, econometrics, segmentation, extrapolation, input–output, simulation, judgment and so on are some main methods of prediction [8]. H.F. Zou et al [4] compared the predictive performance of ARIMA, artificial neural network and the linear combination models for forecasting wheat price in Chinese market. Dean T. Chen et al [5] investigated a composite approach, using vector autoregressions to determine the future values of exogenous variables of the structural model in cotton market. Multi-dimensional testing procedures were adopted to evaluate the accuracy of forecasts. Farooq Malik et al [7] Found that the mean absolute forecasting error and the mean square forecasting error is reduced by applying cascaded neural network relative to conventional artificial neural networks and popular linear models. M. Khashei et al [8], based on the basic concepts of ANNs and fuzzy regression models, proposed a new hybrid method that yields more accurate results with incomplete data sets. SHARIF et al [10] Forecasting Multilevel Technological Substitution by System Dynamics Modeling. Mohapatra et al [11] Incorporating Delphi Results in System Dynamics Models in Case of Indian Tea Industry. In addition there some studies like Jianguo jia [12] in price modeling. Rahdari [6] analyzed the effect of

global steel price auction on Iran's steel stock market's price.

In this study, we analyze domestic steel market by a System Dynamics approach. There are lots of factors which can influence domestic steel price. In this study by Delphi method critical factors of pricing has been choose. Then by a neural network method weight of each sector has been analyzed. Finally a system Dynamics approach shows the relation between price and these main factors.

3. Specifying main factors in pricing

As mentioned above, neural network is one of forecasting methods. In this paper we used Artificial Neural Network (ANN) to weighting domestic steel price's main variables. Delphi method has been used as our variable selection method.

Select, design, and modeling a neural network form effectiveness and efficiency of it. In other word, choosing a suitable neural network is the first step of using neural network as an anticipating method. Among neural networks ANN has been use widely in literature review. Different types of ANN have been used in forecasting [13]. According to literature review more than 95% of neural network's application in trade and market's issues was in multilayer feed forward (MLFF) neural networks [14]. Most researchers found this network as the best method for forecasting. Therefore, in this study a multi layer perceptron (MLP) network has been used. However, some other types of neural networks like RBF, PNN, and GRNN can be useful in predicting price.

All neural networks are combinations of nodes and layers. A MLFF or MLP neural network has three different layers in general; an input layer, middle layer or hidden layer (in some cases more than one layer), and an output. Number of layers and number of neurons in every layer specify a given neural network. There are a lot of different ways to specify architecture of an ANN in literature review [15]. But, most of these methods are so complex to be useful. Besides, degrees of applicability of them in real world's problem are occasionally lower than the real demand. Most of expert believes that trial and error would be respond of this difficulty. In this study, trial and error has been used in most cases.

Every MLP Network has one input and one output layer. Therefore in a MLFF Neural Network defining number of middle layers would be the case. One middle layer for every neural network in order to estimate every complex non-linear function would satisfies our accuracy. Applying one hidden layer for a neural network could lead to some problems in cases that there are lots of neurons. It seems in which using two middle layers could have desirable results. However, there is no exact method to denote number of middle layers. As, number of middle layers have correlation with number of neurons, we define number of layers with respect to number of neurons.

Characterizing number of input, output, and hidden layer's neuron is the next step. Specifying number of input's layer's neuron would be the most important decision in MLP architectures. Usually numbers of input variables which affect the main variable and number of input neurons are the same. In our case number of input neuron has been choose as equal as number of variables. To specify effective variables on steel's price there are lots of methods. Here is the procedure of defining effective variables. First, by Delphi method we define

primary variables which can be used as input layer in Neural Network. Then, we find the most suitable variables. Weight of variables will be defined on the last step. The procedure of Delphi method mentioned as follows.

In Delphi method, all information about the problem including literature review, related articles and papers, most critical variables in this issue, and main financial variables which has been used before in anticipating are sent to experts. Then, experts define indispensible variables. Afterward, opinion of every expert exclusively would be evaluated. These results would be sorted and analyzed. Then, once more, results of next step will put under supervision and evaluating of experts for final regards. Finally, the result will form our variables. The result of accepted variables in Iran domestic steel market has been shown in ***Table 1***.

Row	Name of Variable
1	Type of Contract
2	Time of Contract
3	Expected Price
4	Volume of supply
5	Prior contract volume
6	Global Steel Price
7	Time between contract and transfer
8	Time of transfer
9	Previous Price
10	Volume of Demand
11	Different Between Supply & Demand
12	Exchange Rate

Table 1 - Result of Delphi Method

Specifying middle layer's neurons is the next step. In this ANN the following rules has been used in order to denote No of neurons. In every layer, first choice is n (as the same as the number of input neurons). In general the minimum number of neurons is [n/2]-1 and maximum is 2n+1. As we are going to anticipating steel's price, the output layer has one neuron. Back propagation has been used as the learning algorithm [14]. This algorithm has a popularity of about 95% in most trade and financial problems.

After some trial and error a solitaire layer neural network has been chose. 10 input neurons, 4 hidden neurons, and one output neuron is the structure of our ANN. The result of this Neural Network leads us to final variables which are highly influencing in steel's price forecasting. The results are presented in ***Table 2.***

Row	Name of Variable
1	Time of Contract
2	Expected Price
3	Volume of supply
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7	Previous Price
8	Volume of Demand
9	Different Between Supply & Demand
10	Exchange Rate

Table 2 - Result of specified ANN

4. Dynamics model

In this section by a System Dynamics approach and a causal model we demonstrate relations between main influencing factors on steel pricing. With respect to complexity of assessing price's systems, varieties and intensity of drastic variables, and dynamic nature of affectivity of variables modeling price with classical approach cannot lead us to a desirable resolution. On the other hand, including some parameters like contract time, demander expected price, supplier expected price, and global steel price in classical models faces the solution with some difficulties. Layer-based and indirect analysis in SD mechanism and utilizing graphs to illustrate quality parameters made

SD approach a unique one in these types of problems.

Difference in demand and supply are source of forming price. In an auction in steel stock market excess of demand in compare with supply leads to rivalry between demanders. This phenomenon leads to higher proposed prices by demanders. The highest prices in order are the winners of auction. Supplier and demander expected prices are forecasting of suppliers and demanders about the future of steel' price. Proposed volume, proposed prices, base proposed price, and production plan are impressible by expected price. Time series as one of the forecasting method has been used commonly to anticipating expected price. Prior price and current price also affecting expected price.

Analysis shows that effect of increase in price on expected prices can be positive or negative. ***Figure 1*** shows that increasing demander expected price result in increasing demander's demand. This leads to higher price.

Automobile industries and real estate market are the main demanders' market of steel producer's companies. According to nature of these markets, contract time is in contact with this market.

Global steel price (world steel price), which dramatically influencing by world economic growth, is one of the primary indexes on raw material cost, and so on. Better global economical situation leads to more demand in raw materials' market. This results in more external demand and more total demand. Not need to shed light on that increasing in raw materials affect the other mentioned factors in a one or two much delay. Finally this leads to changing in domestic price (by affect of global steel price).

Supplier expected price and prior contract volume which are the main source of PP, capacity of production, and base proposed price highly influenced by global steel price. Difference of cost and income shows benefit of a company. Benefit is the most critical item in leading a company. More benefit persuades a company to produce more. More produce result in decrease in price. Besides, government strategy to restricting import, and tax in imported steel changes price. In addition, government's strategy in exchange rate may have a benefit for steel companies.

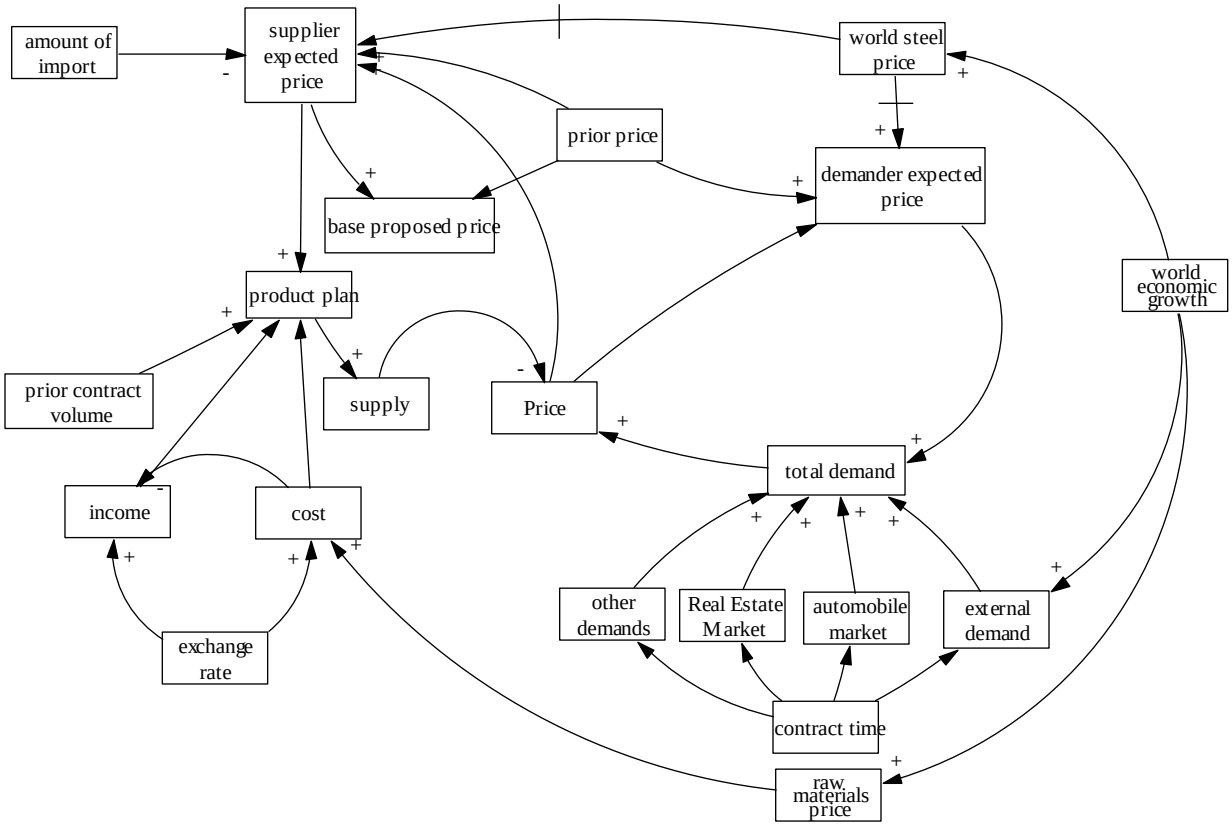

Figure 1

5. Conclusion

In this paper we describe a practical problem in pricing. Domestic steel pricing plays a crucial role in local markets. An ANN method evaluates the proposed affective variables and select best of them. Then, a SD causal approach shows the relation and correlation between these main variables.

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