

A correlation analysis between consumption of Steel and Ferro alloy production in India and China

Ashish Dongare¹, Dr. Anand Muley²

Research Scholar¹, Asst. Professor²

RTM Nagpur University, Nagpur¹, J. M. Patel College, Bhandara²

ABSTRACT

This study has been carried out with the purpose of finding out the relationship between the consumption of Steel and production of Ferro alloys. This study is important since Steel industry is the major consumer of Ferro alloys. In this study the consumption of Steel is studied against the production of Ferro alloys on two parameters one is total usage of finish Steel products and other is per capita consumption of steel. The period of study is from 2006 to 2012 and study is restricted geographically to India and China. To study this relationship the correlation analysis has been carried out firstly between the total usage of finish Steel products and production of Ferro alloys and then between the per capita consumption of Steel in India and China. It has been found that there is positive correlation between consumption of Steel and production of Ferro-Alloys. Thus, confirming dependency of Ferro alloy industry on steel industry.

Keywords

Ferro alloys, Per capita consumption, Steel, Usage.

1. INTRODUCTION

It is said that 19th century was of Europe, 20th century was of America and now 21st century is of Asia. The two Asian giants China and India is proving it correct by growing faster than any other economy in the world. For more than last 20 years China is on an average growing in double digits and India also has shown remarkable growth after Liberalization. China is ranked No. 1 and India ranked No. 3 economy in the world in terms of purchasing power parity (PPP). The growth of any economy is backed by the growth in many sectors. However, Steel is the most critical of them since Steel is an important integral part of infrastructure and many other industries. Therefore, growth of Indian and Chinese economy resulted in the growth of steel industry in India and China. The production of Crude steel for both the countries since 2001 to 2012 is tabulated in **Table 1.1**.

From the table it is evident that Chinese Steel industry is much bigger than the Indian Steel industry. Chinese Steel industry has grown 4.82 times whereas Indian Steel industry by 2.83 times during the period 2001 to 2012.

Now, in the given scenario wherein both the countries have shown remarkable growth in production of Steel, it's very important to understand how the growth of this industry is responsible for the growth of its associated industries.

One of the most closely associated industries of Steel industry is Ferroalloy industry as *Steel industry is the major consumer of Ferro alloys*. (**Ferroalloy** refers to the alloy where the base metal is iron. The elements which are widely used with iron in different proportions are manganese, chromium, silicon, carbon etc.) Thus, consumption of Ferro alloys is directly or indirectly

Table: 1.1

Total Production of Crude Steel (thousand metric tons)		
Years	China	India
2001	151634	27291
2002	182366	28814
2003	222336	31779
2004	272798	32626
2005	355790	45780
2006	421024	49450
2007	489712	53468
2008	512339	57791
2009	577070	63527
2010	638743	68976
2011	701968	73471
2012	731040	77264

Source:- World Steel Association

related to consumption of Steel. Therefore, to understand the relationship between consumption of steel and production of Ferro alloys is important, this will help in understanding the correlation between consumption of steel and production of Ferro alloys.

The purpose of choosing China and India for this study is to see whether the same correlation exist between the two variables (consumption of steel and production of Ferro alloys) for both countries or there is any deviation as China is the main competitor of India in Steel and Ferro alloys sector and it is the largest producer of Steel and Ferro alloys. The other reason of including these two countries is estimation by International monetary fund that India will overtake China in coming years in terms of GDP growth rate. In such scenario when India would be the fastest growing economy in the world, India's Steel industry and other associated industry will also grow faster. So, it becomes imperative to understand the relationship between consumption of steel and production of Ferro alloys as Steel

industry is the major consumer of Ferro alloys. The consumption of Steel is studied on the basis of two parameters:

1. Total usage of finish Steel products and
2. Per capita consumption of Steel.

These two parameters are studied against the production of Ferro alloys to find the correlation.

2. REVIEW OF LITERATURE

Many research papers, books journals have been referred for this study.

G. Dobrotă and C. Căruntu in the research paper 'the analysis of the correlation between the economic growth and crude steel production in the period 1991-2011' analysed the trend of the crude steel production and the correlation between this and the economic growth. It has been found that the economic growth rates influence the production of crude steel in different proportions.

Anghelache in his paper 'Analysis of the Correlation between GDP and the Final Consumption' analyses the correlation of GDP with the Final consumption in Romania and it has been found that Romania's GDP is influenced, mainly, by the evolution of the public and private consumption.

In the paper 'The status of the ferroalloy industry with special reference to South Africa' the Author Smith H. J. analyzes the vital link of the global ferroalloy industry in a variety of critical production chains, as well as its interaction with market forces. He also discussed the South Africa's current and future role is portmised against the background of its mineral wealth and its advantages in regard to infrastructure and other resources.

Shrabanti Pal in the research paper 'A study on capital structure determinants of Indian steel companies' 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.

Par JONSSON *et.al.* 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 steelmaking during the recent years. If the ferroalloy industry work together with these steel companies, which use the cutting edge technology to gather information on inclusion characteristics, both parties will benefit.

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

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

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.

J.R. Didaleusk *et. al.* in their paper 'Changes in the North American ferroalloys industry structure and trends in the industry during the past 20 years' have analyzed 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.

Books on research methodology, annual reports of ministries, and reports of international agencies are also reviewed for the purpose of this study.

3. RESEARCH METHODOLOGY

3.1 Source of the data: - The source of data used for this study is secondary sources. The data has been collected using following sources:

- World steel organization,
- International monetary fund,
- Indian Ferro Alloy Producers' Association
- Government websites like websites of US government Geological department, Indian steel ministry etc.

Further the year books of Indian Bureau of Mines (IBM) are also used to collect the data.

3.2. Sample size and period: - The data for a period of six years i.e. from 2006 to 2012 for Chinese and Indian Steel and Ferro alloy industry is taken for this study. The study is limited geographically to India and China.

3.3 Tools and techniques: - The statistical tool which has been used for data analysis is Pearson Correlation coefficient. The variables used in the study are total use of finished steel products, per capita consumption of Steel and production of Ferro alloys. Hypothesis testing has also been carried out.

3.4 Formulation of Hypothesis:-The hypotheses 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 total use of finished steel products and production of Ferro alloys in China.
- (2) H1:- There is significant positive relationship between the per capita consumption of Steel and production of Ferro alloys in China.
- (3) H1:- There is significant positive relationship between the total use of finished steel products and production of Ferro alloys in India.
- (4) H1:- There is significant positive relationship between the per capita consumption of Steel and production of Ferro alloys in India.

4. DATA ANALYSIS AND HYPOTHESIS TESTING:

The data analysis has been done for China first and then for India. The data for the use of finish steel products and total Ferro alloys production in China is tabulated in the table 4.1. The period taken for the purpose of study is 2006 to 2012.

Table: 4.1

Use of finish steel product and production of Ferro alloys in China (in Million Tons)		
Years	use of finish steel products	Prod. Of Ferro alloys
2006	377.7	14.70
2007	418.4	18.40
2008	446.9	19.20
2009	551.4	23.10
2010	587.6	26.00
2011	634.3	28.10
2,012	646.2	28.30

Source:- US geological survey and world steel association

The data represented in the above table indicates that as the use of finish Steel product is increasing the production of Ferro alloys is also increasing in China.

HYPOTHESIS TESTING:-

H0:- There is no significant relationship between the use of finish Steel products and production of Ferro alloys in China.

H1:- There is significant positive relationship between the uses of finish Steel products and production of Ferro alloys in China.

On applying the Correlation technique we get the results as under:-

Correlation Statistics:

	Usage of steel	Ferro alloy India
Usage	1	
Ferro alloy India	0.992556	1

The calculated coefficient of correlation is 0.992556. On calculating the T value using the t value formula comes out to be **74.81577**.

Formula: 1 T- value formula

$$t = r_{yx} \sqrt{\frac{n-2}{1-r_{yx}^2}}$$

T-value- (Calculated)	74.81577
T-table value(DF-5, Sign.Level-0.05)	0.7545

This calculated value of *T* is greater than its table value and hence we reject the null hypothesis at the given level of significance and may infer that there is significant relationship between the two variables.

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

The other parameter which is taken to study the consumption is per capita consumption of Steel. Therefore the per capita consumption of Steel is tabulated against the production of Ferro Alloys in China in the table 4.2 below.

Table: 4.2

Per capita consumption of steel & production of Ferro alloys in China (in Kg & in Million Tons)		
	Per Capita Steel Consumption(in kg)	Ferro alloy Prod.(in million tones)
2006	287.3	14.70
2007	316.6	18.40
2008	336.4	19.20
2009	413.1	23.10
2010	438.1	26.00
2011	470.7	28.10
2,012	477.4	28.30

Source:- US geological survey and world steel association

HYPOTHESIS TESTING:-

H0:- There is no significant relationship between the per capita consumption of Steel and production of Ferro alloys in China.

H1:- There is significant positive relationship between the per capita consumption of Steel and production of Ferro alloys in China.

The correlation statistics for the above given data is as below:

Correlation Statistics:

	Per Capita Consumption	Ferro alloy production
Per Capita	1	
Ferro alloy prod.	0.992192	1

When the T- value is calculated using formula-1, it comes out to be 71.31481026.

T-value- (Calculated)	71.31481026
T-table value(DF-5, Sign.Level-0.05)	0.7545

Since calculated T- value is greater than T- Table value, we reject the null hypothesis and will accept the alternate hypothesis H1 which states that there is significant positive relationship between the per capita consumption of Steel and production of Ferro alloys in China.

The another aspect of the study is to find whether in case of

India also same relationship exist or not. For this purpose, the same analysis has been done with reference to India.

In the table 4.3 the data on use of finish steel product and Ferro alloys production in India is presented.

Table: 4.3

Use of finish steel product and Ferro alloys production in India (in Million Tones)		
	Use of Finish steel products	Ferro alloy Prod.
2006	45.6	1.65
2007	51.5	2.00
2008	51.4	2.96
2009	57.9	2.22
2010	64.9	2.49
2011	69.8	2.80
2,012	71.6	3.00

Source:- US geological survey and world steel association

H0:- There is no significant relationship between the use of finish Steel products and production of Ferro alloys in India.

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

The correlation statistics for the data given in the table 4.3 is as under:

Correlation Statistics:

	Use of steel	Ferro alloy prod
Use of steel	1	
Ferro alloy prod	0.690537	1

The T value is calculated using the Formula 1. T value calculated and T-value table is represented as below.

T-value- (Calculated)	1.475736
T-table value(DF-5, Sign.Level-0.05)	0.7545

As the calculated value is greater than the tabular value/ critical value of Pearson's Correlation Coefficient for proportion in two tails at 0.05 level of significance with 5 degrees of freedom, we may reject the null hypothesis and it can be stated that there is significant positive relationship between the uses of finish Steel products and production of Ferro alloys in India.

To find the correlation between consumption of Steel and production of Ferro alloys, the per capita consumption of Steel against the Ferro alloys production in India is tabulated in the table 4.4

Table: 4.4

Per capita consumption of steel and Ferro alloys production in India (in Kg & in Million Tones)		
	Per capita consumption of Steel (in Kg)	Ferro alloy Prod.
2006	39.4	1.65
2007	43.9	2.00
2008	43.2	2.96
2009	47.9	2.22
2010	53	2.49
2011	56.2	2.80
2012	56.9	3.00

Source:- US geological survey and world steel association

HYPOTHESIS TESTING:-

H0:- There is no significant relationship between the per capita consumption of Steel and production of Ferro alloys in India.

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

The correlation statistics for the data given in the table 4.4 is as under.

Correlation Statistics:

	Per capita consumption	Ferro alloy Prod
Per capita consumption	1	
Ferro alloy India	0.674151921	1

The coefficient of correlation is calculated as 0.674151921. After calculating, T- values are presented as below:

T-value- (Calculated)	1.38816654
T-table value(DF-5, Sign.Level-0.05)	0.7545

We will reject the null hypothesis as the calculated T- value is higher than the Tabular T- value and accept the alternate hypothesis.

5. CONCLUSIONS

This study has been carried out with an objective of finding the relationship between the consumption of Steel and production of Ferro alloys in India and China. For this purpose, the total usage of finish Steel product and per capita consumption of Steel are studied against the total Ferro alloy production. It has been found that for both the countries, China and India, there is significant positive relationship between the uses of finish Steel products and production of Ferro alloys. The similar results are found when correlation study carried out for per capita

consumption of Steel against Ferro alloy production. Thus, both the parameters of consumption of Steel i.e. use of finish Steel products and per capita consumption of Steel is positively correlated with Ferro alloy production. Therefore, it has been concluded that there is positive relationship between the consumption of Steel and production of Ferro alloys in India and China.

6. REFERENCES

- [1] Anghelache, C. (2011) "Analysis of the Correlation between GDP and the Final Consumption" *Theoretical and Applied Economics*, Vol. XVIII, No. 9(562), pp. 129-138.
- [2] Dobrotă, G. and Căruntu, C. (2013) "The analysis of the correlation between the economic growth and crude steel production in the period 1991-2011" *Metallurgical*, pp. 425-428.
- [3] Harman, C.N. and Rama Rao, N.S.S. "Indian Ferro Alloy Industry- Present status and Future Outlook".
- [4] Harman, C.N. (1996) "Status of Ferro Alloy Industry in the Liberalized Economy" paper presented at National Workshop, Jamshedpur.
- [5] Indian Minerals Yearbooks (from 2001-2013), Ferro-Alloys, Indian Bureau of Mines, Ministry of Mines, Government of India.
- [6] Kothari, C.R.(2004) "Research Methodology Methods & Techniques", *New Age International publisher*, New Delhi, Second Edition, pp. 141,142, 228.
- [7] Smith, H.J. (1992) "The status of the ferroalloy industry with special reference to South Africa" INFACON 6, Proceedings of the 6th International Ferroalloys Congress, Cape Town, Johannesburg, Vol. 1, pp. 3-12.
- [8] Vadde, S. and Srinivas, G.(2012) "The Indian Steel Sector: Development And Potential", *International Journal of Multidisciplinary Research*, Vol. 2, Issue 1, pp.177-186.
- [9] Website of US Geological survey.
- [10] Website of World Steel Associations.
- [11] Website Ministry of Steel, Govt. of India.