WORKING PAPER NO. 97

LIBERALISATION, INDUSTRY-SPECIFIC FACTORS AND INTRA-INDUSTRY TRADE IN INDIA

CHOORIKKAD VEERAMANI

MARCH, 2003

INDIAN COUNCIL FOR RESEARCH ON INTERNATIONAL ECONOMIC RELATIONS
Core-6A, 4th Floor, India Habitat Centre, Lodi Road, New Delhi-110 003

Contents

Foreword

External sector reforms in the nineties were designed to correct the structural distortions and biases that had crept into the economy during the previous two decades. Among these were the bias against exports and in favour of capital intensive industry. The reforms were therefore expected to lead to restructuring and improved efficiently. This study explores an important aspect of this restructuring, the rationalization of product lines by individual firms, specialization in product lines so as to exploit possible economies of scale, and the consequent growth of intra-industry trade (that is, the simultaneous occurrence of exports and imports within the same industry).

The study provides the descriptive statistics of the levels of India's intra-industry trade (IIT) across industry groups and reflect upon some operative forces that are attributable to the observed growth of IIT under liberalisation. The significant growth of IIT in large number industries suggests that the domestic industries are unlikely to go out of business because of trade liberalisation. However, considerable variation is observed in the level and growth of IIT across industries. This is not surprising, as certain industry characteristics are conducive to promote IIT while certain characteristics discourage IIT. The study, using a harmonised data set constructed specifically for the purpose, investigates the influence of various industry-specific factors on the intensity of India's multilateral IIT.

Dr. Arvind Virmani
Director & Chief Executive
ICRIER

March 2003

Liberalisation, Industry-Specific Factors[1] and Intra-Industry Trade in India

*Choorikkad Veeramani**

I. Introduction

It is held that the import substitution policy regime in India, which had been in vogue for nearly three decades since the early 1950s, extended indiscriminate protection to all industries. There had been no pressing need on the part of manufacturing firms to rationalise their product lines. The policy framework provided incentives for firms to diversify rather than to specialise: because of industrial licensing, firms making profits are not allowed to invest in expansion, and they invested instead on diversification. As Bhagwati and Desai (1970, p. 466) put it "…the twin principles of production and trade could be summed up, cynically but realistically: India should produce whatever it can, and India should export whatever it produces".

The economic liberalisation initiatives in India, began in the early 1980s and intensified since the early 1990s, however, are expected to bring about rationalisation in the choice of product lines by individual plants. Production and export of all varieties and components, comprising of an industry, become impossible if economies of scale in production are to be reaped. If the product lines in an industry are differentiated and each is manufactured with increasing returns to scale, then a country may specialise in manufacturing a subset of products for meeting home demand and export, while importing those that are not supplied domestically. Such specialisation patterns may occur at the level of final consumer goods as well as intermediate producer goods. A manifestation of this process is the growth of intra-industry trade (IIT) – that is, the simultaneous occurrence of exports and imports within the same industry.

* I am grateful to Professors D. Narayana, K.J. Joseph, Arvind Virmani, and K.L.Krishna for constructive comments. I also thank the participants at the seminar in ICRIER (December 2002) for helpful suggestions.

[1] The expressions 'industry-specific factors' and 'industry characteristics' will be used interchangeably in the paper.

Indeed, an earlier study highlights that the liberalised policy environment biases trade expansion towards IIT in India (Veeramani, 2002). This study, however, did not delineate the analytical underpinnings behind the observed link between liberalisation and IIT. True, in the context of free trade agreements, there are studies that deal with the question as to why liberalisation leads to the growth of IIT[2]. But, the explanations in those studies can not straightaway be applied in the Indian context as certain "critical missing links" exist in her trade and industrial sector liberalisation initiatives[3]. Can IIT grow despite these missing links? We will take up this question in Section II and provide the explanation in the affirmative. More importantly, let us note that, whatever may the nature and extent of liberalisation be, the level and growth of IIT can vary considerably across industries. The level may remain insignificant in certain industries if their characteristics inhibit IIT. On the other hand, certain industry characteristics are conducive to promote IIT. At least in the case of industries that show higher levels of IIT, the apprehension expressed by some researchers[4] that trade liberalisation would lead to the demise of India's national industries is untenable. Thus, it is crucial to examine how industries differ in their levels of IIT and how various industry-specific factors influence the level? These questions form the major concern of the present paper: after estimating the descriptive statistics of India's multilateral IIT across the manufacturing industries, we analyse the effects of industry-specific factors[5]. The focus on multilateral context (rather than the bilateral contexts) is primarily governed by the fact that India's IIT is characterised by a greater extent of complementarity: within the same industry there are imports from one group of countries and simultaneous exports to another (Veeramani, 2002). If this important aspect is to be captured, it is imperative that the analysis is in the multilateral context.

---

2 See for example, Drabek and Greenaway (1984) and Globerman and Dean (1990).

3 See Ahluwalia (2002) for a detailed discussion. The missing link considered here refers to the absence of significant reforms pertaining to the factor market, especially labor.

4 See for example, Nambiar et al (1999) and Chaudhuri (2002)

5 Veeramani (2002) analyses the influences of country-specific factors on the intensity of India's IIT with her trading partners. This study does not address the question of variation across industries.

A notable feature of the existing literature on the determinants of IIT is that most studies find strong support for country-specific hypotheses, drawn from the theoretical models of IIT, but fragile support for various industry-specific hypotheses (Aturupane et al, 1999). Perhaps, this result is the reflection of enormous difficulties in the analysis of industry-specific factors. For one thing, unlike country-specific hypotheses, most of the industry-specific hypotheses are at best implicit in various theoretical models of IIT rather than being formally derived[6]. The poor results may also be related to difficulties in constructing the industry-specific variable consistent with what is relevant to the theory.

These difficulties notwithstanding, we believe that the analysis in this paper is instructive: we find empirical support for a number of industry-specific hypotheses formulated to explain the industry-pattern of India's IIT. The importance of this paper may also be viewed from the fact that, in the context developing countries, very few studies have been undertaken on the effects of industry-specific factors. Perhaps, a major reason for this lacuna is the non-availability of apropos data to undertake the analysis. We use a unique data set that contains harmonised information pertaining to trade flows (exports and imports), industry characteristics, and firm characteristics. This data set, which draws upon different sources, has been constructed specifically for the present purpose.

The paper is structured as follows. In Section II, we reflect upon some operative forces that are attributable to the observed growth of India's IIT under liberalisation. In Section III, the descriptive statistics of the levels of IIT across industry groups are presented. Section IV deals with the question of a proper approach to be followed in the analysis of industry-specific factors, formulation of testable hypotheses, and selection of variables. Results of the regression analysis are discussed in Section V. Some concluding remarks are given in Section VI. A description of the data set used in the regression model is provided in the Appendix.

[6] For example, there are doubts about the appropriateness of regressing the IIT index on measures of economies of scale or product differentiation. See footnote 1 in Aturupane et al (1999) for references to the studies that express this doubt.

II. Why Does IIT Grow Under Liberalisation in India?

The potential for the occurrence of IIT had been severely limited under the import substitution policy regime in India. For, as already indicated, the policy regime provided indiscriminate protection to domestic producers and hence there was no compulsion on the part of firms to rationalise their product lines. Further, adherence to a tight import regime and to the criterion of 'indigenous non-availability' in granting import licenses meant that the policy framework virtually ruled out the possibility of recording competing imports within an industry.

The scenario, however, had undergone significant changes during the 1990s. The type of allocative efficiency gain resulting from liberalisation is intertwined with the emerging pattern of specialisation. Broadly speaking, three channels of allocative efficiency gains can be possible. First, there could be, what is often emphasised, the inter-industry resource shifts from inefficient to efficient industries. Second, resources may shift from inefficient to efficient firms within an industry. A third possibility is the intra-firm resource shifts from inefficient to efficient activities. In what follows, we briefly discuss the likelihood that these channels are operative in the Indian context, in light of the nature and extent of her liberalisation initiatives.

To begin with, the inter-industry resource re-allocation process is highly unlikely. For liberalisation initiatives that are meant to address the rigidities in the functioning of markets for factors of production - labour, capital and land - are slow to come by and some of the critical steps like labour market liberalisation are yet to be pursued[7]. The reforms undertaken, so far, are mostly those intended to do away with the rigidities in the functioning of the product markets. Persistence of rigidities in the factor markets would stand in the way of re-allocating resources across industries. Even in a situation where factor market rigidities do not exist, the pattern of inter-industry resource re-allocation may come about in myriad ways, resulting in considerable ambiguities, as exposed by

[7] See Joshi and Little (1996), Srinivasan (2000), and Ahluwalia (2002) for extensive discussion. Labor market remains highly restrictive in that "[a]ny firm wishing to close down a plant or to retrench labor in any unit employing more than 100 workers can only do so with the permission of the state government, and this permission is rarely granted" (Ahluwalia, 2002, pp. 76).

Rodrik (1992). In particular, the conventional wisdom that suggests inter-industry specialisation in accordance with comparative advantage as an outcome of liberalisation is suspect[8].

The second channel - the re-allocation of resources from inefficient to efficient firms within the industry – would also be slow to operate as the barriers to exit continue to be stringent in India (though entry rules have been made easier) mostly on account of the legislation preventing retrenchment.

What appears to be plausible is the intra-firm resource shifts from inefficient to efficient activities. Policy-induced incentives for firms to diversify production no longer exist. Instead, firms are likely to restructure their operation by specialising in fewer product lines so as to exploit possible economies of scale[9]. As pointed out by Globerman and Dean (1990), specialisation in the home market will be potentially reinforced by international demand for the differentiated products. Furthermore, in the face of increased foreign competition, highly concentrated industrial structures (like that of India) are especially bound to rationalisation. Indeed, based on their survey, Desai et al (1999) reported that, after the 1991 liberalisation, Indian firms in the machine tool industry have reduced their product range and that they have been vertically

[8] Verdoorn (1960) in the case of Benelux union, and Balassa (1966) in the case of EEC established that the decade following customs union formation was characterised by increasing intra-industry as opposed to inter-industry specialization [see Globerman and Dean (1990) for a number of references]. Thus, the pattern of specialization pursuant upon the initiation of trade liberalisation was not the one whereby different countries specialised in different products. Instead, different countries tended to specialise in different types of a given product and there was an expansion of exports from practically every industry rather than the demise of inefficient manufacturing industries. Also, recent studies suggest that following the demise of central planning, an increasing share of the trade between many Central and Eastern European countries and the European Union is intra-industry in nature (Hoekman and Djankov, 1997). The analysis of Fontagne and Freudenberg (2002) showed considerable growth of IIT in intra-EU trade between 1980 and 1999.

[9] While restructuring is imperative for firms that have been in existence since the pre-reform period, the new entrants would have had the advantage of specializing in their core business right from the beginning.

disintegrating, phasing out the production of components and sourcing more from outside[10].

In essence, the observed growth of IIT under liberalisation is a manifestation of the ongoing process of product rationalisation within the industry[11]. But, the extent of intra-industry restructuring and, therefore, the level of IIT can vary in different industries depending upon whether their characteristics are compatible with the conditions necessary for the occurrence of IIT or not. In what follows, we first provide descriptive statistics of the levels of IIT across industries and then set out to provide some explanations for the observed variation.

III. Descriptive Statistics of the Levels of IIT across Industry Groups

1. Measurement

The intensity of IIT is measured by the well-known Grubel Lloyd (1975) index:

$$GL_i = \frac{(Xi + Mi) - |Xi - Mi|}{(X_i + M_i)} \times 100, \qquad (1)$$

where *GLi* is the index of IIT in industry *i*, and *Xi* and *Mi* are respectively the values of exports and imports in industry *i*. The value of *GLi* ranges from 0 to 100. If there is no IIT (i.e., one of *Xi* or *Mi* is zero) *GLi* takes the value 0. If all trade is IIT (i.e., *Xi* = *Mi*), *GLi* takes the value of 100. Grubel and Lloyd (1975) also suggested the following formula, which is a weighted average[12].

---

[10] A similar trend is observed also in the context of other developing countries. In a review of economic policy reforms in developing countries, Krueger (1992, p.104) noted that "[i]n some instances, firms that held monopoly or quasi-monopoly positions in the domestic market and that were high-cost have been able to make sharp reductions in their cost structure once incentives have been changed. This can come about because of increased specialisation within individual plants in fewer lines of output, because of rationalisation or for other reasons". See also Globerman and Dean (1990) for references to the studies that provide evidences on intra-firm rationalization in the context of free trade agreements.

[11] Perhaps, also important is the growing domestic demand for variety, in the context of liberalization, driven by increasing real income and greater advertising and promotional efforts by firms.

[12] There are measures that make adjustment for trade imbalances as the unadjusted measure is downward biased. However, we do not use them following the conclusion of Vona (1991:690) that "...correction for trade balance raises more empirical problems than it solves...the uncorrected *GL* measure is the best available one and on the whole, possesses desirable properties."

$$GL = \frac{\Sigma\left[\left(X_i + Mi\right) - \left|X_i - Mi\right|\right]}{\Sigma\left(X_i + M_i\right)} \times 100. \qquad (2)$$

An index of marginal IIT, suggested by Brülhart (1994) is also used.

$$B = \frac{\Sigma\left[\left(\left|\Delta X_i\right| + \left|\Delta M_i\right|\right) - \left|\Delta X_i - \Delta M_i\right|\right]}{\Sigma\left(\left|\Delta X_i\right| + \left|\Delta M_i\right|\right)} \times 100. \qquad (3)$$

This index, like the *GL* measure, varies from 0 to 100. The closer the value of *B* to 100, the greater the share of IIT in the *change* in trade flows between the two years in question. Conversely if *B* is closer to 0, the higher the contribution of inter industry trade is in the *change* in trade. As the *B* index relates to the change in trade flows, it is a more "dynamic" measure. The analysis of marginal IIT is important because an increase in interindustry trade will show up as an increase in the *GL* index when the increase in interindustry trade reduces the trade imbalance in the sector for which the measure is carried out (Hamilton and Kniest 1991).

2. Estimates of IIT

The analysis pertains to the manufactured commodities and the products grouped under the 4-digit level of the Indian Trade classification (ITC) are considered an industry. The values of *GL* and *B* at the levels of various sections of commodities and the 2-digit level break up within each section for different years are shown in Table 1[13]. It is evident that the recorded levels of IIT in all sections of commodities (excepting Gems and Jewellery) are considerably higher for the year 2000 as compared to that for 1988. This trend is also reflected at the level of 2-digit industry groups. The majority of industry groups – that is, 28 out of the total 43 - registered an increase of *GL* index in 1995 as

[13] The sections of commodities (indicated in bold letters in Table 1) and the specific years shown in Table 1 are same as those considered by Veeramani (2002). The latter did not provide the 2-digit levels break up as the focus of that study was to examine the trends (at rather aggregate level) and the pattern across trading partners (not across industries). The source of foreign trade data is also the same in both the studies – that is, the official data from the Directorate General of Commercial Intelligence and Statistics (DGCI&S).

compared to the level in 1988. Similar figure in 2000 over 1995 is as high as 32. Significant declines in 2000 over the 1988 levels can be noticed only in two industry groups – that is, Pharmaceutical Products (ITC 30) and Explosives (ITC 36).

It is not just the level of IIT as measured by the `static' *GL* index that shows increase, but increasing share of the change in trade flows is of intra-industry in nature. As many as 35 industry groups showed higher *B* values in 2000 (over 1988) as compared to the levels in 1995 (over 1988). Further, in majority of the industry groups (i.e. 27 out of 43) the *B* values are higher for 2000 (over 1995) as compared to 1995 (over 1988) indicating that as liberalisation proceeds increasing shares of the change in trade flows become intra-industry in nature[14]. Thus, the observed increases of the *GL* values can not be dismissed as the effect of more balanced trade caused by greater inter-industry trade flows. Rather, the phenomenon is truly dynamic in nature, reinforcing the finding that trade liberalisation biases trade expansion towards IIT in India. There are simultaneous expansion of exports and imports from the majority of industry groups. Hence, the apprehension that trade liberalisation would lead to the demise of domestic industries, for the most part, is off the base[15].

There are, however, marked variations in the extent by which the level of IIT grew in different industry groups. The industry groups that recorded the highest increase of *GL* (in terms of the percentage point changes) include Musical Instruments (ITC 92), Soap etc (ITC 34), Aluminium and Articles (ITC 76) etc. These industry groups were among those with very low *GL* values in 1988, while they got positioned among the highest *GL* industry groups by 2000. This could be because that substantial trade liberalisation in these industries took place only in the 1990s. Thus, despite their being inherently IIT intensive, these industries showed low *GL* values in 1988 because protective regime did not necessitate product rationalisation. However, as the industry got exposed to greater

[14] Pharmaceutical Products (ITC 30) and Explosives (ITC 36), which showed a significant decline of *GL*, however, showed consistent improvements in their *B* values. Thus, what caused the decline of *GL* in these industries was the increase in their trade imbalance, while an increasing extent of the change in trade flows were actually intra-industry in nature.

[15] Also consider the finding of Veeramani (2002) that the increased level of IIT is largely export led – that is, caused by a faster growth of exports than of imports.

competitive pressure during the 1990s, product rationalisation became imperative, which gave rise to the higher levels of IIT.

On the other hand, the *GL* values in certain industries remain low, whatever may the extent of liberalisation be, because the inherent characteristics of such industries militate against IIT. Some of the cases in point are Fertilisers (ITC 31), Pulp of Wood etc (ITC 47), and Nickels & Articles (ITC 75)[16].

It appears that the characteristic that causes higher (lower) incidence of static IIT in an industry also causes higher (lower) extent of marginal IIT. For the industry groups that showed declines or only insignificant increases of *GL* during the period also showed the lowest extent of marginal IIT. On the other hand, higher *B* values are observed in industry groups where the *GL* recorded significant increases. Table 2 indicates that the rank correlation between the values of B_i (i.e., marginal IIT at the 4-digit level) and percentage point changes in GL_i's always yield positive and statistically significant coefficient values (see Set 1 in the table). Furthermore, the industry pattern of marginal IIT shows nearly perfect concordance with that of static levels of IIT (See Figure 1). Rank correlation coefficients between the levels of marginal IIT (B_i) and the levels of static IIT (GL_i) are always positive, very high and statistically significant (Table 2, Set 2). In what follows, we set forth to understand the cross-industry variation of GL_i by testing hypotheses that relate IIT to certain industry-specific factors[17].

[16] The case of Fertilizer is not just a matter of its industry characteristics. In addition, a plethora of controls and subsidies remain in this industry on the ground of self-sufficiency, which stand in the way of product rationalization. The details can be seen in the Background Paper on Long Term Policy for the Fertilizer Sector available at the website of the Department of Fertilizers, Government of India (http://fert.nic.in/ltpolicy.htm).

[17] One may wonder if B_i can be considered as the dependent variable in the empirical model, instead of GL_i. The choice of the dependent variable, however, is unlikely to make much difference as the industry pattern of marginal and static IIT is not substantially different from each other. Further, it is difficult to consider the B_i because a theoretical model that can generate marginal intra and inter industry trade does not exist [Brulhart (2002)].

Table 1: Levels of India's IIT (GL) and Marginal IIT (B) across Sections and 2-digit Industry groups

2-digit codes and descriptions	GL			B		
	1988	1995	2000	1995 (over 1988)	2000 (over 1988)	2000 (over 1995)
Chemicals	**24**	**28**	**35**	**28**	**34**	**28**
28: Inorganic Chemicals	9	11	14	10	13	9
29: Organic Chemicals	24	46	60	48	58	49
30: Pharmaceutical Products.	56	21	26	14	24	29
31: Fertilisers	1	1	0	1	0	0
32: Tanning or Dyeing Extracts	21	27	24	24	22	18
33: Essential Oils & Resinoids	43	28	55	23	55	44
34: Soap etc	5	37	50	41	50	20
35: Albuminoidal Substances	14	34	22	39	22	16
36: Explosives	73	11	21	3	13	34
37: Photographic Goods etc.	25	9	17	7	16	29
38: Misc.Chemical Products**.**	24	38	41	37	41	43
Plastics and Rubber	**14**	**33**	**40**	**31**	**41**	**48**
39: Plastics & Articles.	12	39	46	38	47	51
40: Rubber & Articles.	19	18	28	15	28	42
Paper	**8**	**22**	**27**	**24**	**29**	**24**
47: Pulp of Wood etc	0	0	0	0	0	0
48: Paper & Paperboard	4	25	36	27	40	31
49: Printed Books, Newspapers etc	37	55	36	61	36	26
Stone and Cement	**19**	**22**	**28**	**19**	**27**	**22**
68: Articles of Stone etc	23	11	11	8	11	6
69: Ceramic Products.	16	32	40	35	42	33
70: Glass & Glassware.	19	30	48	26	46	39
Gems and Jewellery	**87**	**48**	**62**	**37**	**60**	**58**
71: Natural or Cultured Pearls etc	87	48	62	37	60	58
Base Metals	**15**	**33**	**40**	**31**	**37**	**21**
72: Iron & Steel.	11	33	48	32	42	19
73: Articles of Iron or Steel	35	42	43	34	42	29
74: Copper & Articles	7	6	12	6	13	6
75: Nickel & Articles.	2	4	8	4	9	14
76: Aluminium & Articles	13	68	56	70	45	21
78: Lead & Articles.	3	17	3	26	2	2
79: Zinc & Articles.	1	24	1	39	1	0
80: Tin & Articles.	7	17	19	20	21	22
81: Other Base Metals	8	12	21	13	22	46
82: Tools, Implements etc	30	26	29	25	29	25
83: Misc. Articles of Base Metal.	17	26	35	21	33	36
Machinery	**29**	**38**	**41**	**39**	**42**	**34**
84: Nuclear Reactors, Boilers etc	29	38	38	39	38	28
85: Electrical Machinery	29	37	47	39	48	43
Transport Equipment	**30**	**21**	**38**	**18**	**39**	**24**
86: Railway or Tramway Locomotives	10	22	14	0	11	1
87: Other Vehicles	58	35	47	31	45	49
88: Aircraft, Spacecraft	5	2	48	1	82	0
89: Ships, Boats	2	23	24	4	25	22
Instruments and Apparatus	**30**	**21**	**35**	**19**	**34**	**35**
90: Optical, etc Instruments	32	22	35	19	34	35
91: Clocks & Watches	4	8	30	8	29	31
92: Musical Instruments	1	24	60	30	68	51
Misc. Manufactures	**24**	**32**	**44**	**33**	**45**	**45**
94: Furniture, Mattresses etc	34	33	55	31	54	54
95: Toys, Sports Requisites	18	24	34	25	34	25
96: Misc. Manufactured Articles.	27	38	49	39	48	52

Figure 1: Patterns of Static (GL) and Marginal IIT (B) levels in 2000 across 2-digit groups

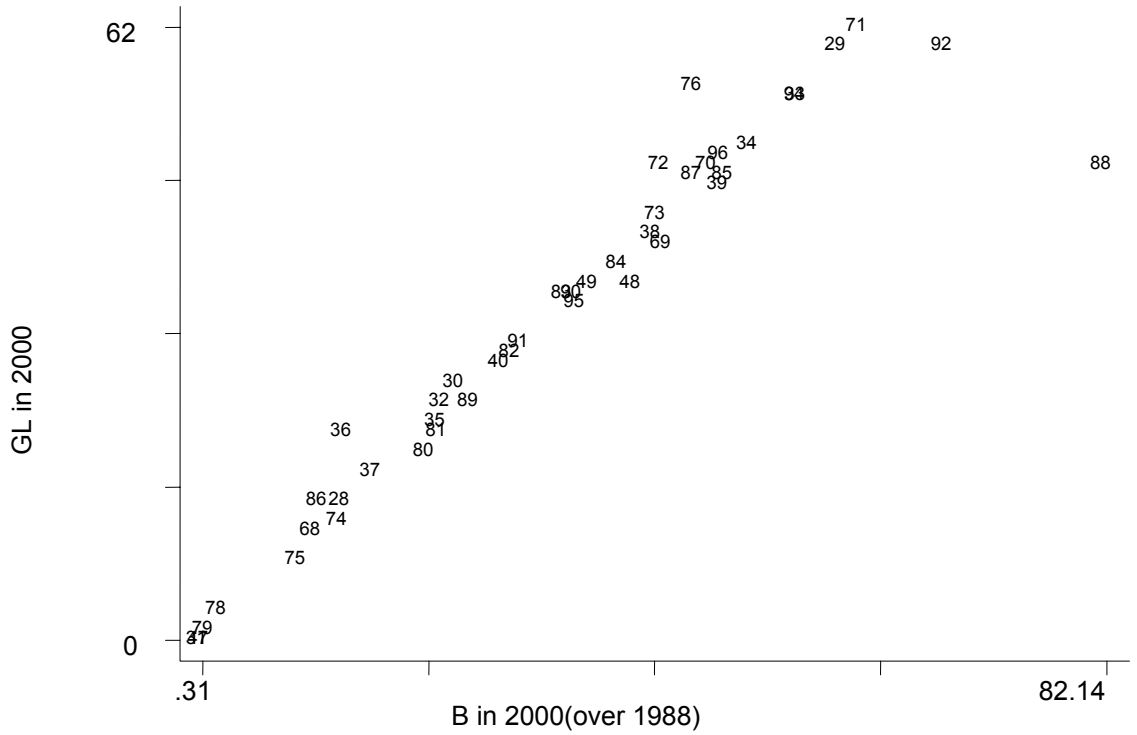

Table 2: The relationship between static and marginal levels of IIT: Rank correlation coefficients.

Description	*Coefficient*
Set 1	
a) Rank correlation between B_i in 1995 and percentage point changes in GL_i as between 1988 and 1995.	0.50
b) Rank correlation between B_i in 2000 (over 1988) and percentage point changes in GL_i as between 1988 and 2000.	0.58
c) Rank correlation between B_i in 2000 (over 1995) and percentage point changes in GL_i as between 1995 and 2000.	0.34
Set 2	
a) Rank correlation between B_i in 1995 and GL_i in 1995	0.79
b) Rank correlation between B_i in 2000 (over 1988) and GL_i in 2000	0.91
c) Rank correlation between B_i in 2000 (over 1995) and GL_i in 2000	0.56

All coefficients are statistically significant at the 0.01 per cent level.

IV. Variation of IIT across Industries: Hypotheses

1. Why a "Looser Paradigm" is Appropriate for Empirical Analysis?

In setting forth the hypotheses that relate the level of IIT to industry-specific factors, we adhere to a looser theoretical paradigm rather than a precise formal model. The appropriateness of this approach is evident from the findings of existing empirical studies, the majority of which drew hypotheses from a variety of models, that a wide range of factors potentially determines IIT. Moreover, as the phenomenon of IIT is "too complex and too product-idiosyncratic", Gray (1988) cautions against specifying any single model and defends the wisdom of following a "looser paradigm". In what follows, we epitomise the major points that justify our approach, before specifying the hypotheses in the next sub-section.

Theoretical interest on IIT arose from the apparent inability of the conventional trade theory to reconcile the phenomenon. The initial strands of theoretical models dispensed with the traditional assumption of perfect competition and incorporated the elements of product differentiation and economies of scale[18]. In these models, demand specifications represent horizontal differentiation (i.e., differentiation by attributes excluding quality) in final consumer products, and scale economies, which are internal to the firm, depend upon the volume of the variety produced. The horizontal models are considered to be of greater relevance for understanding the occurrence of IIT among developed countries. A different strand of analysis, developed in the later years, represents vertical differentiation (i.e., differentiation by quality)[19]. In general, these models predict the pattern of IIT along the lines similar to the pattern of inter-industry trade predicted in the conventional trade model, according the central role to factor endowment differences. The vertical models are considered to be particularly relevant to explain the presence of IIT between unequal partners. An important feature of horizontal

[18] Examples are Krugman (1979, 1980); Dixit and Norman (1980); Lancaster (1980); and Helpman (1981).

[19] The vertical IIT models of Falvey (1981), Falvey and Kierzkowski (1987), and Flam and Helpman (1987) are formulated without recourse to economies of scale. Economies of scale, however, is a critical element in the model of vertical IIT developed by Shaked and Sutton (1984).

and vertical models is that product differentiation, in both, pertains to consumer goods. Ethier (1979, 1982), on the other hand, focussed on differentiated producer goods and advanced a theory of IIT in intermediate goods. His theory is based on the fundamental premises that specialisation takes place at the levels of distinct components used in a manufacturing industry, and that returns to scale depend upon the size of the world market. There were also attempts to construct models of IIT without considering any form of product differentiation: they attempt to explain IIT in identical commodities on the basis of strategic interactions of internationally oligopolistic firms [Brander (1981); and Brander and Krugman (1983)].

As can be gauged from the above discussion, "the new literature does not yet have the generality and unity of traditional trade theory, and it may never be tied up in quite as neat a package" [Krugman (1994, p.64)]. This lacuna is attributed to the absence of a general theory of imperfect competition. Thus, "(t)o arrive at a general theory of trade with imperfect competition is …impossible; the most one can hope for is a catalogue of special models" (Dixit and Norman 1980, p.265). These special models suggest that IIT of various types (horizontal, vertical, IIT in intermediate products and IIT in identical products) can arise as a result of interactions of different elements under a variety of market structures. Yet, the empirical analysis of IIT is complicated for the reasons outlined below.

Typically, the model of IIT focus too narrowly on a single dimension of the problem to the point that it becomes dominant and, therefore, the results are very sensitive to the restrictive assumptions (Gray, 1988). For example, in a recent paper, Markusen (1995) showed that the results in the standard IIT models would be altered when multinational activities are taken into account. This, according to him, arises because of the trade replacing effect of multinational operation. Therefore, as a general analytic framework for empirical testing, the usefulness of any particular model of IIT is limited. None of this suggests that these models are completely off the empirical base: every special model may prove to be of empirical value provided they are applied in

special contexts[20]. In any case, the question under consideration in the present study is very general and, therefore, can not be handled by special models. We may also note that it is too difficult to distinguish the various types of IIT empirically, though the distinction can easily be comprehended at the conceptual level[21].

2 Hypotheses and Variables

In what follows, hypotheses are specified relating the intensity of IIT to various industry-specific factors.

(i) Product differentiation

Two alternative proxies of product differentiation, widely utilised in previous studies, are used in the present analysis: (i) Advertising expenses as a percentage of sales (ADV) and (ii) Ratio of marketing expenses to total costs (MKT).

The majority of empirical studies hypothesise that IIT is positively related to the degree of product differentiation[22]. Two important considerations, however, suggest that the effect of product differentiation on IIT needs to be viewed with greater prudence. For one thing, Ethier (1982) articulated that although the existence of product differentiation is essential to the theory, its degree need not be an essential determinant of the extent of

[20] Thus, Bernhofen (1997) finds empirical support for some of the propositions drawn from the oligopolistic model of IIT in identical commodities. But the context to which he applied the test too was very special – that is, IIT in the bilateral trade between Germany and the United States in a single industry (homogenous petrochemicals). Another interesting study, which combines case study approach and econometric analysis, is Tharakan and Kerstens (1995). This study investigates the bilateral IIT between high-income countries and low-income countries in the toy industry and obtains results that are consistent with the horizontal models.

[21] Some studies attempted to disentangle (based on the unit values of exports and imports) horizontal and vertical IIT to test various hypotheses derived from the two strands of theories separately. This procedure, however, is not appropriate in the present study principally because we are dealing with multilateral IIT. To elucidate, the vertical models are built on an interaction between industry characteristics and country attributes, suggesting that testing of hypotheses drawn from such models should appropriately be carried out in the bilateral contexts. Further data constraints do not allow us to properly carry out the investigation in that direction.

[22] Another measure of product differentiation is the one suggested by Hufbauer (1970), which is defined as the coefficient of variation in export unit values for shipments of the product to various importing countries. Construction of this measure, especially in the present case, is difficult owing to data constraints. Moreover, this proxy has several defects (Gray and Martin 1980).

IIT. A second consideration for exercising caution is the finding of some studies that measures such as advertising intensity are in fact negatively related to IIT[23]. The rationale for the negative relationship may be appreciated from the remark of Caves (1981, pp.208) that ".... styling the advertising to local tastes seems complementary with styling the product itself, so that the production of heavily advertised goods tends (other things, such as scale economies and comparative advantage, permitting) to take place on the same national territory as does their consumption". It is, therefore, appropriate to hypothesise that *ADV* is related to the measure of IIT in a non-linear fashion, an inverted U relationship. A positive relationship is anticipated over some unspecified range because some product differentiation is a pre-requisite for IIT, except in models dealing with identical commodities. However, following the view of Caves (1981), beyond some critical level, a reverse relationship may be anticipated. A similar relationship is hypothesised between *MKT* and the measure of IIT. Production of goods that require heavy marketing expenditure would take place proximate to the area where they are consumed.

(ii) Plant Level Scale economies

The notion of scale economies relevant to the theoretical analysis of IIT corresponds to what Balassa (1967) called “horizontal specialisation or "vertical specialisation". While the former happens when individual plants specialise in the production of finer product varieties, the latter occurs when production of parts, components, and accessories of a particular product are carried out in different plants. But, unfortunately, it is hard to construct their empirical counterparts. Instead, most studies use a proxy for minimum efficient plant scale and hypothesise a negative relationship with the index of IIT because extensive scale economies would confine production to a few locations (e.g. Caves, 1981).

The measure used in the present analysis, following Caves et al (1975), is defined as: the average size (shipments) of the largest plants in an industry accounting for

[23] Examples are Caves (1981), and Marvel and Ray (1987).

(approximately) one-half of industry shipments, divided by total industry shipments (MES)[24].

(iii) Industrial concentration

Competing hypotheses may be formulated regarding the effect of industrial concentration on IIT. Industrial organisation literature highlights that product differentiation is likely to be maximised under monopolistic competition (e.g., Scherer 1979; Spence 1976). In consonance with this result while assuming that higher concentration is associated with fewer numbers of firms, some studies hypothesised a negative relationship between industrial concentration and the extent of IIT [e.g. Greenaway and Milner (1984), Balassa (1986)]. Conversely, industrial concentration may exert a positive influence on IIT. The theoretical rationale is the following.

Caves (1974) pointed out that the reliance on more competitive world markets for sales may dilute the market power of domestic firms in concentrated industries, may render them less conscious of their mutual interdependence in the domestic market, and lead to prices and profits being closer to competitive levels. At the same time, "…concentration, by promoting more collusive behaviour on the home market should induce more small firms to export (because they find their competitive options on domestic sales constrained)" (Auquier, 1980: p.211). Thus, in concentrated industries, even though the dominant firms do not export much of their output, IIT can arise if small firms (in India as well as in India's trading partners) show relatively greater export propensity. With the probable assumption of a positive correlation in the levels of industrial concentration (across industries) between India and her trading partners, we include the three firm concentration ratio (*CON*) as an explanatory variable[25].

---

[24] A higher value of *MES* indicates that the minimum efficient plant scale is relatively higher.

[25] The models of IIT in identical commodities based on Cournot type behaviour of international oligopolists also yield results that suggest a positive relationship between industrial concentration and IIT. In these models, IIT is the result of what is called "reciprocal dumping" i.e., each firm dumps into other firm's home market. This explanation does not seem to be pertinent in the context of developing countries. Also note that a study (refer footnote 19) that attempted a formal testing of this model (in a very special context that was shown to be compatible with the underlying assumptions of the model) could not obtain, for the most part, statistically significant sign for the market concentration variable.

(iv) Multinational Involvement

The effect on IIT of multinational involvement is important in the context of significant policy liberalisation initiated during the 1990s to encourage foreign direct investment in Indian industry. Why should multinationals be exerting influence on IIT? This has to do with what now assumes the status of a stylised fact that multinationals operate in industries characterised by product differentiation [Markusen (1995)]. Markusen also points out that the knowledge-capital model of FDI (which is a refinement of the well-known intangible assets model) identifies exporting and direct investment as alternative strategies for the potential multinational enterprise. Thus, we may expect a negative relationship between IIT and the extent of multinational involvement, representing the replacement of the export sales of differentiated products[26].

The underlying assumption behind this hypothesis is that foreign investment in India is mostly horizontal in nature (i.e., directed towards supplying the local market) rather than vertical. This seems to be the case indeed, as certain institutional features of India remain to be such that they promote horizontal investment while discouraging vertical investment[27]. More on this while discussing the empirical results.

Two alternative variables are employed to capture the effect of multinational involvement: (i) Weighted average of the foreign equity shares of the firms comprising of an industry (FOR1)[28], and (ii) Share of output by the foreign firms in an industry (FOR2)[29].

---

[26] See also Pagoulatos and Sorensen (1975), Caves (1981), and Balassa (1986), who hypothesise a negative relation.

[27] See also Ahluwalia (2002: 75), who notes that "[u]nlike the case in China and southeast Asia, foreign direct investment in India did not play an important role in export penetration and was instead oriented mainly toward the domestic market"

[28] The weight is the share of a firm's output (value) in the industry output.

[29] Foreign firms are identified as those with 25 per cent or more of foreign equity shares.

(v) Other Factors

While the hypotheses specified above pertain to some of the key market structure variables, it may be appropriate to control for certain other factors deemed to have some effects on IIT.

First, following Ethier's (1979, 1982) view of specialisation, the intensity of IIT could be higher in raw materials and intermediate producer goods than in final goods[30]. However, it does not seem to be appropriate to classify the industries (i.e. the products grouped under the 4-digit level of ITC) into intermediates and final: such an attempt, at this level of aggregation, will be arbitrary.

Instead, we include a variable defined as the ratio of gross value added to value of output (GVA). This variable is usually considered as an indicator of vertical integration. But it has a dimension other than vertical integration since the nearer the raw materials end of the production stream a specialist firm's (or industry's) operations are, the higher its value added / value of output ratio tends to be, *ceteris paribus* (Scherer and Ross, 1990). Thus, if this ratio indeed captures the stage of an industry's operation, one would expect it to be positively related to IIT.

Secondly, to a certain extent, IIT can arise from the aggregation of heterogeneous commodities into common industry categories (Greenaway and Milner, 1986). A measure of the degree of industry aggregation - the number of finely disaggregated (8-digit) products comprising of each 4-digit ITC code (AG) - is included to control for such effects.

[30] Marvel and Ray (1987) provides empirical support to this view in the context of the United States.

Finally, the effects of other product-idiosyncratic features are controlled by dummy variables. Separate dummies are given for the various sections of commodities shown in Table 1[31].

V. Regression Analysis

1. Data

The study covers all sections of commodities shown in Table 1 using a data set on Indian manufacturing sector constructed specifically for the present purpose. The basic statistics are assembled from different sources. The foreign trade statistics are from the Directorate General of Commercial Intelligence and Statistics (DGCI&S), supplied in electronic form (namely, India Trades) by the Centre for Monitoring Indian Economy (CMIE). The most comprehensive official source on production statistics of the organised manufacturing sector (or factory sector) is the Annual Survey of Industries (ASI), brought out by the Central Statistical Organisation (CSO). However, in terms of the requirements of this study, the information available from the publications of the CSO is limited. They do not provide data to construct variables representing advertising intensity, marketing expenditure intensity, and the extent of foreign collaboration. Further, data pertaining to individual factories within industries are not provided. Factory (or firm) level data are required to construct variables representing industrial concentration and minimum efficient plant scale. Thus, apart from the ASI, the study uses the CMIE database

[31] Another factor that may wield an influence on IIT is related to the level of trade restriction in an industry. Caves (1981), however, pointed out that theoretical considerations do not lend support to any definite hypothesis relating this variable to IIT in an *inter-industry* setting. Thus, not surprisingly, earlier studies arrived at contradictory results. For example, Pagaloutas and Sorenson (1975) obtained a negative sign and Caves (1981) obtained a positive sign while Balassa (1981) could not arrive at statistically significant result. In the present study, we could not obtain data on trade barriers at the industry level. A proxy that could be considered is the effective tariff rates (total customs revenue divided by total value of import) at the 4-digit level of ITC. However, in the context of India, it is particularly difficult to make any priors about the sign of this variable because tariff reforms is an ongoing process in India. The trade policy reforms in India envisaged a sequential shift from quantitative restrictions to tariffs (tariffication) and then from high to low tariffs. While the process of tariffication is mostly completed and the rates across industries have been reduced, wide dispersion of rates persist suggesting that tariff rationalization process is far from over [Nouroz (2001); Virmani (2001)]. Because of these difficulties – both theoretical and empirical - this variable was not considered.

`Prowess', which provides comprehensive financial statistics of about 6000 companies listed in Bombay Stock Exchange (BSE)[32].

But these are data based on different product classification systems. Therefore, they need to be harmonised. The details of harmonisation are discussed in Appendix A. The final data set contains 759 industries (4-digit). But, for the purpose of harmonising trade with industrial data, it was necessary to group them under 53 broad industrial categories. The dependent variable in the regression equation is the value of *GLi* measured at the 4-digit level, while we are forced to settle at a rather aggregate level in the case of explanatory variables (with the exception of one variable, *AG*). Trade data pertains to the year 1998-9 while data on industry characteristics apply to 1997-8[33].

Correlation matrix and summary statistics of the variables included in the regression model is presented in Table 3 and Table 4, respectively. As expected, *MES* has a significant positive correlation with *CON* while a negative correlation with GVA. The latter correlation may suggest that plant level economies of scale are lower in industries whose operations are nearer to the raw materials end of the production stream. Both the product differentiation variables are positively correlated with the variables representing multinational involvement. This also is expected as multinationals operate in industries characterised by product differentiation.

[32] While trade data from the DGCI&S include the contribution from the unorganized component of the industry as well, the statistics on the corresponding industry characteristics pertain to only the organized (or factory) sector. Data on comparable industry characteristics pertaining to the unorganized sector are hard to come by.

[33] These were the latest years for which data were available in "India Trades" and the ASI, respectively, at the time the exercise was carried out.

Table 3: Correlation Matrix

	GL_i	ADV	MKT	MES	CON	FOR1	FOR2	GVA	CA
GL_I	1.000								
ADV	0.038	1.000							
MKT	-0.018	0.108	1.000						
MES	-0.197	0.181	0.017	1.000					
CON	-0.092	0.385	0.101	0.706	1.000				
FOR1	0.051	0.480	0.257	0.021	0.374	1.000			
FOR2	0.069	0.345	0.291	-0.047	0.328	0.922	1.000		
GVA	0.147	0.137	0.082	-0.407	-0.276	0.368	0.293	1.000	
CA	0.069	0.008	0.090	-0.144	-0.103	0.100	0.115	0.069	1.000

Table 4: Summary Statistics

Variable	No. of Obs	Mean	Std. Dev.	Min	Max
GL_i	759	37.9665	30.6681	0	99.7359
ADV	759	0.4889	0.9879	0	6.5727
MKT	759	0.0219	0.0175	0.0001	0.1558
MES	759	0.2296	0.2277	0.0266	0.8641
CON	759	0.2627	0.2196	0.0324	0.9631
FOR1	759	5.1720	5.5857	0	39.8553
FOR2	759	12.0441	13.6495	0	99.0457
GVA	759	0.2195	0.0801	-0.2151	0.3902
CA	759	7.4717	12.1560	1	233

2. Econometric Results

A Tobit model is used for estimation because in a number of cases the value of the dependent variable records zero. The regression results are presented in Table 5. Overall, the sets of coefficients show statistical significance in terms of chi-square distribution. The remarks in relation to specific variables may be summarised as follows.

The coefficients of *ADV, MKT* and their quadratic terms are supposed to capture the effect of product differentiation on IIT. All these variables yield expected signs with statistical significance. Thus, product differentiation, as measured by the intensity of advertising or marketing expenditure intensity, shows a non-linear influence on the extent of IIT. The relationship is positive only up to an unspecified threshold level. The negative relationship beyond the threshold could be due to the nature of the particular proxies used, rather than as reflecting the definite effect of product differentiation *per se*. Use of

a more accurate measure of product differentiation, which in any case is not available to us, may not yield similar results.

The coefficient of the variable representing plant level scale economies is negative and statistically significant in all specifications. Thus, trade liberalisation will not bring about intra-industry specialisation if it pays, because of substantial plant level scale economies, to organise the spectrum of production activities in one or few locales. On the other hand, greater specialisation opportunities in distinct segments and operations consisting of production process in an industry will promote IIT - a proposition central to the theory of IIT in intermediate goods. For the statistically significant positive coefficient of the variable *GVA* is interpreted to mean the greater likelihood of IIT arising as a result of specialisation in raw materials and intermediate goods.

Firms with different sizes, within an industry, may exhibit different levels of export propensity. Such differences could be more distinct in industries with relatively higher levels of market concentration. The positive coefficient of *CON* is indicative of greater export reliance by small firms in concentrated industries as their competitive options in the domestic markets are constrained because of collusive behaviour by dominant firms[34]. Thus, the share of IIT in gross trade could be higher in concentrated industries even as the relatively dominant firms in such industries may not undertake significant export.

Two alternative measures, *FOR1* and *FOR2,* are employed to capture the effect of multinational involvement. Regardless of the measure being used, it turns out that the extent of multinational involvement is negatively related to IIT, thus providing support to the argument that foreign direct investment replaces exports. This finding also indicates that foreign investments in India have mostly been directed towards supplying the local market, generally referred to as horizontal investment. The effect of multinational involvement on IIT could have been the opposite had foreign investment been largely

[34] An interaction term, MES×CON, was considered as an additional explanatory variable, but could not yield statistically significant results.

vertical in nature - that is, international fragmentation of production process by multinationals by locating each stage of production in the country where it can be done at the least cost.

As inward foreign investment in India originates largely from the developed countries (i.e., from countries with considerably different relative endowments), the dominance of horizontal investment may appear as a divergence from the theoretical prediction that greater factor endowment difference between the countries promotes vertical investment, while greater similarity promotes horizontal investment (Markusen and Maskus, 2002). The problem, however, is not with the theory as much as with certain institutional features of India, which are at odds with the conditions necessary for the theory to work. For one thing, despite the substantial reduction of tariff and non-tariff barriers, India still remains as one of the most protected economies of the world [Virmani (2001), Ahluwalia (2002)]. This creates a powerful incentive for multinationals to undertake tariff jumping horizontal investment and makes India an undesirable destination for vertical investment. Vertical investments are discouraged also for a number of other reasons. First, as mentioned earlier, substantial reforms to do away with the rigidities in the labour market have not yet been undertaken in India. Second, in terms of the availability of infrastructure, suitable for international business, India lags behind most of the East and Southeast Asian economies, which attract the bulk of vertical investments from multinationals[35]. Third, some of the labour intensive industries in India are still reserved for small-scale industries.

[35] The Global Competitiveness Report (2001-2002) shows that in terms of a number of indicators pertaining to infrastructure quality and labor market flexibility, India ranks below most of the Asian economies.

Table 5: Influences of Industry-Specific Factors on IIT: Tobit Regression Results for 1999

Industry Characteristics	1	2	3	4	5
Product Differentiation (ADV)	11.720[a] (2.677)	_	11.357[a] (2.516)	_	6.730[c] (1.719)
ADV²	-1.682[b] (-2.255)	_	-1.747[b] (-2.239)	_	-0.938 (-1.353)
Product Differentiation (MKT)	_	501.425[b] (2.106)	_	493.783[c] (1.810)	_
MKT²	_	-3867.988[b] (-2.321)	_	-3751.372[b] (-2.009)	_
Plant Level Scale Economies (MES)	-25.978[a] (-3.229)	-34.632[a] (-4.013)	-26.139[a] (-3.160)	-35.428[a] (-3.751)	-32.862[a] (-4.161)
Industrial Concentration (CON)	17.703[c] (1.756)	38.762[a] (3.465)	13.029 (1.303)	32.927[a] (2.875)	14.576 (1.588)
Multinational Involvement (FOR1)	-0.812[a] (-2.601)	-0.971[a] (-2.746)	_	_	-0.410 (-1.395)
Multinational Involvement (FOR2)	_	_	-0.195[c] (-1.642)	-0.280[c] (-1.857)	_
Stage of the Industry's Operation (GVA)	59.864[a] (2.948)	57.040[a] (2.791)	47.302[b] (2.441)	43.262[b] (2.216)	35.956[b] (1.966)
Industry Aggregation (log AG)[d]	4.268[a] (3.509)	4.187[a] (3.437)	4.131[a] (3.390)	4.050[a] (3.320)	5.155[a] (4.239)
Chemicals Dummy	25.939[a] (3.799)	21.675[a] (3.094)	24.287[a] (3.559)	19.893[a] (2.845)	_
Plastics and Rubber Dummy	28.838[a] ((3.756)	24.207[a] (3.043)	27.794[a] (3.614)	23.285[a] (2.917)	_
Paper Dummy	16.793[b] (2.002)	11.801 (1.382)	15.345[c] (1.829)	10.291 (1.204)	_
Stone and Cement Dummy	25.220[a] (3.122)	20.999[a] (2.529)	24.358[a] (3.007)	20.444[a] (2.456)	_
Gems and Jewellery Dummy	6.302 (0.624)	3.685 (0.356)	5.645 (0.556)	3.481 (0.333)	_
Base Metals Dummy	29.329[a] (4.359)	24.220[a] (3.447)	28.348[a] (4.204)	23.602[a] (3.345)	_
Machinery Dummy	28.225[a] (4.164)	26.060[a] (3.711)	25.774[a] (3.849)	23.717[a] (3.415)	_
Transport Equipment Dummy	18.749[b] (2.292)	16.459[b] (1.908)	18.097[b] (2.179)	16.863[c] (1.890)	_
Instruments and Apparatus Dummy	10.562 (1.373)	9.628 (1.212)	10.159 (1.316)	9.086 (1.140)	_
Misc. Manufactures Dummy	19.853[b] (2.188)	17.895[b] (1.935)	19.856[b] (2.180)	18.174[b] (1.956)	_
Constant	-5.064 (-0.572)	-7.752 (-0.806)	-1.113 (-0.129)	-3.208 (-0.340)	24.733[a] (4.870)
Log Likelihood	-3451.138	-3452.321	-3453.158	-3454.351	-3468.994
Chi2	100.08[a]	97.71[a]	96.04[a]	93.65[a]	64.37[a]
N	759	759	759	759	759

Note: Dummies are given for all sections in Table 1. This does not create the problem of "dummy-variable trap" as our data set also includes industries (34 items at the 4-digit level) that do not belong to any of the selected sections. These additional industries had to be included for the purpose of harmonising trade with production data (see the Appendix for details) - [a] significant at the 1 per cent level, - [b] significant at the 5 per cent level, - [c] significant at the 10 per cent level - [d] Industry aggregation variable (AG) could yield statistical significance only when transformed into the logarithmic form.

Most of the industry dummies are statistically significant, lending credence to the view of Gray (1988) that the intensity of IIT in an industry is influenced by its product-idiosyncratic features. Equation 5 clearly indicates the importance of controlling for such effects: some of the variables (ADV^2, CON, and FOR1) turn out to be statistically insignificant at the acceptable level if the industry dummies are not included. MKT, MKT^2, MES, GVA and AG consistently retain statistical significance when the dummy variables are dropped[36]. However, in all the specifications considered without including the dummies, ADV^2, CON, FOR1 and FOR2 failed to yield statistical significance. The commodity sections for which the dummies do not yield significant co-efficient values are Gems & Jewellery and Instruments & Apparatus: in the case of Paper the dummy looses statistical significance when the marketing expenditure intensity (instead of advertising expenditure intensity) variable is included. Detailed case studies of specific industries to learn the product-idiosyncratic factors that exert influences on the intensity of IIT appear to be an interesting area for further research.

VI. Concluding Remarks

One of the most plausible outcomes of economic liberalisation in India is the intra-firm reallocation of productive resources from inefficient to efficient product lines. A manifestation of this process is the growth of intra-industry trade (IIT). In this paper, we estimated the levels of IIT across industries in India using a "static" as well as a "dynamic" measure. A descriptive analysis of these estimates highlighted the following. First, in a large number of industries, trade liberalisation was found to be biasing trade expansion towards IIT – that is, within industries, both exports and imports expanded simultaneously. This finding indicates that the domestic industries are unlikely to go out of business because of trade liberalisation. Second, considerable variation was observed in the level and growth of IIT across industries. We pointed out that the extent of IIT could vary in different industries depending upon the effects of industry-specific factors.

[36] ADV looses statistical significance if FOR2 is included instead of FOR1.

Though there are ample evidences to suggest the growing significance of IIT in developing countries, studies attempting to explain the inter-industry variation of such trade are scarce, perhaps owing to data constraints. In this paper, using a harmonised data set, we analysed the influence of various industry-specific factors on the intensity of India's multilateral IIT.

The econometric analysis, adhering to a looser theoretical paradigm, suggested that a number of industry-specific factors are pertinent to understand the pattern of IIT. The avenues for specialisation in narrow product lines and intra-industry restructuring would be larger if an industry is characterised by relatively greater degree of product differentiation. Thus, as evident from the regression results, trade liberalisation would give rise to greater intra-industry trade in such industries. Further, trade liberalisation allow the country to embrace gains from specialisation in distinct segments and operations consisting of production process in an integrated world industry. For the regression results indicated the greater likelihood of IIT as a consequence of specialisation in raw materials and intermediate goods. Conversely, the emergence of IIT is less probable when the spectrum of production activities in an industry is confined to few locales because of plant level scale economies. In such industries, the effect of trade liberalisation is to organise the entire production activities in few locales best suited to exploitation of such economies.

The structure of market also matters: industrial concentration, *ceteris paribus*, promotes IIT. For small firms in concentrated industries are forced to seek market niches abroad because of collusive behaviour by dominant firms on the home market. Multinational operation, however, has a mitigating effect on IIT because the overseas production (for the local market) of differentiated goods substitutes export sales.

Policy measures are called for to attract vertical foreign investment, if multinationals have to augment the process of integrating the Indian industry with the fragmented structure of global production activities. We speculate that the phenomenon of IIT will gain even greater significance in the years to come as India march ahead on

the liberalisation path. Policies geared to removing the rigidities in the functioning of factor markets – e.g., labour market liberalisation – would give a fillip to the ongoing process of product rationalisation in Indian industry. No doubt, research interest on India's IIT is here to stay.

Appendix A: Data Harmonisation

A major difficulty faced by most previous researchers is that trade and industrial production data are often recorded according to different classification systems calling for their harmonisation. This appendix deals with the details concerning the harmonisation of data for the purpose of the present study.

To begin with, export and import data pertaining to the various sections of commodities (shown in Table 1) at 4, 6 and 8-digit levels of ITC are collected for the year 1998-99 from "India Trades". These figures are then matched with 3-digit level industrial statistics from the ASI for the year 1997-98, drawing upon the concordance table prepared by Debroy and Santhanam (1993). They match each of the 3-digit codes of National Industrial Classification (NIC) -1987 with various codes of ITC. Corresponding to the selected sections of commodities, there are a total of 92 codes at 3-digit levels of NIC but some of them are clubbed together and, therefore, the total number reduces to 82 in the concordance table[37].

Trade and production data (from the DGCI&S and the ASI) are further harmonised with the Prowess data corresponding to 1997-98. For this, we made a mapping between the NIC codes and the industry classification in the Prowess (the concordance table is given below). In those cases where the mapping of individual NIC codes with the industrial categories in the Prowess are ambiguous, two or more NIC codes are aggregated: this further reduces the total number of cases from 82 to 66. But 12 of them could not be considered for analysis either because the matching categories are not available in Prowess or because the total number of firms falls short of three, which is the minimum requirement to construct the variable CON; further, one special

[37] A particular NIC code (3-digit) is selected if its trade concordance includes at least one of the ITC codes (4-digit /6-digit /8-digit) belonging to the selected sections of commodities. Trade correspondence in few of the selected NIC codes (3-digit) includes ITC codes (4-digit /6-digit /8-digit) that do not belong to the selected sections: export and import data corresponding to those codes were also used.

case is purposefully dropped[38]. In the end, we have a harmonised data set on 53 industrial groups.

The dependent variable in the regression equation is the value of *GLi* measured at the 4-digit level of ITC[39]. As to the explanatory variables, we are forced to settle at a rather aggregate level, excepting *AG*. Whenever it is possible to secure a particular explanatory variable from both the ASI and the Prowess, we prefer the former, owing to its larger coverage. The question of this choice, however, arose in relation to only one variable (i.e., *GVA*)[40]. The variable *CON* represents the share of largest 3 firms (identified from Prowess on the basis of their value of output), in the total value of industry output (as reported in the ASI). The value of industry output data involved in the construction of FOR1 and FOR2 is from the ASI.

[38] This is 284+85/87/88+89: Newspaper + Periodicals, books, journals etc., block making, binding, etc + Other printed material. The thirteen cases, which are not considered for analysis, are indicated with asterisks in the concordance table.

[39] In few cases, some of the finely disaggregated items (i.e., ITC 6-digit and ITC 8-digit codes) comprising of a particular ITC 4-digit code fall under different NIC-3 digit codes. In such cases, separate GLi values are estimated (treating them as separate industries) after summing up the value of exports (imports) at the finely disaggregated levels. Thus 58 codes (4-digit) are subdivided to a total of 129. An incidental advantage of this procedure is that it helps to discount, to a certain extent, the possibility of spurious IIT caused by categorical aggregation. Following the above procedure, our data set contains as many as 759 (630+129) categories at the 4-digit level (of which, 34 do not belong to the sections in Table 1).

[40] Thus, the extent of aggregation applicable to GVA, which is the only variable based fully on the ASI data, is relatively less.

Matching of NIC codes with Prowess Categories: A Concordance Table

NIC code[a] and Description	*Prowess Categories*
271: Veneer sheets, plywood and their products.	Veneer sheets & sheets of plywood + Plywood.
276+277+279: Wooden furniture and fixtures + Cane bamboo furniture + Products of wood, bamboo, cane, etc.	Wood Products (excluding those under NIC 271 and Cork).
280+282+283: Pulp, paper and paperboard, newsprint + Paper and paperboard articles and pulp articles + Special-purpose paper.	Pulp, waste etc + Paper, newsprint & paperboard (excluding those under NIC 281).
281: Containers, boxes, etc., of paper and paperboard.	Cartons, boxes, cares etc.
284+ (285/287/288) +89*: Newspaper + Periodicals, books, journals etc., block-making, binding, etc. + Other printed material.	Printed books, newspapers etc.
286*: Currency notes, stamps, stamp papers etc.	N.A
300: Industrial, organic and inorganic chemicals	Inorganic chemicals + Organic chemicals
301: Fertilisers and pesticides	Fertilisers + Pesticides
302: Plastic in primary forms, synthetic rubber	Plastic in primary forms + Synthetic rubber
303: Paints, varnishes, dyes and related products, artists' colours and ink	Paints, dyes etc
304: Drugs, medicines and allied products	Drugs, medicines and allied products
305: Perfumes, cosmetics, soaps, toiletries, etc.	Cosmetics and toilet preparations + Soap, washing preparations, waxes
307+308: Matches + Explosives, ammunition and fireworks	Explosives
309: Chemical Products n.e.c.	Photographic or cinemotographic goods + Starches modified, adhesives etc + Miscellaneous chemicals
310: Tyres and tubes	Tyres and tubes + Solid rubber tyres
312: Rubber products n.e.c	Rubber and rubber products (excluding Synthetic rubber and those under NIC 310)
313: Plastic products n.e.c	Plastic Products
314/16: Refined petroleum and products	Petroleum products
317*: Nuclear Fuels	N.A
320: Refractory and structural clay products	Refractory bricks + Bricks blocks and other ceramic products + Other ceramic products
321: Glass and glass products	Glass and Glassware
322/323*: Earthen and plastic products and non-structural ceramic ware	Earthen wares and plaster products
325*: Mica Products	Mica Products
326: Stone goods and stoneware	Pumice stone + Granite + Sandstone etc + Limestone, Mill stone, grindstone etc + Stones nec.
327: Asbestos cement and other cement products	Asbestos - cement Products
329*: Miscellaneous non-metallic mineral products	N.A
330+ (331/337/338) +340+341+342+343+346+349: Iron and steel in primary/semi-finished forms + Semi finished iron and steel products, metal castings and	Primary materials (excluding Ferro alloys) + Steel, semi finished + Castings + Finished steel + Stainless steel + Alloy steel nec + Articles of iron and steel.

metal scrap products + Fabricated structural metal products + Fabricated metal products n.e.c + Furniture and fixtures of metal + Hand tools, weights and measures and general hardware + Metal cutlery, utensils and kitchenware + Metal products n.e.c.	
332: Ferro alloys	Ferro alloys
333+334: Copper in basic forms and semi-finished copper products + Brass in basic forms and semi-finished brass products.	Copper
335: Aluminium in basic forms and semi-finished aluminium products	Aluminium
336: Zinc in basic forms and semi-finished zinc products	Zinc
339: Other non-ferrous metals in basic forms and semi-finished products	Other Base materials
350: Agricultural machinery and parts	Agricultural machinery
351: Mining and Construction machinery equipment and parts	Mining machinery + Construction machinery + Material handling equipment + Lifts and elevators
352: Prime movers, boilers, steam generating plants and nuclear reactors	Prime movers
353: Food and textile machinery	Machinery used in food and beverage industries +Textile including jute machinery
354 +359:Industrial Machinery (other than food and textile machinery) + Special purpose machinery, equipment, components and accessories	Industrial Machinery (excluding those under NIC 353)
355: Refrigerators, air conditioners and fire-fighting equipment and parts and accessories	Refrigerators, air conditioners etc.
356: General-purpose non-electrical machinery, equipment, components, accessories	General purpose machinery
357: Machine tools, accessories and parts	Machine tools
358: Office computing and accounting machinery and parts	Office equipment
360: Electrical machinery and parts	Motors and generators + Transformers + Converters and rectifiers + Switching apparatus + Electric signalling apparatus + Amplifiers and power supplies + Industrial furnaces and ovens + Electrical machinery nec.
361: Insulated wires and cables	Wires and cable insulated
362: Accumulators, primary cells and primary batteries	Primary cells and accumulators
363: Electric lamps	Electric filament or discharge lamps + Radiation lamps +LED lamps + Indicating lamps
364/88: Electric fans, electro-thermic domestic appliances and parts and appliances based on solar energy	Fans and blowers + Domestic appliances (electro mechanical) + Solar appliances
365: Apparatus for radio broadcasting and television transmission, radar apparatus, radio remote control apparatus, etc.	Communication and broadcasting equipment + Strategic electronics equipment + Electronic cameras + CCTV cameras + Electronic relays + Recorders
366: Television receivers, reception apparatus for radio broadcasting, radio telephony/ telegraphy video recording apparatus	Television receivers + Video systems (excluding video camera) + Audio equipment + Audio visual equipment + Cassettes + Loud speakers
367: Computers and computer-based systems	Educational computers + Computer systems +

	Computer peripherals
368*: Electronic valves and tubes and other electronic components n.e.c.	N. A
369*: Radiographic X-ray apparatus, X-ray tubes and parts	X-ray films and plates + X-ray machine + X-ray machine (dental) + Ultra sound scanners + X-analysis equipment + X-ray tubes.
370: Ships and Boats	Ships and boats etc
371/72: Locomotives and parts, railway/tramway coaches, wagons and other railroad equipment	Railway and tramway equipment
373/74/79: Heavy motor vehicles, motor cars and other transport equipment and parts	Commercial vehicles + Passenger cars & jeeps + Automobile ancillaries + Transport equipment n.e.c
375: Motor cycles, scooters, three-wheelers and parts	Two and three wheelers
376: Bicycles, cycle rickshaw and parts	Bicycles, cycle rickshaws etc
377*: Aircraft, spacecraft and parts	Aircraft
378*: Bullock carts, push carts and hard carts	Bullock carts, push carts etc
380: Medical, surgical, scientific and measuring equipment (except optical equipment)	Medical electronics equipment
381: Photographic, cinematographic and optical goods	Optical Instruments + Cameras and other photographic instruments
382: Watches and clocks	Clocks and watches + Electronic watches and clocks
383: Jewellery and related articles	Pearls and precious stones
384*: Currency and coins	N.A
385: Sports and athletic goods	Canvas and sports shoes + Sports goods
386*: Musical instruments	Musical instruments
387*: Stationary articles n.e.c	N.A

[a] - the symbol`/' represents that the particular aggregation of`NIC codes is done by Debroy and Santhanam (1993) and the symbol `+' represents that it is done for the present purpose.

References

Ahluwalia, M.S. (2002) 'Economic Reforms in India Since 1991: Has Gradualism Worked?', *The Journal of Economic Perspectives* 16, 67-88.

Aturupane, C., Djankov, S. and Hoekman, B. (1999) 'Horizontal and Vertical Intra-Industry Trade between Eastern Europe and the European Union', *Weltwirtschaftliches Archiv* 135, 62-81.

Auquier, A. A. (1980) 'Sizes of Firms, Exporting Behaviour, and the Structure of French Industry', *Journal of Industrial Economics*, 29, 203-18.

Balassa, B. (1966) 'Tariff Reductions and Trade in Manufactures among the Industrial Countries', *American Economic Review,* 56, 466-73.

Balassa, B. (1967) *Trade Liberalisation among Industrial Countries: Objectives and Alternatives* (New York: McGrow-Hill).

Balassa, B. (1986) 'The Determinants of Intra-Industry Specialisation in United States Trade', *Oxford Economic Papers*, 38, 220-33.

Bernhofen, D. M. (1999) 'Intra-Industry Trade and Strategic Interaction: Theory and Evidence' *Journal of International Economics*, 47, 225-44.

Bhagwati, J. and Desai. P. (1970) *India: Planning for Industrialisation* (London: Oxford University Press).

Brander, J. A. (1981) 'Intra-Industry Trade in Identical Commodities', *Journal of International Economics*, 13, 313-21.

Brander, J. A. and Krugman, P. R. (1983) 'A Reciprocal Dumping Model of International Trade', *Journal of International Economics,* 13, 313-21.

Brülhart, M. (1994) 'Marginal Intra-Industry Trade: Measurement and the Relevance for the Pattern of Industrial Adjustment', *Weltwirtschaftliches Archiv***,** 130, 600-13.

Brülhart, M. (2002) 'Marginal Intra-Industry Trade: Towards a Measure of Non-Disruptive Trade Expansion', in Lloyd, P.J., and Lee, H H. (eds.) *Frontiers of Research on Intra-Industry Trade* (New York: Palgrave Macmillan).

Caves, R.E., Khalilzadeh-Shirazi, J. and Porter, M.E. (1975) 'Scale Economies in Statistical Analyses of Market Power', *Review of Economics and Statistics,* 57, 133-40.

Caves, R. E. (1974). 'International Trade, International Investment, and Imperfect Markets', Special Papers in International Economics, no. 10, Princeton, International Finance Section, Princeton University.

Caves, R. E. (1981) 'Intra-Industry Trade and Market Structure in the Industrial Countries' *Oxford Economic Papers,* 33, 203-23.

Chaudhuri, S. (2002) 'Economic Reforms and Industrial Structure in India', *Economic and Political Weekly*, January 12, 37, 155-68

Debroy, B and Santhanam A. T. (1993) `Matching Trade Codes with Industrial Codes', *Foreign Trade Bulletin,* Vol. XXIV (July), 5-27.

Desai, A. V., Marc, L. and Hanumantha, C. (1999) 'Machine Tools Industries in India and Chinese Taipei: A Comparison', in Mytelka, L. K. (ed.) *Competition, Innovation and Competitiveness in Developing Countries* (Paris: OECD).

Dixit, A. K. and Norman, V. (1980) *Theory of International Trade* (Cambridge: Cambridge University Press).

Drabek, Z. and Greenaway, D. (1984) 'Economic Integration and Intra-Industry Trade' *Kyklos,* 37, 444-69.

Ethier, W. J. (1979) 'Internationally Decreasing Costs and World Trade', *Journal of International Economics*, 9, 1-24.

Ethier, W. J. (1982) 'National and International Returns to Scale in the Modern Theory of International Trade', *American Economic Review*, 72, 389-405.

Flam, H. and Helpman, E. (1987) 'Vertical Product Differentiation and North-South Trade', *American Economic Review,* 77, 810-822.

Falvey, R. E. (1981) 'Commercial Policy and Intra-Industry Trade', *Journal International Economics*, 11, 495-511.

Falvey, R. E. and Kierzkowski, H. (1987) 'Product Quality, Intra-industry Trade, and Imperfect competition', In Kierzkowski, H. (ed.) *Protection and Competition in International Trade* (New York: Blackwell).

Fontagne, L. and Freudenberg, M. (2002) 'Long-term Trends in Intra-Industry Trade', In Lloyd, P.J., and Lee, H H. (eds.) *Frontiers of Research on Intra-Industry Trade* (New York: Palgrave Macmillan).

Globerman, S. and Dean, J. W. (1990) 'Recent Trends in Intra-industry Trade and their Implications for Future Trade Liberalisation', *Weltwirtschaftliches Archiv*, 126, 25-49.

Gray, H. P. (1988) 'Intra-Industry Trade: An "Untidy" Phenomenon', *Weltwirtschaftliches Archiv*, 124, 211-29.

Gray, H. P. and Martin, J. P. (1980) 'The Meaning and Measurement of Product Differentiation in International Trade' *Weltwirtschaftliches Archiv* 116, 322-29

Greenaway, D. and Milner, C. R. (1984) 'A Cross Section Analysis of Intra-Industry Trade in the U.K', *European Economic Review*, 25, 319-44.

Greenaway, D., and Milner, C. R. (1986) *The Economics of Intra-Industry Trade* (Oxford: Blackwell).

Grubel, H. G., and Lloyd, P. J. (1975) *Intra-Industry Trade* (London: Macmillan).

Hamilton, C. and Kniest, P. (1991) 'Trade Liberalisation, Structural Adjustment and Intra-Industry Trade: A Note', *Weltwirtschaftliches Archiv*, 127, 356-67.

Helpman, E. (1981) 'International Trade in the Presence of Product Differentiation, Economies of Scale and Monopolistic Competition', *Journal of International Economics*, 11, 305-40.

Hoekman, B. and Djankov, S. (1997) 'Determinants of the Export Structure of Countries in Central and Eastern Europe', *The World Bank Economic Review*, 11, 471-87.

Hufbauer, G. C. (1970) 'The Impact of National Characteristics and Technology on the Commodity Composition of Trade in Manufactured Goods', in Vernon, R. (ed.) *The Technology Factor in International Trade*, Universities National Bureau Conference Series, 22 (New York: Columbia University Press).

Joshi, V. and Little, I. M. D. (1996) *India's Economic Reforms 1991-2000* (New Dehi: Oxford University Press).

Krueger, A. O. (1992) *Economic Policy Reform in Developing Countries,* The Kuznets Memorial Lectures at the Economic Growth Centre, Yale University (Oxford: Blackwell).

Krugman, P. R. (1979) 'Increasing Returns, Monopolistic Competition and International Trade', *Journal of International Economics,* 9, 469-79.

Krugman, P. R. (1980) 'Scale Economies, Product Differentiation, and the Pattern of Trade', *American Economic Review*, 70, 950-59.

Krugman, P. R. (1994) *Rethinking International Trade* (Cambridge: MIT Press).

Lancaster, K. (1980) 'Intra-Industry Trade under Perfect Monopolistic Competition', *Journal of International Economics,* 10, 151-75.

Markusen, J.R. (1995) 'The Boundaries of Multinational Enterprises and the Theory of International Trade' *Journal of Economic Perspectives*, 9, 169-189.

Markusen, J.R. and Maskus, K.E. (2002) 'A Unified Approach to Intra-Industry Trade and Foreign Direct Investment', in Lloyd, P.J. and Lee, H.H. (eds), Frontiers of Research in Intra-Industry Trade (Houndmills: Palgrave Macmillan).

Marvel, H. P. and Ray E. J. (1987) 'Intra-Industry Trade: Sources and Effects on Protection', *Journal of Political Economy*, 95, 1278-91.

Nambiar, R.G. Mumgekar, B.L. and Tadas, G.A. (1999) 'Is Import Liberalisation Hurting Domestic Industry and Employment?', *Economic and Political Weekly*, February 13, 34, 417-24.

Pagoulatos, E. and Sorensen, R. (1975) 'Two-Way International Trade: An Econometric Analysis', *Weltwirtschaftliches Archiv* 111, 454-65.

Rodrik, D. (1992) 'The Limits of Trade Policy Reform in Developing Countries', *Journal of Economic Perspectives,* 6, 87-105.

Scherer, F. M. (1979) 'The Welfare Economics of Product Variety: An Application to the Ready-to-eat Cereals Industry', *Journal of Industrial Economics*, 28, 113-34.

Scherer, F. M. and Ross, D. (1990) *Industrial Market Structure and Economic Performance* (Boston: Houghton Mifflin Company).

Shaked, A and Sutton, J. (1984) 'Natural Oligopolies and International Trade', in Kierzkowski, H. (ed.) *Monopolistic Competition and International Trade* (Oxford: Oxford University Press).

Spence, M. (1976) 'Product Selection, Fixed Costs and Monopolistic Competition', *Review of Economic Studies*, 43, 217-35.

Srinivasan, T.N. (2000) *Eight Lectures on India's Economic Reforms*, (New Delhi: Oxford University Press).

Tharakan, P.K.M. and Kerstens, B (1997) 'Does North-South Horizontal Intra-Industry Trade Really Exist? An Analysis of the Toy Industry' *Weltwirtschaftliches Archiv,* 131, 86-105.

Veeramani, C. (2002) 'Intra-Industry Trade of India: Trends and Country-Specific Factors', *Weltwirtschaftliches Archiv***,** 138, 509-33.

Verdoorn, P.J. (1960) 'The Intra-block Trade of Benelux', in Robinson, E.A.G (ed.) *Economic Consequences of the Size of Nations* (London: Macmillan).

Virmani, A (2001) 'India's BOP Crisis and External Reforms: Myths and Paradoxes' Paper presented on September 3, 2001 at the first of series of seminars on *Ten Years of Economic Reforms* organised by the Indian Council for Research on International Economic Relations (Available at http://www.icrier.org/public/AV-%20on%20BoP%20crisis.pdf)

Vona, S. (1991) 'On the Measurement of Intra-Industry Trade: Some Further Thoughts', *Weltwirtschaftliches Archiv*, 127, 678-700.