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Investigating the relationship between Tobin's Q and Intellectual Capital of Firms: An empirical study on Ferrous Metal Industry

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Abstract: **Intellectual capital assumes prominence in knowledge economy. It is both a resource as well as product. Performance of corporate and non-corporate entities in knowledge economy is gauged on the basis of quantity and quality of intellectual capital. Of late Tobin's Q is increasingly found in the literature related to evaluation of intellectual capital. Though it was originally developed as a theory of capital market investments, it is widely used as a measure to quantify the intellectual capital of firms whose assets are traded freely in regulated market. The present study attempts to establish and explore a relationship between intellectual capital and Tobin's Q, by theoretically assessing the suitability of using Tobin's Q for evaluating the intellectual capital of firms, by constructing the components of intellectual capital using objective methodologies and by empirically establishing a relationship between Tobin's Q and intellectual capital. While some studies in the western setting have explored the relationship between Tobin's Q and intellectual capital, this paper set out to empirically test the relationship between Tobin's Q and intellectual capital in ferrous metals industries as they fall under medium low technology segment of knowledge based manufacturing industries in India.**

Keywords: **Intellectual Capital, Tobin's Q, Innovation..**

1. INTRODUCTION

The terms intellectual capital, knowledge capital, intellectual assets or intangible assets are used interchangeably as they all represent a non-physical claim to future benefits. Economists call them as knowledge capital, management experts refer to them as intellectual capital and accountants call them as intangible assets or intellectual assets. Intangible assets are a generic term used to describe the invisible capital of a firm that generates value for it. Intangible assets in its evolving forms are commonly referred to as intellectual capital or knowledge capital or intellectual assets. Legally protected intellectual assets become intellectual property (Prasanna, 2004). According to Edvinsson and Malone (1997), intellectual capital takes three basic forms: human capital, structural capital, and customer capital. Edvinsson and Malone classify structural capital further into organizational capital, process capital and innovation capital. Since the market value of any company represents the present value of its expected cash flows, market value of a company can be used as surrogate for deciphering the value of its intellectual assets. Edvinsson and Malone (1997), state that intellectual capital takes three basic forms: human capital, structural capital, and customer capital. Human capital includes knowledge, skills, and abilities of employees. Human capital is an organization's combined human capability for solving business problems. Human capital is inherent in people and cannot be owned by organizations. Therefore, human capital can leave an organization when people leave. Human capital also encompasses how effectively an organization uses its people resources as measured by creativity and innovation. Structural capital is everything in an organization that supports employees (human capital) in their work. Structural capital is the supportive infrastructure that enables human capital to function. Structural capital is owned by an organization and remains with an organization even when people leave. Structural capital includes such traditional things as buildings, hardware, software, processes, patents, and trademarks. In

addition, structural capital includes such things as the organization's image, organization's information system and proprietary databases. Customer capital is the strength and loyalty of customer relations. Customer satisfaction, repeat business, financial well-being, and price sensitivity may be used as indicators of customer capital. The notion that customer capital is separate from human and structural capital indicates its central importance to an organization's worth. The relationship with customers is distinct from other relationship either within or outside an organization. Edvinsson and Malone (1997a) further classify structural capital further into organizational capital, process capital and innovation capital. Organizational capital includes the organization's philosophy and systems for leveraging the organization's capability. Process capital includes the techniques, procedures, and programs that implement and enhance the delivery of goods and services. Innovation capital includes intellectual properties and intangible assets.

1.1. TOBIN'S Q AND INTELLECTUAL CAPITAL

Though intellectual capital is a phenomenon, it is very hard to pin down because evaluation of intellectual capital is as elusive as its nature. However researchers worldwide are attempting to evaluate intellectual capital through various methods and have developed many tools. Of late Tobin's Q is increasingly found in the literature related to evaluation of intellectual capital. As Tobin's Q is an outcome of the market value of a company which comprises of the value of its tangible assets recorded in its financial statements, the value of its intellectual assets which are usually not recorded in the financial statements and some other factors that influence the stock market, it can also be used to compute the value of intellectual assets of a company (Villalonga, 2004). Tobin's Q cannot provide an accurate figure for individual intellectual assets. It only measures the aggregate value. Tobin's Q is a reliable indicator of intellectual asset intensiveness of a company. The trend analysis of Q of a company can indicate the effective utilization of the intellectual assets by a company. If the Q is falling, either the company is not managing its intellectual assets effectively or the investors' sentiment has moved against it. Tobin's Q is considered as a measure to capture the value of intellectual assets of a publicly traded company [CIMA (2003), Hall (1993)]. Peters & Lucien (2014), observes that technological advantage, market advantage and the efficiency of human resources to be the main components of intellectual assets measured by Tobin's Q. Agrawal & Knoeber (1996), Skinner (1993) and Hirschey & Weygandt (1985) have shown that there is a strong positive correlation between Tobin's Q and intangible expenditures, in particular the R&D expenditures. Cazavan-Jeny (2003) found that there is strong positive correlation between Tobin's Q and intellectual capital constructed through 'stock' of intangibles'. Some other studies have used Tobin's Q in the context of assessing the effect of intellectual capital on Tobin's Q. Sivakoumar (2016), Kanwar (2014), Rahko (2014) Miyagawa et al. (2012), Chadha & Oriani (2009), Kavida (2008), De (2007), Hall (2007), Hall & Oriani (2006), Hall, Thoma and Torrisi (2006), Gleason and Klock (2003), Lau (2003), Hall (1993), Griliches (1981) have found that the 'stock' of intangibles to have a significant impact on Tobin's Q.

1.2 THE 'STOCK' AND 'FLOW' CONCEPT OF INTELLECTUAL CAPITAL

The studies reviewed have either used 'stock' or 'flow' of intellectual assets. Those using the 'flow' concept have adhered to the conservatism of accounting standards and those who have used 'stock' concept have challenged this conservatism. The 'stock' concept exactly fits into the Schumpeterian concept of 'creative destruction' of knowledge and its derivative - innovation. Further, the 'stock' concept holds rational because of the nature of knowledge accumulation where new knowledge accumulates and at the same time, old knowledge becomes obsolete. Since this process of knowledge accumulation and obsolescence is continuous, the researchers who have relied on the 'stock' concept have used Perpetual Inventory Method to compute knowledge capital.

1.3 RELEVANCE OF MEDIUM AND LOW TECHNOLOGY INDUSTRIES

The medium and low technology industries are regarded as providing many points of entry for the developing countries like India, in view of their relative labor-intensity. Medium and low technology industries are characterized as specialized-supplier and scale-intensive industries that include the knowledge intensive businesses that are essential for the production, diffusion and use of technology and thereby contribute towards economic growth (Hauknes and Knell, 2009). As per OECD (2001) and OECD (2011) framework of knowledge based industrial classification, the constituents of medium low technology industries for India are rubber and plastic products, refined petroleum products, non-ferrous metals, ferrous metals, (Sivakoumar, 2016). The present study attempts to explore the relationship between Tobin's Q and intellectual capital of medium low technology industries, with special reference to ferrous metals, since most of the studies in this area have focused on high technology segment of knowledge based manufacturing industries. Though this

industry is classified as medium low technology industry, innovation and technology seems to play a major role in the growth and development of ferrous metals industry. Ferrous metals primarily consist of iron and different varieties of steel. India ranks fourth among the top global iron ore producers. Among the top global consumers of iron ore, India ranks third. The total domestic consumption of iron ore during 2009-10 was reported to be around 90 million tones, of this around 98% was accounted for by iron and steel (including sponge iron industries). Basic metal industry is one of the prime sectors under the manufacturing industries because of the direct or the indirect dependency that the other industry has on this sector. The necessity to produce high quality products which can satisfy the domestic and global demands and to deploy energy efficient techniques of production in order curtail energy related costs have prompted the basic metal industries to invest a significant proportion of their capital towards research and development. The R&D activities in India however are not at par with other countries globally but the efforts given to this sphere cannot be neglected. The long term goal of Indian metal industries to compete with their global peers has also been an instrumental factor towards technology innovation. The pressure to cater to the increasing demands of the domestic industries, which directly or indirectly depend on the finished or semi processed product of the basic metal industries, has also been a factor for investments made towards technology development.

2. RESEARCH PROBLEM

It is evident from the research studies reviewed above, that Tobin's Q is associated with intellectual capital. But, the association is established through correlating the 'expenses' related to intellectual capital or reported intangible assets [Cazavan-Jeny (2003), Agrawal & Knoeber (1996), Skinner (1993) and Hirshey & Weygandt (1985)]. Except Cazavan-Jeny (2003), there is hardly any study to establish a correlative relationship between the Tobin's Q and 'stock' of intellectual capital. There is dearth of studies especially in the Indian context to establish a relationship between Tobin's Q and intellectual capital in a correlative mode, to theorize that there is a positive relationship between Tobin's Q and intellectual capital of firms and the former can be used as an indicator of the later. Further, the research studies applying the 'stock' concept of expenses related to intellectual capital have 'assumed' their own rates of obsolescence and there seems to be lack of uniformity. Hence these assumed rates suffer from selectivity bias. Therefore the present study attempts to establish a relationship between Tobin's Q and intellectual capital to theorize that Tobin's Q is the indicator of intellectual capital of firms, by overcoming the selectivity bias.

2.1 RESEARCH METHODOLOGY

2.1.1 SOURCE OF DATA AND SAMPLE SELECTION

The data was sourced from PROWESS, the electronic database of Centre for Monitoring Indian Economy (CMIE). The CMIE Overall Share Price Index (COSPI) is a total returns index of all firms in India where trading took place on at least 66% of days in last six months. It reflects the equity market of 2800 firms. The market capitalization of COSPI was Rs.61.69 billion at the end of the study period. The market capitalization of BSE was Rs.63.88 billion during the corresponding period. Hence COSPI is an appropriate proxy for market valuation. The firms listed in COSPI Manufacturing Index were chosen for the study. The study period covers a decade, from 2003 to 2013. However for computation of the discernible elements of intellectual capital data was collected from 2001 onwards. The study period assumes significance as it would help to review the impact of transition from soft intellectual property regime to TRIPs compliant strong intellectual property regime. The COSPI ferrous metals index covers 171 firms and this study was carried out on 38 firms, for which complete data were available. Thus the sample covers nearly 22.22 percent of the population available.

2.2 TOBIN'S Q

In this study Tobin's Q is computed as a ratio of market value of a company to its replacement cost of its tangible assets. The market value is computed as a sum of its 365 days average market capitalization and the book value of its debts represented by its long term and short term borrowings. The replacement cost of its assets is computed by the book value of its tangible assets adjusted by its reported intangible assets.

2.3 INTELLECTUAL CAPITAL

Further, in this study Intellectual capital is computed as a 'stock' of capital using perpetual inventory method. Since the process of knowledge accumulation and obsolescence is continuous, the study relies on the 'stock' concept. Perpetual

inventory method is an accounting concept, wherein a firm maintains its inventory on running basis. This concept is widely used in macro economics, for assessing the productivity of a nation's capital stock, for its various accounting purposes, including Gross Domestic Product (GDP). The basic idea behind computing a nation's capital stock using perpetual inventory method is that a nation's capital stock is assumed to be inventory and the stock of inventory increases with capital formation. Once the inventory enters an economy, it remains there forever and generates returns, till it decreases. But, new stock of inventory enters with the depreciation of old stock of inventory. Thus the stock of inventory never falls to zero, (Berlemann & Wesselhoft, 2014). As intellectual capital also follows this phenomenon, Grilliches (1981), Hall (1993), Hall & Oriani (2006), Chadha & Oriani (2009), Rakho (2014), Kanwar (2014) and scores of other researchers have used perpetual inventory method for computing the components of intellectual capital. However amortization rates or depreciation rates of knowledge capital is the key to the construction of stock of intellectual capital.

2.4 OVERCOMING THE 'SELECTIVITY BIAS' OF RATE OF OBSOLESCENCE

Hitherto the research studies attempting to establish a relationship between Tobin's Q and intellectual capital adopting the 'stock' concept found no consensus among themselves on the rate of obsolescence of knowledge and therefore they have assumed their own rates of obsolescence. Further, they have assumed their own rates of obsolescence and attempted to convince the accounting profession on the need for accounting of intellectual assets. This study on the other hand took the accounting profession into confidence and obtained an 'expert' rate of obsolescence for knowledge assets. In this regard this study obtained the perception of the Chartered Accountants of India through an opinion survey. Fifty five percent of the respondents stated that the expenses related to research & development, advertisement, marketing, salaries and wages, training and development and administrative expenses need to be considered as investments. They have also chosen 20 to 30 percent as suitable rates for amortization of these investments as capital stock. However this study has adopted the lower range suggested for construction of the three components of intellectual capital namely innovation capital, relational capital and human capital through perpetual inventory method as follows:

Innovation capital which refers to product and process is measured by:

$$INO\ Cap_{it} = (1-\delta)RD\ Cap_{i,t} - 1 + RD_{it},$$

where *RD* refers to research and development expenses of firms, treated as investments and δ refers to an amortization rate of 20 percent.

Relational capital is measured by:

$$REL\ Cap_{it} = (1-\delta)SD\ Cap_{i,t} - 1 + SD_{it},$$

where *SD* refers to selling and distribution expenses of firms, treated as investments and δ refers to an amortization rate of 20 percent.

Human capital is measured by:

$$HUM\ Cap_{it} = (1-\delta)SWTD\ Cap_{i,t} - 1 + SWTD_{it},$$

where *SWTD* refers to salaries, wages, training and development expenses of firms, treated as investments and δ refers to an amortization rate of 20 percent.

Thus Tobin's Q, Innovation capital, Relational capital and Human capital were computed using the above methods and Pearson's correlation or linear or product-moment correlation was run to establish and explore the relationship between Tobin's Q and Intellectual capital of ferrous metals industry in India.

3. EXPLORING THE RELATIONSHIP BETWEEN TOBIN'S Q AND INTELLECTUAL CAPITAL

In order to explore the relationship between Tobin's Q and intellectual capital, a simple Pearson's correlation is run to establish the relationship.

3.1 TOBIN'S Q AND INTELLECTUAL ASSETS OF FERROUS METALS INDUSTRY

Table I presents the Tobin's Q of ferrous metals industry. It may be seen that the average Q is 0.92 for the study period. Since the average Q value is less than one, it may be understood that either the industry does not manage its intellectual

assets effectively or the investors are pessimistic about its performance during the study period. The table exhibits only the top 25 firms of the industry. But the average Q is based on the entire sample of 38 firms. The Tobin's Q of all the 38 firms is provided in the appendix. Sixteen firms report higher Q than the average. The top 12 firms record a Q of above one which may be interpreted as that these firms posses invisible assets than those reported in the balance sheets. The trend of the Q is mixed during the study period.

Table II presents the value of innovation capital of the firms representing the ferrous metals industry. Though the sample consists of 38 firms, the table presents the top 25 firms only. The innovation capital of all the 38 firms is provided in the appendix. On an average the R&D capital of the firms representing the ferrous metals industry is 128.73 million rupees. Six firms report R&D capital of 1 billion rupees. Steel Authority of India Ltd. and Tata steels Ltd. are top two firms to have innovation assets exceeding 10 million rupees. The trend records a steady increase during the study period.

Table III presents the value of relational capital of the firms representing the ferrous metals industry. Though the sample consists of 38 firms, the table presents the top 25 firms only. The relational capital of all the 38 firms is provided in the appendix. On an average the relational capital of the firms representing the ferrous metals industry is 3054.88 million rupees. All the 25 firms record relational capital exceeding 1 billion rupees. Twelve firms exhibit market related assets exceeding 10 billion rupees. Three firms possess reputation capital exceeding 100 billion rupees. The trend records a steady increase during the study period.

TABLE -I: TOBIN'S Q OF FERROUS METALS INDUSTRY

Name of the Firm	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Avg.	Rank
Jindal Steel & Power Ltd.	0.91	1.02	1.15	1.21	2.77	1.89	2.94	2.84	2.05	1.49	1.83	1
Western India Shipyard Ltd.	1.05	1.20	1.50	1.30	2.15	1.69	1.75	3.15	2.06	1.73	1.76	2
Pennar Industries Ltd.	1.82	1.80	1.70	1.62	1.28	1.29	1.08	1.47	1.12	0.85	1.40	3
Maharashtra Seamless Ltd.	1.39	1.52	1.71	2.26	2.69	1.05	0.85	0.96	0.82	0.73	1.40	4
Rohit Ferro-Tech Ltd.	4.71	3.00	0.97	0.88	0.74	0.76	0.59	0.70	0.62	0.57	1.35	5
Orissa Sponge Iron & Steel Ltd.	0.56	0.67	0.80	0.78	1.47	1.19	2.25	2.21	1.96	1.54	1.34	6
Ramkrishna Forgings Ltd.	2.15	1.17	1.30	1.35	1.43	0.98	0.85	0.96	0.75	0.76	1.17	7
Kamdhenu Ispat Ltd.	3.39	2.45	1.65	0.91	0.56	0.50	0.48	0.53	0.45	0.47	1.14	8
Steel Authority Of India Ltd.	0.96	0.84	0.91	1.12	1.96	1.02	1.31	1.30	0.84	0.68	1.09	9
Electrotherm (India) Ltd.	2.94	1.83	0.64	0.62	0.69	0.71	0.62	0.79	0.74	0.94	1.05	10
Facor Alloys Ltd.	1.14	1.40	2.43	1.29	1.15	1.02	0.59	0.61	0.45	0.42	1.05	11
Tube Investments Of India Ltd.	0.49	0.78	1.40	1.21	0.96	0.68	0.82	1.30	1.25	1.37	1.03	12
Tata Steel Ltd.	1.00	1.14	1.23	1.19	1.29	0.95	0.89	0.90	0.76	0.64	1.00	13
Oil Country Tubular Ltd.	0.55	0.73	0.86	0.78	2.11	0.83	1.14	1.25	0.87	0.78	0.99	14
K E C International Ltd.	1.35	1.35	1.36	1.05	1.28	0.70	0.93	0.82	0.51	0.51	0.99	15
Manaksia Ltd.	1.63	1.46	1.30	1.34	0.96	0.65	0.67	0.81	0.56	0.46	0.98	16
L G B Forge Ltd.	0.81	0.81	0.81	0.81	0.81	0.81	0.89	0.96	0.95	1.11	0.87	17
Steelcast Ltd.	0.51	0.68	1.30	1.38	1.04	0.74	0.68	0.80	0.72	0.84	0.87	18
Rajratan Global Wire Ltd.	0.61	0.81	1.06	0.98	0.84	0.78	0.80	1.14	0.80	0.69	0.85	19
Welspun Corp Ltd.	0.98	0.61	0.77	0.79	1.26	0.80	0.94	0.88	0.61	0.51	0.81	20
Uni Abex Alloy Products Ltd.	0.50	0.77	1.36	1.00	0.87	0.62	0.74	0.85	0.65	0.69	0.81	21
L G Balakrishnan & Bros. Ltd.	0.80	1.00	1.18	0.92	0.82	0.55	0.58	0.67	0.63	0.56	0.77	22
J S W Steel Ltd.	0.90	0.61	0.69	0.73	1.04	0.76	0.86	0.84	0.65	0.63	0.77	23
Hinduja Foundries Ltd.	0.64	0.65	0.41	1.22	1.24	0.77	0.73	0.81	0.67	0.56	0.77	24
Electrosteel Castings Ltd.	0.80	0.80	0.83	0.85	0.88	0.65	0.79	0.76	0.64	0.59	0.76	25
IND AVG	1.07	0.98	1.01	0.95	1.11	0.80	0.87	0.97	0.78	0.72	0.92	

*Industry average based on a sample of 38 firms.

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TABLE-II: INNOVATION CAPITAL OF FERROUS METALS INDUSTRY

Name of the Firm	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Avg.	Rank
Steel Authority Of India Ltd.	1708.46	1776.28	1813.98	1941.98	2306.88	2723.30	2944.10	3318.66	3579.80	3885.28	2599.87	1
Tata Steel Ltd.	468.98	639.40	673.48	745.94	873.90	994.38	1099.20	1525.72	1608.64	1675.36	1030.50	2
Sujana Universal Inds. Ltd.	255.60	255.60	255.60	255.60	255.60	255.60	255.60	255.60	255.60	255.60	255.60	3
Maharashtra Seamless Ltd.	139.80	139.80	139.80	139.80	139.80	139.80	139.80	139.80	139.80	126.00	138.42	4
Tube Investments India Ltd.	41.66	43.04	31.16	22.50	55.30	97.56	138.28	192.36	228.08	279.76	112.97	5
J S W Steel Ltd.	38.10	42.30	36.96	37.02	31.98	91.06	127.24	167.92	229.86	267.24	106.97	6
I S M T Ltd.	99.30	99.30	99.30	99.30	99.30	99.30	99.30	99.30	91.40	74.28	96.01	7
K E C International Ltd.	48.30	48.30	48.30	50.50	53.56	55.72	56.92	105.52	175.12	240.12	88.24	8
Jindal Steel & Power Ltd.	21.60	23.22	26.10	33.12	44.32	52.54	69.42	107.54	142.74	245.96	76.66	9
Hinduja Foundries Ltd.	1.52	1.00	0.68	9.86	20.36	71.84	106.48	139.68	185.42	169.92	70.68	10
Oil Country Tubular Ltd.	9.26	14.42	20.66	40.32	66.26	72.60	60.02	45.28	29.24	18.00	37.61	11
L G Balakrishnan & Bros. Ltd.	19.80	23.56	28.72	33.48	38.94	37.32	31.82	32.64	41.14	53.58	34.10	12
Electrotherm (India) Ltd.	20.72	26.30	25.58	23.60	23.96	36.72	52.70	41.38	29.04	54.50	33.45	13
Sunflag Iron & Steel Co. Ltd.	9.24	7.16	10.78	9.64	8.52	7.28	9.56	46.30	79.78	67.16	25.54	14
Mahindra Ugine Steel Co. Ltd.	13.58	12.56	12.40	14.42	19.54	30.88	33.24	38.50	43.04	34.02	25.22	15
Electrosteel Castings Ltd.	14.10	14.10	14.10	14.10	14.10	15.30	18.46	21.14	23.90	27.98	17.73	16
Jindal Stainless Ltd.	6.00	8.20	7.96	14.58	18.98	21.52	19.12	19.18	20.72	25.06	16.13	17
Mukand Ltd.	8.60	8.02	8.06	9.24	12.06	14.74	17.68	19.72	20.90	24.90	14.39	18
Lakshmi Precision Screws Ltd.	0.56	1.62	9.02	14.98	16.64	17.30	14.56	18.14	22.62	27.78	14.32	19
G S Auto International Ltd.	15.60	15.60	15.60	15.60	15.60	15.60	13.70	14.78	11.32	7.50	14.09	20
Steelcast Ltd.	4.50	4.50	4.10	3.78	6.84	8.12	11.16	15.94	23.68	31.92	11.45	21
Usha Martin Ltd.	2.82	3.00	3.00	3.00	8.90	11.82	13.82	17.42	21.64	26.00	11.14	22
Ramkrishna Forgings Ltd.	8.70	8.70	8.70	8.70	8.70	8.70	8.70	8.70	8.70	8.70	8.70	23
Welspun Corp Ltd.	7.50	7.50	7.50	7.50	7.50	9.20	9.46	9.60	9.62	9.52	8.49	24
Orissa Sponge Iron & Steel Ltd.	3.10	4.38	5.34	5.98	7.80	9.00	9.90	6.90	7.32	4.56	6.43	25
IND AVG	78.92	85.79	87.85	94.37	110.24	129.81	142.05	169.71	186.18	202.41	128.73	

*Industry average based on a sample of 38 firms.

TABLE -III: RELATIONAL CAPITAL OF FERROUS METALS INDUSTRY

Name of the Firm	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Avg.	Rank
Tata Steel Ltd.	22336.80	25458.48	28446.38	31526.60	33651.42	36151.44	38953.90	43030.60	47799.28	56977.78	36433.27	1
Steel Authority Of India Ltd.	22484.20	24009.28	26641.42	27093.54	27776.10	28611.10	27931.64	27515.92	27705.64	30614.82	27038.37	2
J S W Steel Ltd.	1330.80	3739.96	6993.52	10390.66	13142.22	15590.28	17178.14	18776.24	22427.30	28028.64	13759.78	3
Jindal Steel & Power Ltd.	1298.38	2686.12	4252.26	5949.30	7016.64	8286.72	7857.50	8841.66	9466.32	10645.20	6630.01	4
Welspun Corp Ltd.	347.02	1733.50	2552.36	3077.88	4863.44	6152.36	6568.30	6733.20	6869.14	6261.80	4515.90	5
Jindal Stainless Ltd.	1943.90	2128.82	2439.78	3499.80	4158.54	4154.50	4255.94	4363.86	5009.94	7135.86	3909.09	6
Electrosteel Castings Ltd.	2227.78	2449.80	2630.92	3042.70	3407.30	3880.94	4024.54	4634.48	4657.98	5258.46	3621.49	7
Usha Martin Ltd.	1871.42	2408.96	2683.20	2932.54	3125.66	3688.88	4025.62	3835.30	3639.44	3538.72	3174.97	8
Tube Investments Of India Ltd.	2211.84	2412.98	2508.28	2699.20	2720.88	2791.30	3130.78	3531.72	4076.70	4436.52	3052.02	9
K E C International Ltd.	1105.80	1105.80	1105.80	1462.80	1971.90	2487.90	2601.20	2699.60	2653.52	3149.16	2034.35	10
Sunflag Iron & Steel Co. Ltd.	937.48	1221.30	1397.44	1718.22	1788.08	1839.36	2220.32	2599.38	2911.88	3327.20	1996.07	11
Mukand Ltd.	1124.26	1262.44	1458.36	1795.20	2026.48	2020.34	2244.34	2434.14	2466.92	2352.98	1918.55	12
I S M T Ltd.	32.60	250.74	505.82	736.30	937.44	1118.48	1055.28	1195.40	1406.48	1455.28	869.38	13
Maharashtra Seamless Ltd.	291.62	291.28	363.94	537.14	714.92	1498.82	1428.06	1305.46	1203.86	949.30	858.44	14
Electrotherm (India) Ltd.	20.98	24.86	99.46	239.70	523.08	904.66	1312.14	1744.94	1744.70	1412.50	802.70	15
Kalyani Steels Ltd.	411.72	495.30	579.34	744.78	866.62	852.58	920.56	1029.30	1036.42	942.80	787.94	16
L G Balakrishnan & Bros. Ltd.	463.48	497.28	538.06	635.52	768.58	870.08	913.16	899.10	888.94	926.38	740.06	17
Rohit Ferro-Tech Ltd.	38.70	57.00	95.74	161.50	373.38	590.44	723.96	906.90	1174.52	1638.30	576.04	18
Manaksia Ltd.	340.44	426.62	461.88	428.76	484.22	510.26	546.84	671.98	783.70	898.44	555.31	19
Oil Country Tubular Ltd.	51.14	64.26	117.16	254.02	489.56	596.92	596.86	726.02	791.30	910.28	459.75	20
Pennar Industries Ltd.	97.84	131.34	226.76	260.38	327.94	375.12	468.92	582.18	632.12	651.30	375.39	21
Kamdhenu Ispat Ltd.	32.52	42.08	67.46	93.80	148.38	229.94	364.56	550.26	768.52	986.18	328.37	22
Facor Alloys Ltd.	92.40	104.50	104.68	121.34	171.48	204.12	291.48	445.50	564.30	510.00	260.98	23
Lakshmi Precision Screws Ltd.	132.30	135.32	154.14	175.48	209.70	241.92	273.34	330.64	382.50	385.66	242.10	24
G S Auto International Ltd.	145.64	159.92	171.98	175.26	188.42	216.52	252.34	294.72	332.24	348.52	228.56	25
IND AVG	1628.89	1944.46	2295.63	2644.01	2964.10	3282.46	3450.93	3707.30	4019.22	4611.83	3054.88	

*Industry average based on a sample of 38 firms.

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TABLE - IV: HUMAN CAPITAL OF FERROUS METALS INDUSTRY

Name of the Firm	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Avg.	Rank
Steel Authority India	108466.14	113375.36	121582.34	135473.06	172695.00	206825.86	204879.74	217242.72	226170.54	236676.74	174338.75	1
Tata Steel Ltd.	42054.24	42973.62	43244.60	44980.46	49128.90	57069.02	64368.70	73220.56	81226.56	91995.00	59026.17	2
J S W Steel Ltd.	925.74	1763.42	2590.28	3659.20	5420.14	6854.36	8561.32	11445.40	14428.62	16961.78	7261.03	3
Jindal Steel Power	749.40	1044.16	1597.08	2103.50	2977.10	3977.58	5042.00	6423.42	8445.32	10498.28	4285.78	4
Tube Investments	2312.98	2443.96	2647.06	2963.86	3463.00	3935.44	4495.86	5507.66	6402.34	7156.38	4132.85	5
K E C Int. Ltd.	2513.10	2513.10	2513.10	2630.10	2978.00	3458.74	4089.10	4957.02	5914.94	7043.06	3861.03	6
Usha Martin Ltd.	1718.56	1777.72	1929.12	2161.42	2419.80	2615.22	2858.64	3286.78	3786.14	4396.66	2695.01	7
Jindal Stainless Ltd.	980.90	1120.72	1305.06	1645.04	2201.18	2675.78	3117.02	3711.04	4288.60	5438.44	2648.38	8
Mukand Ltd.	1630.54	1702.72	1813.82	1960.76	2194.30	2384.16	2596.22	3034.54	3420.04	3732.76	2446.99	9
Welspun Corp Ltd.	295.98	404.26	723.08	1172.84	1706.60	2412.70	3180.76	4137.62	4716.44	5512.16	2426.24	10
Hinduja Foundries	1108.52	1228.72	1466.54	1760.04	2041.92	2259.68	2391.40	2651.00	3794.42	3321.12	2202.34	11
Electrosteel Castings	1000.84	1108.92	1269.52	1500.84	1770.74	2159.28	2583.92	3045.28	3364.62	3706.10	2151.01	12
I S M T Ltd.	278.28	619.10	988.02	1364.86	1736.58	2027.42	2228.94	2482.94	2838.28	3114.96	1767.94	13
Mahindra Ugine	722.84	723.34	761.86	927.42	1191.80	1446.60	1742.24	1695.34	1725.42	1815.86	1275.27	14
L G Balakrishnan	610.78	669.32	760.46	913.02	1093.02	1221.54	1332.42	1580.72	1958.76	2327.02	1246.71	15
Sunflag Iron & Steel	467.64	563.70	649.64	759.90	958.92	1133.80	1377.54	1631.70	1861.86	2052.16	1145.69	16
Electrotherm (India)	74.36	98.40	164.94	287.16	526.06	785.68	1109.28	1457.66	2265.26	2325.50	909.43	17
Lakshmi Precision	469.30	525.80	584.52	662.10	773.92	885.94	1009.26	1178.00	1369.90	1550.98	900.97	18
Manaksia Ltd.	352.82	395.96	448.32	505.50	569.54	625.80	688.06	795.46	936.22	1068.58	638.63	19
Kalyani Steels Ltd.	151.82	229.48	349.42	481.16	616.04	701.10	703.56	781.32	863.88	967.34	584.51	20
Maharashtra Seam	212.28	256.66	316.04	392.94	509.26	603.74	701.12	793.48	955.42	1102.26	584.32	21
Pennar IndustriesLtd.	182.14	184.96	254.62	260.02	336.44	465.82	610.16	813.00	1023.92	1181.66	531.27	22
Orissa Sponge Ltd.	438.16	440.70	415.52	395.58	389.88	487.84	578.98	663.64	710.78	671.48	519.26	23
Facor Alloys Ltd.	335.70	372.10	392.52	425.80	476.66	503.64	556.20	572.86	612.34	643.50	489.13	24
Oil Country Tub.Ltd.	118.80	128.98	153.40	184.80	240.78	445.08	593.44	638.54	743.36	809.56	405.67	25
IND AVG	4457.89	4683.88	5009.73	5557.69	6851.29	8164.79	8529.55	9396.58	10205.77	11070.80	7392.80	

*Industry average based on a sample of 38 firms.

Table IV presents the value of human capital of the firms representing the ferrous metals industry. Though the sample consists of 38 firms, the table presents the top 25 firms only. The human capital of all the 38 firms is provided in the appendix. On an average the human capital of the firms representing the ferrous metals industry is 7392.80 million rupees. All the 25 firms record human capital exceeding 1 billion rupees. Sixteen firms exhibit human assets exceeding 10 billion rupees. One company possesses human capital exceeding 100 billion rupees and Steel Authority of India Ltd. tops the list with over 1000 billion rupees as human assets. The trend records a steady increase during the study period.

3.2 RELATIONSHIP BETWEEN TOBIN'S Q AND INTELLECTUAL CAPITAL OF FERROUS METALS INDUSTRY

The table V presents correlation coefficients of the Tobin's Q and the three components of intellectual assets chosen for the study namely innovation capital, relational capital and human capital.

Table -V: CORRELATION BETWEEN TOBIN'S Q AND INTELLECTUAL CAPITAL OF FERROUS METALS INDUSTRY

		INTASSETS	INNOVCAP	RELCAP	HUMCAP
INTASSETS	Pearson Correlation	1	.450**	.389**	.489**
	Sig. (2-tailed)		.000	.000	.000
	N	380	380	380	380

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation coefficients of Pearson's correlation indicate that there is a moderate correlation between Tobin's Q and innovation capital, relational capital and human capital of the firms in the ferrous metals industry. Further the correlation coefficients are significant at 0.01 levels.

4. CONCLUSION

James Tobin developed the famous quotient 'Q' in 1969 as a measure of the market value of the financial claims on the firm relative to the replacement cost of a firm's capital stock. Q refers to the cost of buying a firm in the financial sector relative to the cost of creating a new firm. Many research studies have used Tobin's Q in the context of intellectual capital. While some studies in the western setting have explored the relationship between Tobin's Q and intellectual capital, that too in the high technology segment of knowledge based manufacturing industries, this paper has empirically tested the relationship between Tobin's Q and intellectual capital in ferrous metals industries as they fall under medium low technology segment of knowledge based manufacturing industries in India. It is seen that there is positive correlation between all the components of intellectual capital and Tobin's Q, though the relationship exhibits a moderate correlation. Since there is positive correlation between all the components of intellectual capital and Tobin's Q in this industry, the conjecture that Tobin's Q is a reliable indicator of intellectual capital of firms appears to be credible, even though it falls under the medium low technology segment of knowledge based manufacturing industries.

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