

COMPARATIVE PANEL DATA ANALYSIS ACROSS 5 MANUFACTURING INDUSTRIES: A CASE STUDY ON FIXED VERSUS RANDOM EFFECTS

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Abstract: *The paper considers estimation of panel data models to capture a picture of the nature of Indian industry in the post liberalisation period. With data ranging from 1991 to 2015, the gamut of five heavyweight industries such as cement, drugs and pharmaceuticals, steel, automobile passenger vehicles and engine provide a framework that nests both the fixed and random effects set up. The aforementioned industries are selected on the basis of them playing prominent role in the post-liberalisation growth process. Industry data is secondary in nature and is retrieved from CMIE database. The study pivots around Herfindahl index which is a benchmark measure of concentration. Economic theory and empirical evidence suggest that, industry concentration presents a clear picture of the conduct and performance of the market structure. This paper checks the impact of economic indicators like size setup, ROCE, D/E ratio and sales on the concentration of these industries. Herfindahl index is used as a dependent variable of industry concentration. The effects of these determinants on shaping up of these prominent industries reveal the changes taking place due to trade liberalization. This paper attempts to compare two methods of panel and shows why one of them explains the changes better than the other. For instance, the possible reason why size setup would negative linkage with Herfindahl index in the steel industry could be due to liberalisation neutralizing the effect of size setup and encouraging increased concentration in Steel sector. We compare and contrast the results found from fixed panel versus random panel to show which approach explains the variation in concentration better and its subsequent implications.*

Key words: *Industry concentration, Panel Data, Herfindahl index*

I. INTRODUCTION:

Indian industry, like in many other industrial nations, work under numerous controls forced by government for strategic reasons. The pattern of industry concentration in manufacturing sector during the regulated tenure was a direct result of government planning rather than getting determined by market powers. By the 1980s, a long stretch of industrial slump, particularly technological slowdown, led way for deregulation. There was some relaxation of import barriers through reformed trade and industrial policy measures. 'Broad banding' of licenses was presented: this measure enabled firms to utilize their current authorized limit (beforehand attached to a narrower product line) to expand to a more extensive scope of related items. 'For instance, market shares of individual firms in any manufacturing sector were determined largely by licensed capacity allocations. It is hardly surprising that sectors in which licenses were restricted to a handful of firms tended to display high levels of concentration. On the other hand, small scale sector firms had a tendency to have a scattered structure. With financial changes that ostensibly started in the 1980s, and picked up unmistakable pace after 1991, numerous segments in Indian industry have been continuously deregulated and exposed to global rivalry. The post - liberalization industrial policy came in the wake of severe balance of payments crunch. The process initiated in the 1980s did bring about some positive results on the industrial growth front.

This paper evaluates the predictors of industry concentration of five heavy domestic industries through alternative models. The industries included in this study are Cement, drugs and pharmaceutical, steel, AMV and Engine manufacturing. The industrial policy statement of the government to continue to pursue a policy framework encompassing encouragement of entrepreneurship, development of indigenous technology through investment in research and development, bringing in new technology, dismantling of the regulatory system, development of capital markets and increased competitiveness are all applicable for the aforementioned domestic heavy industries. The interest lies in the spread of industrialization to backward areas of the country with active promotion through right kind of incentives, institutions and infrastructure investments. The prime objective of Industrial Policy Statement was to maintain sustained growth in productivity, enhance gainful employment and achieve optimal utilization of human resources, to attain international competitiveness and transform India into a major player in the global arena. The focus of the policy was to unshackle the industry from bureaucratic controls. This needed policy reforms in many areas. In the first instance, a substantial modification in industrial licensing policy was considered necessary with a view to ease restraints on capacity creation, and respond to emerging domestic and global opportunities by improving productivity. Accordingly, the policy statement included abolition of industrial licensing for most industries, with the exception of a few industries for reasons of security, strategic concerns, and social and environment issues. Compulsory licensing was required only in respect of eighteen industries. These included inter alia coal and lignite, distillation and brewing of alcoholic drinks, cigar and cigarettes, pharmaceuticals, white goods and hazardous chemicals. Small sector continued to be reserved. Norms for setting up industries (except for industries subject to compulsory licensing) in cities with more than one million populations were further liberalized. Recognizing the complementarity of domestic and foreign investment, the FDI was accorded a significant role in the industrial policy of 1991. FDI up to 51 per cent foreign equity in high priority industries requiring large investments and advanced technology was permitted. Foreign equity up to 51 per cent was also allowed in trading companies primarily engaged in export activities. These initiatives were expected to provide a boost to investment besides enabling access to high technology and marketing expertise of foreign

companies. With a view to inject technological dynamism in the Indian industry, the government provided automatic approval for technological agreements related to high priority industries and eased procedures for hiring of foreign technical expertise. Major initiatives towards restructuring of public sector units were initiated, in view of their low productivity, over staffing, lack of technological up gradation and low rate of return. In order to raise resources and ensure wider public participation PSU's, it was decided to offer its share-holding stakes to mutual funds, financial institutions, general public and workers. Similarly, in order to revive and rehabilitate chronically sick PSU's it was decided to refer them to the Board of Industrial and Financial Reconstruction (BIFR).

Industrial policy in India

India's strategy for post-independent growth focused on import substitution, substantial control of the private and public sector in domestic heavy industries prominently mentioned in this study. These procedures were embraced to boost self-confidence in the economy, while in the meantime guaranteeing that financial power isn't restricted in a couple (Kaushik, 1997). These strategies were adopted in part to promote self-reliance in the economy, while at the same time ensuring that economic wealth is not concentrated in the hands of few (Kaushik, 1997). With its reliance on government to fast track the development of a self-sufficient economy, it nationalized banks, implemented regulatory and licensing structures to direct private investments to priority sectors, or imposed high tariffs on consumer goods, imposed foreign exchange controls and discouraged foreign investments (Kaushik, 1997). In particular, the Industry (Development and Regulations) Act of 1951 mandated the government to reserve certain industries for the public sector and imposed licensing requirements for new ventures and substantial expansion in the private sector. To prevent the concentration of wealth, two other legislations were enacted: the Capital Issues (Control) Act of 1947 and the Indian Companies Act of 1956. The Capital Issues Act promoted the wide distribution of share ownership, while the Companies Act restricted inter-corporate investments and directorships (Rajakumar and Henly, 2007).

However, an evaluation of these policies by the Indian government in the 1960s showed an increase in large business groups from 1951 to 1968. It was noted by one of the investigating committees that the then existing controls in fact helped large firms by restricting the entry of new firms (Rajakumar and Henly 2007). Thus, in 1969, India passed the Monopolies and Restrictive Trade Practices (MRTP) Act that regulated monopolistic and restrictive trade practices. The Act required large and dominant firms (as defined by the MRTP Act) to register with the Central Government, and to secure government approval for expansions, mergers, new ventures and appointment of directors in other companies. Limits were also imposed on the total assets that these firms can accumulate (Bhattacharjea, 2008). However, tight government controls in the economy and an inward-looking strategy, promoted inefficient industries and a "license-permit-quota raj" that stifled competition. The results of these strategies showed sluggish growth from the '50s to the early 1980s, averaging 3-5 percent, with average annual increase of per capita income at 1.3 percent. This, while growth rates in the developing world during a period of expansion of global trade, averaged at 3 percent per capita (Das, 2006).

During the 1970s, industrialists began to lobby for liberalization, particularly, in the importation of raw materials and machinery. In the early 1970s, the government gradually relaxed industry regulation, and trade regulation in the late 1970s. More substantial reforms were put in place starting 1985 through import liberalization, decline of the government's monopoly rights over certain imports, easing of regulation of the private sector, and provision of export incentives. Also, the asset limit imposed on large and dominant firms under the MRTP Act was raised from 1985-1986, which freed up these firms to venture into new products and businesses (Panagariya, 2006). However, while average growth increased to around 5.6 percent as a result of these reforms, unchecked spending and a growing public debt contributed to India's fiscal problems in the early 1990s (Das, 2006). In 1991 India adopted sweeping and significant economic policy reforms that included removal of most import quotas, further reduction of tariff and non-tariff barriers, liberalization of foreign investments, industry deregulation, and limitation of the scope of participation of the public sector in industry (Das, 2006; Kohli, 2006; Konchar, Kumar, Rajan, Arvind and Tokatlidis, 2006).

Licensing and registration requirements for large and dominant firms under the MRTP Act were also removed, except for a few industries (Bhattacharjea, 2008). And more importantly, approach to economic policy-making also underwent a paradigm shift. From a "command and control" economy, policy shifted to the adoption of market principles (Panagariya, 2004). While there was a slight increase in GDP per capita since the 1980 reforms, there appeared to be a more marked increase after the 1991 reforms. Trade openness, likewise increased since the 1991 reforms. Since the late 1960s, India adopted two competition laws: (a) the Monopolies and Restrictive Trade Practices (MRTP) Act of 1969; and (b) the Competition Law of 2002, which superseded the MRTP Act. The MRTP Act regulated monopolistic and restrictive trade practices (1969) and unfair trade practices (1984 amendment) (MRTPA, Sections 10 (a) and (b), 36A and 36B; Indian Ministry of Corporate Affairs 2004-2005; Bhattacharjea 2008). It also established the MRTP Commission, a quasi-judicial body attached to the Ministry of Corporate Affairs, to enforce the provisions of the MRTP Act (MRTPA, Section 5.). With the implementation of market reforms since 1991, the MRTP Act was deemed to be insufficient to meet the challenges of the new policy environment. Thus in 2003, a new competition law, the Competition Act of 2002 was enacted. The Competition Act covers: (a) prohibition of anti-competitive agreements, including cartels (Competition Act, Section 3); (b) prohibition against abuse of dominant position (Competition Act, Section 4); (c) regulation of mergers and acquisitions of large corporations (Competition Act, Sections 5 and 6); and (d) competition advocacy (Competition Act, Section 49). It also established the Competition Commission of India (CCI), a quasi-judicial body authorized to investigate, hear, decide cases and sanction violations of the Competition Act, as well as regulate mergers and acquisitions (Competition Act, Sections 18 and 40). Amendments in 2007 established the Competition Appellate Tribunal authorized to hear cases on appeal from the CCI (Ministry of Corporate Affairs 2010-2011). After amendments in 2007 and 2009, the Competition Act became effective on September 1, 2009. The MRTP Commission was then dissolved in October 2009, and the CCI took over its functions. Pending cases of the MRTP Commission were also transferred to the CCI as a result (Ministry of Corporate Affairs 2010-2011).

From the methodological point of view, in most panel data modelling, Fixed Effects (FE) analysis is assumed to be the conventional method for estimating longitudinal data. However this paper confronts the assumption and compares it with Random Effects (RE) model. Apart from incorporating random coefficients, RE models are flexible and reveal complex variance functions. The paper does not only argue for endogeneity but also makes room for heterogeneity across entities. While Fixed Effects Model is frequently used as a default time series technique in economics, Random Effects too have increasingly gained notability in the field of social science. Each of these techniques is useful due to their varied applicability.

II. LITERATURE REVIEW:

Panel data Analysis is developed for two dimensional data consisting of cross-section as well as time. According to Robinson (2012), "Non-parametric models include additive, unknown, individual-specific components and allows also for cross-sectional and temporal dependence". Panel data has benefitted many econometric model settings after the seminal paper by Hsiao, (1986). Although many papers models have attempted to specify panel models with trends and individual effects, applying non-parametric methods reduces the risk of misspecifying the model. For instance, the paper by Robinson (2012) successfully specified nonparametric trend model with dynamic cross-sectional effects. Another instance is the use of non-parametric fixed effects model in the works of Hoderlein et al. (2011). Li et al. (2011), Ruckstuhl et al. (2000) justified panel regression estimation with dynamic time series with fixed size across the cross-sections in a non-parametric set-up. The paper has followed non-parametric estimation showing time dependence keeping cross-sectional size fixed. Few other papers by Carroll et al. (2003) and Wang (2003) explored the time dependence keeping cross-sectional size fixed and a possible efficiency gain emerging out of it. The paper by Henderson et al. (2008) estimated additive individual effects in non-parametric regression whereas the paper by Evdokimov (2010) used non-additive individual effects in a similar setup.

Although the industrial organization literature suggests a number of measures, in empirical research the state of competition or the degree of seller's concentration in a market is generally measured as by using market shares of the firms, n firm concentration ratio(CRn), the Herfindahl-Hirschman Index(HHI).In the Indian context also, past studies largely used these measures to examine the state of market concentration. For example while Kambhampati(1996) assessed the structure of the market on the basis of CRn, Ramaswamy(2006), Behra(2007), and Mishra and Behra(2007), and Mishra(2008) used HHI as the measure of market concentration in the Indian industry sector. On the other hand, Basant and Morris(2000) and Mishra(2005) used n-firm concentration, the HHI and PCM to substantiate the findings. However, Pushpangadan and Shanta(2008) examined the dynamics of competition in terms of the persistence of profit rates. While the conclusions on market concentration are likely to be influenced by the measures used, very little attention is given to examining the accuracy of various alternative measures of market concentration by using the criteria as suggested by Ginivicius and Cirba(2009).

The licensing mechanism too affected levels of industrial concentration. The number of firms and their market shares were directly determined by capacity allocations. In some sectors licenses were restricted to a handful of firms, usually in order to prevent 'unnecessary duplication of investment', resulting in relatively concentrated markets (Athreye and Kapur 2004).

Levels of concentration in Indian industry were also influenced by the policy towards foreign investment and imports. In the wake of the foreign exchange crises of the 1960s, the economic regime became relatively hostile to new investment by foreign firms. This tended to preserve the relatively concentrated structure in some industries that were dominated by incumbent foreign firms (Athreye and Kapur 2001).On the whole, the pattern of concentration during the regulated phase was a product of government design rather than market forces. By the early 1980s, a long period of industrial stagnation, especially technological stagnation, created pressure for deregulation. There was some liberalization of import policy and partial reform of industrial policy in 1985. 'Broad-banding' of production licenses was introduced: this change allowed firms to use their existing licensed capacity (previously tied to a narrow product specification) to manufacture a broader range of related products. In this regulated phase, market structure and patterns of industrial concentration were shaped, wittingly or unwittingly, by government policy. For instance, market shares of individual firms in any manufacturing sector were determined largely by licensed capacity allocations. It is hardly surprising that sectors in which licenses were restricted to a handful of firms tended to display high levels of concentration. On the other hand, sectors that were reserved for small-scale firms tended to have a relatively fragmented structure. With economic reforms that arguably began in the 1980s, but gained prominence after 1991, many sectors in Indian industry have been progressively deregulated and exposed to foreign competition. It is reasonable to expect that, after deregulation, the market structure would be determined less by government policy and more by normal competitive processes. The study of Athreye and Kapur 2004 explored the determinants of industrial concentration before and after liberalisation. The investigation shows that one factor that plays a major role is the aggregate size of the market. If the market is large relative to setup costs in an industry, competitive entry tends to create a fragmented market structure. This suggests that the degree of concentration may be inversely related to the size of the market. Sutton (1991, 1998) argued that this traditional size-structure relationship may not hold in industries that are technology intensive or advertising intensive. In such industries larger markets may provide incentives for competitive escalation of advertising and technology expenditures, and the escalated levels of such expenditures may not be compatible with a fragmented market structure.

III. METHODOLOGY :

Panel data is useful for cases where the pattern of entities is observed over time (cross-sectional time-series data). Panel data allows controlling for unobservable variables like differences in industry-specific business practices. For this study, we apply both fixed effect and random effect model to check which model is a better fit to express the variation in industry concentration. For the fixed effect, unit of entity considered here are individual industries with specific characteristics of their own.Using fixed effect model will assist in capturing industry-specific factors, thereby allowing for individual heterogeneity. Panel is also capable of capturing patterns across time but not across industries (i.e. government regulations such as liberalisation etc). In this case, 'year' represents the unit of time variable (t).

Fixed effects model equation can be expressed as:

$$Y_{it} = \beta_i X_{it} + \alpha_i + u_{it} \text{ ----- (1)}$$

Where – α_i (i=1...5) is the intercept for individual industry (5 entity-specific intercepts).

Y_{it} is the dependent variable where i = industry and t = 1991-2015; unit of time= 1 year.

X_{it} represents independent variables, i= industry 1 to 5.

β_1 is the coefficient for X,

u_{it} is the error term.

The rationale behind random effects model is that, unlike the fixed effects model, the variation across entities is assumed to be random and uncorrelated with the predictor or independent variables included in the model: "...the crucial distinction between fixed and random effects is whether the unobserved individual effect embodies elements that are correlated with the regressors in the model, not whether these effects are stochastic or not" [Green, 2008, p.183].

An advantage of random effects is that one can include time invariant variables (i.e. gender). In the fixed effects model these variables are absorbed by the intercept.

Random Effects model equation can be expressed as:

$$Y_{it} = \beta_{it}X_{it} + \alpha + u_{it} + \varepsilon_t \text{----- (2)}$$

Where – α_i ($i=1, \dots, 5$) is the intercept for individual industry (5 entity-specific intercepts).

Y_{it} is the dependent variable where i = industry and t = 1991-2015; unit of time= 1 year.

X_{it} represents independent variables, i = industry 1 to 5.

β is the coefficient for X ,

u_{it} is the error term.

ε_t is the random error term across industries

Random Effect model assumes that the unique errors (u_i) are not correlated with the regressors thereby permitting the time-invariant factors to act as independent explanatory variables..

To decide between fixed or random effects, a Hausman test is performed where the null hypothesis stands as error terms (U_i) are not correlated with the regressors vis-à-vis error terms are correlated. The acceptance of null hypothesis is that a random effect is the appropriate predictor of the model. Alternatively, the rejection of the null hypothesis implies the fixed effects would be a more appropriate measure. The test primarily checks if the unique errors (u_i) are correlated with the predictor.

IV. DATA: The paper uses four predictors, viz. Debt-Equity Ratio, Sales, Size Setup and Return on Capital Employed to evaluate their effects on industry concentration. Industry concentration is again represented by Herfindahl Index. Data is collected from 2016 CMIE industry database.

Herfindahl index (HHI):

To measure the industry concentration, we use the Herfindahl-Hirschman Index, taking into account both the number of firms and the inequality of market shares. The Herfindahl index provides measure of industrial concentration for any industry this index is computed as the sum of the squared market shares of all firms in any industry; In a market economy,

$$HHI = S_1^2 + S_2^2 + \dots + S_K^2 = \sum_{i=1}^K S_i^2$$

in which K is the number of firms in the industry and S_i denotes the market share of firm i . HHI is measured by industry and by year.

Industrial concentration refers to the extent to which production is concentrated amongst firms in an industry. The number of active firms in the industry provides a simple measure of concentration; the greater is the number of firms the less concentrated (more competitive) is market structure. High concentration is usually indicative of lack of competition, with direct implications for prices, profits and economic welfare. The value of industrial concentration ranges from 0 (denoting extreme fragmentation) to 1 (extreme concentration).

Debt equity ratio (DE ratio): Debt-equity ratio is a measure of the relative contribution of the creditors and shareholders or owners in the capital employed in business. Simply stated, ratio of the total long term debt and equity capital in the business is called the debt-equity ratio. It can be calculated using a simple formula:

$$\text{Debt-equity ratio} = \text{Total liabilities} / \text{Equity}$$

This financial tool gives an idea of how much borrowed capital (debt) can be fulfilled in the event of liquidation using shareholder contributions. It is used for the assessment of financial leverage and soundness of a firm and is typically calculated using previous fiscal year's data.

Sizesetup: It measures the size of the market relative to the setup cost of a typical production unit. The size of the market for any industry is measured by aggregating the sales in that industry, while setup costs are measured as net fixed assets in that industry. Set up costs refer to the cost of setting up a plant of minimum efficient scale. If the size of the market (the average level of demand) is large relative to set up costs, a large number of firms may be able to exist profitably creating a more fragmented structure. On the other hand if the market is small relative to setup costs, the industry would be more concentrated.

ROCE: Return on capital employed is a profitability ratio that measures how effectively assets are performing while taking into consideration long term financing. ROCE is calculated by dividing net operating profit or EBIT by the employed capital.

Although the industrial organization literature suggests a number of measures, in empirical research the state of competition or the degree of seller's concentration in a market is generally measured as by using market shares of the firms, n firm concentration ratio (CR $_n$), the Herfindahl-Hirschman Index (HHI).

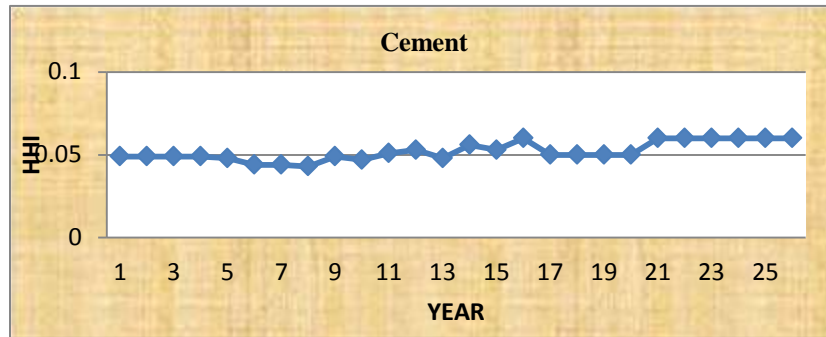
$$ROCE = \frac{\text{Net operating profit or EBIT}}{\text{Employed Capital}}$$

Another variable that has been considered is Sales.

V. RESULTS AND ANALYSIS:

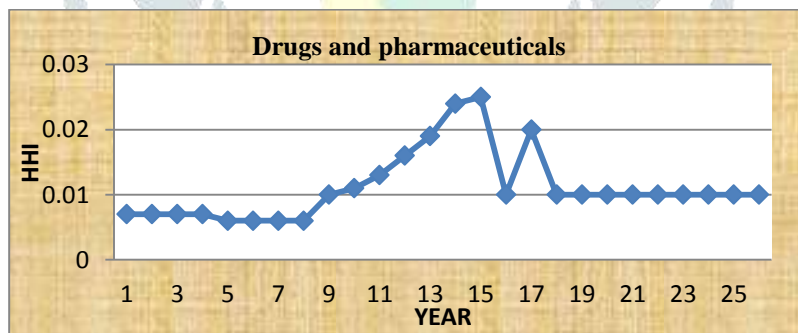
V.1. Descriptive: The graphs 1-5 describe the change in concentration in the five major Indian industries. The cement industry shows stable concentration in the first 4-5 years of liberalization which then fell in the 6-8th year. The extent of concentration has been increasing since the 9th year, reached a plateau at 0.05 in the 16th-21st year and finally at 0.6 in the last 4-5 years.

Cement

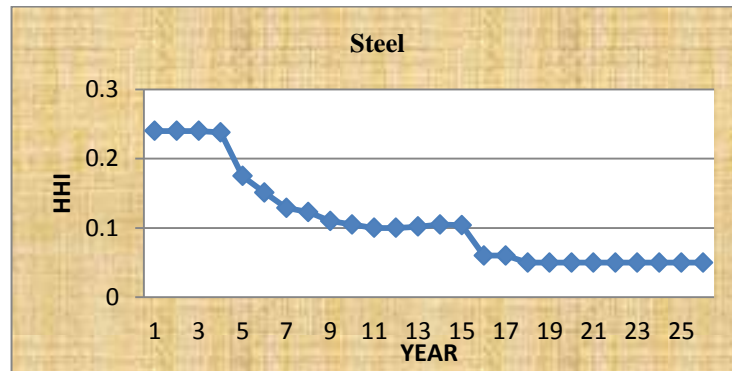


The structure of the industry can be viewed as fragmented, although the concentration at the top has increased, as the top 5 players control around 60.28% of market share, which was 55% in 1989-90, whereas the other 39.72% of market share is distributed among 50 minor players. The fragmented structure is a result of the low entry barriers in the post decontrol period and the ready availability of technology. The extent of concentration in the Indian cement industry has increased over the years. This concentration mainly occurs from the acquisition by the larger and the more efficient units taking over relatively weaker units. Some of the key benefits (ICRA 2006) include-economies of scale resulting from larger size of operation, time and cost saving for setting up new plant, access to new market, special facilities of the acquired company. The booming demand for cement attracted global majors who entered Indian domestic market through mergers, acquisitions, joint ventures or Greenfield projects. In 2005-06 the major players include France’s Lafarge, Holcim from Switzerland, Italy’s Italcement and Germany’s Heidelberg Cements.

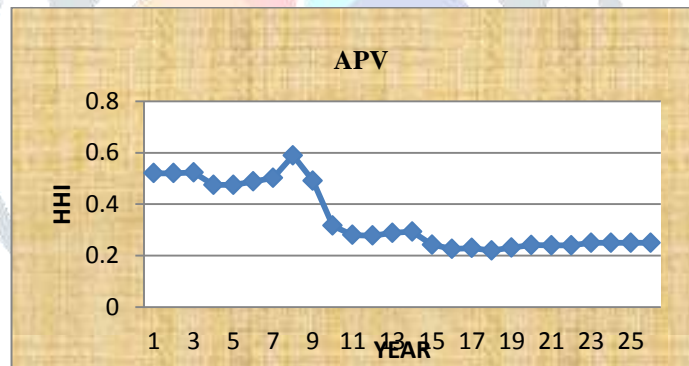
Drugs and pharmaceuticals



As the country has embarked on the new patent law regime, with concurrent liberalization of industrial, trade and price control policies, the industry is experiencing major changes. There is consolidation in the industry in the form of mergers, acquisitions, joint ventures, contract research and manufacturing etc. The foreign companies are acquiring the leading Indian companies. Ranbaxy’s acquisition by Daichii, Piramal’s acquisition by Abbott, and Dabur’s acquisition by Fresenius Kabi Oncology Ltd. are just a few examples where the leading Indian pharma companies have been acquired by the foreign companies. “Many of the world’s leading pharmaceutical companies have subsidiaries or other operations in India. Multinational companies like GlaxoSmithKline (GSK) Baxter, Aventis, Pfizer, Novartis, Wyeth, and Merck have been active in India’s pharmaceutical market mainly through subsidiaries. The reintroduction of product patents precipitated the return of a large number of other MNCs, some of whom left during the process patent era. MNC pharmaceutical companies have also been attracted by tax holidays, the deduction of capital R&D expenditures, and other financial incentives offered by the Indian government” (Greene 2007).

Steel:

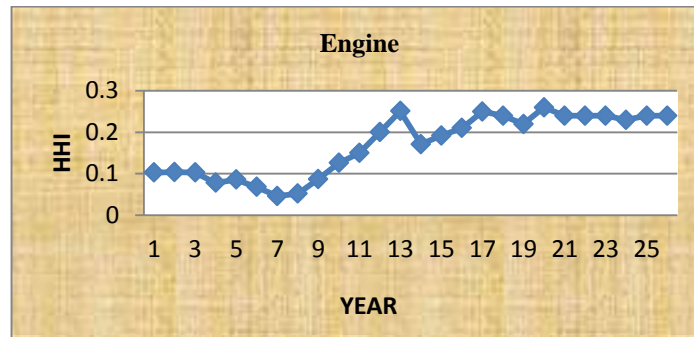
Till early 1990s, when economic liberalization reforms were introduced, the steel industry continued to be under controlled regime, which largely constituted regulations such as large plant capacities were reserved only for public sector under capacity control measures; price regulation; for additional capacity creation producers had to take license from the government; foreign investment was restricted; and there were restrictions on imports as well as exports. However, after liberalization—when a large number of controls were abolished, some immediately and others gradually—the steel industry has been experiencing new era of development. Major developments that occurred at the time of liberalization and thenceforth were: large plant capacities reserved for public sector was removed, elimination of export restrictions, Import tariff reduced from 100 to 5% and decontrol of domestic steel prices (Government Of India , ministry of Steel Annual Report 2007-08). The future, it appears, will continue to be dominated by a few large players and the industry will remain oligopolistic – as it is internationally. TISCO, public sector entities, POSCO, Jindals, Essar, and Arcelor-Mittal will be among the major players. There is a key factor behind the predominance of large units and oligopolistic industry structure is the production process. Steel sector was the first to be liberalized and we can see from our study that there are enough players; though the industry is concentrated in some segments. However, this in no way suggests that the sector should be subject to regulation, which also includes the government. In this sector, therefore a far-sighted pro-competitive action would be more to deal with enabling rapid entry and expansion, reducing controls on international trade, and ensuring a level playing field. Regulation should thus be restricted to case of market failures like natural monopolies, externalities and asymmetric information between buyers and sellers.

Automobile-passenger vehicle

After 1991 with the introduction of New Industrial policy and with the death of license raj automobile industry was allowed to expand. The passenger car segment has been dominated by three vendors – Maruti Suzuki, Hyundai and Tata Motors (which together accounted for 70 percent of passenger car sales in 2009-10).

Considering the robust growth the industry is currently witnessing, it is clear that any new entrant would need to demonstrate consistent and clear differentiators to make a play for a leadership position in the Indian market. After the relaxation of restriction in FDI Many multinationals like Daewoo, Peugeot, General Motors, Mercedes-Benz, Honda, Hyundai, Toyota, Mitsubishi, Volvo, Ford and Fiat entered the market. As the new entry took place concentration in industry declines rapidly as it is showing in the graph.

Engine



The industry is concentrated because engine market is characterized by (a) pricing power, (b) strong technology led entry barrier –which needs to be constantly upgraded and (c) not so easily replicable distribution channel. The industry dynamics are ‘robust and firm’ by retaining pricing power and discipline even in this tough environment. Technology and distribution network are very high entry barriers for any new player; sheer price competition will not serve business ambitions. The dominant players in this are Ashok Leyland Limited, Bajaj Auto Limited, Cummins India Limited, Greaves Cotton Limited, Kirloskar Oil Engines Limited, Mahindra & Mahindra Limited, Tata Motors Limited etc.

V.2. Fixed effect model:

The model allows for heterogeneity or individually across industries by allowing them to have their own intercept value. The intercept is time invariant but differ across industries. The model assists in controlling unobservable variables and avoids omitted variable bias in estimation. The result for fixed effects estimation is depicted here. The dependent variable Herfindahl Index shows statistical significance with adjusted R square of 71.4%. However, the explanatory variables D-E Ratio, Sales, Size setup and ROCE do not show any statistical significance.

Fixed Effect Summary Table

Variable	Coefficient	Effects	Values
C	0.11***	R Squared	0.732
D E RATIO	0.009	Adjusted R squared	0.714
Sales	-0.00	F statistics	41.4
Size Setup	0.00	Probability	0.00
ROCE	0.001	S.D.	0.13

V.3. Random effect model:

Here the five industries have a common mean value for the intercept. The dependent and independent variables are the same as that in the previous model. The explanatory variables D E Ratio and Sales show statistically significant results. However the adjusted R- squared shows poor values along with insignificant F-statistics.

Random Effect Summary Table

Variable	Coefficient	Effects	Values
C	0.15***	R Squared	0.035
D e ratio	-0.02***	Adjusted R squared	0.04
Sales	0.001***	F statistics	1.144
Size Setup	0.00	Probability	0.339
ROCE	0.001	S.D.	0.13

V.4. Hausman test:

After estimating the aforementioned models, it has to be decided which model is good to accept. Hausman Test is used to choose which model is suitable. The test checks through hypothesis testing. The H_0 checks if the individual unobserved effects are uncorrelated with the included variables X_{it} . If p-value is insignificant, we shall accept the null implying Random effect is more efficient and preferable. .

H₀ => Random-effects Model is appropriate

H₁ => Fixed-effects is appropriate.

Hausman Test Summary

Chi-square statistic	315.4***
Adjusted R-squared for HHI (fixed)	0.714***
Adjusted R-squared for HHI (random)	0.04

The Hausman test reveals statistically significant p-value leading to rejection of the null hypothesis. Therefore, the acceptance of alternative hypothesis leads to selecting Fixed Effects model as the suitable model. The corresponding adjusted R-squared values also affirm significant explanation through the fixed effect model.

VI. CONCLUSION

“The key insight is that if the unobserved variable does not change over time, then any changes in the dependent variable must be due to influences other than these fixed characteristics.” (Stock and Watson, 2003, p. 289-290). As our analysis suggests, fixed effect turns out to be the suitable route to describing our model. The rationale is heavily influenced by individual industry specific characteristics. Nevertheless this study leads us to improving substantive and statistical analysis of panel in terms of time-series and cross-sectional data on multiple level. Fixed-effects will not work well with data for which within-cluster variation is minimal or for slow changing variables over time but it will in case model such as this.

VII. REFERENCES

- [1] Ahluwalia, I.J., (1985), Industrial Growth in India: Stagnation since the mid-1960s. *Delhi: Oxford University Press.*
- [2] Athreye, S. and Kapur, S., (2001), Private Foreign Investment in India: pain or panacea? *The World Economy*, 24, 399-424.
- [3] Athreye, S. and Kapur, S., (2004), Industrial Concentration in a Liberalising Economy: A Study of Indian Manufacturing.
- [4] Baltagi, B.H. (2008). *Econometric Analysis of Panel Data. Wiley Publications.*
- [5] Basant, R., (2000). Corporate Response to Economic Reforms, *Economic and Political Weekly*, 813-822.
- [6] Basant, R. and Saha, S.N., (2004). Determinants of Entry in the Indian Manufacturing Sector, mimeo, Indian Institute of Management Ahmedabad.
- [7] Basant, R and S Morris (2000): *Competition policy in India: issues for a globalizing economy*, project report submitted to the Ministry of Industry, Govt. of India, New Delhi.
- [8] Bhattacharjea, A., (2003). India's Competition Policy: An Assessment. *Economic and Political Weekly.*
- [9] Carroll, R.J., Lin, X., Linton, O.B., Mammen, E., (2003). Accounting for correlation in marginal longitudinal nonparametric regression. In: Lin, D.Y., Heagerty, P.J. (Eds.). *Second Seattle Symposium on Biostatistics. In: Lecture notes in Statistics.*, Springer-Verlag, Berlin.
- [10] Chakraborty, S. (2017). Industry Concentration vis-à-vis Sustainable Growth-Case of Some Specific Indian Industries. *International Journal of Management Studies*. 4(1), 95- 105.
- [11] CMIE (various years), Industry: Market Size and Shares. *Economic Intelligence Service, Centre for Monitoring the Indian Economy, Mumbai.*
- [12] Evdokimov, K. (2010): Identification and Estimation of a Nonparametric Panel Data Model with Unobserved Heterogeneity. *Discussion paper, Princeton University.*
- [13] Ginevicius, R and Cibra, S. (2009). Additive Measurement of Market Concentration. *Journal of Business Economics and Management*, 10(3), 191-198.
- [14] Greene, H.W. (2008). *Econometric Analysis. 6th ed., Upper Saddle River, N.J. Prentice Hall.*
- [15] Henderson, D. J., R. J. Carroll, and Q. Li (2008): Nonparametric Estimation and Testing of Fixed Effects Panel Data Models. *Journal of Econometrics*, 144(1), 257–275.
- [16] Hoderlein, S., Mammen, E., Yu, K., (2011). Non-parametric models in binary fixed effects panel data. *Econom. J.* 14, 351–367.
- [17] Kambhampati, U.S., (1996), Industrial Concentration and Performance: A Study of the Structure, Conduct and Performance of Indian Industry. *Delhi: Oxford University Press.*
- [18] Kaushik, S. (1997). India's Evolving Economic Model: A Perspective on Economic and Financial Reforms. 56 (1): 71-84.
- [19] Konchar, K., U.Kumar, R.Rajan, A.Subramanian, and I. Tokatlidis. (2006). India's Pattern of Development: What Happened, What Follows. NBER Working Paper 12023. Cambridge, Massachusetts.
- [20] Mishra, P. and Behra, B. (2007). Instabilities in Market Concentration: An Empirical Investigation In Indian Manufacturing Sector. *Journal of Indian School of Political Economy*, 19(3), 419-449.
- [21] Pushpangadan, K. and Shanta, N. (2008). Competition and Profitability In Indian Manufacturing Sector. *Indian Economic Review*, 43(1), 103-123.
- [22] Panagariya, A., (2004), India in the 1980s and 1990s: A Triumph of Reforms. *International Monetary Fund working paper 4/43.*
- [23] Rajakumar, J. and J. Henly. (2007). Growth and Persistence of Large Business Groups in India. *Journal of Comparative International Management*, 10(1):3-22.
- [24] Ruckstuhl AF, Welsh AH, Carroll RJ. (2000). Nonparametric function estimation of the relationship between two repeatedly measured variables. *Statistica Sinica*. 10:51–71.
- [25] Stock, J. H., & Watson, M. W. (2007). *Introduction to Econometrics. Boston: Pearson/Addison Wesley.*
- [26] Sutton, J., (1991). Sunk Costs and Market Structure: Price Competition, Advertising, and the Evolution of Concentration. (*MIT Press*).
- [27] Sutton, J., (1998). *Technology and Market Structure: Theory and History. (MIT Press).*
- [28] Wang, N., 2003. Marginal nonparametric kernel regression accounting for withinsubject correlation. *Biometrika*, 90, 43–52.
- [29] Annual Survey of Industries (2010-11): Retrieved December 23, 2018 from <http://www.csosiw.gov.in> India Info line: Retrieved December 18, 2017, from India Info line: <http://www.indiainfoonline.com/blog>.
- [30] CARERATINGS: <http://www.careratings.com/upload/NewsFiles//Studies> , Retrieved December 18, 2018, from <http://www.careratings.com>.
- [31] Cement Manufacturers' Association: <http://www.cmaindia.org/industry/facts-about-cement-industry.html>, Retrieved December 22, 2017 from <http://www.cmaindia.org>.

- [32] CMIE (Various Years): Industry: Market Size and Shares, Economic Intelligence Service, MUMBAI: Retrieved from <http://www.economicoutlook.cmie.com>.
- [33] CRISIL (2014): <https://www.crisil.com/research/customised-research-bulletin.html>, Retrieved from <http://www.crisil.com>.
- [34] India info line: Retrieved December 18, 2017, from India Info line: <http://www.indiaonline.com/blog>.
- [35] Joint plant committee Report Govt. of India (2007): <http://www.cci.gov.in/market-research>, Retrieved December 27, 2017 from <http://www.cci.gov.in>.
- [36] KPMG India, The Indian Automotive Industry, Evolving Dynamics. KPMG India. Retrieved December 16, 2017 from https://www.kpmg.de/docs/Auto_survey.
- [37] Ministry of Steel (2007-08). <http://www.steel.gov.in/annualreport>, Retrieved December 23, 2016, from <http://www.steel.gov.in>.
- [38] MOSPI (2010-11) Ministry of Statistics and Program Implementation (2010-11). Retrieved December 23, 2017, from <http://www.mospi.nic.in>.
- [39] SIAM (Various Years). Retrieved December 16, 2017 from <http://www.siamindia.com/publications>
- [40] World Steel Association (2015). Retrieved December 23, 2017 from <http://www.wsa.org>

VIII. APPENDIX

Correlation Tables:

Table 1: Correlation between variables in Cement Industry

1	DER	SIZESETUP	ROCE	SALES	HHI
DER	1.000	.293	-.621**	.068	-.464*
SIZESETUP	.293	1.000	.170	.659**	.043
ROCE	-.621**	.170	1.000	.562**	.263
SALES	.068	.659**	.562**	1.000	.059
HHI	-.464*	.043	.263	.059	1.000

Table 2: Correlation between variables in Drugs and Pharmaceutical Industry

2	DER	SIZESETUP	ROCE	SALES	HHI
DER	1.000	-.200	-.415*	.077	-.203
SIZESETUP	-.200	1.000	.108	.150	.506**
ROCE	-.415*	.108	1.000	.232	.359
SALES	.077	.150	.232	1.000	-.401*
HHI	-.203	.506**	.359	-.401*	1.000

Table 3: Correlation between variables in Steel Industry

3	DER	SIZESETUP	ROCE	SALES	HHI
DER	1.000	.054	-.644**	-.044	.521**
SIZESETUP	.054	1.000	.249	.583**	.249
ROCE	-.644**	.249	1.000	.469*	-.320
SALES	-.044	.583**	.469*	1.000	.294
HHI	.521**	.249	-.320	.294	1.000

Table 4: Correlation between variables in APV Industry

4	DER	SIZESETUP	ROCE	SALES	HHI
DER	1.000	-.181	-.682**	-.300	.689**
SIZESETUP	-.181	1.000	.320	.441*	-.160
ROCE	-.682**	.320	1.000	.355	-.198
SALES	-.300	.441*	.355	1.000	-.093
HHI	.689**	-.160	-.198	-.093	1.000

Table 5: Correlation between variables in Engine Industry

5	DER	SIZESETUP	ROCE	SALES	HHI
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DER	1	-.069	-.589**	.292	-.696**
SIZESETUP	-.069	1	.060	.159	.035
ROCE	-.589**	.060	1	.315	.404*
SALES	.292	.159	.315	1	-.172
HHI	-.696**	.035	.404*	-.172	1

Panel Estimation Method:

Dependent Variable: HERF_INDEX
 Method: Panel Least Squares
 Date: 03/06/18 Time: 12:17
 Sample: 1991 2016
 Periods included: 26
 Cross-sections included: 5
 Total panel (balanced) observations: 130

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.115908	0.017499	6.623526	0.0000
D_E_RATIO	0.009790	0.007036	1.391520	0.1666
SALES	-0.000289	0.000694	-0.416009	0.6781
SIZESETUP_NFA_SALES_	4.86E-05	0.000459	0.105876	0.9159
ROCE	0.001482	0.001338	1.108302	0.2699

Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.732546	Mean dependent var	0.136985	
Adjusted R-squared	0.714863	S.D. dependent var	0.136445	
S.E. of regression	0.072859	Akaike info criterion	-2.333856	
Sum squared resid	0.642325	Schwarz criterion	-2.135334	
Log likelihood	160.7006	Hannan-Quinn criter.	-2.253190	
F-statistic	41.42674	Durbin-Watson stat	0.135624	
Prob(F-statistic)	0.000000			

Dependent Variable: HERF_INDEX
 Method: Panel EGLS (Cross-section random effects)
 Date: 03/06/18 Time: 12:20
 Sample: 1991 2016
 Periods included: 26
 Cross-sections included: 5
 Total panel (balanced) observations: 130
 Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.156361	0.016998	9.198773	0.0000
D_E_RATIO	-0.020931	0.006315	-3.314675	0.0012
ROCE	-0.001720	0.001148	-1.498844	0.1364
SALES	0.001546	0.000647	2.389114	0.0184
SIZESETUP_NFA_SALES_	8.59E-05	0.000455	0.188892	0.8505

Effects Specification				
Cross-section random				
Idiosyncratic random				
Weighted Statistics				
R-squared	0.035316	Mean dependent var	0.136985	
Adjusted R-squared	0.004446	S.D. dependent var	0.136445	
S.E. of regression	0.136141	Sum squared resid	2.316812	
F-statistic	1.144026	Durbin-Watson stat	0.076047	
Prob(F-statistic)	0.339001			
Unweighted Statistics				
R-squared	0.035316	Mean dependent var	0.136985	
Sum squared resid	2.316812	Durbin-Watson stat	0.076047	

Correlated Random Effects - Hausman Test
 Equation: Untitled
 Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	315.436495	4	0.0000

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
SALES	-0.000289	0.001546	0.000000	0.0000
ROCE	0.001482	-0.001720	0.000000	0.0000
D_E_RATIO	0.009790	-0.020931	0.000010	0.0000
SIZESETUP_NFA_SALES_	0.000049	0.000086	0.000000	0.5404

Cross-section random effects test equation:
 Dependent Variable: HERF_INDEX
 Method: Panel Least Squares
 Date: 05/08/18 Time: 12:24
 Sample: 1991 2016
 Periods included: 26
 Cross-sections included: 5
 Total panel (balanced) observations: 130

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.115908	0.017499	6.623526	0.0000
SALES	-0.000289	0.000694	-0.416009	0.6781
ROCE	0.001482	0.001338	1.108302	0.2699
D_E_RATIO	0.009790	0.007036	1.391520	0.1666
SIZESETUP_NFA_SALES_	4.86E-05	0.000459	0.105876	0.9159

Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.732546	Mean dependent var	0.136985	
Adjusted R-squared	0.714863	S.D. dependent var	0.136445	
S.E. of regression	0.072859	Akaike info criterion	-2.333856	
Sum squared resid	0.642325	Schwarz criterion	-2.135334	
Log likelihood	160.7006	Hannan-Quinn criter.	-2.253190	
F-statistic	41.42674	Durbin-Watson stat	0.135624	
Prob(F-statistic)	0.000000			