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# Predicting the effect of effective factors in determining the price of iron ore, using the method of neural fuzzy networks

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**Abstract**

The aim of the present study was to mathematically model the forecast of iron ore prices and its by-products. The present study is applicable in terms of its purpose, and survey in terms of data. The main data collection methods in the present study are library methods. The daily price of Iranian oil was obtained by referring to the website of the Organization of the Petroleum Exporting Countries (OPEC). The daily price of iron ore stocks was extracted from the website of the Commodity Exchange, and the price of Bahar Azadi coins and the dollar rate were extracted from the Central Bank of Iran. The indices were first extracted from library studies. In this study, the statistical population includes the daily price of iron ore stocks for 2,058 working days. Given that severe fluctuations in stock prices will affect the forecast; the statistical sample used in this study includes daily iron ore stock prices during the period of companies entering the stock exchange from 20/03/2016 to 19/03/2022. Matlab and Dematel software were used for predictions made by fuzzy inference. Based on the findings of the studies, 12 variables were extracted as predictor variables to design the prediction model. Dematel results showed that 7 factors: other suppliers' prices, seasonal effect of order registration, prices of past periods, government tariff rate, exchange rate, oil price, and world iron ore price were the most influential factors. Adaptive neural fuzzy approach is one of the important approaches for comparing the effectiveness of different factors. The results showed that the exchange rate has the highest frequency among the seven available variables, followed by the world iron ore price.

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## Extended Abstract

### Introduction

Continuous and sustainable economic growth in any economy requires the optimal mobilization and allocation of resources at the national level. In economic literature, capital is considered the lifeblood of the economic system, and its formation has been emphasized as one of the determining factors of economic growth and development. Basically, the rate of economic growth and development depends on capital accumulation on the one hand; and on the other hand, on the productivity factor in economic activities. These two basic factors depend on the nature of the investment process; therefore, one of the most important tasks of financial markets is to facilitate capital formation. Capital markets can well handle both of the aforementioned tasks of capital accumulation and increasing economic productivity (Farajian & Farajian, 2022).

The iron ore trade in the world has faced major changes with the rapid growth of developing economies in regions such as China, India, and South Korea as key growth centers in this sector, and the industrialized economies of the European Union and North America are gradually losing their dominant role in this market. Currently, the developing regions of Asia are the center of growth in steel production and consumption. Most steel-producing regions import most of their iron ore resources, and some others have insignificant or uneconomic iron ore resources. The most prominent of these are the steel industries of China and Japan. The growth in demand for iron ore imports has led to a significant increase in production in countries such as Brazil and Australia, as a combination of large, high-quality iron ore resources accessible to ports, and iron ore resources for the export market have been developed. In view of what has been said, the present study seeks to answer the question: what are the effective factors in determining the price of iron ore and how is the comparison of effective factors using the fuzzy neural network method?

### Theoretical literature

The iron ore industry plays a key and influential role in the growth and development of a country. On the one hand, this industry is fundamental in development, and on the other hand, it is considered a benchmark for the industrialization of countries. Therefore, its improvement and development is of particular importance. Basic industries such as transportation, construction, machinery manufacturing, mining and other industries related to energy production and transmission are dependent on products made from iron ore. Therefore, global demand for iron ore is high and will remain stable in the future, if not increase (Hao et al, 2018). After the 2008 financial crisis, when supply and demand fell sharply, supply and demand were on an upward trajectory. Of course, so far the growth rate of supply has been greater than demand, and it is likely that the iron ore surplus will continue to grow, which could ultimately have a significant impact on iron ore prices. World crude iron ore production in 2010 reached 1.238 billion tons, with a growth of 15% compared to 2009. This number was 1.694 and 1.8 billion tons in 2013 and 2014, respectively. The apparent consumption of iron ore in 2010 was 144.8 million tons, which was an increase of 13.2% compared to the previous year. This number was 168.1 and 171.5 million tons in 2013 and 2014, respectively (Hao et al, 2018).

### Factors Affecting Iron Ore Prices

### Economic Factors

The economic situation of each country and the global economic situation in general have a major impact on the level of domestic and foreign demand for iron ore, and as a result, it has a significant impact on the export of iron ore in exporting countries (Azimi & Afrough, 2015).

**Political Factors**

Other factors affecting the trend of iron ore exports are political factors and trends. These factors are often accompanied by economic burdens. Regional and international political crises and the increasing acceleration of arms races can also be a powerful factor in increasing the production and export of iron ore (Azimi & Afrough, 2015).

**Substitute goods**

Although iron ore substitutes do not have an immediate impact on iron ore exports, they can have a significant impact in the long term. With the passage of time and the advancement of science and technology, new possibilities are provided for the production of new types of petrochemical products that are not only more resistant and more malleable, but also have greater relative advantages over iron ore in terms of erosion and application methods (Farajian & Farajian, 2021).

**Price levels**

The price level of iron ore products is also one of the factors affecting its export volume. Among the factors that have increased the export volume of iron ore products from countries such as Japan and other common market countries to the domestic markets of the United States has been the low price level of exported products compared to the price level of domestic production in the United States (Farajian & Farajian, 2021).

**Exchange rate changes**

The exchange rate is one of the most important variables affecting exports. It is important to examine the speed of the impact of these variables on exports. As trade between countries increases, exchange rate fluctuations are considered one of the most important sources of corporate risk (Mojdeganlou & Hosseini, 2021).

## Research Methodology

The present study is applicable in terms of its purpose, and survey in terms of data. The main data collection methods in the present study are library methods. The statistical population includes elements, components, and individuals or units that share at least one attribute. In this study, the statistical population includes the daily price of iron ore stocks for 2058 business days. Given that severe stock price fluctuations will affect the forecast, the statistical sample used in this study includes the daily prices of iron ore stocks during the period of companies' entry into the stock exchange from 20/03/2016 to 19/03/2022. For the predictions made by the fuzzy inference system, MATLB and DEMATEL software were used.

## Research findings

In this section, the adaptive neural fuzzy approach, which is one of the important approaches for comparing the effectiveness of different factors, is used. The important point is that in this section, 7 influential factors that are the result of the DEMATEL method are examined and explored, and their effect on the final or output variable, i.e. the price of iron ore, is examined in pairs; and finally, the factors that have the highest frequency are listed. First, the influencing factors (prices of other suppliers, seasonal effect of order registration, prices of past periods, government tariff rate, exchange rate, oil price, world price of iron ore) are introduced as a result of the DEMETL method. According to the results, the exchange rate has the highest frequency among the seven variables available, followed by the world price of iron ore. After that, the seasonal effect of order registration and the variables of government tariff rate and oil price are followed. The least frequent variable is the price of past periods, which has only been dominant once in the permutations.

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## Discussion and Conclusion

The aim of the present study was to predict the price of iron ore and its by-products based on time series neural networks. For this purpose, first, library studies were conducted based on which, 12 variables were extracted as predictor variables to design the prediction model. The results of DEMETL show that 7 factors: price of other suppliers, seasonal effect of order registration, prices of past periods, government tariff rate, exchange rate, Oil price and world iron ore price were the most influential factors. The results showed that the exchange rate has the highest frequency among the seven variables, followed by the world iron ore price. After that, the seasonal effect of order registration and the variables of government tariff rate and oil price are next. The least frequent variable is the price of past periods, which has only been dominant once in the permutations. The results of this finding are somewhat consistent with the results of Lee et al., (2017) and Lin & Si (2021).