# MEASURING VERTICAL AND HORIZONTAL INTRA-INDUSTRY TRADE FOR TURKISH MANUFACTURING INDUSTRY OVER TIME

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF SOCIAL SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

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IN PARTIAL FULLFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE
IN
THE DEPARTMENT OF ECONOMICS

SEPTEMBER 2003

Approval of the Graduate School of Social Sciences

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I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science.

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This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

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## ABSTRACT

### MEASURING VERTICAL AND HORIZONTAL INTRA-INDUSTRY TRADE FOR TURKISH MANUFACTURING INDUSTRY OVER TIME

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September 2003, 160 pages

In traditional trade theories, foreign trade plays the role of filling the gap of products not produced within the country. However, in the early 1960s increasing exchange of similar products, intra-industry trade, in the world trade have been observed by trade theorists. After the realization of the fact that intra-industry trade has become a very important part of world trade, more comprehensive studies on intra-industry trade have been conducted. At the end of the 1970s, trade theorists started to analyze intra-industry trade between developed countries (horizontal intra-industry trade) and intra-industry trade between developed and developing countries (vertical intra-industry trade) separately, because their characteristics were different. Horizontal intra-industry models were characterized by attribute variation between products while vertical intra-industry models were characterized by quality variation.

This study investigates the issue of measurement of horizontal and vertical intra-industry trade for Turkish manufacturing industry. We address the questions of whether the intra-industry trade in Turkish manufacturing sector is more of the horizontal or the vertical type and whether the vertical industries dominates horizontal industries in number at the 3- digit industry level.

Empirical analyses shows that the majority of intra-industry trade in Turkish manufacturing sector is of the vertical nature; Turkish manufacturing

sector exports lower quality varieties in exchange for higher quality varieties. Also, our empirical analyses indicate that a large percent of 3- digit industries considered as primarily involved in intra-industry trade are vertical industries.

**Keywords:** Quality Variation, Attribute Variation, Grubel and Lloyd Index, Unit Value Index

# ÖZ

## TÜRK İMALAT SEKTÖRÜNDE DİKEY VE YATAY SEKTÖR İÇİ TİCARETİN ZAMAN İÇİNDE ÖLÇÜLMESİ

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Eylül 2003, 160 sayfa

Geleneksel ticaret teorilerinde, dış ticaretin rolü ülke içerisinde üretilmeyen malların boşluğunu doldurmaktır. Ama, 1960lı yılların başından itibaren, bilim adamları benzer ürünlerin eşanlı olarak hem ihraç edilip hem de ithal edilmesindeki artışa, diğer bir deyişle sektör-içi ticaretteki artışa, dikkat çekti. Sektör-içi ticaretin dünya ticaretinin önemli bir bölümünü oluşturduğunun anlaşılmasından sonra, bu konuda daha kapsamlı çalışmalar yapıldı. 1970li yılların sonunda, bilim adamları gelişmiş ülkeler arasındaki sektör-içi ticaret (yatay sektör-içi ticaret) ile gelişmiş ve gelişmekte olan ülkeler arasındaki sektör-içi ticareti (dikey sektör-içi ticaret) ayrı ayrı incelemeye başladı, çünkü bunlar farklı özelliklere sahipti. Yatay sektör içi ticaretin en önemli özelliği ürünler arasındaki nitelik farkı iken dikey sektör-içi ticaretin en önemli özelliği ürünler arasındaki kalite farkı idi.

Bu çalışmanın amacı dikey ve yatay sektör-içi ticaretin ölçümünü Türk üretim sektörüne uyarlamaktır. Bu çalışmada Türk üretim sektöründeki sektör içi ticaretin çeşidinin dikey mi yoksa yatay mı olduğu ve 3-basamaklı endüstri düzeyinde dikey endüstrilerin mi yoksa yatay endüstrilerin mi hakim olduğu sorularına cevap aradık.

Hesaplamalarımız Türk üretim sektöründeki sektör-içi ticaretin çoğunluğunun çeşit olarak dikey olduğunu göstermektedir. Bir başka deyişle,

Türk üretim sektörü benzer ürünlerin düşük kalitelisini ihraç ederken aynı anda yüksek kalitelisini ithal etmektedir. Ayrıca, sektör-içi ticaretin yoğun olduğu 3 basamaklı endüstrileri ele aldığımızda, hesaplamalarımız bu tip endüstrilerin büyük bir çoğunluğunun dikey endüstriler olduğuna dikkat çekmektedir.

**Anahtar Kelimeler:** Kalite Farklılaşması, Nitelik Farklılaşması, Grubel ve Lloyd Endeksi, Birim Değer Endeksi

To My Family

**ACKNOWLEDGMENTS**

I would like to express my deep gratitude to my supervisor Prof. Dr. Güzin Erlat for her invaluable guidance and support. Studying with her was a great honour for me. I will never forget her for her invaluable support throughout this study.

My special thanks go to Prof. Dr. Haluk Erlat for his help and support throughout the study. I have been lucky to have spent the last three years with him. I will always remember his kindness and understanding. Thank you Professor Haluk Erlat.

I would like to thank Prof. Dr. Yusuf Ziya Özcan for his participation in my masters committee and for sharing his valuable ideas with us.

I sincerely appreciate my friend Eda Ustaoğlu, with whom I shared three years at METU. With her friendly conversations, she motivated me very much. Thanks my friend.

Finally, I would like to thank my family who always believed in me for their support, patience and encouragement.

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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# CHAPTER 1

# INTRODUCTION

Traditional trade theory as embodied either in the Heckscher-Ohlin-Samuelson[1] (H-O-S) postulate or in the Ricardian model is fundamentally a theory of 'inter-industry trade'. This theory predicts that a country will export the commodity whose production requires intensive use of that country's cheap factor and import the commodity whose production requires intensive use of that country's scarce factors. In other words, trade is generated by supply side differences. "Accordingly, one would expect trade between countries with different factor endowments to be most prevalent, that is, trade, mainly, between developed (the North) and developing (the South) countries" (Nillson, 1999). However, in the early 1960s some trade theorists[2] have noticed that most of the world trade actually takes place between developed countries with similar income structure (Memiş, 2001). Moreover, they have noticed that much of the trade between developed countries involves two-way exchange of goods produced with similar factor endowments. Therefore, they hypothesized that different countries do not necessarily specialize in different products but instead different countries may specialize in different types of a given commodity. As a result, intra-industry trade (IIT) theory, the simultaneous exports and imports of the same statistical product group, has emerged as a complement to inter-industry trade theory.

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[1] The H-O-S, 2×2×2 model implies two countries, two commodities and two factors of production. These two countries have different factor endowments and so trade occurs between these countries due to differences in factor prices. (Kenen, 1989).

[2] See Verdoorn (1960), Linder (1961), Posner (1961), Michaely (1962) and Kojima (1964)

Broadly speaking, two classes of explanations may be given for the aggregate behavior of IIT over time : 'demand spectrum aspect' and 'supply spectrum aspect'. Demand side theories on IIT (Linder 1961, Lancaster 1980, Helpman1981) places emphasis on diversification of consumer tastes. These theories predict that the extent of IIT will be larger, the higher and the more similar the income levels of trading partners are (Hellvin, 1996), because, when the income level increases so does the demand for differentiated goods. Also, the more similar the per capita income is, the more similar will be the demand structure and therefore the demand will be larger for varieties produced in the partner country. As a result, demand side theories point out that, in identical economies diversity of consumer preferences lead to IIT (Lancaster 1979). Supply side theories (Helpman 1981, Krugman 1981 and Helpman and Krugman 1985), on the other hand, focus on the ability to produce a wide-range of differentiated products. These theories predict that higher average-per-capita income represents a higher average capital-labor (K/L) endowment ratio.

> On the assumption that industries that are capital intensive tend to have relatively more production of differentiated products, countries with higher average K/L ratios will experience a greater share of intra industry specialization (Bergstrand, 1990).

Therefore, as pointed out by supply side theorists, product differentiation is the most important source of IIT in identical economies. It can be concluded, from demand and supply side theories that trade in differentiated products are most likely to take place between countries with similar factor endowments and with high level of per capita income or, in other words, between developed countries

More comprehensive studies on the development of IIT have been conducted after the realization of the fact that IIT has become a very important part of the world trade, in particular among developed market economies. The models of IIT generated by Lancaster (1980), Krugman (1979; 1981), Helpman (1981), and Dixit and Norman (1980), horizontal intra industry (HIIT) models, explain IIT by horizontal product differentiation (attribute variation between products of a similar quality) in combination with increasing returns to scale. According to these trade theorists such trade may be expected to be most frequent among countries on the same level of economic development, with the same relative factor endowments of

resources and with a higher level of per capita income and in goods where products are horizontally differentiated and finally in markets characterized by monopolistic competition. Although HIIT models state that IIT is most likely to take place between developed countries (north-north IIT), over the period 1975-1980 the amount of IIT occurring between developed and developing countries (north-south IIT) has started to grow rapidly. The realization of north-south IIT has become the starting point for the development of a new IIT model, the vertical intra-industry (VIIT) model. Falvey (1981) was the founder of the VIIT model. His model is considered as an alternative to that of modeling IIT as a consequence of horizontal product differentiation and increasing returns to scale. In his VIIT model, he explains the IIT in vertically differentiated products (quality variation between products) by retaining the constant returns to scale assumption of the traditional H-O-S theorem. According to him VIIT is more likely to take place between economies at different levels of income. As a result, during the 1980s the idea that IIT takes place between economically similar countries has lost its validity and a period of horizontal-vertical distinction has started in IIT theory.

Besides the trade theorists approaching the IIT subject from the theoretical point of view, there are also researchers who approach the subject from the methodological and the empirical point of view. IIT theory owes a profound debt to the efforts of Verdoorn (1960), Kojima (1964), Balassa (1966), Grubel and Lloyd (1971), Aquino (1978) and Greenaway and Milner (1981; 1983) on the issue of measurement of IIT and to the efforts of Aquino (1978), Greenaway (1983; 1984) and Balassa (1986) for providing an extensive databank of evidence on recorded IIT and, finally, to the efforts of Abd-el Rahman (1991) and Greenaway, Hine and Milner (1994; 1995) for testing specific hypothesis related to IIT and for decomposing IIT into HIIT and VIIT.

The measurement of IIT, conducting case studies and empirical studies on IIT and finally decomposition of IIT as HIIT and VIIT is also applicable to the case of Turkish foreign trade. “Turkey underwent major changes in her trade regime when an outward-oriented growth policy was adopted in 1980s; this brought an expansion in exports as well as a change in composition of exports.” (Erlat, 1998). The composition of exports has shifted from traditional to non-

traditional sectors[3] (differentiated goods sector). Whether Turkey's trade structure is predominantly inter-industry or intra-industry and whether there has been a shift towards IIT has been investigated extensively (Erlat and Erlat 2003a and Memiş 2001). However, these studies have not considered the horizontal-vertical distinction in IIT theory. Although there has not been given enough importance to this distinction, decomposition of IIT as horizontal and vertical IIT is quite important for the Turkish manufacturing industry, because, as already pointed out by Abd-el-Rahman (1991), HIIT and VIIT are affected differently by some explanatory variables such as country-specific and industry-specific variables. If we distinguish horizontal industries from vertical ones, we can determine more easily how to treat each industry; for example, we know that we should promote product innovation in horizontal industries and capital improvement in vertical industries. For this reason, in this thesis, the emphasis will be on horizontal and vertical IIT for Turkish manufacturing sector so that we can determine in which sectors the dominant form of IIT is horizontal and in which sectors it is vertical.

Therefore, in the following chapter a survey of theoretical and empirical studies on models of HIIT and VIIT will be presented. In Chapter 3, measures of IIT and its decomposition as vertical and horizontal will be described. Chapter 4 will contain the empirical results of applying measurement of IIT and its decomposition to the Turkish manufacturing sector for the period 1989-2001. Finally in Chapter 5, conclusions of our case study will be presented.

[3] See Erlat (1998), Erlat and Erlat (2003b) for the classification of traditional and nontraditional sectors by using "Cumulative Export Performance Function".

# CHAPTER 2

# THE THEORIES AND THE EMPIRICAL ANALYSIS OF VERTICAL AND HORIZONTAL INTRA-INDUSTRY TRADE

## 2.1 The Theories of Vertical and Horizontal Intra-Industry Trade

Over the last twenty years, a set of new theories has been put forward to complement and/or substitute for the simple H-O-S model. H-O-S theory is based on the idea that differences in factor endowments between countries are the source of comparative advantage; comparative advantage is the determinant of international trade and, therefore reflects inter-industry trade. If inter industry trade is the dominant form of trade, then there will be no reciprocal trade of products related to the same industry. Accordingly, one would expect one-way trade between countries with different factor endowments (north-south trade) to be most prevalent in the H-O-S model (Nillson, 1999). However, the H-O-S model seemed incapable of explaining certain significant empirical findings about the world economy. The most important one of them was the Leontief–paradox, namely the growth in two-way trade[4] between similar economies with near identical factor endowments (north-north trade) (Stewart, 1984). This incapability of the H-O-S paradigm in explaining two-way north-north trade was the starting point of the emergence of a new trade theory, namely intra-industry trade theory [5] (IIT).

One of the earliest empirical works demonstrating the importance of IIT between developed countries with similar factor endowments was Grubel and Lloyd (GL) (1975). According to GL (1975) the H-O-S model with its reliance on relative factor endowments as the basis for trade cannot provide a satisfactory

[4] Reciprocal trade of products belonging to the same industry
[5] Simultaneous exports and imports of products belonging to the same industry

explanation for the phenomenon of IIT. As a result they focused their attention on 'preference diversity' as a source of trade. This focus has its more immediate origins in the observation about trade in Linder (1961). Two other important theoretical contributions were made soon after the publication of the GL work. Dixit and Stiglitz (1977) have modeled situations where individuals value 'product variety' and where the production side of the economy is characterized by 'monopolistic' rather than 'perfect competition'. An alternative model of 'product variety' has been demonstrated by Lancaster (1979). In this version, products represent a bundle of characteristics and every consumer has his most preferred 'package' of characteristics. This, again, gives rise to demand for variety at the aggregate level.

> Due to the existence of internal economies of scale, only some consumers are able to obtain their ideal products, others buy 'differentiated products' that only approximate their most preferred model. Both the Dixit-Stiglitz and Lancaster approach to 'product differentiation' rely on the existence of 'increasing returns to scale' and 'monopolistic competition'; none of them was compatible with the H-O-S theorem (Kierzkowski, 1984).

These three developments (GL 1975, Dixit and Stiglitz 1977 and Lancaster 1979) have points in common. Explanations of trade based on 'preference diversity' have been based on 'non-competitive' assumptions and upon an assumption of 'increasing returns to scale'. However, the introduction of ideas of 'preference diversity', 'imperfect competition' and 'increasing returns to scale' by these three developments to international trade theory have resulted in the problems that cannot be solved by the traditional trade theories.

The theoretical literature on IIT theory is very extensive. It is possible to distinguish two kinds of IIT, horizontal and vertical IIT. Horizontal intra-industry trade (HIIT) arises when there is a two-way trade in products of similar quality with different attributes (horizontally differentiated products). The theoretical basis for such trade was developed by Lancaster (1980), Krugman (1981), Helpman (1981; 1987) and Bergstrand (1990). In these models, IIT emerges in monopolistically competitive markets with increasing returns to scale on the supply side and diverse consumer preferences on the demand side (Mora, 2002). Also, these models suggest that the more similar countries are in terms of their

endowments, the greater the share of HIIT. Alternative models of IIT include vertical intra-industry trade (VIIT). VIIT is trade in varieties of products characterized by different qualities (vertically differentiated products). The theoretical basis for this type of IIT was developed by Falvey (1981) and Falvey and Kierzkowski (1987). In these models, IIT will take place in perfectly competitive markets but there are no increasing returns to scale in production (Mora, 2002). VIIT models suggest that greater the difference in the level of factor endowments between countries, the greater will be the share of VIIT.

> The two sets of models are different in their predictions. Whereas HIIT is more likely to take place between countries with high and similar per-capita incomes (north-north IIT), VIIT is more likely to take place between countries at different levels of per capita incomes (north-south IIT) (Hellvin, 1996).The distinction between VIIT and HIIT is an important one. The vertical models can explain IIT without recourse to economies of scale and hence, without seriously vitiating the precepts of the H-O-S theorem. However, this is not the case of horizontal models in which interaction between scale economies and (horizontal) product differentiation is an essential ingredient (Tharakan and Kerstens, 1995).

The existence of vertical versus horizontal product differentiation does not mean that IIT cannot take place in homogenous goods. “In the extreme case, two identical countries of the same size with the same taste patterns and access to the technology may still engage in trade when trade takes place under ‘duopoly’ conditions”(Williamson and Milner (1991)). The model of Brander (1981) succeeds in showing that international trade can occur even in a world of one homogenous good produced at the same cost at home and abroad.

> One can think that this type of trade is socially wasteful because it involves moving goods pointlessly across borders and uses up resources in doing so. But, this is not the case. Although there is a social waste of resources stemming from transportation costs that must be incurred, there is also a social gain from increased competition between duapolists: consumers face lower prices after trade (Kierzkowski, 1996).

The social value of such trade depends, therefore, on the net effect of these losses from transportation cost and offsetting social gain from increased competition.

In the literature, however, the models of IIT in homogenous goods are not as important as models of IIT in horizontally differentiated goods (HIIT models)

or models of IIT in vertically differentiated goods (VIIT models). In the following sections HIIT and VIIT models will be analyzed separately in detail.

### 2.1.1 Models of Horizontal Intra-Industry Trade

"The models of HIIT explicitly introduce economies of scale and imperfect competition in the analysis unlike models of VIIT" (Tharakan and Kerstens (1995)). Therefore, a fairly large percent of HIIT takes place under 'monopolistically competitive' markets. The models of HIIT in 'monopolistically competitive markets' have in common explicit assumptions of increasing returns to scale, free entry and exit and an assumption that consumer preferences are sufficiently diverse to ensure that a large number of single product firms can co-exist in the final equilibrium (Greenaway, 1987). These models can be categorized as 'neo-Chamberlinian[6]' and 'neo-Hotelling[7]'. Both of these models exist under conditions of 'monopolistic competition'. However, the treatment of consumer preferences differs between these two models.

> In the former, the consumers endeavor to consume as many different varieties as possible and more than one firm will produce the same variety. In the latter, different consumers have different preferences for alternative varieties of given commodities (Tharakan and Kerstens, 1995).

Although the models of HIIT in monopolistically competitive markets assume free entry and a small level of scale economies, in practice this may not be the case. Entry may be restricted and/or level of scale economies may be large relative to total market demand. Under these circumstances, the number of firms operating in the market will be quite small, in other words, market structure will be an oligopolistic one. Eaton and Kierzkowski (1984) was the first to assert the existence of HIIT under oligopoly conditions. Therefore, it can be said that an oligopolistic market is an alternative market structure under which HIIT can take place.

Accordingly models of HIIT can be categorized as neo-Chamberlinian, neo-Hotelling and Eaton and Kierzkowski model. These three models differ from

[6] For detail see Dixit and Stiglitz (1977), Krugman (1979, 1980) and Dixit and Norman (1980)
[7] For detail see Lancaster (1979, 1980) and Helpman (1981)

each other with respect to market structure on which they are based. While neo-Chamberlinian and neo-Hotelling models are based on monopolistically competitive markets, the other is based on oligopolistic markets.

#### 2.1.1.1 Neo-Chamberlinian Models

Neo-Chamberlinian models consider monopolistic competition and horizontally differentiated goods on the supply side. On the demand side, model is based on 'love of variety' approach.

> According to this approach all varieties enter the individual's utility function in a symmetrical fashion; that is, individuals gain utility from greater variety, in other words, from being able to consume more varieties, rather than from being able to consume a preferable variety (Williamson and Milner ,1991).

Fundamental work on demand for variety was done by Dixit and Stiglitz (1977) in the context of a closed economy organized along lines of the Chamberlinian model of imperfect competition. In their model, trade is caused by economies of scale rather than by differences in factor endowments. The Dixit and Stiglitz model was then applied to the open economy by Krugman in a series of articles (Krugman, 1979, 1980, 1982), as well as by Dixit and Norman (1980). Then, the essential features of the neo-Chamberlinian model can be illustrated by reference to these authors.

Kierzkowski (1996), by reference to Krugman (1979), illustrates the essential features of the neo-Chamberlinian model. In Krugman's (1979) model it is assumed that all consumers are alike and that their taste patterns can be represented by the following utility function:

$$U = \sum_{i} v(c_i) \qquad v' > 0, v'' < 0 \qquad (2.1)$$

where $v'$ and $v''$ are the first and second order derivatives of $v$ with respect to $c_i$ and $c_i$ denotes consumption of the $i$th good by the representative consumer. The goods entering the above utility function are produced by one differentiated-

product industry; there is no need to bring an outside homogenous good at this stage. The discussion refers initially to a closed economy.

Equation (2.1) has the property that the level of utility increases as the number of goods consumed by an individual goes up, ceteris paribus. To see this point the model represents the equation (2.1) in a more specialized form:

$$U = \sum_i c_i^{\theta} \qquad 0 < \theta < 1 \qquad (2.2)$$

The model supposes that initially $n$ goods were consumed, that their prices were the same and equal to one, and that the representative consumer had a money income of $I$. It follows that he must have consumed the same quantity of each good, $\bar{c}$ (in fact, $\bar{c} = I/n$). Given the initial conditions, the level of utility reached by the individual was:

$$U(n) = n\bar{c}^{\,\theta} \qquad (2.3)$$

Later, the model assumes that the same consumer with the same income and prices is offered $nk$ goods instead of $n$ goods to consume. Through straightforward substitution, the difference in the utility levels associated with the two bundles can be shown as

$$U(nk) - U(n) = n\bar{c}^{\,\theta}\,(\ k^{1-\theta} - 1) \qquad (2.4)$$

If variety is greater in the second situation, $k > 1$ and the expression in (2.4) must be positive. By consuming less of every good ($I/nk$ instead of $I/n$) but more goods, the level of utility attained goes up even though one's income is the same and prices are unchanged. This is how variety makes you better off.

As a second step, Kierzkowski (1996) turns to the supply side of Krugman's 1979 model. In this model, only one factor, labor, is required, and

production functions are the same for all goods. They can be represented in terms of the number of labor units, $l_i$, required to produce $x_i$ quantity of good $i$:

$$l_i = \alpha + \beta x_i \qquad \alpha, \beta > 0 \tag{2.5}$$

where $l$ denotes labour inputs, $\alpha$ and $\beta$ denote fixed and marginal costs respectively. Given that the coefficient $\alpha$ is assumed to be greater than zero, there are economies of scale in production. With increasing returns to scale ($l_i / x_i$ decreases as $x_i$ increases) there will be only one producer of a particular differentiated good, and this producer will try to exploit his monopoly power over a segment of the market, in other words, it will equate marginal revenue with marginal cost. If all differentiated goods are taken into account there will be as many producers as the number of products supplied to the market. Given the utility function in (2.4) and the production function in (2.5), the profit maximizing condition for a particular producer, equating marginal revenue with marginal cost, becomes:

$$P_i(x_i)(1 - 1/e_i) = \beta \, \mathrm{w} \tag{2.6}$$

where $e_i$ is the elasticity of the demand facing the individual firm, and $w$ stands for the wage rate.

If new firms can be set up, no profits can be made in equilibrium even though every producer tries hard to achieve this goal, as equation (2.6) testifies. The zero profit condition is a property of Chamberlin's model of monopolistic competition:

$$\pi_i = P_i x_i - (\alpha + \beta x_i) w = 0 \tag{2.7}$$

From the zero profit condition it can be concluded that the total cost of production of good $i$ has to be equal to total revenue:

$$P_i x_i = (\alpha + \beta x_i) w \tag{2.8}$$

Equation (2.8) can be put differently as price equals average cost to determine the price which each representative firm will charge:

$$P_i = (\frac{\alpha}{x_i} + \beta) w \tag{2.9}$$

Since solutions for $P, x$ and $c$ will take the same values for all $i$s, the Chamberlinian zero profit condition can be simplified by disappearance of the subscript $i$. Also, it can be further simplified by setting $w$ = 1.0.

$$P = \frac{\alpha}{x} + \beta \tag{2.10}$$

Because of the fact that all varieties enter the consumers' utility function symmetrically and since differentiation is costless, no two firms will ever produce the same variety in the Chamberlinian model. Therefore, the output of any single firm will be

$$x_i = Lc_i \tag{2.11}$$

where

$$L = \sum l_i \tag{2.12}$$

In other words production of a good $x_i$ is equal to the consumption of a representative individual ($c_i$) times the labor force ($L$) since the individuals are identical with workers. By this definition of $x_i$ equation (2.10) can be written alternatively as

$$P = \frac{\alpha}{Lc} + \beta \tag{2.13}$$

Kierzkowski (1996) presents the equilibrium conditions (2.6) and (2.13) in Figure 1 as in Krugman (1979). In the figure, the vertical axis represents price and horizontal axis represents per capita consumption of every good. The PP schedule depicts equation (2.6); it is upward-sloping because it is assumed that the elasticity of demand facing an individual producer gets smaller as his output expands. The ZZ curve in Figure 1 shows equation (2.13). The intersection of the two schedules determines the equilibrium price, $P_0$ and the level of per capita consumption of every good, $c_0$. The level of output of every firm, $x_0$, can be obtained by multiplying $c_0$ by $L$. The number of varieties in the economy is left undetermined. But, it can be easily determined under full employment conditions by the size of the labour force ($L$) and the amount of labour required ($l_i$) to produce a representative variety. Under full employment conditions

$$L = nl_i = n(\alpha + \beta x_i) \tag{2.14}$$

The only unknown in this equation is $n$, the degree of product variety, and it can be calculated as

$$n = \frac{L}{l_i} = \frac{L}{\alpha + \beta x_i} \tag{2.15}$$

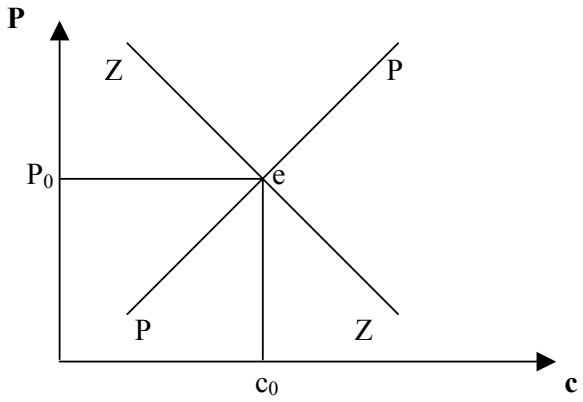



**Figure 1** Equilibrium in the Krugman Model

The degree of product variety under equilibrium conditions can be presented as $n^*$, where

$$n^* = \frac{L}{l_0} = \frac{L}{\alpha + \beta x_0} \tag{2.16}$$

Finally, as one might expect, symmetry in the neo-Chamberlinian model ensures that all varieties are produced in the same quantities and, in equilibrium, sell at the same price.

These features are valid for a single closed economy.

> To provide an explanation of intra-industry trade Krugman (1979) simply assumes the existence of a second economy identical in every respect to the home economy. Assuming zero transport costs, two-way trade in differentiated goods will take place even if an identical range of varieties was produced in each country pre-trade. This follows because no firm has an incentive to produce exactly the same good that is already produced by another firm, namely, a perfect substitute (Greenaway, 1987).

Thus further product differentiation will occur once trade opens: competition forces a producer from one of the two countries to exit the industry or to produce a new variety. Then, IIT in differentiated products will result (Williamson and Milner ,1991).

According to Williamson and Milner (1991), the characteristics of the post-trade equilibrium will be similar to those of the pre-trade equilibrium: prices and outputs of all varieties will be identical. No two countries have a comparative advantage in any subset of products and yet there is a basis for trade: namely, increased variety. The total number of varieties ($n_T$) available to all consumers will now be increased to:

$$n_T = \frac{(L_H + L_F)}{l_i} = n_h + n_f \tag{2.17}$$

where $L_H$ is the labour force at home country and $L_F$ is the labour force in the foreign country. And, $n_h$ is the number of varieties produced at home country and $n_f$ is the number of varieties produced at the foreign country. Thus, although the opening of trade has no effect on the level of output or the number of firms producing in either country, consumers have twice the number of products available. Given their preference for diversity, they consume some of all varieties. If $n_T$ varieties are consumed by every one at home and at the foreign country, but only $n_h = n_f$ are produced in each country, then there must be two-way trade between the two countries through the exchange of varieties.

> Gains from trade in this particular model of HIIT are the outcome of increased variety. This is a consequence of the special form of the utility function adopted. If per unit costs decrease as the scale of production increases, gains could come simultaneously from increased variety and from reduced prices of domestic and foreign-produced differentiated goods following the enlargement of markets, which results from the opening of trade (Williamson and Milner,1991).

However, several limitations of this model can be identified. Although the post-trade number of varieties can be specified, the location of firms, and therefore the pattern of trade are indeterminate. Also, nothing can be said about which varieties will be produced domestically and which will be imported. Helpman and Krugman (1985) have reacted to this shortcoming by accommodating differences in initial factor endowments. In such a case also, as long as some firms in both

economies produce differentiated goods, IIT will take place since the monopolist producer will sell in both economies.

#### 2.1.1.2 Neo-Hotelling Models

The neo-Hotelling model, as in the neo-Chamberlinian case, is also based on monopolistic competition and horizontally differentiated products on the supply side of the economy. However, from the demand spectrum, consumer preferences characteristics of the neo-Hotelling model are completely different from those of the neo-Chamberlinian model. While the Dixit-Stiglitz-Krugman model is based on 'love of variety' approach, the neo-Hotelling model questions this approach and introduces a new one; the 'ideal variety' approach.

> According to the 'ideal variety' approach, individuals have different most preferred locations, in other words mixes of attributes, and each individual consumes only his or her most preferred variety, or the 'nearest available'. Under this approach individuals gain utility from being able to consume preferable variety. The alternative, Chamberlinian, 'love of variety' approach is to claim that all varieties enter the individual's utility function in a symmetrical fashion. Individuals gain utility from consuming more varieties, rather than from being able to consume a preferable variety as in the case of 'ideal variety' approach (Williamson and Milner, 1991).

Fundamental characteristics of the neo-Hotelling model have been constructed by Lancaster (1980) and Helpman (1981).

> In the basic neo-Hotelling model, neo-Hotelling model under closed economy conditions, consumer preferences are uniformly distributed around a circle. Decreasing costs in production ensures that the number of varieties produced is finite and this in turn ensures that some consumers obtain their ideal variety, others consume a variety that is not ideal, or do not consume at all. When a consumer becomes further far away from his ideal variety, the price he will be willing to pay falls in proportion to his distance from the ideal variety. From the production point of view, closed economy equilibrium conditions of the neo-Hotelling model are very similar to those of the neo-Chamberlinian model. The profit maximizing solution for any individual firm is achieved when marginal revenue is equal to marginal cost (zero profit condition). The profit maximizing behaviour, free entry and decreasing costs determine the number of varieties produced ($n$) in the economy. All of these varieties have an equal market share and, therefore, sell at the same price. This equilibrium with $n$ firms

producing $n$ varieties and earning zero profits is described by Lancaster (1980) as perfect monopolistic competition (Greenaway, 1987).

International trade conditions of the neo-Hotelling model are brought into picture by Kierzkowski (1996) with reference to Lancaster (1980). Under trade conditions, two economies identical in all respects were considered. Each economy has two sectors; a homogenous product industry and a differentiated product industry. While the homogenous good is produced under constant returns to scale, there are economies of scale to be achieved in the differentiated product industry. There are no barriers to entry and hence profits must be driven to zero in equilibrium. Under increasing returns to scale technology, only a limited number of differentiated products can be produced although an infinitely large number of them are demanded. Suppose that pre-trade condition of home country was as depicted in the Figure 2. Each point on the circle represents an ideal model for some individuals. If four models ($m_1, m_2, m_3, m_4$) are produced under closed economy conditions, the consumers with ideal models $c_1, c_2, c_3, c_4$ were very lucky; they got exactly what they liked best. Others pay the same price for models that did not correspond to their most preferred specifications. Suppose now that free trade takes place between the home country and in an identical foreign county. There are also four foreign firms but, instead of producing, $m_1, m_2, m_3, m_4$, they happen to produce four other models, one of which is halfway between $m_1$ and $m_2$, one between $m_2$ and $m_3$, and so on. It can be seen that free trade would be beneficial for some consumers and harmful to none, because, some consumers will be closer to their ideal model as the number of firms, each producing a different variety, increases. Trade will be entirely of intra-industry character in such a situation.

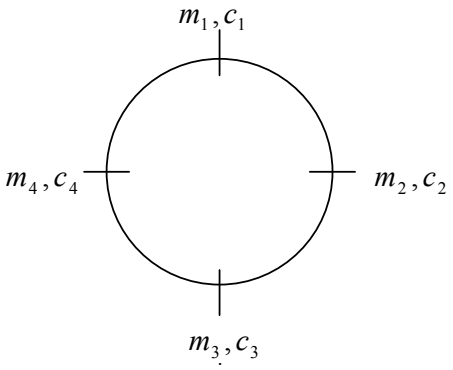



**Figure 2** Alternative Specifications of a Horizontally Differentiated Commodity

According to Kierzkowski (1996) when two countries are like twins**,** trade will nevertheless take place and it will be entirely IIT. However, in case of identical economies nothing can be said about which varieties will be produced domestically and which will be imported. This problem was also the most important shortcoming of the neo-Chamberlinian model. The neo-Hotelling model has reacted to this shortcoming by accommodating differences in initial factor endowments and asserted that factor endowments may differ between countries and the differentiated product industry may be relatively capital intensive while the homogenous product industry is relatively labour intensive. In such a case, as Lancaster (1980) and Helpman (1981) have already shown, intra- and inter-industry trade will coexist. Both countries will be exporting and importing simultaneously the differentiated product; however, the country with the higher overall capital-labour ratio will be a net exporter of the differentiated product while the other country is a net importer. In order to balance the trade, the relatively capital poor country will be the only exporter of the homogenous product. Therefore, there will be uni-directional trade in the homogenous good sector while there is a bi-directional trade in the differentiated product sector since each good will be produced in only one country.

As a result, IIT in a capital intensive, differentiated product determined by economies of scale and monopolistic competition, coexists with inter-industry trade in a labour intensive, homogenous product driven by cross country differences in relative factor endowments (Nilsson 1999). Other things being

equal, the greater the difference between initial factor endowments the smaller the share of IIT in overall trade.

#### 2.1.1.3 Eaton and Kierzkowski Model

Eaton and Kierzkowski (1984) have developed an IIT model that is based on oligopolistic markets and horizontally differentiated products. The model has been the proof of the idea that an oligopolistic market is an alternative market structure under which HIIT can take place.

Before bringing into the picture international trade under oligopoly, Eaton and Kierzkowski (1984) have constructed the basic features of the model under autarky. They have used Lancaster's (1971) formulation to characterize demand for the horizontally differentiated products. In this formulation each consumer $i$ has an ideal variety of good B (differentiated product), which can be characterized by a parameter $\theta_i$. An individual will purchase an alternative variety that deviates from the ideal if the price of the alternative is sufficiently lower. Then the utility function will be

$$V(Y, p_i, \theta_i, Z_i) = \max\left\{\mathrm{Y - p_i} - \left|\theta_i - Z_i\right|, Y - \bar{p}\right\} \qquad (2.18)$$

where $Z_i$ stands for the variety consumed by an individual $i$; $p_i$ is the price of the differentiated product; and $Y$ denotes individual's income. The utility function (2.18) has the following characteristics: At most one unit of differentiated product will be bought. The maximum price that an individual $i$ is willing to pay for it is $p$ provided that the available variety corresponds exactly to $\theta_i$, this price falls linearly with the distance $\left|\theta_i - Z_i\right|$. When the price for all available differentiated products exceeds $\bar{p} - \left|\theta_i - Z_i\right|$ the consumer will spend his entire income on good A (homogenous product).

From the production point of view, the production of good B is characterized by increasing returns to scale. The total cost of producing x unit of the differentiated good B is

$$C = k + cx \tag{2.19}$$

where $c$ is marginal cost and $k$ represents fixed cost. In contrast with the literature in monopolistically competitive markets, a firm incurs the fixed costs when it chooses a variety to produce, before it decides on the level of output and price. Entry and price decisions are thus taken sequentially rather than simultaneously.

An essential pre-requisite to generating an oligopoly solution is the restriction that Eaton and Kierzkowski (1984) impose on the number of varieties that are demanded. Two cases are considered, first where there is only one type of consumer that demands a specific variety; second, where there are two types of consumers each demanding a different ideal variety. In the two-consumer case, there will be no more than two firms, each specialising in one variety, in equilibrium. In order to reach this conclusion, rules concerning entry have been specified.

> Entry into the market for differentiated good is unrestricted. If an entrant believes that it will make profit it can enter. However, as already mentioned, entry is sequential rather than simultaneous. One firm decides to enter the market with a specific variety; the subsequent firm take this variety as given and decides whether or not to enter. Taking the two-consumer case, $n_1$ consumers demand variety $\theta_1$ and $n_2$ consumers demand variety $\theta_2$. The varieties $\theta_1$ and $\theta_2$ are considered to be horizontally differentiated. The number of firms in the market depends on $k, c, n_1, n_2$, prices of different varieties, and the economic distance or in other words, the extent of the difference of the production functions between $\theta_1$ and $\theta_2$. If $k$ and $c$ are very large but $n_1, n_2$ and $p$ are very low, then a new entry would be unprofitable. However, if $k$ and $c$ are sufficiently small and $n_1, n_2$ and $p$ are sufficiently large, then a new entry would be encouraged. As long as two incumbent firms are producing varieties $\theta_1$ and $\theta_2$ further profitable entry is impossible, since Bertrand price competition drives the price to marginal cost of at least one firm. As a result, in equilibrium, there will be no more than two firms in two-consumer case in the Eaton and Kierzkowski model (Greenaway, 1987).

After giving the basic features of a single economy under autarky, Eaton and Kierzkowski (1984) provided an explanation of a shift from autarky to trade by introducing a second economy. They realised that when trade opens up, the

number of varieties traded, the number of firms producing those varieties and the magnitude of the net benefits of trade clearly depend on the initial assumptions made with regard to autarky in the trading economies or more specifically depend on the autarkic distribution of preferences in each country. The distance on the product spectrum between pre-trade and post-trade varieties and whether there is any overlap is also important. If, for instance, economies are identical, then the opening of trade will result in a single producer of each variety, with each being sold at a lower price. In the event that one producer is located in each country we would clearly have IIT in horizontally differentiated products, or in other words HIIT.

> In the Eaton-Kierzkowski model, however, this need not necessarily follow, because there is a homogenous good sector and, in some circumstances, one country can specialise in both varieties of the differentiated good, exchanging this for the homogenous good (Greenaway, 1987).

In this case the direction and type of international trade will not be IIT but it will be inter-industry trade.

### 2.1.2 Models of Vertical Intra-Industry Trade

The distinction between vertical and horizontal models is an important one. HIIT models are usually expressed as a way of explaining IIT flows between developed countries. However, IIT between developed and developing countries, namely VIIT, may be expected to be of a different kind and caused by other factors than IIT among developed countries themselves. That is to say, VIIT models require a modification of the usual explanations.

An essential and innovative element in VIIT models is the postulation of vertical product differentiation by quality as the crucial determinant in IIT between developed and developing countries.

> Furthermore, vertical models can explain IIT without recourse to scale economies and imperfect competition and hence, without seriously vitiating the precepts of the H-O-S theorem. This is not the case for the horizontal models in which the interaction between economies of scale, (horizontal) product differentiation and imperfect competition are essential ingredients (Tharakan and Kerstens, 1995).

It can be said that a fairly large percent of VIIT takes place in 'perfectly competitive' markets. The first explicit paper concerning VIIT in perfectly competitive markets is Falvey (1981). In this paper, Falvey showed that VIIT may arise in situations where large numbers of firms produce varieties of different qualities without increasing returns in production. By this way he has extended the H-O-S theorem to construct the neo-Hecksher-Ohlin model.

Although not as widespread as the neo-Hecksher-Ohlin model, Shaked and Suttan (1984) has constructed a VIIT model in which the number of firms is endogenous. In their 1984 paper Shaked and Suttan showed that VIIT may also arise in a market structure with small numbers of firms and increasing returns to scale unlike the neo-Hecksher-Ohlin model.

These two models of VIIT can be distinguished depending on the market structure on which they are based. The Neo-Hecksher-Ohlin model exists under 'perfectly competitive' markets, while the Shaked and Suttan model exists under 'natural oligopoly'.

#### 2.1.2.1 Neo-Hecksher-Ohlin Models

This approach can be considered as an alternative to that of modelling IIT as a consequence of scale economies and monopolistic competition. The first paper on this approach is Falvey (1981). Falvey (1981) attempts to minimize the departure from the traditional H-O-S theorem by modifying the standard framework in a minor fashion. In the traditional $2 \times 2 \times 2$ H-O-S model, two factors are used to produce two commodities in two countries. This model assumes that differential factor endowments that cause autarkic factor price differences between the potential trading partners are the reason for trade. There is also the assumption of constant returns to scale in the H-O-S model. Falvey (1981) retains these two central assumptions of traditional theory. However, for the sake of extending the H-O-S model, he makes two crucial modifications.

> First, he assumes that one of the two factor inputs used in each industry (capital) is specific to that industry. The second modification is that each industry is no longer assumed to produce a single homogenous product, but instead can produce a range of products using as inputs labour and its own industry specific capital, in other

> words, at least one industry is assumed to produce a differentiated commodity. The commodity concerned is vertically differentiated, differentiated with respect to quality (Greenaway, 1987).

Falvey (1981), after touching upon his basic modifications, constructs the closed economy features of the Neo-Heckscher-Ohlin model. The industry under consideration is assumed to posses a given stock of capital $(K)$ and to be able to hire labour $(L)$ at the given wage rate $(w)$. Using the services of $K$ and $L$, the industry can produce a range of products, which will be referred to as different 'qualities'. On the supply side, product quality is determined by the capital-labour ratio $(\alpha)$ used in the production. Higher quality products require more capital-intensive techniques and therefore have higher prices. On the other hand, from the demand side, demand for each quality is taken to be a function of the prices of all qualities and total consumer income.

> Consumers are assumed to prefer high quality to low quality products. Since, however, choice is income constrained some consumers will initially be confined to some low quality variety with substitution towards higher qualities resulting from income increases (Greenaway, 1987).

Trade conditions of the neo Heckscher-Ohlin model are again explained by Falvey (1981). According to Falvey (1981) trade takes place in a two-country (home and foreign) world, in each of which the industry under consideration has a given capital stock (*K and K*,* respectively) and faces given wage rates (*w and w**, respectively). Capital is industry specific and internationally immobile, but is freely mobile in the production of this industry's various qualities in each country. The returns to capital (*r and r*,* respectively) adjust so as to maintain the full employment of the two capital stocks. Each industry is assumed to be perfectly competitive. Then, for any given returns to capital in the two countries, domestic production costs $(c)$ and foreign production costs $(c^*)$ for a given quality $\alpha_i$ can be represented as

$$c = w + \alpha_i r \tag{2.20}$$

$$c^* = w^* + \alpha_i r^* \tag{2.21}$$

It is assumed that the home (foreign) country is relatively well endowed with capital (labour) resulting in $w^*<w$ and $r^*>r$. Given these autarkic factor price differences the home country will enjoy a comparative advantage in a range of high quality products while the foreign country enjoys a comparative advantage in a range of low quality products. To see this Falvey (1981) identifies the 'marginal quality' $\alpha_1$, such that

$$c(\alpha_1) - c^*(\alpha_1) = 0$$

or,

$$w + \alpha_1 r - (w^* + \alpha_1 r^*) = 0 \tag{2.22}$$

and correspondingly

$$\alpha_1 = \frac{w - w^*}{r^* - r} \tag{2.23}$$

For all other qualities,

$$c(\alpha_i) - c^*(\alpha_i) = \frac{w - w^*}{\alpha_1}(\alpha_1 - \alpha_i) \tag{2.24}$$

It can be seen from (2.24) that the home country has a comparative advantage whenever

$$\left(c(\alpha_i) - c^*(\alpha_i)\right) < 0$$

Since $w^* < w$, $\frac{\left(w - w^*\right)}{\alpha_1} > 0$, therefore

$\left(c(\alpha_i) - c^*(\alpha_i)\right) < 0$ if and only if $\alpha_1 < \alpha_i$.

From (2.24) it is apparent that the home country has a comparative advantage in those qualities which require more capital-intensive techniques than the marginal quality, and is at a comparative cost disadvantage in the other (lower) qualities. Therefore the higher wage home country will specialise and export those qualities above the margin $(\alpha_i > \alpha_1)$, and import the below marginal qualities $(\alpha_i < \alpha_1)$.

> Since higher quality requires higher capital-intensity in production, the capital abundant country exports relatively high quality products while the labour abundant country exports relatively low quality products and IIT occurs as a consequence of countries' specialisation in the production of different varieties (Torstensson, 1996).

An extension of this work can be found in Falvey and Kierzkowski (1987). IIT is derived in a manner similar to that described above. One extension is that the capital-abundant country will have a comparative advantage in higher quality goods and this advantage will become larger as one moves up the quality spectrum. Further the model implies that vertically differentiated products will be distinguishable in terms of both quality and price. The Falvey and Kierzkowski models are of importance since many international markets are characterized by IIT in vertically differentiated goods.

#### 2.1.2.2 Shaked and Suttan Model

In a series of papers (Shaked and Suttan 1982; 1983; 1984) Shaked and Suttan examined the case of 'natural oligopoly' and trade in vertically differentiated products. They focused on situations where the number of firms that can enter a market with new, higher-quality varieties is bounded by the demand and supply characteristics of the market. According to Shaked and Suttan (1984) large numbers of qualities would be available if the income range is wide, fixed (R&D) costs associated with quality improvements are low and average variable costs rise sharply as a result of quality improvements.

> By contrast, if unit variable cost doesn't rise steeply with quality – this case is likely to be relevant in situations where the main burden of quality improvements falls on fixed costs, rather than increases in labour and raw material inputs – then an upper bound exists to the number of firms which can survive with positive market shares, and prices in excess of unit variable cost, at a Nash-equilibrium in prices.

> This later situation is denoted as the 'natural oligopoly' case. (Shaked and Suttan,1984).

Basic autarky and trade features of the Shaked and Suttan model are explained by Williamson and Milner (1991) by reference to Shaked and Suttan (1982; 1983; 1984). In the Shaked and Suttan model under autarky conditions, only two home firms producing distinct qualities can survive, given the country's income distribution. The reason for this is that competition on quality drives all firms to produce the highest quality possible, but (Bertrand) price competition between similar qualities drives price to marginal cost and causes the exit of firms.

According to the Williamson and Milner (1991) the Shaked and Suttan model analyses the impacts of the opening of trade under two different approaches: identical economies approach and different economies approach. If the two economies are identical in all respects, their combined market will still support only two firms. Given the competition in quality and in price referred to above, the number of firms that can be supported is independent of market size. When trade opens up, therefore, two of the firms will exit and two will remain to serve the joint market. A priori it is impossible to predict the direction and type of trade involved in this case. However, in the event that one firm from each country exists, the result will be IIT in vertically differentiated products. But, if the two economies are different, differences in income distribution facilitates a larger number of firms in the post-trade equilibrium, with the higher (average)-income country specialising in a range of higher quality products and the lower (average)-income country specialising in lower-quality products. Since trade drives down prices in general and consumers prefer higher quality, it is lowest-quality firms that tend to be driven from the market. Thus, other things being equal, VIIT is more likely, the greater the degree of taste overlap between economies. The opening of two-way trade will be welfare improving in both of the above cases, since competition will drive down prices, while market expansion will induce overall quality improvement.

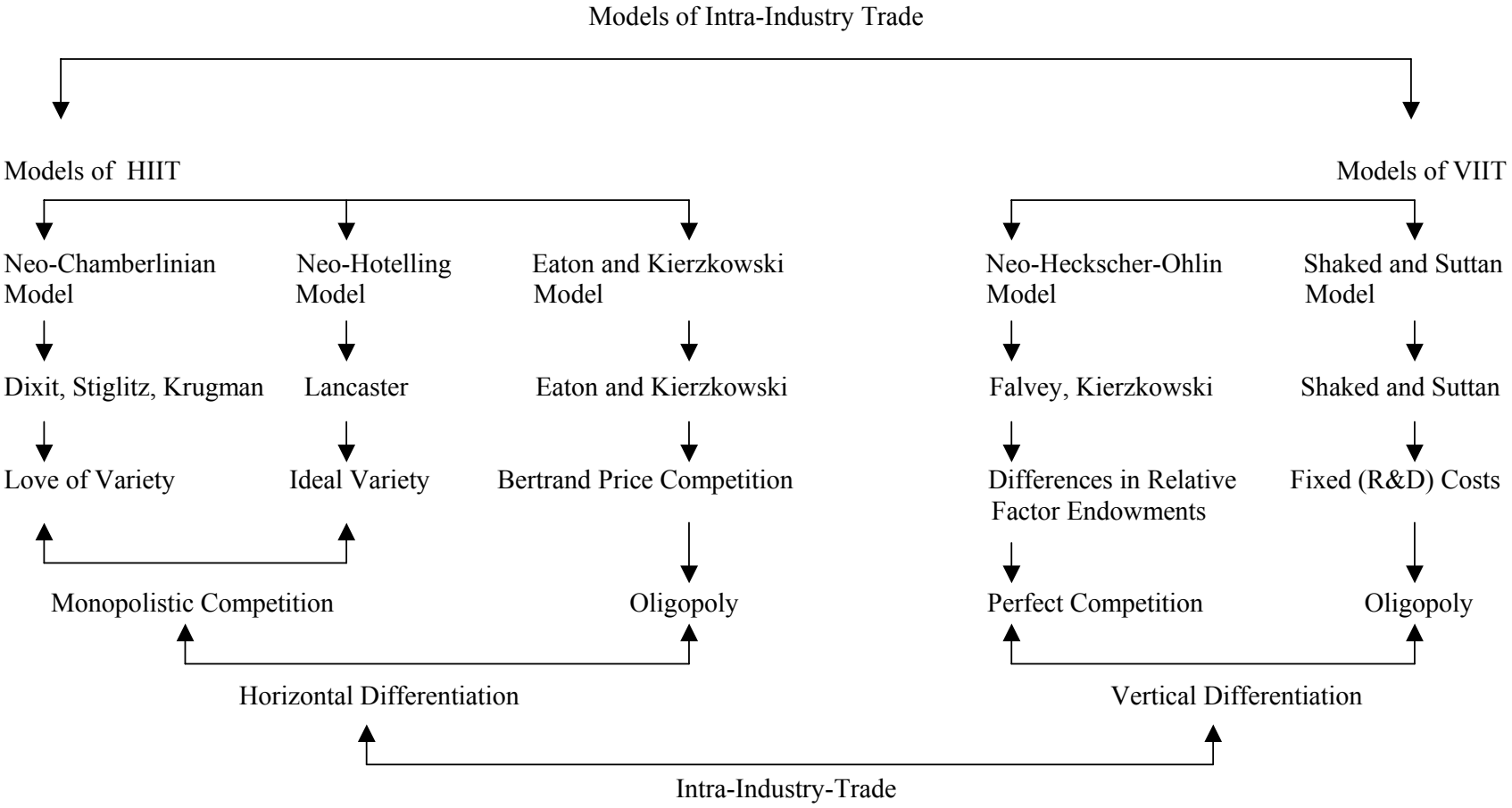
As a result, according to the Shaked and Suttan model, the more dissimilar the economies are, the larger the number of producers will be and the more the

distribution of income becomes closer, the lower the number of firms in the combined economy. This result is similar to the concept of trade overlap concerning the Linder (1961) hypothesis.

### 2.1.3 Concluding Remarks on Theories of HIIT and VIIT

Various approaches to the explanation of the two-way international exchange of vertically and horizontally differentiated goods have been outlined in sections 2.1.1 and 2.1.2 The models discussed are capable of explaining the different sources and determinants of IIT and the different market structures that allow the emergence of IIT. However, it is quite difficult to collect the predictions of these models under the same roof, because they vary in their assumptions regarding consumer preferences, returns to scale, entry conditions, product differentiation and cost conditions. Table 1 tries to summarize the theoretical models mentioned above (Memiş, 2001).

**Table 1.** Overall Summary of Founder and Determinants of HIIT and VIIT Models



## 2.2 The Empirical Analysis of Vertical and Horizontal IIT

The literature on empirical analysis can be broadly sub-divided into studies that are primarily of a documentary nature and studies that are primarily of an explanatory nature. The former tend to report the results of calculating HIIT and VIIT at a particular point or points in time for a given country (or countries). The latter attempts to explain observed country or industry differences in HIIT and VIIT and, increasingly, take an econometric approach.

### 2.2.1 Documentary Studies

Documentary studies are relatively straightforward when compared with econometric ones.

> The scope of studies completed so far covers developed market economies (e.g. Aquino, 1978; Caves, 1981; Greenaway, 1983; Balassa, 1986; Jordan, 1993), less developed countries (e.g. Balassa, 1979; Lundberg, 1988; Schüller, 1995) and centrally planned economies (Lee and Lee, 1993; Greenaway, 1984; Hellvin, 1996). As well as providing a very extensive data bank of evidence on recorded IIT, these studies also provide sufficiently comprehensive information on the features of the phenomenon. For example, the growth of average levels of IIT appears to be directly related to the growth of per capita income; average level of IIT appear to be higher in developed market economies than less developed countries and centrally planned economies; recorded IIT seems to be higher in countries that are party to some kind of integration arrangement, such as the European Union; levels of IIT tend to be considerably higher in manufactures than in non-manufactures. These can be regarded as 'stylised facts' because of the regularity with which they are observed. In all cases, the 'facts' are readily explainable. Informal empiricism leads one to expect, for instance, that IIT should be more widespread in manufactures than in non-manufactures, since it seems reasonable to suppose that product differentiation and scale economies are likely to be more common in manufacturing activities. However, going beyond casual empiricism and testing specific hypothesis relating to the growth or pattern of IIT was necessary to obtain more formal results. (Greenaway and Milner, 1987).

Econometric studies have accelerated to fulfil this aim.

### 2.2.2 Econometric Studies

Unlike documentary studies, econometric analysis of this issue encompasses several methodological and practical difficulties. For example there are genuine problems in testing specific models that may differ only in assumptions. Even when one has specified a model to be tested, many variables included in the model are quite difficult to proxy, product differentiation and scale economies being the obvious examples. In spite of these shortcomings a dozen or so econometric analyses that test hypothesis relating to country and industry characteristics have now been published. These studies differ in their country and industry coverage, the time period encompassed, the specifications of their models, the proxies used and even in the manner in which they measure IIT.

After the confirmation of the fact that country specific and industry specific variables affect HIIT and VIIT differently, econometric analyses testing hypothesis related to country and industry characteristics of determinants of HIIT and VIIT separately have developed. For this purpose, Greenaway, Milner and Elliot (1999) have constructed econometric models of HIIT and VIIT taking country characteristics and industry characteristics as explanatory variables.

In their HIIT model, Greenaway, Milner and Elliot (1999) seek to test the Chamberlinian-Heckscher-Ohlin model by using horizontal, rather than total, IIT as the dependent variable. The model of HIIT that they test is as follows:

$$HB_{jk} = \alpha_0 + \alpha_1 \left| \frac{Y_j}{N_j} - \frac{Y_k}{N_k} \right| + \alpha_2 \left( \frac{Y_j + Y_k}{2} \right) + \alpha_3 \left| Y_j - Y_k \right| + \alpha_4 PD_j + \alpha_5 MS_j + \alpha_6 SE_j + \alpha_7 MNE_j + e_j \qquad (2.25)$$

where

$HB_{jk}$ = Share of HIIT in a country's bilateral trade in industry $j$ with country $k$

$Y$ = National income ($i$ = home country, $k$ = trading partner)

$N$ = Population size

$PD_j$ = Proxy for horizontal product differentiation in industry $j$

$MS_j$ = Measure of market structure in industry $j$

$SE_j$ = Proxy for (minimum efficient) scale in industry $j$

$MNE_j$ = Measure of importance of multinational enterprises in industry $j$

The expected signs of this regression equation are $\alpha_1 < 0$, $\alpha_2 > 0$, $\alpha_3 < 0$, $\alpha_4 > 0$, $\alpha_5 > 0$, $\alpha_6 < 0$, $\alpha_7 > 0$. By using the expected signs, the country characteristics and industry characteristics of the determinants of HIIT are given by Greenaway, Milner and Elliott (1999) respectively as follows:

i.) Country characteristics:

1.) The smaller the difference in capital stock per worker (a proxy for income per capita) between two countries, greater will be the share of HIIT ($\alpha_1 < 0$).
2.) The greater the average market size of two countries, greater will be the share of HIIT ($\alpha_2 > 0$).
3.) The smaller the difference in absolute income between two countries, greater will be the share of HIIT ($\alpha_3 < 0$).

ii.) Industry characteristics:

1.) The greater the degree of horizontal product differentiation, greater will be the share of HIIT ($\alpha_4 > 0$).
2.) The greater the number of firms in an industry, greater will be the share of HIIT in that industry ($\alpha_5 > 0$)
3.) The smaller the minimum efficient scale, larger will be the number of firms, larger will be the number of horizontally differentiated varieties and so greater will be the share of HIIT ($\alpha_6 < 0$)
4.) The greater the involvement of multinationals, greater will be the share of HIIT ($\alpha_7 > 0$)

> Models of VIIT are rarer, being theoretically more intractable. They date from the seminal contributions of Falvey (1981) and Shaked and Suttan (1984). The model of Falvey predicts that the share of VIIT will be larger for any pairs of countries, the greater the difference in the capital/labour endowment or per capita income. Further, he expects that the amount of VIIT be positively related to the average market size of the two countries. Industry specific factor are less precisely defined. There is no scale economies motive for specialisation but there is a market with large numbers of firms. Shaked and Suttan (1984) have quite a different framework altogether. Theirs is a model with much more explicit role for market structure, with IIT being driven by scale economies which are significant relative to the total market. (Greenaway, Milner and Elliott, 1999).

By taking the theoretical framework of the VIIT model into account, Greenaway, Milner and Elliott (1999) draws the econometric model of VIIT as follows:

$$VB_{jk} = \beta_0 + \beta_1 \left| \frac{Y_j}{N_j} - \frac{Y_k}{N_k} \right| + \beta_2 \left( \frac{Y_j + Y_k}{2} \right) + \beta_3 PD_j + \beta_4 MS_j + \beta_5 SE_j + \beta_6 MNE_j + e_J \tag{2.26}$$

where

$VB_{jk}$ = Share of VIIT in a country's gross bilateral trade in industry *j* with country *k*

In this regression equation that takes the VIIT as control variable, expected signs are given as $\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 < 0$, $\beta_{4<}^{>} 0$, $\beta_{5<}^{>} 0$, $\beta_6 > 0$. By using the expected signs, the country characteristics and industry characteristics of the determinants of VIIT are given by Greenaway, Milner and Elliott (1999) respectively as follows:

i.) Country characteristics:

1.) The greater the difference in capital stock per worker between two countries, greater will be the share of VIIT ( $\beta_1 > 0$ ).
2.) The greater the average market size of two countries, greater will be the share of VIIT ( $\beta_2 > 0$ ).

ii.) Industry characteristics:

1.) The smaller the degree of horizontal product differentiation, greater will be the share of VIIT ( $\beta_3 < 0$ ).

2.) The greater the involvement of multinationals, greater will be the share of VIIT ( $\beta_6 > 0$ ).

According to Greenaway, Milner and Elliott (1999), ambiguity in expected signs of $\beta_4$ and $\beta_5$ stems from the difference in theoretical assumptions of Falvey (1981) and Shaked and Suttan (1984) regarding scale economies and market structure.

As a result, although the diversity in theoretical models creates some difficulties, the separation of horizontal and vertical differentiation facilitates empirical analyses and allows the investigation of the empirical robustness of alternative models.

### 2.2.3 Concluding Remarks on Empirical Analysis of HIIT and VIIT

**'**On Empirical Evidence' it has now been reached a point where a significant body of literature exists both of an econometric and of a documentary nature. The evidence, which now applies to a large number of countries, provides a more complete understanding of the factors that explain IIT than a decade ago.

After briefly summarizing the theoretical and empirical models behind HIIT and VIIT in this chapter, in the following chapter, measurement of IIT and its decomposition as vertical and horizontal IIT will be discussed.

# CHAPTER 3

# MEASUREMENT OF VERTICAL AND HORIZONTAL INTRA-INDUSTRY TRADE

Although several measures of IIT appeared in the sixties (Verdoorn 1960, Michaely 1962, Kojima 1964, Balassa 1966), none of them could go beyond a preparatory study. Grubel and Lloyd (1971, 1975) has been the pioneer study in the development of explicit papers concerning the measurement of IIT. The solution proposed by Grubel and Lloyd (GL) was subsequently disputed by Aquino (1978), who was later criticised by Greenaway and Milner (1981, 1983). By the aid of these papers, the measurement issue has advanced a lot in the literature.

Developments in measures of ITT have prepared the ground for an important refinement in the IIT literature. This refinement was the decomposition of IIT as horizontal and vertical, which has been done theoretically since the early 1980s. Abd-el Rahman (1991) was the first in decomposing IIT by using unit value measures. His method was later utilised by Greenaway, Hine and Milner (1994) to obtain an index on the measurement of HIIT and VIIT separately.

In the following sections the measures of IIT and the measures of HIIT and VIIT will be analysed.

## 3.1 The Measures of IIT

The definition of industry and the aggregation problem can be regarded as the principal complication with the measurement of IIT. According to Grubel and Lloyd (1975) each statistical class of traded goods, regardless of the level of aggregation, is considered to represent the trade of an 'industry'. Before

calculating the IIT indices, it is necessary to aggregate commodities in order to arrive at meaningful industry categories.

> For instance, in the United Nation's Standard International Trade Classification (SITC) system each industry category is comprised of a number of sub-classes of products that are similar, but nonetheless not perfectly homogenous (Pagoulatos and Sorensen, 1975).

The aggregation system is a very problematic issue and creates controversy among scholars. According to Grubel and Lloyd (1975), the criteria of aggregation are the extent of commodities' substitutability in consumption and the similarity of input requirements in production. However, according to Pagoulatos and Sorensen (1975), an industry may often contain products that have quite distinct input requirements. Furniture made of wood and steel, for instance, are classified in a common industry category (SITC: 821, Rev3) even though the input requirements are substantially different. These problems can be overcome by taking the 3-digit or 2-digit level of trade statistics as the most conventional definition of an industry.

After touching upon the basic problems of measures of IIT, a survey of IIT measures constructed since the mid of sixties will be explained in what follows.

### 3.1.1 Balassa Index

A variety of measures of IIT have been offered in the sixties. Although these measures have not dealt with IIT directly, they have prepared the ground for the explicit measures of IIT. Perhaps the most important of these was that proposed by Balassa (1966). "In his 1966 work, Balassa used several indices to question whether the EEC (European Economic Community) led to inter- or intra-industry specialisation" (Vona, 1991). His indices are presented in the following formulas:

$$B_i = \frac{|x_i - m_i|}{x_i + m_i} \tag{3.1}$$

$$B = \frac{1}{n}\sum_{i=1}^{n} B_i \tag{3.2}$$

where $x_i$ and $m_i$ indicate the exports and imports of a certain country in industry $i$. Summing across industries and taking the arithmetic mean leads to a measure ($B$) of the degree of a country's inter-industry specialisation (the complement to unity of $B$ measures the degree of intra-industry specialisation).

If exports and imports match each other in each industry, the index approaches zero. According to Balassa, this signifies a low degree of inter-industry specialisation (with a correspondingly high degree of intra-industry specialisation) On the other hand, if exports and imports differ widely, the index approaches unity, indicating high inter-industry specialisation (and low intra-industry specialisation).

### 3.1.2 Grubel and Lloyd Index

Balassa's (1966) index laid the foundation for Grubel and Lloyd (GL) index proposed in 1971.

> However, Grubel and Lloyd (1971) criticized Balassa's index both because it is a simple arithmetic mean of each industry's index (and thus fails to reflect the different weight of each industry) and it does not consider corrections for trade imbalances (Vona, 1991).

By a simple modification of the Balassa index, Grubel and Lloyd (1971) have introduced their own indices.

Grubel and Lloyd (1971) analysed GL indices as GL index at an elementary industry level ($GL_i$) and GL index for all trading industries ($GL$). GL index for the $i$ th industry is given as:

$$GL_i = (1 - B_i) = \left(1 - \frac{|x_i - m_i|}{x_i + m_i}\right) = \frac{(x_i + m_i) - |x_i - m_i|}{(x_i + m_i)} \tag{3.3}$$

where $i$ = the $i$ th of $n$ industries at a given level of statistical aggregation. $GL_i$ measures IIT (the numerator of the fraction) as a percentage of the country's trade in commodity $i$. Its value ranges between zero (when either $x_i$ or $m_i$ is zero

so that there is no IIT in commodity $i$) and 1 (when $x_i = m_i$, so that all trade in commodity $i$ is IIT).

The second direction of GL index at an elementary industry level involves the comparison of the $GL_i$'s at the different levels of aggregation.

> For the $i$ th industry, at a particular level of aggregation, $x_i$ and $m_i$ are each made up of the exports and imports of industries defined at a more disaggregated level (a higher level of the SITC), called $x_{ij}$ and $m_{ij}$ respectively. In this situation, the percentage of IIT for the $i$ th industry is calculated by using the sums $\sum_j x_{ij}$ and $\sum_j m_{ij}$ (Grubel and Lloyd, 1971):

$$GL_{i,A} = \frac{\sum_j \left(x_{ij} + m_{ij}\right) - \left|\sum_j x_{ij} - \sum_j m_{ij}\right|}{\sum_j \left(x_{ij} + m_{ij}\right)} \tag{3.4}$$

where $i =$ *ith* of n industries at a given level statistical aggregation, $j =$ the component sub-group categories at the $i-1$ level of aggregation. However, the $GL_{i,A}$ index can be distorted as a result of categorical aggregation.

> Because, as Gray (1979) already recognised, aggregation bias induced by 'opposite sign effect' arises when sub-group trade imbalances have opposite signs. If, for example, one is measuring IIT for a given third digit industry $i$ that comprises two fourth digit sub-groups, with different factor ratios, aggregation of opposite signed imbalances will serve unambiguously to inflate $GL_{i,A}$[8]. If the sub-group imbalances all have the same sign, $GL_{i,A}$ turns out to be a sum of the individual trade weighted sub-group indices (Greenaway and Milner, 1983).

[8] Suppose industry $i$ comprises sub-industries a and b,

$$GL_{i,A} = \left[1 - \frac{\left|x_a + x_b - m_a - m_b\right|}{\left(x_a + x_b + m_a + m_b\right)}\right]$$

If $(x_a - m_a) > 0$ while $(x_b - m_b) < 0$ aggregation will result in them offsetting each other. If in the limit $\left|x_a - m_a\right| = \left|x_b - m_b\right|$ a $GL_i$ index of 1 would be recorded suggesting that all trade in the product group was of an intra-industry type

If no adjustment is made for categorical aggregation, there will be obvious hazards in the interpretation of empirical results. Computation of an adjusted measure of $GL_{i,A}$ index is a way in which one can attempt to establish the influence of aggregation bias. An adjusted index of $GL_{i,A}$ for categorical aggregation is as follows:

$$C_i = \left[ 1 - \frac{\sum \left| x_{ij} - m_{ij} \right|}{\sum \left( x_{ij} + m_{ij} \right)} \right] \tag{3.5}$$

where $0 \le C_i \le GL_{i,A} \le 1$.Thus, for example, rather than summing exports and imports in a number of fourth-digit sub-groups and then taking their absolute difference for the numerator (as in $GL_{i,A}$), one sums the absolutes values of individual fourth-digit imbalances to obtain the numerator. Clearly, when all fourth-digit imbalances have the same sign, $GL_{i,A} = C_i$, if they have differing signs $C_i < GL_{i,A_i}$ . Therefore, when $C_i$ rather than $GL_{i,A}$ is used, the opposite signed imbalances do not offset each other and the resultant measure becomes free of this distortion.

While calculating GL index at country level (*GL*) Grubel and Lloyd (1971) takes into account their criticism about Balassa index (3.2). Therefore, they propose a weighted average of the values of $GL_i$, with weights given by the relative size of each industry's exports plus imports in the total value of exports plus imports of the N industries. The weighted average was then defined by the following formula:

$$GL = \sum_{i=1}^{N} GL_i \left( x_i + m_i \right) / \sum_{i=1}^{N} \left( x_i + m_i \right) = \frac{\sum_{i=1}^{N} \left[ \left( x_i + m_i \right) - \left| x_i - m_i \right| \right]}{\sum_{i=1}^{N} \left( x_i + m_i \right)} \tag{3.6}$$

By comparison of their own indices at different levels of aggregation and by modification of Balassa indices, Grubel and Lloyd (1971,1975) discussed the measurement problems explicitly.

### 3.2 The Measures of Vertical and Horizontal IIT

Confounding horizontal and vertical IIT may result in non-robust empirical findings, because, as Abd-el-Rahman (1991) and Greenaway et al. (1995) already pointed out, the determinants of each type of IIT differ. After the realisation of this fact in the nineties, attempts to break down total IIT into HIIT and VIIT has accelerated in a considerable manner.

Several different methods for measuring quality differences in trade were proposed in order to assess the relative importance of horizontal and vertical IIT.

> The most important of them was the one proposed by the Abd-el Rahman (1991). His method for measuring quality differences has been based on the use of unit value (UV) indexes which measure the average price of a bundle of items from a given product grouping. He utilized relative unit values of exports and imports to decompose IIT into horizontal and vertical IIT" (Greenaway, Hine and Milner (1994)). "The rationale for using UVs as an indicator of quality is the presumption that a variety sold at a higher price will typically be of higher quality than a variety sold more cheaply (Stiglitz, 1987).
>
> Unit Values themselves may be computed in several ways, for example per item, per tonne or per square metre. Torstensson (1991) has successfully used unit values per item to analyse the pattern of Swedish VIIT in relation to factor endowments. Oulton (1991) and Abd-el Rahman (1991) have employed unit values per tonne in study of U.K. and French trade respectively. However, this does not mean that the use of unit value measure brings no problems. One problem with using unit values per item as a measure of quality is that unit prices may be a function of size as well as other characteristics which are more related to quality (for example durability, dependability) and, in some cases, the latter may be inversely related to size. Thus, a more expensive, large but poorly finished car can be regarded as of lower quality than a smaller, cheaper but well-finished car. Unit values per tonne are similarly problematic. For example, a higher quality product may be made out of heavier material so that its value per tonne is lower than that of an inferior quality item. (Greenaway, Hine and Milner, 1994).

But, these problems are not as important as to prevent the use of the UV measure in practice.

Abd-el-Rahman's (1991) methodology of using relative unit values of exports and imports in disentangling horizontal from vertical IIT have been utilized by Greenaway, Hine and Milner (1994, 1995) to construct a measure of horizontal and vertical IIT. For this purpose, they divided the IIT calculated at 5-digit SITC level for U.K. trade into horizontal and vertical components using relative UVs of exports and imports. They defined HIIT as the simultaneous export and import of a 5 digit SITC product where the UV of export relative to UV of import lies within a range of $\mu$ 15 percent and defined IIT as vertical if relative UVs lie outside this range.

More Formally, letting $UV_{ij}^{m}$ denote the unit values of imports at the 5-digit level (j) and $UV_{ij}^{x}$ denote the unit value of exports at the 5-digit level, horizontally (H) differentiated products are taken to be those that satisfy

$$1-\alpha \leq \frac{UV_{ij}^{x}}{UV_{ij}^{m}} \leq 1+\alpha \tag{3.7}$$

and vertically (V) differentiated products are taken to be those that satisfy

$$\frac{UV_{ij}^{x}}{UV_{ij}^{m}} \langle 1-\alpha \quad \text{or} \quad \frac{UV_{ij}^{x}}{UV_{ij}^{m}} \rangle 1+\alpha \tag{3.8}$$

Vertically differentiated products are further subdivided as low quality vertical products (if relative unit values of exports to imports is less than $1-\alpha$) and high quality vertical products ( if relative unit values of exports to imports is greater than $1+\alpha$). The dispersion factor $\alpha$ may taken to be 0.15 or 0.25.

To obtain an explicit measurement of HIIT and VIIT for the 3-digit sector, take the total number of 5-digit sector in that sector as $n$ and assume that $n_1$ of them exhibit HIIT and $n_2$ of them exhibit VIIT. Then

$$HB_i = \frac{\sum_{i=1}^{n_1}\left((x_{ij} + m_{ij}\right) - \sum_{i=1}^{n_1}\left|x_{ij} - m_{ij}\right|}{\sum_{i=1}^{n}\left(x_{ij} + m_{ij}\right)} \tag{3.9}$$

$$VB_i = \frac{\sum_{i=1}^{n_2}\left((x_{ij} + m_{ij}\right) - \sum_{i=1}^{n_2}\left|x_{ij} - m_{ij}\right|}{\sum_{i=1}^{n}\left(x_{ij} + m_{ij}\right)}$$

so that the GL index for the 3-digit sector obtained as a weighted average of the i-digit sector, $B_i$, may be expressed as

$$B_i = HB_i + VB_i \tag{3.10}$$

Constructing an explicit measurement for HIIT and VIIT at country level is similar to that for total IIT. For this purpose, we take the total number of 3-digit industries as $N$ and assume that $N_1$ of them exhibit HIIT while $N_2$ of them exhibit VIIT. Then

$$HB = \frac{\sum_{i=1}^{N_1}\left[\left(x_i + m_i\right) - \left|x_i - m_i\right|\right]}{\sum_{i=1}^{N}\left(x_i + m_i\right)} \tag{3.11}$$

$$VB = \frac{\sum_{i=1}^{N_2}\left[\left(x_i + m_i\right) - \left|x_i - m_i\right|\right]}{\sum_{i=1}^{N}\left(x_i + m_i\right)}$$

After summarising measures for IIT, HIIT, VIIT and UVs in this chapter, in the next chapter we will present our empirical work on the analysis of HIIT and VIIT for the Turkish manufacturing industry.

# CHAPTER 4

# EMPIRICAL ANALYSIS OF VERTICAL AND HORIZONTAL INTRA-INDUSTRY TRADE

## 4.1 The Data

In this study, we have computed the level of IIT, HIIT and VIIT indices for Turkish manufacturing industry at the 3-digit level, 5-digit level and at the country-level, for the years 1989 to 2001 by using the 5-digit data classified according to the SITC–Rev.3. The data used in calculating these measures were obtained from State Institute of Statistics. They are export and import figures given in quantity and in $US values and cover 3076 sectors at the 5-digit level. The names of the 3-digit categories included in SITC-Rev.3 are listed in Table A.1 of the appendix. The names and the associated calculations for the 5-digit industries take up an enormous part of this study. However, they will not be reported in the thesis but may be provided as excel files upon request.

## 4.2 Empirical Results of the GL Indexes

In this study we have dealt with the GL indices at the elementary industry level and at the country level. For this purpose, we first computed the $GL_i$ index as given in (3.3) for all 5-digit industries for the time period 1989-2001.

Although we have computed the $GL_i$ index for all 5-digit industries, this is not our main purpose; our main purpose is to obtain a GL index for 3-digit industries from the 5-digit data. Therefore, we have reconstructed our data so that each 3-digit industry comprises several 5-digit sub-groups. As we explained in chapter 3, GL index for 3-digit industries which comprises several sub-groups can

be computed in two ways. One of them is the $GL_{i,A}$ index which sums exports and imports in a number of 5-digit subgroups and then takes their absolute difference for the numerator as in equation (3.4). However, this method is problematic when the sub-group imbalances have opposite signs, because, opposite signed imbalances drives up the $GL_{i,A}$ index. Therefore, we have used the second method and computed the $C_i$ index which sums the absolute values of individual 5-digit imbalances to obtain numerator as in equation (3.5). Table A.2 of the appendix summarizes the results of our calculations of the $C_i$ index for 3-digit industries, between the time periods 1989-2001.

While calculating the GL index at the country level ($GL$) for the years 1989-2001, we have taken the weighted average of the values of the $C_i$ index as in equation (3.6), with weights given by the relative size of each 3-digit industry's exports and imports in the total value of exports and imports of the all 3-digit industries. The values of the aggregate $GL$ indexes for the years 1989-2001 are summarised in Table 2 and plotted in Figure 3. We note from Table 2 and Figure 3 that even though the level of IIT exhibits an upward sloping tendency, inter-industry trade is the dominant form in the trade of Turkish manufacturing industry for the years 1989-2001.

**Table 2.** Aggregate GL indexes, 1989-2001

| Years | GL Index | Years | GL Index |
|---|---|---|---|
| **1989** | 0,154 | **1996** | 0,206 |
| **1990** | 0,150 | **1997** | 0,214 |
| **1991** | 0,148 | **1998** | 0,236 |
| **1992** | 0,154 | **1999** | 0,254 |
| **1993** | 0,159 | **2000** | 0,252 |
| **1994** | 0,194 | **2001** | 0,288 |
| **1995** | 0,185 | | |

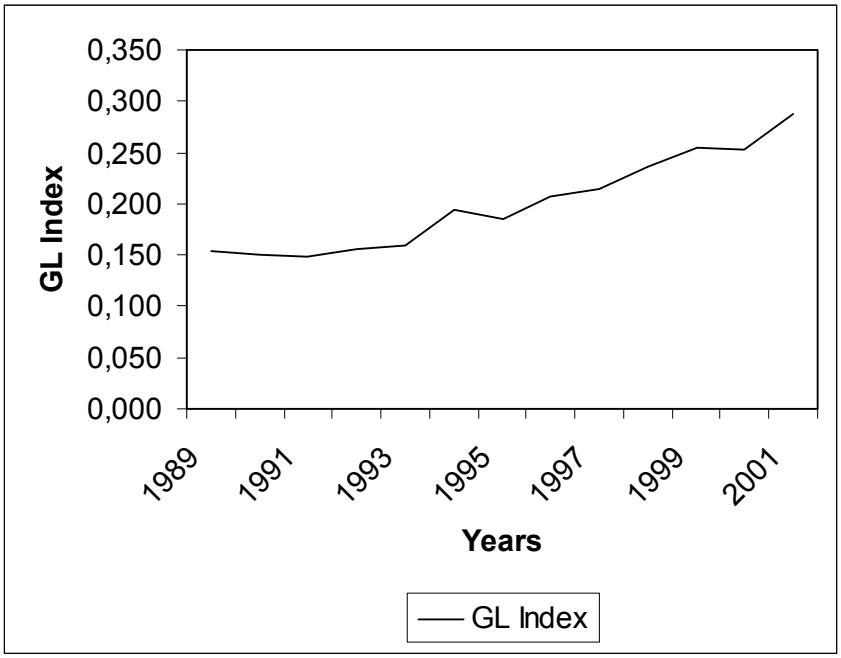



**Figure 3** Plot of Aggregate GL Indexes, 1989-2001

### 4.3 Empirical Results of Unit Value Calculations

In the previous section, we have computed the IIT indexes both at the elementary industry level and at the country level for the time period 1989-2001. Since our purpose is to decompose these IIT values into their horizontal and vertical components, we have to know in which industries the dominant form of trade is HIIT and in which VIIT. Therefore, in this section, we determined horizontal and vertical industries by computing the unit value (UV) indexes.

As already mentioned in the chapter 3, UV indexes measure the average price of a bundle of items from a given product grouping and the unit values of exports relative to the unit values of imports are utilised to decompose IIT into HIIT and VIIT. By using this definition of UV indexes, we first calculated the average price of exports and imports for a given 5-digit industry and we took their relative values to reach UV index for that 5-digit industry. Then, we repeated this

process for all 5-digit industries in our 5-digit data between the time periods 1989-2001.

After calculating the UV indexes for all 5-digit industries between the time periods 1989-2001, we have used the formula (3.7) and (3.8) in order to determine horizontal and vertical 5-digit industries. In this process, we took the dispersion factor as 0.15 ($\alpha = 0.15$) and arrived at the conclusion that in a 5-digit industry the dominant form of trade is HIIT if

$$0{,}85 \leq \frac{UV_x}{UV_m} \leq 1{,}15$$

and the dominant form of trade is VIIT if

$$\frac{UV_x}{UV_m} < 0{,}85 \text{ or } \frac{UV_x}{UV_m} > 1{,}15$$

VIIT can also be distinguished as high quality VIIT (if $\frac{UV_x}{UV_m} > 1{,}15$) and low quality VIIT (if $\frac{UV_x}{UV_m} < 0{,}85$). Moreover, in a 5- digit industry, the dominant form of trade is inter-industry trade if either of the UVs is zero. And, last of all, there are some 5-digit industries in which both export and import values are zero. We call such industries as no-trade industries. Distribution of 5-digit industries as vertical (LQ)[9] industries, vertical (HQ)[10] industries, horizontal industries, inter-industries and no-trade industries for the time period 1989-2001 have been presented in Table A.4.2 of the appendix. Based on this Table, we calculated the number of each type of 5-digit industries for each year between the time periods 1989-2001. The results are summarised in Table 3 and plotted in Figure 4.

The first thing one can easily notice from Table 3 is that nearly half of the 5-digit industries, out of 3075, are low quality vertical industries for each year.

[9] By vertical (LQ), we mean low quality vertical industries

[10] By vertical (HQ), we mean high quality vertical industries.

That is, almost half of the Turkish manufacturing industry exports low quality products while importing high quality products. When we analyse the Figure 4 we see that the number of low quality vertical industries rises steadily and reaches its maximum value of 1841 in 1998. Although it starts to decline in 1999, this decline can not compensate the previous rises. Therefore, when we compare 1989 and 2001, in 2001 there are more low quality production at the 5-digit level.

**Table 3.** Distribution of Number of 5-digit Vertical (LQ and HQ) Industries, Horizontal Industries, Inter Industries and No-Trade Industries, 1989-2001

| Years | Vertical(LQ) | | Vertical(HQ) | | Horizontal | | Inter-Industry | | No-Trade | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | # | % | # | % | # | % | # | % | # | % | |
| **1989** | 1427 | 46 | 558 | 18 | 239 | 8 | 729 | 24 | 122 | 4 | 3075 |
| **1990** | 1337 | 43 | 654 | 21 | 256 | 8 | 744 | 24 | 84 | 3 | 3075 |
| **1991** | 1373 | 45 | 614 | 20 | 259 | 8 | 714 | 23 | 115 | 4 | 3075 |
| **1992** | 1397 | 45 | 674 | 22 | 280 | 9 | 641 | 21 | 83 | 3 | 3075 |
| **1993** | 1381 | 45 | 789 | 26 | 278 | 9 | 543 | 18 | 84 | 3 | 3075 |
| **1994** | 1534 | 50 | 696 | 23 | 314 | 10 | 451 | 15 | 80 | 3 | 3075 |
| **1995** | 1551 | 50 | 743 | 24 | 315 | 10 | 399 | 13 | 67 | 2 | 3075 |
| **1997** | 1798 | 58 | 680 | 22 | 344 | 11 | 197 | 6 | 56 | 2 | 3075 |
| **1998** | 1841 | 60 | 630 | 20 | 324 | 11 | 201 | 7 | 79 | 3 | 3075 |
| **1999** | 1784 | 58 | 637 | 21 | 356 | 12 | 214 | 7 | 84 | 3 | 3075 |
| **2000** | 1708 | 56 | 661 | 21 | 392 | 13 | 239 | 8 | 75 | 2 | 3075 |
| **2001** | 1768 | 57 | 618 | 20 | 344 | 11 | 262 | 9 | 83 | 3 | 3075 |

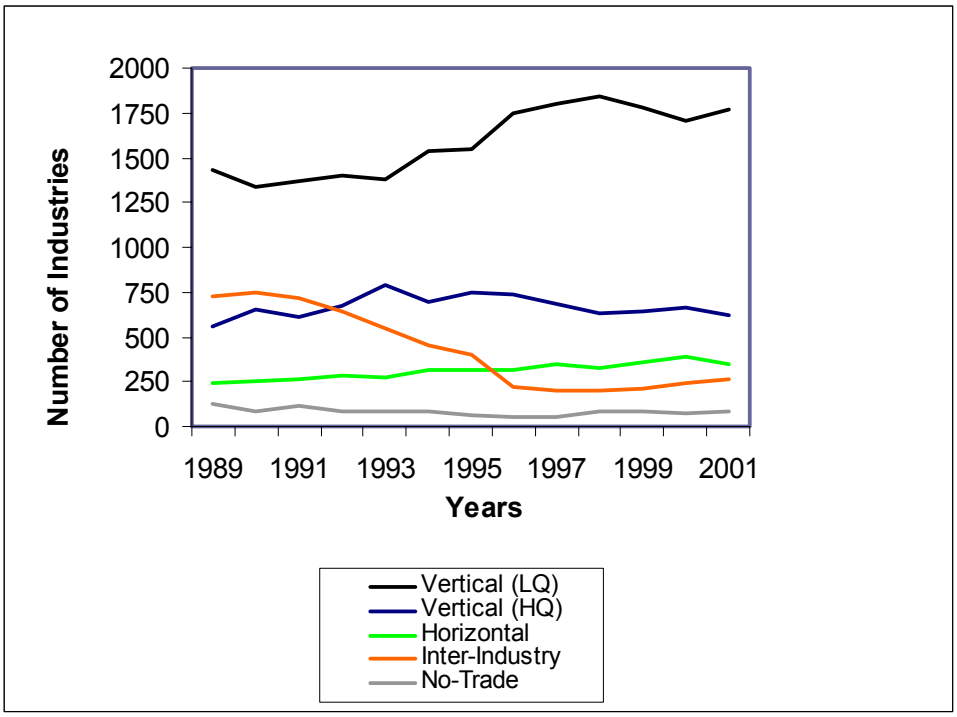



**Figure 4** Distribution of Number of 5-digit Vertical (LQ and HQ) Industries, Horizontal Industries, Inter-Industries and No-Trade Industries, 1989-2001

As we said above, nearly half of the total numbers of 5-digit industries are low quality vertical industries. According to Table 3, another half is shared by high quality vertical industries, horizontal industries, inter-industries and no-trade industries. We see from Figure 4 that the number of horizontal industries has always been below the number of low quality and high quality vertical industries. This means that our manufacturing industry is producing at extremes. That is, we are either producing goods of low quality compared to our neighbours or the reverse. The number of industries in which there is no quality difference between exports and imports, horizontal industries, are not so significant in the given time period. However, the number of horizontal industries exhibits a small but steady increase from 1989 to 2001 except a sharp decline in 2001.

When we look at Figure 4 we see that the number of high quality vertical industries has always been below the number of low quality vertical industries, because, Turkey is a labour-abundant country and, therefore, UV of its exports

falls below the UV of its imports in most of the industries. Also, we see that the number of high quality vertical industries fluctuates less when compared to the low quality vertical industries. Although the number of high quality vertical industries takes its maximum value of 789 in 1993, it usually fluctuates around 600. Reason of this even distribution may be the difficulty in raising the quality in capital-poor countries, such as Turkey.

The method of computing the UV indexes for 3-digit industries is not so much different from that of the 5-digit industries. However, unlike 5-digit industries case, in 3- digit industries case, we are not provided with the dollar values and quantities of exports and imports directly. But, we derived the dollar value and the quantity of exports and imports for a 3-digit industry by summing the sub-group dollar values and quantities of exports and imports separately. And, we repeated this process for all 3-digit industries and for all years. By using the dollar values and quantities of exports and imports for 3-digit industries, we have obtained the UV indexes for each 3-digit industry between the time periods 1989-2001. Results of UV calculations for the 3-digit industries are given in Table A.3 of the appendix.

After calculating the UV indexes of 3-digit industries for the 1989-2001 periods, we took the dispersion factor $(\alpha)$ as 0.15 and sorted out 3-digit industries as low quality vertical industries, high quality vertical industries, horizontal industries, inter-industries and no-trade industries for the time period 1989-2001. Results are presented in Table A.4.1 of the appendix. By the help of this table we have constructed Table 4 and the corresponding Figure 5 which represents the distribution of number of each type of 3-digit industries for the period 1989-2001.

Most striking part of the Table 4 and the corresponding Figure 5 is the continuous decline in the number of 3-digit low quality vertical industries from 1989 to 1993. Such a decline may take place as a result of a capital improvement and the four years time period may be long enough for such an improvement. We can support this idea by analysing Table 4 more carefully. We see from the Table 4 that while the number of low quality vertical industries falls for the period 1989-1993, the number of high quality vertical industries rises nearly at the same rate. In other words, there is a shift from low quality vertical industries to high quality

vertical industries between the time periods 1989-1993. Such a shift may again take place due to a capital improvement. However, after 1993, this decline is reversed and the number of low quality vertical industries turns back to its 1989 level, even exceeds it.

Our 3-digit results for horizontal industries and for high quality vertical industries are not so much different from those of the 5-digit industries. Again, for all the existing years, the number of low quality vertical industries and the number of high quality vertical industries are above the number of horizontal industries (Figure 5). That is, the number of industries in which there is no quality difference between the exports and the imports are relatively small. When we come to the high quality vertical industries, they are relatively higher in number when compared to the horizontal industries. However, their number exhibits a continuous decline in the 1993-1999 sub-period. As we can see from Table 4, any decrease in the number of high quality vertical industries in the sub-period 1993-1999 are compensated by an increase in the number of low quality vertical industries. This means that there is a shift from high quality vertical industries to low quality vertical industries after 1993. This shift may be explained by a decrease in the capital per labor ratio, because, as we said before, when the capital intensity decline, export UV relative to import UV declines and the number of low quality vertical industries increases.

As a result of empirical analysis of UV calculations, we can say that the low quality vertical industries are dominant in both 5-digit industries and in 3-digit industries.

**Table 4.** Distribution of Number of 3-digit Vertical (LQ and HQ) Industries, Horizontal Industries, Inter Industries and No-Trade Industries, 1989-2001

| Years | Vertical(LQ) | | Vertical(HQ) | | Horizontal | | Inter-Industry | | No-Trade | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | # | % | # | % | # | % | # | % | # | % | |
| **1989** | 154 | 59 | 63 | 24 | 25 | 10 | 12 | 5 | 6 | 2 | 260 |
| **1990** | 151 | 58 | 66 | 25 | 32 | 12 | 8 | 3 | 3 | 1 | 260 |
| **1991** | 144 | 55 | 78 | 30 | 26 | 10 | 7 | 3 | 5 | 2 | 260 |
| **1992** | 141 | 54 | 75 | 29 | 29 | 11 | 11 | 4 | 4 | 2 | 260 |
| **1993** | 137 | 53 | 86 | 33 | 26 | 10 | 6 | 2 | 5 | 2 | 260 |
| **1994** | 143 | 55 | 73 | 28 | 29 | 11 | 12 | 5 | 3 | 1 | 260 |
| **1995** | 139 | 53 | 69 | 27 | 42 | 16 | 8 | 3 | 2 | 1 | 260 |
| **1996** | 160 | 62 | 67 | 26 | 26 | 10 | 3 | 1 | 4 | 2 | 260 |
| **1997** | 156 | 60 | 62 | 24 | 33 | 13 | 5 | 2 | 4 | 2 | 260 |
| **1998** | 165 | 63 | 59 | 23 | 29 | 11 | 4 | 2 | 3 | 1 | 260 |
| **1999** | 161 | 62 | 56 | 22 | 36 | 14 | 4 | 2 | 3 | 1 | 260 |
| **2000** | 147 | 57 | 72 | 28 | 31 | 12 | 6 | 2 | 4 | 2 | 260 |
| **2001** | 152 | 58 | 66 | 25 | 29 | 11 | 5 | 2 | 8 | 3 | 260 |

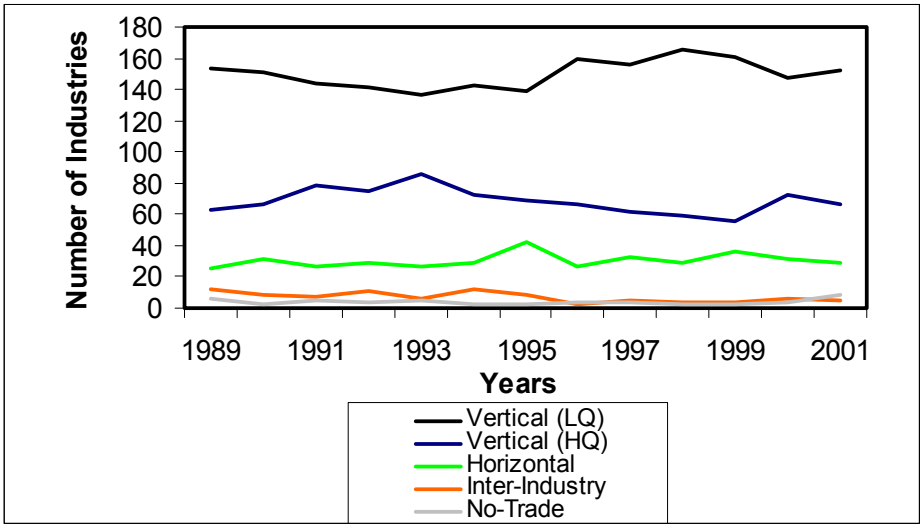



**Figure 5** Distribution of Number of 3-digit Vertical (LQ and HQ) Industries, Horizontal Industries, Inter-Industries and No-Trade Industries, 1989-2001

## 4.4 Empirical Results of Decomposition of the IIT Index as HIIT and VIIT Index

We presented the computation of aggregate IIT index ($GL$) and the computation of IIT index for each 3-digit industry which comprises several 5-digit subgroups ($C_i$) for the period 1989-2001, in the section (4.2). However, our aim is to decompose these IIT indexes into their horizontal and vertical parts. Therefore, in this section, we will perform the decomposition by using our findings in section (4.3).

We started the decomposition at the country level. In section (4.3), we had determined the 3-digit industries which exhibit HIIT and VIIT for the time period 1989-2001. By using this information, we have computed the HIIT and the VIIT indexes at the aggregate level as in the formula (3.11). Table 5 summarizes the results of the decomposition of the $GL$ index into its horizontal and vertical parts for the years 1989-2001.

**Table 5.** Decomposition of the GL Index into its Horizontal and Vertical Parts

| Years | | GL Index | HIIT Index | VIIT Index | Years | | GL Index | HIIT Index | VIIT Index |
|---|---|---|---|---|---|---|---|---|---|
| **1989** | Value | 0,154 | 0,052 | 0,102 | **1996** | Value | 0,206 | 0,045 | 0,161 |
| | % | | 0,34 | 0,66 | | % | | 0,22 | 0,78 |
| **1990** | Value | 0,150 | 0,038 | 0,112 | **1997** | Value | 0,214 | 0,046 | 0,169 |
| | % | | 0,25 | 0,75 | | % | | 0,21 | 0,79 |
| **1991** | Value | 0,148 | 0,032 | 0,117 | **1998** | Value | 0,236 | 0,033 | 0,203 |
| | % | | 0,21 | 0,79 | | % | | 0,14 | 0,86 |
| **1992** | Value | 0,155 | 0,043 | 0,112 | **1999** | Value | 0,255 | 0,035 | 0,220 |
| | % | | 0,28 | 0,72 | | % | | 0,14 | 0,86 |
| **1993** | Value | 0,160 | 0,028 | 0,132 | **2000** | Value | 0,253 | 0,038 | 0,215 |
| | % | | 0,17 | 0,83 | | % | | 0,15 | 0,85 |
| **1994** | Value | 0,194 | 0,055 | 0,139 | **2001** | Value | 0,288 | 0,037 | 0,251 |
| | % | | 0,28 | 0,72 | | % | | 0,13 | 0,87 |
| **1995** | Value | 0,186 | 0,052 | 0,134 | | | | | |
| | % | | 0,28 | 0,72 | | | | | |

It can be noticed from Table 5 that VIIT index constitutes a significant part of the *GL* index for all the years between the time periods 1989-2001. The percentage of VIIT index is greater than 65% each year. This percentage goes as high as 83% in the 1989-1993 sub-period. But, it starts to decline in 1994 and fluctuates around a level of 75% until 1998. When we come to the year 1998, percentage of VIIT index jumps to a level of 86% and continues to fluctuate around this level from 1998 onwards. All of these can also be seen from Figure 6 which depicts the distribution of percentages of the HIIT and the VIIT indexes in a bar chart for the years 1989-2001. At the end of our calculations, we can say that the intra-industry trade in Turkey is predominantly vertical in nature.

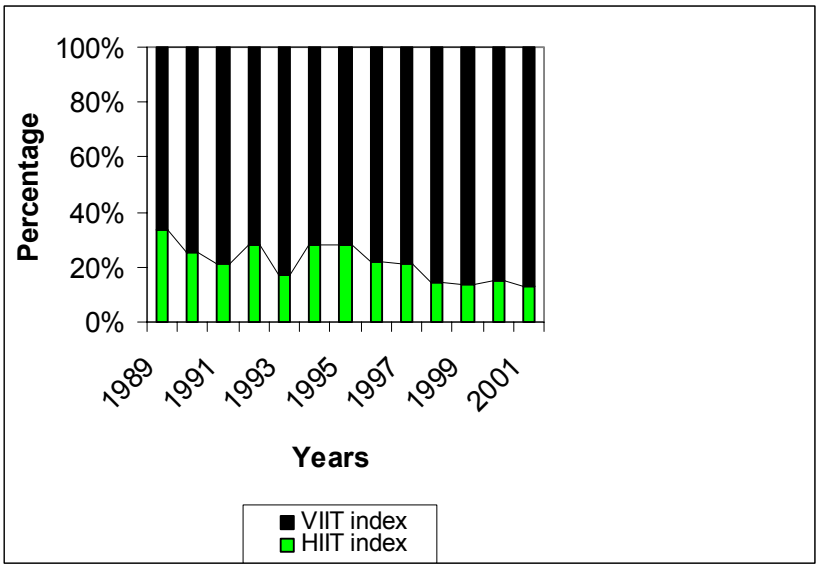



**Figure 6** Distributions of Percentages of Aggregate HIIT and VIIT Indexes, 1989-2001

After decomposing the aggregate IIT index into its horizontal and vertical parts, we dealt with the decomposition at the 3-digit industry level. For this purpose, we took 1989, 1992, 1995, 1998 and 2001 years as the sample years and concentrated on 3-digit industries with $C_i$ indexes greater than 0,5. Table 6 gives the SITC codes, numbers and percentages of 3-digit industries with more than 0,5 $C_i$ index in the selected years. If the 3-digit sectors with $C_i$ s more than 0,5 were

regarded as primarily involved in intra-industry-trade, then we see from Table 6 that their percentages are quite low. But, it rises steadily. We also see from Table 6 that some industries have $C_i$ indexes greater than 0,5 in most of the selected years, these industries are 023 (Butter and other fats), 043 (Barley), 248 (Wood and railway sleepers of wood), 266 (Synthetic fibres suitable for spinning), 581 (Tubes, pipes and hoses), 635 (Wood manufactures), 651 ( Textile yarn), 722 (Tractors) and 821 (Furniture and Parts thereof).

**Table 6.** SITC Codes, Numbers and Percentages of 3- digit Industries with more than 0,5 $C_i$ Index

| **Years** | **SITC Codes** | **#** | **%** |
|---|---|---|---|
| **1989** | 023, 043, 248, 263, 266, 512, 573, 581, 582, 676, 678, 692, 693, 722, 763, 898 | 16 | 0,06 |
| **1992** | 023, 024, 043, 074, 248, 266, 431, 542, 571, 573, 625, 635, 651, 653, 762, 783, 793, 821, 883, 898 | 20 | 0,07 |
| **1995** | 023, 024, 025, 043, 074, 248, 266, 583, 635, 651, 652, 653, 655, 664, 666, 678, 691, 692, 693, 821 | 20 | 0,07 |
| **1998** | 023, 041, 043, 074, 264, 266, 278, 285, 334, 581, 583, 612, 625, 629, 635, 642, 652, 653, 654, 655, 664, 666, 678, 691, 692, 695, 722, 775, 821, 831, 851 | 31 | 0,11 |
| **2001** | 023, 041, 043, 045, 074, 111, 248, 264, 278, 283, 288, 291, 553, 581, 583, 612, 629, 635, 642, 651, 652, 653, 654, 664, 666, 673, 694, 699, 716, 742, 744, 748, 772, 781, 782, 784, 785, 813, 821, 851, 893 | 41 | 0,15 |

After determining the 3-digit industries with $C_i$ index more than 0,5 for the selected years , we tried to decompose the $C_i$ indexes of these industries into their horizontal and vertical parts. In section (4.3), we had determined the 5-digit industries which exhibit HIIT and VIIT for the time period 1989-2001. By using this information, we have computed the HIIT and the VIIT indexes for these 3-

digit industries as in the formula (3.9). Results of these decompositions will be analyzed year by year in the following paragraphs.

Decomposition results for the year 1989 are given in Table 7. If we consider industries whose VIIT index exceeds whose HIIT index as vertical in nature or the reverse, then we arrive at a conclusion from Table 7 that, except for sectors 266, 512 and 676, all of the sectors under consideration exhibit high levels of VIIT. We can say that, in 1989, %81 of the 3-digit industries with more than 0,5 $C_i$ index are vertical in nature. This result supports our finding that IIT in Turkey is predominantly vertical in nature.

**Table 7.** Decomposition Results for the Year 1989

| SITC Codes | $C_i$ Index | HIIT Index | VIIT Index |
|---|---|---|---|
| **023** | 0,61 | 0,00 | 0,61 |
| **043** | 0,50 | 0,00 | 0,50 |
| **248** | 0,57 | 0,00 | 0,57 |
| **263** | 0,77 | 0,00 | 0,77 |
| **266** | 0,60 | 0,54 | 0,05 |
| **512** | 0,51 | 0,51 | 0,01 |
| **573** | 0,59 | 0,00 | 0,59 |
| **581** | 0,72 | 0,00 | 0,72 |
| **582** | 0,63 | 0,00 | 0,63 |
| **676** | 0,57 | 0,52 | 0,05 |
| **678** | 0,51 | 0,00 | 0,51 |
| **692** | 0,75 | 0,00 | 0,75 |
| **693** | 0,57 | 0,00 | 0,57 |
| **722** | 0,70 | 0,00 | 0,70 |
| **763** | 0,79 | 0,00 | 0,79 |
| **898** | 0,57 | 0,00 | 0,57 |

Although SITC codes of the 3-digit industries with more than 0,50 $C_i$ index differ between the years 1992 and 1995, their decomposition results are very similar. In 1992 and 1995, the number of industries which are assumed to be primarily involved in intra-industry trade rises to a level of 20 from 16. However, the number of industries which exhibit horizontal characteristics out of these 20 industries is still quite low. Except for three industries (266, 571and 651) in 1992

and four industries (266, 652, 655 and 693) in 1995, all the remaining 3-digit industries with more than 0,50 $C_i$ index carry vertical characteristics. Decomposition results for the years 1992 and 1995 are presented in Table 8.

**Table 8.** Decomposition Results for the Years 1992 and 1995

| SITC Codes (1992) | $C_i$ Index | HIIT Index | VIIT Index | SITC Codes (1995) | $C_i$ Index | HIIT Index | VIIT Index |
|---|---|---|---|---|---|---|---|
| **023** | 0,61 | 0,00 | 0,61 | **023** | 0,61 | 0,00 | 0,61 |
| **024** | 0,54 | 0,15 | 0,39 | **024** | 0,56 | 0,00 | 0,56 |
| **043** | 0,50 | 0,00 | 0,50 | **025** | 0,80 | 0,00 | 0,80 |
| **074** | 0,61 | 0,00 | 0,61 | **043** | 0,50 | 0,00 | 0,50 |
| **248** | 0,81 | 0,01 | 0,80 | **074** | 0,64 | 0,00 | 0,63 |
| **266** | 0,59 | 0,51 | 0,07 | **248** | 0,77 | 0,00 | 0,77 |
| **431** | 0,73 | 0,00 | 0,73 | **266** | 0,77 | 0,75 | 0,02 |
| **542** | 0,52 | 0,00 | 0,52 | **583** | 0,60 | 0,00 | 0,60 |
| **571** | 0,65 | 0,65 | 0,00 | **635** | 0,67 | 0,15 | 0,52 |
| **573** | 0,62 | 0,04 | 0,57 | **651** | 0,58 | 0,25 | 0,32 |
| **625** | 0,56 | 0,00 | 0,56 | **652** | 0,72 | 0,49 | 0,23 |
| **635** | 0,52 | 0,01 | 0,51 | **653** | 0,62 | 0,09 | 0,53 |
| **651** | 0,51 | 0,30 | 0,22 | **655** | 0,79 | 0,56 | 0,23 |
| **653** | 0,52 | 0,05 | 0,47 | **664** | 0,63 | 0,02 | 0,61 |
| **762** | 0,51 | 0,00 | 0,51 | **666** | 0,82 | 0,32 | 0,50 |
| **783** | 0,68 | 0,00 | 0,68 | **678** | 0,65 | 0,25 | 0,39 |
| **793** | 0,66 | 0,00 | 0,66 | **691** | 0,52 | 0,03 | 0,49 |
| **821** | 0,61 | 0,00 | 0,61 | **692** | 0,69 | 0,00 | 0,69 |
| **883** | 0,55 | 0,00 | 0,55 | **693** | 0,62 | 0,56 | 0,06 |
| **898** | 0,50 | 0,00 | 0,50 | **821** | 0,59 | 0,01 | 0,58 |

When we come to the year 1998, the number of 3-digit industries with more than 0,5 $C_i$ index rises approximately % 50 when compared to the year 1995 and reaches to a level of 31. Decomposition results for 1998 are provided in Table 9. According to Table 9, only five of the 31 industries (041, 266, 654, 666 and 678) carry horizontal characteristics, the remaining %83 exhibit vertical characteristics. The result is not so much different from the previous years' analyses.

In the last year of the our analysis, the year of 2001, the number of 3- digit industries considered as primarily involved in IIT continues its rise and reaches 41. According to Table 10 which summarizes our decomposition results for the year 2001, HIIT dominates just in four of the 41 industries (288, 612, 652 and 654). The percentage of industries in which the dominant form of IIT is VIIT reaches its peak level of %90 in the year 2001. The most striking point for this year is that the percentage of industries which exhibit horizontal characteristics reaches its lowest point while the percentage of industries which exhibit vertical characteristics reaches its peak point.

**Table 9.** Decomposition Results for the Year 1998

| SITC Codes | $C_i$ Index | HIIT Index | VIIT Index | SITC Codes | $C_i$ Index | HIIT Index | VIIT Index |
|---|---|---|---|---|---|---|---|
| **023** | 0,61 | 0,00 | 0,61 | **652** | 0,75 | 0,11 | 0,64 |
| **041** | 0,67 | 0,64 | 0,02 | **653** | 0,65 | 0,21 | 0,44 |
| **043** | 0,50 | 0,00 | 0,50 | **654** | 0,63 | 0,60 | 0,03 |
| **074** | 0,51 | 0,00 | 0,51 | **655** | 0,66 | 0,30 | 0,36 |
| **264** | 0,56 | 0,00 | 0,56 | **664** | 0,75 | 0,00 | 0,75 |
| **266** | 0,58 | 0,40 | 0,18 | **666** | 0,79 | 0,49 | 0,30 |
| **278** | 0,61 | 0,01 | 0,60 | **678** | 0,52 | 0,38 | 0,14 |
| **285** | 0,55 | 0,00 | 0,55 | **691** | 0,67 | 0,00 | 0,67 |
| **334** | 0,54 | 0,02 | 0,53 | **692** | 0,78 | 0,00 | 0,77 |
| **581** | 0,53 | 0,00 | 0,53 | **695** | 0,52 | 0,02 | 0,50 |
| **583** | 0,70 | 0,01 | 0,69 | **722** | 0,71 | 0,00 | 0,71 |
| **612** | 0,58 | 0,00 | 0,58 | **775** | 0,63 | 0,11 | 0,52 |
| **625** | 0,72 | 0,00 | 0,72 | **821** | 0,55 | 0,00 | 0,55 |
| **629** | 0,67 | 0,00 | 0,67 | **831** | 0,63 | 0,00 | 0,63 |
| **635** | 0,50 | 0,14 | 0,37 | **851** | 0,64 | 0,00 | 0,64 |
| **642** | 0,53 | 0,08 | 0,45 | | | | |

**Table 10.** Decomposition Results for the Year 2001

| SITC Codes | $C_i$ Index | HIIT Index | VIIT Index | SITC Codes | $C_i$ Index | HIIT Index | VIIT Index |
|---|---|---|---|---|---|---|---|
| **023** | 0.61 | 0.00 | 0.61 | **653** | 0.58 | 0.07 | 0.51 |
| **041** | 0.53 | 0.01 | 0.52 | **654** | 0.59 | 0.50 | 0.10 |
| **043** | 0.50 | 0.00 | 0.50 | **664** | 0.55 | 0.00 | 0.55 |
| **045** | 0.67 | 0.00 | 0.67 | **666** | 0.57 | 0.00 | 0.57 |
| **074** | 0.63 | 0.00 | 0.63 | **673** | 0.55 | 0.26 | 0.29 |
| **111** | 0.57 | 0.00 | 0.57 | **694** | 0.70 | 0.00 | 0.70 |
| **248** | 0.72 | 0.00 | 0.72 | **699** | 0.63 | 0.04 | 0.59 |
| **264** | 0.87 | 0.00 | 0.87 | **716** | 0.50 | 0.00 | 0.50 |
| **278** | 0.85 | 0.01 | 0.85 | **742** | 0.51 | 0.06 | 0.45 |
| **283** | 0.60 | 0.00 | 0.60 | **744** | 0.56 | 0.15 | 0.40 |
| **288** | 0.77 | 0.47 | 0.30 | **748** | 0.53 | 0.00 | 0.53 |
| **291** | 0.53 | 0.00 | 0.53 | **772** | 0.52 | 0.00 | 0.52 |
| **553** | 0.58 | 0.00 | 0.58 | **781** | 0.75 | 0.00 | 0.75 |
| **581** | 0.69 | 0.00 | 0.69 | **782** | 0.64 | 0.00 | 0.64 |
| **583** | 0.71 | 0.00 | 0.71 | **784** | 0.74 | 0.00 | 0.74 |
| **612** | 0.64 | 0.58 | 0.07 | **785** | 0.54 | 0.19 | 0.35 |
| **629** | 0.78 | 0.00 | 0.78 | **813** | 0.76 | 0.02 | 0.74 |
| **635** | 0.64 | 0.17 | 0.47 | **821** | 0.55 | 0.00 | 0.55 |
| **642** | 0.53 | 0.09 | 0.44 | **851** | 0.65 | 0.00 | 0.65 |
| **651** | 0.55 | 0.20 | 0.35 | **893** | 0.52 | 0.00 | 0.52 |
| **652** | 0.72 | 0.50 | 0.22 | | | | |

At the end of the decomposition calculations at the 3-digit industry level, we first arrive at a conclusion that only a very small percentage of the 3- digit industries exhibit $C_i$ values greater than 0,5; however, the number of such industries rises steadily from 1989 to 2001. This rise can be seen clearly from Figure 7. Second, we arrive at a conclusion that horizontal industries composes a very small percentage of the 3-digit industries with $C_i$ values greater than 0,5 in all the selected years. And the reverse is true for the vertical industries. Figure 8 describes the year by year changes in the percentages of horizontal and vertical industries with $C_i$ values greater than 0,5.

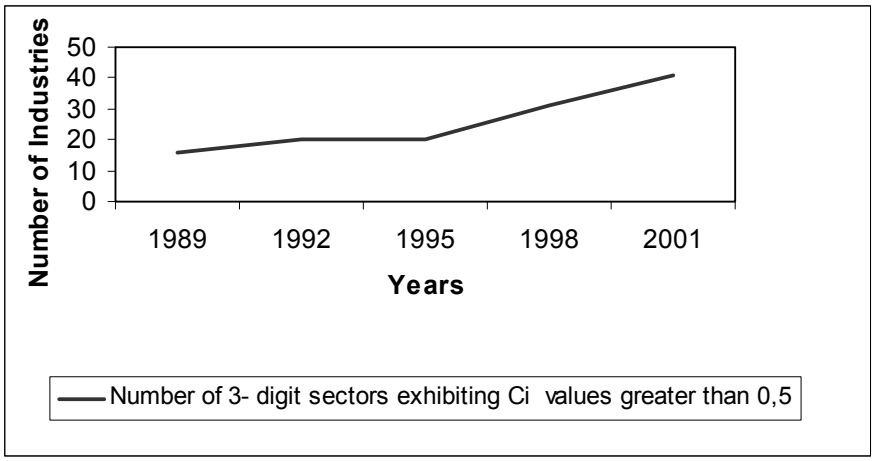



**Figure 7** Distribution of Number of 3-digit Industries Exhibiting $C_i$ Values Greater than 0,5

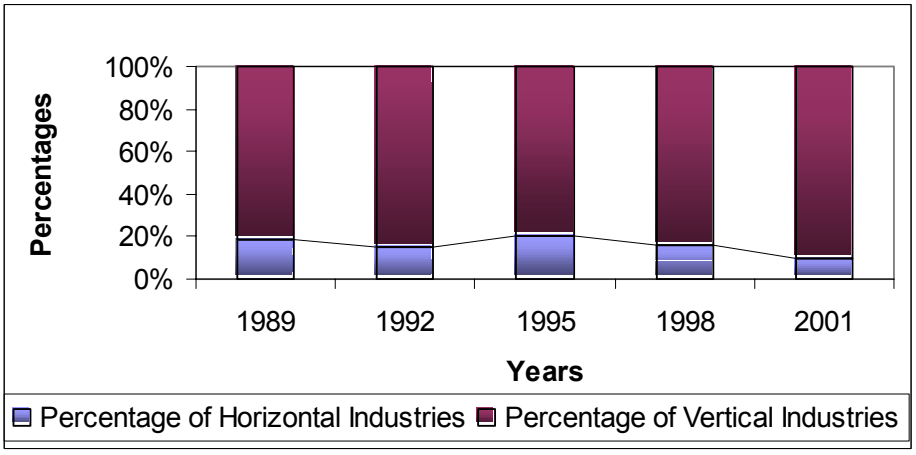



**Figure 8** Percentages of Horizontal and Vertical Industries in 3-digit Industries with $C_i$ Values Greater than 0,5

If we were to sum the implications of the empirical results pertaining to the Turkish manufacturing sector, it would be safe to summarize the results at the country level and at the 3-digit industry level separately. At the country-level, we arrived at the conclusion that although the level of IIT increased from 1989 to 2001, it still could not reach a significant level and quite a large percent of it was

composed by the VIIT index. At the 3-digit industry level, the result is not different from that of the country level. Though the number of 3-digit industries considered as primarily involved in IIT increased steadily in the given time period, it remained at an insignificant level and the vertical industries made up a large percent of such industries. At the end, we can say that IIT in Turkey is, still, not at a considerable level and it is predominantly of the VIIT type.

# CHAPTER 5

# CONCLUSIONS

In this thesis, our aim was to separate out the horizontal and the vertical IIT for the Turkish manufacturing industry. We have persuasive reasons in doing so. First of all, the theory suggests that they are affected differently by country-specific and industry-specific factors. Moreover, trade policy innovations affect differently the industries in which the HIIT or the VIIT dominates.

For this purpose, in the first chapter, we summarized the emergence of IIT theory and the initial attempts in decomposing the IIT as HIIT and VIIT. Theoretical divisions in intra-industry trade theory, the simultaneous exports and imports of the goods which are close substitutes, as horizontal IIT and vertical IIT started in the 1970s. The HIIT models explained the IIT by attribute variation between products of similar quality while the VIIT models dealt with quality variation between products. After this theoretical decomposition attempt, scholars approaching the IIT subject from the methodological point of view tried to decompose the index which measures the extent of IIT into its horizontal and vertical parts over the last decade.

The inability of the traditional H-O-S model in explaining the certain significant empirical findings about the world economy, such as the growth in the two-way trade between similar economies with near identical factor endowments, was the starting point of the emergence of IIT theory. Afterwards, IIT theory analysis has been divided into two as HIIT and VIIT. Scholars have tried to establish the theoretical and the empirical basis of the HIIT and VIIT. The theoretical studies on HIIT suggest that IIT emerges in monopolistically competitive markets with increasing returns to scale on the supply side and diverse consumer preferences on the demand side. The alternative model of IIT, the VIIT model, suggests that IIT takes place in perfectly competitive markets but

there are no increasing returns to scale in production. Oligopoly is an alternative market structure under which both HIIT and VIIT can take place, however it is not so widespread. The empirical studies indicate that the two sets of models are different in their predictions. Whereas HIIT is more likely to take place between countries with high and similar per-capita incomes, VIIT is more likely to take place between countries at different levels of per-capita incomes. The second chapter points out these theoretical and empirical explanations and summarizes the theoretical models and empirical studies on HIIT and VIIT.

The emergence of intra-industry trade theory required the construction of an index which measures the extent of IIT. Grubel and Lloyd (1971) has been the pioneer in the development of explicit papers concerning the measurement of IIT. After the theoretical decomposition of IIT as HIIT and VIIT in the early 1980s, a refinement in the measurement of IIT has been necessary. This refinement was the decomposition of the IIT index as HIIT and VIIT index. Abd-el Rahman (1991) was the first in decomposing the IIT index by using unit-value measures. Greenaway, Hine and Milner (1994) used his method to obtain explicit measures of HIIT and VIIT. The third chapter consists of a survey of these explicit measures of IIT, HIIT and VIIT.

As we pointed out before, even though the HIIT is more likely to take place between countries with high and similar per-capita incomes, VIIT is more likely to take place between countries at different levels of per-capita incomes. Therefore, the distinction between HIIT and VIIT is an important one for developing countries, such as Turkey. If we distinguish horizontal industries from vertical ones, we can determine more easily the trade policy we should follow in each industry. For this purpose, in this study, we tried to find answers to some questions on IIT structure of Turkish manufacturing sector such as, whether the IIT in Turkish manufacturing sector is more of horizontal or vertical type and whether the vertical industries dominates the horizontal industries at the 3-digit industry level.

Our calculations started with the GL measurements at the 5-digit industry level, at the 3-digit industry level and at the aggregate level. Later on, we calculated the unit value index of each industry at the 5-digit and at the 3-digit

industry level in order determine which industries exhibit HIIT and which exhibit VIIT. After these basic calculations which cover the years from 1989 to 2001, we tried to decompose the GL indexes into their horizontal and vertical parts. We presented our results in Chapter 4. We have reached the conclusions below, which may be considered as the answers to the questions that our study is based on.

1. The level of aggregate IIT in Turkish manufacturing sector exhibits an upward-sloping tendency in the time period 1989-2001; however, its level can not reach a significant level in this period.

2. Secondly, based on our unit value calculations, we reached the conclusion that nearly half of the total numbers of the 3-digit and the 5-digit industries are low quality vertical industries.

3. Considering the decomposition results of the aggregate IIT, the VIIT index constitutes a significant part of the IIT index of the Turkish manufacturing sector for all the years between the time periods 1989-2001.

4. Finally, for decomposition at the 3-digit industry level, we dealt with the years 1989, 1992, 1995, 1998 and 2001 and with the industries with GL indexes greater than 0.5. Decomposition results at the 3-digit industry level are not so different from those of the aggregate level. Though the number of 3-digit industries considered as primarily involved in IIT increased steadily in the given time period, it remained at an insignificant level and the vertical industries made up a large percent of such industries.

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