

**Concentration and Performance Relationship: A Firm Level Study of Indian Chemical Industry****Dr Rajwinder Singh Gill,**Associate Professor,  
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E-Mail: [rgill241@gmail.com](mailto:rgill241@gmail.com)**Abstract**

*This study analyzes the market concentration-performance relationship based on the firm level data of chemical industry of India over the period of 2007-2018. The study reveals that the industry has presented increasing trends in the market concentration overtime. Moreover, positive relationship has been found between the market concentration and profitability of firms. So far, the performance of such firms in the stock markets is concerned; large firms are better performers than the small and middle-sized firms. Profits in the previous period were found to have positive effect on concentration in this analysis. Besides, book value per share bears positive relationship with market concentration ratio. So, the study highlights the larger gains for the top firms in the industry in terms of profitability and the stock market performance.*

*Keywords: Market Concentration, Price-Cost Margin, Book Value and Market Value of stocks, Beta Value of Stocks, Earning per Share*

**Introduction:**

The Indian Chemical Industry, today, has sizeable position in India's science-based industries<sup>1</sup>. It has equipped itself, overtime, with wide ranging capabilities in the complex field of drug manufacturing and technology. It ranks very high in the third world, in terms of technology, quality and range of chemicals manufactured. Since the industry has experienced considerable policy shifts and patents laws in recent years<sup>2</sup>, hence, it is expected that the industry might had experienced structural changes. The firms that had worked merely as agencies to foreign companies are now holding world class R&D facilities and are capable of producing most sophisticated material and complex compounds,

etc. In the recent years the industry has registered remarkable growth (13 percent per annum between 2013 and 2018). The share in world exports has grown too. India's chemical industry is now one of the largest in the world in terms of volume. Its rank is 34th in terms of value<sup>3</sup>. Given this background, market concentration, performance and their relationships in this industry are studied here with following

**Objectives:**

- To study the level and change in market concentration overtime.
- To examine the nature of relationship between market concentration and performance.
- Whether such positive relationships lead to better performance of firms in stock market.
- To observe, whether increased market valuation also enhances market concentration overtime.

After giving brief introduction in section, section-2 provides a brief overview of the industry. A brief account of review of previous literature is discussed in section-3. Methodology, data base and

<sup>1</sup> A science-based industry is an industry which relies on the use of scientific innovations and discoveries and their application rather than physical abilities.

<sup>2</sup> January 1, 2005 was the date of enactment of an amendment to India's patent law that reinstated product patents for the first time since 1972. The legislation took effect on the deadline set by the WTO's Trade-Related Aspects of Intellectual Property Rights (TRIPS) agreement, which mandated patent protection on both products and processes for a period of 20 years. Under this new law, India will be forced to recognize not only new patents but also any patents filed after January 1, 1995.

<sup>3</sup> Economic Survey (2006-07 and 2008-09)

definition of variables used are explained in section-4. Results are discussed in section-5. Concluding remarks are given in last section.

To have better support in the subsequent discussion, important input and output variables are examined here for the industry as a whole. During the study period, the industry experienced remarkable capital formation especially after 2015 as is shown in table-1(a). It seems as if the need to invest in the infrastructure to build R&D facilities after the enforcement of new patent law in 2015 has forced the firms to invest more and more. However, employment growth was relatively slow. It remained meager at only 2.8 percent per annum, whereas emoluments being disbursed to employees have increased rapidly (11 percent). Why did this happen in this industry? The companies either started paying more to their skill based employees or they have hired costlier R&D experts to boost their R&D procedures at the place of unskilled or semi-skilled workers.

**Table 1(a): Performance of Important Variables (Chemical Industry)**

| Year            | Fixed Capital (Rs Crores) | No. of Workers (No's) | Total Emoluments (Rs Crores) | Value of Output (Rs Crores) |
|-----------------|---------------------------|-----------------------|------------------------------|-----------------------------|
| 2009            | 10288.82                  | 177030                | 1646.49                      | 31893.06                    |
| 2010            | 11603.28                  | 190680                | 1904.77                      | 35407.82                    |
| 2011            | 10794.31                  | 183373                | 1893.73                      | 32702.50                    |
| 2012            | 12139.79                  | 173492                | 1935.08                      | 35026.08                    |
| 2013            | 12809.35                  | 182458                | 2135.03                      | 39178.40                    |
| 2014            | 14068.69                  | 178383                | 2333.67                      | 42805.22                    |
| 2015            | 14564.27                  | 195234                | 2693.68                      | 48499.33                    |
| 2016            | 19536.53                  | 207183                | 3235.13                      | 59993.76                    |
| 2017            | 23446.52                  | 220781                | 3842.57                      | 68798.14                    |
| 2018            | 26255.19                  | 235649                | 4272.71                      | 76461.05                    |
| TGR (2009-2018) | 10.9                      | 2.8                   | 11                           | 10.9                        |

**Table 1(b): Performance of Important Variables (Chemical Industry)**

| Year | Gross Value Added (Rs crore) | Profit (Rs crore) | Exports (Rs crore) | Share of Exports (Percentage) | Labour Productivity (Lakh per employee) |
|------|------------------------------|-------------------|--------------------|-------------------------------|-----------------------------------------|
| 2009 | 6504.21                      | 3838.59           | N.A.               | N.A.                          | 18.01                                   |
| 2010 | 8037.70                      | 4924.31           | N.A.               | N.A.                          | 18.57                                   |
| 2011 | 6201.37                      | 3334.21           | N.A.               | N.A.                          | 17.83                                   |
| 2012 | 7226.10                      | 4419.38           | N.A.               | N.A.                          | 20.19                                   |
| 2013 | 8532.05                      | 5725.54           | 12826              | 32.74                         | 21.47                                   |

|                 |         |         |       |       |       |
|-----------------|---------|---------|-------|-------|-------|
| 2014            | 9185.38 | 6254.66 | 15213 | 35.54 | 24.00 |
| 2015            | 10829.1 | 7700.63 | 17857 | 36.82 | 24.84 |
| 2016            | 12733.4 | 9080.83 | 22216 | 37.03 | 28.96 |
| 2017            | 15411.8 | 11283.7 | 26895 | 39.09 | 31.16 |
| 2018            | 17200.3 | 12268.9 | 30760 | 40.23 | 32.45 |
|                 | 9       | 0       |       |       |       |
| TGR (2009-2018) | 11.6    | 14.9    | 19.7  | ----  | 7.5   |

Values of output and value added variables have performed positively but gross value added has over performed the value of output. Hence, either the cost of production has decreased or/and the industry was able to fetch higher price in the market and price cost margin has registered increasing trend. This has further been corroborated by the performance of profit variable. For, it revealed 14.9 percent growth per annum during the period under consideration (Table-1b). As is mentioned earlier, the exports for the industry have made significant growth in this period of time.

#### Methodology, Data Base and Variables Defined:

To study the aforementioned objectives various statistical and econometric techniques are used. Concentration ratios, Harfindhal-Harishman index, coefficient of variation and Entropy index are used to measure market concentration in chemical industry. Market performance is measured through the level of profitability, price-cost margin and net-worth. Performance in stock market and its relationships with performance and market concentration are captured with market value over book value of assets and capital asset pricing. Trend growth rate has been used to decipher growth overtime. Moreover, Linear and non-linear regressions have been run to ascertain the relationship between market concentration and performance variables.

The study is based on secondary data, both for industry and firm level, sourced from Annual Survey of Industries, RBI Handbook of Statistics on Indian Economy, CMIE's Prowess data base on firms, Bombay Stock Exchange Official Directory and various on-line data providing agencies for the period of 2007-2018. The websites of the selected firms are also be used to corroborate. Period of study is dictated by the availability of appropriate data.

*Variables defined:*

**Concentration Ratio:** The concentration ratio indicates whether an industry is comprised of a few large firms or many small firms. The four-firm concentration ratio, which consists of the market share (expressed as a percentage) of the four largest firms in an industry, is a commonly used concentration ratio.

**Herfindahl-Hirschman Index (HHI):** It measures market concentration by calculating sum of square of the market share of each firm. The HHI is expressed as:

$$n$$

$$H = \sum_{i=1}^n s_i^2$$

Here  $S_i$  is market share of  $i$ th firm

**Coefficient of Variation (CV):** A statistical measure of the dispersion of data points in a data series around the mean.

**Profitability ratios:** Projection of earnings as compared to expenses and other relevant costs incurred during a specific period of time.

**Price-Cost Margin (PCM):** The difference between total revenue (R) and total cost of production (C) as a fraction of total revenue, that is  $(R-C)/R$ .

**Net worth:** A firm's total assets minus total liabilities is its net worth.

**Net Worth Ratio:** It is the ratio of net profit to share holder's investment.

**Market value of assets:** The current quoted price at which investors buy or sell a share of common stock or a bond at a given time.

**Book Value:** The value at which an asset is carried on a balance sheet. It is calculated by reducing accumulated depreciation from the cost of an asset.

**Capital assets pricing model:** A model that describes the relationship between risk and expected return and that is used in the pricing of risky securities.

**P E Ratio:** A valuation ratio of a firm's current share price compared to its per-share earnings.

**EPS:** The portion of a company's profit allocated to each outstanding share of common stock. Earnings per share serves as an indicator of a company's profitability.

#### 4.1 Concentration

What is the behavior of chemical industry of India as far as market concentration is concerned? To study this aspect, the concentration ratios and HHI is

calculated for this industry too and the results are shown in table 2. The figures in this table have shown increasing trend in market concentration of chemical industry. CR-4, which was at the level of 18.62 in 2006,

**Table 2: concentration in Chemical Industry**

| Year       | CR-4   | CR-8   | CR-20  | HHI    |
|------------|--------|--------|--------|--------|
| 2006       | 18.618 | 35.177 | 52.255 | 0.0434 |
| 2007       | 19.034 | 33.432 | 55.560 | 0.0356 |
| 2008       | 20.244 | 34.172 | 56.206 | 0.0354 |
| 2009       | 17.971 | 31.873 | 54.130 | 0.0291 |
| 2010       | 20.319 | 33.486 | 57.597 | 0.0325 |
| 2011       | 24.402 | 39.303 | 59.882 | 0.0304 |
| 2012       | 24.347 | 41.723 | 62.726 | 0.0321 |
| 2013       | 26.347 | 43.294 | 67.073 | 0.0367 |
| 2014       | 26.628 | 42.620 | 65.410 | 0.0362 |
| 2015       | 26.823 | 42.437 | 66.666 | 0.0353 |
| 2016       | 26.215 | 42.312 | 66.113 | 0.0322 |
| 2017       | 28.073 | 43.889 | 66.751 | 0.0337 |
| 2018       | 26.693 | 42.522 | 67.277 | 0.0321 |
| <b>TGR</b> |        |        |        |        |
| 2006-      | 3.9    | 2.6    | 2.2    | -0.8   |
| 2013       | 5.3    | 3.6    | 3.1    | -2.3   |
| 2014-      | 0.5    | 0.3    | 0.6    | -2.9   |
| 2018       |        |        |        |        |
| 2006-      |        |        |        |        |
| 2018       |        |        |        |        |

reached at 26.35 in 2013 and stayed there for rest of the period. Similarly, CR-8 has risen from 35.18 to 42.52 and CR-20 from 52.25 to 67.28. The facts can be further vindicated from trend growth rate (see table 2). CR-4 has risen at 3.9 percent per annum, though most of it has come during the period 2006-2013 i.e. 5.3 percent. Trend is more or less the same for CR-4 and CR-20. On the other hand, HHI result has shown a negative change in the level of market concentration during the study period. Why did this happen? This explains the fact that the total number of firms contributing actively has increased with time, but even then the top firms have gone stronger during this period.

Why did the concentration pattern behaved in such way in this industry? The change in concentration can be explained in the light of government policy change. The patent law under WTO was being implemented from March 2015. It was expected that only large firms with well established R&D facilities can survive in coming times. The fear of future hard times led to takeovers of many small firms by large firms during 2006-2015. After March 2015 the fear submerged because

the effect of implementation of the new patent law was not as harsh as it was expected. Consequently, the concentration did not increase during 2015-08.

To further analyze the concentration behavior of chemical industry, the coefficient of variation (CV) in output in CR-4 group, CR-20 group and for all firms (HHI) group and the results are shown in table 3. The table shows very significant results. CV for both CR-4 group

**Table-3: Coefficient of Variation in Output Values Levels**

| Year | C.V. for CR-4 | C.V. for CR-20 | C.V. for HHI |
|------|---------------|----------------|--------------|
| 2006 | 0.887         | 1.074          | 1.950        |
| 2007 | 0.827         | 0.835          | 1.730        |
| 2008 | 0.780         | 0.841          | 1.755        |
| 2009 | 0.571         | 0.698          | 1.596        |
| 2010 | 0.678         | 0.771          | 1.760        |
| 2011 | 0.474         | 0.701          | 1.716        |
| 2012 | 0.390         | 0.690          | 1.834        |
| 2013 | 0.557         | 0.735          | 2.023        |
| 2014 | 0.573         | 0.767          | 2.042        |
| 2015 | 0.495         | 0.708          | 1.975        |
| 2016 | 0.273         | 0.617          | 1.913        |
| 2017 | 0.223         | 0.654          | 1.936        |
| 2018 | 0.131         | 0.574          | 1.906        |

and CR-20 group has decreased constantly during the study period which reflects that the difference of level of production between top four and even between top twenty firms has decreased significantly. It shows that the benefit of increasing concentration was not limited only to one or two top firms but many big firms have shared the fruit. Calculated results of CV for HHI group have revealed a different factor (see table 3 col. 4). CV for all firms has increased up to 2014 and then came down. This result vindicates the already mentioned factor that the fear of implementation of new patent law has hurt the small firms more than its actual implementation.

#### 4.2 Performance and its relation with concentration

The results of different performance indicators calculated for chemical industry are being presented here. Performance in terms of price-cost margin (PCM) shows increasing trend during the study period (see table 4). The PCM earned by all firms was Rs 915.88 crores in 2006, which

**Table 4: Levels of Price-Cost Margin and Profitability in Chemical Industry**

| Year    | PCM (In Crores) | Profit/Output |           |       | Profit/Net worth |           |       |
|---------|-----------------|---------------|-----------|-------|------------------|-----------|-------|
|         |                 | 4- Firms      | 20- Firms | Total | 4- Firms         | 20- Firms | Total |
| 2006    | 915.88          | 14.62         | 11.97     | 9.49  | 14.62            | 27.40     | 25.87 |
| 2007    | 846.68          | 15.31         | 10.39     | 7.72  | 15.31            | 22.90     | 17.87 |
| 2008    | 993.21          | 15.68         | 10.62     | 7.88  | 15.68            | 22.17     | 17.28 |
| 2009    | 1105.11         | 12.94         | 10.00     | 7.44  | 12.94            | 22.08     | 16.31 |
| 2010    | 1527.25         | 13.55         | 10.11     | 8.69  | 13.55            | 24.15     | 19.25 |
| 2011    | 1792.43         | 14.13         | 10.86     | 8.85  | 14.13            | 24.50     | 19.60 |
| 2012    | 2381.46         | 18.93         | 12.11     | 9.83  | 18.93            | 29.35     | 22.05 |
| 2013    | 2971.92         | 20.54         | 13.81     | 10.76 | 20.55            | 31.75     | 24.24 |
| 2014    | 3648.80         | 18.42         | 14.07     | 10.82 | 18.42            | 31.32     | 23.16 |
| 2015    | 3801.41         | 13.82         | 12.62     | 10.77 | 13.82            | 24.26     | 20.07 |
| 2016    | 4822.00         | 13.76         | 13.49     | 11.57 | 13.76            | 25.41     | 21.10 |
| 2017    | 7087.83         | 19.88         | 16.96     | 13.86 | 19.88            | 33.38     | 26.32 |
| 2018    | 7906.07         | 17.58         | 16.11     | 13.21 | 17.58            | 31.69     | 24.55 |
| TGR (%) | 21.7            | 1.7           | 3.8       | 4.6   | 1.7              | 2.4       | 2.0   |

has gone up more than eight folds in twelve years to be Rs 7906.07 crores in 2018. The price-cost margin has increased for every year except 2007. The trend growth rate for PCM has been as high as 21.7 percent per annum during this period. PCM was also calculated as ratio to output. It was calculated for CR-4 group, CR-20 group and for all firms to correlate for the performance with concentration. The price-cost margin/output ratio was highest in CR-4 group i.e. for top four firms for all the years, followed by CR-20 group and it was lowest when averaged for all firms. But the trend growth rate is lowest for top four firms and is highest for all firms taken together (see table 4 col. 3, 4 and 5).

A ratio of price-cost margin for total net worth of firms is also calculated for these three groups. The ratio was highest for top twenty firms taken together and was lowest for top four firms. The growth is again highest for CR-20 group. The PCM/Net Worth ratio grew at the rate of 2.4 percent per annum (trend growth rate) during 2006-2018 (see table 4).

PCM is a variable which is determined by market and cost factors. Market concentration increases monopoly power and helps the firms to charge higher price in the market.

In this context, the following equation has been estimated and the results are presented in Table-5

$$PCM_t = \alpha + \beta CR_{4t} + \mu_t \text{-----} (1)$$

**Table 5:- Regression of Price-Cost Margin on Concentration Ratio**

| Variable     | Coefficient | Standard Error | t-statistics | Prob.  |
|--------------|-------------|----------------|--------------|--------|
| Constant     | 0.7262*     | 0.1096         | 6.7927       | 0.0000 |
| CR           | 0.1947*     | 0.0320         | 6.0803       | 0.0001 |
| F-Statistics | 36.97*      |                |              | 0.0001 |
| R-Square     | 0.7871      |                |              |        |
| Durban       | 1.51        |                |              |        |
| Watson       |             |                |              |        |
| Statistics   | 12          |                |              |        |
| N            |             |                |              |        |

\* Indicates Significant Value

Table-5 justifies the regression as F-statistics has turned out to be highly significant. There is a significant and positive relationship between PCM and CR which highlights the fact that increase in concentration ratio gives boost to the profitability. However, the positive and significant value of constant reveals that apart from the CR there are other factors which contribute to the profitability of the firms in the chemical industry. Moreover the explanatory power of the model is sizeable.

To have further insight in such relationship the square of  $CR_4$  has been added to equation-1 to capture the impact of rate of change in concentration on the price-cost margin and the following equation has been estimated.

$$PCM_t = \alpha + \beta CR_{4t} + \gamma CR_{4t}^2 + \mu_t \text{----- (2)}$$

**Table 6:- Regression of Price-Cost Margin on Concentration Ratio and Rate of Change of Concentration Ratio**

| Variable                     | Coefficient | Standard Error | t-statistics | Prob.  |
|------------------------------|-------------|----------------|--------------|--------|
| Constant                     | 0.6769*     | 0.0030         | 224.99       | 0.0000 |
| CR <sub>4</sub>              | 0.3761*     | 0.0033         | 113.53       | 0.0000 |
| CR <sub>4</sub> <sup>2</sup> | -0.0044*    | 0.0019         | -2.22        | 0.0511 |
| F-Statistics                 | 30285.05*   |                |              | 0.0000 |
| R-Square                     | 0.8199      |                |              |        |
| Durban                       | 2.7182      |                |              |        |
| Watson                       |             |                |              |        |
| Statistics                   | 12          |                |              |        |
| N                            |             |                |              |        |

\* Indicates Significant Value

Values given in table-6 highlights that the explanatory power of the model increased significantly and the resulted observed in the

previous table-5 did not disturb. However, the coefficient attached to  $CR^2$  turned out to be negative and significant indicates that the rate of change in concentration is negatively affecting the profit which is consistent with the results received in the Herfindahl index.

Profits earned in one period helps the firm to generate funds for additional investments in next round. Therefore, profitability may support the firms to have bigger share in the market in the subsequent round. To verify this relationship market concentration is regressed on PCM and the following equation has been estimated.

$$CR_{4t} = \alpha + \beta PCM_{t-1} + \mu_t \text{----- (3)}$$

**Table 7:- Regression of Concentration Ratio on Previous PCM**

| Variable           | Coefficient | Standard Error | t-statistics | Prob.  |
|--------------------|-------------|----------------|--------------|--------|
| Constant           | -1.7431     | 1.0447         | -1.6684      | 0.1296 |
| PCM <sub>t-1</sub> | 3.6311*     | 0.7550         | 4.8093       | 0.0010 |
| F-Statistics       | 23.129*     |                |              | 0.0009 |
| R-Square           | 0.7198      |                |              |        |
| Durban             | 0.9554      |                |              |        |
| Watson             |             |                |              |        |
| Statistics         | 11          |                |              |        |
| N                  |             |                |              |        |

\* Indicates Significant Value

Values given in the table on shows that previous year's price - cost margin is positively related to concentration ratio and helps the firms to achieve better market share in the subsequent round of production.

Concentration in current period also depends on the previous period's concentration. In this context the following equation has been estimated.

$$CR_{4t} = \alpha + \beta CR_{4t-1} + \mu_t \text{----- (3)}$$

**Table 8:- Regression of Concentration Ratio on previous year's Concentration Ratio**

| Variable           | Coefficient | Standard Error | t-statistics | Prob.  |
|--------------------|-------------|----------------|--------------|--------|
| Constant           | 0.2476      | 0.1956         | 1.2656       | 0.2343 |
| CR <sub>4t-1</sub> | 0.8276*     | 0.1436         | 5.7625       | 0.0002 |
| F-Statistics       | 33.206*     |                |              | 0.0001 |
| R-Square           | 0.7685      |                |              |        |
| Durban             | 2.2709      |                |              |        |
| Watson             |             |                |              |        |
| Statistics         | 12          |                |              |        |
| N                  |             |                |              |        |

\* Indicates Significant Value

The values given in table-8 justify our hypothesis that bigger firms have larger scope to become bigger overtime as the coefficient attached to  $CR_{4t-1}$  is positive and significant. And the explanatory power of the equation is also sufficient.

#### 4.3 Stock Value Performance and Concentration

**Table 12: Correlation between Profitability and Stock Market Variables for different levels of Market Concentration**

| Variables                  | 4-FIRMS | 20- FIRMS | TOTAL |
|----------------------------|---------|-----------|-------|
| Profitability & Book Value | 0.483   | 0.479     | 0.446 |
| Profitability & PE Ratio   | 0.032   | -0.011    | 0.021 |
| Profitability & EPS        | 0.043   | 0.021     | 0.030 |

The industry performance in stock market in the period 2006-2014 was better than the overall performance of the stock market as is clear from the  $\beta$  value for this period i.e. 1.385 as is presented in the table 9. But the momentum was lost in the next period i.e. 2014-08. In this period the  $\beta$  value is insignificantly positive (0.004).

(5)

#### Concluding Remarks

Chemical industry has shown increasing trend in market concentration during the era of liberalization. However the increase was sharper up to 2015. It seems as if the fear of foreign competition has hurt the small firms of this industry. The difference of value of output among top firms has decreased in the study period. Same has happen for top twenty firms too. Market share Performance variable of the industry has also increased at significant rate during the period. The industry has outperformed the stock market between the years 2009 and 2014. For rest of the years it has underperformed the market. The industry has performed well up to 2014 in the stock market. The

momentum was lost after that. Positive correlation has been established between market concentration and profitability. Positive correlation has been established between profitability and book value and profitability and earning per share. So the discussion highlights the larger gains for the top firms in the industry in terms of profitability and the stock market performance.

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