The Evolution and Structure of the Two-wheeler Industry in India*

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Abstract

This paper studies the evolution of the competitive structure of the two-wheeler industry in India. The evolution of the industry's competitive structure is traced using Kendall's Index of Rank Concordance and the Evans-Karras test of convergence. The industry seems to be characterized by oligopoly with the onset of economic reforms not making much difference to industrial structure. Convergence of sales and capacity at the level of the industry is conditional while it is absolute at the level of the segment.

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I. Introduction

Contemporary research has examined market structure in order to explain consumer brand preferences based on attributes of these brands. While Elrod (1988), Chintagunta (1994) and Elrod and Keane (1995) use static market structure models, Erdem (1996) uses a dynamic model. In another study, Bresnahan and Greenstein (1999) have examined the principal structural features of the computer industry in the U.S. at the industry-wide and segment-levels. They explain the persistence of dominant computer firms, their decline in the 1990s and the changes in the competitive entry in this industry. They discover that technological competition in the industry has increased through a) the formation of young platforms serving newly founded segments that challenged established platforms through the process of indirect entry and b) divided technical leadership resulting from the vertical disintegration of platforms. Other studies that have examined industrial structure include Baldwin and Gorecki (1994), Adelman (1951), Golan et. al. (1996) and Amato (1995).

It is noteworthy that all such studies of evolution of industries have largely been confined to the US and the Canadian experience. More specifically there does not exist any work along these lines for the Indian industrial sector. The Indian industrial sector has undergone profound regulatory changes in recent times as a consequence of the economic reforms program put together in between 1988 and 1991. Consequent to these reforms some of the industries that have been influenced the most have been the consumer durables industry (such as two-wheelers, washing machines, televisions etc.), the automobile industry and certain financial services. Typically an economy undergoing industrial reforms resorts to regulatory changes and redefines the role of the public sector in order to create a climate of growth and foster private competition. Therefore it is pertinent to examine the structure and

evolution of industries (such as consumer durables) in economies where reforms have taken place, for such industries show a propensity to evolve into oligopolies in the long run. It would be important in this context, to analyze the impact that economic reforms have had on industrial structure and to understand the implications thereof for the design of an appropriate regulatory mechanism in response.

In an evolving industry especially in emerging economies like India, it is extremely important to formulate optimal policies on competition in order to promote both competition as well as growth. In the U.S., for example, these objectives form the basis for regulatory mechanisms enshrined in the Sherman Act of 1890, the Clayton Act of 1914 (which targeted price discrimination) and the Robinson-Patman Act of 1936. The Miller-Tydings Act of 1937 modified the Sherman Act with regard to firms' policies on using distribution channels and giving specific dealer rebates etc. One should note that for the Indian consumer durables industry the last point is crucial, since most manufacturers operate through dealers and, the dealer margins have been on the rise in order to provide protection for respective market-shares[1]. This fact could actually constitute "unfair" trade practices on the part of the firms. The Indian two-wheeler industry resembles a cartel in the manner in which non-price factors are used to make the output of a given firm more valuable than that of a rival. The resulting higher price is due to this added cost. If the consumers valued the additional services generated by this competition above its cost, presumably these services would have been produced in a competitive market as well.

Posner (1976) argues that if antitrust laws are not formulated appropriately, competing sellers might be able to engage in "conscious parallelism" or tacit collusion and that the

[1] The dealer margins have increased from around 5% to about 30% of the ex-factory price between 1988 and 1999. The number of exclusive dealerships has also increased.

Sherman Act has proved ineffectual in dealing with the latter form of collusion. Bork (1978), however, asserts that only explicit collusion was likely to exist given that collusion without detailed communication and agreement (tacit) was not likely to be successful. In India, laws like the Monopolies and Restrictive Trade Practices Act (MRTP) and Foreign Exchange Regulation Act (FERA) were designed to control monopolistic tendencies in the markets. If these tendencies create welfare losses, then, there is a case for framing appropriate antitrust legislation.

The competitive policy so developed must be able to distinguish between real competition and purely theoretical competition. Competitive policy is not a road to Utopia or a complete basis for public policy (Areeda and Kaplow (1988)). Yet as Stigler (1966) points out, an optimal policy on competition often prevents the defects of social organization from being made worse by preventing deliberate adoption of restrictive practices by firms.

In this paper we assess the degree of imperfection in the two-wheeler industry in particular. The reason is that this industry underwent a sea change during 1985-1991 due to economic reforms introduced in this period. These reforms were aimed at encouraging competition. During this period, the two-wheeler industry saw the largest proliferation of brands in the consumer durables industry but whether this indeed led to enhanced competition is an empirical question, not yet examined. This paper purports to address this question.

Market imperfections are typically examined by calculating the Herfindahl index and the four-firm concentration ratios at the industry-wide and segment levels. Industrial economists have been debating the usefulness of these indices in assessing market concentration. While Posner (1976) argues that concentration ratios are but one of the indicators of collusive tendencies and that it is necessary to include fringe firms in the

analysis, Adelman (1951), Amato (1995), Golan, Judge, and Perloff (1996), and, Baldwin and Gorecki (1994) have shown that the Herfindahl index forms a much sounder indicator of the structure and performance of a given industry than four-firm concentration ratios.

The Herfindahl index is used, to a considerable extent, by the structuralist school, which postulates that competition, is a state of affairs (Reid, (1987)). While four firm concentration ratios and Herfindahl indices have their virtues as indicators of market concentration at a point in time, it is also important to understand the evolution of market power over time. Such an inquiry would also be in consonance with the Austrian school, which believes that competition should be examined as a process. In this spirit Baldwin and Gorecki (1994) track the mobility of firms (which captures shifts in market structure) by using a variant of the instability index of Hymer and Pashigian (1962). We have used the Kendall's rank concordance test to put into perspective the mobility of the firms. This is a more robust measure of tracking mobility of firms over time, since it also incorporates certain aspects of Lorenz type measurements to indicate relative positions of firms over time. If this index is used along with the concentration ratios, one can identify the contributors towards concentration over time in a clearer manner. This test also enables us to examine whether the dominance of any given firm persists over time and if this dominance is increasing/decreasing. However, a study of dominance in terms of persistence of ranks needs to be supplemented with one on dominance in terms of levels. If the ranks of firms in terms of shares in sales do not alter much over time, one still needs to assess whether differences between the sales shares of these firms are narrowing over time. The Evans and Karras (1996) test of convergence is ideally suited for this purpose. This test enables us to examine whether firms within the industry as a whole, tend to grow at similar rates in the long run and captures

the dynamics associated with the long-term growth of volumes and market-shares at the segment and industry-wide levels. This, then, sheds light on the inter-firm dependencies at these two levels, which in turn has implications for the competitive strategies of firms. We also conduct this test for production capacities of firms to test whether capacity expansion was the result of competition within the industry.

This paper, therefore, attempts to analyze key aspects of the structural characteristics of consumer durables industry in India. An analysis of the evolution of this industry has implications for firms within the industry, as well as for regulators and policymakers. While inter-firm linkages would be pertinent to firms in the context of competitive strategies, the analysis of price movements in the industry and its segments relative to the general price level, and the structure of competition within the industry and individual segments therein are of importance to regulators. Capacity growth movements have implications for future policymaking within the industry.

Based on the results of this paper we can make certain general conclusions about the consumer durables industries. For example, we establish that a) consumer durables industries will evolve as oligopolies at the industry-wide level and at the level of the segments, b) that the convergence of growth rates of sales volume and market-share is likely to be conditional[2] at the level of the industry and absolute[3] at the segment level.

[2] We can loosely define conditional convergence to imply that in the long run, its own past vector of means will determine growth rate of a firm.

[3] Absolute convergence implies that the growth rate of a firm is moving towards the vector of means of other firms in the industry in the long-run.

The rest of the paper is organized as follows. Section II describes the evolution of the two-wheeler industry, while section III details the model and data used. Results are discussed in section IV and section V concludes.

II. Evolution of the Indian two-wheeler industry

The two-wheeler industry (henceforth TWI) in India has been in existence since 1955. It consists of three segments viz., scooters, motorcycles, and mopeds. The increase in sales volume of this industry is proof of its high growth. In 1971, sales were around 0.1 million units per annum. But by 1998, this figure had risen to 3 million units per annum. Similarly, capacities of production have also increased from about 0.2 million units of annual capacity in the seventies to more than 4 million units in the late nineties[4].

The TWI in India began operations within the framework of the national industrial policy as espoused by the Industrial Policy Resolution of 1956. (See Government of India 1980, 1985, 1992). This resolution divided the entire industrial sector into three groups, of which one contained industries whose development was the exclusive responsibility of the State, another included those industries in which both the State and the private sector could participate and the last set of industries that could be developed exclusively under private initiative within the guidelines and objectives laid out by the Five Year Plans (CMIE, 1990). Private investment was channelised and regulated through the extensive use of licensing giving the State comprehensive control over the direction and pattern of investment. Entry of firms, capacity expansion, choice of product and capacity mix and technology, were all effectively controlled by the State in a bid to prevent the concentration of economic power. However due to lapses in the system, fresh policies were brought in at the end of the sixties.

[4] All sales figures are from various issues of ACMA, capacity figures from various Five Year Plan documents.

These consisted of MRTP of 1969 and FERA of 1973, which were aimed at regulating monopoly and foreign investment respectively. Firms that came under the purview of these Acts were allowed to invest only in a select set of industries.

This net of controls on the economy in the seventies caused several firms to a) operate below the minimum scale of efficiency (henceforth MES), b) under-utilize capacity and, c) use outdated technology. While operation below MES resulted from the fact that several incentives were given to smaller firms, the capacity under-utilization was the result of i) the capacity mix being determined independent of the market demand, ii) the policy of distributing imports based on capacity, causing firms to expand beyond levels determined by demand so as to be eligible for more imports. Use of outdated technology resulted from the restrictions placed on import of technology through the provisions of FERA.

Recognition of the deleterious effects of these policies led to the initiation of reforms in 1975 which took on a more pronounced shape and acquired wider scope under the New Economic Policy (NEP) in 1985. As part of these reforms, several groups of industries were delicensed and 'broadbanding'[5] was permitted in select industries. Controls over capacity expansion were relaxed through the specification of the MES[6] of production for several industries. Foreign investment was allowed in select industries and norms under the MRTP Act were relaxed.

These reforms led to a rise in the trend rate of growth of real GDP from 3.7% in the seventies to 5.4% in the eighties. However the major set of reforms came in 1991 in response

[5] Delicensed industries meant that firms no longer required licenses from the State to enter the industry or expand their plants. Broadbanding meant that a firm could manufacture products related to the ones they were currently making without the need for a separate license.
[6] This meant that expansion of capacity till the MES did not now require a license.

to a series of macroeconomic crises that hit the Indian economy in 1990-91[7]. Several industries were deregulated, the Indian rupee was devalued and made convertible on the current account and tariffs replaced quantitative restrictions in the area of trade. The initiation of reforms led to a drop in the growth of real GDP between 1990 – 1992, but this averaged at about 5.5% per annum after 1992. The decline in GDP in the years after reforms was the outcome of devaluation and the contractionary fiscal and monetary policies taken in 1991 to address the foreign exchange crisis. Thus the Industrial Policy in India moved from a position of regulation and tight control in the sixties and seventies, to a more liberalized one in the eighties and nineties.

The two-wheeler industry in India has to a great extent been shaped by the evolution of the industrial policy of the country. Regulatory policies like FERA and MRTP caused the growth of some segments in the industry like motorcycles to stagnate. These were later able to grow (both in terms of overall sales volumes and number of players) once foreign investments were allowed in 1981. The reforms in the eighties like 'broadbanding' caused the entry of several new firms and products which caused the existing technologically outdated products to lose sales volume and/or exit the market. Finally, with liberalization in the nineties, the industry witnessed a proliferation in brands.

A description of the evolution of the two wheeler industry in India is usefully split up into four ten year periods. This division traces significant changes in economic policy making. The first time-period, 1960-1969, was one during which the growth of the two-wheeler industry was fostered through means like permitting foreign collaborations and phasing out of

[7] The Indian economy was faced with several problems at this time. Foreign exchange reserves were down to two month's imports, there was a large budget deficit, double digit inflation, and with India's credit rating downgraded, private foreign lending was cut off. Also the Gulf war in 1990 brought about an increase in oil prices, and India had to import oil for over US$ 2 billion (GATT Secretariat, 1993).

non-manufacturing firms in the industry. The period 1970-1980 saw state controls, through the use of the licensing system and certain regulatory acts over the economy, at their peak. During 1981-1990 significant reforms were initiated in the country. The final time-period covers the period 1991-1999 during which the reform process was deepened These reforms encompassed several areas like finance, trade, tax, industrial policy etc. We now discuss in somewhat greater detail the principal characteristics of each sub period.

a) 1960 – 1969

The automobile industry being classified as one of importance under the Industrial Policy Resolution of 1948 was therefore controlled and regulated by the Government. In order to encourage manufacturing, besides restricting import of complete vehicles, automobile assembler firms were phased out by 1952 (Tariff Commission, 1968), and only manufacturing firms allowed to continue. Production of automobiles was licensed, which meant that a firm required a licensing approval in order to open a plant. It also meant that a firm's capacity of production was determined by the Government. During this period, collaborations with foreign firms were encouraged. Table 1 illustrates the fact that most firms existing in this period had some form of collaboration with foreign firms. Table 1 also gives the details of the various firms that existed in the industry during this time period and the product/s they manufactured.

Table 1 here.

b) 1970 – 1980

This was a period during which the overall growth rate of the two-wheeler industry was high (around 15% per annum). Furthermore, the levels of restriction and control over the industry

were also high. The former was the result of the steep oil price hikes in 1974 following which two-wheelers became popular modes of personal transport because they offered higher fuel-efficiency over cars/jeeps[8]. On the other hand, the introduction of regulatory polices such as MRTP and FERA resulted in a controlled industry. The impact of MRTP was limited as it affected only large firms like Bajaj Auto Ltd. whose growth rates were curbed as they came under the purview of this Act. However, FERA had a more far-reaching effect as it caused foreign investment in India to be restricted. In the motorcycle segment FERA caused technological stagnation[9], as a consequence of which, neither new products nor firms entered the market since this segment depended almost entirely on foreign collaborations for technology. The scooter and moped segments on the other hand were technologically more self-sufficient and thus there were two new entrants in the scooter segment and three in the moped segment.

c) 1981 – 1990

The technological backwardness of the Indian two-wheeler industry was one of the reasons for the initiation of reforms in 1981. Foreign collaborations were allowed for all two-wheelers up to an engine capacity of 100 cc. This prompted a spate of new entries into the industry (Table 1) the majority of which entered the motorcycle segment, bringing with them new technology that resulted in more efficient production processes and products[10]. The variety in products available also improved after 'broadbanding' was allowed in the industry in 1985 as

[8] Between 1974-79, sales of two-wheelers increased by 60%, while that of cars declined by 21% and jeeps grew only by 11%.

[9] Indian motorcycles in the seventies had two major drawbacks viz., low fuel-efficiency and high weight. Worldwide however, there was a trend towards using high-strength, low-weight materials for various components which resulted in vehicles that were compact and had lower weight. Since fuel-consumption of a two-wheeler depended on its weight, lighter vehicles meant greater mileage. These drawbacks were overcome in the eighties when foreign collaborations were once again allowed (see footnote 10).

a part of NEP. This, coupled with the announcement of the MES of production for the two-wheeler industry[11], gave firms the flexibility to choose an optimal product and capacity mix which could better incorporate market demand into their production strategy and thereby improve their capacity utilization and efficiency.

These reforms had two major effects on the industry: First, licensed capacities went up to 1.1 million units per annum overshooting the 0.675 million units per annum target set in the Sixth Plan. Second, several existing but weaker players died out giving way to new entrants and superior products[12] (table 1).

d) 1991 – 1999

The reforms that began in the late seventies underwent their most significant change in 1991 through the liberalization of the economy[13]. The two-wheeler industry was completely deregulated. In the area of trade, several reforms were introduced with the goal of making Indian exports competitive[14].

The two-wheeler industry in the nineties was characterized by a) an increase in the number of brands available in the market which caused firms to compete on the basis of

[10] Fuel-efficiency improved by (60-100)% in the new vehicles. In the seventies, motorcycle mileage was on an average between 25 to 50 kmpl (kilometer per liter), which had now improved to 50 to 80 kmpl. For mopeds it improved from 50 kmpl to 80 kmpl. Output of the engines also increased from 3-4 HP to 10 HP per 100 cc.

[11] In the two-wheeler industry, MES was pegged at 2,00,000 units and 5,00,000 units of annual licensed capacity for non-exporting and exporting firms respectively (CMIE, 1990).

[12] In the scooter segment, models with features like self-starter facility, automatic transmission system, gear-less riding etc. were introduced that were traditionally not available in scooters. In the motorcycle segment, the new 100 cc models compared well against the existing heavier models of 250 cc, 350 cc etc. as these were lighter and more fuel-efficient.

[13] Joshi and Little (1996) discuss the economic crisis of 1991 and the policy response of the Indian government.

[14] The EXIM Scrip was introduced which granted exporters entitlements worth 40% of their export earnings. Similarly quantitative restrictions were replaced with import duties which were around 85% of the two-wheeler industry (GATT Secretariat, 1993).

product features[15] and b) increase in sales volumes in the motorcycle segment vis-à-vis the scooter segment[16] reversing the traditional trend[17].

III. Data and Methodology

The data for this study was obtained from Infopoint, Center for Monitoring Indian Economy. Monthly sales volume data for various brands of two-wheelers in the three segments in different Indian states, between the time-period 1988-1998, was used. This ten year time period was chosen as it spanned all major structural shifts that had taken place in the Indian economy in the recent past and would thus enable the study of the effects of liberalization in 1991, on the two-wheeler industry. Data was available for selected brands only.

In order to identify the modeling approach we first tested the sales data for unit roots using the Augmented Dickey-Fuller test and the Philips-Perron tests. No unit roots were present indicating that methods applicable to stationary time series would be appropriate. We then attempted to identify the oligopolistic tendency in the two-wheeler industry by calculating the annual Herfindahl Index for firms. We also checked for the existence of certain forces of competition that were not conducive to optimal price setting during this period. We then examine whether the positions of dominance and less dominance in a

[15] Firms in the industry introduced products that had almost the same product design but varied in features offered. For instance both Bajaj Auto Ltd. and Kinetic Motors Ltd. introduced scooterettes (a hybrid between a scooter and a moped) in 1998 and 1999. The model offered by the former firm had a two-speed transmission system which was its distinguishing feature, while the separate oil and fuel tank was the unique feature offered by Kinetic. In the motorcycle segment, while Hero Honda models offered fuel-efficiency, Yamaha models offered better output power. In the scooter segment, the four-stroke feature was introduced in the nineties (traditionally scooters were always two-stroke) which was a distinguishing feature since it fulfilled the year 2000 emission norms.

[16] Industry sales figures show that scooter sales in 1990 formed 52% of the total two-wheeler sales that year, while the corresponding figures for the motorcycle and moped segments were 26% and 22%. By 1997, these figures had changed to 43%, 36% and 21% respectively (ACMA, various issues).

[17] The increasing usage of motorcycles over scooters resulted from a) superior attributes such as increased mileage, greater stability (due to larger wheel-base), maneuverability etc. available in motorcycles, that have resulted from, b) significant improvement in product design of motorcycles, while scooters essentially had the same basic design for the last forty years.

segment have been occupied by different firms over time and also if the relative positions of firms are changing over time. Finally we test whether sales of firms grow at different rates. This test is conducted both at the industry-wide and segment-specific levels.

One of the methods to examine the presence of non-competitive forces within the industry is through the construction of the Herfindahl Index and concentration ratios. These have historically been used in the U.S. to formulate antitrust laws aimed at regulating competition. The Herfindahl Index is calculated as follows

$$\sum_{i=1}^{n}\left(\frac{x_i}{\sum_{i=1}^{n} x_i}\right)^2 \qquad \textbf{... 1}$$

Where, n is the number of brands, x_i is the volume of brand i.

The Herfindahl Index was calculated at the level of the individual segments and for the industry as a whole at each time point in the sample. Table 2 shows the Herfindahl Index for specific time periods and the corresponding four-firm concentration ratios.

Table 2 here.

In order to examine whether changes in competitive forces through liberalization have led to some form of stability in the prices in TWI relative to the general level of prices, we compared indices of price calculated for individual segments and for the industry, with that of wholesale price index for manufactured goods. The index was calculated using 1988 as base. The results are shown in figure 1.

Figure 1 here.

To track the mobility of firms within a segment and to discover whether the positions of firms change over time we compute Kendall's Index of Rank Concordance (see Boyle and

McCarthy (1997), and Jha et. al. (1999)). Changes in positions of firms will indicate a change in the competitive structure of the industry. For example, if larger firms face diminishing returns due to competitive forces they would stop being market leaders. On the other hand, stability in ranks would imply that certain firms continue to exercise excessive influence in the market.

The methodology of Kendall's Index of Concordance is as follows. For any segment of two-wheelers under study, if all brands had the same ranks in all the years, then the variance of the sum of the ranks in all the years for all brands would be the maximum. The coefficient of concordance (W) can be thought of as an index of divergence of the actual agreement from the maximum possible (perfect) agreement. The degree of actual agreement in ranks obtained by the brands/markets in various years is reflected by the degree of variance among the J (total number of brands or markets) sums of ranks. Thus *W* is calculated as:

$$W = s/\left[(1/12)(k^2)J\left(J^2 - 1\right)\right] \quad \textbf{... 2}$$

where s = sum of squares of the observed deviations from the means of R_j (the sums of the ranks obtained by a particular brands or markets in different years), that is

$$s = \left[\sum_j R_j - mean(R_j)\right]^2 \quad \textbf{... 3}$$

where mean(R_j) is the mean of R_j, *k* is the number of years and *J* the number of brands/markets ranked.

Now, $(1/12)k^2\left(J^3 - J\right)$ is the maximum possible sum of squared deviations, i.e., the sum of *s* which would occur with perfect agreement among *k* rankings. The value of the rank concordance index varies between zero and one. The coefficient of concordance is calculated for the first two sets of rankings (i.e., the first two years), then for the first three years and so

on until for all the years. This enables us to study the mobility of rankings across time. The probability associated with the occurrence under H_0 (rankings are unrelated to each other) of any value as large as an observed W can be determined by finding χ^2 by the formula:

$$\chi^2 = s[(1/12)kJ(J+1)] = k(J-1)W \quad \text{... 4}$$

with degrees of freedom J-1. The results are presented in Tables 3 – 5.

Tables 3 to 5 here.

Kendall's Index of Concordance will indicate how the gap between the leader and follower firms in a segment moves over time. Given that the results could indicate a widening gap which would imply an increasing dissimilarity between firms, it would be necessary to examine whether the growth rates of these firms in the long-run tend to become similar (i.e., whether they converge to an equilibrium mean in the long-run).

In order to obtain better characterization of the evolution of the competitive structure of this industry we carried out tests of convergence in levels. Convergence tests for levels have had a chequered history and have, as Boyle and McCarthy (1997) (among others) point out, some difficulties in interpretation. Refinements to the standard tests have been offered by, for example, Evans and Karras (1996). The methodology for this test (henceforth called the Evans and Karras test) is as follows. Consider (the log of) the sales volume of firm n; call this y_t. Apply OLS to equation 5.

$$\Delta(y_{nt} - \bar{y}_t) = \delta_n + \rho_n(y_{n,t-1} - \bar{y}_{t-1}) + \sum_{i=1}^{p} \varphi_{ni}\Delta(y_{n,t-1} - \bar{y}_{t-1}) + u_{nt} \quad \text{... 5}$$

where a bar (-) over a variable indicates its mean value. ρ_n will be negative if the growth rates of firms converge, zero otherwise. The φ*'s* are parameters such that all roots of $\sum_i \varphi_{ni} L^i$ lie outside the unit circle. After applying OLS to equation 5, one obtains the

standard error of each regression $\hat{\sigma}_n$. Then we compute the normalized series $\hat{z}_{nt} \equiv (y_{nt} - \bar{y}_t)/\hat{\sigma}_n$ for each n.

Next we use OLS to obtain the parameter estimate $\hat{\rho}$ and its t-ratio $\tau(\hat{\rho})$ by estimating

$$\Delta\hat{z}_{nt} = \hat{\delta}_n + \rho\hat{z}_{n,t-1} + \sum_{i=1}^{p} \varphi_{ni}\Delta\hat{z}_{n,t-i} + \hat{u}_{nt}$$

as a panel for $n = 1,2,....N$ (firms) and $t = 1,2,...,T$ (time) where $\hat{\delta}_n \equiv \delta_n / \hat{\sigma}_n$ and $\hat{u}_{nt} \equiv u_{nt} / \hat{\sigma}_n$. Then if $\tau(\hat{\rho})$ exceeds an appropriately chosen critical value, one can reject the $H_0 : \forall_n \rho_n = 0$ in favor of $H_1 : \forall_n \rho_n < 0.$ In case H_1 is accepted, there is convergence in levels. If H_0 can be rejected, then we calculate the F-ratio:

$$\Phi(\hat{\delta}) = \frac{1}{N-1}\sum_{n=1}^{N}\left[\tau(\hat{\delta}_n)\right]^2,$$

where $\tau(\hat{\delta})$ is the t-ratio of the estimator of $\hat{\delta}_n$ obtained by applying ordinary least squares to equation 5 for brand n. If $\Phi(\hat{\delta})$ exceeds an appropriately chosen critical value, we can infer that convergence is conditional. If not, convergence may be absolute. In order to confirm absolute convergence, a more powerful test is used. Equation 5 implies that $-\delta_n/\rho_n$ is the unconditional mean of $y_{nt} - \bar{y}_t$, if $\rho_n < 0$. Consequently, absolute convergence can be tested against conditional convergence by comparing $\Phi(\hat{\eta})$, the heteroskedasticity-consistent F-ratio obtained by applying least squares to

$$-\hat{\delta}_n/\hat{\rho}_n = \nu + \eta' x_n + w_n, \qquad n = 1,2,...., N, \qquad \textbf{... 6}$$

to an appropriately chosen critical value from the $F(K, N-K-1)$ distribution. In (6), $\hat{\delta}_n$ and $\hat{\rho}_n$ are the estimators of δ_n and ρ_n obtained by applying ordinary least squares to

equation 5, x_n is a $K \times 1$ vector of variables describing brand n, ν is a parameter, η is a $K \times 1$ parameter vector, and w_n is an error term. The results are shown in table 6.

Table 6 here.

IV. Results

In a consumer durables industry in which there is a proliferation of brands we expect the long-run competitive structure at the level of the industry to be oligopolistic. This is due to the fact that in order to survive firms must introduce new brands which might improve capacity utilization even as this induces brand competition. This, in turn, will cause only a few large firms in the industry to survive indicating that in the long-run, a brand proliferated consumer durable industry will tend towards oligopoly. We expect a general downward stickiness in prices and resultant increase of volatility in non-price variables such as sales volumes, market-shares etc. Convergence is likely to be absolute at the level of the segment and conditional at the level of the industry. Competitive strategies (which include product-development and other strategies aimed at innovation and technological change) are more inter-dependent at the level of the market-segment than at the level of the industry. This is due to the fact that within each segment the products are, to a large extent, similar. Hence we can expect convergence to be absolute at the level of the segment and conditional at the level of the industry[18].

[18] Bain (1950) lists five criteria for determining whether a market (industry) is workably competitive. The following are the general signs of non-workable competition a) constant supernormal profits, b) persistent excess capacity (scale of production), c) excessive selling costs, d) lag in adopting cost saving technologies and, e) scale of many firms outside the optimal range. The evidence from the Indian TWI satisfies most of these criteria. We find that the capacities do not converge which implies that competition does not influence capacity building. The selling costs (for example, retailers' margins) are excessive and have grown rapidly. The rate of technology adoption has been quite slow as is clear from the fact that it was in late 1998 that a four-stroke technology was adopted, though this was available for many years.

The principal results of this study are as follows.

1. The Herfindahl Index was calculated over a period of 10 years, for both the two-wheeler industry as a whole, and for each of the segments. Besanko et al., (1996) state that if the Herfindahl Index is between 0.2 to 0.7, the market will be oligopolistic. If the index is 0.1 or lower, then the market is tending toward monopolistic or perfect competition. In this paper it is found that on an average the index has varied between 0.20 and 0.25 for the two-wheeler industry (Table 2). This implies that this industry has evolved into an oligopolistic industry where, product differentiation is a decisive variable. At the level of the individual segments, the oligopolistic forces are more pronounced both in the pre-reform and post-reform periods with the index varying on an average between 0.3 and 0.8. Four firm concentration ratios were also calculated at the level of the industry and individual segments (Figure 1). It is seen that while the concentration ratio for the industry is lower than that for the individual segments, the ratios are always higher than 60% at both levels. This indicates the existence of an oligopolistic structure at the segment and industry levels[19].

2. From Kendall's Rank Concordance test it is seen that the null hypothesis of no agreement between ranks is rejected throughout the period of study. This indicates that over time (including periods of increased competition say in the post-liberalization period), the positions of firms have not changed significantly relative to each other implying that the dominant firm has remained dominant, while the less dominant firms have retained their respective positions

[19] We constructed the Herfindahl Index and concentration ratios for consumer durables with differing life spans, such as cars, washing machines and refrigerators. We found the Herfindahl index varied between 0.4 – 0.6 for the same time-period for which it was constructed for the two-wheeler industry. The four-firm concentration ratios are persistently above 70% for these other industries. The concentration ratio measures the degree to which an industry is dominated by few large firms. The four-firm concentration ratio is defined as the percentage contribution by the largest four firms in the industry to the total industry sales. A ratio that is higher than 50 or 60 percent indicates that the industry is likely to be oligopolistic (Salvatore, 1996). This reinforces our claim that a consumer durables industry in the long-run will be oligopolistic.

relative to the dominant firm. It is also seen that while respective positions are maintained, the gap between the dominant and less-dominant firms is increasing with time. This is true at the segment and industry levels.

3. The Evans and Karras test of Convergence shows that for the industry as a whole, firms will tend to grow at a single equilibrium rate of growth in the long-run, i.e., the likelihood of any firm within the industry or within a product segment, growing at a rate that is consistently faster than others is low in the long-run.

4. When each of the three segments is analyzed separately, it is found that in the scooter segment there is absolute convergence for both pre reform (1986-1990) and post reform (1991-1998) periods. The motorcycle segment yields similar results. But in the moped segment, convergence is absolute in the pre-reform period and conditional in the post-reform period. At the industry-wide level convergence is found to be conditional[20].

V. Conclusions

The computed Herfindahl Index indicate that the Indian two-wheeler industry continues to be oligopolistic in the post-reforms period[21] even though the degree of concentration has declined. This implies that the deregulation of the industry has not led to substantially higher competition. This may reflect the inadequacy of regulatory policy and/or the nature of the technology of the industry wherein an oligopolistic structure is natural.

[20] We conducted tests of cointegration on price indices constructed for the various segments. The results reveal that the various segments are not cointegrated implying that markets are segmented at the industry-wide level. However we obtained a cointegrating relationship between the segments and the wholesale price index for manufactured goods. The former reinforces the fact that convergence at the level of the industry is likely to be conditional rather than absolute. From the latter result, one is able to see that individual segments can be affected by movements of the wholesale prices.

[21] The Evans test was conducted for capacities of firms in the two-wheeler industry. It was found that the growth rates of capacities of firms do not converge to an equilibrium value in the long run. This implies that small firms in the industry remain small as they do not make sufficient profits to plough back for purposes of capacity expansion. Therefore these firms do not have any effect on the larger firms in terms of causing diminishing returns/fall in profits in the latter. Consequently, larger firms also do not increase capacity. This accounts for the Herfindahl Index remaining at around 0.20-0.25 for the two-wheeler industry over the years.

The values of the Herfindahl Index also indicate that the three segments of the industry have responded in different ways to changes in the forces of competition. This is an outcome of liberalization which led to an unequal number of entrants in each segment. We find that the motorcycle segment has had a greater number of entries than did the scooter or moped segments.

Thus, it is quite possible that when competition-inducing policies are introduced, there could be an unequal number of entrants in each segment, which would then further increase oligopoly in some segments and for the industry as a whole. Oligopoly could also result from the fact that it is existing firms that are introducing new brands rather than new firms entering the industry. When the movement of prices in the three segments is considered, it is seen that prices (net of inflation) have not decreased though the number of brands has increased. This is indicative of oligopoly. Therefore, future reforms in the industrial policy covering the two-wheeler industry will probably need to incorporate some mechanism to induce new firms to enter the industry.

The results for Kendall's Rank Concordance Test suggest that a few of the firms in the industry exercise undue influence in the market. This is due to the structure of competition in the market which has led larger firms to succeed in consolidating capacities while smaller firms have remained less-dominant. The Kendall's test also enables us to identify the firms that have contributed to the high levels of concentration in the industry in addition to tracing the mobility of firms in the industry as a whole. This result should come in handy in the formulation of policies on competition which contains appropriate antitrust mechanisms.

Conventional wisdom will lead us to believe that proliferation of brands is a sign of competition. We however find that one of the measurable indices of competition, viz.; the

extent of price flexibility is non existent. Non price competition is the norm. This is the outcome of broad banding. Declining firms have taken advantage of this provision and introduced more brands that are for the most part similar. This has lead to highly fractured markets and persistent oligopolistic tendencies.

From the results of the Evans and Karras convergence test and, from the definition of absolute convergence it can be inferred that in the scooter and motorcycle segments, inter-brand transmittal of information through promotion, product development, pricing etc. is likely to be effective in influencing the growth rates of other firms in these segments. The firms in the moped segment on other hand, probably compare themselves with firms in another segment (such as scooters) or with other modes of transport[22] and are therefore not inter-dependent. This would explain why convergence is conditional in this segment.

[22] Firstly, the scooterette which was first introduced in 1991 in this segment was a hybrid between a scooter and a moped. The scooterette offered more engine power than a moped, and was more fuel-efficient, cheaper and easier to ride (gear-less) than a scooter. The scooterette was therefore an upgradation of the moped and possibly a step-through between mopeds and scooters. Secondly, mopeds being at the lower end of the spectrum of two-wheelers are also aimed at consumers using non-motorized modes of personal transport like bicycles. Therefore firms in this segment are likely to perceive themselves as competing with the scooter segment (in the former case) and other modes of transport (in the latter case).

References

Adelman, M.A. 1951. The Measurement of Industrial Concentration. The Review of Economics and Statistics 33, 269-296.

Amato, L. 1995. The Choice of Structure Measure in Industrial Economics. Quarterly Journal of Business and Economics 34, 39-52.

Areeda, P., Kaplow, L. 1988. Antitrust Analysis: Problems, Text, Cases. Little, Brown and Company.

Automotive Component Manufacturers Association of India (ACMA). 1998. Automotive Industry in India, Facts and Figures 1997-1998. Mumbai.

Automotive Component Manufacturers Association of India (ACMA).1994. Automotive Industry in India, Facts and Figures 1993-1994. Mumbai.

Bain, J. 1950. Workable Competition in Oligopoly: Theoretical Consideration and Some Empirical Evidence. American Economic Review 35, 37-38.

Baldwin, J., Gorecki, P. 1994. Concentration and Mobility Statistics in Canada's Manufacturing Sector. The Journal of Industrial Economics XLII, 93-103.

Besanko, D., Dranove, D., Shanely, M. 1996. The Economics of Strategy. United States of America. John Wiley and Sons Inc.

Bork, R., 1978. The Antitrust Policy Paradox: A Policy at War with Itself. New York. The Free Press

Boyle G., McCarthy, T. 1997. A Simple Measure of β Convergence. Oxford Bulletin of Economics and Statistics 59, 257-264.

Bresnahan, T., Greenstein, S. 1999. Technological Competition and the Structure of the Computer Industry. The Journal of Industrial Economics 47, 1 – 40.

Center for Monitoring Indian Economy. 1990. The Liberalization Process, Mumbai.

Chintaunta, P. 1994. Heterogenous Logit Model Implications for Brand Positioning. Journal of Marketing Research 31, 304 – 311.

Elrod, T. 1988. Choice Map: Inferring a Product Market Map from Observed Choice Behavior. Marketing Science 7, 21 – 40.

Elrod, T., Keane, M. 1994. A Factor-Analytic Model for Representing the Market Structure in Panel Data. Journal of Marketing Research 32, 1 – 16.

Erdem, T. 1996. A Dynamic Analysis of Market Structure Based on Panel Data. Marketing Science 15, 359 – 378.

Evans P., Karras, G. 1996. Convergence Revisited. Journal of Monetary Economics 37, 249-265.

GATT Secretariat. 1993. Trade policy Review: India, Vol. 1.

Golan A., Judge, G., Perloff J. 1996. Estimating the Size Distribution of Firms using Government Summary Statistics. The Journal of Industrial Economics XLIV, 69-80.

Government of India. 1980. Sixth Five Year Plan (1980-85). New Delhi: Planning Commission.

Government of India. 1985. Seventh Five Year Plan (1985-90). New Delhi: Planning Commission.

Government of India. 1992. Eighth Five Year Plan (1992-97). New Delhi: Planning Commission.

Hymer, S., Pashigian, P. 1962. Turnover of Firms as a Measure of Market Behavior. Review of Economics and Statistics 44, 82-87.

Jha, R., Mohanty, M., Chatterjee, S., Chitkara, P. 1999. Tax Efficiency in Selected Indian States. Empirical Economics 24, 641-654.

Joshi, V., Little, I. 1996. India's Economic Reforms: 1991-2001. New Delhi, Oxford University Press.

Posner, R. 1976. Antitrust Law: An Economic Perspective. Chicago and London. The University of Chicago Press.

Reid, G. 1987. Theories of Industrial Organization. Oxford. Basil Blackwell.

Salvatore, D. 1996. Managerial Economics in a Global Economy. New Delhi, McGraw-Hill, Inc.

Stigler, G. 1966. The Economic Effects of the Antitrust Laws. Journal of Law and Economics 9, 225.

Tariff Commission. 1968. Report of the Tariff Commission on the Automobile Industry. New Delhi, Government of India.

Table 1
Details of firms within the two-wheeler industry

Period of entry	Name of the Indian firm	Name of foreign collaborator, if any	Segment	Brand name of product
1955 - 1969	Enfield India Ltd. (EIL)*	Enfield Ltd., U.K.	motorcycle	Royal Enfield 350 cc
	Automobile Products of India (API)*	Innocenti Ltd., Italy	scooter	Lambretta
	Bajaj Auto Ltd. (BAL)	Piaggio Ltd., Italy	scooter	Vespa
	Ideal Jawa Pvt. Ltd. (IJPL)*	Jawa Ltd., Czechoslovakia	motorcycle	Yezdi, 250 cc
	Escorts Ltd. (EL)*	CEKOP, Poland	motorcycle	Rajdoot, 175cc
1970 - 1980	Kinetic Engineering Ltd. (KEL)	-	moped	Luna
	Scooters India Ltd. (SIL)*	-	scooter	Vijai
	Maharashtra Scoters Ltd. (MSL)	-	scooter	Priya
	Majestic Auto Ltd. (MAL)	-	moped	Hero Majestic
	Sundaram Clayton Ltd. (SCL)	-	moped	TVS 50 cc
1981 - 1990	TVS	Suzuki, Japan	motorcycle	Ind-Suzuki 100 cc
	Bajaj Auto Ltd.	Kawasaki, Japan	motorcycle	Kawasaki Bajaj 100 cc
	Escorts Ltd.	Yamaha, Japan	motorcycle	Yamaha RX 100 cc
	Hero Majestic Ltd.	Honda, Japan	motorcycle	Hero Honda 100 cc
	Kinetic Engineering Ltd.	Honda, Japan	scooter	NH 100 cc
	Lohia Machinery Ltd.	Piaggio, Italy	scooter	Vespa XE
	Enfield India	Zundapp-Werke GmBH	moped motorcycle motorcycle motorcycle	50cc 50cc 80cc 100cc
1991-1999	Bajaj Auto Ltd.	-	moped - scooterette	Sunny
	TVS	-	scooter - scooterette	Scooty
	Kinetic	Honda	scooter - scooterette	Marvel
	TVS	-	scooter	Spectra
	Kinetic Motors**	-	scooterette	Style

* indicates firms/brands whose sales declined in the eighties
** In 1998, the joint venture between the Firodias Group of India (Kinetic) and Honda of Japan came to an end when the former bought out Honda's stake of 51%. However in return for royalty and technical fees, Honda continued to supply technical know-how to the new Kinetic Motors Company Ltd. (KMCL).

Table 2

Herfindahl Index and Four-firm Concentration Ratio results

Industry	Segment	Herfindahl Index			Four-firm Concentration Ratios		
		88-90	91-93	94-99	88-90	91-93	94-99
Two-wheelers	industry-wide	0.20	0.24	0.22	76	72	75
	scooter	0.62	0.73	0.71	99	94	75
	motorcycle	0.29	0.34	0.32	82	76	79
	moped	0.45	0.29	0.33	97	98	97

Table 3
Kendall's Rank Concordance Test (scooters)

Time Period				
	1988-1995		1995-1998	
k	w	Chi-sq	w	chi-sq
2	1.0000	4.0000	1.0000	6.0000
3	1.0000	6.0000	1.0000	9.0000
4	1.0000	8.0000	1.0000	12.0000
5	1.0000	10.0000	1.0000	15.0000
6	1.0000	12.0000	1.0000	18.0000
7	1.0000	14.0000	1.0000	21.0000
8	1.0000	16.0000	1.0000	24.0000
9	1.0000	18.0000	1.0000	27.0000
10	1.0000	20.0000	1.0000	30.0000
11	1.0000	22.0000	1.0000	33.0000
12	1.0000	24.0000	1.0000	36.0000
13	1.0000	26.0000	1.0000	39.0000
14	1.0000	28.0000	1.0000	42.0000
15	1.0000	30.0000	1.0000	45.0000
16	1.0000	32.0000	1.0000	48.0000
17	1.0000	34.0000	1.0000	51.0000
18	1.0000	36.0000	1.0000	54.0000
19	1.0000	38.0000	1.0000	57.0000
20	1.0000	40.0000	1.0000	60.0000
21	1.0000	42.0000	0.9819	61.8571
22	1.0000	44.0000	0.9826	64.8545
23	1.0000	46.0000	0.9834	67.8522
24	1.0000	48.0000	0.9840	70.8500
25	1.0000	50.0000	0.9846	73.8480
26	1.0000	52.0000	0.9852	76.8462
27	1.0000	54.0000	0.9857	79.8444
28	0.9656	54.0714	0.9862	82.8429
29	0.9358	54.2759	0.9867	85.8414
30	0.9100	54.6000	0.9871	88.8400
31	0.9126	56.5806	0.9875	91.8387
32	0.9150	58.5625	0.9879	94.8375
33	0.9174	60.5455	0.9882	97.8364
34	0.9196	62.5294	0.9886	100.8353
35	0.9216	64.5143	0.9889	103.8343
36	0.9236	66.5000	0.9892	106.8333
37	0.9255	68.4865	0.9795	108.7297
38	0.9273	70.4737	0.9709	110.6842
39	0.9290	72.4615	0.9716	113.6769

Table 3 cntd…

Time Period		
1988-1995		
k	**w**	**chi-sq**
40	0.9306	74.4500
41	0.9322	76.4390
42	0.9337	78.4286
43	0.9351	80.4186
44	0.9365	82.4091
45	0.9378	84.4000
46	0.9390	86.3913
47	0.9402	88.3830
48	0.9414	90.3750
49	0.9250	90.6531
50	0.9100	91.0000
51	0.9116	92.9804
52	0.9131	94.9615
53	0.9146	96.9434
54	0.9160	98.9259
55	0.9174	100.9091
56	0.9187	102.8929
57	0.9058	103.2632
58	0.8939	103.6897
59	0.8828	104.1695
60	0.8844	106.1333
61	0.8742	106.6557
62	0.8647	107.2258
63	0.8559	107.8413
64	0.8477	108.5000
65	0.8400	109.2000
66	0.8329	109.9394
67	0.8262	110.7164
68	0.8201	111.5294
69	0.8143	112.3768
70	0.8090	113.2571
71	0.8040	114.1690
72	0.7994	115.1111
73	0.7951	116.0822
74	0.7911	117.0811
75	0.7874	118.1067
76	0.7839	119.1579
77	0.7807	120.2338
78	0.7778	121.3333
79	0.7750	122.4557
80	0.7725	123.6000
81	0.7702	124.7654
82	0.7680	125.9512
83	0.7660	127.1566
84	0.7642	128.3810
85	0.7625	129.6235
86	0.7610	130.8837
87	0.7595	132.1609

Table 4
Kendall's Rank Concordance Test (mopeds)

Time Period				
	1988-1990		1991-1998	
k	w	Chi-sq	w	chi-sq
2	1.000	4.000	1.000	6.000
3	1.000	6.000	0.911	8.200
4	0.813	6.500	0.925	11.100
5	0.760	7.600	0.904	13.560
6	0.778	9.333	0.900	16.200
7	0.796	11.143	0.902	18.943
8	0.813	13.000	0.900	21.600
9	0.778	14.000	0.901	24.333
10	0.760	15.200	0.904	27.120
11	0.752	16.545	0.907	29.945
12	0.750	18.000	0.903	32.500
13	0.751	19.538	0.901	35.123
14	0.755	21.143	0.900	37.800
15	0.760	22.800	0.876	39.400
16	0.766	24.500	0.877	42.075
17	0.772	26.235	0.878	44.788
18	0.778	28.000	0.862	46.533
19	0.767	29.158	0.865	49.295
20	0.760	30.400	0.868	52.080
21	0.764	32.095	0.871	54.886
22	0.769	33.818	0.874	57.709
23	0.773	35.565	0.878	60.548
24	0.737	35.361	0.867	62.450
25	0.705	35.227	0.859	64.440
26	0.666	34.641	0.863	67.292
27	0.634	34.247	0.856	69.356
28	0.608	34.024	0.860	72.214
29	0.585	33.954	0.863	75.083
30	0.567	34.022	0.866	77.960
31	0.579	35.892	0.869	80.845
32	0.590	37.771	0.872	83.738
33	0.601	39.657	0.875	86.636
34	0.611	41.549	0.870	88.729
35	0.621	43.448	0.873	91.629
36	0.630	45.352	0.875	94.533

Table 4 cntd…

Time Period		
1991-1998 cntd…		
k	**W**	**chi-sq**
37	0.824	91.476
38	0.821	93.568
39	0.824	96.446
40	0.9306	74.4500
41	0.9322	76.4390
42	0.9337	78.4286
43	0.9351	80.4186
44	0.9365	82.4091
45	0.9378	84.4000
46	0.9390	86.3913
47	0.9402	88.3830
48	0.9414	90.3750
49	0.9250	90.6531
50	0.9100	91.0000
51	0.9116	92.9804
52	0.9131	94.9615
53	0.9146	96.9434
54	0.9160	98.9259
55	0.9174	100.9091
56	0.9187	102.8929
57	0.9058	103.2632
58	0.8939	103.6897
59	0.8828	104.1695
60	0.8844	106.1333
61	0.8742	106.6557
62	0.8647	107.2258
63	0.8559	107.8413
64	0.8477	108.5000
65	0.8400	109.2000
66	0.8329	109.9394
67	0.8262	110.7164
68	0.8201	111.5294
69	0.8143	112.3768
70	0.8090	113.2571
71	0.8040	114.1690
72	0.7994	115.1111
73	0.7951	116.0822
74	0.7911	117.0811
75	0.7874	118.1067
76	0.7839	119.1579
77	0.7807	120.2338
78	0.7778	121.3333
79	0.7750	122.4557
80	0.7725	123.6000
81	0.7702	124.7654
82	0.7680	125.9512
83	0.7660	127.1566
84	0.7642	128.3810
85	0.7625	129.6235
86	0.7610	130.8837
87	0.7595	132.1609

Table 5
Kendall's Rank Concordance Test (motorcycles) 1988 - 1998

k	w	chi-sq	K	W	chi-sq	k	w	chi-sq
2	0.9714	9.7143	44	0.4461	98.1483	86	0.4731	203.4131
3	0.9492	14.2381	45	0.4365	98.2063	87	0.4758	206.9781
4	0.9500	19.0000	46	0.4252	97.8012	88	0.4786	210.5758
5	0.8537	21.3429	47	0.4138	97.2492	89	0.4814	214.2049
6	0.8413	25.2381	48	0.4039	96.9286	90	0.4850	218.2519
7	0.8274	28.9592	49	0.3874	94.9232	91	0.4878	221.9304
8	0.8250	33.0000	50	0.3726	93.1505	92	0.4905	225.6377
9	0.8377	37.6984	51	0.3669	93.5621	93	0.4938	229.6124
10	0.8446	42.2286	52	0.3598	93.5568	94	0.4973	233.7305
11	0.8545	47.0000	53	0.3559	94.3118	95	0.4992	237.1153
12	0.8508	51.0476	54	0.3506	94.6526	96	0.5024	241.1409
13	0.8499	55.2418	55	0.3561	97.9264	97	0.5055	245.1865
14	0.8507	59.5510	56	0.3631	101.6599	98	0.5089	249.3683
15	0.8425	63.1905	57	0.3673	104.6859	99	0.5123	253.5666
16	0.8424	67.3929	58	0.3742	108.5090	100	0.5141	257.0495
17	0.8394	71.3529	59	0.3785	111.6457	101	0.5178	261.4847
18	0.7517	67.6508	60	0.3805	114.1492	102	0.5210	265.7236
19	0.6809	64.6842	61	0.3872	118.0835	103	0.5234	269.5724
20	0.6251	62.5143	62	0.3915	121.3610	104	0.5259	273.4432
21	0.5822	61.1361	63	0.3958	124.6750	105	0.5290	277.7220
22	0.5485	60.3377	64	0.4022	128.6935	106	0.5314	281.6262
23	0.5221	60.0435	65	0.4084	132.7421	107	0.5337	285.5510
24	0.4940	59.2857	66	0.4146	136.8196	108	0.5361	289.4956
25	0.4787	59.8343	67	0.4167	139.5942	109	0.5391	293.8213
26	0.4616	60.0092	68	0.4188	142.3922	110	0.5421	298.1593
27	0.4541	61.3051	69	0.4214	145.3699	111	0.5441	301.9738
28	0.4539	63.5391	70	0.4253	148.8707	112	0.5461	305.8095
29	0.4514	65.4516	71	0.4293	152.4138	113	0.5481	309.6658
30	0.4505	67.5698	72	0.4317	155.4021	114	0.5501	313.5422
31	0.4508	69.8740	73	0.4310	157.3105	115	0.5521	317.4381
32	0.4522	72.3467	74	0.4352	161.0399	116	0.5541	321.3530
33	0.4544	74.9726	75	0.4378	164.1708	117	0.5560	325.2865
34	0.4575	77.7717	76	0.4430	168.3434	118	0.5580	329.2381
35	0.4611	80.6966	77	0.4468	172.0031	119	0.5600	333.2073
36	0.4649	83.6733	78	0.4492	175.1917	120	0.5620	337.1937
37	0.4690	86.7593	79	0.4518	178.4768	121	0.5644	341.4848
38	0.4750	90.2469	80	0.4545	181.8048	122	0.5664	345.4973
39	0.4797	93.5336	81	0.4572	185.1740	123	0.5683	349.5257
40	0.4858	97.1631	82	0.4600	188.5830	124	0.5707	353.8464
41	0.4736	97.0790	83	0.4638	192.4710	125	0.5726	357.8990
42	0.4628	97.1803	84	0.4665	195.9433	126	0.5738	361.4679
43	0.4539	97.5869	85	0.4693	199.4515			

Table 6
Evans and Karras test of Convergence

	Time period	$\hat{\rho}$	$\tau(\hat{\rho})$	$\phi(\hat{\delta})$	$\phi(\hat{\eta})$
two-wheeler industry	1995 - 1998	0.0185 (0.0445)	2.016 (0.044)	5.755 (0.05)	-
scooters	1988 - 1998	-0.0254 (0.0207)	-2.339 (0.020)	4.703 (0.05)	3.043 (0.05)
motorcycles	1988 - 1998	-0.08361 (0.0000)	-5.065 (0.000)	3.545 (0.05)	1.999 (0.05)
mopeds	1991 - 1998	-0.07044 (0.0057)	-2.779 (0.005)	11.505 (0.05)	-

N.B. In each case, the panel t-statistic $\tau(\hat{\rho})$ is significant denoting convergence. In the case of the two-wheeler industry as a whole and the segment of mopeds, the F-value $\phi(\hat{\delta})$ is greater than the critical value denoting conditional convergence. In the case of the scooter and motorcycle segments, both $\phi(\hat{\delta})$ and $\phi(\hat{\eta})$ are less than the critical value denoting absolute convergence.

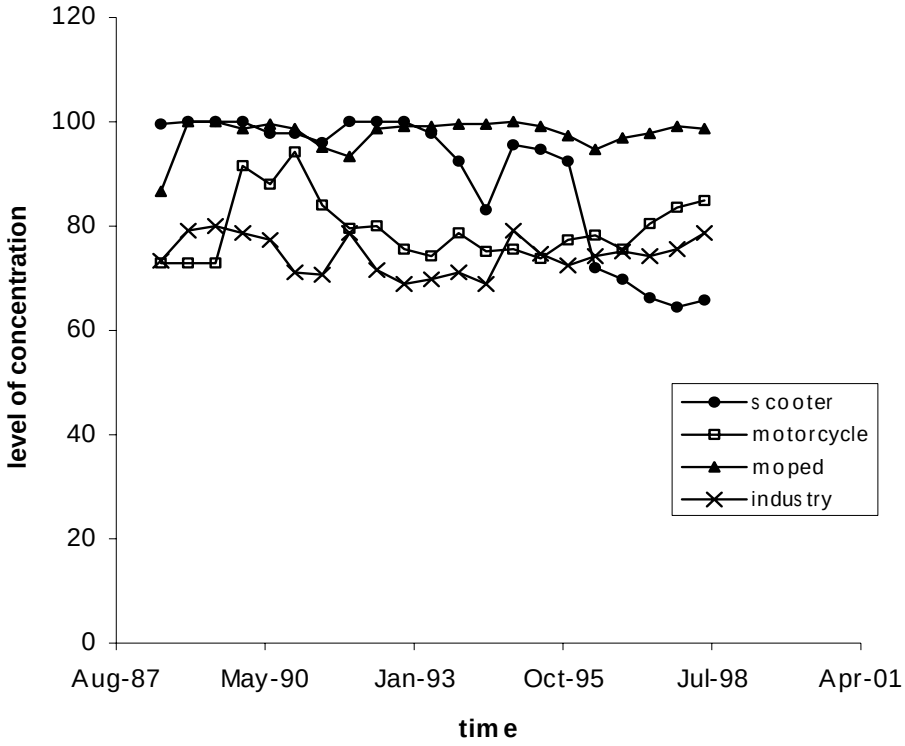

Figure 1
Four-firm concentration ratios for the individual segments and the industry