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A STUDY TO ANALYSE THE RELATIONSHIP BETWEEN THE PRODUCTION OF STEEL AND FERRO ALLOYS IN THE WORLD WITH SPECIAL REFERENCE TO INDIA

ASHISH V. DONGARE
RESEARCH SCHOLAR
RTM NAGPUR UNIVERSITY
NAGPUR

DR. ANAND MULEY
ASST. PROFESSOR
J. M. PATEL COLLEGE
BHANDARA

ABSTRACT

There is huge scope for Indian Steel Industry to increase its market share in the world's total steel production considering the consistent growth rate of Indian economy in coming years, slowdown of other emerging economies, domestically increasing usage of the steel etc. Ferro alloys are vital inputs for production of all the types of steels. The steel industry and steel and iron industry are the major consumer of Ferro alloys. Therefore, it is imperative to study the relationship between these two industries. And for this purpose a study to analyze the relationship between the production of steel and the production of Ferro alloys in the world with special reference to India has been done. In this research paper, the data for a period of twelve years are collected from various authenticated secondary sources and tabulated appropriately. The data is then analyzed using the various statistical tools such as correlation analysis, hypothesis testing etc. From the data analysis and discussion, it is found that there is significant relationship exist between the production of steel and production of the Ferro alloys at global level. Further, with reference to India also the same relationship stands valid.

KEYWORDS

Ferro alloys, production, relationship, steel industry.

INTRODUCTION

The world has evolved a lot after the World War II. This development has been possible because of the remarkable performance of various industries and one of the most important out of them is the steel industry. Steel industry is considered as the core industry across the globe and its economic importance is immense. This industry has gone through various phases of economic cycle which results in increase or decrease in the production of steel as the usage of the steel is linked to the economic activities such as infrastructural development and others. In spite of going through good and bad patches, the overall production of the steel has shown remarkable growth. The production of the steel in the world since 1950 till 2014 has been tabulated in **the table 1**. In 1950 the world steel production was 189 million tonnes which rises to 1665 million tons in 2014. This means world steel industry has grown around **9 times** in last 65 years.

TABLE 1: WORLD STEEL PRODUCTION 1950 TO 2014 (Million Tonnes)

Year	Production
1950	189
1960	347
1970	595
1980	717
1990	770
2000	850
2005	1148
2010	1433
2014	1665

Source:- World Steel Association

There are many industries which are directly or indirectly linked to Steel Industry and Ferro alloys industry is one of them. Ferro alloys are vital inputs for production of all the types of steels. They are used to impart various properties to the steel and steel industry is the major consumer of Ferro alloys which suggest that Ferro alloy industry is allied industry of steel Industry. Thus, it is important to understand how closely these two industries have been associated with each other and hence the purpose of this paper is to study how significantly these industries are related to each other. To find out this here a study has been carried out to analyze the relationship between the production of steel and production of Ferro alloys. The research involves the study of production of steel in the world to understand the trend in steel production. Later, the production of steel and the Ferro alloys for a period of twelve years have been studied very thoroughly. Appropriate statistical tools have been used so as to ensure the accuracy in the data analysis. To study the relationship of the above stated industries the analysis has been done for the world as a whole as well as for India separately since in this study the special reference has been given to India. The findings and conclusions are discussed thereafter.

REVIEW OF LITERATURE

In the research paper 'A study on capital structure determinants of Indian steel companies' author '*Shrabanti Pal*' used the correlation and regression analysis to explore the relationship between dependent variable leverage and other independent variables like tangibility, size, non-debt tax shield, growth opportunity, profitability and business risk.

In the paper 'the analysis of the correlation between the economic growth and crude steel production in the period 1991-2011' the authors *G. Dobrotă, C. Căruntu* has carried out the study with the purpose of analyzing the trend of the crude steel production and the correlation between this and the economic growth. The data used were reported to a set of six countries for the period 1991 to 2011. The results obtained demonstrate the fact that the economic growth rates influence the production of crude steel, but in different proportions from a country to another.

Authors *Par Jonsson, Thobias Sjoqvist, and Oystein Grong* in their article on 'Future Demands on Ferroalloys from the Customers in the Steel Industry', discussed the possible reasons for increasing trend in improving the knowledge of how size, distribution and composition of inclusions change during steel making in the recent years.

In a paper of 'A brief history of Indian iron and steel industry', the author *K.N.P. Raahas* described the journey of Indian Steel industry.

In the paper 'Indian Ferro Alloy Industry– Present Status and Future Outlook' the authors *C.N. Harman and N.S.S.RamaRao*, discussed in detail about the evolution of the Indian Ferro alloy industry in a phased manner.

B. Sinha and M. Ayyamperumal in their paper 'Technology of Ferro Alloys Making in India- A status and Recent Developments', highlighted the production technology. The technology of bulk ferro alloy processing in general and Research and Development activities carried out in particular have been discussed in detail in this paper.

In the paper 'The Indian Ferroalloy Industry At Cross Roads'- the paper for Metals & Minerals Review – Ferroalloy Special – January 2013 issue the author *PrabhashGokarn*, has discussed in detail the various aspects regarding the past performance of the industry and the expected growth of it.

The authors *Didaleusky, J.R., Jorgenson, J.D., Corathers, L.A., Fenton, M.D., Kuck, P.H., Papp, J.F., Polyak, D.E., Shedd, K.B.* in their paper 'Changes in the North American ferroalloys industry structure and trends in the industry during the past 20 years' have analysed the changes in the North American (Canada, Mexico, and the United States) ferroalloys industry between 1987 and 2007 with respect to production, imports, exports, pricing, and the structure of ownership since 1987. They found that in North America there has been a decline in ferroalloys production. The number of operating companies and plants has decreased, and there has been a steady decrease in ferroalloy production while overall world production has increased.

NEED/IMPORTANCE OF THE STUDY

As per World Steel Association, often abbreviated as world steel-the international trade body for the iron and steel industry, in the steel production in 2014, China was at the top with the 822.7 million tonnes production and India was at number four with 86.5 million tonnes steel production. India's market share in world's total steel production is only 6% whereas China's market share is more than 50%. China's market share increases from 18% in 2001 to 50% in 2014. This is the period when China recorded highest growth rate in the world and it is the undoubtedly the fastest growing economy in the world. But as estimated by IMF China's growth will slow down in coming years and India will become the fastest growing economy of the world by 2019. In such scenario when the overall growth would slow down, naturally China's steel production will also slow down which will create an opportunity for Indian steel makers to increase their market share in world steel production. Further on consumption side, India's per capita consumption of steel in 2014 was just 59.9 kg which is very low as compared to major nations of the world. China's usage of the steel increases from 153.6 million tons to 700.2 million tons while during the same period India's steel usage increases from 27.4 million tons to 73.7 million tons. This shows that the usage of steel in India is very low as compared to China. Now, India is in process of developing world class infrastructure which naturally increases the domestic demand/consumption/usage of the steel.

Thus, expected slowdown in China, increasing demand of steel from other developing countries to meet their infrastructure requirements and increasing domestic demand for steel keeping in view the overall trend of steel in consumption across the globe and decent pace of overall growth of the Indian economy compared to other countries, Indian Steel Industry has golden opportunity to increase the market share. So, when Indian Steel Industry will grow, the industry which is closely associated with Steel Industry has all the potential to grow. Ultimately, these associated industries will be benefited by the growth of the steel industry. Therefore, the analysis of the relationship between the production of steel and Ferro alloys becomes very important in finding out association of these two industries which ultimately help Indian Ferro alloy industry to be in the state of readiness to match up the requirement of Indian Steel industry

OBJECTIVES

The core objective of this study is to find out whether there is any relationship between the production of steel and the Ferro alloys. This study is in special reference to India keeping in mind huge prospect of growth for Indian steel industry. Thus the objectives of the study are as under:-

1. To study the relationship between the production of Steel and Ferro alloys at global level.
2. To study the relationship between the production of Steel and Ferro alloys in India context.

RESEARCH METHODOLOGY

NATURE AND SOURCE OF THE DATA

The data which is being used for the purpose of this study is collected from secondary sources. The websites of various international national agencies such as world steel organization, international monetary fund, Indian Ferro Alloy Producers' Association; government websites like websites of US government Geological department, Indian steel ministry etc. are used for collecting the data. Further the year books of Indian Bureau of Mines (IBM) are also used to collect the data.

SAMPLE SIZE AND PERIOD

The data for a period of twelve years i.e. from 2001 to 2012 for world and Indian steel and ferro alloy industry is taken for this study.

TOOLS AND TECHNIQUES

Pearson Correlation coefficient is used to find out the relationship between production of steel and production of the Ferro alloys. The variables used in the study are quantitative variables. Hypothesis testing has also been carried out.

FORMULATION OF HYPOTHESIS

The hypothesis are formulated taking into account the objective of the study. The hypothesis for this study as follows:

1. **H1:** There is significant positive relationship between the production of Steel and Ferro alloys at global level.
2. **H1:** There is significant positive relationship between the production of Steel and Ferro alloys in case of India.

DATA ANALYSIS AND HYPOTHESIS TESTING

The data for the world's total Ferro alloys production versus world's total steel production is tabulated in the table 2. The data is taken from 2001 to 2012 and this period represent both bull and bear phase-Bull run in around 2003-04 especially in emerging economies and bear phase in 2008-09.

TABLE 2: PRODUCTION OF FERRO ALLOYS & STEEL AT WORLD LEVEL (in MT)

Year	Ferro alloy production	Steel Production
2001	19,200,000	851,073,000
2002	20,300,000	904,170,000
2003	22,800,000	969,915,000
2004	26,300,000	1,062,541,000
2005	28,000,000	1,147,805,000
2006	32,800,000	1,250,107,000
2007	37,900,000	1,348,122,000
2008	37,600,000	1,343,269,000
2009	38,300,000	1,238,285,000
2010	45,800,000	1,432,761,000
2011	48,300,000	1,537,206,000
2012	47,900,000	1,559,472,000

Source: US geological survey and world steel association

TABLE 3: CORRELATION STATISTICS

	Ferro alloy production	Steel Production
Ferro alloy production	1	
Steel Production	0.982617439	1

The coefficient of correlation is calculated as 0.982617439. The calculated value is nearer to the 1, indicating the significantly positive correlation between the two variables.

HYPOTHESIS TESTING

H0:- There is no significant relationship between the production of the Steel and Ferro alloys at global level.

H1:- There is significant positive relationship between the production of the Steel and Ferro alloys at global level.

In this case, on calculating the t value using the t value formula $t = \{r(n-2) / \sqrt{1-r^2}\} / \sqrt{1/2}$ comes out to be **45.03626999**

Now, on using **T (DIST)** function in excel worksheet with $t = 45.036$, degrees of freedom= 2 and for two tail the values comes out to be **0.000000000007019**.

This number is very low as compared to significant level 0.05 hence we reject the null hypothesis H0 and accept the alternate hypothesis H1.

INDIAN CONTEXT

The data for the India's total Ferro alloys production versus India's total steel production is tabulated in the table 4. The data is taken for twelve years i.e. from 2001 to 2012.

TABLE 4: PRODUCTION OF STEEL & FERRO ALLOYS IN INDIA (in '000 MT)

Year	Ferro Alloy	Steel
2001	903	27291
2002	828	28814
2003	1,016	31779
2004	1,239	32626
2005	1,480	45780
2006	1,645	49450
2007	2,001	53468
2008	2,965	57791
2009	2,220	63527
2010	2,494	68976
2011	2,797	73471
2012	3,000	77264

Source: Indian Bureau of Mines and world steel association

TABLE 5: CORRELATION STATISTICS'

	Prod. of Ferro Alloy	Prod. of Steel
Prod. of Ferro Alloy	1	
Prod. of Steel	0.943761727	1

The coefficient of correlation is calculated as 0.943761727. The calculated value is nearer to the 1, indicating the significantly positive correlation between the two variables.

HYPOTHESIS TESTING

H0:- There is no positive relationship between the production of the Steel and Ferro alloys in India.

H1:- There is significant positive relationship between the production of the Steel and Ferro alloys in India.

In this case, on calculating the t value using the t value formula $t = \{r(n-2) / \sqrt{1-r^2}\} / \sqrt{1/2}$ comes out to be **13.6353**

Now, on using **T (DIST)** function in excel worksheet with $t = 45.036$, degrees of freedom= 2 and for two tail the values comes out to be **0.000000087121**.

This number is very low as compared to significant level 0.05 hence we reject the null hypothesis H0 and accept the alternate hypothesis H1.

CONCLUSIONS

- 1) Thus from the above data analysis and discussion, it is concluded that there is significant positive relationship between the production of the Steel and Ferro alloys at global level.
- 2) Further, with reference to India also there is significant positive relationship between the production of the Steel and Ferro alloys.

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