CHAPTER 2

CONCEPTUAL FRAMEWORK OF INTRA-INDUSTRY TRADE
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International Trade has always been a fascinating field for economists and different theories had been proposed to discuss the reason for involvement of a country in international trade. The first formal attempt was done by Adam Smith in 1776. He proposed the theory of “Absolute Advantage” in which he said that a country should specialize to produce that commodity which it can produce more cheaply than others, using the same amount of resources. He assumed that absolute advantage of a producer of a commodity is a precursor of international trade therefore an exporting country must be able to produce a commodity, using the same given resources, more than its competitors. But this theory was not realistic because there were several countries which did not possess absolute advantage in the production of any commodity but were involved in the international trade.

Later on David Ricardo, in 1817, proposed the theory of “Comparative Advantage” in which he said that a country should specialize the production of that commodity in which it has the greatest comparative advantage or the least comparative disadvantage. Therefore a country should export those commodities in which it has maximum comparative advantage and import those commodities where its comparative advantage is minimum. Both of these theories (Absolute Advantage and Comparative Advantage) belong to “Classical Theory of International Trade”, although helped in framing the concept for reasons of international trade, but not devoid of criticisms. The major limitations of these theories were they focused only on one factor of production that is labor. They considered only labor costs for the production of a commodity but practically this were not the truth because the cost of capital also was an integral part of production costs. Moreover these theories were unable to explain the reasons for international trade of Least Developing Countries (LDCs) because they were not having absolute/comparative advantage in producing a good.
Thereafter several theories were proposed to explain the reason of international trade, a few important ones to mention here are – Haberler’s theory of Opportunity Cost and Mills theory of Reciprocal Demand. But the most popular and widely accepted theory was proposed by Eli Heckscher and Bertin Ohlin in 1919, the theory of Factor Endowment. This theory was popularly known as H-O theory, the theory says that if a country rich in capital should produce and export capital-intensive commodities and import labor-intensive commodities while a country rich in labor should produce and export labor-intensive commodities and import capital-intensive commodities. The H-O theorem, focuses on the supply side factors, was an improvement over Classical theories and was widely accepted for the basis of international trade. The theorem was able to explain the reason for differences in comparative advantage which the Classical theories were unable to explain. Although the theorem had some limitations but it was accepted for a long period of time.

A different type of trade pattern was observed by Leontief in 1950s. He observed that although US is a capital-rich country but it exports labor-intensive commodities and import capital-intensive commodities. Later on Linder, 1961, also found something contradictory to the existing trade theories that country with similar per-capita income has similar demand pattern and therefore they trade in similar but differentiated commodities. This finding was in contradiction to the existing factor endowment theory which says that differences in factor endowment plays a key role in determining the trade pattern between the two countries, more dissimilar countries will trade more and trade in different products. Later on Hanink (1988) empirically proved that most of the propositions discussed by Linder were valid.

The term “intra-industry trade” was first used by Balassa (1966) and initial empirical work was done by Grubel (1967) where he studied on the relationship between IIT and trade liberalization of EEC (European Economic Community). The research in this direction picked up specially after the work of Grubel and Lloyd (1971) where they developed an index to measure IIT and they also proved that IIT is a “pure phenomenon”. The revelation of intra-industry trade has changed the perspective of defining
international trade, earlier “supply-side factor” was considered as a major determinant but now “demand-side factor” is considered as a major determinant of international trade.

Intra-Industry Trade represents a major portion of world trade today and is supposed to be more important than inter-industry trade. Brulhart (2008) calculated the Gl-index for the world and found that it has increased from 20% to 44% between the periods 1962 to 2006, at SITC 3 digit level. Later on, with the further development of the concept, intra-industry trade was disentangled into two parts – horizontal intra-industry trade (HIIT) and vertical intra-industry trade (VIIT). In case of HIIT, products differ in their attributes but do not differ in quality or price as well as production techniques and factors of production used are assumed to be same. On the other hand, in case of VIIT, products can differ in terms of quality and therefore price also, here it is assumed that producers use different production techniques and factors of production. This bifurcation of intra-industry trade into HIIT and VIIT helped in understanding the concept in a better way. The significance of HIIT over inter-industry trade is that while in case of inter-industry trade, reallocation of resources between industries take place, HIIT does not require any redistribution between industries however it may be possible within industries. On the other hand, VIIT seems to be a specialization within industries along the quality spectrum, a phenomenon which is somewhere between the traditional view of intra-industry trade and the one of comparative advantage (classical/neo-classical theory).

Figure 2.1 depicts the relationship between market structure, product differentiation and types of trade – both inter-industry trade and intra-industry trade, as shown on the next page:
Figure 2.1 Relationship between Market Structure, Product Differentiation and Types of Trade

Source: Fontagné and Freudenberg (1997)

Figure 2.1 shows the different types of market structure favoring inter-industry trade, horizontal intra-industry trade and vertical intra-industry trade. It shows that monopolistic competition leads to HIIT while both oligopoly and perfect competition may lead to VIIT. It also shows the way of development of the theory of intra-industry trade.

In the present chapter the development of the theory of intra-industry trade has been discussed in chronological order. The present chapter is divided into two sections, the first section deals with the development of concepts of intra-industry trade and the second section deals with the development of the methodological issues of the intra-industry trade.
2.1 DEVELOPMENT OF CONCEPTS OF INTRA-INDUSTRY TRADE

Till 1950, the most widely accepted theories for international trade were “Ricardian theory of comparative advantage” and “Heckscher-Ohlin (H-O) theory of factor endowment. The theory states that each country should produce and export the commodity which uses its abundant factor extensively and is produced at lowest costs. Although the theory was widely accepted but it was not proved empirically because of unavailability of any technique. Later on, in 1954, after the invention of input-output analysis, H-O theory was tested empirically by Leontief. He analyzed the trade pattern of US, for the year 1947, and he was surprised to find that “although US is a capital abundant country but it exports labor-intensive products and imports capital-intensive products” and this finding was known as “Leontief Paradox”. Since the finding was contradictory to the then existing theories of international trade, therefore it was not accepted and criticized by many researchers on the grounds that the selection of the year is not appropriate, 1947 was the year in which trade was not stable. Later on, Leontief again performed his test, called as Leontief second test, and this time he selected the year 1951 for trade data. This time again he got the same result that “US imports is more capital-intensive than exports”, in-fact, import was 6 per cent more capital-intensive than export.

Leontief paradox added a new dimension to the analysis of international trade and it changed the way of analyzing the pattern of international trade. Later on, in 1961, Linder also worked on testing the empirical validity of H-O theorem and possible solution to the Leontief Paradox. His findings were also contradictory to the H-O theorem. He proposed an alternative theory of trade that was consistent with Leontief’s findings. He hypothesized that “nations with similar demand would develop similar industries and these nations would trade with each other in similar but differentiated products”. He used *per capita* income as a proxy for demand structure of a country because the assumption was that similar the income level, similar will be the demand structure. Linder's hypothesis opened a new vista for explaining the reason for international trade. He advocated the demand based theory of international trade rather than the existing one supply based theory involving factor endowments. This finding changed the perspective
of analyzing international trade and instigated the research in the direction of finding demand structure as determinants of international trade. Later on his work was extended by Hanink (1988) who empirically proved that the fundamental relationships expressed by Linder were valid. Although Linder hypothesized that similar demand structure would lead to the development of similar industries and hence similar but differentiated products, but he did not use the term “intra-industry trade” specifically.

Specifically the term “intra-industry trade” was first used by Balassa (1966) for simultaneous export and import of goods of same industry between the trade partners. Since then, a large number of theoretical and empirical studies have been conducted to explain the phenomenon. The first empirical work on the topic was performed by Grubel (1967) where he studied the nature and pattern of intra-industry trade during the trade liberalization period of EEC (European Economic Community). Although by the end of 1960s the concept was recognized but it did not draw enough attention until its measurement technique was developed by Grubel and Lloyd (1971). Later on with the further development in the concept, intra-industry trade was further divided into two categories – horizontal intra-industry trade (HIIT) and vertical intra-industry trade (VIIT). Horizontal product differentiation means that many varieties of the products are available but these varieties do not differ significantly in terms of quality or price; while in case of vertical product differentiation several varieties of a product are available and these varieties differ in terms of quality and price significantly. All these works have been discussed in detail in the coming section of the present chapter. Here in the section few important theoretical models have been discussed in chronological order, to highlight the development of theory of intra-industry trade.

2.1.1 THE DIXIT-STIGLITZ MODEL

This model proposed in the year 1977 and it was one of the first theoretical models to explain the reason for the existence of intra-industry trade. The model basically focuses on the issue of quantity versus diversity. The model emphasized that the consumer would prefer to consume different varieties even for same product group, therefore the model is
also known as “love-of-variety” model. Thus, a consumer who is indifferent between the quantities (1,0) and (0,1) of the two commodities prefer the mix of (1/2, 1/2) to either extreme. The model was based on monopolistic environment where a producer of an individual variety has a little bit of monopoly power for supplying its own product, therefore the model assumes a strong competition between different producers producing different varieties of a product. Here all the consumers are assumed to be alike. Let $c_i$ be the level of consumption of a particular variety $i$ and let $N$ be the total number of varieties available. The model uses a constant elasticity of substitution (CES) function for the utility $U$ derived from the consumption of the product as a function of consumption $c_i$ of the $N$ varieties:

$$U = \left( \sum_{i=1}^{N} c_i^\rho \right)^{1/\rho}; 0 < \rho < 0 \quad \text{2.1.1}$$

Here it is assumed that all varieties enter into consumers’ utility functions symmetrically. The utility of consumer will increase not only by consuming more of each goods but by increasing the number of goods. Also, even-if the consumer has less of each good, if he has more goods his utility increases.

On the supply side, it is assumed that each good has an identical production function and uses a single factor of production, labor, and are assumed to be produced under increasing returns where a portion of total cost is fixed. Therefore, one producer produces only one product and there are as many producers as products. Therefore the model provides a framework to understand that how demand structure of an economy may lead to intra-industry trade.

### 2.1.2 THE LANCASTER MODEL

The Lancaster (1980) model applied the analysis of perfect monopolistic competition to the problems of intra-industry trade. The kind of economies considered here was manufacturing based economy characterized by product-differentiated groups. It is
assumed that all products of a product group posses the same characteristics, but in different proportions and this proportion defines its *specifications*. Specifications are assumed to vary smoothly in a continuous manner over some convex set which is referred as *product-spectrum* of that group, in such a way that each group has an infinite number of potential products.

Individuals are assumed to have preferences over characteristics of goods rather than a collection of goods. If all goods in the group, actual or potential, were available in that circumstances individual would prefer his "*most-preferred goods*" or "*ideal products*". Due to the diversity in consumer preferences, the most prefer goods vary over consumers.

The market structure, here, assumed to perfectly monopolistic competition, i.e., perfectly informed firms facing perfectly informed consumers under conditions of perfect flexibility in choice of specifications, absence of collusion and free and willing entry. He further assumed that the individual firm selling a product within the group has two decision variables, price and specifications, instead of single variable, price, as assumed in traditional theory.

He considered different probable cases of the economic conditions of trading economies like trade of single and multi-group manufacturing sectors between identical economies, the role of preference diversity of consumers, size differences and false comparative advantage, true comparative advantage, and the effects of protection. He showed the possibility of intra-industry trade in all the conditions and interestingly, he also showed that, increase in tariff barrier on a product group may lead to increase in overall intra-industry trade, because of increase in the bilateral trade in other product groups.

Finally he concluded that intra-industry trade not only may occur between similar economies, it is most likely to occur between such economies and the volume may be much higher than trade based on comparative advantage.
2.1.3 THE KRUGMAN MODEL

Krugman worked on monopolistic competitive environment and based his work on the basis of Dixit-Stiglitz model with slight modifications. He (Krugman, 1979) considered the effect of growth of labor, trade and factor mobility on intra-industry trade. He found that economies of scale leads to increase in trade even if there are no international differences in tastes, technology or factor endowments.

In another work (Krugman, 1980, 1981), he considered the trade between economies with similar factor endowments and the role of large domestic markets in promoting exports. He concluded that similar countries will have an incentive to trade, their trade will typically be in products produced with similar factor proportions and this trade will not involve the income distribution effects, a characteristic of conventional trade. He also worked on the effect of home-market on the pattern of trade and found that in the presence of increasing returns, countries will tend to export those goods for which they have relatively large domestic markets.

2.1.4 THE FALVEY MODEL

Falvey’s (1981) model was different from all the models of intra-industry trade discussed so far in the respect that it is focused on vertical differentiation of the product rather than horizontal differentiation. He put forward his model with two interesting features – first – intra-industry trade is generated without increasing returns to scale or imperfectly competitive markets, and second – the countries produce vertically differentiated products. Rather than modifying the traditional theory of trade and working on new theory, he tried to minimize the departure from traditional theory by modifying the standard framework in only two essential respects – first – he assumed that one of the two factor inputs used in each industry (capital) is specific to that industry, and second – each industry is no longer assumed to produce a single homogeneous output, but instead can produce a range of products using as inputs labor and its own industry specific capital. Intra-Industry Trade then appears if countries specialize in production within this range.
He assumed 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 rate (W and W* respectively), and each industry can produce a continuum of products of different qualities. Higher quality products requires more capital-intensive techniques of production and have higher prices. He showed that higher wage home country (W>W*) has comparative cost advantage of those qualities which require more capital-intensive qualities, as also predicted by H-O theory.

He recognized the importance of differences in product quality in international trade, which was not discussed till then. He developed a model for trade within a multi-product industry where the industry’s dimensions were defined by a range of outputs obtainable from a particular type of capital. He, therefore, concluded that intra-industry trade would be a natural outcome of this condition without requiring the presence of increasing returns to scale or imperfectly competitive markets. He also showed empirically that volume of intra-industry trade is inversely proportional to the level of trade restrictions.

2.1.5 THE SHAKE AND SUTTON MODEL

The model was proposed by Shaked and Sutton in 1983 and was mainly concerned with the analysis of price competition in vertically differentiated goods. They proved that for vertical differentiation the economic condition is just opposite to that of horizontal differentiation. They proposed that in case of vertically differentiated products, finiteness condition (i.e., only few firms will survive) is necessary and sufficient and it is just opposite to the case of horizontal differentiation where monopolistic market environment is required (i.e., large number of firms). That condition refers to the relationship between consumer’s willingness to pay for quality improvements and the change in unit variable costs. They suggested that this condition would likely to hold in those industries where the main burden of quality improvements is on R&D or other fixed costs while unit variables would rise only slowly with increase in quality. Finally they concluded that – it may be possible that product innovation is also accompanied by process innovation and
unit variable costs may fall, and it is the situation where the finiteness property holds along with the relevant interval of quality, which they termed as “natural oligopoly”.

2.1.6 THE ABD-EL-RAHMAN MODEL

The model proposed by Kamal Abd-el-Rahman in the year 1991. This was the first model which formally differentiated the horizontal intra-industry trade with the vertical one. He categorized all the types of trade into three categories – first – one way trade – implies export (import) level for which the reversal import (export) flows are either insignificant (less that 10 per cent compared with the other flows) or non-existent; second – Intra-range trade – this is vertical differentiation trade category where export and import unit values difference equal to or greater than 15 per cent; and third – two way trade in similar products – this is horizontal differentiation trade category where difference between export and import unit value is maximum up to 15 per cent. This is further categorized into two parts: bilateral – where export and import partners are same and triangular – if the two partners are different.

Apart from this the model demonstrated that “in the conditions of imperfect competition, firms producing the same types of goods are distinguished by specific competitive advantages and disadvantages against a background of collective comparative advantages and disadvantages related to the industry to which they belong”. Therefore, he concluded that in comparative disadvantaged industries, the difference between exporters and non-exporters are particularly large in the case of productivity. In such industries, firms that manage to export despite the collective comparative disadvantage conditions seem, therefore, to be endowed with a specific advantage of their own.

2.1.7 THE DAVIS MODEL

Davis (1991) worked on the effect of economies of scale and intra-industry trade. Till then, most of the models of intra-industry trade were considered that increasing returns to scale is necessary to account for the volume of intra-industry trade among developed
economies, while he concluded that this is not necessary. He discussed an example of perfectly intra-industry goods in which countries with identical endowments and arbitrarily small technical differences, trade substantial amounts of goods of identical factor intensities.

He developed a simple model that can give a unified account of inter-industry trade as well as intra-industry trade. The striking feature of the model was that intra industry trade attained a maximum at a point where countries had identical factor endowment ratios. He also proved that increasing returns are not a necessary condition for intra-industry trade.

In his other work (Davis, 1995), he emphasised that both H-O and Ricardian models are still relevant for explaining intra-industry trade. He developed a Heckscher-Ohlin-Ricardo model which showed that even the countries of identical factor endowments would still trade due to differences in their technologies, as this would encourage specialization and therefore trade, in the same way as discussed in the Ricardian model. Moreover, the intra-industry trade is possible even at constant return to scale while increasing returns is not at all a necessary condition.

2.2 DEVELOPMENT OF MEASUREMENT ISSUES OF INTRA-INDUSTRY TRADE

The work on analyzing intra-industry trade had been started after the finding of Leontief Paradox in 1954 and Balassa used the term “intra-industry trade” specifically in 1966. Although some empirical work had been done during that period (like Grubel in 1967), but the progress in the development of concept got a real impetus after the development of a tool to measure the degree of intra-industry trade, developed by Grubel and Lloyd in 1971, which is popularly called as GL-index. After the development of GL-index to measure the degree of intra-industry trade, so many indices were proposed by different researchers as well as the research got initiative in the direction of finding the determinants of intra-industry trade. Initial works regarding the measurement issues were done mainly for developed countries and it was believed that intra-industry trade is a characteristic of international trade of developed countries only, but later on different
works had also been done for developing countries which showed that intra-industry trade is also a part of their trade.

So many works have been done so far regarding the measurement issues of intra-industry trade and it is not possible to cover all of them, therefore in this section, few of them which are relevant to the present study, have been discussed here.

2.2.1 THE GRUBEL APPROACH

Grubel (1967) tried to present some empirical measures to explain the nature of international trade among the members of European Economic Community (EEC) and he found that intra-industry trade is dominating specially in trade liberalization period. He used two sets of data – first set consists of trade statistics covering intra-EEC trade of SITC three-digit manufacturing industries for the years 1955, 1958 and 1963; and in the second he used import-export data for the years 1959 and 1963 aggregated on the SITC one-digit level.

He framed his hypothesis from traditional H-O theorem which says that trade liberalization would lead to specialize a country in that area where the country is in relatively advantageous condition, and hence “export-to-import” or “import-to-export” ratio should increase as the trade liberalization takes place – this is because if a country is net exporter (importer) before trade liberalization then its export-to-import (import-to-export) ratio will be high. He hypothesized that after the liberalization process, the country will specialize itself in producing those goods where it is in a relatively advantageous position, which will lead to further increase in export-to-import (import-to-export) ratio. But his findings were quite opposite and he found that both the ratio decreased with the advent of trade liberalization, which clearly shows that increase in trade was more intra-industry trade rather than inter-industry.

In other work, he categorized different products into two categories – one where differentiation was easy (like manufactured) and the other where differentiation was quite difficult (like raw materials). He found that, with the trade liberalization, trade of first
category of products increased very much than that of second category, and this also shows the importance of intra-industry trade.

Finally he made three conclusions from his work – first – trade liberalization, among countries with similar resource endowments, and the level of development will lead to more intra-industry trade because industry would like to shift into new product lines rather than entirely new set up; second the basic model of intra industry specialization implies that the traditional measure of estimating demand by price elasticity will not work well because it will underestimate the increase in multinational trade due to trade liberalization; and third – his model is also capable to explain the simultaneous export and import of capital.

2.2.2 THE GRUBEL AND LLOYD APPROACH

They were among the first economists who developed an index to measure the degree of intra-industry trade (Grubel and Lloyd, 1971). They defined intra-industry trade for an industry \( i \), at any given level of aggregation, as the value of exports of an industry which is exactly matched by imports of the same industry. To facilitate comparisons of these measures for different industries and countries, they expressed them as a percentage of each industry’s combined exports and imports. The formula for measuring intra-industry trade, proposed by them, was

\[
Bi = \frac{[(Xi + Mi) - |Xi - Mi|]}{(Xi + Mi)} \times 100 \quad \ldots \quad (2.2.2.1)
\]

where \( Xi \) and \( Mi \) stands for the exports and imports of the product group \( i \), respectively. The value of \( Bi \) would vary from 0 to 100. If all trade was balanced, it would be equal to 100, means pure intra-industry trade; on the other hand, if all trade was one way, \( Bi \) would equal to 0, means pure inter-industry trade.
To obtain the average level of intra-industry trade for a country, they proposed calculating a weighted mean, using the relative size of exports and imports of a particular product group as weights. It is shown as:

\[
\bar{Bi} = \frac{\sum_{i}^{n} Bi(Xi + Mi)}{\sum_{i}^{n} (Xi + Mi)} \times 100 \quad \text{.... (2.2.2.2)}
\]

the above formula can also be written as:

\[
\bar{Bi} = \frac{\sum_{i}^{n} (Xi + Mi) - \sum_{i}^{n} |Xi - Mi|}{\sum_{i}^{n} (Xi + Mi)} \times 100 \quad \text{.... (2.2.2.3)}
\]

One of the main problems with the above two equations is that it makes no allowance for any imbalance in a country’s total trade. When a country has a large trade imbalance (surplus or deficit), it will be biased downward and the true extent of intra-industry trade will, therefore, be underestimated. To avoid the problem, they proposed an alternative formula, which adjusts for any trade imbalance, as:

\[
Ci = \frac{\sum_{i}^{n} (Xi + Mi) - \sum_{i}^{n} |Xi - Mi|}{\sum_{i}^{n} (Xi + Mi) - |\sum_{i}^{n} Xi - \sum_{i}^{n} Mi|} \times 100 \quad \text{.... (2.2.2.4)}
\]

Equation 2.5 is used whenever country’s total trade is unbalanced.
They studied Australian trade data for the year 1968-69 and showed that as the level of aggregation increases, degree of intra-industry trade increases. They found that the degree of Australia’s IIT increased from 20% at SITC 3-digit to 43% at SITC 1-digit.

They found that Australia’s intra-industry trade was maximum with New-Zealand and South Africa, which were the countries with similar kind of resource endowments as that of Australia’s.

Apart from this, they studied the nature of Australia’s IIT, mainly for two sectors – iron and steel (SITC 67) and petroleum products (SITC 332). In both the cases the degree of intra-industry trade was found to be high. In case of iron and steel, it was high because of scale economies; while in the case of petroleum products, it was high because the northern part of Australia, to avoid huge transportation costs, imports their requirement of petroleum.

They, therefore, explained the main reasons for intra-industry trade, which were – specialization in narrow product ranges, joint production unmatched by complementarities in demand and trade across borders in high transportation cost industries.

Finally they concluded that, intra-industry trade is a real phenomenon and in-fact it is prevalent in almost all industries in the OECD countries including Australia.

2.2.3 THE BALASSA APPROACH

He also proposed a measure for intra-industry trade in the year 1974 and his work was again based on the international trade of European Economic Community. He measured intra-industry trade by taking the sum of the ratios of trade balance (exports minus imports) to total trade (exports plus imports) for each product group and then dividing by the number of product groups, as shown:
\[ E_j = \frac{1}{n} \sum_{i} \frac{|X_i - M_i|}{(X_i + M_i)} \] ......... (2.2.3.1)

here \( j \) stands for country \( j \) and \( i \) for the product group \( i \) out of \( n \) industries. The formula shows that \( E_j \) tends towards zero when all trade is intra-industry trade and towards one when all trade is inter-industry trade.

2.2.4 THE AQUINO APPROACH

He criticized the Grubel and Lloyd approach for failing to fully correct for an imbalance in a country’s overall trade. According to him, the GL-index underestimated the true extent of intra-industry trade. His argument was that \( C_i \) is itself a weighted average of the individual product group ratios, \( B_i \). However, these are also downwardly biased whenever a country’s total trade is unbalanced. Therefore each \( B_i \) needs to be adjusted, not just the summary formula. Therefore, he proposed adjusting each \( B_i \) whenever a country’s total trade is unbalanced and then estimating the overall average for the country using the adjusted \( B_i \) ratios. He proposed estimating hypothetical export and import values for each product group \( i \) on the assumption that total trade is balanced. The formula for calculating these hypothetical export and import values are:

\[ X_i^e = \frac{1}{2} \frac{\sum (X_i + M_i)}{\sum X_i} \quad \text{AND} \quad M_i^e = \frac{1}{2} \frac{\sum (X_i + M_i)}{\sum M_i} \] . (2.2.4.1)

these hypothetical values were then inserted into equation 2.2.2.3 of GL-index to obtain a trade-imbalance-adjusted summary measures of intra-industry trade, as shown:
\[ Q = \frac{\sum (X_i + M_i) - \sum |X_i^e - M_i^e|}{(X_i + M_i)} \times 100 \]  

........... (2.2.4.2)

Aquino method gives a lower estimate of intra-industry trade than GL-index.

### 2.2.5 THE GREENAWAY AND MILNER APPROACH

They worked on the measurement issues of intra-industry trade (Greenaway and Milner, 1981). They discussed the problems regarding measurement of intra-industry trade at the industry level that whether and how to appropriately adjust the industry indices for the effects of overall trade imbalance. Their work was based on the UK’s trade data between 1976 to 1979. They calculated unamended GL-indices for second-digit SITC level with Aquino indices amended, first for the imbalance on the overall visible trade and then for the imbalance on the manufactured goods only. They found the variability in the direction of adjustment in the industry or sub-group indices.

Furthermore, they were not satisfied with the “Equiproportionality in Adjustment”, i.e., balancing effect would be equiproportional to each industry or groupings within a particular set, as suggested by Aquino. They said that the assumption would be valid if price and income elasticities of demand, for all imports and exports, were identical and if supply was infinitely inelastic.

They, therefore, concluded that even-if macro-disequilibrium is identifiable, it cannot be generalized at industry level because intra-industry trade is a product of industry characteristics and not of macro-economic adjustment process.

In another work (Greenaway and Milner, 1983), they again discussed the measurement issue and found that the main problem regarding the measurement of intra-industry trade is the unknown influence of “categorical aggregation”. They discussed the approaches to assess the influence of categorical aggregation at the level of statistical aggregation, most typically equated with and “industry”, i.e., third-digit SITC level.

They said that categorical aggregation occurs when industrial categories are misclassifieds, i.e., activities with different production functions are erroneously grouped.
together. This problem can be overcome by regrouping of categories, but there are two major problems associated with it – first – the absence of any unique criteria for regrouping, and second – it is not clear how one allocates trade in parts and components in any reclassified scheme.

They found a compromise between ignoring the problems and regrouping. They suggested three ways to find out the influence of aggregation bias – measurement at a lower level of aggregation, measurement according to alternative classification system and computation of an adjusted Bi index. In the first case – one can expect that as we move towards disaggregated level, intra-industry trade will decrease. If the average level of IIT falls substantially, from one level to another, this could be an indication of the presence of categorical aggregation. In the second case – one can check the sensitivity of Bi index with alternative basis of classifications. This enables one to compare Bi indices from the two data sets. In the third case – they suggested to use Ci in place of Bi, i.e., when categorical aggregation inflates Bi, Ci will be an appropriate measure.

Therefore, they suggested checking categorical aggregation is easy to manage rather than regrouping the data set.

2.2.6 THE BALASSA AND BAUWENS APPROACH

Balassa and Bauwens, 1987 tried to test the hypotheses about the factors influencing the extent of intra-industry trade in a multi-country and multi-industry framework. Their investigation was limited to trade in manufactured goods where product differentiation predominates. Their work was based on 38 countries (mix of developed and developing) and they selected total 152 industry categories. They classified all the countries into four different categories – first – all countries; second – among developed countries; third – among developing countries; and fourth – between developed and developing countries.

They analyzed the determinants of intra-industry trade of every country with every other country and in each industry category. They considered two classes of determinants of
intra-industry trade – country characteristics and industry characteristics. These two categories had further been categorized into different subcategories, as shown below:

**Figure 2.2 Determinants of Intra-Industry Trade**

<table>
<thead>
<tr>
<th>Determinants of Intra-Industry Trade</th>
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<tbody>
<tr>
<td><strong>Country Characteristics</strong></td>
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<tr>
<td><strong>Common Characteristics</strong> – like –</td>
</tr>
<tr>
<td>average per capita income, average</td>
</tr>
<tr>
<td>country size, size differences,</td>
</tr>
<tr>
<td>distance, common borders, and</td>
</tr>
<tr>
<td>average trade orientation</td>
</tr>
<tr>
<td><strong>Specific Characteristics</strong> – like –</td>
</tr>
<tr>
<td>participation in economic integration</td>
</tr>
<tr>
<td>scheme, and common language</td>
</tr>
<tr>
<td><strong>Industry Characteristics</strong> – like –</td>
</tr>
<tr>
<td>product differentiation, marketing</td>
</tr>
<tr>
<td>costs, variability of profit rates,</td>
</tr>
<tr>
<td>scale economies, industrial</td>
</tr>
<tr>
<td>concentration, foreign investment,</td>
</tr>
<tr>
<td>foreign affiliates, tariff dispersion</td>
</tr>
<tr>
<td>and off-shore assembly</td>
</tr>
</tbody>
</table>

Source: Compiled from Balassa and Bauwens, 1987

In most of the cases, they found that the results obtained were matched with the theoretical concepts. Among the Common Characteristics, intra-industry trade was found to be positively correlated with average income level, average country size, trade orientation and the existence of common borders, and was negatively correlated with income inequality, inequality in country size and distance.

Among the Specific Characteristics, intra-industry trade was found to be positively correlated with the cases of trade agreements like ECM (European Common Market), EFTA (European Free Trade Association) and LAFTA (Latin American Free Trade Area).
Among the Industry Characteristics, intra-industry trade was found to be positively correlated with product differentiation, marketing costs, the variability of profit rates and off-shore procurements; while it was negatively correlated with product standardization, industrial concentration and foreign direct investment.

In the last they concluded that the simultaneous introduction of country and industry characteristics offer advantages over a decomposition of estimating equations into equations containing only country or industry characteristics.

2.2.7 THE HANINK APPROACH

Hanink, 1988, presented a model based on geographical product differentiation which directly focuses upon trade as market interactions. The model defines market homogeneity across national boundaries as the basis for international trade. His work was based on the Linder’s model of international trade. According to Linder, international trade caused by market homogeneity but limited by distance, is the same thing as intraregional trade. Linder’s model, however, did not incorporate the hierarchical flow of goods. Hanink extended the Linder’s model and incorporated the hierarchical flow, and therefore the variety across goods, as an additional rationale for existing geographical patterns of international trade. He discussed that in a central place system of intraregional trade there is a hierarchical order of settlements. The highest order settlement, i.e., the one with the largest population, is the focus of trade in the region because it is at that place that the widest variety of goods is available. Variety of goods decreases by hierarchical steps as the population of settlement decreases by hierarchical steps.

Hanink conducted empirical tests for the extended Linder’s model and found that, as expected, trade intensity is an increasing function of market homogeneity, a decreasing function of distance and an increasing function of variety across goods. He further discussed that trade theory is developed within the context of trade reality. The theory of comparative advantage was developed at a time when it was able to describe the existing trade patterns. As economic reality changed, the power of comparative advantage theory diminished and alternative trade theories emerged. Product Life Cycle theory, for
example, was developed in the context of post World War II trade which was dominated by the United States. As the international economy continues to change, however, the American dominance has turned to relative decline, and with the coincident increase in transnational corporation activity, product life cycle theory's validity becomes questionable. Then after the market interactions, as discussed by Linder, became a reality. For example, much of the economic growth of the newly industrializing countries results from their successful differentiation of products, specially for export markets rather than for domestic markets.

Finally, he concluded that the fundamental relationships expressed in the extended Linder model seem valid.

2.2.8 THE BERGSTRAND APPROACH

Till 1990, different studies regarding measurement issues of intra-industry trade had been done. These cross-country studies had found systematic empirical relationships between the share of intra-industry trade, between the two countries, and the average levels of and inequalities between their gross domestic products (GDPs), per capita GDPs and tariffs. Although these relationships were robust across econometric studies, a unified theoretical framework for including each one of these particular variables had not yet been established. Bergstrand, 1990, tried to extend the theoretical work of different economists, proposed for understanding the nature of intra-industry trade, by analyzing how each of the six determinants discussed above, as well as the average level of and inequality between their capital-labor endowment ratios, specifically influences their share of intra-industry trade in a given commodity group.

He undertook eight different propositions, for understanding the nature of intra-industry trade, and tested them empirically. These propositions were: the share of IIT between two countries will be lower the greater the inequality between their relative capital labor endowment ratios; the share of IIT will be lower the greater the inequality between per capita incomes, because of greater divergence in tastes; the share of IIT will be higher or lower the greater the average capital-labor ratios of the two countries, depending upon
their relative factor intensities in production; the share of IIT in luxury (necessity) goods will be higher (lower) the average level of economic development (here he assumed that differentiated goods are luxury while the homogeneous goods are necessity); the share of IIT will be lower the greater the inequality between their economic sizes; the share of IIT will be higher the greater their economic size; the share of IIT will be lower, the greater the inequality between their tariff level; the share of IIT will be lower, the greater their average tariff level, i.e., artificial barriers to trade. He considered the data of OECD countries and the dependent variable was the logit of an average of 3-digit SITC bilateral GL-IIT index.

He found that empirical results on all the propositions had the same sign as expected theoretically, although some of them were not statistically significant as well as the value of $R^2$ and adjusted $R^2$ were low. His model also revealed that a greater similarity of two countries’ per capita incomes would be associated with more intra-industry trade both for supply (Heckscher-Ohlin-Samuelson) and demand (Chamberlin-Linder) reasons simultaneously.

He “uncoupled”, for the first time, the effects of higher average capital-labor ratio and higher average per capita income of two countries on the share of IIT. He empirically proved that, for some manufacturing industries, a higher average capital-labor endowment ratio for the two countries can lower the share of intra-industry trade, even though a higher average per capita income can raise it.

### 2.2.9 THE HUMMELS AND LEVINSOHN APPROACH

Hummels and Levinsohn, 1993, revisited Helpman’s test and reconsidered the evidence. Their objective was not to amend the Helpman’s theoretical work but rather they applied a combination of different data and different econometric methods and question whether the data still support the theory’s specific predictions.

Helpman worked on OECD countries and found that as countries become more similar in size, the volume of trade as a proportion of GDP increases. They re-estimated the
Helpman’s model using both OECD countries and non-OECD (NOECD) countries, and found that regression result strongly supports the Helpman’s original findings.

They did panel data regression analysis also for OECD countries and rather than using “per-capita income” as a proxy of factor endowment, they used the real factors like “per labor GDP” and “capita-labor ratio”. They finally concluded that, instead of factor differences explaining the share of intra industry trade, much of the intra industry trade appears to be specific to country-pairs. Therefore, according to them, the effects of geography are more important in explaining the pattern of intra-industry trade. Since, as they found, much of the intra-industry trade is specific to country-pairs, they were skeptical about the prospects for developing any general theory to explain it.

2.2.10 THE GREENAWAY, HINE AND MILNER APPROACH

Greenaway, Hine and Milner worked for studying the importance of horizontal and vertical intra-industry trade in United Kingdom’s total trade. In their work, they explained the importance of country specific factors as well as disentangling horizontal and vertical intra-industry trade in the total trade.

In their first work (Greenaway, Hine and Milner, 1994) they deployed a new methodology based on the work of Abd-el-Rahman (1991), to identify vertical and horizontal intra-industry trade in the UK and estimated a model which was aimed at establishing whether country-specific factors are important in explaining the relative importance of vertical and horizontal IIT in the UK’s trade. They used unit value of a product as a proxy for the quality of the product, as used by Rahman. In their study, intra-industry trade in the UK trade, with each of its partner countries, was calculated at the 5-digit SITC level, using unadjusted GL-index. To differentiate between HIIT and VIIT, they used 15% as dispersion factor. They found that almost 70% of the UK’s IIT was vertical in nature and just about 30% was horizontal. The incidence of HIIT was highest where EC (European Countries) member states were concerned and lowest in case of geographically distant trading partners. They also found that high-quality vertical intra-
industry trade (HQVIIT) exceeds the low-quality VIIT (LQVIIT) with the majority of trading partners.

They also tried to find out the determinants of UK’s intra-industry trade and for that they used OLS (Ordinary Least Square) method for a sample of 62 countries. Here they found that the sign of market size variable (average market size) and integration dummy variables were same as expected theoretically, but the sign of factor endowment proxy (difference in per capita income) did not. They found that country-specific factors were relevant to explain the pattern of IIT. Both market size and membership of a customs union were relevant for VIIT while the relative factor endowments did not support the model. The pattern of HIIT also appeared to be influenced by country-specific factors, though the results were not as strong as the case of VIIT. Finally they concluded that “there are persuasive reasons for believing that it is worthwhile to separate-out HIIT and VIIT, because their determinants are different”.

In their second work (Greenaway, Hine and Milner, 1995), they pointed out not only the relative importance of vertical and horizontal intra-industry trade in the UK, but also demonstrated how a failure to separate them out can impact on the interpretation of empirical result. They calculated intra-industry trade in UK trade with all its partner countries, i.e., on a multilateral basis. They used 5-digit SITC trade data of UK. Intra-Industry Trade had been divided into horizontal and vertical components using relative unit values of exports and imports and used 15% as well as 25% dispersion factor, for separating out the horizontal with the vertical IIT. They considered 77 industries for calculating IIT and defined industries as 3rd digit level of aggregation. They performed a regression analysis, separately for horizontal and vertical IIT, to find out the sign/relationships of different determinants on these two forms of IIT. Different determinants they used were – proxy variable for horizontal product differentiation in the industry, proxy variable for scale economies in industry, a measure of market structure competitiveness of industry and measure of importance multinational enterprises in the industry.

The result of regression analysis was encouraging and they found that it is important to separate horizontal IIT with the vertical one, because theory also suggested to do so.
Their findings also suggested that the determinants do differ but not always in the expected fashion. IIT in vertically differentiated products was not well explained by the small numbers model rather they found that it is positively related with the number of firms in the industry, i.e., large numbers model applied. Vertical IIT was also positively linked to the vertical product differentiation. On the other hand, they did not find any evidence of attribute differentiation being positively related to horizontal IIT and this form of IIT appeared to be associated with few firms. Therefore they concluded that it is not the case always that determinants of total IIT support the large numbers model (on the presumption that horizontal IIT is the predominant form).

2.2.11 SOME OTHER APPROACHES

Gullstrand, 2002, worked on the Chamberlin-Heckscher-Ohlin-Samuelson (CHOS) model to test empirically the theoretical relevance of different methods of measuring intra-industry trade. He specifically worked on refining three measurement issues – adjustment of aggregation biases, the definition of inter- and intra-industry specialization at the product level, and the distinction between horizontal and vertical intra-industry trade. His findings underlined the importance of calculating IIT indices on bilateral trade flows on a low aggregation level in order to disentangle horizontal and vertical IIT. His results confirmed most of the predicted signs of the proxies, and revealed an interesting inverted U-shaped relationship between IIT and economies of scale, however, the interpretation of one key variable, differences in factor endowment, differed between the methods of measuring IIT. Therefore, he finally concluded that it is important to disentangle horizontal and vertical intra-industry trade, and that the specialization pattern across industries is important within rather homogeneous product groups; in other words, the choice of method of measuring intra-industry trade does matter.

Fontagné, Freudenberg and Gaulier, 2005, worked on different theories proposed till then regarding intra-industry trade and disentangling it into horizontal and vertical intra-industry trade. They emphasized that intra-industry trade is not only about trading similar products, on the other hand, two-way-trade in vertically differentiated products has been
the main contribution to the growth of IIT among developed economies. They tried to differentiate intra-industry trade with two-way-trade in vertically differentiated products. According to them, “an exchange of motors for motors (of certain cylinder capacity) represents two-way trade in intermediate goods; likewise and exchange of cars for cars (of a certain cylinder capacity) represents two-way-trade in final goods; but exporting motors and re-importing cars incorporating these motors corresponds to a vertical division of labor, not intra-industry trade”. They categorized the world trade into three different types of trade – inter-industry trade, intra-industry in horizontally versus vertically differentiated products. They showed that the increase in intra-industry trade in world level is due to two-way-trade of vertically differentiated products. The second thing what they found was that – specialization according to the classical theories of international trade (inter-industry trade) has recently recovered, due to increasing participation of emerging economies in the world trade. Therefore they predicted that, in future, the magnitude and the nature of internal adjustments induced by trade openness will change, as our economies will progressively go back to the traditional patterns of international specialization.

Cabral, Falvey and Milner, 2008, investigated, both theoretically and empirically, the relationship between differences in factor endowments and intra-industry trade, and its types. They started their study because they found the conflict between theory and empirical results regarding intra-industry trade. While the theory focused on HIIT, empirical studies show that VIIT is a dominant form of intra-industry trade. This phenomenon was explained by earlier researchers as – VIIT, like net trade (NT), will show a positive monotonic relationship with endowment differences between countries. Therefore they developed a general equilibrium framework model which allowed for the simultaneous existence of HIIT, VIIT and NT, by which they tested the relationship between endowment differences and the shares of HIIT, VIIT and NT in total bilateral trade. The assumption they made regarding the behavior of HIIT was quite conventional – larger endowment differences would reduce such type of trade; on the other hand the assumptions regarding VIIT were factor and trading partner specific. VIIT should grow with differences in sector specific factor endowments, as long as these differences remain small. The effects of larger specific factor endowment differences depend on whether the
specific factor is used by the industry or not. If not, then VIIT declines for larger endowment differences; if so, then the share of VIIT increases (decreases) if the trading partner has an ever larger (smaller) endowment.

Their result of European Union (EU) trade with its 51 major trading partners, confirmed that HIIT declines with growing endowment differences. They also confirmed about the sensitivity of VIIT flows to the magnitude of endowment differences. The specific predictions on endowment differences in the specific factor used by the industry (assumed to be capital) were also confirmed. But the non-linearity predicted for specific factors (assumed to be land) did not appear, perhaps due to insufficient variability in the sample. Overall these findings supported the view that both within and between industry specialization and trade can be driven by factor endowment considerations, and undermine the view that VIIT is simply disguised inter-trade associated with industry (dis)aggregation.