

## Chapter 4

### Intra-industry trade: categorising products according to trade theories

*The revelation of simultaneous exports and imports within industries (defined as intra-industry trade - IIT) between countries of similar development levels is one of the most important empirical findings of the 1960s concerning international trade (Fontagné, Freudenberg and Peridy, 1997: 7).*

#### 4.1 Introduction

The most noteworthy feature of the post-World War II global economy is the rise of exports and imports of similar goods or intra-industry trade (IIT). This is the key in untangling the theories. This phenomenon is not new. Marshall (1920: 104) notes, “a country often exports a commodity over one frontier, while she practically imports the same over another ... But, more commonly, the commodities which into trade of this kind differ a little from one another, though called by the same name”.

Chapter 3 described various trade theories most of which predicted that countries would tend to specialise in the production and export of certain products. No empirically acceptable explanations were found and new theories arose.

No trade theory gives a complete representation of the reality. Policy-makers need a comprehensive integrated picture. The key question is – what are the determinants of IIT? Clearly, if there are sectors in which IIT is taking place, and they respond differently to certain variables, the policy responses would vary. The vast body of literature on IIT analyses both country and industry effects.

The purpose of this chapter is therefore to:

1. Describe phenomena and critically analyse the causes of IIT;
2. Define and quantify the extent of IIT; and
3. Develop a typology of causes of IIT that can be used to identify the determinants of South African exports.

Section 4.2 describes the phenomena of IIT and identifies causes that could explain why it occurs within a classical explanation of trade. Once these explanations are removed, IIT is then expressed in terms of new trade theories. These expositions and various attempts to categorise products are described in section 4.3. Techniques of measuring IIT and problems encountered in measuring

IIT are described in section 4.4. In section 4.5 a framework given by Fontagné et al., (1997) is discussed to disentangle products and used to relate products to certain theories.

## 4.2 Describing and explaining IIT

The question why IIT occurs is important, as its determinants could also be determinants of trade. This section analyses the technical and possible economic causes of IIT. It can be explained within the Heckscher-Ohlin model, after taking into account:

- Classification and aggregation of products;
- Seasonal fluctuations (e.g. fruit, tourism);
- Aggregation of trade without considering geographic factors;
- Entrepôt trade (e.g. Singapore, Panama);
- Transportation costs (important for bulky items);
- Joint production (financing of traded goods); and
- Government-induced price distortions (taxation).

### (i) Industry classification

IIT refers to the degree of overlapping in trade. A reason for the failure to appreciate high levels of IIT is that trade data are not sufficiently disaggregated, either by area or industry. There are a number of different classification systems, including the Harmonised System (HS) used for customs purposes, the International Standard Industrial Classification (ISIC), and the Standard International Trade Classification (SITC). These are hierarchy-based systems which allow for different levels of aggregation. The more aggregated the industries are, the more likely IIT is to occur.

Specialisation can take place within industries. Firms, especially multinational corporations, are integrating their operations across borders and splitting the value-added chain. Components can be made in one region or country and supplied to an affiliate in another. Depending on the level of aggregation and the classification system, the components and final product will be classified under the same heading. Because the multinationals have plants in developed countries, trade will occur between them. This phenomenon occurs largely because of differences in wage levels, which suggests that trade is generated by Ricardian or Heckscher-Ohlin factors.

**(ii) Seasonal variations**

If seasonal growing variations are ignored, IIT will be higher. Trade statistics are often aggregated annually and summer exports (imports) are compared with winter imports (exports). If climate is considered a factor of production, seasonal patterns need to be disaggregated to identify the extent to which it influences trade. Using US quarterly data, Kaneda (1998) finds fluctuations of as much as 43 per cent and 15 per cent for apparel imports and exports respectively, and 7 per cent and 12 per cent for aggregate imports and exports respectively. Seasonal fluctuations of aggregate exports have decreased substantially over time.

**(iii) Geography**

Geography plays an import role in trade and depending on how it is aggregated, will influence IIT indexes. However, entrepôt trade where goods are imported and re-exported without any further processing, value addition or distribution in the country, occurs where an intermediary is located in a particular commodity centre and facilitates worldwide distribution. Regional hubs such as Singapore and Panama are playing an increasingly important role in this type of trade. Unless such trade is accounted for, IIT would seem higher than it actually is.

**(iv) Transaction costs**

Transaction costs have tended to reduce during the past century. Recent developments in information and communications technology have added impetus to this trend. The declining real costs of international telecommunications, and rapid advances in global communications and internet technologies, have allowed the previously vertically integrated production processes to be segmented and dispersed around the world. This has fostered a new division of labour that encourages global outsourcing and specialisation. Since the 1970s, the use of containers has contributed to reducing the cost of trade. Nevertheless, the costs of transporting certain goods are still very high. This is especially true with goods of low value and high volume or weight. In such cases, it may be easier to set up manufacturing or production locally rather than importing.

Lower transaction costs, especially marketing costs, allow manufacturers a larger and more diversified market. Selling goods on the internet, for example, gives manufacturers immediate access to global customers. Although this would, in theory, tend to reinforce traditional trade theory, in reality firms are creating niche markets in which economies of scale and monopolistic markets are important.

**(v) IIT due to foreign direct investment (FDI)**

Helpman and Krugman (1985) conclude that multi-national corporations' (MNC) activity will positively correlate with horizontal IIT after controlling for country-specific effects. This is empirically supported for country-specific factors (i.e. endowments, income levels, distance) but not industry-specific factors (market structure, scale, product differentiation). Greenaway, Hine and Milner (1994) argue that this may be the result of misspecification, in particular the failure to distinguish horizontal from vertical IIT.<sup>1</sup> Vertical IIT is likely to be associated with FDI as foreign firms combine their technological knowledge with local endowments to produce goods of varying qualities that are exported. With horizontally differentiated products, foreign investors export goods previously produced in the investor's home country (Markusen & Venables, 1997). The impact on IIT depends on the export structure of the industry in the foreign country prior to FDI, with horizontal IIT increasing if the industry did not produce similar goods or if the foreign entrants have positive net exports.

**4.3 Classification of products**

From classical theory, there are a number of broad categories of theories that describe the pattern of international trade. Trade theory can be divided into those theories based on supply conditions (Ricardo, Heckscher-Ohlin, and technology) and those based on demand conditions. Following Hufbauer (1970) and Hirsch (1974), Winters (1985) identifies three classes of goods, each with their own sources of comparative advantage:

- *Ricardo*: Goods are allocated on the basis of production conditions. These goods would include natural resources and simple processing industries based on materials. Comparative advantage generally lies with developing countries because they are less disadvantaged in this sphere than in other types of trade.
- *Heckscher-Ohlin*: Goods comprised mainly those of "footloose" manufacturers with well-established technologies and no specific sectors. They migrate around the world in search of the best of the factor endowments. Examples include textiles, ferrous metals and building materials. Comparative advantage accompanies factor endowments. Such trade would be relatively important between developing and developed countries.

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<sup>1</sup> They conclude that the determinants of vertical and horizontal IIT differ, but not always in the expected manner. For the UK, vertical IIT appears to be better supported by models with large numbers of firms, but this is not the case for horizontal IIT. Scale economies were found to be significant only for horizontal IIT, while FDI was not a significant determinant of either type of IIT. In a more recent analysis of intra-EU IIT, Fontangé *et al.*, (1997) find that FDI and scale are positively associated with both horizontal and vertical IIT, while product differentiation is positive for vertical and negative for horizontal IIT.

- *Technology goods*: Goods emanate from developed countries. Production is sophisticated, rapidly developing and non-transferable (Winters, 1985).

New trade theory introduces differentiated products. From the mid-1980s onwards, the empirical literature refined the distinction between IIT into horizontally and vertically differentiated products.<sup>2</sup> Although firms producing differentiated products do not compete only on price, there may or may not be variations in price. Horizontal IIT develops when produced goods are similar in quality, but different in their features and attributes.

#### 4.4 Product differentiation

Even after allowing for these factors, the extent of IIT cannot be explained in terms of endowments. Drawing on new trade theory, alternative explanations for IIT are proposed. To use these theories it is necessary to consider various product classifications. Traditional trade theory assumes products are completely homogeneous or perfect substitutes in consumption. Although many products are categorised as being similar, consumers may perceive them as different. Because consumers are heterogeneous, goods (imported or domestic) are imperfect substitutes. Manufacturers respond and differentiate their products according to their characteristics (Lancaster, 1980) or quality (Falvey, 1981). Differentiated products compete mainly on factors other than price. The determinants of the former result from industries in similar economies responding to diverse tastes. In the latter, firms respond to different production functions in countries with different factor endowments. Product differentiation can explain the large shares of IIT. Firms across borders produce similar goods that are distinguished or simply differentiated from one another by brand, other subtle differences, or more technical differences.<sup>3</sup>

##### (i) Horizontal differentiation

Abd-el-Rahman (1991) and Greenaway, Milner and Elliot (1999) propose a distinction between horizontal and vertical IIT because the determinants of each type differ. It seems that vertically differentiated IIT responds to factor endowments, whereas horizontal IIT notably depends on efficient scale variables and monopolistic competition.

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<sup>2</sup> Horizontal and vertical differentiation should not be confused with business administration literature's vertical and horizontal clusters. Vertical industrial clusters comprise groups of firms that are part of a single supply chain, while horizontal industrial clusters comprise firms that produce similar products. Understanding the competitive drivers of these clusters is important, but not in terms of IIT.

<sup>3</sup> Manufacturers also require differentiated inputs. It is common for manufacturers to use different suppliers, both locally and internationally, for their components because of availability, price and quality, and to ensure that they do not become dependent on a single source.

Horizontally differentiated IIT arises when there is two-way trade in products of similar quality, but different characteristics or attributes. Horizontal IIT is driven by product differentiation and scale economies. The smaller the minimum efficient scale of production, the greater the number of firms in an industry, the greater the number of varieties supported by the market and the greater the magnitude of IIT. Countries with similar income are likely to engage in horizontal IIT. Horizontal IIT is associated with a high degree of product differentiation and scale economies.

Because products can be sold at different prices or different mark-ups in different markets, Porter (1990) places a great deal of emphasis on demand factors. In an increasingly globalised economy, consumers have more knowledge about different products.

## **(ii) Vertical differentiation**

Simultaneous export and import of similar goods of varying qualities give rise to vertically differentiated IIT and follows traditional endowment-based models, with the relatively capital-abundant country exporting higher quality products and the relatively labour-abundant country exporting lower quality goods. Falvey (1981) shows that vertically differentiated IIT arises when large numbers of firms produce varieties of different qualities without increasing returns in production. Falvey's model explains trade from the supply side, predicting that share of vertically differentiated IIT will be positively correlated with market size and the difference in per capita income in the context of the Heckscher-Ohlin-Samuelson theory, with capital moving freely between firms of a given sector but not between sectors. The higher the income, the greater the abundance of capital and the greater the propensity to specialise in high-quality manufactures. Lower income labour-abundant countries specialise in low-quality manufactures. The share of vertically differentiated IIT increases where many big firms produce numerous varieties of products (Falvey & Kierzkowski, 1987). They explain vertically differentiated IIT from the demand side by modelling demand for different qualities as a function of the quality's relative price and consumer income. This is because higher income consumers demand higher quality products.

Shaked and Sutton (1984) explain vertical differentiation IIT models in the context of an oligopoly context by assuming that the quality of a product depends on research and development. This is a fixed cost and more suitable to high-technology sectors. From the demand side, higher income consumers will demand superior goods. The equilibrium is obtained in a three-stage game where entry, quality of the product and price decisions are taken. Increased turnover because of international trade and the presence of scale economies contributes to lower average cost. For the enterprise to remain competitive and profitable, research and development need to increase. In the new equilibrium, for a given price, the quality of all varieties will be higher, and with the

remaining firms located in different markets, vertical differentiated IIT will occur. It is therefore not clear what impact scale or concentration has as a determinant of vertically differentiated IIT.

**(iii) Homogeneous products**

Most IIT is explained by differentiated products, whether horizontal or vertical. The models of Brander (1981), and Brander and Krugman (1983) explain IIT with homogeneous goods. IIT can occur without product differentiation when a highly concentrated market structure leads to two-way flows of homogeneous products and is known as reciprocal dumping. Inter-industry trade can occur without comparative advantage if external economies of scale are present.

**4.5 Measuring IIT**

The simplest measurement of IIT is given by:

$$B_j = \frac{x_j - m_j}{x_j + m_j} \dots\dots\dots (1)$$

Where  $x_j$  and  $m_j$  are the exports and imports from sector or industry  $j$ .

Here  $B_j = 1$  or  $-1$  indicates complete specialisation, while  $B_j = 0$  suggests perfect IIT. Not much else can be deduced from  $B_j$ .

This indicator was developed from the instrument by Balassa (1965) commonly used to measure revealed comparative advantage (RCA), (Greenaway & Milner, 1986). The assumption is that a country will export a product in which it has a comparative advantage and import products in which it has a comparative disadvantage. This calculation reveals the relative balance of trade across manufacturing sectors:

$$RCA = \frac{\frac{x_{ki}}{\sum_{k=1} x_{ki}}}{\frac{x_{k'}}{\sum_{k'=1} x_{k'}}} \dots\dots\dots (2)$$

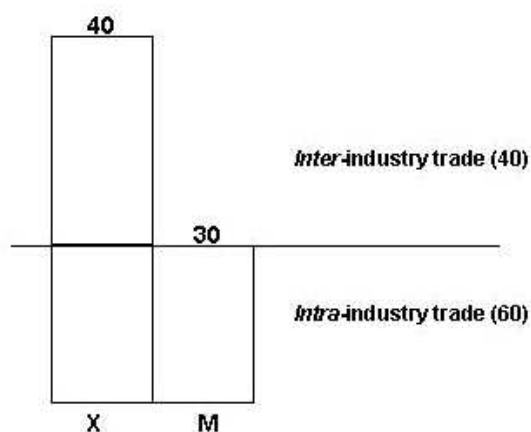
where:

- $x_{ki}$  is country  $k$ 's exports of commodity  $i$ ;
- $k' = 1 \dots f \dots k'$  represents  $k$ 's trading partners (usually total world trade).

If a country only exports (with no imports) a commodity, the RCA will be one, which shows that there is specialisation (inter-industry trade). Zero suggests that there is a lack of specialisation and IIT is occurring. Negative values imply comparative disadvantages. The RCA is a purely descriptive measure. By assessing changes in the RCA over time, it is possible to discern in which sectors there is strengthening, although this may be caused by reduced imports and not because of improved competitiveness (Valentine & Kransnik, 2000: 269).

A widely used indicator for measuring the importance of IIT in an economy's trade pattern is proposed by Grubel and Lloyd (1975). The Grubel-Lloyd indicator calculates the part of balance trade or trade overlap relative to total trade of a given industry. It takes values between zero and one. The closer the Grubel-Lloyd indicator is to one, the bigger the share of IIT in the total trade of the economy.

**Figure 1 Degree of trade overlap**



Source: Fontagné *et al.*, (1997: 28).

A country's total trade can be disaggregated into inter- and intra-industry trade. The total trade in any industry  $i$ , can be expressed as  $(X_i + M_i)$  where  $X_i$  refers to exports of the industry; and  $M_i$  to imports. The two components are as follows:

- Inter-industry trade or net trade, is the value by which exports exceeds imports and is denoted as  $|X_i - M_i|$ ; and
- IIT is the value of trade in an industry to the extent that exports are matched by imports, and is equal to  $(X_i + M_i) - |X_i - M_i|$ , or total trade minus inter-industry trade.

The empirical literature of IIT uses almost exclusively an index given by:



$$GL_j = \frac{x_j + m_j - |x_j - m_j|}{x_j + m_j} = 1 - \frac{|x_j - m_j|}{x_j + m_j} \dots\dots\dots (3)$$

By disaggregating total trade to trade with particular countries and sectors into particular products, an adjusted Grubel-Lloyd index is given as:

$$IIT_{jk} = \left\{ 1 - \left[ \frac{\sum_i |x_{ijk} - m_{ijk}|}{\sum_i x_{ijk} + m_{ijk}} \right] \right\} \times 100 \dots\dots\dots (4)$$

Contemporary theoretical synthesis widely holds that IIT is caused by monopolistic competition and (internal) increasing returns, although comparative advantage is still at work for countries separated by a high economic distance, i.e. a large difference in factor endowments, technology levels, etc. Economic distance between countries is the basis for not only specialisation between industries along a comparative advantage scheme, but also specialisation along ranges of quality, within industries. Combining these two kinds of product differentiation into a single model of imperfect competition in which consumers choose first among qualities and then among varieties of each quality, explains why different countries will engage in IIT in vertically differentiated products whereas similar ones will engage in IIT of varieties within similar qualities. Ethier (1982) and Harrigan (1995) question the appropriateness of regressing IIT indices on measures of scale or product differentiation, as the Grubel-Lloyd index is invariant to changes in these variables in the standard trade model with monopolistic competition.

Fontagné *et al.* (1997) hold that the type of differentiation appears to be central to explaining the determinants of trade. They propose a methodology that breaks down total trade into three trade types:

- One-way trade;
- Two-way trade in similar products; and
- Two-way trade in vertically differentiated products.

Two-way trade is given when the trade overlap of the minority flow represents at least 10 per cent of the majority and Fontagné *et al.* (1997) give it when:

$$\frac{\min(X_{kk'it}, M_{kk'it})}{\max(X_{kk'it}, M_{kk'it})} > 10\% \dots\dots\dots (5)$$

Horizontally differentiated IIT or two-way trade in similar products is given when:

$$\frac{1}{1,15} \leq \frac{UV_{kk'it}^x}{UV_{kk'it}^m} \leq 1,15 \dots\dots\dots (6)$$

where:

- UV is the unit value for each product; and
- The superscripts  $x$  and  $m$  represent export and import respectively.

Horizontal intra-industry trade assumes that

- Consumers love variety and
- There are increasing returns to scale in the production of the differentiated good.<sup>4</sup>

Two similar countries will trade because the larger size of the combined market makes it possible to produce more varieties of the differentiated goods than is possible in an autarchic equilibrium. Each country will end up importing the varieties it does not produce at home. Both countries are better off with trade than under autarchy, because more varieties are available to consumers and this at a lower price because of economies of scale.

Vertical intra-industry trade assumes that

- Consumers differ in their level of income; and
- The number of producers per country is restricted.

Each country can therefore only produce a limited variety of qualities of the good and each consumer buys the quality that corresponds best to his budget constraint.

Reducing trade barriers would then lead to trade even if the two trading partners are very similar countries. The fact that enterprises sell to both countries increases the range of different qualities produced and available to consumers. Welfare improves with trade because many consumers will be able to find product qualities that are more suitable to their budget.

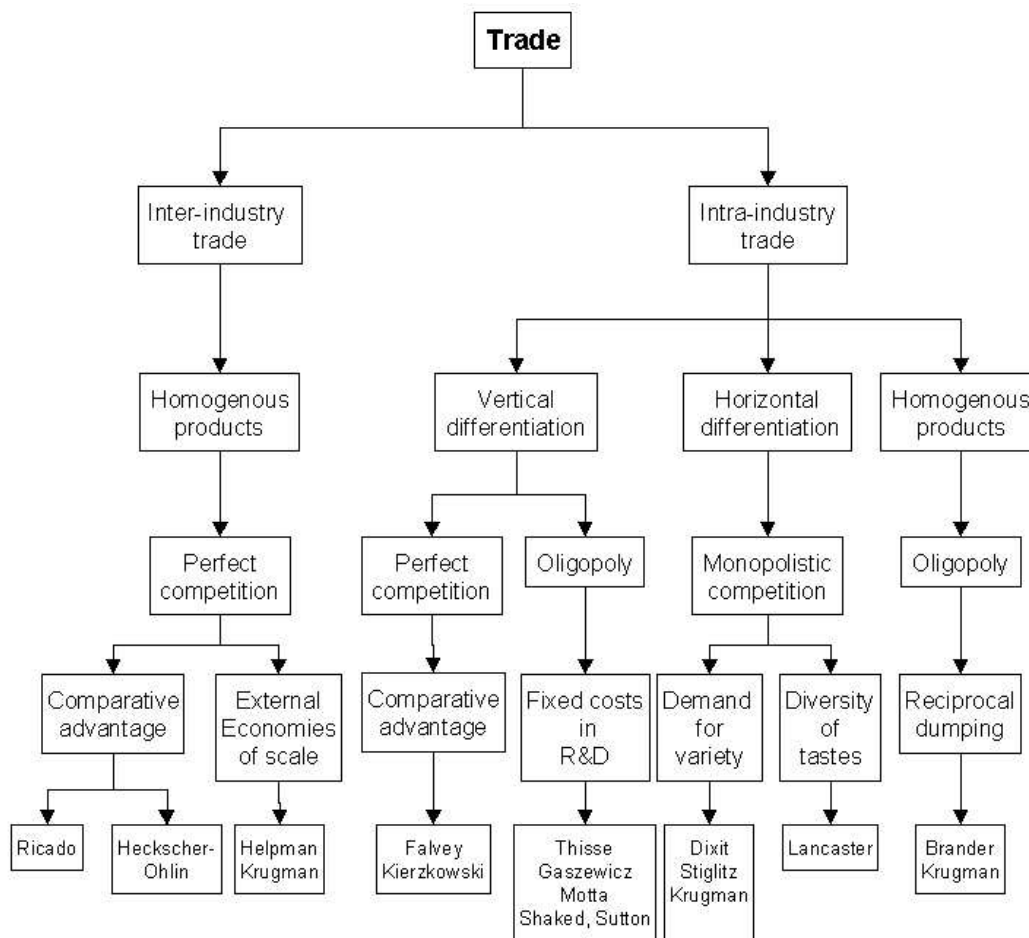
#### 4.6 IIT determinants of trade

Using the framework given by Fontagné *et al.* (1997: 17) and South African trade data, products and sectors are classified and reported in Appendix 10.

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<sup>4</sup> In some models the “consumers” of the differentiated good are actually producers themselves: they use the differentiated good as an intermediate input in the production of a homogeneous final good.

Figure 2 Differentiation, market structure and the determinants of trade



Source: Adapted from Fontagné *et al.* (1997).

Empirical research has tried to disentangle horizontal from vertical intra-industry trade in countries' trade flows. Horizontal intra-industry trade has tended to receive more attention than vertical intra-industry trade<sup>5</sup>, although empirical trade literature finds that a larger share of intra-industry trade is actually vertical intra-industry trade. Greenaway *et al.*, (1994) find that at the end of the eighties two-thirds of the UK's intra-industry trade was vertical. Fontagné *et al.*, (1997) find that more than half of the total intra-EU trade in 1994 is vertical intra-industry trade.

Several studies indicate that countries specialise in certain quality niches. Jansen and Landesmann (1999) find that quality of exports is correlated with per capita GDP as a proxy for the level of development.

<sup>5</sup> See Krugman (1990) for an overview on the trade literature related to horizontal intra-industry trade.

**(i) Data**

As with most empirical analysis, data is a problem. Using South African trade data, it is virtually impossible to determine unit values as quantities are often not given<sup>6</sup>. Using the unit price can cause problems. It is not clear how quality is measured, especially over time. A motor vehicle purchased in 2004 is not the same product as the one purchased in 1970, even if it is produced by the same manufacturer with the same basic specifications.<sup>7</sup> Instead of using unit prices, a classification system developed by Rauch (1999) is adapted to South African data. He identified three possible product types:

- Differentiated products;
- Reference priced products; and
- Homogeneous goods.

Rauch (1999: 9) treats homogeneous and reference price products separately because “the former have specialized traders that centralise price information while the same is only potentially true for the latter.” Reference price goods are an in-between category that has characteristics of both homogeneous and differentiated products. The classification depends on whether the product:

- Is traded in an organised exchange or is “homogeneous”;
- Is not traded in an organised exchange, but has some quoted “reference price”, such as in industry publications; and
- Does not have any quoted price or “differentiated.”

Products can also be classified according to factor intensity as agriculture, mineral (or natural resource), labour and capital-intensive products according to the United Nations Broad Economic Categories Classification. Given the nature of the export data, it is not possible to capture all aspects of technological upgrading from national statistics. All methods used to categorise

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<sup>6</sup> Many strange outliers can only be verified at enterprise level. A typical problem is that traders will enter the number of containers rather than the weight or volume required for a particular HS code. A particular eight-digit HS code may have more than one product. (Further problems regarding the data are discussed in Appendix 8).

<sup>7</sup> Aiginger (2001) provides a set of indicators to monitor the quality position: Share of quality intensive industries in value added (net relative quality elasticities (RQE) of production); Share of quality intensive industries in exports (net RQE of exports); Share of exports in high quality sectors of industries; Export unit value; Import unit value; Relative unit value (export UV/Import UV); Share of value added in sunk cost industries (technology + marketing driven); Share of exports in sunk cost industries (technology + marketing driven); Share of value added in skill intensive industries; Share of exports in skill intensive industries; Share of value added in industries with high contents of knowledge-based services; Share of exports in industries with high contents of knowledge-based services; Share of value added in industries with high product differentiation (PD); Share of exports in industries with high

products by technology rely on judgment when assigning products to a category. Lall (2000) extends systems devised by Pavitt (1984) and the OECD (1994) to take account of product groups or clusters of particular export interest to the developing world.

#### (vi) South African exports

Appendix 9 lists South Africa industrial sectors according to the classification methods described above. The first four columns include the IIT index calculated according the Grubber-Lloyd method for various periods. The following columns include: the number of firms in that sector in South Africa, the Herfindahl-Hirshman index, whether the sector is a net import or exporter, whether the products are homogenous or differentiated, and if they are differentiated whether they are vertically or horizontally differentiated, and the weighted average according to the general export incentive scheme (GEIS) classification<sup>8</sup>. This allows classification of sectors according to the Fontagné *et al.* (1997) methodology.

**Table 1 Classification of products according to Fontagné *et al.*, (1997) methodology**

Sector	Broad classification
Food	Inter industry, homogenous or horizontally differentiated products
Beverages	Intra-industry, horizontally differentiated products
Tobacco	Inter industry, horizontally differentiated products
Textiles	Intra-industry, vertically differentiated products
Clothing	Intra-industry, mainly horizontally differentiated products
Leather	Intra-industry, horizontally and vertically differentiated products
Foot	Intra-industry, horizontally and vertically differentiated products
Wood	Inter industry, homogenous products
Paper	Intra-industry, horizontally and vertically differentiated products
Print	Intra-industry, vertically differentiated products
Petro	Intra-industry, horizontally differentiated products
Basic chemicals	Intra-industry, horizontally differentiated products
Other chemicals	Intra-industry, horizontally and vertically differentiated products
Rubber	Intra-industry horizontally and vertically differentiated products
Plastic	Intra-industry horizontally and vertically differentiated products
Glass	Intra-industry horizontally and vertically differentiated products
Non-metal products	Intra-industry horizontally and vertically differentiated products
Iron	Intra-industry vertically differentiated products
Nonferrous metal	Intra-industry vertically differentiated products
Metal	Intra-industry vertically differentiated products
Machinery	Intra-industry horizontally and vertically differentiated products
Electric machinery	Intra-industry horizontally and vertically differentiated products
Motor vehicles	Intra-industry horizontally differentiated products
Transport	Intra-industry horizontally and vertically differentiated products
Furniture	Intra-industry horizontally differentiated products
Other	Intra-industry horizontally and vertically differentiated products

Source: Own calculations

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product differentiation (PD); Share of value added in globalised industries (Openness); and Share of exports in globalised industries (Openness).

<sup>8</sup> The higher this number, the greater is the chance that the industry manufactures differentiated products.

Most manufactured products exported by South Africa have a large intra-industry component. There are however a number of products that South Africa imports that are inter-industry. Many manufactured exports are differentiated.

#### **4.7 Conclusion**

The main driving force of IIT is increasing returns to scale or unit costs of production that decline as the quantity produced increases, although there are also other reasons. IIT is reinforced by the existence of scale economies. This is particularly true when the products are differentiated. Countries producing a small range of differentiated goods that enjoy the potential of economies of scale will be able to reduce their costs and prices if they produce more. The result will be substantial two-way trade at lower costs.

The techniques used to measure IIT, in combination with other factors, can be used to identify which products and sectors comply with which theory. Policies and interventions can then be developed to stimulate the export of particular sectors, as prescribed by each theory.

Although IIT analyses a countries imports and exports the focus of this study is exports. The next chapter will therefore quantify the impact of each determinant or variable on exports from South Africa per industry. This will confirm how applicable IIT is in contributing to an understanding of trade, particularly exports, and how it can be applied to sectoral policy making.