

eISSN: 2981-1554

Original Article (Qualitative)

# Study of iron ore pricing prediction using dynamic neural network method and the trend of factors' effectiveness and impact.

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## Receive:

18 September 2025

## Revise:

28 November 2025

## Accept:

28 January 2026

## Abstract

The aim of the present research is to study the iron ore pricing forecasting using dynamic neural network method and factors' influence and effectiveness trend. The present study is applicable in terms of its purpose, and survey in terms of data. The statistical population includes daily iron ore stock prices for 2058 working days. Given that severe stock price fluctuations will affect the forecast; the statistical sample used in this study includes daily iron ore stock prices during the period of companies' entry into the stock exchange from 21/03/2016 to 20/03/2023. Python programming language was used to model the dynamic neural network, and DEMATEL software was used for the influence and effectiveness of factors. The results showed that the dynamic neural network model (LSTM) with its high ability to model the nonlinear effects of macroeconomic variables showed the best performance in predicting iron ore prices. After optimizing the parameters (3 layers and 64 neurons), this model achieved the highest coefficient of determination (R<sup>2</sup>) of 0.985 and the lowest root mean square error (RMSE) of 0.051. Sensitivity analysis indicated that steel prices were the most important variables for predicting iron ore prices. The results of DEMATEL also showed that interest rates were the strongest antecedent (influencing) factor in the economic system, while iron ore production was the strongest a posteriori (influencing) factor. These findings emphasize that iron ore prices are highly dependent on macroeconomic and financial conditions and that the dynamic neural network is a superior tool for predicting them.

## Keywords:

Economic system,  
iron ore pricing,  
volatility  
clustering,  
dynamic neural  
network

**Please cite this article as (APA):** Naji, Y., Mollaei, H. R. , Raeispour Rajabali, A. and Mohammad Bagheri, M. (2026). Study of iron ore pricing prediction using dynamic neural network method and the trend of factors' effectiveness and impact. *Journal of New Approaches in Management and Marketing*, 4(4), 110-130.



<https://doi.org/10.22034/jnamm.2026.547880.1155>



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## **Extended Abstract**

### **Introduction**

Today, the rate of economic growth and development depends on capital accumulation on the one hand, and on the productivity factor in economic activities on the other. 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). Given the key impact of mineral product prices on calculating the cut-off grade and net present value of mining projects, reliable forecasting of mineral product prices is an important and fundamental issue in economics and the design and planning of open-pit metal mining. Given the high volatility of iron ore prices, its accurate forecasting is one of the critical issues in the design of open-pit mines to increase decision-making certainty (Sadegh Beigi Aliayee et al., 2025). Iron ore is the main raw material for steel production. The iron ore market has always been affected by different and variable conditions. There are many large and small producers and exporters active in this industry (Jan Nesari & Aghajani Bazazi, 2023).

Iron is one of the most useful metals in the world. The global price of iron ore is determined by supply and demand. There are several variables, including steel prices, steel production, oil prices, gold prices, interest rates, inflation rates, iron production, and aluminum prices, that affect the global price of iron ore (Mehrdanesh et al., 2021). Iron ore does not have a direct substitute, but steel produced from iron ore has substitutes such as aluminum. On the other hand, any planning for the future requires predicting the future situation. Manufacturing companies need product price forecasts to plan, produce economic analysis of projects, review new investments for development, and so on. Steel production and consumption is today one of the main branches of development of countries and societies. The presence of the steel industry in a region has a significant impact on the process of development of culture, knowledge level, employment generation, research, education and trade of that region. Human daily life is mixed with steel, and steel industries play an important role in the construction, reconstruction and development of the country. Considering that the difference between the consumption and production of crude steel in the country in 2009 was more than 8.9 million tons, investment and growth of the steel industry in the country seems economical and logical; provided that the location of the process, production, supply of natural resources and energy, and project management are selected correctly (Azimi & Afrogh, 2015).

Accordingly, the present study seeks to answer the question: how to predict iron ore pricing using the dynamic neural network method and the process of influence and effectiveness of factors?

### **Theoretical Framework**

#### **Iron Ore Pricing**

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 a fundamental industry in development, and on the other hand, this industry 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 the production and transmission of energy are dependent on products produced from iron ore. Therefore, the global demand for iron ore is high and will remain stable in the future, if not increase (Hao et al., 2018).

Sadegh Beigi Aliayee et al. (2025) studied the optimization of global iron ore price forecasting using intelligent methods. The main features of the forecasting model were based

on the analysis of the correlation coefficients of iron ore prices and the dependent variables of six parameters including price, copper, gold, silver, oil, crude, transportation cost and iron ore demand. They were limited and normalized to improve the performance of intelligent algorithms. Then, a multivariate linear regression model of iron ore price forecasting based on the features was obtained with a coefficient of determination of 0.85. Finally, the frog leap metaheuristic algorithm was used to optimize the model, which led to an increase in the value of R<sup>2</sup> and a decrease in RMSE and MSE.

Souza et al. (2024) presented a new approach to predicting iron ore prices using weighted fuzzy time series analysis. Given the large number of effective parameters and the complex relationships between them, artificial intelligence-based approaches can be used to predict iron ore prices.

### **Research Methodology**

The present study is applicable in terms of purpose, and survey in terms of data. The statistical population includes the daily price of iron ore stocks for 2058 working days. Given that the strong fluctuations in stock prices will affect the forecast; therefore, the statistical sample used in this study includes the daily prices of iron ore stocks in the period of companies entering the stock exchange from 21/03/2016 to 20/03/2023.

### **Research findings**

For modeling the dynamic neural network, the Python programming language was used, and DEMATEL software was used for the effects and effectiveness of factors. The results showed that the dynamic neural network model (LSTM) with its high ability to model the nonlinear effects of macroeconomic variables showed the best performance in predicting iron ore prices. After optimizing the parameters (3 layers and 64 neurons), this model achieved the highest coefficient of determination (R<sup>2</sup>) equal to 0.985 and the lowest root mean square error (RMSE) equal to 0.051. Sensitivity analysis indicated that steel prices are the most important variable for predicting iron ore prices. The results of DEMATEL also showed that the interest rate is the strongest antecedent factor in the economic system, while iron ore production is the strongest adversarial factor. These findings emphasize that iron ore prices are highly dependent on macroeconomic and financial conditions, and that the dynamic neural network is a superior tool for predicting them.

### **Conclusion**

The present study aimed to investigate the prediction of iron ore pricing using the dynamic neural network method and the trend of factors' effectiveness and effectiveness. The results of this study are consistent with the results of Karami Moghaddam & Vishlaghi (2025), Hadian et al. (2025), Isiaka (2025), Bamiri et al. (2025), Safarloo et al. (2024), Suryani & Syamsulbahri (2024), Butson et al. (2023), Bekhit et al. (2023), and Adibzadeh & Roknabadi (2023). Karami Moghaddam & Vishlaghi (2025) showed that a fair payment system in laws, the right to legal promotion and advancement, job security based on the law, determining salaries and benefits based on the approved and unified government table, legal protections in critical situations, and equality and prohibition of legal discrimination were raised as the most important legal factors.

According to the results of the study, it is proposed to replace the core of traditional predictive models with deep learning architecture (LSTM), a review of risk management systems, focusing on key nonlinear drivers and implementing metaheuristic optimization methodologies and hybrid models should be implemented.