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The Indian Economy Since Liberalisation: the Structure and Composition of Exports and Industrial Transformation (1980 – 2000)

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Abstract

This paper assesses empirically structural change in the Indian manufacturing based export sector, based on an analysis of 143 industries / product groupings (mainly manufacturing industries). Trade indices such as Balassa's revealed comparative advantage (RCA) index, and other variants commonly employed in the literature are used in our analysis. Regression analysis on the RSCA indices is used to further analyse structural change. Thereafter, the stability of the RCA indices is examined, as well as the process of their intertemporal evolution. Three technology categories (high technology, medium technology and low technology) are examined individually and SITC product codes are used as proxies for export industries, in order to look at industry movements within each of these groups. This analysis enables us to assess the export performance of Indian industries in the selected product-industry groupings in detail and evaluate the prospects for growth of particular Indian industrial groupings.

JEL codes: F14, L6

Keywords: India, revealed comparative advantage, manufacturing exports, industrial transformation

1. Introduction

India's role in world trade and India's export performance have been relatively neglected areas in recent research. Even less well understood is the performance of large Indian firms and their role in overseas markets. A balance of payments crisis and India's subsequent trade liberalisation (1991) brought to an abrupt end decades of Nehruvian socialist ideas. The result has been a profound reassessment of economic strategy for growth and the role of state along with a realisation of the need for institutional transformation. Economic realities have had a deep impact on the political economy of growth and the political economy of trade in India. These developments have been accompanied by fundamental changes in India's institutional framework, as the economy has transformed from an autarky to a relatively open economy.

In this paper, the first issue is the general one concerning India's trade with the other countries across a number of commodity groupings. The aim of analysis is to identify trends from the data and to assess the relative industrial strengths and weaknesses empirically. The basic framework we adopt is that market structure, combined with the institutional underpinnings within the economy, impact on corporate practices and inform industry-wide (and firm level) strategy. Industry response is proxied by trade data (available on value and destination of exports). Finally, the soundness of strategy at the firm and at the industry level determines trade performance.

In this analysis, trade indices such as Balassa's revealed comparative advantage (RCA) index, and other variants commonly employed in the literature (including Vollrath's indices of comparative advantage and the revealed symmetric comparative advantage index, among other things) are employed to analyse the relative strengths of India's export sectors. Proudman and Redding's (2000) study is expanded to carry out a graphical pre-test and informal analysis of the broad trends in industrial change in India. Following Hart and Prais (1956), Cantwell (1989), Dalum, Laursen and Villumsen (1998) and Hinloopen and van Marrewijk (2001), regression analysis on the RSCA indices is used to further analyse structural change. Thereafter, the stability of the RCA indices is examined, as well as the process of their intertemporal evolution. Finally, econometric techniques are employed to examine the persistence / mobility patterns for India's export industries. Analysis is performed for each of the three technology categories (high technology, medium technology and low technology) individually, in order to look at industry movements within each of these groups. This analysis enables us to examine the export performance of Indian industries in the selected product-industry groupings in detail and evaluate the prospects for growth of particular Indian industries in groupings with different technology parameters. Such an analysis provides insights into the effectiveness of policy reforms. We can thus estimate the extent to which successful Indian industries have moved upwards in terms product sophistication, and the industrial structural change in terms of our chosen technology classification of industries.

The political economy aspect and the role of institutions influence the potential for future industrial growth as well as the sustainability of the growth process. Indian export performance is strongly influenced by system specific parameters. With India's history of having an interventionist state, protectionism and a large public sector, Indian capitalism and markets lie somewhere on the continuum extending from the Atlantic/ Rhenish modes of capitalism on the one hand, and *dirigisme* in France onwards to market socialism in China on the other. In the context of an activist state, Bardhan's (1984) dominant coalition hypothesis provides a useful starting point for the nature of the interaction between the political process and business interests. Interest group interactions impact upon the process of resource allocation within the economy. Directly unproductive rent seeking activity, within government and industry further diminish the possibilities for the generation of surpluses for reinvestment in the production process (including exports). These factors thus impose constraints within which industry must operate, and worse-off industries (seeking more protection and state intervention) create unnecessary barriers for the more efficient producers, and lead to distortions in the economic process. Thus the political economy of the resource allocation process, the interaction between elements of the national elite and interest groups, and the concomitant changes in business strategy become critical for our analysis. Taken in totality, these forces have a profound impact on export performance of Indian firms.

Classical trade theory, especially the notion of comparative advantage, postulates that gains from exchange maximize welfare and that free trade increases economic prosperity. Ricardian theory explains this from cost and technological differences while the Heckscher-Ohlin-Samuelson theory considers factor endowments and factor price differentials to explain this difference.

In empirical work, the concept of comparative advantage has been used extensively. In fact the commodity pattern of comparative advantage is a central concept in international trade theory. This is despite the fact that the notion of comparative advantage faces a measurement problem because it is defined in terms of relative autarkic price relationships that are not observable in post-trade equilibria. This is because trade statistics reflect post-trade positions. Ballance et al (1987) provide a simple theoretical framework for understanding the notion of comparative advantage. It is argued that economic conditions (EC) in the various trading countries ultimately determine the international pattern of comparative advantage (CA). This emergent pattern of CA, in turn, governs the pattern of trade, production and consumption (TPC) among countries. Indices constructed from post-trade variables (such as TPC) are employed to estimate comparative advantage and they are termed as 'revealed' comparative advantage (RCA) indices. These causal indices are linked as follows (Ballance et al (1987: 157):

$$EC \rightarrow CA \rightarrow TPC \rightarrow RCA \quad (1)$$

In a two-country, two factor, two-product world the application of this 'model' is straightforward, with deterministic relationships between CA and TPC.[1] But once we generalise to a world in which there are more than two countries, products or factors, the deterministic links between TPC and CA break down (Drabicki and Takayama, 1979). However, Deardoff (1980) has demonstrated that under relatively general conditions there is a negative correlation between net exports and relative autarkic prices. This in turn suggests that there are limits to the extent to which the pattern of trade may depart from that identified in the deterministic specification of the model specified in (1a). From this we can conclude that while comparative advantage may

[1] However, the relationship between RCA and TPC would be stochastic given the fact that we face data problems like measurement errors and/ or inappropriate aggregations.

not be precisely measurable, indices based on real world post-trade observations may ‘reveal’ much about the underlying pattern of comparative advantage.

2. Data sources, industrial sectors selected and technological categories employed

This paper is an empirical study which aims to assess the changing trade position of the Indian economy based on an analysis of 143 industries / product groupings (mainly manufacturing industries, with commodity type, resource based exports being excluded) at the three digit level of Standard Industrial Trade Classification (SITC) classification. Data has been obtained from the *UNCTAD Handbook of Statistics 2002*, which itself compiles data made available by the Indian Ministry of Commerce (*Monthly Statistics of the Foreign Trade of India - Annual Number*, various issues). The latter data set provides in greatly disaggregated form statistics relating to India’s exports by SITC grouping broken down by destination of exports. Given the extremely disaggregated and large data set made available by the latter source mentioned above, annual export data is studied at decennial intervals (1980-2000). By an examination of trade data, the structural changes emergent in the Indian economy (post liberalisation) can be deduced. By analysing a matrix of product-industry groupings, which are subdivided into high technology (HT), medium technology (MT) and low technology (LT) categories[2], SITC product codes are used as a proxy for export industries. The industries chosen for analysis are listed in Appendix 1. Also included in the analysis is the category labelled as ‘other resource based exports’ which have been chosen because of their importance in the industrial structure of Indian exports, especially as some of the products classified in this category include important intermediate goods that impact on the performance of other key industries. Further, some of the categories included here require a fair degree of technical competence, even though many such industrial processes and techniques are now regarded as mature and well-known. Greater emphasis is given to, and further detailed analysis is carried out for, the HT, MT and LT sectors (and, of course, for the manufacturing sectors chosen as a whole as well). While further refinement of these categories is possible by defining sub-categories (for example high-technology export

[2] This classification is based on Lall (2002), OECD (1994) and Pavitt (1984).

sectors can be classified into two sub-sectors, the first encompassing a 'higher' technology definition than the second one), such measures are not always practically useful owing to the limited number of industries available and possible serious consequences arising through small-sample biases and general loss of degrees of freedom while undertaking statistical and econometric analysis. Therefore, a relatively aggregative approach or parsimonious approach is necessitated in our analysis.

3. Methodology

3.1 Export indices, comparative advantage and Measures of international specialisation

Liesner (1958) was the first to use post-trade data to quantify comparative advantages, and he attempted this by devising indices of relative export performance as proxies for comparative cost so as to measure the effect of an entry into the European Common Market on UK industry. The most frequently use measure is, however, Balassa's (1965) 'revealed' comparative advantage which adjusts Liesner's methodology by normalizing the export measure formulated. Balassa's (1965) revealed comparative advantage (henceforth RCA) approach assumes that the 'true' pattern of comparative advantage can be observed from post-trade data. RCA measures can be employed to analyse the changing pattern of comparative advantage across commodities as a result of a process of accumulation of physical and human capital that characterises economic development (Balassa, 1979). The RCA measure can be distorted by availability of data at various levels of aggregation and data biases can be created by government policy interventions such as non-tariff barriers (NTBs) and through export subsidies. Balassa's stages of comparative advantages thesis advocates a 'catch-up' process which shifts economies from one area of comparative advantage to another. As a result, developing economies often exhibit a process whereby they take over labour-intensive product lines from developed countries and this leads to a production shift because of which developed countries concentrate on the export of technology-intensive products. The theoretical literature on growth and trade stresses that comparative advantage is dynamic and develops endogenously over time. One strand of the literature (Lucas, 1988); Young, 1991; Grossman and Helpman, 1991) demonstrates that the growth rate of a country may be permanently reduced by a 'wrong' specialisation. Yet another strand (Findlay, 1970 and 1995; Deardoff, 1974) emphasises the role of factor accumulation in determining the evolution of international trade. The standard Heckscher-Ohlin model implies a very close relation between factor composition and trade dynamics. It postulates that the pattern of trade specialisation changes only if trading partners experience a change in their relative factor endowments. As a result, the existence of persistent trade patterns is perfectly consistent with the model, provided factor endowments of countries do not change significantly with respect to their main trading partners. Grossman and Helpman (1990, 1991), under the assumption that knowledge spillovers are international in scope, have demonstrated that the history of the production structure of a country does not affect its long-run trade pattern, which depends only on relative factor endowments. In contrast, some other models show that dynamic scale economies arising from 'learning by doing' are country specific, suggesting a lock-in effect for the pattern of specialisation. Krugman (1987) and Lucas (1988) show that in the presence of dynamic scale effects, the long-run trade pattern is determined by initial comparative advantage. New trade models suggest that the pattern of trade tends to become more specialised over time. Proudman and Redding (2000) analyse the role of international trade and endogenous technical change and show that a precisely specified model yields ambiguous conclusions as to whether trade patterns display persistence or mobility over time. In other words they conclude that this is an empirical question.

3.2 Measuring Trade Specialisation

The most frequently employed measure of trade specialisation is the Revealed Comparative Advantage Index first proposed by Balassa (1965). Given a group of reference countries the Balassa Index basically measures normalised export shares, where the normalisation is with respect to the exports of the same industry in the group of reference countries. In particular, following Hinloopen and van Marrewijk (2001: 4), if X_j^A is country *A*'s export value of industry *j*, X_j^{ref} is industry *j*'s export value for the group of reference countries, and we define $X^i = \sum_j X_j^i$ for *i = A, ref*, then country *A*'s Balassa Index (*BI*) of revealed comparative advantage for industry *j*, BI_j^A, equals:

$$BI_j^A = \frac{X_j^A / X^A}{X_j^{ref} / X^{ref}} \tag{2}$$

If BI_j^A exceeds 1, country *A* is said to have a comparative advantage in industry *j*, since this industry is more important for country *A*'s exports than the exports of reference countries. The Balassa Index, *BI*, is thus based on observed trade patterns. It measures a country's exports of a commodity relative to its total exports and relative to the corresponding export performance of a set of countries.

The Balassa Index has several limitations. Its value is asymmetric since it varies from one to infinity for commodities (or industries) in which a country has a revealed comparative advantage, but only from zero to one for commodities (or industries) with a comparative disadvantage, with a (weighted) average of 1.0. Equivalently, for an industry, if RCA exists *BI* values lie between [1, ∞); if RCA does not exist *BI* values lie between [0, 1].

As a result, if the mean of the Balassa Index is higher than the median, then the distribution of *BI* will be skewed to the right (Ferto and Hubbard (2003): 2). Hinloopen and van Marrewijk (2001) investigate the distribution of the Balassa Index for export performance of similar countries to a third market using European Union (12 countries) and Japan's trade data, analysing the EU-12 as a group, and individual countries as well, between 1992 and 1996. They conclude that in all cases the Balassa index was found to be very skewed with a median well below one, a mean well above one, and a monotonically declining density function. This process appeared to be very well defined in the sense that distribution changes very little from one period to the next. In their calculations, analysing annual rather than monthly trade flows, or pooling values of the Balassa Index was seen to have only a mild influence on the distribution. They found observations for individual industries to be more persistent over time for annual rather than monthly trade flows. The widely used criterion '*BI* >

1' to identify sectors with an RCA was found to select one-third of the exporting industries. However, the distribution of *BI* was found to differ considerably across countries, making comparisons across countries problematic. As Dalum et al (2001: 427) point out, a skewed distribution violates the assumption of normality of the error term in the regression analysis, which makes the *t*-statistics unreliable. Additionally, the use of the RCA in regression analysis gives much more weight to values above one, as compared to observations below one.

To deal with the skewness problem Dalum et al (2001) propose a revealed symmetric comparative advantage index (*RSCA*) which is:

$$RSCA = \frac{BI - 1}{BI + 1} \qquad (3)$$

The RSCA's lie between [-1, +1] and avoid the problem of having to deal with zero values in logarithmic transformation of the Balassa index (when an arbitrary constant is not added to a *BI* value). The chief benefit of this method is that it attributes changes below unity the same weight as changes above unity. However, the disadvantage is that forced symmetry does not necessarily imply normality in the error terms and it may hide some of the *BI* dynamics (Ferto and Hubbard (2003)).

Proudman and Redding (2000) point out that the arithmetic mean of the Balassa Index across sectors is not necessarily equal to one. According to them, the numerator of (2) is unweighted by the share of total exports accounted for by a product group, while the denominator is a weighted sum of export shares of all commodities. Consequently, if a country's trade pattern is described by high export shares in a few sectors which account for a small share of exports to the reference market, this implies high values for the numerator of the Balassa Index and low values for the denominator. This results in a mean value of *BI* above one for a given country. Furthermore, average values of *BI* may change over time, hence misleading conclusions may be drawn about a country's average extent of specialisation based on the Balassa Index. To correct this, Proudman and Redding (2000) propose an alternative RCA measure where a country's export share in a given product group is divided by its mean export share in all product groups, so that, for exports in the *j*th sector from country *A*, there being *n* sectors in all, we have:

$$BPR_j^A = \frac{X_j^A / \sum_A X_j^A}{\frac{1}{n}\sum_j (X_j^A / \sum_A X_j^A)} \qquad (4)$$

The mean value of this normalised *BI* given by *BPR* in (4) is constant and equal to one. *BPR* thus normalises the *BI* measure by its cross-section mean in order to abstract from changes in the average extent of specialisation. Ferto and Hubbard (2003: 3) point out that the normalised *BI* index (i.e. the *BPR* index) loses its consistency with respect to the original *BI*, because it may display the opposite status when *BI* value falls in the range between one and its mean.

Proudman and Redding (2000) employ an informal method of graphical analysis of the evolution of the BPR Index (given in (4)) over time. Industries are first ordered in terms of increasing values of moving averages of the BPR index over a period of time and deviations of the BPR index from the value of 1 are graphed. Such figures reveal information concerning intra-distribution dynamics. If patterns of internationalisation in a given economy exhibited persistence, one would expect the distribution of the BPR index to remain similar across successive time periods. Industries with high values in one period of time (initial time period) would also have high RCA values in the end period. A complete absence of specialisation corresponds to an equal share of exports in all sectors which implies that we would observe a BPR index value of 1 in all sectors with zero standard deviation. If an economy were increasingly specialising in a subset of industries, one would observe BI (or its proxy such as the BPR index) systematically increasing in specific sectors and systematically decreasing in others. The distribution of a revealed comparative advantage index would therefore exhibit an increasing mass at extreme values of RCA.

Hillman (1980) looks at the relationship between the Balassa Index and comparative advantage as indicated by pre-trade prices, abstracting from the issues arising from the possibility of government intervention on exports. According to his analysis, the *BI* index is not appropriate for cross-commodity comparison of comparative advantage, because for these cases the value of *BI* does not correspond to the notion of comparative advantage in the Ricardian sense of pre-trade relative prices. Equally importantly, Yeats (1985) provides empirical evidence to demonstrate that the *BI* index fails to serve as an appropriate cardinal or ordinal measure of a country's RCA in the country-industry approach. But Yeats (1985) concludes that quantitative evidence developed by the RCA approach is fully consistent with the predictions of the factor proportions theory and basic Ricardian precepts.

Hillman (1980) formulated a condition that must be fulfilled in order to obtain a correspondence between the *BI* index and pre-trade relative prices in cross-country comparisons for a given product. He showed that comparative advantage calculated in accordance with pre-trade relative prices for country *A* in commodity *j* requires the following necessary and sufficient condition:

$$1-\frac{X_j^A}{W_j} > \frac{X_j^A}{X^A}\left(1-\frac{X^A}{W}\right) \tag{5}$$

where X_j^A is exports of commodity *j* by country *A*, X^A is total exports of country *A*, W_j is world exports of commodity *j* and W is the world's total exports. Under the assumption of identical homothetic preferences across countries, the condition in equation (6) is necessary and sufficient to guarantee that changes in the *BI* index are consistent with changes in countries' relative factor endowments. To test (6) empirically, Marchese and de Simone (1989) transform Hillman's condition (Hillman Index, HI) into the following form:

$$HI = \left(1-\frac{X_j^A}{W_j}\right) / \frac{X_j^A}{X^A}\left(1-\frac{X^A}{W}\right) \tag{6}$$

If *HI* is larger than unity, the *BI* index used in cross-country comparisons will be a good indicator of comparative advantage. Marchese and de Simone (1989) contend that *HI* should be calculated in any empirical research attempting to identify long-term implications of trade liberalisation using *BI*. Marchese and de Simone (1989) and Hinloopen and van Marrewijk (2001) estimate *HI*. The former test for 118 exporting countries in 1985 and find that *HI* is violated in less than 10 percent of the cases, while the latter find violations for only 7 percent of the export value and less than 1 percent of the number of observations. These results suggest that Hillman's condition may be less restrictive than might have been expected.

Brasili et al (2000: 237) argue that RCA indices are widely used because measures based on net exports are more comprehensive indicators of the concept of specialisation. There has been much scepticism in the trade literature about governments 'picking winners'. Ferto and Hubbard (2002: 8) cite Vollrath who argues that government intervention and competitiveness tend to be inversely related. The implication is that those product groups which reveal a comparative advantage could become even more internationally competitive if markets were to become more open.

Ballance et al (1987) suggest some simple statistical test for examining the extent to which various RCA indices are consistent in their identification of comparative advantage. It is conventional to interpret an RCA index as a measure to identify the extent to which a country has a comparative advantage (or disadvantage) in a given product, which Ballance et al (1989) term as cardinal interpretation of an RCA index. Two other interpretations are offered: that the index provides a ranking of products by degree of comparative advantage and that the index identifies a binary type demarcation of products based on comparative advantage and comparative disadvantage. These are termed as ordinal and dichotomous interpretations, respectively. The consistency test of the indices as cardinal measures of comparative advantage is based on the correlation coefficient between paired indices in each of the years under consideration. The consistency test of the indices as ordinal measures of comparative advantage is similar, but based on the rank correlation coefficient for each pairing. The test of the indices as a dichotomous measure is simply the share of product groups in which both paired indices suggest comparative advantage or comparative disadvantage.[3] Ballance et al (1987) conclude that the indices are less consistent as cardinal measures, but the consistency tests offer more support for use of the indices as a binary measure of comparative advantage. It is prudent to treat RCA indices as binary rather than cardinal measures of comparative advantage.

[3] For more details, refer to Ballance et al (1987) and Ferto and Hubbard (2002).

It is important to consider the issue of stability of the Balassa Index over time. Following Hinloopen and van Marrewijk (2001) we can distinguish between two types of stability (at least): (i) the stability of Balassa indices from one period to the next and (ii) the stability of the value of the Balassa indices for particular product groups from one period to the next. Several approaches can be employed to estimate the stability of the Balassa Index.

Hoekman and Djankov (1997) and Ferto and Hubbard (2002) employ a simple indicator of stability. They calculate the relative importance (in terms of percentage shares) of those products that reveal a comparative advantage in time period *t1* but a relative comparative disadvantage (RCD) in *t2* or vice versa i.e. an RCD in *t1* but an RCA in *t2*. In addition, they estimate the correlation coefficient between the RCA index in time period *t1* and the index in subsequent time periods.

3.3 Analysing industrial structural transformation

Pavitt (1987) argues that technology is firm-specific, cumulative and differentiated, as a result of which industrial structure and innovation processes in a given place or within a group of firms tend to reflect past technological accumulation, which implies a degree of persistence in industrial structure. A corollary is that once a certain industrial structure emerges or takes root, industrial comparative advantage and the technological advantages underpinning it would tend to remain relatively stable over time. Technological strength across industrial sectors tends to change only gradually. These ideas are implicit in Rosenberg (1982) and Dosi (1984).

Following Cantwell (1989), the theory of technological can be understood to encompass the following three propositions. First, technological change is cumulative, as a result of which the sectoral composition of innovation and comparative advantage remains stable over large periods of time, often spanning one or two decades. The alternative hypothesis is that technological change follows a random course, where relative innovative activity switches between industries. The main issue is the nature of comparative advantage held by national firms (in things like technology creation), and the stability of that pattern of comparative advantage over time. Thus inter-country comparisons of comparative advantage over time are not the subject of enquiry here. This implies that the day-to-day adaptation of technology, through an interaction between its creation within the firm and its use in production, has a more pervasive influence than the major technological breakthroughs which give rise to entirely new production processes. Even radically new technologies, once they move beyond the purely scientific and experimental stage, often rely upon or are integrated with earlier technologies in the course of their development. As a result of this, innovation tends to advance through a process of continual refinement and extension of established technologies. In any given industry firms tend to push forward with a sequence of innovations conditioned by the prevailing 'technology paradigm'. These firms are geared up to problem-solving R&D and production engineering in areas of technology in which they have accumulated substantial practical experience.

The second proposition holds that technological change develops incrementally, so that firms tend to move between related sectors gradually, a process that can be described as related diversification of industrial activity. This builds on and develops Schumpeterian ideas about processes leading to 'creative destruction', whereby old industries and techniques give way to new ones, through a rapid process of change and transformation. However, in Cantwell's (1989) terms, although underlying technology and skills continue to build upon the past, industrial applications could change gradually, which in extreme cases would give rise to new industries.

The third proposition is that technological change is differentiated between firms and locations, as are levels of comparative advantage. The path of technological development followed by a particular firm or in a particular location is distinctive and characterised by elements that are specific to that firm or location.

It would be expected that technological accumulation and the pattern of industrial comparative advantage would remain fairly stable over time, for firms in any given national industry. If revealed comparative advantage would be expected to show such persistence patterns, it would be reasonable to suppose that RCA indices and transforms such as the RSCA indices would also remain fairly stable over time. If the RSCA index is calculated for a national group of firms at two different points in time, then these two sectoral distributions of revealed symmetric comparative advantage should be positively correlated with one another. However, since the nature of innovative activity changes over time, the degree of correlation is likely to fall, the further apart are the two groups of years under consideration.

In this context, a Galtonian regression model can be employed, which is a statistical technique for bivariate distributions. The approach was originally employed by Hart and Prais (1956), who used it to analyse size distribution of firms. Some other applications of this technique have been made by Cantwell (1989) for technological innovations in industry, by Hart (1976) and Creedy (1985) for income distribution in the UK, and by Sutcliffe and Sinclair (1980) for the case of seasonality of tourist arrivals in Spain. In the context of industrial structural transformation and evolution of revealed comparative advantage, the correlation between the sectoral distribution of the RSCA index at time *t2* and at an earlier time period *t1* is estimated through the simple cross-section regression represented by:

$$RSCA_{jA}^{t2} = \alpha_j + \beta_j RSCA_{jA}^{t1} + \varepsilon_{jA} \tag{7}$$

where superscripts *t1* and *t2* describe the initial year and the final year (for analysis), respectively. The dependent variable, *RSCA* at time *t2* for sector *j* in country *A*, is tested against the independent variable which is the value of the *RSCA* in the initial year *t1*. α and β are standard linear regression parameters. The equation given above is estimated for a given country. In this analysis it is assumed that the regression is linear and that the residual ε_{jA} is stochastic (ε_{jA}~N (0, σ) and independent of $RSCA_{jA}^{t1}$. As will be explained in the following, If β = 1, this suggests an unchanged pattern of *RSCA* between periods *t1* and *t2*. If β > 1, the country tends to be more specialised in product groups in which it already specialised, and it is less specialised in those industries where initial specialisation is low.[4] In other words, the initial specialisation of the country is strengthened. If 0 < β < 1, then commodity groups with low (negative) initial RSCA indices grow over time, while groups with high (positive) initial RSCA indices decline. The special case where β < 0 indicates a change in the sign of the index. It must be noted, as Dalum et al (1998) point out, that β > 1 is not a necessary condition for growth in the overall specialisation pattern. This is valid if the

[4] A coefficient value above unity indicates that countries have become more specialised, with countries having an initial relative advantage increasing theirs and countries with an initial relative disadvantage seeing that disadvantage made worse.

cross-industry RSCA index at each point in time approximately conforms to a normal distribution.

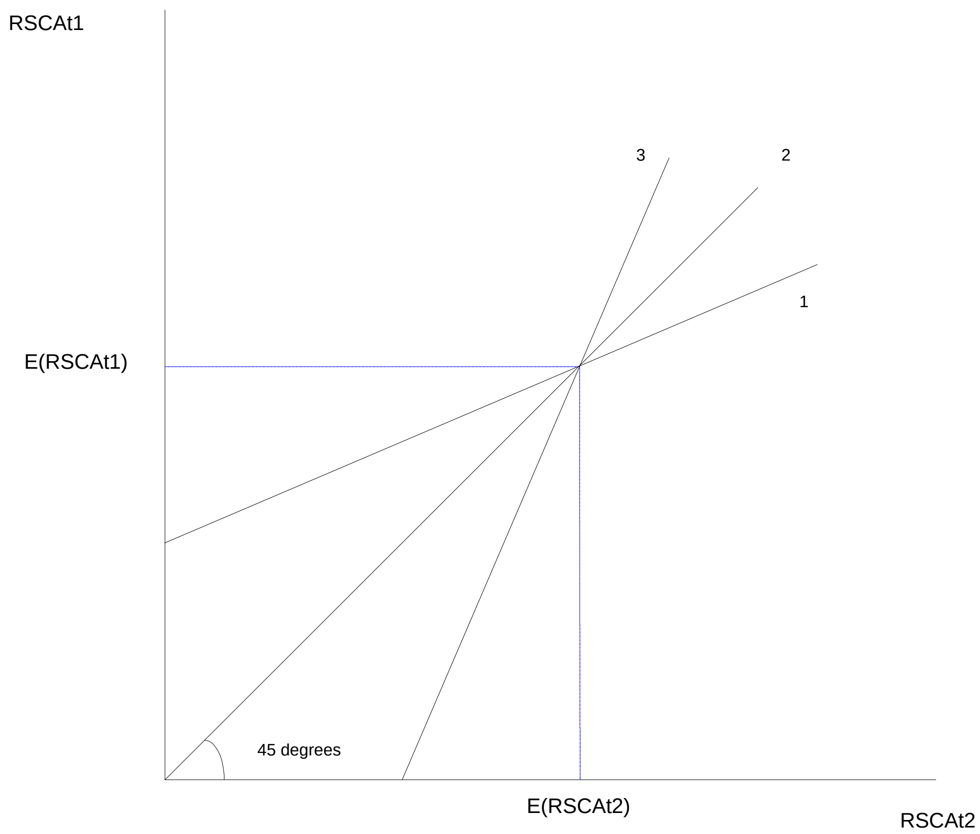


Figure 1: Regression using the RSCA index
(Adapted from Cantwell (1989: 28))

The regression line will pass through the point of the means and in Figure 1, for ease of exposition, this is shown to be the point where the mean of each distribution happens to be the same, the expected values of the distribution being given by E(RSCAt1) = E(RSCAt2). The analysis does not depend upon the values of the means being identical, but it can be seen that a sizeable difference between them may be indicative of a substantial measure of skewness in one of the indices, which consequently departs significantly from a normal distribution. In Figure 1, the regression line (2) is drawn in such a way that the estimated coefficient $\hat{\beta}$ takes the value of one. This implies not only that the ranking of industries remains unchanged (advantaged industries remain advantaged, while disadvantaged industries remain disadvantaged), but also that they retain the same proportional position (advantaged industries do not become any more advantaged, and disadvantaged industries do not become any more disadvantaged). Where $\hat{\beta} < 1$, as in line (3), there is a proportional shift in which already advantaged industries tend to become still more advantaged, while disadvantaged industries become even more disadvantaged.

In the case of regression line (1) where $\hat{\beta} > 1$, disadvantaged industries improve their position, and advantaged industries slip back. This has been termed as 'regression towards the mean' (Galton (1889) cited in Hart (1976); Cantwell (1989: 28)). In case we have the following condition, that $0 < \beta < 1$ then industries remain in the same ranking, but they come closer to one another. The magnitude of $(1 - \beta)$ therefore measures what is referred to as the regression effect, and this is how the estimated coefficient ($\hat{\beta}$) is interpreted.

If $\beta < 0$, then the very ranking of industries is reversed, which is contradictory to the prediction of cumulativeness of the theory of technological accumulation and accretion of comparative advantage. The expectation that $\beta > 0$, such that the RSCA index is positively correlated across two points in time can readily be tested for a given country. The relevant test of $\hat{\beta}$ being significantly different from zero is the *t*-test. [5]

The test for whether $\hat{\beta}$ is significantly greater than zero is a test of the proposition of cumulativeness against the alternative that the sectoral composition of innovation is random. However, the second proposition to be set alongside that of cumulativeness in the industrial pattern of innovation is that of incremental change. If firms generally innovate in order to gradually adapt their existing technological strengths, they may still begin to shift the industrial nature of their activity. As the pattern of demand changes, and technology evolves, the sectoral distribution of innovation in a country may change, even though it may still be drawing on a similar set of underlying technological skills. The effect is likely to be more pronounced the further apart the RSCA distributions are in time.

[5] In a regression equation with only one independent variable, the *t*-test is equivalent to an *F*-Test, which refers to the significance of the regression as a whole.

The condition under which cumulativeness in the industrial distribution of innovation outweighs incremental change is that $\beta \geq 1$. Strictly speaking, if there were a path dependent cumulative process with no change in the technological relatedness between sectors and therefore no shift in the underlying industrial structure of innovation (no incremental change), it would evolve towards a position where the proportion of innovations accounted for by each industry was stable and fixed (Arthur et al (1987)). This would correspond to $\beta = 1$, and to a regression effect (1- β) exactly equal to zero.

The test whether cumulativeness outweighs incremental change in the period in question is hence the *t*-test of $\hat{\beta}$ not being significantly less than one (equivalent to a regression effect which is negative or not significantly different from zero). Where $\hat{\beta}$ is significantly greater than zero but significantly less than once then elements of cumulativeness and incremental change are combined. If cumulativeness dominates initially over relatively shorter periods ($\hat{\beta} \geq 1$), tests would reveal the length of time that it takes for incremental change to play a significant role ($0 < \beta < 1$). In such instances, the regression analysis should be supported by a more detailed examination of the actual shifts in the RSCA index, in order to investigate the actual evolution of sectoral strengths and weaknesses.

The preceding regression analysis of the RSCA distribution also facilitates a simple test of changes in the degree of revealed symmetric comparative advantage. The degree of revealed symmetric comparative advantage in a country can be measured by the variance of its RSCA index, which shows the extent of the dispersion of the distribution around the mean. Pavitt (1987) used the standard deviation of an analogous concept, the revealed technological advantage (RTA) index, which is the square root of the variance, as a measure of such specialisation. Soete (1980) also analysed the variance of RTA indices. Such analysis can be extended to the preceding RSCA regression analyses, where the standard deviation (which is the square root of the variance), of the RSCA index can be identified as a measure of such revealed symmetric comparative advantage.

The procedure for estimating changes in the variance of the distribution over time follows from Hart (1976) and Cantwell (1989). Taking equation (7) above, if the variance of the RSCA index at time *t2* is denoted by $\left(\sigma^{t2}\right)^2$ then:

$$\left(\sigma^{t2}\right)^2 = \beta_j^{\,2}\left(\sigma^{t1}\right)^2 + \sigma_\varepsilon^2 \tag{8}$$

R_j^2 is given by:

$$R_j^{\,2} = 1 - \left(\sigma_\varepsilon^2 \big/ (\sigma^{t2})^2 \right) = ((\sigma^{t2})^2 - \sigma_\varepsilon^2)\left(1 \big/ (\sigma^{t2})^2 \right) \tag{9}$$

Combining equations (2) and (3) gives us:

$$(\sigma^{t2})^2 - \sigma_\varepsilon^2 = \beta_j^{\,2}(\sigma^{t1})^2 = R_j^{\,2}(\sigma^{t2})^2 \tag{10}$$

Equation (10) can be rewritten to show the relationship between the variance of the two distributions as follows:

$$\left(\sigma^{t2}\right)^2 / \left(\sigma^{t1}\right)^2 = \beta_j^2 / R_j^2 \tag{11}$$

This can be simplified to:

$$\sigma^{t2} / \sigma^{t1} = \left|\beta_j\right| / \left|R_j\right| \tag{12}$$

From equation (12) we can see that the degree of trade specialisation rises when $\beta^2 > R^2$, and it falls when $\beta^2 < R^2$. A high variance indicates a high or narrow degree of specialisation, while a low variance indicates that the country has a broad range of technological advantage or a low degree of specialisation. Using the estimated regression values, the extent of specialisation rises where $\left|\hat{\beta}_j\right| > \left|\hat{R}_j\right|$, and it falls where $\left|\hat{\beta}_j\right| < \left|\hat{R}_j\right|$. This result can be reparametrised as follows. If $\left|\hat{\beta}_j / \hat{R}_j\right| > 1$, then specialisation increases, while if $\left|\hat{\beta}_j / \hat{R}_j\right| < 1$, specialisation decreases.

The estimated coefficient ($\hat{R}$) is a measure of the mobility of industries up and down the RSCA distribution. A high value of $\hat{R}$ indicates that the relative position of industries is little changed, while a low value indicates that some industries are moving closer together and others further apart, quite possibly to the extent that the ranking of industries changes. The magnitude of (1-$\hat{R}$) thus measures what is described by Cantwell (1989) as the 'mobility effect'. The 'mobility effect' would capture the tendency of the rankings of the firm export specialisation altering over time. The Galtonian effect, on the other hand, would capture any tendency of reversion towards the mean for the distribution as a whole. It may well be that even where the regression effect suggests a fall in the degree of specialisation due to a proportional move in industries towards the average ($\beta < 1$), that is outweighed by the mobility effect, due to changes in the proportional position between industries ($\beta > R$).

Dalum et al (1998) use regression analysis to test whether the stability of the Balassa indices change. As mentioned previously, Dalum et al (1998) employ the RSCA index (given in (4)) to estimate equation (7).

$$RSCA_{jA}^{t2} = \alpha_j + \beta_j RSCA_{jA}^{t1} + \varepsilon_{jA} \quad (7)$$

Following Cantwell (1989), Dalum et al (1998) contend that it can be shown that:

$$\left(\sigma^2\right)^{t2} / \left(\sigma^2\right)^{t1} = \beta_j^2 / R_j^2 \quad (11)$$

and hence

$$\sigma^{t2} / \sigma^{t1} = \left|\beta_j\right| / \left|R_j\right| \quad (12)$$

where R_j is the coefficient of variation from the regression and σ^2 is the variance of the dependent variable. From the preceding, it follows that the pattern of a given distribution remains unchanged when $\beta = R$. If $\beta > R$ then the degree of specialisation has grown, while if $\beta < R$ then the degree of specialisation has decreased. Brasili et al (2000: 238) employ the widespread practice whereby standard deviations of sectoral RCAs in the initial and final year are compared.

4. Empirical results

4.1 Pre-test using the Hillman's condition

We begin by employing Marchese and de Simone's (1989) transform of Hillman's index (HI) which is given in equation (6). If *HI* is larger than unity, the *BI* index used in cross-country comparisons will be a good indicator of comparative advantage.

Marchese and de Simone (1989) contend that *HI* should be calculated in any empirical research attempting to identify long-term implications of trade liberalisation using *BI*. Accordingly we first estimate equation (6), the results of which are presented in Appendix 2. All estimates for India for the sectors chosen (SITC 3-digit level industries) show a value higher than one, thus fulfilling Hillman's condition.

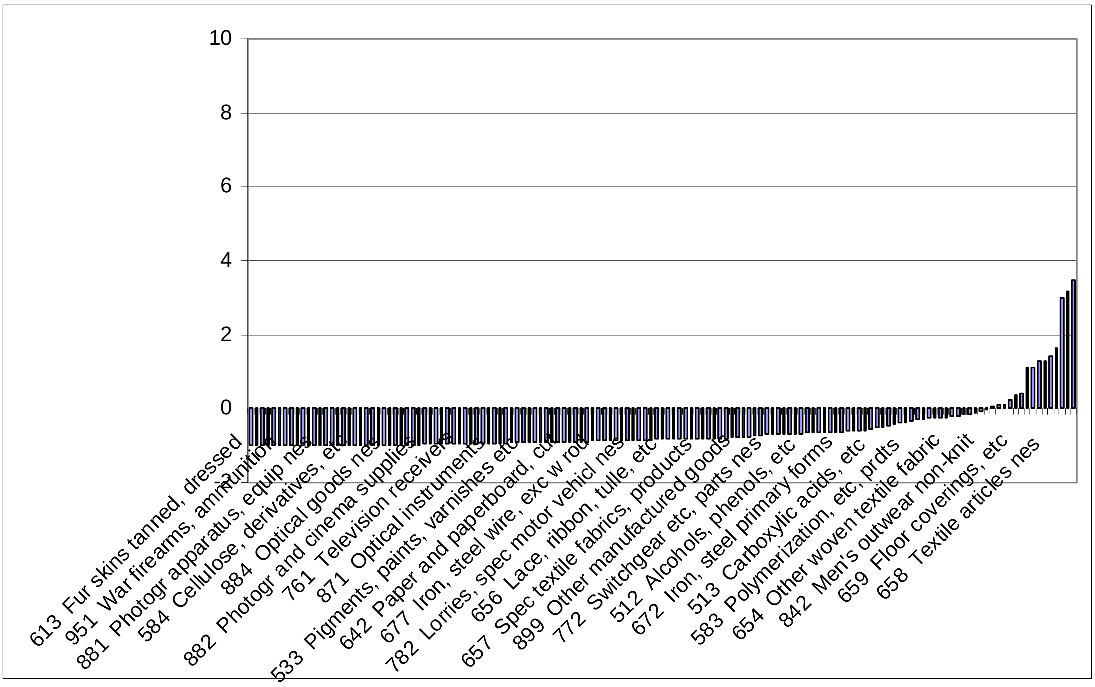
4.2 Initial graphical inspection

Following Proudman and Reading (2000), we first carry out a visual examination of a transform of the Balassa Index, which has been defined earlier in equation (4). Unlike Proudman and Reading (2000), owing to limited data being available and the possibility of loss of several degrees of freedom, we do not employ five moving averages, but we use BPR index values for three points at decennial intervals for an initial qualitative assessment, the years being 1980, 1990 and 2000. Since India's liberalisation process was initiated in 1991, a comparison of the latter decade (1990 to 2000) would hopefully be 'long' enough to reveal (at least the initial) impact of liberalisation on the structure of India's export industries, as against the pre-reform decade (1980 to 1990) which would serve as a comparator and as a period where the Indian economy was largely characterised by autarkic policies and import-substituting industrialisation. An assumption here, of course, is that the initial and long-term trends are in the same direction. All the figures based on BPR estimations are drawn to the same scale to facilitate visual comparison. Industries are first ordered in terms of increasing values of moving averages of the BPR index over a period of time and deviations of the BPR index from the value of 1 are graphed. Such figures reveal information concerning intra-distribution dynamics. If patterns of internationalisation in a given economy exhibited persistence, one would expect the distribution of the BPR index to remain similar across successive time periods. Industries with high values in one period of time (initial time period) would also have high RCA values in the end period. A complete absence of specialisation corresponds to an equal share of exports in all sectors which implies that we would observe a BPR index value of 1 in all sectors with zero standard deviation. If an economy were increasingly specialising in a subset of industries, one would observe BI (or its proxy such as the BPR index) systematically increasing in specific sectors and systematically decreasing in others.

The distribution of a revealed comparative advantage index would therefore exhibit an increasing mass at extreme values of RCA.

A cursory examination of Figures 2, 3 and 4 shows that for the case for India between 1980 and 2000, there isn't any obvious graphical evidence of persistence. Neither is there evidence suggesting an increasing mass at extreme values of RCA. Values for BPR in 2000 (Figure 2) show a smaller area for positive values of BPR as compared to BPR values in 1990 (BPR > 0) shown in Figure 3. The area for BPR 1990 (BPR > 0) is itself greater than (positive) BPR values in 1980 (Figure 4). Figure 4 shows greater concentration in 1980 (for positive values for the BPR index) as compared to both 1990 and 2000. For positive values of the BPR index, the implication is that compared to 1980, 1990 seems to show a reduction in comparative advantage at least in some sectors, and this process continues in 2000. The picture is much less clear for the case where BPR values are negative. It can generally be deduced that while the fraction of industries exhibiting negative BPR values is the same in 1980 and 1990, it shows a significant increase in 2000[6].

Figure 2: BPR 2000



[6] In 2000, there are a third fewer industries / SITC sectors showing a BPR value greater than 0.

Figure 3: BPR 1990

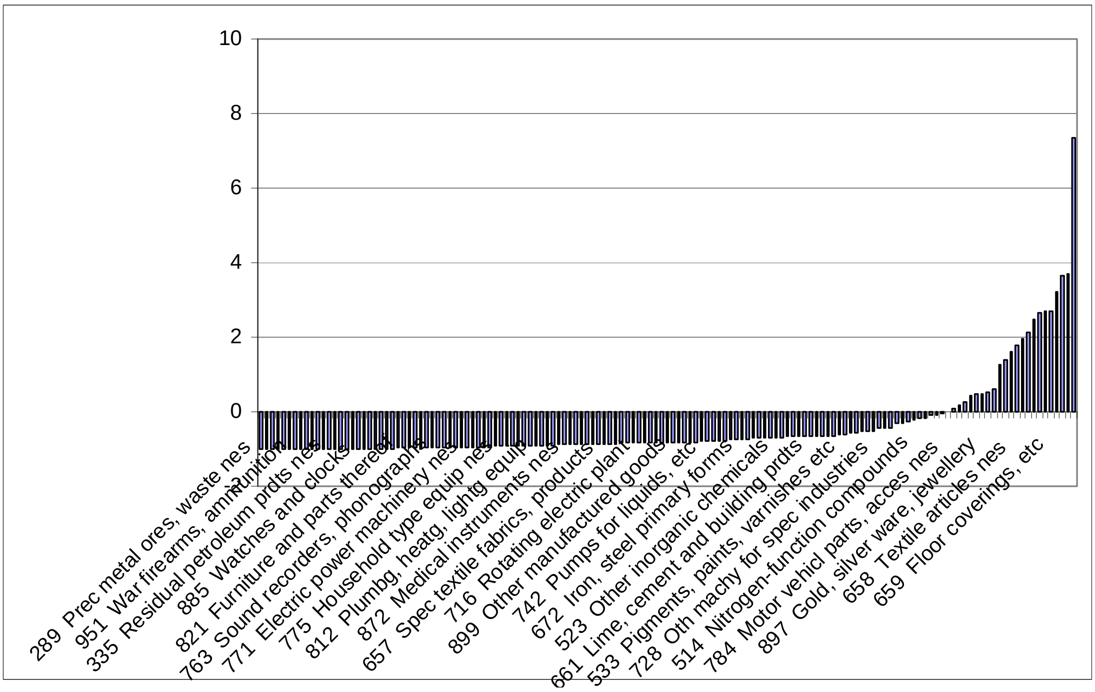
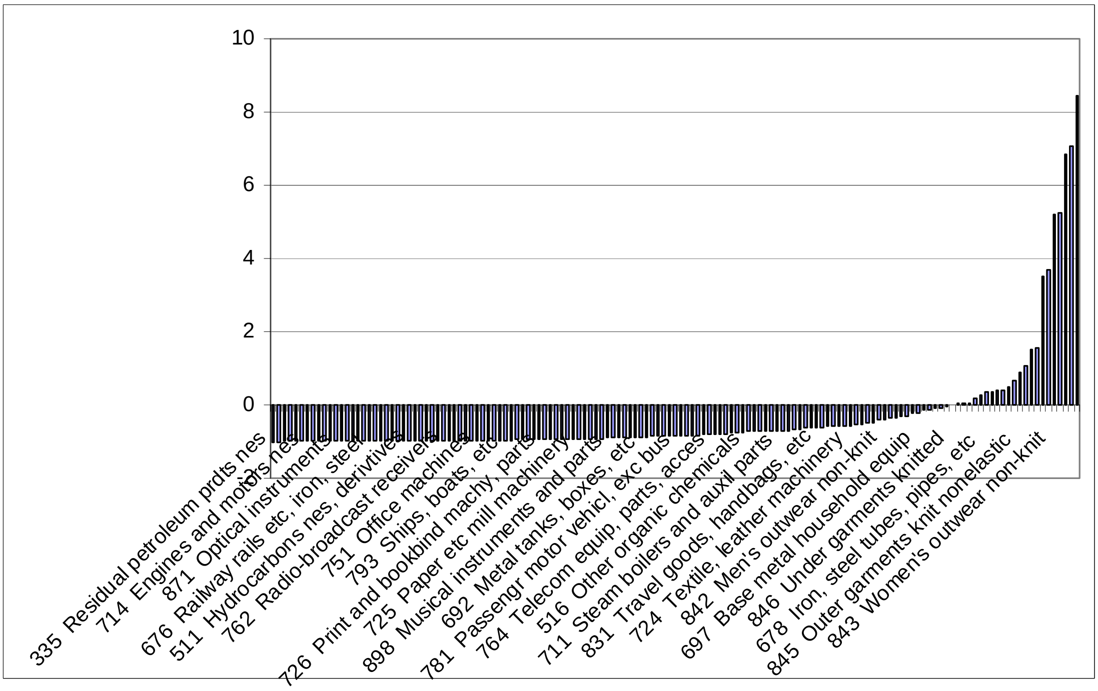


Figure 4: BPR 1980



4.3 Mean RSCA values and intertemporal changes

The first step in our analysis is to calculate the RSCA index (using equation (3)). Once we obtain estimates for the RSCA index it is useful to compare values for the RSCA index over time. We first look at the category ‘All Industries’ (or AI) which hereafter always refers to the chosen set of 143 SITC 3-digit manufacturing based export industries. Thereafter we examine three subsets which are ‘high technology’ export industries (HT), ‘medium technology’ export industries (MT) and ‘low technology’ export industries (LT).

Table 1: Mean RSCA values and number of industries (All Industries)			
	1980	1990	2000
Mean RSCA (RSCA > 0)	0.41014	0.37416	0.44686
Number of industries (RSCA >0)	37	43	44
Mean RSCA (RSCA < 0)	-0.64716	-0.65575	-0.52420
Number of industries (RSCA < 0)	106	100	99

The number of industries (AI) (with RSCA > 0) shows a rise from 1980 to 1990, and a rise as well from 1990 to 2000. The mean value (RSCA > 0) falls between 1980 and 1990, and rises between 1990 and 2000. This implies an improved aggregate industrial performance (improvement in comparative advantage on average) over 1990-2000, while there was a decline between 1980-1990 (for industries with RSCA > 0). As we would expect, the number of industries with RSCA < 0, falls between 1980 and 1990, and between 1990 and 2000. More significantly, the mean RSCA value is falling (in absolute terms) between 1980 and 1990, and between 1990 and 2000. This implies a reduction in comparative disadvantage or an increased comparative advantage over the period 1980-1990 and 1990-2000 (for industries with RSCA < 0).

Table 2: Mean RSCA values and number of industries (LT)			
	1980	1990	2000
Mean RSCA (RSCA > 0)	0.51727	0.51548	0.49446
Number of industries (RSCA >0)	20	21	26
Mean RSCA (RSCA < 0)	-0.47452	-0.51057	-0.42457
Number of industries (RSCA < 0)	21	20	15

The number of LT industries (RSCA>0) shows a rise throughout the period 1980 to 1990 and 1990 to 2000 (while the number of LT industries with RSCA < 0, show a fall for the corresponding periods). The mean value of RSCA shows a secular decline for industries with RSCA > 0, which implies a reduction in comparative advantage. For RSCA < 0, there is first a rise in (absolute) value (1980 to 1990) i.e. increased comparative advantage on average, and then a fall (1990 to 2000) implying a reduction in comparative advantage.

Table 3: Mean RSCA values and number of industries (MT)			
	1980	1990	2000
Mean RSCA (RSCA > 0)	0.26491	0.17418	0.30832
Number of industries (RSCA >0)	11	10	7
Mean RSCA (RSCA < 0)	-0.70699	-0.67123	-0.53086
Number of industries (RSCA < 0)	47	48	51

The number of MT industries (RSCA>0) shows a fall throughout the period 1980 to 1990 and 1990 to 2000 (while the number of LT industries with RSCA < 0, show a rise for the corresponding periods). The mean value of RSCA shows a decline (1980 to 1990) followed by a rise (1990 to 2000) for industries with RSCA > 0. But for RSCA < 0, there is a secular fall in (absolute) value through both periods, which implies a reduction in comparative advantage on average.

Table 4: Mean RSCA values and number of industries (HT)			
	1980	1990	2000
Mean RSCA (RSCA > 0)	NA	NA	NA
Number of industries (RSCA >0)	0	0	0
Mean RSCA (RSCA < 0)	-0.71679	-0.69687	-0.64594
Number of industries (RSCA < 0)	18	18	18

NA: Not applicable

In the HT sector, for all industries, there are no industries exhibiting RSCA > 0. For those industries with RSCA < 0, there is a secular fall in (absolute) value of the mean RSCA through both periods. This implies a reduction in comparative advantage on average for such industries.

4.4 Regression analysis

We begin our regression analysis by looking at the chosen manufacturing based export sectors as a whole. We employ the revealed symmetric comparative advantage (RSCA) index specified in section 3 and for reasons cited there. Following Hart and Prais (1956), Cantwell (1989), Dalum, Laursen and Villumsen (1998) and Hinloopen and van Marrewijk (2001), regression analysis on the RSCA indices is used to further analyse structural change. We use the specification set out in equation (7), viz.:

$$RSCA_{jA}^{t2} = \alpha_j + \beta_j RSCA_{jA}^{t1} + \varepsilon_{jA}$$

All regressions have been estimated using *Eviews 4.1* and *Eviews Beta 5*. As in the previous section, we first consider the category 'All Industries' and thereafter we examine HT export industries (HT), MT export industries (MT) and LT export industries. We perform two sets of regression for each category first for the period 1990 to 2000 and then for the period 1980 to 1990. Diagnostic test results are given in the appendix.

As mentioned previously, if $\beta = 1$, this suggests an unchanged pattern of *RSCA* between periods *t1* and *t2*. If $\beta > 1$, the country tends to be more specialised in product groups in which it already specialised, and it is less specialised in those industries where initial specialisation is low.[7] In other words, the initial specialisation of the country is strengthened. If $0 < \beta < 1$, then commodity groups with low (negative) initial RSCA indices grow over time, while groups with high (positive) initial RSCA indices decline. The special case where $\beta < 0$ indicates a change in the sign of the index. From equations (11) and (12) it follows that the pattern of a given distribution remains unchanged when $\beta = R$. If $\beta > R$ then the degree of specialisation has grown, while if $\beta < R$ then the degree of specialisation has decreased. Using the estimated regression values, the extent of specialisation rises where $|\hat{\beta}_j| > |\hat{R}_j|$, and it falls where $|\hat{\beta}_j| < |\hat{R}_j|$.

The regression results obtained for AI, LT, MT and HT are presented in full detail in Appendix 3. A summary of the results is presented in Table 5.

[7] A coefficient value above unity indicates that countries have become more specialised, with countries having an initial relative advantage increasing theirs and countries with an initial relative disadvantage seeing that disadvantage made worse.

Table 5: Summary of estimated β and R values (AI, LT, MT and HT)								
	AI		LT		MT		HT	
	β	R	β	R	β	R	β	R
1990_2000	0.81178	0.83329	0.76493	0.8629	0.56426	0.6029	0.68948	0.7155
1980_1990	0.76226	0.78716	0.82173	0.8139	0.51089	0.6024	0.68987	0.7528

The results in Table 5 allow us to test, first examine whether β is greater than, less than or equal to 1. The results are presented in Table 6.

Table 6: β compared to unity (AI, LT, MT and HT) (Galtonian reversion to the mean)								
	AI		LT		MT		HT	
	Result	Industry effect	Result	Industry effect	Result	Industry effect	Result	Industry effect
1990_2000	$\beta < 1$	D	$\beta < 1$	D	$\beta < 1$	D	$\beta < 1$	D
1980_1990	$\beta < 1$	D	$\beta < 1$	D	$\beta < 1$	D	$\beta < 1$	D

D: decline; I: improvement

As can be seen from Table 6, there is evidence which suggests a decline in the comparative advantage of export industries. In other words for all categories, over both decades, there is evidence suggesting a decrease in comparative advantage or an increase in comparative disadvantage.

Table 7: Comparison of β and R values (AI, LT, MT and HT) (Cantwell's 'mobility effect')								
	AI		LT		MT		HT	
	Result	Industry effect	Result	Industry effect	Result	Industry effect	Result	Industry effect
1990_2000	$\beta < R$	D	$\beta < R$	D	$\beta < R$	D	$\beta < R$	D
1980_1990	$\beta < R$	D	$\beta > R$	I	$\beta < R$	D	$\beta < R$	D

Table 7 is also derived from Table 5. In Table 7 we compare the value of β with R, using the decision rules elaborated earlier. In this instance, we find support for a similar conclusion in terms of a decline being exhibited in every case, except Low Technology industries for the period 1980-1990 which show an increase in comparative advantage, as opposed to all other cases which show a decline in comparative advantage.

4.5 Wald tests

We perform Wald tests to test restriction on the coefficients estimated through equation (7) as follows:

Test 1: Null hypothesis $H_1 1$: $\beta = 1$

Test 2: Null hypothesis $H_2 1$: $\beta = R$

In Tables 8, 9, 10 and 11, we test $H_1 1$ using a Wald Test for AI, LT, MT and HT, respectively.

Table 8 : Wald Test 1: $\beta = 1$ (All Industries)						
	F-statistic		Chi-square		Null hyp summary	
	Value	Probability	Value	Probability	Value	Std Error
1990_2000	17.2227	0.0001*	17.2227	0.0001*	-0.18821	0.04535
1980_1990	22.3432	0.0000*	22.3432	0.0000*	-0.23774	0.05030

* : For each table, significant at the 99% confidence interval.
**: For each table, significant at the 95% confidence interval.
***: For each table, significant at the 90% confidence interval.

Table 9 : Wald Test 1: $\beta = 1$ (LT)						
	F-statistic		Chi-square		Null hyp summary	
	Value	Probability	Value	Probability	Value	Std Error
1990_2000	10.7390	0.0022*	10.7390	0.0010*	-0.23506	0.07173
1980_1990	3.60397	0.0651**	3.60397	0.0576**	-0.17828	0.09391

Table 10 : Wald Test 1: $\beta = 1$ (MT)						
	F-statistic		Chi-square		Null hyp summary	
	Value	Probability	Value	Probability	Value	Std Error
1990_2000	19.07339	0.0001*	19.07339	0.0000*	-0.43574	0.09977
1980_1990	29.2279	0.0000*	29.2279	0.0000*	-0.48911	0.09047

Table 11 : Wald Test 1: $\beta = 1$ (HT)						
	F-statistic		Chi-square		Null hyp summary	
	Value	Probability	Value	Probability	Value	Std Error
1990_2000	3.4051	0.0836**	3.4051	0.0650**	-0.31052	0.16827
1980_1990	4.2304	0.0564**	4.2304	0.0397*	-0.31012	0.15078

An examination of Tables 8, 9, 10 and 11 shows us that the test results are significant at least at the 95% confidence interval. We can thus reject the null hypothesis that $\beta = 1$ for all cases considered at least at the 5% significance level. The conclusion is that we do not find evidence to support $H_1 1$, which implies that β is statistically different from 1.

In Tables 12, 13, 14 and 15, we test $H_2 1$ using a Wald test for AI, LT, MT and HT, respectively.

Table 12 : Wald Test 1: $\beta=R$ (All Industries)						
	F-statistic		Chi-square		Null hyp summary	
	Value	Probability	Value	Probability	Value	Std Error
1990_2000	0.22509	0.6359	0.22509	0.6352	-0.02152	0.04535
1980_1990	0.24515	0.6213	0.24515	0.6205	-0.024904	0.05030

* : For each table, significant at the 99% confidence interval.
**: For each table, significant at the 95% confidence interval.
***: For each table, significant at the 90% confidence interval.

Table 13 : Wald Test 1: $\beta=R$ (LT)						
	F-statistic		Chi-square		Null hyp summary	
	Value	Probability	Value	Probability	Value	Std Error
1990_2000	1.86515	0.1799	1.86515	0.1720	-0.09796	0.07173
1980_1990	0.006943	0.9340	0.006943	0.9336	-0.00783	0.09391

Table 14 : Wald Test 1: $\beta=R$ (MT)						
	F-statistic		Chi-square		Null hyp summary	
	Value	Probability	Value	Probability	Value	Std Error
1990_2000	0.15002	0.7000	0.15002	0.6985	-0.03864	0.09977
1980_1990	1.02199	0.3164	1.02199	0.3120	-0.0.9146	0.09047

Table 15 : Wald Test 1: $\beta=R$ (HT)						
	F-statistic		Chi-square		Null hyp summary	
	Value	Probability	Value	Probability	Value	Std Error
1990_2000	0.23909	0.8790	0.23909	0.8771	-0.02602	0.16827
1980_1990	0.17415	0.6820	0.17415	0.6764	-0.06292	0.15078

An examination of Tables 12, 13, 14 and 15 shows us that the test results are not statistically significant for all the cases and time periods under consideration. We can thus not reject the null hypothesis that $\beta = R$ for all cases considered. The conclusion is that we do not find evidence which would lead to a rejection of $H_2 1$, which tests whether β is statistically different from R.

These two results in conjunction imply that while evidence for India suggests that β is statistically different from 1, all our chosen subsets (for the time periods being considered) exhibit signs of industrial decline and a decline in comparative advantage. This is the component of the regression that is captured by a notion of a Galtonian mean reversion where, for the entire distribution of firms being considered over this time period, there is evidence of diminishing comparative advantage. However, the Wald Test results for the second null hypothesis ($\beta = R$) do not support a rejection of the null for all subsets and periods under consideration, which suggests that while there may be an overall decline in comparative advantage, such developments are not inconsistent with possible increases in comparative advantage in some industries or reductions in comparative advantage in some industries as a result of the 'mobility effect'.

5. Conclusions

We examine a subset of export data for India's exporting industries at the 3-digit SITC level for the period 1980-2000, in order to examine the initial effects of India's 1991 trade reforms on the structure of India's export industries. These industries are subdivided into three further subsets classed as low technology, medium technology and high technology, based on Pavitt (1984), OECD (1994) and Lall (2002).

We pre-test the appropriateness of using comparative advantage indices for our data set using the Hillman (1980) condition. Results from our pre-test confirm that the use of revealed comparative advantage indices (and their transforms) would be justified for the data set being examined. Proudman and Reading's (2000) graphical technique allows us to visualise the process of industrial change for India. Both the graphical analysis and an analysis of mean RSCA values demonstrate that India's export industries are undergoing a process of transformation and evidence suggests that during the post-1991 (post reform) period a significant (and perhaps) ongoing process of industrial transition has been happening, which has accompanied the decision by India to liberalise trade and to move from a closed, autarkic economy to an open 'marketised' economy.

We use the revealed comparative advantage index (which is a transform of the Balassa (1965) index) to carry out regressions on a cross-section of industries over two time periods (1980-1990 and 1990-2000). We then examine the significance of a Galtonian process of mean reversion and Cantwell's notion of a 'mobility effect', using Wald tests to examine structural change. We do not find evidence to support $H_1 1$, which implies that β is statistically different from 1. Our results point towards diminishing comparative advantage in India's export industries. In other words for all categories, over both decades, there is evidence suggesting a decrease in comparative advantage or an increase in comparative disadvantage. In terms of the mobility effect and $H_2 1$, we find support for a similar conclusion in terms of a decline being exhibited in every case, except Low Technology industries for the period 1980-1990 which show an increase in comparative advantage, as opposed to all other cases which show a decline in comparative advantage. These two results in conjunction imply that while evidence for India suggests that β is statistically different from 1, all our chosen subsets (for the time periods being considered) exhibit signs of industrial decline and a decline in comparative advantage. For the entire distribution of firms being considered over this time period, there is evidence of diminishing comparative advantage. However, the Wald Test results for the second null hypothesis ($\beta = R$) do not support a rejection of the null for all subsets and periods under consideration, which suggests that while there may be an overall decline in comparative advantage, such developments are not inconsistent with possible increases in comparative advantage in some industries or reductions in comparative advantage in some industries as a result of the 'mobility effect'.

These results are derived from a small sample and only nine years of the post-reform period have been studied. It may well be the case that these are transitional, short-term effects which may well change over time. It seems plausible to expect *ceteris paribus*, that trends towards diminishing comparative advantage would eventually coincide with some declining firms exiting from the export sector, so that comparative advantage indicators would eventually show a rise. As more time elapses and more observations become available, it would become possible to assess this process more completely, especially if steady-state equilibria are exhibited in the technology based subsets that we have examined. Finally, India's long neglected service sector industries are showing signs of massive growth (especially in the information technology sector) and as more data becomes available, it would be possible to ascertain if an overall decline in comparative advantage in manufacturing is accompanied with an increase in the comparative advantage in the services sector.

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Appendix 1

Table : SITC Codes and Sector Description	
RB 2: OTHER (RESOURCE BASED)	**MT 2: PROCESS**
281 Iron ore and concentrates	266 Synthetic fibres for spinning
282 Iron and steel scrap	267 Other man-made fibres
286 Uranium, thorium ores, conc	512 Alcohols, phenols, etc
287 Base metals ores, conc nes	513 Carboxylic acids, etc
288 Non-ferrous metal scrap nes	533 Pigments, paints, varnishes etc
289 Prec metal ores, waste nes	553 Perfumery, cosmetics, etc
323 Briquettes, coke and semi-coke	554 Soap, cleansing, etc preps
334 Petroleum products, refined	562 Fertilizers, manufactured
335 Residual petroleum prdts nes	572 Explosives, pyrotechnic prdts
411 Animal oils and fats	582 Prdts of condensation, etc
511 Hydrocarbons nes, derivtives	583 Polymerization, etc, prdts
514 Nitrogen-function compounds	584 Cellulose, derivatives, etc
515 Organo-inorgan compounds, etc	585 Plastic materials nes
516 Other organic chemicals	591 Pesticides, disinfectants
522 Inorg chem elmnt, oxides, etc	598 Miscel chemical prdts nes
523 Other inorganic chemicals	653 Woven man-made fib fabric
531 Synth dye, natrl indigo, lakes	671 Pig iron, etc
532 Dyes nes, tanning products	672 Iron, steel primary forms
551 Essential oils, perfume, etc	678 Iron, steel tubes, pipes, etc
592 Starch, inulin, gluten, etc	786 Trailers, non-motor vehicl nes
661 Lime, cement and building prdts	791 Railway vehicles
662 Clay, refractory building prdts	882 Photogr and cinema supplies
663 Mineral manufactures nes	**MT 3: ENGINEERING**
664 Glass	711 Steam boilers and auxil parts
667 Pearl, prec, semi-prec stones	713 Intern combust piston engines
688 Uranium, thorium, alloys	714 Engines and motors nes
689 Non-fer base metals nes	721 Agricult machinry exc tractor
LT1: TEXTILE, GARMENT AND FOOTWEAR	722 Tractors non-road
611 Leather	723 Civil engineering equip, etc
612 Leather, etc, manufactures	724 Textile, leather machinery
613 Fur skins tanned, dressed	725 Paper etc mill machinery
651 Textile yarn	726 Print and bookbind machy, parts
652 Cotton fabrics, woven	727 Food machinery, non-demestic
654 Other woven textile fabric	728 Oth machy for spec industries
655 Knitted, etc, fabric	736 Metal working machy, tools
656 Lace, ribbon, tulle, etc	737 Metal working machinery nes
657 Spec textile fabrics, products	741 Heating, cooling equipment
658 Textile articles nes	742 Pumps for liquids, etc
659 Floor coverings, etc	743 Pumps nes, centrifuges, etc
831 Travel goods, handbags, etc	744 Mechanical handling equipment
842 Men's outwear non-knit	745 Non-electr machy, tools nes
843 Women's outwear non-knit	749 Non-electr machy parts, acces
844 Under garments non-knit	762 Radio-broadcast receivers
845 Outer garments knit nonelastic	763 Sound recorders, phonographs
846 Under garments knitted	772 Switchgear etc, parts nes
847 Textile clothing accessoris nes	773 Electricity distributing equip
848 Headgear, non-textile clothing	775 Household type equip nes
851 Footwear	793 Ships, boats, etc

LT2: OTHER PRODUCTS	812 Plumbg, heatg, lightg equip
642 Paper and paperboard, cut	872 Medical instruments nes
665 Glassware	873 Meters and counters nes
666 Pottery	884 Optical goods nes
673 Iron, steel shapes, etc	885 Watches and clocks
674 Iron, steel univ, plate, sheet	951 War firearms, ammunition
675 Iron, steel hoop, strip	**HIGH TECHNOLOGY MANUFACTURES**
676 Railway rails etc, iron, steel	**HT 1: ELECTRONIC AND ELECTRICAL**
677 Iron, steel wire, exc w rod	716 Rotating electric plant
679 Iron, steel castings unworked	718 Oth power generating machinery
691 Structures and parts nes	751 Office machines
692 Metal tanks, boxes, etc	752 Automatic data processing equip
693 Wire products, non-electric	759 Office, adp machy parts, acces
694 Stell, copper nails, nuts, etc	761 Television receivers
695 Tools	764 Telecom equip, parts, acces
696 Cutlery	771 Electric power machinery nes
697 Base metal household equip	774 Electro-medical, xray equip
699 Base metal manufactures nes	776 Transistors, valves, etc
821 Furniture and parts thereof	778 Electrical machinery nes
893 Articles of plastic nes	**HT 2: OTHER**
894 Toys, sporting goods, etc	524 Radioactive etc materials
895 Office supplies nes	541 Medicinal, pharmaceutical prdts
897 Gold, silver ware, jewellery	712 Steam engines, turbines
898 Musical instruments and parts	792 Aircraft, etc
899 Other manufactured goods	871 Optical instruments
MEDUIM TECHNOLOGY MANUFACTURES	874 Measuring, controlg instruments
MT 1: AUTOMOTIVE	881 Photogr apparatus, equip nes
781 Passengr motor vehicl, exc bus	
782 Lorries, spec motor vehicl nes	
783 Road motor vehicles nes	
784 Motor vehicl parts, acces nes	
785 Cycles, etc, motorized or not	

Annex Table 1: Technological classification of exports (SITC 3-digit, revision 2)
Note: Excludes 'special transactions' like electric current, cinema film, printed matter, special transactions, gold, works of art, coins, pets.
HT: high technology, MT: medium technology; LT: low technology
Source: Based on Lall (2002), Pavitt (1984) and OECD (1994).

Appendix 2: Hillman Index Values for India

HILLMAN INDEX VALUES FOR INDIA
If HI>1, it means BI will be a good indicator for comparative adv, esp in cross section studies.
All values for India are greater than one (ignoring zeroes in denominators)

	1980	**1990**	**2000**
All products			
RB 2: OTHER (RESOURCE BASED)			
281 Iron ore and concentrates	17.32566	28.83031	120.5972
282 Iron and steel scrap	19684.46	6769.773	57776.58
287 Base metals ores, conc nes	144.2706	101.6681	307.823
288 Non-ferrous metal scrap nes	66724.33	2512.169	47683.28
289 Prec metal ores, waste nes	13582.53	na	137307.6
323 Briquettes, coke and semi-coke	82854.78	105612.2	64924.66
334 Petroleum products, refined	264.4122	34.51237	23.65669
335 Residual petroleum prdts nes	na	29577.52	1893.066
411 Animal oils and fats	27413.71	66737.49	19143.82
511 Hydrocarbons nes, derivtives	13320.88	566.4718	285.1475
514 Nitrogen-function compounds	2618.579	185.3788	187.3399
515 Organo-inorgan compounds, etc	72499.18	761.3856	262.1609
516 Other organic chemicals	645.3961	397.3877	82.80189
522 Inorg chem elmnt, oxides, etc	1491.208	864.3477	471.6009
523 Other inorganic chemicals	429.9345	462.3301	477.7391
531 Synth dye, natrl indigo, lakes	162.7753	98.0689	91.65089
532 Dyes nes, tanning products	7803.352	4194.798	4165.847
551 Essential oils, perfume, etc	784.4879	419.5834	593.0618
592 Starch, inulin, gluten, etc	6964.377	14201.61	879.2049
661 Lime, cement and building prdts	860.3931	424.1728	109.1153
662 Clay, refractory building prdts	1898.12	2600.212	1070.665
663 Mineral manufactures nes	472.5957	1161.743	1156.569
664 Glass	650.4284	3928.818	665.6955
677 Iron, steel wire, exc w rod	1055.617	726.6086	747.3399
678 Iron, steel tubes, pipes, etc	127.0712	442.4402	290.7217
679 Iron, steel castings unworked	1944.281	425.6849	256.6275
LT1: TEXTILE, GARMENT AND FOOTWEAR			
611 Leather	19.88869	38.2694	114.4447
612 Leather, etc, manufactures	114.7367	42.0083	101.52
613 Fur skins tanned, dressed	5738.344	na	na
651 Textile yarn	133.9149	49.06156	21.33064
652 Cotton fabrics, woven	20.40574	30.24783	39.06579
654 Other woven textile fabric	34.81625	89.81839	117.9254
655 Knitted, etc, fabric	24010.05	247.707	1338.094
656 Lace, ribbon, tulle, etc	625.9702	1235.804	556.8998
657 Spec textile fabrics, products	903.506	1063.501	493.9065
658 Textile articles nes	25.68813	50.60231	36.51037
659 Floor coverings, etc	36.97056	37.43506	65.04386
831 Travel goods, handbags, etc	440.8021	130.7429	126.5434
842 Men's outwear non-knit	278.9533	210.2167	101.6863
843 Women's outwear non-knit	26.92658	16.85372	20.32598
844 Under garments non-knit	65.22881	39.77864	41.3915
845 Outer garments knit nonelastic	91.40416	60.5324	66.43033
846 Under garments knitted	172.5476	63.32039	40.45752
847 Textile clothing accessoris nes	191.7147	160.4034	146.5244
848 Headgear, non-textile clothing	429.2771	54.03594	82.51437

851 Footwear	166.5654	95.63264	112.95
LT2: OTHER PRODUCTS			
642 Paper and paperboard, cut	1991.755	4694.131	886.912
665 Glassware	718.5129	1179.871	801.5861
666 Pottery	12099.67	11792.94	6586.812
673 Iron, steel shapes, etc	1075.599	296.5521	257.3934
674 Iron, steel univ, plate, sheet	2372.973	426.4557	75.5446
676 Railway rails etc, iron, steel	19780.51	35121.62	29713.75
691 Structures and parts nes	196.9824	1173.544	534.6403
692 Metal tanks, boxes, etc	1378.48	925.5459	2414.147
693 Wire products, non-electric	632.9382	1081.924	822.9731
694 Stell, copper nails, nuts, etc	373.0314	933.8852	515.5337
695 Tools	121.1263	251.2285	243.4321
696 Cutlery	3602.83	1121.366	1102.037
697 Base metal household equip	215.5004	476.6873	116.3739
699 Base metal manufactures nes	165.8589	121.908	135.4069
821 Furniture and parts thereof	1285.561	6593.45	952.6045
893 Articles of plastic nes	596.161	360.0022	208.85
894 Toys, sporting goods, etc	276.3958	529.2748	719.3668
895 Office supplies nes	2897.646	3206.278	577.3638
897 Gold, silver ware, jewellery	455.182	98.84971	42.58014
898 Musical instruments and parts	1868.744	688.1223	124.3388
899 Other manufactured goods	1059.601	787.5458	438.7065
MT 1: AUTOMOTIVE			
781 Passengr motor vehicl, exc bus	1074.415	793.0201	440.5998
782 Lorries, spec motor vehicl nes	650.1785	1646.981	653.0456
783 Road motor vehicles nes	290.7646	483.4983	675.4495
784 Motor vehicl parts, acces nes	104.3564	148.8757	125.5812
785 Cycles, etc, motorized or not	81.91451	154.3968	148.306
MT 2: PROCESS			
266 Synthetic fibres for spinning	1508009	591.3788	1373.753
267 Other man-made fibres	289996.3	6748.74	6738.809
512 Alcohols, phenols, etc	26547.76	747.3762	278.0984
513 Carboxylic acids, etc	4173.394	1541.164	199.1935
533 Pigments, paints, varnishes etc	399.3474	355.0802	1074.182
553 Perfumery, cosmetics, etc	216.5904	158.2351	322.8419
554 Soap, cleansing, etc preps	177.574	207.881	1662.055
562 Fertilizers, manufactured	3159.322	166254.4	5249.301
572 Explosives, pyrotechnic prdts	10004.4	7410.757	4902.705
582 Prdts of condensation, etc	9604.102	2003.312	275.4806
583 Polymerization, etc, prdts	6786.322	995.9903	142.1836
584 Cellulose, derivatives, etc	16038.47	13834.83	6023.412
585 Plastic materials nes	7681.442	64077.18	29044.27
591 Pesticides, disinfectants	5621.015	309.1509	164.4585
598 Miscel chemical prdts nes	1471.064	1047.35	271.3981
653 Woven man-made fib fabric	190.4467	114.4266	88.53654
671 Pig iron, etc	4470.597	420.9288	320.8607
672 Iron, steel primary forms	2818.779	566.6549	251.1664
678 Iron, steel tubes, pipes, etc	127.0712	442.4402	290.7217
786 Trailers, non-motor vehicl nes	10693.2	473.6634	6962.604
791 Railway vehicles	244.0965	2640.748	5405.136
882 Photogr and cinema supplies	10327.65	7555.605	2727.432
MT 3: ENGINEERING			
711 Steam boilers and auxil parts	602.1237	1535.924	3826.738
713 Intern combust piston engines	116.9563	192.8965	227.7944
714 Engines and motors nes	142264.2	60252.91	5283.68
721 Agricult machinry exc tractor	1610.513	1388.871	2209.41

722	Tractors non-road	39893.39	6765.692	1952.338
723	Civil engineering equip, etc	1826.073	3463.396	4105.08
724	Textile, leather machinery	391.7565	178.8486	405.855
725	Paper etc mill machinery	2436.522	5269.139	3838.303
726	Print and bookbind machy, parts	3099.529	817.3936	1564.795
727	Food machinery, non-demestic	536.2959	882.3248	1849.648
728	Oth machy for spec industries	437.8395	258.3728	312.0975
736	Metal working machy, tools	253.7639	339.6651	544.4908
737	Metal working machinery nes	2821.893	3279.955	1374.507
741	Heating, cooling equipment	528.6554	924.1484	873.2137
742	Pumps for liquids, etc	346.3727	692.2237	583.5402
743	Pumps nes, centrifuges, etc	1166.143	633.3837	603.0568
744	Mechanical handling equipment	1140.063	810.1647	1303.291
745	Non-electr machy, tools nes	1193.47	1449.492	1122.834
749	Non-electr machy parts, acces	623.4105	755.6006	235.3586
762	Radio-broadcast receivers	9791.036	8900.551	231421.2
763	Sound recorders, phonographs	14333.39	3671.499	6074.485
772	Switchgear etc, parts nes	356.9693	614.3882	320.6318
773	Electricity distributing equip	392.695	346.0415	370.4042
775	Household type equip nes	343.51	2084.072	1055.559
793	Ships, boats, etc	4075.207	503.7701	857.5068
812	Plumbg, heatg, lightg equip	1455.857	1542.12	1647.482
872	Medical instruments nes	3415.517	1195.011	918.488
873	Meters and counters nes	579993.4	855015.7	5374.407
884	Optical goods nes	640.3541	6436.447	4370.414
885	Watches and clocks	5685.292	7636.17	894.4815
951	War firearms, ammunition	54243.13	114363.8	41399.75
HT 1: ELECTRONIC AND ELECTRICAL				
716	Rotating electric plant	816.7473	900.6228	466.1541
718	Oth power generating machinery	54634.4	21169.55	7581.681
751	Office machines	6372.536	1891.645	3321.817
752	Automatic data processing equip	24480.12	305.8985	612.3124
759	Office, adp machy parts, acces	15262.45	422.6097	245.1735
761	Television receivers	175348.8	1842.419	1783.064
764	Telecom equip, parts, acces	818.225	1258.232	526.2534
771	Electric power machinery nes	1021.719	3080.806	456.574
774	Electro-medical, xray equip	12606.1	3508.723	490.45
776	Transistors, valves, etc	1988.944	462.8274	528.4504
778	Electrical machinery nes	189.1452	180.6633	179.0711
HT 2: OTHER				
524	Radioactive etc materials	na	181366	10109.76
541	Medicinal, pharmaceutical prdts	68.4637	39.16618	35.8948
712	Steam engines, turbines	3700.763	126442.6	26457.07
792	Aircraft, etc	3423.892	3154.807	741.5758
871	Optical instruments	50260.59	2198.172	1348.052
874	Measuring, controlg instruments	610.8269	749.035	688.5785
881	Photogr apparatus, equip nes	2562.933	2465.316	9093.524

Appendix 3: Detailed Regression Results

Table A: Regression results for All Industries (AI) (1990 to 2000)

Dependent Variable: RSCA00
Method: Least Squares

Sample: 1 143
Included observations: 143
RSCA00=C(1)+C(2)*RSCA90 (R = 0.833297)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.055512	0.029239	1.898557	0.0597
C(2)	0.811779	0.045354	17.89871	0.0000
R-squared	0.694384	Mean dependent var		-0.225412
Adjusted R-squared	0.692217	S.D. dependent var		0.531747
S.E. of regression	0.295004	Akaike info criterion		0.410231
Sum squared resid	12.27085	Schwarz criterion		0.451669
Log likelihood	-27.33149	Durbin-Watson stat		1.480286

Table B: Regression for All Industries (AI) (1980 to 1990)

Dependent Variable: RSCA90
Method: Least Squares

Sample: 1 143
Included observations: 143
RSCA90=C(1)+C(2)*RSCA80 (R = 0.787159)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.061287	0.033930	-1.806282	0.0730
C(2)	0.762256	0.050296	15.15527	0.0000
R-squared	0.619620	Mean dependent var		-0.346060
Adjusted R-squared	0.616923	S.D. dependent var		0.545843
S.E. of regression	0.337840	Akaike info criterion		0.681397
Sum squared resid	16.09313	Schwarz criterion		0.722835
Log likelihood	-46.71987	Durbin-Watson stat		1.972428

Table C: Regression results for HT (1990 to 2000)

Dependent Variable: HT00
Method: Least Squares

Sample: 1 18
Included observations: 18
HT00=C(1)+C(2)*HT90 (R = 0.7155)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.165462	0.128728	-1.285360	0.2170
C(2)	0.689480	0.168277	4.097296	0.0008
R-squared	0.512014	Mean dependent var		-0.645937
Adjusted R-squared	0.481515	S.D. dependent var		0.312859
S.E. of regression	0.225277	Akaike info criterion		-0.038532
Sum squared resid	0.811996	Schwarz criterion		0.060398
Log likelihood	2.346791	Durbin-Watson stat		1.503593

Table D: Regression results for HT (1980 to 1990)

Dependent Variable: HT90
Method: Least Squares

Sample: 1 18
Included observations: 18
HT90=C(1)+C(2)*HT80 (R = 0.7528)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.202368	0.119902	-1.687768	0.1108
C(2)	0.689876	0.150780	4.575394	0.0003

R-squared	0.566797	Mean dependent var	-0.696866
Adjusted R-squared	0.539722	S.D. dependent var	0.324689
S.E. of regression	0.220282	Akaike info criterion	-0.083381
Sum squared resid	0.776384	Schwarz criterion	0.015549
Log likelihood	2.750430	Durbin-Watson stat	2.423159

Table E: Regression results for MT (1990 to 2000)

Dependent Variable: MT00
Method: Least Squares

Sample: 1 58
Included observations: 58
MT00=C(1)+C(2)*MT90 (R = 0.6029)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.133077	0.065458	-2.033019	0.0468
C(2)	0.564256	0.099774	5.655336	0.0000

R-squared	0.363512	Mean dependent var	-0.429578
Adjusted R-squared	0.352146	S.D. dependent var	0.370827
S.E. of regression	0.298476	Akaike info criterion	0.453623
Sum squared resid	4.988939	Schwarz criterion	0.524673
Log likelihood	-11.15506	Durbin-Watson stat	1.383533

TableF: Regression results for HT (1980 to 1990)

Dependent Variable: MT90
Method: Least Squares

Sample: 1 58
Included observations: 58
MT90=C(1)+C(2)*MT80 (R = 0.60235)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.258449	0.063178	-4.090782	0.0001
C(2)	0.510890	0.090471	5.647026	0.0000

R-squared	0.362832	Mean dependent var	-0.525472
Adjusted R-squared	0.351454	S.D. dependent var	0.396237
S.E. of regression	0.319099	Akaike info criterion	0.587244
Sum squared resid	5.702154	Schwarz criterion	0.658293
Log likelihood	-15.03006	Durbin-Watson stat	1.902165

Table G: Regression results for LT (1990 to 2000)

Dependent Variable: LT00
Method: Least Squares

Sample: 1 41
Included observations: 41
LT00=C(1)+C(2)*LT90 (R = 0.8629)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.146779	0.042357	3.465300	0.0013
C(2)	0.764938	0.071730	10.66410	0.0000
R-squared	0.744636	Mean dependent var		0.158229
Adjusted R-squared	0.738088	S.D. dependent var		0.529783
S.E. of regression	0.271129	Akaike info criterion		0.275105
Sum squared resid	2.866924	Schwarz criterion		0.358694
Log likelihood	-3.639662	Durbin-Watson stat		2.357288

Table H: Regression results for LT (1980 to 1990)

Dependent Variable: LT90
Method: Least Squares

Sample: 1 41
Included observations: 41
LT90=C(1)+C(2)*LT80 (R = 0.8139)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.007343	0.054918	0.133712	0.8943
C(2)	0.821725	0.093907	8.750371	0.0000
R-squared	0.662539	Mean dependent var		0.014968
Adjusted R-squared	0.653886	S.D. dependent var		0.597646
S.E. of regression	0.351604	Akaike info criterion		0.794925
Sum squared resid	4.821377	Schwarz criterion		0.878514
Log likelihood	-14.29597	Durbin-Watson stat		2.135618

Table I : AI_DUM

Dependent Variable: RSCA90
Method: Least Squares
(R=0.8225; Jarque-Bera statistic:7.586 Prob: 0.023)
Sample: 1 143
Included observations: 143

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.065892	0.031526	-2.090047	0.0384
RSCA80	0.791539	0.047092	16.80832	0.0000
DUM33	1.184679	0.316047	3.748431	0.0003
DUM73	1.038245	0.316295	3.282520	0.0013
R-squared	0.676540	Mean dependent var		-0.346060
Adjusted R-squared	0.669559	S.D. dependent var		0.545843
S.E. of regression	0.313772	Akaike info criterion		0.547274
Sum squared resid	13.68495	Schwarz criterion		0.630150
Log likelihood	-35.13006	F-statistic		96.90962
Durbin-Watson stat	1.975450	Prob(F-statistic)		0.000000

Table J: LT_DUM

Dependent Variable: LT00
Method: Least Squares
(R=0.90766; Jarque-Bera statistic:2.0496 Prob: 0.358)
Sample: 1 41
Included observations: 41
LT00=C(1)+C(2)*LT90+C(3)*DUM7

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.169815	0.036071	4.707797	0.0000
C(2)	0.789061	0.060633	13.01363	0.0000
C(3)	-0.959265	0.232032	-4.134191	0.0002

R-squared	0.823860	Mean dependent var	0.158229
Adjusted R-squared	0.814589	S.D. dependent var	0.529783
S.E. of regression	0.228121	Akaike info criterion	-0.047524
Sum squared resid	1.977492	Schwarz criterion	0.077859
Log likelihood	3.974242	Durbin-Watson stat	2.250460

Table K: MT_DUM

Dependent Variable: MT90
Method: Least Squares
(R=0.84433; Jarque-Bera statistic:4.686 Prob: 0.096)
Sample: 1 58
Included observations: 58
MT90=C(1)+C(2)*MT80+C(3)*DUM6+C(4)*DUM19+C(5)*DUM22+C(6)
*DUM25

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.262842	0.044032	-5.969346	0.0000
C(2)	0.625906	0.064685	9.676226	0.0000
C(3)	1.069704	0.226702	4.718555	0.0000
C(4)	0.990327	0.225558	4.390569	0.0001
C(5)	0.843740	0.225424	3.742896	0.0005
C(6)	0.837647	0.225961	3.707051	0.0005

R-squared	0.712879	Mean dependent var	-0.525472
Adjusted R-squared	0.685271	S.D. dependent var	0.396237
S.E. of regression	0.222292	Akaike info criterion	-0.071955
Sum squared resid	2.569509	Schwarz criterion	0.141195
Log likelihood	8.086682	Durbin-Watson stat	2.016633

Table L: Normality test results summary[8]

	All Industries		LT		MT		HT	
	Jarque-Bera stat	Prob	Jarque-Bera stat	Prob	Jarque-Bera stat	Prob	Jarque-Bera stat	Prob
1990_2000	4.170	0.124	13.835	0.001	1.265	0.531	7.86	0.020
1980_1990	18.45	0.000	7.953	0.019	17.214	0.001	0.0193	0.99

8 All regression that exhibit normality failures have been reanalysed and normality failures have been corrected for by the introduction of dummy variables. In all such cases, the conclusions obtained preciously from the uncorrected regression remain unchanged. The value of the Jarque-Bera statistic in each case of normality failure is not 'very' high and it is well known that the Jarque-Bera statistics are very sensitive to outliers. Finally, for the sake of completeness and coherent analysis it was decided to retain all the relevant cases, because for all practical purposes the consequences of normality failures seem to be negligible. Cases: (AI 1980_1990), (LT 1990_2000) and (MT 1980_1990).