Industrial Concentration in a Liberalising Economy: A Study of Indian Manufacturing[+]

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Abstract

We study the evolution of industrial concentration in twelve manufacturing sectors in Indian industry over the period 1970-99. Our aim is to examine the impact of economic liberalisation on concentration. Given the strong regulation of Indian industry till the mid 1980s, the market structure in most industries was largely an product of government policy. With deregulation, we might expect the pattern of concentration to be determined by the interaction between the technological characteristics of the industry and what we might call the normal competitive processes.

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1 Introduction

The economic reforms of 1991 are often seen as a watershed in the management of Indian industry. Through much of the 1960s and 1970s Indian industry was highly regulated and protected. Most formal manufacturing sectors were subject to licensing requirements and capacity controls. Many sectors were reserved for the public sector or for small-scale firms. Controls on imports and tariffs protected Indian industry from foreign competition. In a process that arguably began in the 1980s, but gained prominence after 1991, Indian industry has been progressively deregulated and exposed to domestic and foreign competition. In this paper we study the impact of this liberalisation on patterns of industrial concentration in Indian manufacturing.

In the regulated phase the pattern of industrial concentration was a direct outcome of industrial policy. Early regulation was guided by a perceived need to conserve scarce capital: in order to prevent 'unnecessary duplication of investment', in many sectors production licenses were restricted to a handful of firms. Market shares were determined largely, though not entirely, by capacity allocations at the level of individual firms and plants. Sectors subject to such licensing requirements and capacity regulations were, quite often, relatively concentrated. On the other hand some sectors were reserved for small-scale firms to support higher levels of employment: if firms were required to be below some size, these sectors would have been relatively fragmented. With deregulation, we might expect the pattern of concentration to be determined by the interaction between the technological characteristics of the industry and what we might call the normal competitive processes.

How does competition affect the levels of industrial concentration? The traditional 'size-structure relationship' contends that industries in which the size of the market is large relative to setup costs, competitive entry would result in a fragmented market structure. Sutton (1991, 1998) pointed out that for industries that were technology-intensive or advertising-intensive this simple relationship may break down: If larger markets create incentives for a competitive escalation of advertising and technology expenditures, the heightened level of such expenditures may preclude fragmentation. Thus the pattern of industrial concentration in unregulated markets might be sensitive to a range of variables: notably, setup costs, advertising expenditure and technology

expenditures of firms. Relying on the framework developed by Sutton, we refer to these factors collectively as the 'sunk cost variables'.

We study the pattern of concentration for a cross-section of 53 manufacturing sectors of Indian manufacturing over the period 1980-99. For a subset of twelve manufacturing sectors (for which a longer time series was available), we also study the evolution of concentration over the period 1970-99. Studying concentration is of interest because it is indicative, at least in unregulated markets, of the degree of market power of firms. If indeed the above sunk costs variables influence concentration levels in unregulated markets, we would expect these variables to become more significant in the post-liberalisation phase. The greater role of these variables may well lead to a decrease in industrial concentration in some sectors, but could result in higher levels of concentration in advertising- and technology-intensive industries.

Industrial concentration in India was definitely affected by these policy changes. However we find that the crucial determinants of changes in concentration differ across industries. This suggests that the nature of competition differs across sectors, which may imply the need for sector-specific competition policies. We also assess the importance of industry specific differences in competition and 'behavioural' differences in competition due the strategic conduct of firms as the policy environment changed competitive rules within an industry.

The paper is organised as follows. Section 2 reviews the theoretical and empirical literature on concentration and outlines the liberalisation of industrial policy in India. Section 3 describes our data and methodology. Section 4 discusses our empirical findings and Section 5 concludes with a summary of our findings and their implications for the design of future industrial policy.

2. Factors influencing concentration

Industrial concentration refers to the extent to which production is concentrated amongst firms in an industry. For unregulated industries, a long-standing and plausible approach relates concentration levels to setup costs in that industry. The latter refers to the cost of setting up a plant of minimum efficient scale, which is

determined primarily by the technology in use in that industry. If the size of the market (say, the average level of demand) can support only a handful of firms operating at minimum efficient scale, the equilibrium structure would be relatively concentrated. Larger markets can accommodate more firms of efficient size, and so would be more fragmented. As Sutton (1991) has pointed out, this size-structure relationship may be tempered by the intensity of price competition in an industry. In industries where price competition is very intense, profit margins are lower, and firms may be unable to recoup the setup costs. Such intense price competition would make a fragmented market structure harder to sustain. Consequently, equilibrium levels of concentration are likely to be higher.

The size-structure relation may even break down in industries in which advertising and technology play an important role. Suppose the nature of the industry or product is such that firms have an incentive to increase such expenditures to gain market shares. In the long run, the increased level of expenditures is sustainable only if profitability is high enough. Relatively fragmented market structures are unlikely to sustain such high levels of profitability, resulting in the creation of a more concentrated structure through gradual exit and consolidation of firms. To the extent the level of advertising and technology expenditure is endogenous to the market structure, larger market size may be associated with an escalation of sunk costs in advertising or technology expenditures, with no concomitant reduction in concentration.

Thus, Sutton's framework offers some theoretical insights regarding the relationship between market size and market structure. For industries in which advertising and technology do not play a major role, concentration is likely to be a decreasing function of market size, measured relative to setup costs. However, in industries where technology and/or advertising matter, the size-structure relationship is more complex. Sutton's analysis is more nuanced than this casual summary suggests, but it helps us to identify the variables that may be relevant to the determination of industrial structure: apart from the technologically-given setup costs, the endogenously-determined level of advertising expenditures and technology expenditures all affect industrial concentration. In keeping with Sutton's terminology, we will refer to these as the 'sunk-cost variables'.

Our argument is that, given the tight regulatory framework prior to liberalization, these factors were unlikely to have mattered much in the determination of concentration. After liberalisation, the emergence of a broadly competitive environment created greater scope for advertising and expenditure on technology. To understand this, we review the changes in the policy environment in India.

Industrial and economic policy in India

Planned industrial development in India incorporated substantial control of industry. The Industrial Policy Resolution of 1956 reserved certain industries for the public sector, by prohibiting the entry of private-sector firms (examples include steel manufacture, aviation, petrochemicals). This was deemed necessary to release resources for public sector investment in the core sectors of the economy. The strategy of planned development ran into unforeseen crises (foreign exchange crises, two wars, two droughts). Industrial policy was quite reactive in the 1960s, but somewhat perversely moved towards more restriction to mitigate the visible symptoms of these crises. For instance, the foreign exchange crises paved the way for the Foreign Exchange Regulation Act (1973). The Monopolies and Restrictive Trade Practices Act aimed to control the perceived abuse of the licensing system by the big business houses. These changes are detailed in Table la below.

(Tables 1a&b)

By the mid-1980s, a long period of industrial stagnation, especially technological stagnation, created pressure for deregulation. As early as 1984, there was some limited liberalization of industrial policy and import policy. The New Industrial Policy in 1991 carried this process further. Table 1b shows that many of these changes reversed the earlier restrictive policies. It is interesting that unlike the previous crises that had led to a more restrictive environment, the crises of the late 1980s led to liberalization.

The early regulation affected the pattern of industrial concentration through a variety of channels. The licensing regime governed the entry and exit of firms as well as the level of production capacity. Allocated licenses were extremely particular in terms of product specification of what could be manufactured. There was no

mechanism for the exit of inefficient or unprofitable firms. The Monopolies and Restrictive Trade Practices Act of 1969 imposed additional restrictions on large business houses, dampening the tendency towards growing concentration in some sectors.

Some sectors were reserved for the small-scale sector, in order to mitigate the perverse consequences of capital-intensive industrialization in a labour-surplus economy. While only a few industries were so reserved initially -- the Third Five-Year Plan (1961-66) listed only nine – by the late 1970s, the scope of the small scale sector had expanded to cover most products that could be produced in the small scale sector. Given that small firms risked losing their preferential status if they expanded output, its implications for concentration were obvious. According to Gang (1995) three sectors --- mechanical engineering, chemical products and auto ancillaries – accounted for most of the small firms. In these sectors, the regulatory regime created artificially low levels of concentration.

In some cases, a dualistic structure emerged with some large firms and a fringe of small producers, with little movement between categories of firms. Where sectors were reserved for small-scale manufacture, but incumbent firms were allowed to continue at frozen capacities (e.g. in the soap industry), such a dualistic structure was the natural outcome.

On the whole, the pattern of concentration during the regulated phase was a product of government design rather than market forces. Not surprisingly, deregulation changed things. The early deregulation of the 1980s introduced ‘broad-banding’ of production licenses: this change allowed firms to use their existing licensed capacity (previously tied to a narrow product specification) to manufacture a broader range of related product. Though licensing requirements were formally retained, they were granted more easily. The later New Economic Policy of 1991 abandoned formal licensing requirements in most but not all industrial sectors. These changes facilitated fresh entry in some sectors, lowering concentration levels. In 1985, the government introduced legislation to enable the exit of inefficient or 'sick' (i.e., chronically unprofitable) firms, which increased concentration in other sectors. Overall liberalization created an environment in which market structure was fashioned more by market forces than government policy.

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 (see Athreye and Kapur, 2001). Imports were restricted through licensing and tariffs, ostensibly to conserve foreign exchange and provide protection to the fledgling industries. Prior to 1978, import licenses were the preferred mode and they were issued on the basis of the twin criteria of 'essentiality' and 'domestic non-availability'. Domestic availability was judged without reference to price, and with the broad based growth of manufacturing, it became relatively difficult to meet this non-availability criterion. Tariff policy acted to complement these quantitative restrictions. At an average rate of 122%, tariffs in India in the late-1980s were higher than most other countries.[1] Tariffs insulated many sectors from price competition: this allowed many inefficient firms to survive, and may have supported a more fragmented structure relative to what stronger price competition may have created.

With import liberalisation, tariff levels fell (see Table 1b for major policy changes). This lowered the costs of capital good or embodied technology imports. Changes in the patent laws and the relaxation of restrictions on royalty payments led to a marked increase in technology expenditures.

Of course, deregulation may increase or decrease the level of concentration. In sectors where deregulation allowed the incumbent firms to increase their market dominance, concentration could increase. In other sectors, deregulation may have eroded the advantages of incumbency, resulting in lower concentration. Hence, a cross-section study might identify such effects. Further, the impact of deregulation even within a sector may be complicated: for instance, concentration may rise in the early stages of deregulation and then fall over time. Our results suggest that this may be the case in established industries as well. Consider for instance the passenger car industry. Till the early 1980s the Indian passenger car industry was an effective duopoly, with the two large manufacturers, Premier Automobiles and Hindustan Motors. In the early 1980s, Maruti Udyog was set up (as a public sector firm in

collaboration with Suzuki of Japan). Maruti imported technology (and, for a while, even the cars, in the form of knocked-down kits). Given that Maruti cars were technologically-superior to the models sold by the incumbents, Maruti acquired a dominant share in the market very quickly. However, as a consequence of further liberalisation, other manufacturers entered too: now a proliferation of models has been accompanied by a reduction in concentration.

It is tempting to relate changes in concentration directly to the key policy changes (say the policies on entry or exit, for instance). However we view deregulation as enabling concentration levels to approach their 'equilibrium' values, and these are determined by a host of factors. In particular, we look at how the effect of policy changes was mediated through their impact on the 'sunk cost' variables. For instance, rather than relate changing concentration levels in the passenger car industry to policy changes directly, we aim to study how policy changes affected the strategic behaviour of firms in this sector. Notably, technology intensity rose sector-wide after 1980; the proliferation of models has been accompanied by increased marketing expenditures. As the industry adapted to modern assembly lines, set-up costs for new entrants rose. In this paper, we study the relationship between concentration and these sunk-cost variables, both across and within various manufacturing sectors.

3. Empirical methodology

3.1 The econometric model

The econometric model aims to model changes in concentration across industries and overtime. We follow existing empirical studies in modelling changes in concentration as an adaptive process. Let C_{it} denote the concentration level in industry *i* in period *t.*

$$\Delta C_{it} = \lambda_i (C_{it}^* - C_{i,t-1}) + \varepsilon_{it}, \text{ where} \qquad (1)$$

$$C_{it}^* = \alpha_i + \beta_i' W_{it} + \gamma_i t$$

[1] Estimates from World Bank (1989)

Concentration levels adjust towards their equilibrium value, C_{it}^{*}. Here λ_i is the partial adjustment coefficient ($0 \le \lambda_i \le 1$), and ε_{it} is the usual error term. In this specification, equilibrium concentration depends, apart from the industry-specific intercept, α_i, and time trend, $\gamma_i t$, on a vector of sunk cost variables. We have $\beta_i' W_{it} = \sum_k \beta_{ik} W_{ikt}$. In our model, we consider three kinds of sunk cost variables, so that *k*=1,2,3.

The reduced form of the above dynamic model can be written as:

$$\Delta C_{it} = \lambda_i \alpha_i + \lambda_i \beta_i' W_{it} + \lambda_i \gamma_i t - \lambda_i C_{i,t-1} + \varepsilon_{it}$$

or

$$C_{it} = \theta_{0i} + \sum_{k=1}^{3} \theta_{ki} W_{kit} + \theta_{4i} t + \theta_5 C_{i,t-1} + \varepsilon_{it} \qquad (2)$$

Pesaran and Smith (1995) caution against an automatic use of pooled data in dynamic estimations, such as (2) above, without ascertaining the degree of heterogeneity in the underlying slope coefficients. They show that in the presence of heterogeneity the imposition of the assumption of a single common slope coefficient in the data produces inconsistent (and biased) estimates of the slope coefficient. To ascertain the degree of heterogeneity, we estimated equation (2) for twelve industrial sectors for which a long time series (1970-99) was available. We then computed the degree of dispersion around the mean of the individual industry regressions (computed as a simple average of individual country means) to assess if a panel estimation was indicated.

For the twelve industries for which the dynamic model was estimated, the structural parameters could also be recovered from the reduced equation (2): we have λ_i = (1- θ_5) and β_k = (θ_k /λ). Estimating this equation thus tells us about the influence of particular factors in influencing concentration in each industry. The results and the recovered values of the structural parameters are contained in Table 5, and discussed in Section 4.1.

Pesaran and Smith (1995) have also shown that if the parameters are random across industry and independent of **W**, the long-run relationship can be estimated from the levels cross-section

$$C_i = \alpha^* + \beta' W_i + u_i \qquad (3)$$

where β is the mean of the β_i, and α^* will reflect average intercept and mean trend effect. We do not estimate the dynamic model from the cross-section, because the average of the lagged dependent variable is clearly endogenous. Further, if the time span of the data is long enough, the average of these cross sectional coefficients do provide a consistent estimate of the average long term effect of each of the **W** factors. In the presence of heterogeneity in the underlying slope coefficients, the mean group estimator based on (3) may provide a better measure of the long term impact of the factors influencing concentration.

Thus, we estimate 20 cross-section levels regressions (based on (3) above), for each year from 1980-99, interpreting them as changing long-run estimates of the relationship between concentration and the sunk-cost variables. The estimated β coefficients for each period are then plotted in Figures 1- 3. This exercise reveals how the relative influence of various factors influencing concentration across industries changed over time, perhaps in response to changes in industrial policy. We also estimate a two way fixed effects model based on (3) writing $\alpha^* = \alpha_i + \alpha_t$, for the entire time span of the data (1970-99) and for the liberalisation period (1985-99).

3.2 Data and Variables

We use a longitudinal data set of balance-sheet data, from 1970 to 1999, of publicly-listed manufacturing companies to estimate our model. The data we use is maintained by the Reserve Bank of India and is described in Appendix 1. The data identify an industrial sector code for each firm. This allows us to aggregate data across firms for any particular industrial sector of interest. Thus, for example, advertising intensity would be the sum of advertising expenditures by all firms in the industry as percentage of the total sales of the industry.

The panel of data is however unbalanced and data for several industrial sectors started from 1975 or 1978. We excluded industries that seemed to group together

firms of different types - other rubber products, other non-ferrous metals - for examples. The full list of the 53 industries included in the cross section analysis is detailed in Appendix 1. For the time-series regressions, we selected twelve industrial sectors from the dataset which had data from 1970-99, in which the number of reporting firms did not drop to one in any year and a homogenous industry grouping of firms.[2] For the cross section levels regressions we started from 1980, the year after which significant de-regulation took place in industrial policy, and estimated twenty different regressions. Thus, the cross sectional regressions were estimated across 53 manufacturing sectors and for 20 years.

The measure of concentration we use as the dependent variable in our empirical analysis is the Herfindahl index. This index is constructed as the squared sum of market shares of all firms in any industrial sector. There are alternative measures of industrial concentration. The simplest measure would consider the number of active firms in the industry. Alternatively, we could have considered the *n*-firm concentration ratio: the share of industry output controlled by the largest *n* firms. Kambhampati (1996), for instance, uses the four-firm concentration ratio. We find that the Herfindahl index is more suitable for longer spans of data.[3] The dependent variable, HERF2 is the value of the index expressed in percentage terms. The lagged value of HERF2 also enters in the dynamic estimations (for each industry over time) as an independent variable.

We included three measures of sunk cost proxying the size-setup ratio, marketing intensity and technology intensity of industries. MKTINT is the industry's marketing intensity measured as the total of all advertising and selling expenses as a percentage of industry sales. Firms in our dataset report 'selling expenses' separately from advertising expenses. The former include sales commissions to retailers, which are quite important to maintenance of distribution networks in rural areas and non-metropolitan settings with poor reach of conventional advertising channels. We use a

[2] ADF tests for the time series variables are contained in Appendix 2.
[3] Since the Herfindahl index combines information on the variance of shares and numbers it can be decomposed in interesting ways. Using the same data set, Kambhampati and Kattuman (2003) decompose the Herfindahl index into two components: one showing the volatility of market shares and the other showing the gain of smaller (fringe) firms. Our interest is however on studying the influence of sunk cost variables upon the Herfindahl index itself.

composite term, marketing expenses, to capture all selling costs. Marketing intensity is computed as the percentage of these costs to overall industry sales.

TECHACQ is the industry's technology acquisition intensity and measured as the sum of technology fees and royalties by all firms in the industry as a percentage of total industry sales. For many Indian firms, expenditure on technology acquisition is often more important than R&D expenditures. We have thus constructed a composite measure of technology acquisition costs as a percentage of sales to use instead of R&D expenditures.

SIZSETUP is the ratio of industry sales to average net fixed assets. T refers to time, and NUMBER is control variable for the number of reporting firms. The Herfindahl index is quite sensitive to the number of firms included especially in sectors where numbers are small or in years when there is a fall in numbers due to non-reporting by certain firms. This also affects the calculation of size to set-up costs where the denominator is the average of net fixed assets across firms in an industrial sector in any one year. For both these reasons we use the number of reporting firms as a control variable for possible measurement errors.

(Table 2 here)

Table 2 summarises the variables used in the analysis, and indicates the hypothesised sign on the coefficients.

4. Results

The first part of our empirical analysis addresses the issue of what causes the variability of concentration equation over time: is this variability due to differences in the response of firms to the new policies or is it because the new policies favoured different industrial sectors differently? Consider our example from the automobile sector. Was the variability in concentration in the passenger cars market due to the fact that import liberalisation allowed firms like Maruti Udyog and Tatas to import technology and so win greater market shares over their competitors, or was it because freer imports of technology were always more likely to influence concentration in the technology intensive automobiles sector more than, say, in sugar or breweries?

To examine this question we decompose the variability in the three **W** variables and in concentration into between and within industry components of variation. If the former component dominates the overall variation then we could say that concentration was mostly determined by the changes in the nature of industries. If the latter component dominates then of course we would conclude it was firm strategies that changed concentration more.

(Table 3 here)

Table 3 reports both the mean values and the between and within variance of the variables over the period 1980-99. Over the liberalisation period, in all cases, the between variance dominated the total variance – implying that the differences between sectors in concentration and the sunk cost variables was larger than their differences over time.

4.1 The dynamic model

We use time series data for twelve industries. Table 4 reports the descriptive statistics. The first row reports the mean value of the dependent variable, averaged over time for each of the twelve industries. Concentration ranges from around 4% (for the sugar industry) to over 20% for machine tools, and wool textiles.

(Table 4 here)

Regression estimates for the dynamic model are reported next in Table 5. Looking across the industries, these results suggest that concentration in each industry was influenced possibly by factors specific to that industry. Six of the twelve industries show a significant time trend in concentration levels. Of these, breweries, chemical fertilizers, medicinal preparations and cement show a decreasing time trend in concentration while dyes & dye-stuffs and cotton textiles show an increasing trend.

(Table 5 here)

Marketing intensity seems to significantly affect concentration in sugar, auto vehicles, machine tools and paper. Indeed, in all except sugar, higher marketing intensity is associated with lower concentration. Technology acquisition costs too have a significant *negative* impact on levels of concentration in Jute textiles and machine tools. Size set up costs impact concentration positively in woolen textiles,

auto-vehicles and machine tools. It has a negative impact on concentration in dyes & dyestuffs and medicinal preparations.

The autoregressive parameter is significant in six of the twelve industries (cotton textiles, wool textiles, jute textiles, auto vehicles, chemical fertilisers, and dyes and dyestuffs). This suggests that the partial adjustment framework that underlies the estimated equation (2) is relevant only in these industrial sectors, and for the others this is a misspecification. There are other signs of misspecification in the remaining industrial sectors. Autocorrelation in breweries and medicinal preparations suggests that the 'right' equation should have more lagged dependent variables as explanatory variables. The estimated values of λ for Sugar, medicinal preparations and cement are also close to 1, suggesting that a more appropriate dependent variable is the *level* of concentration.

Overall these results cast serious doubts about the usefulness of pooled or panel estimations of equation (2). We used a method described by Boyd and Smith (2000) to examine departures from the long-run pooled mean. As we discussed in Section 3, for these twelve industries this can be obtained by averaging the industry coefficients. Table 6 reports the deviations of each industry's coefficient (normalized by the standard error of the average mean). As can be seen some of these deviations are very large (greater than 1) especially in the case of marketing intensity and technology intensity. A panel estimation imposing a single slope coefficient on the entire panel would be inappropriate and would also yield inconsistent (and biased) estimates of the common slope coefficient.

(Table 6 here)

The interesting question for us is to understand is why there are these different patterns across industrial sectors. For some industries, namely cotton textiles and brewery, we find that the 'sunk cost' variables are not significant in explaining concentration. This is not surprising given that in these sectors government policy control has survived in the form of lingering capacity regulation, control over pricing or reservation as small-scale industries. Sectors that were liberalized to a greater extent (in our sample this includes auto vehicles, machine tools, dyes and paper) allowed a much greater play for market forces. Here the sunk cost variables do affect levels of concentration.

Where the sunk cost variables do have a significant impact upon concentration, they often have the wrong sign from that predicted in Table 2. In the immediate aftermath of liberalization, we might expect concentration levels to fall as new firms enter and at the same time an increase in technology and advertising expenditures as firms compete for larger market shares. Of course over a longer run, such heightened levels of expenditure may not be sustainable. We would then expect that technology and advertising intensive sectors would tend to have growing levels of concentration as conventional theory predicts. Many of the industrial sectors in our sample could be in the transitional phase, given that liberalisation started in the 1980s and gathered pace in the 1990s.

4.2 Cross-section estimates

Figures 1 to 3 plot the estimated coefficients for MKTINT, TECHAQ, SIZSETUP for equation (3), over the period 1980 to 1999.[4] The dotted lines denote the confidence interval around the mean at two standard errors. The value of the mean group estimator and its standard error is also reported on each figure. The coefficient of MKTINT on concentration varies in sign over this period: for of the recent period, its value is positive, though it assumed negative values from 1986 to 1991. The mean group estimator too has a negative value. One plausible explanation for this pattern may run as follows: the underlying relation between concentration and MKTINT may be positive, but the temporarily negative values of the coefficient after the mid-1980s reflect a process in which different industries move to a new equilibrium, but at different speeds. There was a concomitant widening of the confidence interval accompanying these changes.

(Figures 1-3 here)

However, the relationship between concentration and TECHINT as seen in Figure 2 appears to move to a positive relation after 1985. The mean group estimator too is positive. For SIZSETUP too, the pattern in Figure 3 suggests a transition from mostly negative values before 1985 to positive values after that and this is reflected in the positive value for the Mean Group estimator. This is what we would expect if the cost structure of manufacturing as a whole switched from predominantly exogenous to

endogenous sunk costs. One possibility is that liberalisation enabled easier imports of capital goods and technology.

Interestingly, this explanation lends support to the thesis (see DeLong 2001) that the reforms of the mid-1980s were more significant in terms of their impact on economic activity than the much-emphasised reforms of 1991. To test if this is indeed the case, we estimated (3) with fixed time and industry effects for the periods 1970-84, 1985-99, 1991-99 and 1970-99. The results reported in Table 7 do indeed confirm the change in underlying coefficient values after 1985. In particular, the relationship between concentration and the size set-up ratio emerges as positive and significant in the later period.

(Table 7 here)

5. Conclusion

Prior to liberalization, market structure in Indian manufacturing was largely an artifact of government policy. This was hardly surprisingly given the nature and extent of regulatory control. We would expect deregulation and liberalization to alter the picture, though the precise effects could vary across industries. Concentration levels may rise or fall depending on the specifics of individual sectors. The dynamic picture within individual sectors could be complicated too, as deregulation alters the strategic choices of incumbents and enables new entry. This variability suggests the need for a sector-specific rather than general examination of the impact of deregulation on concentration. Looking across sectors, we also find that concentration was more affected by sunk cost variables in the period before 1991 than after.

The fact that implications of deregulation for concentration differ across sectors strongly supports the need for a sector-specific approach to competition policy. While this is quite common practice in developed countries, many developing economies have yet to develop this approach. Recent discussions of the Competition Bill suggest that India is taking the right path. A second implication suggested by our analysis in Section 1 is that policy changes respond to increases in levels of concentration: in that sense regulatory policy may have an element of 'endogeneity'.

[4] The full estimated equations corresponding to these are available from the authors.

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Table 1a: Key changes in India's industrial policy regime, 1950-1980

Industries (Development and Regulation) Act, 1951	Specified the Schedule I industries where licenses were required for firms with fixed investment above a certain level of investment or import content of investment above a certain level
Companies Act, 1951	Restrictions on the operation of managing agencies, which affected the operation of many British companies in India
Industrial Policy Resolution, 1956	Articulated the role of public investment in planned development and specified: Schedule A industries reserved exclusively for state enterprises Schedule B industries where further expansion would be by state enterprises
Corporate Tax policies, 1957-1991	Specified rates of corporate tax on companies incorporated outside India. These were usually between 15-20% higher than the rates applied to large Indian companies during this period.
Monopolies and Restrictive Trade Practices Act, 1969	All applications for a license from companies belonging to a list of big business houses and subsidiaries of foreign companies were to be referred to a 'MRTP Commission' which invited objections and held public hearings before granting a license for production.
Industrial Policy Notification, 1973	Made licensing mandatory for all industries above certain investment limits Specified industry Schedules IV and V , where licensing was mandatory for all firms irrespective of size Small scale industry reservation introduced for some industries. Small was defined based on an investment limit.
Industrial Policy Statement, 1973	Specified the criteria and list of Appendix I of 'core' industries to which large business houses and foreign firms were to be confined. Main criteria for being an Appendix 1 industry were that of local non-availability or domination of a sector by a single foreign firm. Schedule A industries from IPR, 1956 could not figure in the Appendix 1 list.
Foreign Exchange Regulation Act, 1973	Foreign companies operating in India were required to educe their share in equity capital to below 40%. Exceptions were decided on a discretionary basis if: The company was engaged in 'core' activities (as defined in IPS, 1973) The company was using sophisticated technology or Met certain export commitments
Industrial Policy Resolution 1977	Expanded the scope of reservations of particular lines of business activity for production in the small scale industrial sector. Small industry concessions would be lost if firm grew to a certain 'large' size.

Table 1b: Key changes in India's industrial policy regime, 1980-1999

Policy announcements, 1985	Business houses were not restricted to Appendix 1 industries as long as they moved to industrially backward regions Minimum asset limit defining business houses was raised from Rs. 200 million to Rs. 1 billion
Amendment to MRTP Act, 1985	A company could be referred to the MRTP commission only if it showed assets greater than Rs. 1 billion.
New Industrial Policy 1991	Abolished licensing for all except 18 industries. Large companies no longer needed MRTP approval for capacity expansions Number of industries reserved for the public sector in Schedule A (IPR1951), cut down from 17 to 8; Schedule B was abolished altogether. Small firms were allowed to offer upto 24% of shareholding to large enterprises. Limits on foreign equity holdings were raised from 40 to 51% in a wide range of industries and foreign exchange outflows as dividends were balanced by export earnings. EXIM scrips (import entitlements linked to export earnings) were introduced and were freely tradable and could be used for all categories of imports. Actual user requirements for import of capital goods, raw materials and components under OGL were removed. Royalty limits increased to encourage technology imports.
Policy announcements, 1992-99	Number of industries requiring licensing steadily decreased. By 1998 the number of industries requiring compulsory licensing was down to 9. Oil exploration and Minerals were removed from list of reserved industries for the public sector, bringing the number of Schedule A industries down to 6. Infrastructure industries like basic telecom and power opened to private ownership (including foreign ownership). Small scale industry reservations decreased: 15 items including ready made garments are removed from reserved list. Investment limit for defining a firm as small scale raised from Rs. 7.5 million to Rs. 30 million. Pricing of coal, drugs and pharmaceuticals de-regulated.
Tariff reductions, 1992-99	Peak tariffs reduced to 110% in 1992 and gradually brought down to 40% in 1998. List of freely importable goods expanded Reform of structure of tariffs.

Source for Table 1: Adapted from Sivadasan, J. (2002), with authors' additions.

Table 2: Variables used in the analysis and expected coefficient values

Variable Name	Relation to Equation (2) or (3)	Description	Expected signs
HERF2	C_{it}		
HERF2(-1)	C_{it-1}	Lagged value of the Herfindahl index	*In equation (2) only* (+) as $0 \leq \lambda_1 < 1$
MKTINT	$\mathbf{W}_{1it}$	Value of industry's marketing intensity; marketing intensity is total of all advertising and selling expenses as a percentage of industry sales	(+)
TECHACQ	$\mathbf{W}_{2it}$	Value of industry's technology acquisition intensity; technology intensity is the sum of royalties paid (in rupees and foreign currency) + technology fees in foreign currency, by all firms in the industry as a percentage of total industry sales	(+)
SIZSETUP	$\mathbf{W}_{3it}$	Ratio of industry sales to average net fixed assets	(-) But can become positive in the presence of endogenous sunk costs
TIME	T		*In equation (2) only* Can take any sign.
NUMBER	Control variable	The number of reporting firms in each year, controls for measurement errors of right hand side variable and spurious increases in the Herfindahl index due to under-reporting in certain years	(-) . Increasing numbers of firms decrease the Herfindahl index and vice versa.

Table 3: Variability between and within industries (1980-99)

Variable		Mean	Std dev	Minimum	Maximum
HERF2	Overall	31.840	26.489	1.101	100.00
	Between		23.355	2.459	95.512
	Within		12.393	-10.873	89.051
MKTINT	Overall	1.642	1.647	0.000	12.618
	Between		1.222	0.127	6.702
	Within		1.078	-4.429	8.989
TECHACQ	Overall	0.373	1.414	0.000	19.796
	Between		1.246	0.002	9.138
	Within		0.770	-5.299	11.030
SIZSETUP	Overall	60.084	94.038	0.502	1112.769
	Between		71.907	4.553	353.802
	Within		59.852	-278.842	819.051
NUMBER	Overall	18.112	24.328	1	249
	Between		20.885	1.367	104.64
	Within		12.525	-64.221	166.779

Notes: (i) The above figures are estimated by STATA.

(ii) The between mean is calculated over 53 industrial sectors and is $\bar{x}_{i.}$ The within mean is calculated as (x_{it} - $\bar{x}_{i}$ + $\bar{\bar{x}}$) where $\bar{\bar{x}}$ is the global mean computed over 1441 observations.

Table 4: Descriptive statistics, dynamic model (1970-1999)

Variable	Sugar	Cotton Textiles	Wool Textiles	Jute Textiles	Brewery	Auto Vehicles	Machine Tools	Chemical Fertilisers	Dyes & Dyestuffs	Medicinal prep.	Cement	Paper
HERF2												
mean	4.325	6.928	30.458	6.857	20.170	18.058	22.789	15.798	18.462	4.306	16.446	9.611
std devn	1.490	6.082	11.822	2.918	10.686	3.029	4.315	3.141	3.498	0.616	4.099	3.619
Min	2.468	1.100	15.028	3.382	10.131	13.860	16.601	10.289	14.238	3.306	9.875	5.972
max	8.412	20.650	64.255	12.609	47.407	25.048	32.933	20.223	29.237	5.353	23.265	22.186
MKTINT												
mean	0.428	1.472	3.954	0.671	4.449	0.965	2.535	0.464	1.915	3.493	0.692	0.720
std devn	0.106	0.482	0.634	0.129	1.856	0.482	1.051	0.374	0.334	0.629	0.337	0.382
Min	0.241	0.924	2.956	0.414	2.250	0.312	1.019	0.120	1.136	2.612	0.325	0.294
max	0.693	3.175	5.508	0.844	11.780	2.871	4.197	1.457	2.569	5.198	1.506	1.529
TECHACQ												
mean	0.076	0.117	0.076	0.019	0.492	0.323	0.366	0.481	0.073	0.144	0.548	0.112
std devn	0.067	0.225	0.151	0.032	0.585	0.194	0.369	0.632	0.079	0.186	0.326	0.135
Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
max	0.254	0.898	0.758	0.118	2.020	0.680	1.811	3.251	0.378	0.671	1.120	0.540
SIZSETUP												
mean	147.242	353.802	23.518	110.940	56.968	61.430	33.147	29.651	31.187	269.186	35.794	57.521
std devn	76.489	359.291	18.417	87.842	27.600	20.653	6.986	9.383	8.113	54.368	10.864	17.366
Min	30.965	14.877	6.084	20.850	16.772	34.941	21.110	12.222	17.378	162.130	16.762	36.923
max	270.574	1112.769	79.130	258.207	102.157	117.426	51.915	47.505	48.770	393.362	62.329	98.481
NUMBER												
mean	45.900	100.333	8.330	24.867	19.467	19.933	11.433	18.433	12.800	63.333	24.967	39.533
std devn	14.947	78.171	1.971	10.708	4.769	6.948	1.073	4.790	2.398	11.050	9.661	9.515
Min	20.000	18.000	5.000	12.000	11.000	13.000	10.000	12.000	9.000	52.000	15.000	25.000
max	70.000	249.000	13.000	42.000	28.000	34.000	13.000	29.000	16.000	89.000	45.000	62.000

Notes to Table 4: The industry group Cotton textiles was re-classified into finer categories in later years. The number of firms in initial years is thus quite large – 249 reporting firms from 1970-75, 113 reporting firms from 1975-80 and 91 reporting firms thereafter.

Table 5: Time series estimations for twelve industry groups (1970-99)

Variable	Sugar	Cotton Textiles	Wool Textiles	Jute Textiles	Brewery	Auto Vehicles	Machine Tools	Chemical Fertilisers	Dyes & Dyestuffs	Medicinal prep.	Cement	Paper
Constant	7.096***	-12.352***	28.667**	15.651***	57.732***	23.782***	39.408***	24.821***	19.773***	7.812***	25.222***	16.455**
MKTINT	2.706**	0.857	3.053	-1.512	-0.026	-1.767***	-1.364**	-1.706	-0.772	-0.204	-0.081	-4.422*
TECHACQ	-2.472	0.841	1.616	-9.689*	1.610	0.872	-3.359***	-0.270	-11.576	0.384	3.674***	-9.135
SIZSETUP	0.001	0.006	0.332*	0.005	-0.035	0.120***	0.223***	-0.030	-0.201***	-0.003*	-0.053	0.060
HERF2	0.006	0.094***	0.684**	0.048*	-0.021	0.069***	0.214	-0.019*	0.405***	-0.021	0.026	0.237
TIME	0.032	0.891***	0.007	-0.039	-0.600***	-0.022	0.005	-0.319**	0.167**	-0.055**	-0.318***	0.112*
NUMBER	-0.097***	0.013	-4.575**	-0.318***	-1.364***	-0.638***	-2.134***	-0.103	-0.211	-0.016	-0.174**	-0.258*
Structural parameters												
λ	0.994	0.906	0.316	0.952	1.021	0.931	0.786	1.019	0.595	1.021	0.974	0.763
β_{1i}	2.722	0.946	9.662	-1.588	-0.025	-1.897	-1.736	-1.674	-1.299	-0.200	-0.083	-5.799
β_{2i}	-2.487	0.928	5.113	-10.178	1.577	0.937	-4.274	-0.265	-19.468	0.376	3.770	-11.980
β_{3i}	0.006	0.104	2.165	0.050	-0.021	0.074	0.273	-0.019	0.682	-0.021	0.026	0.311
Diagnostics												
R-squared	0.924	0.904	0.935	0.935	0.899	0.747	0.785	0.736	0.652	0.775	0.874	0.460
Adjusted R-squared	0.904	0.879	0.918	0.918	0.873	0.681	0.730	0.667	0.562	0.716	0.842	0.319
S.E. of regression	0.461	2.113	3.394	0.835	3.812	1.710	2.244	1.811	2.315	0.328	1.631	2.987
Sum squared resid	4.894	102.721	265.008	16.035	334.304	67.237	115.851	75.454	123.314	2.479	61.177	205.187
F-statistic	46.602	36.203	54.793	55.211	34.138	11.341	14.035	10.702	7.197	13.184	26.698	26.698
Prob(F-statistic)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Autocorrelation												
Durbin-Watson	1.604	1.871	1.315	1.825	0.586	2.140	1.385	1.488	1.800	1.152	0.780	1.950
LM test F-statistic	0.421	1.540	0.913	0.071	13.741***	1.624	1.022	1.204	0.085	3.132**	0.128	0.139

Table 6: Dispersion of industry coefficients around mean value

Variable	Sugar	Cotton Textiles	Wool Textiles	Jute Textiles	Brewery	Auto Vehicles	Machine Tools	Chemical Fertilisers	Dyes & Dyestuffs	Medicinal prep.	Cement	Paper
MKTINT												
Average value	*-0.722*											
Standard error	*2.033*											
Z-values	3.061	1.212	3.408	-1.157	0.329	-1.412	-1.009	-1.351	-0.417	0.151	0.274	-4.067
TECHACQ												
Average value	*-2.276*											
Standard error	*5.100*											
Z-values	-2.026	1.287	2.062	-9.243	2.057	1.319	-2.913	0.177	-11.130	0.830	4.120	-8.689
SIZSETUP												
Average value	*0.035*											
Standard error	*0.138*											
Z-values	-0.253	-0.248	0.077	-0.249	-0.289	-0.135	-0.032	-0.285	-0.456	-0.258	-0.308	-0.195

Notes: Computed from Table 5.

Table 7: Change in the long-term relationship between concentration and sunk cost variables

	Coefficient	S.Error	significance
1970-84, N*T=649			
constant	38.18	3.07	***
MKTINT	0.98	0.41	**
TECHACQ	3.07	1.01	***
SIZSETUP	0.00	0.01	
NUMBER	-0.08	0.07	
Residual sum of squares	47949.38		
F (70, 578)	73.46		***
1985-99, N*T=792			
constant	34.60	3.04	***
MKTINT	-0.14	0.40	
TECHACQ	2.96	0.41	***
SIZSETUP	0.04	0.02	*
NUMBER	-0.44	0.09	***
Residual sum of squares	74803.43		
F (70, 721)	63.48		***
1991-99, N*T=474			
constant	38.37	3.55	***
MKTINT	-0.078	0.51	
TECHACQ	2.80	0.50	***
SIZSETUP	0.10	0.03	***
NUMBER	-0.81	0.16	***
Residual sum of squares	36888.74		
F (64, 409)	50.91		***
1970-99, N*T=1441			
constant	36.49		
MKTINT	0.73	0.30	**
TECHACQ	2.89	0.43	***
SIZSETUP	0.27	0.11	**
NUMBER	-0.28	0.05	***
Residual sum of squares	198829.70		
F (85,1355)	65.07		

Notes:

(i) The panel is unbalanced and we estimated equation (3) as a fixed effects model with industry and time effects, but do not report the time and industry dummies here.

(ii) Estimations done in STATA, wit the following syntax

xi: regress herf2 mktint techaq sizsetup number i.sic i.year

Appendix 1: A note on the firm level data used in the analysis

The Reserve Bank of India conducts censuses of the public and private limited companies at periodic intervals (typically every 5 years). We rely here on these unpublished data on medium and large non-government, non-financial, public limited companies (i.e. those quoted on the stock exchange). Summary statistics based on this data are published periodically as reports on the Finances of Medium and Large Public Limited Companies. The coverage of industrial sectors is not complete as the Annual Survey of Industries. The exclusion of small firms is not a serious omission: except in a handful of sectors (e.g. leather) they are unlikely to be the principal competitors of publicly listed firms. The exclusion of government-owned companies is more serious as, over time, they came to contribute a substantial fraction of manufacturing output in the economy. The exclusion of 'unlisted' companies misses out firms such as the automobile giant Maruti Udyog Ltd (owned by Suzuki, Japan and the Government of India).

The data is longitudinal and, as available for the period 1965-2001 as a sequence of surveys. For confidentiality of financial data, companies are identified by a company code rather than company names. Firms are assigned to a three-digit industry code based on their primary activity. Reporting of firms is not uniform across all years and so the number of firms in an industry also fluctuates due to reporting. The cross-section analysis used data on 53 industry groups. Industries that appeared to be miscellaneous groupings were deliberately excluded. The industry coverage of data improves in later years and complete data for all industries are available from 1983.

Table A1: List of 53 industries used in the cross section regressions

Industry code	Description
310	Grains and Pulses
320	Edible vegetable and hydrogenated oils
331	Sugar
341	Cigarettes
342	Tobacco (other than cigarettes)
351	Cotton textiles (spinning)
352	Cotton textiles (weaving)
353	Cotton textiles(composite)
354	Other cotton textiles
355	Jute textiles
356	Silk and Rayon textiles (spinning)
357	Silk & Rayon textiles (weaving)
358	Silk &Rayon textiles(composite)
359	Woollen textiles
360	Ginning pressing and other textile products
370	Breweries and distilleries
380	Leather & leather products
410	Iron & Steel
420	Aluminium
441	Auto vehicles
442	Automobile components
443	Railway equipment

445	Cables
446	Dry cells
447	Electric lamps
449	Machine tools
450	Textile machinery
452	Steel tubes and pipes
453	Steel wire ropes
454	Steel forgings
456	Aluminium ware
461	Chemical fertilisers
462	Dyes and dyestuffs
463	Man made fibres
464	Plastic raw materials
466	Medicines and pharmaceutical preparations
467	Paints, varnishes and allied products
469	Industrial and medical gases
470	Matches
510	Mineral Oils
521	Cement (hydraulic)
522	Asbestos and asbestos cement products
531	Structural clay products
532	Ceramics
541	Tyres and tubes
551	Paper
552	Products of pulp and board
553	Wood products, furniture and fixtures
561	Glass containers
571	Printing
572	Publishing
573	Printing, publishing and allied activities
580	Plastic products

Appendix 2: Order of integration, I(p), of the variables: summary of ADF tests

Industry	Model: Intercept only				Model: Trend and intercept			
	HERF2	MKTINT	TECHACQ	SIZSETUP	HERF2	MKTINT	TECHACQ	SIZSETUP
Sugar	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(0)
Cotton Textiles	I(1)	I(1)	I(0)	I(0)	I(1)	I(0)	I(1)	I(0)
Woollen Textiles	I(1)	I(1)	I(1)	I(1)	I(2)	I(0)	I(1)	I(1)
Jute textiles	I(1)	I(1)	I(0)	I(1)	I(1)	I(0)	I(1)	I(0)
Breweries	I(0)	I(1)	I(4)	I(1)	I(1)	I(1)	I(1)	I(1)
Auto Vehicles	I(0)	I(0)	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)
Machine Tools	I(4)	I(1)	I(0)	I(0)	I(2)	I(0)	I(0)	I(1)
Chemical Fertilisers	I(1)	I(0)	I(0)	I(0)	I(0)	I(1)	I(0)	I(1)
Dyes and Dyestuffs	I(0)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(2)
Medicinal preparations	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(2)	I(2)
Cement	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)
Paper	I(0)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)	I(2)
Printing, Publishing & allied activities	I(0)	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)

Figure 1: Change in coefficient on marketing intensity (eqaution 3) overtime
[Mean group estimator = -0.463, Std error= 2.13]

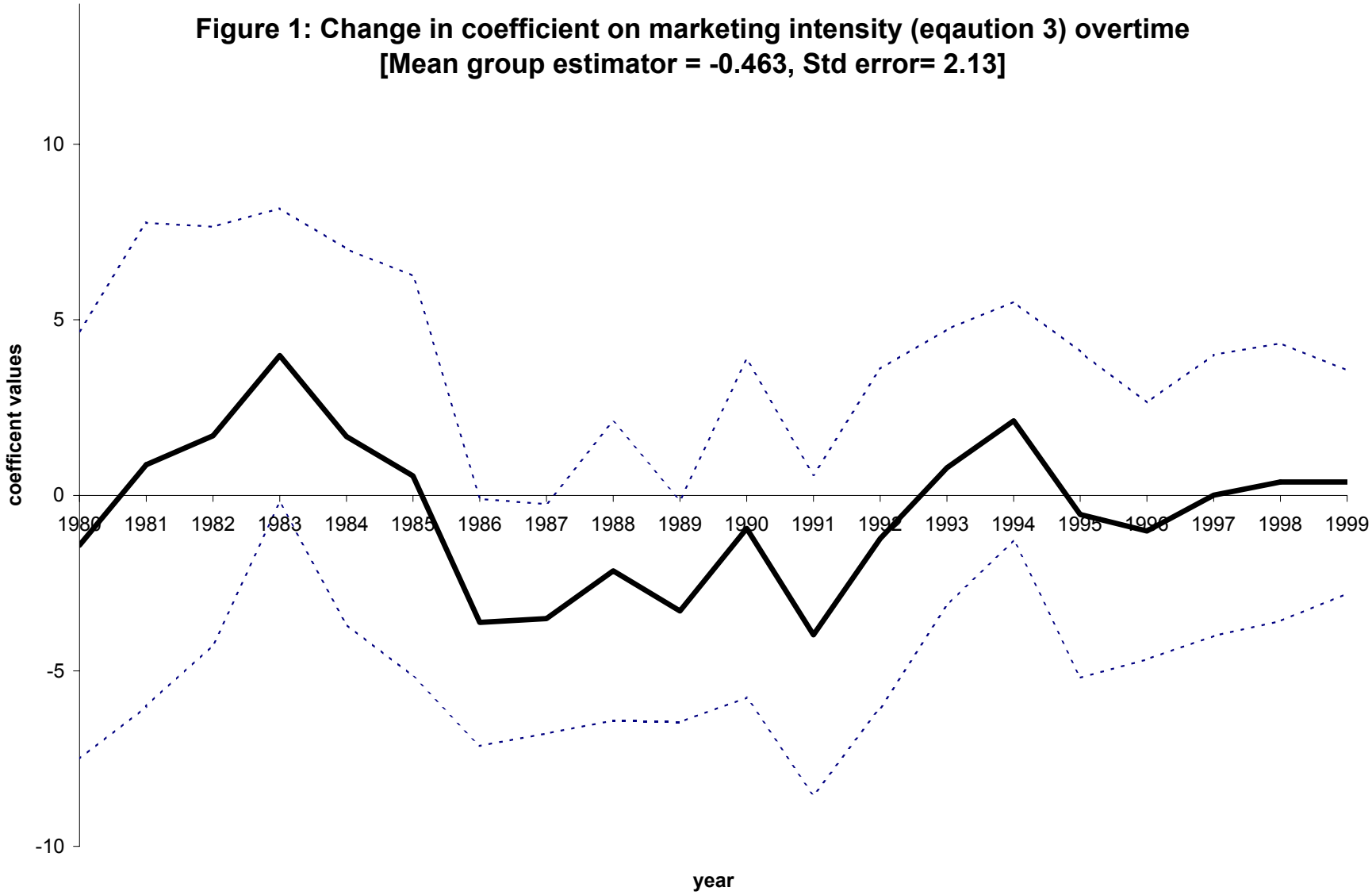

Figure 2: Change in coefficient on technological intensity (equation 3) overtime
[Mean group Estimator= 2.18, Standard Error=2.047]

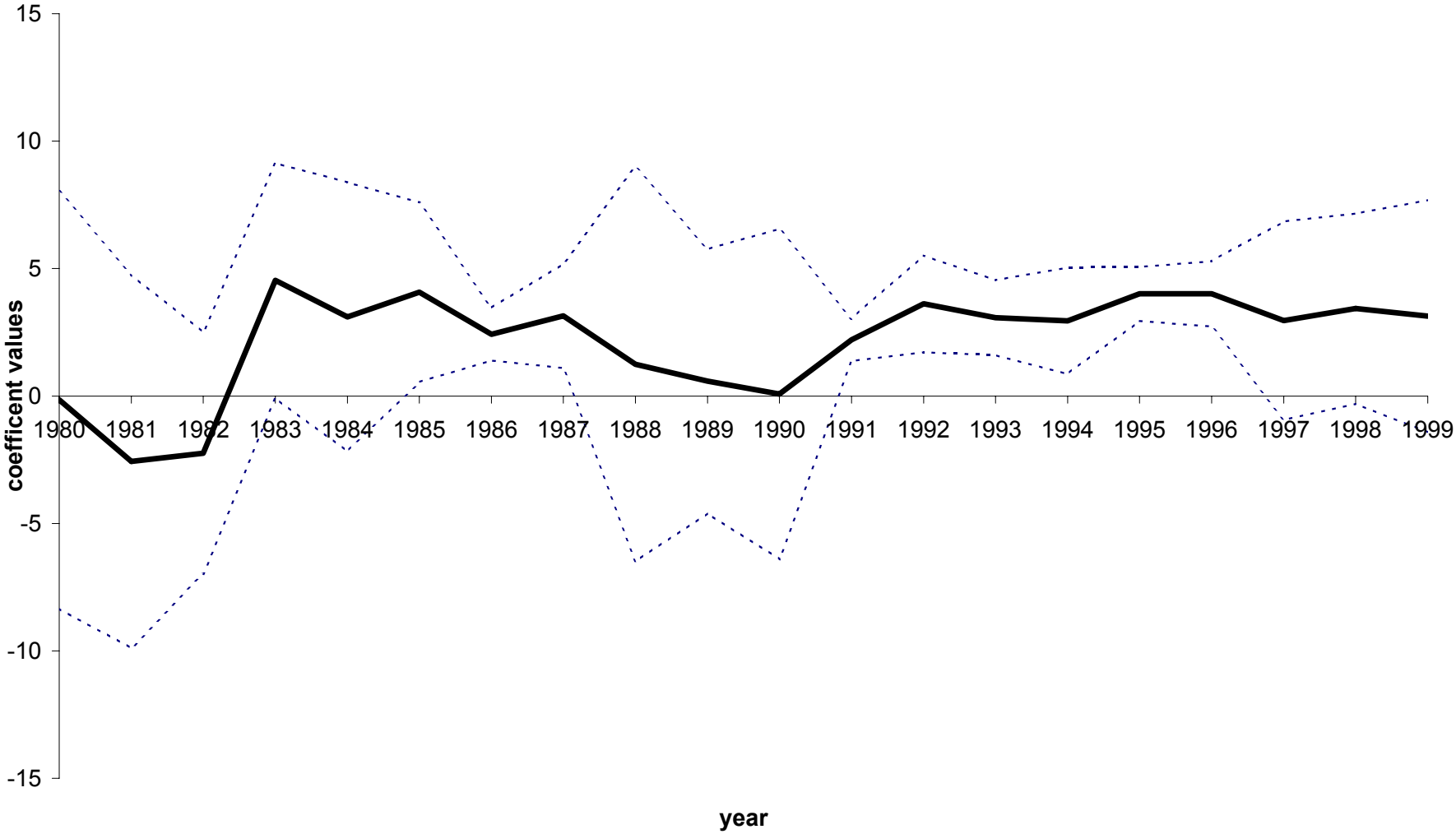

Figure 3: Change in coefficent on the ratio of market size to set-up costs (equation 3) overtime
[Mean Group estimate=0.084, Standard error=0.135]