EVOLUTION OF NEW TRADE THEORY: METHODOLOGICAL ISSUES AND SOME EVIDENCES

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CERTIFICATE

This is to certify that the dissertation entitled **"EVOLUTION OF NEW TRADE THEORY: METHODOLOGUCAL ISSUES AND SOME EVIDENCES"** submitted by me in partial fulfillment of the requirement for the award of **Master of Philosophy** has not been previously submitted for any other degree of this or any other University.

(Kaustav Banerjee)

We recommend that this dissertation be placed before the Examiners for evaluation.

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I dedicate this work to my parents whose love and sacrifice has moulded my life.

CONTENTS

Chapter I

Introduction

The Ricardian legacy, which has for long been the defining feature of traditional trade theories, sought to explain trade as an outcome of (national) comparative advantage. This view can be interpreted as one, which explains trade arising out of nations taking advantage of their differences. The predicted pattern of trade would then result in specialization. Taking the Hecksher – Ohlin – Samuelson model of trade, as one which embodies the spirit of traditional trade theory, we discover that nations abundantly endowed with a specific factor will export those goods whose production requires intensive use of that specific factor. Simply, a nation abundantly endowed with capital will export capital intensive goods. The logical conclusion which follows is that trade occurs between dissimilar nations (dissimilar with regards to factor endowment and intensities) resulting in nations specializing according to their comparative factor advantage.

The empirical evidence (e.g. Grubel and Llyod, 1975 and Balassa ,1975) however, brought to light other possibilities — trends revealed that the growing magnitude of trade was taking place between advanced capitalist nations, which were similar in their factor endowments. More interestingly, trade was occurring in *similar differentiated products* — a phenomenon identified as *intra industry trade* in the literature. The empirical evidence revealed a clear departure from the main postulates of the H-O-S model. The testing of the H-O-S postulates went on to become one of the classic debates that triggered a huge body of research in the theory of international trade. Clearly, an alternative explanation was sought to explain IIT. The corpus of research on IIT has proceeded along two lines — first, theoretical models based on increasing returns and imperfect competition, which came to be known as New Trade Theory (which is the object of study in this dissertation). The second approach dealt with cross-sectional studies at the industry and country levels, which explored the relationship between IIT and industry and country characteristics. The core assumption of traditional trade models is that of perfect competition. Theorists in the 60's and 70's realized that this assumption, though unrealistic[1], was used due to the absence of proper techniques to analyze imperfect competition. In real life markets are observed to be characterized by imperfect competition rather than the traditional assumption of perfect competition. The role of *economies of scale — increasing returns* in particular as a cause of international trade was relegated to the margins of trade theory[2] due to the incompatibility of introducing scale economies with a perfectly competitive market structure. A *methodological* departure was required to tackle the problem of imperfectly competitive markets.

Chapter II traces the various attempts by economic theorists to formalize such departures. These departures can be loosely categorized under three distinct heads[3]. The *Marshallian* approach is the first of these departures, which assumes *increasing returns as external to firms*. The second departure is the story of applying formal models of

[1] Perfect competition relies on the *auctioneer* mechanism, which leads firms to act as price-takers — prompting the label of being unrealistic. The theories of market games, however, are modeled more realistically taking firms as price-setters. The main conclusion of this literature is that Walrasian equilibrium is sustained as *Nash equilibrium* of a market game under very weak assumptions. There may exist, once additional assumptions are introduced, Nash equilibrium other than the Walrasian one. There is, in fact, very weak support for the view that only Walrasian outcomes can be supported as Nash equlibria of market games with price-setting agents — see J.P.Benassy (1986).

[2] Modern theorists like Ohlin had pointed out that nations may also trade because there are intrinsic advantages of specialization arising out of economies of scale.

[3] See Krugman (1990).

Chamberlinian monopolistic competition to trade; which occupies, till date, the bulk of the attention of trade theorists dealing with imperfect market structures. With new insights in the field of *Industrial Organization Theory* and *Game Theory* in the 70's, the way was paved for the next departures. This gave rise to models of *oligopoly,* which were used to formalize trade theory. All these approaches to international trade that emphasize the role of increasing returns and imperfect competition represent a new school of thought in trade theory — which Krugman defines as *new trade theory*[4].

The normative analysis of trade policy is also open to questioning once we incorporate imperfect competition. The traditional theory of trade relied on the two Welfare theorems to prescribe free trade as a welfare enhancing policy. The new look at trade with imperfect market structures curtails such unambiguous and sweeping policy prescriptions for free trade. Market distortions may hurt domestic players and hence prompt government intervention. We try to broadly trace the developments in new trade theory based on the Marshallian, Chamberlinian and Cournot approaches to the problem of market structure. We discuss these approaches through specific models, which we feel captures the spirit of their respective categories. Our approach in Chapter 1 is restricted to analyzing trade theory under different forms of imperfect market structures — analysis for trade policy is not the main theme of this research. Hence, mention of policy issues shall only be incidental according to relevance.

New trade theory has largely been preoccupied with looking at international trade through the concept of imperfect competition. These older approaches have mostly focused on *general equilibrium* models of international trade, while devoting incidental importance to *market structure*. An interesting area of research emerges if we focus on

[4] Ibid.

the problem of market structure as the starting point and then build a narrative of trade, which is what we do in *Chapter III.* Thus, when a firm (*and not a nation*) trades — it's perception of segmented markets give rise to *strategic interaction* among other firms in these markets. *Multimarket* interactions then, would require careful analysis of markets and trade would be a profit-maximizing outcome of such interactions. Different identifiable markets would entail separate cost considerations. In the context of trade, one would expect a firm to incur less costs to serve it's home market than the foreign market. Trade policies and a host of other reasons (e.g. tariffs, freight charges etc.) influence these costs. Segmented markets would then give rise to a different form of conduct— thus justifying our attempt to redefine *intraindustry trade as international industrial organization*[5], thereby giving prevalence to market structure in our analysis. Since there is no single unified theoretical literature dealing specifically with these issues, we would attempt to formalize such a framework.

The assumptions of price-taking firms and free entry in markets have helped in constructing the narrative of perfect competition in economic theory in general and neoclassical trade theory in particular. There has existed, albeit at the margins of economic theory, a parallel enquiry regarding the imperfect nature of the markets.

This movement from perfect competition to imperfect competition can be succinctly captured if we use the *theory of games*. Game theory, which studies at an abstract level interactive decision process in which the players are aware of their mutual strategic interdependence, thus, paves the way for a rigorous analysis of imperfectly competitive markets.

[5] see Grossman (1993).

There is of course a very important underlying assumption, which runs through traditional trade models and continues to prevail even in New Trade theory. This is the assumption of product homogeneity. The assumption of the models discussed in Chapters II and III, all assume the existence of homogenous products. Apart from this there is the assumption of perfect information, which is assumed to exist among firms about costs, among consumers regarding the price distribution and regarding quality of products sold. These assumptions, in turn, take away the potential of modeling product differentiation (can be horizontal or vertical differentiated) in new trade theory. This is what we propose to do in *Chapter IV*. Explicitly, we take the case of differentiated products, prevalence of asymmetric information to model intraindustry trade.

In *Chapter V*,we look at the various empirical tests of intraindustry trade — some methodological debates as well as few case studies. Since the focus of this work is theoretical models of new trade theory, we take typical case studies which throw light on the nature of trade between similar nations (i.e. North-North); dissimilar nations (i.e. North-South). We also take a look at the Indian experience regarding intraindustry trade.

Finally, we look at the various policy measures, which can be taken by governments, to facilitate intraindustry trade. Another interesting policy implication of looking at trade as multimarket oligopolistic interaction is the role of Anti-trust and Competition policy. We conclude with certain specific shortcomings of new trade theory and the problems faced in modeling imperfect competition in general.

The lack of any unified theory of new trade has been the inspiration behind this dissertation. This work is an attempt to formalize the different methodological approaches, which form the bedrock of new trade theory. Also we incorporate some evidences as case studies, which in turn support the different methodological approaches used. The scope for further research in this area remains — modeling information in such frameworks, which could not be incorporated in the scope of this work.

Chapter II

Negotiating the problem of Market Structure in the Theory of International Trade: Emergence of New Trade Theory.

In this chapter we trace the developments in new trade theory based on the Marshallian, Chamberlinian and Cournot approaches to the problem of market structure. We discuss these approaches through specific models, which we feel captures the spirit of their respective categories. Our approach here is restricted to analyzing trade theory under different approaches to imperfect market structures — analysis for trade policy is not the main theme of this research and hence mention of policy issues shall only be incidental according to relevance.

II .1 The Marshallian Approach

Frank Graham's[1] argument for protection introduced the Marshallian approach to trade under increasing returns. Later theorists like Matthews (1949), Kemp and Negishi (1970), Chacoliades (1978) and others analysed trade in the presence of increasing returns using explicit *general equilibrium* models. Excessive reliance on these techniques — offer curves, production possibility curves etc. acted as a barrier to the possible merger of the theories of increasing returns and comparative advantage as a unified theory of trade. Ethier's (1982a) approach was to model trade in presence of external economies from the allocation of resources to production and trade rather than the other way round [2]. This minor change led to a new set of modeling techniques.

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[1] see Graham (1923).

[2] The focus is on factor prices and factor content of trade rather than on product prices and trade.

II .1.1 The Marshallian model — a brief discussion:

We discuss, in brief, the newer Marshallian version, which bears a resemblance to the Ricardian model — it describes a framework where there are 2 countries, 2 goods, 1 factor of production and identical technology.

Ethier's[3] formulation assumes that one good is produced at constant returns to scale at firm level but is subject to positive externality at industry level, i.e. there are increasing returns. In other words there are country specific externalities — each country's domestic industry (rather than the world industry) is subject to increasing returns. The other good is produced at constant returns at both firm and industry levels. Both goods are assumed to be traded costlessly. The role played by increasing returns is that it leads to (international) specialization and trade.

The problem here is of *multiple equilibria* — the model throws up three different kinds of equilibria. One country produces both and the other only produces the good characterized by constant returns. Second, both countries specialize in different goods. Third, one country produces both while the other specializes in the good with increasing returns. Even, in the simplest formulation, either country can end up with any of the three possible outcomes yielding six possible equilibria.

The difference between the first kind of equilibria (both countries produce the good with constant returns to scale) and the remaining two is in its implication for factor prices and welfare. The first kind of equilibria will yield equal wages but not the other two. Equal wages would imply that welfare is independent of the country where the production is taking place. In the other two equilibria either country would produce the good with increasing returns, thus allowing for some common characteristics between the

[3] See Ethier (1982a).

two kinds of equilibria. The volume of both outputs would be the same across equilibria implying that welfare (both for the individual as well as the world) is independent of the production location of the good with increasing returns. This reduces, to some extent, the indeterminacy of the model characterized by multiple equilibria.

The commonality that this model shares with the Hecksher-Ohlin model in terms of factor price equalization is symptomatic of trading equilibria "when trade reproduces the integrated economy" [4]. The Marshallian models of external economies then, with a slight modification[5], would ask us to imagine a world in which there are at least as many constant returns to scale industries as there are factors, alongwith some industries characterized by increasing returns. Alongwith this we assume that trade reproduces the integrated economy. This logically leads to factor-prize equalization, provided we focus on net trade in factor services rather than trade in goods.

Some general conclusions of the Marshallian approach:

- Even though, there is some indeterminacy in the pattern of trade, the factor proportions theory holds. Also, nations will be net exporters of the services of factors with which it is abundantly endowed.
- The trading economy is characterized by geographical concentration of each industry subject to nation-specific increasing returns.
- Gains from trade (for all nations) occur due to the opportunity to exchange factor services at prices different from those that prevail in autarky.

[4] see Helpman and Krugman, 1985.
Note: Equal wage equilibrium in which trade reproduces the integrated economy is not the only possible outcome even in the simplest models.

[5] The model outlined above is a 2x2 model. But to reproduce the integrated economy we need to have as many constant returns to scale sectors as there are factors of production. The minimal model which embodies this property is a 2x3 model— 2factors and 3 goods, one of which is characterized by increasing returns to scale — (see Krugman, 1990, p: 70).

- Additional gains arise if the world scale of production with increasing returns outweighs the national scale that would prevail in the absence of trade.

The next modeling technique that we are going to discuss is that of monopolistic competition in international trade.

II .2 Monopolistic Competition:

The modeling techniques developed under the aegis of monopolistic competition paved the way for analyzing a large number of similar but differentiated products. Product heterogeneity – in terms quality, design, branding and other kinds of attributes in the product space, throws light on the different kinds of differentiated product. The scope of substitutability between similar but differentiated product implies that each firm faces a large potential competition from similar brands. Thus the models are monopolistic since each firm is the unique supplier of a product but on the other hand they are competitive since each firm faces a large potential competition from firms producing similar products. Chamberlin (1933) described this market scenario as monopolistic competition. Similar ideas were also considered by Pierro Sraffa (1926) and Joan Robinson (1931).

The stylized models of monopolistic competition typically assume free entry — i.e. allowance is made for the existence of a countably infinite number of potential firms offering similar differentiated products. The most commonly used approach in models of monopolistic competition by different theorists is the representative consumer approach — the representative consumer has symmetric tastes over the set of differentiated products. Such an approach has been used by Spence (1976), Dixit & Stiglitz (1977 & 1979). Other approaches involve models in which consumers have heterogeneity in tastes—i.e. preferences are defined over the attributes of the product. Such models have been used by Gorman (1956) & Lancaster (1979). Apart from these, there are models where consumer preferences are randomly distributed — Sattinger (1984), Hart (1985a,b), Penloff & Salop (1985).

The introduction of models of monopolistic competition in the theory of international trade, especially aiding new trade theorists to explain intra-industry trade. Trade theorists applied the Chamberlinian "large group" model in a general equilibrium framework to construct models of trade. The Chamberlinian explanation fits those industries, which are characterized by an entry-process coupled with the new firms ability to choose a different product location than those of the incumbent firms. Firms retain some 'local' monopoly power (given its ability to differentiate)—the demand curve faced by firms is downward sloping. Also free entry— driving profits to zero is a realistic description of industries that are characterized by economics of scale.

We can identify two approaches utilized by various trade theorists in the 70's to construct models of trade—These different approaches however may yield (as shown by Anderson et.al 1989) similar demand systems.

Since different approaches to monopolistic competition do not alter the general conclusions derived in new trade theory, we will briefly discuss the working of two of the most well known Chamberlinian models — i.e. the Dixit-Stiglitz model and the synthesis[6] approach as the representative models to characterize the monopolistic competition approach to trade theory.

[6] See Helpman and Krugman (1985)

Similar Chamberlinian models have also been used by Dixit-Norman (1980), Ethier (1982 b), Helpman (1981), Krugman (1979,1981). For the purpose of explanation we produce below a simple version of the Dixit-Stiglitz model of trade.

II .2.1 A simple version of the Dixit-Stiglitz model:

The framework and the assumptions of their exercise is as follows —

In the closed economy there is

- Only one scarce factor of production — labour.
- The economy can produce any of a large number of goods (which are indexed by i). The goods actually produced are ordered from 1 to n, (n is assumed to be a large number, although small relative to number of potential products).
- All consumers / residents share the same utility function (representative consumer):

$$U = \sum_{i=1}^{n} v(c_i), \qquad v'>0, v''<0; \text{ where } c_i\text{= consumption of the } i^{th} \text{ good.} \qquad (1)$$

- Because of the additive separable specification of U(c), the elasticity of substitution is equivalent to the demand elasticity that each monopolistic competitor faces.

  Elasticity of demand facing an individual producer is defined as

$$\varepsilon_i = -\frac{v'}{v''c_i} \text{ where it is assumed that } \frac{\partial \varepsilon_i}{\partial c_i} < 0 \,^{7} \qquad (2)$$

- All goods are produced under same cost condition

[7] This assumption is not essential. In fact, the main results hold if we take a CES utility function where each firm faces a demand with constant elasticity. This assumption implies a derivative demand with quadratic or higher power term in prices, such that ε becomes more elastic with higher prices. Krugman (1980) also justifies this assumption arguing that increasing demand elasticity when variety of products grows implies that each final good is more finely differentiated and products become closer substitutes.

$$\ell_i = \alpha + \beta x_i \quad , \alpha, \beta > 0; \tag{3}$$

ℓ_i = labour used in producing i[th] good; x_i= output of i[th] good; α =fixed cost, there are decreasing average costs and constant marginal costs.

- Production equals consumption.

  i.e. $x_i = Lc_i$ (4)

- There is full employment –

$$L = \sum_{i=1}^{n} \ell_i = \sum_{i=1}^{n} [\alpha + \beta x_i]$$

Working of the model:

This model determines price of each good relative to wage (i.e. $\frac{p_i}{w}$), output (i.e. x_i), and the number of goods produced (i.e. n).

Symmetry ensures that all goods actually produced will be in the same quantity and at the same price.

$$p = p_i \text{ and } \quad x = x_i \ \forall \text{ i} \tag{6}$$

Deriving the demand curve:

The representative consumer maximizes utility (1) s.t. budget constraint.

The F.O.C. (first order condition) yields

$$v'c_i = \lambda p_i \ , \quad (\text{i} = 1, \ldots.., \text{n}) \tag{7}$$

λ is the shadow price on the budget constraint, interpreted as marginal utility of income.

Deriving pricing policy:

Substituting (4) in (7) we get,

$$p_i = \lambda^{-1} v'\left(\frac{x_i}{L}\right) \quad (8)$$

if the number of goods produced is large, each firm's pricing policy will have a negligible effect on marginal utility of income, so λ can be taken as fixed. So elasticity of demand of the i^{th} firm is as noted above in (2).

Deriving the profit function of firms:

Each firm being small ignores strategic interaction. firm i maximizes profit, i.e.,

$$\pi_i = p_i x_i - (\alpha + \beta x_i)w \quad (9)$$

F.O.C. reveals profit maximizing price as

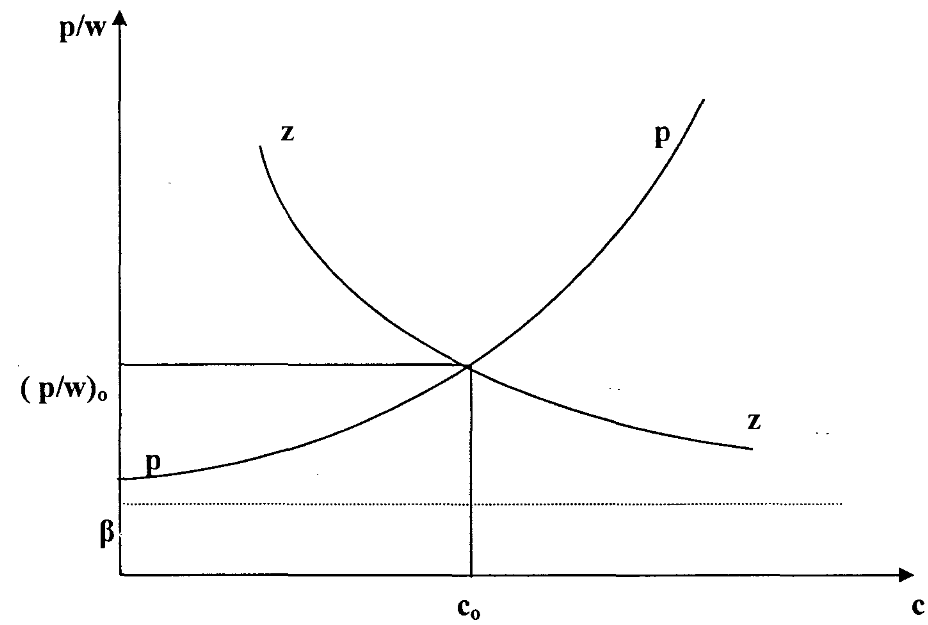
$$p_i = \frac{\varepsilon}{(\varepsilon - 1)}\beta w \quad (10)$$

$$\text{or, } \frac{p}{w} = \frac{\beta\varepsilon}{(\varepsilon - 1)}$$

Profits are driven to zero by free entry. Hence, we have from (9),

$$0 = px - (\alpha + \beta x)w \quad (11)$$

$$\frac{p}{w} = \beta + \frac{\alpha}{x} = \beta + \frac{\alpha}{Lc} \quad (12)$$



The intersection of the **pp**-schedule (from 10) and the **zz**-schedule (from12) determines individual consumption of each good and it's price. Hence, we also get output per firm from (4). Also, the assumption of full employment gives the equilibrium number of goods produced; i.e.

$$n = \frac{L}{(\alpha + \beta x)}$$

Effects of trade:

We suppose there exists 2 such similar countries of the kind discussed above, i.e. countries have identical tastes and technology (assumption of a single factor model rules out difference in factor endowment). In conventional models there would be no justification for two such countries to trade. However, *in this model there is trade as well as gains from trade. Trade is opened between these economies at zero transportation cost.*

Main results:

- Equalization of wage rates in both countries

- Equalization of prices of any good
- Welfare increases in both because of higher real wage (w/p) and because of increase in consumer choice.
- Direction of trade is indeterminate but volume of trade is determinate

Thus, the representative consumer now maximizes the utility function :

$$U = \sum_{i=1}^{n} v(c_i) + \sum_{i=n+1}^{n+n^*} v(c_i),$$

(goods 1,…,n produced at home and n+1,…,n+n* produced in the foreign country).

$$n = \frac{L}{(\alpha + \beta x)} \quad \text{and} \quad n^* = \frac{L^*}{(\alpha + \beta x)}$$

The share of inputs in the home country expenditure will be $\frac{L^*}{L + L^*}$.

The value of imports, i.e. $M = \frac{wL.L^*}{L + L^*} = M^*$. Trade is balanced, since each individual's budget constraint is satisfied. The significant result here is that *trade is mutually beneficial — as the variety of products increases.*

Next, we discuss the other well known model of monopolistic competition in trade, i.e. Helpman-Krugman's synthesis model.

II .2.2 A discussion on Helpman-Krugman's synthesis model:

We imagine then, a world that consists of two nations, endowed with two factors of production capital and labour, using the same technology to produce two goods. Additionally we assume (like we did for the Marshallian approach) that one of these goods is homogenous and produced under constant returns to scale, while the other is differentiated and produced under increasing returns. The homogenous product is in a perfectly competitive setup while differentiated products are subject to product-specific economies of scale. Further, a suitable choice of units can be assumed which would render all potential products symmetric, with identical cost and demand systems. The set of potential products is sufficiently large (countably infinite number of firms each producing a differentiated product) and the market share of individual products sufficiently small giving rise to a monopolistically competitive market structure. Such a structure supports the existence of free entry non-cooperative equilibrium, which drives profits to zero.

International trade allows for the reproduction of the integrated economy. There is a certain set of resource allocations to the two sectors, factor prices, product prices etc. which correspond to this outcome. Whether trade reproduces the integrated economy or not, depends on the possibility of allocation of production among trading nations in such a manner so as to employ full employment of factors, with each nation producing non-negative amounts of every good[8]. For further clarity, we assume the differentiated product to be capital-intensive. Also, the home country is capital-abundant while the foreign country is labour-abundant. A redistribution of resources from one country to the other would result in the home country (i.e. capital-abundant) becoming a net exporter of the differentiated good (i.e. capital-intensive good) — thus supporting the familiar result in traditional trade theory. In other words, *the theory of comparative advantage continues to hold at the level of interindustry trade*.

The story of *intraindustry* specialization comes in with the concept of scale economies and monopolistic competition. If we imagine production of the differentiated product is split between the two countries, then scale economies will ensure that the output of each individual differentiated product is in one of the two countries. There is

[8] see Dixit and Norman (1980).

some indeterminacy regarding which country produces which product but it hardly makes a difference to the narrative of intraindustry trade. More important is the fact that the industry with increasing returns in each nation will be producing a different set of products — giving rise to the outcome whereby the home country (in the specifications of this model) emerges as the net exporter of the differentiated product. Thus, the industry with increasing returns exhibits both *intraindustry* as well as *interindustry* trade.

The **additional results** which we observe in this formulation are:

- Even if both countries are similar, there will be trade in the product with increasing returns due to intraindustry specialization.
- The proposition of intraindustry trade will outweigh interindutry trade when the trading patterns are similar.

This closes the discussion of monopolistic competitive models in trade. We will briefly consider certain extensions to the Chamberlinian framework to address specific trade related issues.

II .2.3 Extensions of the Chamberlinian model:

- *Gains from trade* → Although the results of the Chamberlinian model are similar to those derived with the Marshallian approach, there are certain departures with respect to *gains from trade*. The relevant scale variable in the Chamberlinian models is the firm-specific scale of production as opposed to the industry specific scale economies in the Marshallian models. Also the effects on scale due to trade are not obvious, given entry. The other difference is that in the Chamberlinian model, trade may give rise to additional gains due to *brand proliferation* – i.e. increase in variety. It is precisely this characteristic of product differentiation that gives rise to a difference. With the representative consumer approach (i.e. Dixit-Stiglitz preferences) the elasticity of demand for individual brands is constant – trade gives rise to *greater variety not greater scale*[9]. As we shall see in chapter IV, there is a likelihood of trade resulting in higher elasticity of demand in the Hotelling –Lancaster approach. This in turn would imply that firms operate lower down on their average cost curves. Hence, the larger home-market would support greater product diversity along with lower average cost[10]. Helpman and Krugman (1985) have shown that under certain assumptions both scale of production and product diversity would monotonically increase with gross industry output. The logical conclusion to this story is that trade is beneficial if the world output of the differentiated product (i.e. displaying increasing returns to scale) is larger than the national output which could prevail under autarky.

- *Intermediate goods* → International trade based on economies to scale is more likely in intermediate rather than in final goods[11]. Ethier's argument is that the scope of product differentiation (given that the world market is likely to be too small to allow for complete exhaustion of scale gains) is greater for highly specialized inputs, capital-goods rather than for consumer goods. The phenomenon that trade reproduces the integrated economy keeps the broader trade framework intact even when we introduce this distinction between goods – i.e. intermediate and final.

[9] see Dixit and Norman (1980), Krugman (1980, 1981).
[10] see Krugman (1981).
[11] see Ethier (1982), Helpman and Krugman (1985, chapter 11).

- *Non-traded goods* → Introduction of non-traded goods[12] also does not alter the results of the model. The only implication is that differences in the size of national markets may give rise to newer incentives for factor mobility.
- *Transport costs* → The key element in the assumption of trade reproducing the integrated economy is one of assuming zero transport costs. If transport costs are incorporated then the model would yield different results. If we consider the following scenario – a product can be produced at either location but can be sold in both markets. We also assume that there exists some transport costs, but the scale effect is strong enough to assure that production is specialized in at least one of the two locations (i.e. in one of the two countries). In such a scenario the production location would be chosen so as to minimize the transportation costs, which implies that production takes place in the country with the smaller market. Depending on the specifications regarding transport costs[13], we might have an outcome, where, ceteris paribus, countries with relatively larger domestic markets will tend to be net exporters[14].
- *Alternative market structures* → The core results survive if we view the market structure as being "contestable"[15] rather than the Chamberlinian large group.
- *Multinational Corporations* → One of the most interesting insights offered by new trade theory lies in the explanation of the working of the multinational firm. Multinational firms have stretched the logic of profits beyond the boundaries of the nation-state, especially in the context of a rapidly globalizing world order.

[12] see Helpman aqnd Razin (1984), Helpman and Krugman (1985, chapter 10).
[13] Transport costs can be linear or quadratic – the difference in the cost functions often yield separate outcomes.
[14] see Venables (1985 b), Krugman (1980), Helpman and Krugman (1985).
[15] See Baumol, Panzar and Willig (1982).

New trade theory not only explains the locational decision of the firm but also their competitive advantage vis-à-vis local producers in various markets. The ownership of certain product-specific assets (like technical know-how, branding etc.) give multinational firms some market power over local firms. This process implies product differentiation, which, of course, could not be explained by traditional theory. The national character of the firm was predominant in the theory of trade which reflected the nature of capitalism in the last century. The emergence of multinational enterprises brings to light the *supranational* nature of the firms and hence it becomes important to understand the complexity of decision, organization and production in such a context. Markusen (1984) and Helpman (1984 b) constructed general equilibrium models of MNC's based on the rationale of market power conferred to the owner of a product-specific asset. In Markusen, we find the multinational firm operating plants in two locations taking advantage of the existence of multiplant economies. Such firms treat activities like advertising, marketing, R&D and distribution as non-rival (joint) inputs since these can be provided in one location to support production and sales in other locations. This explains the trend wherein the MNC engages in manufacturing activities in each of the locations (separated by nation-state boundaries) but undertakes their corporate activities in the home country. Helpman's approach describes the later activity as "headquarter services" and firms decision to locate its manufacturing activities offshore is due to the existence of cheap labour. Helpman's[16] model (which is an extension of the previous model) allows the firm to execute both types of integration — horizontal

[16] see Helpman (1985).

and vertical. This analysis of monopolistic competition in similar differentiated products results in a prediction of larger volume of intrafirm trade in accordance with the empirical observation. Rather than carrying out its manufacturing activities at a separate location, the firms may also choose to carry out manufacturing by granting licenses for product-specific assets. In Markusen and Helpman we find that the firm's internalization decision is exogenous. As opposed to this in Ethier[17] we discern an endogenization of the firm's decision of internalization. This arises due to the asymmetric information across nation-state boundaries, which make the writing of state-contingent contracts even more difficult. The integrated MNC responds more effectively when it endogenizes the entire process rather than granting licenses to other foreign firms. These new models clear away the misconception that MNC's trigger a high degree of factor mobility. Rather, what we discover is that MNC's represent an extension of control and not necessarily a movement of capital. This implies that direct foreign investment should not be looked upon only as investment but rather as part of MNC's internalization of operations.

Next, we briefiy look at the Cournot approach to trade in a general equilibrium setting

II .3 The Cournot approach:

The lack of any general theory of oligopoly has been a constant deterrent in studying market imperfections. Thus we have one hand the Marshallian approach, which preserves the notion of perfect competition by assuming scale economies to be external to firms; while on the other, we have the Chamberlinian approach which breaks the world of perfect competition and constructs one which is inhabited by several small monopolists.

[17] see Ethier (1986).

The lacunae in between these two approaches could be filled once the theory of oligopoly was incorporated.

We can trace the earliest models of oligopolistic competition to the seminal work of Antonie-Augustin Cornot (1838) and Joseph Bertrand (1883). These nineteenth century models were later to be discovered as applications of the core concept of non-cooperative game theory — i.e. the well-known concept of Nash equilibrium. The Cournot approach assumes that in an imperfectly competitive market (Cournot specifically assumed a duopoly), firms take the output decision of rivals as given. This redefines the motive for international trade by focusing on the market structure while the other two approaches trace the incentive for trade to the existence of decreasing costs (i.e. increasing returns) alone. Dixit's model[18] shows that the utility of the Cournot approach lies in its applicability to the analysis of trade policy. The narrative of trade, once we use the Cournot approach, proceeds along two lines — first, the scope of trade in reducing monopoly power and second, trade occurring due to the existence of segmented markets leading to the possibility of price discrimination.

We deal with the first aspect, which emerges from the story of market share/power. There exists, then, two countries having oligopolistic industries where the firms engage in a Cournot competition. The result of such a strategic interaction is the Cournot-Nash equilibrium — which proves that the equilibrium prices exceed marginal costs. The markup (here defined as the difference between equilibrium price and marginal cost[19]) depends on the firm-specific perception of demand elasticity. Additionally we also assume, that, the same price will prevail under autarky in such

[18] see Dixit (1987).

[19] Markup is generally defined as (price – marginal cost) / price, i.e. (P - Mc) / P.

industries. Trade in such a scenario would have no effect if we assume the market to be perfectly competitive. But the Cournot approach tells us a different story — trade will make firms access a much larger and more competitive market where each firm would perceive a higher elasticity of demand of exports, thus prompting each firm to increase output. With an expansion in industry output, prices decline and welfare increases in both countries (which are assumed to be symmetrical) due to a reduction of monopoly distortions.

Potential trade[20] rather than actual trade exerts this procompetitive effect. The rationalization of the number of firms occurs due to the existence of firm-specific scale economies. Those firms, which are unable to cover their average costs have only one option — exit.

Dixit-Norman's model[21] clearly shows that trade in a Cournot market results in a world industry characterized by lesser number of firms having larger market share (than the aggregation of national industries under autarky). Hence, we find a reduction in monopoly distortions coupled with increased productive efficiency. The narrative of economies of scale fits this plot precisely because of the fact that decreasing costs are one of the most "natural" explanations of imperfectly competitive markets.

The trajectory of trade theory that we've traced so far relies on the dual motives of competitive advantage and scale economies as the combined cause of trade. The Cournot approach identifies a totally different reason for trade — the firms in a imperfectly competitive setup have an incentive to increase sales by "dumping"[22]. The

[20] Firms perceptions about demand elasticities result in a change in the slope of the demand curve.
[21] see Dixit and Norman (1980).
[22] see Caves and Jones (1977) regarding the issue of dumping as a result of monopolistic price discrimination.

concept of trade arising out of oligopolistic rivalry of firms can be found in the seminal work of Brander (1981).

The industry we imagine, following Brander, consists of two firms in different countries with each firm being able to choose separately their sales to each national markets taking their rival's output decision as given. In autarky each firm behaves as a monopolist restricting output to sustain the monopoly price. There is an incentive for each firm to sell in the rival's home market as long as the markup can be sustained. This process, when continued, yields an outcome where the two symmetric firms share each market equally.

If we consider the Brander-Krugman[23] model (which is an extension of the Brander model), we witness the phenomenon of two-way trade involving the same product[24].

II .3.1 The Brander-Krugman model of reciprocal dumping:

The assumptions of the Brander-Krugman model are as follows:

- 2 identical countries — domestic and foreign.
- Each country has one firm producing homogenous product Z.
- Each firm has a Cournot perception — each assumes that the rival's output is fixed in each country.
- Domestic firm produces output x for domestic consumption and output x* for foreign consumption.

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[23] see Brander and Krugman (1983)

[24] This phenomenon has also been referred to in the literature as "intra-industry trade" (Balassa, Grubel and Lloyd), "two-way trade" (Gray), "overlap trade" (Finger), "horizontal trade" (Kojima), "cross-hauling" (Brander), or "two-way trade in similar products" (Abed -El-Rahman).

- There are constant marginal costs c
- Transport cost is of the "iceberg" type — marginal cost of export is $\frac{c}{g}$, when $0 \le g \le 1$.
- Similarly foreign firm produces y for domestic consumption and y* for foreign consumption.

Working of the model:

The profit function are:

$$\pi = xp(Z) + x^* p^*(Z^*) - c\left(x + \frac{x^*}{g}\right) - F, \quad \text{where F=fixed cost} \tag{1}$$

$$\pi^* = yp(Z) + y^* p^*(Z^*) - c\left(\frac{y}{g} + y^*\right) - F^* \tag{2}$$

Due to symmetry we can consider only one country. Therefore, the profit maximization w.r.t own output yields the following F.O.C.s

$$\pi_x = xp' + p - c = 0 \tag{3}$$

$$\pi^*_y = yp' + p - \frac{c}{g} = 0 \tag{4}$$

These are the "best reply" functions in implicit form, solution of which is the trade equation.

Let $\sigma = \frac{y}{z}$ be the foreign share in domestic market

$\varepsilon = -\frac{p}{zp'}$ be the domestic demand elasticity.

We get the best reply function as

$$p = \frac{c\varepsilon}{\varepsilon + \sigma - 1} \tag{3*}$$

$$p = \frac{c\varepsilon}{g(\varepsilon - \sigma)} \tag{4*}$$

Solving for p and σ we get

$$p = \frac{c\varepsilon(1+g)}{g(2\varepsilon - 1)} \tag{5}$$

$$\sigma = \frac{\varepsilon(g-1)+1}{(1+g)} \tag{6}$$

The S.O.C.s are also satisfied, i.e. $\pi_{xx} = xp' + 2p' < 0$ and $\pi^*_{yy} = yp'' + 2p' < 0$. (7)

Therefore (5) and (6) are the equilibrium values. Some additional conditions are also imposed: $\pi_{xx} = xp'' + 2p' < 0$ and $\pi_{yx} = yp'' + p' = 0$ (8)

This condition gives downward sloping best-reply functions which implies that the marginal revenue of one firm declines when the rival increases it's output. Positive solutions to (5) and (6) tells us that two way trade takes place if $\varepsilon < \frac{1}{(1-g)}$ at equilibrium. This implies that $(p > c/g)$ price exceeds marginal export cost and there is positive foreign market share for the firm, i.e. $\sigma > 0$.

Some observations:

- At equilibrium —
  - ➢ each firm has a larger home market share compared to it's export market share. The (perceived) marginal revenue is higher in the export market.
- Due to transportation costs —

- effective marginal cost of delivery on a unit of export is higher than a unit of domestic sales. This result is consistent with higher marginal revenue and therefore, (perceived) marginal revenue can equal marginal cost in both markets (for any positive levels of output).
- Each firm has a smaller markup over cost in it's export market than at home. Therefore, the f.o.b. price for export is lower compared to the domestic price — hence reciprocal dumping occurs.
- Generally, a decrease in transport costs causes
  - a gain due to falling costs of current import
  - a (net) gain, due to a rise in consumption, which equals the price in excess of marginal import costs.
  - a loss due to high cost imports displacing domestic production.

General welfare effects *(under free entry)*:

There are n firms (in each country) in equilibrium. Hence, the after trade price can be represented as

$$p = \frac{c\varepsilon n(1+g)}{g(2n\varepsilon - 1)} \tag{9}$$

and the foreign market share is

$$\sigma = \frac{n\varepsilon(g-1)+1}{(1+g)} \tag{10}$$

Pre-trade free entry equilibrium is derived for the domestic industry, where each firm maximizes profit. So, the F.O.C. yields

$$x_i p' + p - c = 0 \tag{11}$$

$$\pi_i = x_i p - cx_i - F = 0 \quad \text{(Zero profit condition)} \tag{12}$$

After trade the following results are observed (zero profit holds)

- price falls — therefore consumer surplus rises. Hence, welfare rises.
- firms have lower average costs and combined output, i.e. $(x_i + x_i^*)$ exceeds original production level (even though x_i falls).

Main conclusions:

- neither comparative cost advantage nor economies of scale necessary for trade — **trade occurs due to oligopolistic interaction among firms.**
- explains both the phenomena of reciprocal dumping and intraindustry trade.
- if transport costs are low, trade increases welfare. Also, in the Cournot model (under free entry), there is post trade welfare increase.

II .4 Outsourcing — A Possible Extension:

With homogenous product and prices as strategic variable, there is no reciprocal dumping. But, once we imagine a world of differentiated products (which anyway seems a more plausible assumption), we observe this phenomenon of reciprocal dumping. The most interesting feature of this class of models is the inclusion of the firms' perception of segmented markets which gives rise to the above results. Moreover, intraindustry motives compliment the modern day firm's deliberate business strategy of differentiation, which throws up this outcome of two way trade in similar products. The firm's production is assumed to be located only in it's home country. The possibility of *outsourcing* (which can be interpreted as an internal decision to save transport costs) is ignored. Incorporation of outsourcing business practices in such models would provide an explanation for two way "foreign direct investment".

The general equilibrium models we have discussed have negotiated successfully the problem of market structure under imperfect competition. These models have done away with the restrictive assumption of price-taking in trade models (as present in traditional models based on the assumption of perfect competition). We deal with the problem of multimarket strategic interactions (including the question of entry) in the next chapter. This would involve a shift from general equilibrium models to the partial equilibrium framework — the justifications and subsequent methodologies employed to deal with such a shift is the objective of the next chapter. We briefly contrast the results derived using the partial framework with those derived in this chapter.

Chapter III

Rethinking Intra-Industry Trade as International Industrial Organization: Some Methodological issues.

> "...Since trade ignores national boundaries, and the manufacturer insists on having the world as a market, the Flag of his nation must follow him..."
> U.S. President Woodrow Wilson, 1907.

New trade theory has largely been preoccupied with looking at international trade through the concept of imperfect competition. These approaches have mostly focused on *general equilibrium* models of international trade, while devoting incidental importance to *market structure*. An interesting area of research emerges if we focus on the problem of market structure as the starting point and then build a narrative of trade. Such a shift would, of course, require some justification. The stage of capitalism, we are witnessing, has brought about a significant change in the nature of our unit of microanalysis — the *firm*, which has acquired a distinct *supranational* character. Hence, when a firm (and not a nation) trades — it's perception of segmented markets give rise to *strategic interaction* among other firms in these markets. *Multimarket* interactions then, would require careful analysis of markets and trade would be a profit-maximizing outcome of such interactions. Different identifiable markets would entail separate cost considerations. In the context of trade, one would expect a firm to incur less costs to serve it's home market than the foreign market. Trade policies and a host of other reasons (e.g. tariffs, freight charges etc.) influence these costs.

Segmented markets would then give rise to a different form of conduct— thus justifying our attempt to redefine *intraindustry trade as international industrial* *organization*[1], thereby giving prevalence to market structure in our analysis. Since there is no single unified theoretical literature dealing specifically with these issues, we would attempt to formalize such a framework[2] in this chapter. The seminal work by Bulow et al.[3] inspired later attempts at looking at trade as *multimarket oligopolistic interactions.* Though the authors' explicit focus was industrial organization and not international trade, this work can be used as a turning point in trade theory. The change in the strategic variable in one market influences competitors' (or potential competitors) strategies in a second market. Significantly, when the competition is between firms selling similar differentiated products we can expect some interesting results on intraindustry trade.

We introduce below the multimarket model by Bulow et al.

Multimarket model:

Bulow et al. show that whether the action (i.e. change in the strategic variable in one market) results in costs or benefits in the second market depends on two factors

- Whether the two markets exhibit *joint economies* or *joint diseconomies*
- Whether competitors regard their products as *strategic substitutes* or *strategic complements*[4].

The assumptions of their exercise is as follows:

- There are two firms A and B and two markets 1 and 2 — firm A is a monopolist in market 1 and a duopolist with firm B in the other market (i.e. market 2)
- Firm A chooses strategic variable S_1^A and S_2^A and firm B simultaneously chooses S_2^B.

[1] see Grossman (1993).
[2] See Brander (1981), Helpman and Krugman (1985, chap:5) for trade theoretic models.
[3] see Bulow, Geanokopolos and Klemperer (1985).
[4] With strategic substitutes B's optimal response to more aggressive play by A is to be less aggressive.

- A higher level chosen for this variable — S_i^F, (i =1,2; F =A, B) indicates more *aggressive* play [5].
- Firm A is a monopolist in market 1 and hence chooses $S_1^A = q_1^A$.
- Demand is independent across markets[6].
- Exogenous "shock" variable Z affects profitability of market 1.

[Notations: R_i^F – revenue of firm F in market i assuming Z=0; C^F – total cost of firm F assuming Z=0]

Therefore firm A's profit can be written as

$\Pi^A(S_1^A, S_2^A, S_2^B, Z) = R_1^A(S_1^A) + R_2^A(S_2^A, S_2^B) - C^A(S_1^A, S_2^A, S_2^B) + Z\, S_1^A$, (since $S_1^A = q_1^A$)

similarly, B's profit is

$\Pi^B(S_2^A, S_2^B) = R_2^A(S_2^A, S_2^B) - C^B(S_2^A, S_2^B)$

If the profit functions are all differentiable, then there will be 3 first order conditions that must be satisfied at an interior Nash Equilibrium:

$$\frac{\partial \pi^A}{\partial S_1^A} = \frac{\partial R_1^A}{\partial S_i^A} - \frac{\partial C^A}{\partial S_1^A} + Z = 0 \qquad (1)$$

$$\frac{\partial \pi^A}{\partial S_2^A} = \frac{\partial R_{21}^A}{\partial S_2^A} - \frac{\partial C^A}{\partial S_2^A} = 0 \qquad (2)$$

$$\frac{\partial \pi^B}{\partial S_2^B} = \frac{\partial R_2^B}{\partial S_2^B} - \frac{\partial C^B}{\partial S_2^B} = 0 \qquad (3)$$

[5] Strategic variable can be thought of as quantities or levels of advertisement. If the strategic variable is price, then lower price means *aggressive* play, then we can think of S as inverse of prices.
[6] Only effect comes from interrelated costs.

The effect of a shock which makes market 1 marginally more profitable can be expressed as

$$\begin{pmatrix} \dfrac{\partial^2\pi^A}{\partial S_1^A \partial S_1^A} & \dfrac{\partial^2\pi^A}{\partial S_1^A \partial S_2^A} & \dfrac{\partial^2\pi^A}{\partial S_1^A \partial S_2^B} \\ \dfrac{\partial^2\pi^A}{\partial S_2^A \partial S_1^A} & \dfrac{\partial^2\pi^A}{\partial S_2^A \partial S_2^A} & \dfrac{\partial^2\pi^A}{\partial S_2^A \partial S_2^B} \\ 0 & \dfrac{\partial^2\pi^B}{\partial S_2^B \partial S_2^A} & \dfrac{\partial^2\pi^B}{\partial S_2^B \partial S_2^B} \end{pmatrix} \begin{pmatrix} dS_1^A \\ dS_2^A \\ dS_2^B \end{pmatrix} = \begin{pmatrix} -dZ \\ 0 \\ 0 \end{pmatrix} \tag{4}$$

It is further assumed that the equilibrium is strictly (locally) stable implying that the determinant $|\pi|$ of the matrix, π, in (4) is negative. Also, in the absence of market 1, market 2 would still be strictly stable, hence we have $\pi_{22}\pi_{33} > \pi_{32}\pi_{23}$. Another assumption made is that the products are strategic substitutes, i.e. $\partial\pi^A / \partial S_2^B < 0$ and $\partial\pi^B / \partial S_2^A < 0$. Also note, that, if $\partial^2\pi^A / \partial S_1^A \partial S_2^A = -\partial^2 C^A / \partial S_1^A \partial S_2^A < 0$ there are *joint diseconomies*[7], across markets, and if $\partial^2\pi^A / \partial S_1^A \partial S_2^A > 0$, there are *joint economies.*

Solving (4) for dS_1^A / dZ, dS_2^A / dZ, and dS_2^B / dZ we get the following results:

- $dS_1^A / dZ > 0 \rightarrow$ A positive shock to the marginal profitability of market 1 causes firm A to sell more in market 1.
- $sign(dS_2^A / dZ) = sign(\partial^2\pi^A / \partial S_1^A \partial S_2^A) \rightarrow$ As a consequence of the previous result, firm A adopts a more aggressive strategy (or a less aggressive strategy) in market 2 depending on whether the market exhibits joint economies (joint diseconomies)
- $sign(dS_2^B / dZ) = sign[(\partial^2\pi^A / \partial S_1^A \partial S_2^A).(\partial^2\pi^B / \partial S_2^B \partial S_2^A)] \rightarrow$ Whether B's equilibrium strategy is to be more (or less) aggressive depends on:

[7] Joint diseconomies mean that being more aggressive in one market raising sales there lower the marginal profits from being a little more aggressive in the other market.

i. whether there are joint economies or diseconomies across markets, and,

ii. whether a more aggressive strategy by A in market 2 (increasing S_2^A) raises or lowers B's marginal profitability.

The term ($\partial^2\pi^B/\partial S_2^B \partial S_2^A$), which can be of either sign both in homogenous or differentiated quantity competition or differentiated product price competition, represents the change in marginal profitability to firm B, when B is more aggressive, due to firm A being aggressive. If $\partial^2\pi^B/\partial S_2^B \partial S_2^A < 0$, then B regards its product as a strategic substitute to A, and if $\partial^2\pi^B/\partial S_2^B \partial S_2^A > 0$, then B regards its product as a strategic complements. Typically, if products are strategic substitutes, B's optimal response to more aggressive play by A is to be less aggressive (i.e. B decreases S_2^B). Alternatively, if products are strategic complements, B's optimal response to more aggressive play by A is to be more aggressive (i.e. B increases S_2^B).

There are certain interesting extensions of the multimarket model. We present below the one concerning international trade.

Application of the Multimarket model→ Dumping in international trade.

The definition of dumping used in this model depicts situations where firms sell in a market to the point where marginal revenue is less than marginal cost. Dumping can be explained with the help of the strategic effect —

- If firm sells (products which are strategic substitutes) only in the rival's market, then a subsidy given to that firm, will result in an increased profit margin. In other words, the government subsidizes a domestic firm to dump it's low priced products in the rival's market.

- In sequential markets, firms may deliberately produce unprofitably in one period — this makes the rival less aggressive in future periods and thus firms gain strategic benefits.

Our attempt to conceptualize intraindustry trade as international industrial organization would require a closer look at strategic interactions among price-setting firms. This can be succinctly captured if we focus on the particular form of the market rather than the entire economy. Thus we move on to consider a detailed methodology required to focus on market structure, i.e. the methodological shift from general equilibrium models to partial equilibrium and then focus on the tools used in analyzing the particular games. We then conclude with a model (Ben Zvi and Helpman) which uses these approaches (i.e. partial equilibrium game-theoretic approach) in the theory of international trade.

Some methodological issues:

- **From *general* to *partial equilibrium* analysis**

The kind of analysis we are attempting requires us to study strategic interaction among firms in a market or a group of interrelated markets, abstracting from connections with the rest of the economy. This kind of analysis calls for what is known as the *partial equilibrium* analysis[8]. The Marshallian idea is that the partial equilibrium approach is justified when the industry being studied represents only a small share of the consumer's budget. Small income effects[9] would then imply, that changes in the industry should not

[8] Most models in the literature about imperfect markets and international trade rely on a general equilibrium analysis.

[9] We refer to the *income effect* in the Slutsky equation.

cause significant changes in other markets[10]. This phenomenon (i.e. small income effects) is significant because casual empiricism suggests that expenditure share of consumers associated with a typical oligopolistic industry is small. The Slutsky equation in elasticity form is as follows:

$\eta_i = \eta_i^c + p_iD_i / I \; \eta_i^I$,

where $\eta_i = -(p_i/q_i).\ \partial D_i / \partial p_i$ is the demand elasticity,

η_i = compensated demand elasticity (Hicksian elasticity of demand)

$\eta_i = I/q_i\ .\ \partial D_i / \partial I$ income elasticity of demand.

Therefore, if the proportion of income spent on the good (i.e. p_iD_i / I) is small, then , ceteris paribus, it yields small income effects on that good[11]. When there are small income effects we have downward sloping demand curves because the compensated demand is downward sloping. The ceteris paribus assumption is problematic if we consider what becomes of the income elasticity of demand when expenditure share on the good is small.

The Marshallian approach[12] to consumer surplus and downward sloping demand is based on the supposition that "marginal utility of money to the individual purchaser is the same throughout" and "on the assumption, which underlines our whole reasoning, that his expenditure on any one thing, as, for instance, tea, is only a small part of his whole expenditure"[13]. A constant utility of money implies that income effects are absent. Vives[14] derives sufficient conditions on consumer preferences for small income effects.

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[10] Particularly, the relative prices of products in other markets.
[11] This is similar to the Hicksian position as stated in Hick's discussion of the law of demand, see Hicks (1946).
[12] see Vives (1987).
[13] see Marshall (1920).
[14] see Vives (1999, chapter 3).

The sufficient condition requires consumer preference to be smooth and symmetric enough, and that no two goods can be perfect substitutes. In other words, *differentiated products* in *oligopolistic* industries are ideal for considering income effects and justify a partial equilibrium analysis.

Now we consider specific tools, which can be used to model partial equilibrium. This shift from perfect competition models of trade to imperfect competition models of trade is best captured using the theory of games, which is what we deal with below.

- ***From perfect to imperfect competition — a game theoretic approach***

The assumption of a perfectly competitive market guarantees that economic agents operate in the absence of any strategic interaction amongst themselves. Some defining conditions for such a scenario are outlined below.

- The presence of a large number of buyers and sellers in the market implies that both are *price-takers*.
- There is *free entry*.
- The products are *homogenous* and hence they are near perfect substitutes. Perfect substitutability further guarantees that all products end up with the same market price.

These have been the main underlying assumptions, which have helped in constructing the narrative of perfect competition in economic theory. There has existed, albeit at the margins of economic theory, a parallel enquiry regarding the imperfect nature of the markets.

The pioneering work of Augustin Cournot (1838) explained quantity decisions in monopoly and oligopoly regimes. The Cournot model is one in which small number of firms are aware of the strategic interactions with regard to quantities (with rivals) which is present in such markets[15]. Bertrand (1838) proposed an alternative approach that treats price (and not quantities as assumed by Cournot) as the strategic variable. Therefore when products are homogenous, we find that a price competition leads to the competitive outcome (i.e. price equals marginal cost) even when there is a duopoly. Edgeworth's (1881) model of bilateral monopoly relies on the contract curve which throws up a Pareto optimal outcome for both players. Edgeworth's theory extended to the case of multilateral exchange where he showed that this exchange yields the set of competitive allocations of the goods when the number of players tends to infinity.

Thus the foundations for a theory of imperfect competition laid down by Cournot, Bertrand and Edgeworth relied on the strategic interaction amongst economic agents and perfect competition emerged only as a limiting case when the number of agents tended to infinity. The analysis of oligopolistic markets as envisaged by Cournot, Bertrand and Edgeworth is restricted to rivalry among sellers selling a homogenous product. Hotelling (1929) and Chamberlin (1933) challenged this key assumption of product homogeneity. We shall focus, in the next chapter, on the seminal work by Harold Hotelling who analyzed *spatial competition* among sellers who were located near each other in the product space. *Thus strategic rivalry in a spatial context can be thought to be analogous to product differentiation.* Competition amongst differentiated products (where differentiation is analyzed in a spatial context) breaks the restrictive assumption of homogeneity of products, which happened to be one of the cornerstones of perfectly competitive markets.

[15] Perfect competition emerges as a limit case in the Cournot model when the number of firms tends to infinity.

This movement from perfect competition to imperfect competition can be succinctly captured if we use the *theory of games*. Game theory, which studies interactive decision process in which the players are aware of their mutual strategic interdependence, thus, paves the way for a rigorous analysis of imperfectly competitive markets.

- ***Market Structure*→** The term market structure describes the number of sellers in the market and hence, reveals the degree of *concentration/competition,* which prevails in such markets[16]. A brief overview of the different market structures studied under imperfect competition is presented below[17]:

Number of Sellers / Product type	One	Few	Many
Homogenous	Homogenous Monopoly	Homogenous Oligopoly	Perfect Competition
Differentiated	Differentiated Monopoly	Differentiated Oligopoly	Monopolistic Competition

The difference between homogenous and differentiated product is introduced to support a more precise theoretical analysis. Product homogeneity represents the situation when, even the smallest price differential results in the entire demand shifting to the lowest priced seller. Similarly the distinction between few and many sellers is purely for explanatory convenience. What is important is, whether, the sellers are aware of their strategic interaction in the context of the market. Sellers of differentiated products are, in

[16] The competition among buyers is taken to be symmetric – when this property is violated, we have strategic competition among buyers which results in monopsony, duopsony or oligopsony (depending on the number of buyers).
[17] This follows from Gabszewicz (1999).

real life, quite aware of the fact that the demand for her product depends on her own-price as well as the price of substitute products. Thus it becomes increasingly difficult to buy the argument favoring perfect competition — models assuming perfect competition make for an easy price-quantity market solution. More importantly, the three properties (discussed above) — i.e. equality of price and marginal cost, zero profits and exit of intramarginal firms logically extend to guarantee efficient resource allocation[18].

One of the advantages of using game theory is that it minutely studies the decision making process of firms. Often, it becomes relevant to distinguish between the long run variables and the short run ones. This gives us a sharper tool of analysis when we are interested in market games, especially multimarket games with entry, differentiated products etc. the concept of the stage game captures these concerns in theoretical models. We look at the different theoretical structures of stage games before studying different kinds of market.

- ***The Stage Game***[19] →

There are compelling reasons for distinguishing different stages in a market game, especially of the type we are discussing. We generally deal with market outcomes, which, are determined by one-shot games. One-shot games implicitly assume that all decisions taken by firms are taken simultaneously and the players interact all at once in the market. Separating any game into stages follows the Marshallian[20] distinction between the short run and the long run. This distinction is not chronological but rather analytical — the

[18] There are apart from modeling techniques, very strong political arguments favoring the assumption of perfect competition. Liberal market ideology wants to paint a picture wherein, markets guarantee decentralization of decision-making and non-concentration of power in the hands of a few—this imagery can only be constructed if we accept the unrealistic assumption of atomistic market structure. And, of course, economists feel good if their models can ensure, at least on paper, an efficient allocation of resources in the economy.

[19] see Philips (1993) for a detailed analysis.

[20] see Marshall's Principles (1952, book V, chapter V, section6).

long run implies that the variables under study can be adjusted fully. The preliminary step is the investment/disinvestment decision taken by the firm (i.e. by entry or exit from the industry) is the long run aspect. The step which typically follows is one in which the profits are determined — i.e. profits which motivated entry or exit in the previous stage. The latter stage determines the former, and also the long run decision is more difficult to change than the short run decision.

The formulation of such decision processes is typically captured by a *two-stage game*. The players can be imagined to solve the successive 'subgames' or stages before the game actually starts. Hence, the two-stage game[21] captures the Marshallian approach by solving the short run problem (i.e. stage 2) first, for any given number of firms. The first stage equilibrium number of firms sustains the second stage equilibrium profits. *The equilibrium concept for solving stage games is the 'subgame perfect' or simply 'perfect' equilibrium*[22]. The solution of the last stage gives 'estimates of these incomes' (i.e. the subgame equilibrium profits) which directly govern supply' (i.e. solves for the equilibrium number of firms in the first stage). When the game is actually played the equilibrium number of firms are put into operation in the first stage, which yield equilibrium profits in the next stage.

➢ *Market structure, Sunk costs and Entry:* The need to distinguish different types of market arises due to the existence of sunk costs and the nature of the product. Typically, in some markets advertising (or generally, non-price competition) is prevalent while in others it is not (especially when products are homogenous). Also sunk costs can be *exogenous* or *endogenous,* which further complicates matters.

[21] see Sutton (1991)
[22] see Selten (1975).

Thus, it would be useful to distinguish between markets exhibiting different characteristics. Schmalensee (1992) categorizes industries with low advertisement-sales ratio as *type* I markets while the advertising intensive ones are clubbed under *type* II[23].

I. <u>Type I markets and sunk costs</u> → Industries characterized by free entry and N exante identical firms are captured by the following model, where the profit of firm *i* is expressed as

$$\pi_i = (P_i - c)q_i - A_i - \sigma \tag{1}$$

A_i = advertising/demand-shifting outlay.

σ = technologically fixed (set up) cost.

The focus of the following sections is to model the interactions between the exogenous and endogenous definitions of such costs to determine the equilibrium pattern of market structure.

- *Exogenous sunk costs*→ In this category, the only sunk costs incurred are the exogenous costs (σ) of setting up their plant. Typically the fixed expenditure incurred at the first stage of the game is treated as sunk costs which leads us to analyze competition in the next stage[24]. We can distinguish two subgames depending on the nature of the product— i.e. either homogenous or differentiated.

[23] see Sutton (1991) for a detailed study. Note: Schmalensee' category of type I refers to six industries studied by Sutton (in Sutton,1991). The remaining 14 industries (in the same study) refer to type II industries.

[24] The intensity of competition differs when we consider games with different second stage subgames. The games we are interested in can have either a Cournot or a Bertrand competition (in the second stage). We shall study the different subgame perfect equilibrium market structures thrown up by the different approaches in the next section.

a] Homogenous product: In this case, entry occurs upto the point at which (stage 2) profits of the last entrant covers the sunk costs incurred on entry at the previous stage. For such an industry concentration declines with the increase in market size (since increase in market size raises profits and induces further entry). This also implies that *economies of scale become less important as a constraint on equilibrium market structure in large economies.* The 'toughness of price competition'[25] in the next stage affects the results of the first stage. The results derived in a two stage game is different from the results obtained by using the traditional Bain paradigm. The Bain effect talks of higher concentration implying higher margins and hence higher profitability. While the stage game approach throws up the result that *'toughness of price competition'*[26] makes entry less profitable thus raising equilibrium concentration levels. In terms of the model, we can take A_i to be exogenous. Thus, in the symmetrical model we set $A_i = 0, \forall i$. Ex-post identical firms produce a homogenous product, so we can write

$c_i = c$; $p_i = p$ and $q_i = S/_{NP}$, where S=total expenditure on the product. If we assume S to be a constant and that the percentage markup, $(p-c)/p$ can be approximated by k/N^{α} for $k > 0, \alpha > 0, N \geq 1$. Zero-profit condition gives the equilibrium number of firms N*, i.e.

$$N^{*} = \left[k\left(\frac{S}{\sigma}\right)\right]^{\frac{1}{(1+\alpha)}} \tag{2}$$

[25] Sutton (1991).
[26] This is Sutton's coinage, ibid.

where $\left(\frac{S}{\sigma}\right)$ is the effective size of the market; α measures the 'toughness of price competition'. So, for any $\alpha > 0, N^* \to \infty$ as $S \to \infty$,

i.e. any measure of concentration tends to zero as market size increases; doubling S less than doubles N*. Also, $\frac{\partial N^*}{\partial \alpha} < 0$, implying that tougher price competition results in higher equilibrium concentration because it gives rise to a greater divergence between pre-entry and post-entry margins.

Therefore, when firms offer a homogenous product and incur exogenous sunk costs, we can expect the equilibrium level of concentration to decline with the ratio of market-size to sunk cost, i.e. $\left(\frac{S}{\sigma}\right)$, and to increase with the toughness of price competition (i.e. α).

b] Differentiated products: The kind of differentiation modeled here is of the horizontal type (which arises in simple locational models of the Hotelling kind). Consumers are spread over space[27] and incur a disutility (e.g. if they bear transportation costs) in purchasing from buyers located away from them. Firms incur setup costs and consumers buy the least priced product (price inclusive of transport costs-that increases with distance). The models of this kind often suffer from a problem of multiple equilibria. For any given market size, there may exist a fragmented equilibria (large number of firms sell at the same location) or a concentrated equilibria (small number of firms sell at many

[27] space here can denote geographical space or product space.

locations). To illustrate this case we consider a variant of Schmalensee' (1986) model of price competition[28], where profits of firm i can be expressed as

$$\pi_i = (p_i - c)S\left[p_i^{-e} \Big/ \sum_{j=1}^{n} p_j^{-e}\right] - \sigma \tag{3}$$

where, e denotes toughness of price competition and $\left[p_i^{-e} \Big/ \sum_{j=1}^{n} p_j^{-e}\right]$ represents firm i's market share. There exists symmetric Nash equilibria in prices, $\forall N \geq 2$ if $e > 2$. The zero-profit condition gives the equilibrium number of firms:

$$N^* = \frac{c(S/\sigma) + e}{e - 1} \tag{4}$$

the results are similar to the previous case, i.e. as $S^* \to \infty, N^* \to \infty$; also doubling s less than doubles N, and $\frac{\partial N^*}{\partial e} < 0$.

The core result of models of exogenous costs in two stage games in type I markets is that — an increase in market size (S) relative to setup costs (σ) may lead to indefinitely low levels of concentration in these industries.

- Effect of concentration – market size relationship due to difference in posterior subgames → The toughness of competition can differ depending on whether firms consider *Cournot* strategies or *Bertrand* strategies or strategies of *joint profit maximization*. The relationship between the degree of market concentration (measured by $1/N$) and market size (S) depends precisely on the intensity of competition (in the second stage) in the following ways:

[28] see Schmalensee (1992).

i. for joint profit maximization there can be as many producers as there are firms that would cover the setup cost (σ) with their profit share, for a given market size (see figure below). Market concentration falls monotonically as S/σ goes up.

ii. for Cournot competition, $1/N$ declines as market-size increases, but degree of concentration is higher for any given value of S.

iii. for Bertrand competition, monopolization of the industry takes place as entry is totally deterred — even for a duopoly prices would be pushed down to marginal costs and lead to negative profits.

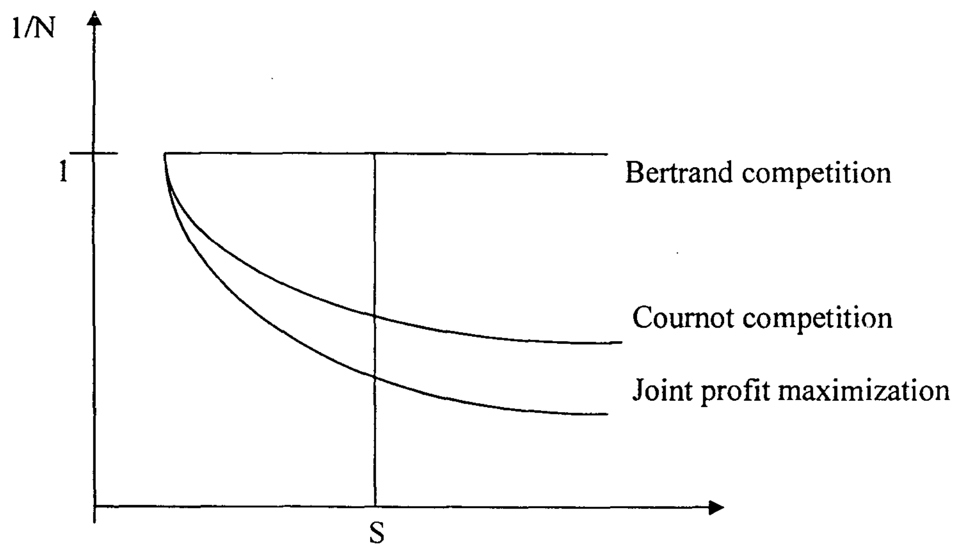

Fig: Concentration-Market size relationship.

Source: Sutton (1991, figure 2.2).

The presence of horizontal product differentiation shifts the concentration-market size curve downwards and to the left and transforms the curve into a lower bound[29]. If each firm produces a single product, then an increase in market size would result in a more fragmented market structure. If the firms are multiproduct firms, then we would

[29] see Shaked and Sutton (1987, 1990).

find multiple equilibria — some characterized by many producers producing a single variety and a smaller number producing several varieties. If a firm adds a new variety to it's product line, it may end up with higher sales at given prices and thus secure a larger market share without engaging in a price competition. As opposed to this, the industry may have a large number of firms offering a smaller number of products. In such a scenario, tougher price competition acts as a barrier to entry. Brand proliferation maybe a deliberate strategy aimed at monopolization[30]. Any of these strategies leads to a degree of market concentration represented by a point that lies above the concentration-market size curve, thus making it a lower bound.

II. Type II markets and sunk costs →

- *Endogenous sunk costs:*

Endogenous sunk costs are characteristic of type II markets (i.e. advertising intensive). Firms incur these costs in a bid to enhance consumers' willingness-to-pay for a particular product. This implies that the firms want to upgrade/advertise quality, i.e. these are examples of vertical differentiation. Endogenous sunk costs, therefore, are generally advertising and R&D costs. The consumers' willingness-to-pay is a non-decreasing function of u, an index of (perceived) quality. Two stage games are used to model type II markets as well. The firms decide to enter (with fixed cost σ), and, if they enter, choose the level of advertising expenditure $A(u)$ in the first stage. In the second stage firms engage in price/output competition. The advertising cost can be represented as $A(u) = \frac{a}{\gamma}(u^{\gamma} - 1)$, where $\gamma > 1$. If $u = 1, A(1) = 0, A'(1) = a$. Therefore a small initial outlay

[30] see Schmalensee, (1978).

at $u = 1$ produces a corresponding return to an expense a, which can be thought as cost per message. A higher γ implies rapid diminishing returns.

Therefore total costs can be expressed as: $\sigma + A(u) = \sigma + \frac{a}{\gamma}(u^{\gamma} - 1)$. Depending on the functions chosen we can model type II markets as a three stage game or a two stage game[31]. We consider two models to capture the idea of endogenous sunk costs, which in turn throws light on the possible relationship between toughness of non-price competition and free entry concentration.

The first model:

- $A_i = 0$ in (1), price is fixed (in the previous stage), and both quality (u) and market share can be increased by increasing the cost per unit. Profits of a typical firm would be $\pi_i = (p - c_i)S\left[c_i^e \Big/ \sum_{j=1}^{N} c_j^e\right] - \sigma$ (5)

$[c_i^e \big/ \sum_{j=1}^{N} c_j^e]$ is the market share function derived as the output from a random utility model. There $\exists$ symmetric, zero-profit Nash Equilibrium in $c_i, \forall e > 0$, with equilibrium number of firms given by

[31] Note: Schmalensee raises the following objections regarding the two stage approach (see Schmalensee, 1992 for details):

i. Product design may be (typically) longer lived than prices and advertisement budgets are regularly revised in view of short term changes in market conditions (price rigidity can hold for very long periods). The confusion here is in the understanding of chronological time as opposed to analytical time—long run decisions (first stage) donot necessarily take more time than the short term (second stage) decisions. One can use a dynamic set up and look at Markov perfrect equilibrium in such cases.
ii. The effects of advertising on demand donot generally have to be long lived (see Berndt, 1991).
iii. Entry deterring effect of advertising costs is not different from any other form of *non-price competition*, here A(u) can be taken as an specific type of sunk cost.
iv. Two stage are not necessary to show that N*converges to a positive constant, see discussion following equation (8) of this model.

Nonetheless, it is accepted that a two stage approach gives a clear picture of the economics of such markets.

$$N^* = \frac{p\left(S/\sigma\right) + e}{1 + e} \tag{6}$$

As before, $N^* \to \infty$ as $S \to \infty$; non-price competition (which focuses on unit cost) resembles price competition in the limit. Higher e (i.e. more sensitive market share is to quality) implies tougher quality competition and smaller number of firms in equilibrium.

The second model[32]:

This model shows that the two stage approach is not necessary for N^* to converge to a positive constant as market size grows. The only necessity is that market share has to be sufficiently sensitive to variations in fixed costs, implying that rivalry is focused on fixed costs (not on per unit price-cost margins). Definitely, the nature of competition is tough.

The assumptions of the exercise are: p and c are exogenous and increasing advertising outlays can increase market share.

The profit of firm i can be expressed as

$$\pi_i = (p - c)S\left[c_i^e \Big/ \sum_{j=1}^{N} c_j^e\right] - A_i - \sigma \tag{7}$$

$[c_i^e \big/ \sum_{j=1}^{N} c_j^e]$ is the market share function arising out of a random utility model.

$(p - c)S\left[c_i^e \big/ \sum_{j=1}^{N} c_j^e\right]$ approximates returns to advertising in the second stage.

For $0 \le e \le 2, \exists$ symmetric Nash equilibrium in A_i (with non-negative profits). Larger is e, *ceteris paribus*, higher are advertising costs per firm and lower will be profits. The equilibrium number of firms is given by

[32] see Schmalensee (1976,1986).

$$N^{*} = \frac{(1-c) \pm \sqrt{(1-e)^2 + 4e\left(\frac{\sigma}{S} \bullet \frac{1}{p-c}\right)}}{2\left(\frac{\sigma}{S} \bullet \frac{1}{p-c}\right)} \qquad (8)$$

For $e \leq 1$, the single value of N^{*} [that satisfies (8)] tends to grow without bound as $S \to \infty$. Advertising is not particularly tough and concentration converges to zero as the size of the market grows. Thus, if market shares are mildly responsive to advertising, it is possible to have type I behavior with endogenous advertising costs.

For $e = 1, N^{*} = \sqrt{(p-c) \bullet \frac{S}{\sigma}}$, i.e. doubling the market size less than doubles N (also $S \to \infty, N^{*} \to \infty$), so that advertising per firm grows without bound as market grows to maintain zero-profits.

For $1 < e \leq 2, N^{*} \to N^{**} \equiv \left[e/(e-1) \right]$ as $S \to \infty$. This means advertising competition is tougher and no more than N^{**} firms can earn non-negative profits no matter how large the market becomes.

The core result of type II markets (with endogenous costs) is that the level of concentration converges to a lower bound (under very general conditions), no matter how large the market becomes. Additionally, toughness of non-price competition (here advertising) ensure that the market structure does not become fragmented as S increases — i.e. there will be less number of firms in such markets.

An interesting area of concern is the modeling of the posterior game. Different posterior games (we shall consider Cournot and Bertrand) throw up different outcomes. This is what we intend to do in the following section focusing on the Cournot vs. Bertrand debate.

Cournot vs Bertrand:

Models of multimarket oligopolies often yield different outcomes depending on the specific assumption of competition — e.g. Cournot or Bertrand. The models we have discussed generally use a Cournot approach (to characterize competition in the second stage). Scherer's (1980) view regarding such competition is that firms are more likely to engage in price competition, *à la Bertrand.* Theorists often consider Bertrand competition to be a better approximation of competition, especially in differentiated products. However, Kreps and Scheinkman (1983) have shown that Cournot competition describes the outcome of a two-stage game in which firms choose capacity levels in the first stage and later, when they are precommited to the capacity level, they choose prices (anticipating the outcome of the second stage game). Thus the solution is *subgame perfect*. The firms can precommit to a capacity level but not to a price and hence, the *price-quantity* decisions are separated in a reasonable way in this formulation.

The methodological issues discussed above form the bedrock for a model of intraindustry trade in multimarket setting. Ben-Zvi and Helpman's model [33](1993) is a classic example of looking at trade as international industrial organization. They use a type I model with homogenous products in the context of multimarket interaction.

Type 1 Market Model of oligopoly in segmented markets-Ben Zvi and Helpman.

The firms choose capacity, in the first stage, which can be used to serve either market — home or abroad. In the next stage, firms choose selling prices for different markets. Firms have the power to discriminate (in prices) but this depends on the working

[33] see Ben-Zvi and Helpman (1993).

of the specific market. In the third stage, firms allocate sales across markets[34]. An interesting insight is revealed in this approach — wherein firms set prices before sales allocation. In the accepted formulation, sales are allocated before prices are set. This model is suitable for situations where firms first set prices, then receive orders and deliver — which seems a realistic description of the majority of transactions.

The assumptions of the Ben Zvi-Helpman model are as follows:

- There are 2 markets, indexed by $i = 1,2$.
- One firm is located in each market — firm j is located in market j.
- Firms compete in three stages — they choose capacities $\bar{x}^j$ in the first stage. In the second stage they choose prices $p^j = (p_1^j, p_2^j)$, where p_i^j is the price charged by firm j in market i. In the final (third) stage, firms choose sales $x^j = (x_1^j, x_2^j)$, where x_i^j describes sales of firm j in market i.
- There exists a capacity build up cost.
- The unit profit vector of firm j (excluding capacity setup costs) is $\pi^j = (p_1^j - t_1^j - c^j, p_2^j - t_2^j - c^j)$, where c^j is unit manufacturing cost and t_i^j is unit sales cost of firm j in market i (e.g. transport costs, tariffs, export subsidies, sales tax etc.)
- Typically it is cheaper to sell in the home market than in the rival's market, i.e. $t_k^j > t_j^j, k \neq j$. In the context of international trade, this inequality is reinforced by existence of tariffs. Alternatively, export subsidies can reverse this inequality.

[34] This model follows Kreps and Scheinkman's (1983) model of applying the Cournot approach to a stage game. However, the third stage, described in the present model, is an addition to the Kreps-Scheinkman formulation.

- The demand function in market i is $D_i(p_i)$, where p_i is the consumer price. $D_i(p_i)$ is continuous and decreasing.
- In each market, there exists a large number of competitive retailers who buy goods from producers, sell them to final users and operate with zero costs. Resale transactions are assumed away. Thus the market clearing price p_i is determined by $D_i(p_i) = x_i^1 + x_i^2$. Let producer j's request price be denoted as p_i^j.

  if, $p_i > p_i^j \rightarrow$ retailers buy additional units for producer j;

  $p_i < p_i^j \rightarrow$ retailers refuse to buy from producer j;

  $p_i = p_i^j \rightarrow$ retailers indifferent and sends half the order to each. If one producer does not satisfy the placed orders it is rechanelled to the rival.

  This procedure generates the efficient rationing rule[35].

  - All the above information is known to all players, i.e. this is a model of perfect information. The outcome of such oligopolistic interaction is identified with the subgame perfect equilibrium of this three-stage game (this game is solved by backward induction, as discussed above).

<u>*Third stage — the Sales game*</u> $\rightarrow$ the capacity vector $\bar{x} = (\bar{x}^1, \bar{x}^2)$ and price vector $p = (p^1, p^2)$ are given. These conditions impose restrictions on feasible sales. Firm j's decision problem is

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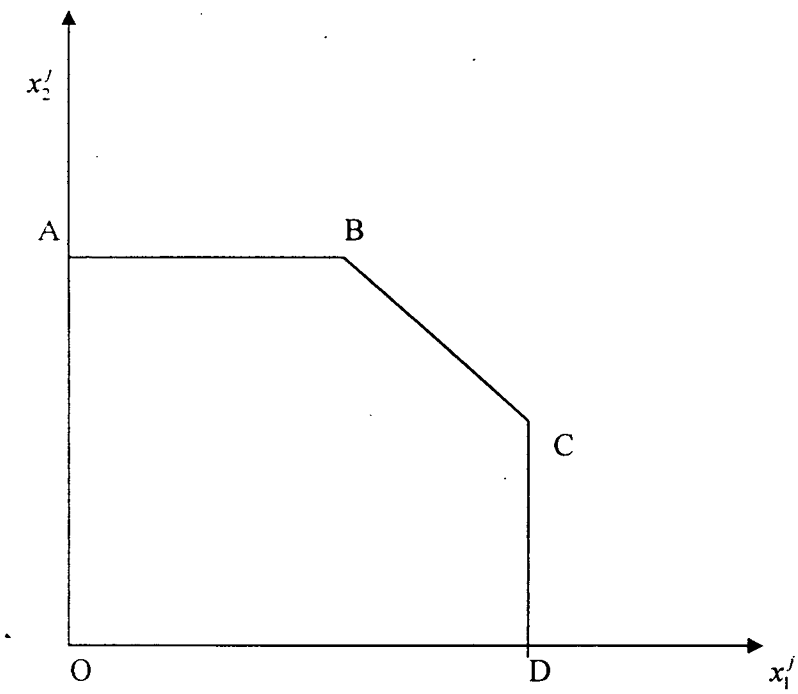
[35] The efficient rationing rule: if $p_i^1 < p_i^2$, firm 1 supplies as much as it wants till $D_i(p_i^1)$. If firm 1 chooses not to supply all this quantity, firm 2 can choose to supply upto $D_i(p_i^2) - x_i^1$, (provided this expression is non-negative). When both change the same price, firm j is free to choose sales upto the limit $\max\left[\frac{D_i(p_i^j)}{2}, D_i(p_i^j) - x_i^k\right]$.

$$\max_{x^j} . \pi^j \cdot x^j$$

$$\text{s.t. } x_1^j + x_2^j \le \overline{x^j},$$

$$x_i^j \le \begin{cases} D_i(p_i^j), & p_i^j < p_i^k \\ \max.\left[\dfrac{D_i(p_i^j)}{2}, D_i(p_i^j) - x_i^k\right], & \text{for } p_i^j = p_i^k, \quad i = 1,2. \\ \max.[0, D_i(p_i^j) - x_i^k], & p_i^j > p_i^k \end{cases}$$

This is a linear programming problem whose constraints are depicted in the figure below:



Some of the adjacent points, e.g. A and B, can coincide. Given positive unit profit levels, solution is at B (when unit π's are higher in market 2) and at C (when unit π's are higher in market 1). When unit profits are equalized, the solution set is the entire line segment $\overline{BC}$. Whenever the constraints are as described above, and the rival increases sales in market i, the firm responds either by not changing sales in market i or by redirecting sales to the other market. When points B and C coincide below the full capacity line (the downward sloping line segment), then the firm responds by reducing sales in market i without changing sales in the other market. Also quantity response is one-to-one with expansion of the rival.

Let $X(p,\bar{x})$ be the set (x^1,x^2) that constitutes a pure strategy Nash equilibrium of the sales game, then for every $(p,\bar{x}), \exists$ an agreeable sales allocation.

<u>*Second stage — the Price game*</u> → Taking capacity as given, prices are chosen. Since in the third stage there is a unique agreeable payoff: $\pi_s(\mathrm{p},\bar{\mathrm{x}}) = [\pi_s^1(\mathrm{p},\bar{\mathrm{x}}), \pi_s^2(\mathrm{p},\bar{\mathrm{x}})]$.

Firm j's problem is to $\max\limits_{p^j}.\ \pi_s^j(\mathrm{p},\bar{\mathrm{x}}), \quad j = 1,2.$

The Nash equilibrium of this price game gives the solution to the second stage. The problem is that there may not exist pure strategy equilibrium to the price game[36].

<u>*First stage — the Capacity game*</u> → When firms choose capacity, they form expectations on the outcome of the second stage for every choice of capacity. Most of the economic characteristics which describe the resulting equilibria depend on the last two stages of this model. Therefore, they (resulting equilibria) are independent of the expectational structure in the first stage and apply to all subgame perfect equilibria.

[36] Kreps and Scheinkman (1983) derived this result for a single market. The underlying reason for non-existence can be traced to the presence of large capacity in the first stage.Tirole (1988) shows that build up costs determine the level of capacity, among other things. The problem of existence is assumed away in this multimarket model to focus on the characterization of equilibrium — which is the object of study. In general, there does not exist a single Nash equilibrium or focal point to the price games.

The core results of the Ben Zvi-Helpman model is as follows:

- If a firm sells in a market, it charges the consumer price. This implies that retailers make zero profits. Also, when both firms sell in a market, they charge the same price.
- Whenever average unit sales costs are higher in a rival's market than in the home market, at most one firm sells in its rival's market. The cost differentials exist because of high transport costs. Thus, there will be no cross-hauling of homogenous products which contradicts the accepted result. When both players (selling positive quantities) serve both markets, each sells a positive quantity in it's home market. In the context of international trade we uncover an interesting implication — oligopolistic competition in segmented markets per se cannot explain intraindustry trade (in homogenous products). The existence of tariffs (which increase unit sales costs of rivals) reinforces this result. Whenever transport costs and tariffs are sufficiently high there is an absence of intraindustry trade.
- Arbitrage opportunities are absent whenever retailers (and other agents) face cross-market transport costs that are no less than those of firms.
- The (absolute) value of price differentials converges to a upper bound due to the existence of cross-market transport costs. If transport costs tend to zero, so does the price differential. The absence of transport costs lead to price equalization in both markets (independent of the cost and demand structures). This contradicts the accepted formulation, where price competition brings price integration across markets despite the existence of segmented markets.

- When unit sales cost are zero and positive capacity build up costs exists, the equilibria of the three stage game coincides with the equilibria of a one-shot single market Cournot competition[37]. Thus, a priori identification of separate markets does not necessarily imply segmented markets.

One can criticize the need for the third stage sales game in the above-mentioned model. When we solve the second stage game, the sales allocation follows given the assumption regarding the efficient rationing rule. The third stage sales game may be a detailed description of real life transactions but from the point of view of modeling, it appears unnecessary.

One can also raise the question regarding the real life justification of prioce equilibrium in most of these models. Specifically, how do firms reach that price equilibrium *noncooperatively* in real life, given that they are not aware of the models of game theory? This convergence to price equilibrium can be explained if we look at actual pricing practices in the industry, which is the reason for the digression below.

Digression: Enforcing price equilibrium in the stage game — the convention of pricing in industries.

The price equilibrium that theorists derive in the stage games can be traced to the pricing schemes followed in industries. These conventions of pricing are followed by firms in a particular industry, which play the same role as the calculation of equilibrium prices using inverse demand in game theoretic models. We briefly try and categorize the

[37] The typical demand function for a single market Cournot game would be $D(p) = D_1(p) + D_2(p)$. This boils down to $D(p) = \bar{x}^1 + \bar{x}^2$, in every equilibrium of the last two stages. Thus there exists a unique equilibrium to this price game. The first stage is constrained by $D(p) = \bar{x}^1 + \bar{x}^2$, thus it can be treated as a one-shot Cournot game.

different customs practiced by firms[38]. These pricing schemes are typically practiced in the time domain (practice of parallel pricing), in the space domain (discriminatory delivered pricing) and in the income domain (best-price clauses). All the three are modeled as two stage games, where firms announce a common price in the first stage and then play the price game in the next stage. Under all the schemes, each player adjusts her price to that of her rival in a precise way. These customs enforce the price equilibrium in the second stage.

a) Parallel pricing — One firm announces a change in price well in advance and others follow. It is not necessary that the leader announces the changed price. This practice holds for both homogenous and differentiated products[39]. The announced price acts as a signal, which ensure that all firms converge to this single price in equilibrium.

b) Discriminatory pricing — In a spatial context firms may charge on delivery, i.e. the delivered price is the basing point price plus the transportation costs. The unique delivered price is obtained by following the custom of charging the lowest combination of a base price plus freight to the point of delivery. Thus it amounts to choosing the lowest price signal as the common price. Thisse and Vives (1991) derive an interesting result in the context of spatial pricing policies — *price discrimination (on the basis of location) emerges as the unique Nash equilibrium.*

c) Best-price policies — When consumers differ in their income levels (i.e. have different marginal-willingness-to-pay), they search for the cheapest deal in the market. Firms respond to such a scenario by giving discounts to some customers.

[38] this categorization follows Philips, (1993).
[39] for details on parallel pricing, see Macleod (1985) and d'Aspremont et al. (1991).

There is a possibility (as shown by Holt and Scheffman) that prior announcement of price changes along with the best-price clause may result in the market price falling below the Cournot equilibrium price.

Summarizing then we see that in the first stage the firms announce and determine a common price — the price of the first mover in parallel pricing, the lowest delivered price if the custom of spatial alignment holds, or the lowest announced list-prices for the best-price schemes. The players adjust their respective prices accordingly. These conventions enforce the narrative of price equilibrium in the stage game.

We have covered the methodological shift from general equilibrium to partial equilibrium in this chapter using the theory of games. The modeling technique we used was that of the stage games. Using such a framework, Ben Zvi and Helpman derive contradictory results to that of the model of reciprocal dumping. The restrictive assumption of perfect competition regarding entry and exit has been dealt with at length. The assumption, which all these models fail to break, is that of product homogeneity. That is the focus of our next chapter — new modeling techniques are required to include trade in differentiated products. We will develop in the next chapter the modeling techniques required to deal with such a scenario — specifically the theory of spatial competitions will be used to construct simple models of trade in differentiated (both horizontal and vertical) products.

Chapter IV

Product Differentiation and the Theory of International Trade: Models of Spatial Competition

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Space — The Final Frontier.

Star Trek.

The methodological approaches we have dealt with in the previous chapters have established models of trade using theories of imperfect competition. The shift from general equilibrium models to partial equilibrium models has succeeded in dealing comprehensively with strategic interactions among the firms in the context of trade. The use of game theoretic stage models throw light on trade processes taking into account the question of entry and distinguishing between the decision variables (long run vs. short run) at the firm level. Though these models have succeeded in breaking the price-taking and free entry assumptions of perfect competition, they have not been able to break the restrictive assumption of product homogeneity. The models used in new trade theory cannot pinpoint which country produces which kind of product (e.g. Helpman and Krugman's synthesis model, Brander and Krugman's model of reciprocal dumping etc.). The typical assumption of homogenous products acts as a constraint in developing finer models, which can address these issues. The assumption of symmetry is used in the models of new trade theory to justify the fact that it is not necessary to deduce which country produces which goods, thus the story of product homogeneity holds for those models. In this chapter we will try and do away with this restrictive assumption of homogenous products and attempt to construct models of trade involving differentiated products. We would try to develop sharper results in trade theory regarding the possible types of products traded by different firms (located in different countries). This can be possible if we can construct more realistic models, which would deal with trade in similar differentiated products occurring in imperfect markets.

Empirical observation of industries brings to light certain uncomfortable real life facts regarding the nature of products, which are exchanged in the market. Uncomfortable facts need a closer look rather than being swept under the carpet of assumptions, which happens to be an acceptable practice in theoretical models. Some of these uncomfortable real life facts[1] are as follows:

- A large number of industries (especially those producing consumer goods) produce a large number of similar but differentiated products (e.g. variety of cars, mobile phones etc.).
- No two consumer goods, produced by different firms in the same industry, are identical (e.g. observe the differences between the small cars Maruti, Santro, Matiz etc. which cater to the same class of consumers in the market or for that matter different brands of toothpaste).
- The set of products produced by firms in any one industry is a small subset of possible products. This deals with products that are differentiated by marginally varying the options available for existing products (e.g. mileage in bikes, options in mobile phones etc.).
- A small number of firms produce a range of differentiated products (especially in the consumer good industry). Brand proliferation is a deliberate strategy on the part of incumbent firms to block entry (e.g the market for soft drinks in India is largely controlled by Pepsi and Coke, each selling different flavours).

[1] See Eaton and Lipsey (1989) for a further details.

- Any individual consumer purchases only a small subset of the products available from any one industry (e.g. this stems from brand loyalty—consumers typically buy a particular brand of cigarette).
- Different consumers buy different bundles of differentiated products thus revealing heterogeneity in tastes; these differences cannot be explained due to income disparities alone.

Casual observation can reveal many more of such real life examples, thereby calling into question the assumption of product homogeneity in theoretical models. How can theorists model such industries in light of such observations? More specifically, what are the modelling techniques that are required to deal with differentiated products? Obviously the demand systems dealing with such industries will be different. We categorize the different approaches[2] used in modelling differentiated products by different theorists.

Different demand systems used in modeling differentiated products:

(i) **Representative consumer approach**—the representative consumer has symmetric tastes over the set of differentiated products. Such an approach has been used by Spence (1976), Dixit & Stiglitz (1977 & 1979).

(ii) **Horizontal Product Differentiation**— large number of consumers [usually a continuum of consumers] each with a most preferred horizontal attribute. Income effects are generally ignored in such models[3]. These models started with the classical model by Hotelling

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[2] see Corchon (1996).

[3] Horizontally differentiated products have a positive demand when offered at the same price—this implies that the representative consumer approach captures only horizontal differentiation.

(1929) and can be seen in later models by d'Aspremont, Gabszewicz & Thisse (1979 & 1983), Salop (1979).

(iii) **Vertical product differentiation** — consumers have identical preferences but heterogeneity is embedded in the differences in income of the consumers. These models capture the phenomenon where richer consumers can only afford higher quality products. Additionally, when vertically differentiated products have the same price, then one brand captures the entire demand. Models having these characteristics are seen in the works of Gabszewicz & Thisse (1979) and Shaked & Sutton (1983).

(iv) Models in which **consumers have heterogeneity in tastes**—i.e. preferences are defined over the attributes of the product. Such models have been used by used by Gorman (1956) & Lancaster (1979).

(v) Models where **consumer preferences are randomly distributed** — Sattinger (1984), Hart (1985a,b), Penloff & Salop (1985).

Spence (1976), Dixit-Stiglitz (1977) were amongst the first of the theorists who used the story of the "representative consumer". This process captures the consumers "love for variety" in the product space (modelled in the previous Chapter). The other approach used by Lancaster (1979) imagines consumer heterogeneity arising out of different preferences over product attributes. Thus the former approach sees product differentiation in the form of production of a variety not yet produced, while, in the latter it takes the form of offering a variety possessing certain attributes not present in previous varieties. Anderson, de Palma and Thisse (1989) have shown that under certain assumptions, categories (i), (iv) & (v) generate similar demand systems. These approaches, of course, offer demand side explanations for differentiated products.

Apart from this, there are supply side explanations for differentiated products as well. If the diversity of tastes is assumed to be such that every differentiated product would be demanded by some consumer when priced at minimum average cost, we would get a scenario where all such (possible) products would be produced. In these circumstances, the bound on the number of products would come from the supply side. This can be explained by production non-convexities — resulting from indivisibilities of fixed capital, product development costs etc. This implies that the firms face decreasing average costs over an initial range of output.

There are two basic modelling approaches to differentiated products that are prevalent in the literature:

i. The *non-address* approach → this is the traditional approach, which models consumers' preference over a predetermined set of all possible goods, which may be finite or countably infinite. The models using the representative consumer approach and the Chamberlinian large group fall in this category. We have dealt at length with these issues in the previous chapter.

ii. The *address* approach → this approach follows Hotelling's (1929) seminal paper, where the consumers' tastes are distribution over some continuous interval of parameters in the product space. Different consumers have different most preferred locations in the product space, which can be thought of as having different *addresses* in that space. Products are defined by their address in space, thus making the set of all possible products infinite.

We deal with the address branch approach in this chapter (the non-address models have been dealt with in the previous chapters). These models are also called *models of spatial competition* — typically modelled as a *two-stage game*, where firms choose their *locations in the first stage and then compete in prices*. The firms are aware that their choice of location influences the competition in the next stage. Firms located closer in space will face tough price competition in the next stage. Alternatively, firms located far apart will soften the price competition. This gives rise to what we call the *Principle of Differentiation* — when firms locate near each other we have the principle of minimum differentiation (as in Hotelling's Main Street model, 1929) and when they locate further apart we get the principle of maximum differentiation (as in the model by d'Aspremont et al. 1979). The notion of perfect equilibrium captures this idea.

The models of spatial competition are modelled such that space confers market power to the firms. Market activities performed over dispersed points in space imply that each player finds only few rivals in its immediate neighbourhood. This also means that a slight price cut does not drive the entire demand to the lowest priced firm, unlike Bertrand's model of homogenous products. The presence of transportation costs (bourne by consumers) strengthens such an inference. Thus spatial competition typically involves few players giving rise to strategic interactions amongst the players — thereby, lending itself to a game-theoretic analysis.

The population of consumers (in spatial models) can be spread over geographical area, while firms sell a homogenous product locate in the same space. Homogenous products imply that the transportation costs are typically bourne by consumers; hence their preference (i.e. the consumers) is such that they buy from the firm located closest to them. This minimizes consumers' transportation costs. Thus the customer base of a firm depends on its location and pricing policy. This can be solved as a two-stage noncooperative game, which involves players (i.e. firms), prices and/or locations as strategies, and profit functions as the payoffs.

We are interested in trade games, which involve differentiated products and the subsequent modelling techniques. Apart from modelling firm location involving initial geographical set up, the economic relevance of spatial models stems from the fact that it can be imagined to be a direct analog in industries with differentiated products. The product substitutes are dispersed over space, á la Lancaster, thus giving the seller of a particular variant a quasi-monopoly in her hinterland. The consumers in the sellers hinterland obviously prefer that variant other possible substitutes. The counterpart of transportation costs is the disutility incurred by consumers who do not find their 'ideal variant'. In the geographical set up discussed above, the consumers bore the transportation costs. Thus spatial models are most well equipped in dealing with differentiated products. We have already seen that differentiation can be of two types — *horizontal* and *vertical*[4]. In spatial models different modelling techniques help us in distinguishing between the two forms of differentiation[5].

- **Inside Location Games** (used in modelling *horizontal* differentiation) → this corresponds to the process of spatial competition with firms locating within the subspace where consumers themselves are located. The typical example of such

[4] Two variants of the same product are said to be horizontally differentiated whenevr, sold at the same price, some consumers prefer one variant to the other. Two variants of the same product are said to be vertically differentiated whenevr, sold at the same price, all consumers prefer the same variant (if products are differentiated by quality, consumers would prefer the higher quality product than the lower quality if sold at the same price.

[5] See Gabszewicz and Thisse (1992) for further details.

games is provided by firms, which locate within the residential area — Hotelling's Main Street model (1929).

- **Outside Location Games** (used in modelling *vertical* differentiation) → the analog to vertical differentiation in spatial competition, where firms locate outside the residential area, e.g. shopping complexes outside the city. All consumers prefer to buy from the shopping complex closest to the city.

Another advantage with models of spatial competition is that it offers a natural framework for studying price discrimination in imperfect markets. When the transportation costs are under the control of firms, they can discriminate with respect to the consumer location. Price discrimination can be modelled using price schedules (i.e. price functions) instead of price scalars (i.e. mill pricing) in the posterior stage game. Additionally, the spatial models are ideal for modelling *non-price* competition as well.

Thus we would use the models of spatial competition to model trade in differentiated products. We would try and model the outside location games to capture which kind of firms (located either in developed or developing countries) trade in which kind of differentiated products. This specification has not been dealt with in the trade literature. Helpman Krugman's synthesis model (which we discussed in previous chapters) could not predict this along with most other models of new trade theory. Our attempt is to sharpen the results derived in new trade theory using models of spatial competition.

An interesting question crops up regarding the strategic variable in the posterior stage, i.e. whether the strategic variables are prices or quantities. We deal very briefly with the suitable choice of the strategic variable below.

Cournot vs. Bertrand:

One of the main reasons for modelling the posterior game as a Bertrand competition is that it is analytically convenient to deal with — i.e. when demand is aggregated in address models, we proceed by deriving the demand functions. Often these functions are quite difficult to invert (e.g. if we have n firms, then we have to invert a system with n-equations). Apart from modelling convenience, the very nature of equilibrium is different under Cournot and Bertrand competition[6]. d'Aspremont et al. (1979) have questioned the existence of price equilibrium in address models that do not involve the assumption of no-mill-price-cutting. The source of non-existence in such models is the incentive for undercutting prices, which of course requires prices to be the strategic variables. This incentive is removed when there is Cournot competition[7]. Given cost and demand conditions, firms must generally announce prices in address models, as market forces cannot throw up market-clearing prices with differentiated products (unlike the case for homogenous products).

Many industries , however, face long lags in production — the present period's production decision fixes the next period's output. These industries typically have quantity decisions preceding their price decisions[8]. Such firms are forced to make

[6] For example in models of natural oligopoly. For further details see Shapiro (chapter 6, Handbook of Industrial Organization, 1989). With the Bertrand assumption we have differentiated products, while with Cournot we donot.

[7] See Salant (1986). Salant proves the existence of quantity equilibrium in one-dimensional address models in a general framework.

[8] Ibid.

conjectures about the market-clearing prices for their quantities, thereby giving rise to Cournot competition in quantities. Kreps and Scheinkman's (1983) result for homogenous products (which we discussed in the last chapter) is applicable to differentiated products as well. Firms simultaneously choose quantities in the first stage and then compete in prices — the subgame perfect equilibrium is identical to a Cournot equilibrium inspite of the posterior game being a price game. The reason behind this could be that firms recognize the destructiveness of Bertrand competition and hence curb their non-cooperative price competition by committing themselves to a limited quantity. When demand is correctly predicted, the equilibrium typically throws up Cournot outcomes. If however, there are unexpectedly low demands, firms engage in Bertrand competition by undercutting prices. Additionally, Singh and Vives (1984) construct a two-stage game in which firms choose prices or quantities and then compete accordingly. Their model throws up quantity competition as a dominant strategy, which results in Cournot equilibrium.

Obviously, nothing definite can be said about modelling posterior stages of such games — i.e. whether quantity competition or price competition is a better strategic variable in such models. As Eaton and Lipsey (1989) suggest, there is clearly scope for further research by reworking spatial models using quantity competition.

We try and construct a trade model below, which captures trade in vertically differentiated products. We use a spatial two-stage model for our exposition. General models of horizontal product differentiation can be similarly constructed.

Model of trade in vertically differentiated products (varying in quality):

This is a possible model of trade in vertically differentiated products, i.e the outside location game. We model this scenario as a two stage game where firms choose technologies in the first stage and then compete in prices. The equilibrium concept is that of subgame perfect equilibrium.

Assumptions:

- There are 2 firms one in each country A and B.
- There are 2 types of technology T_1 and T_2 (technology platform)[9]. Both technologies are available in both countries. Type T_i technology implies cost c_i ; $i = 1,2$. We assume $T_1 > T_2$, this implies $c_1 > c_2$. The economic implication is that higher technology gives higher quality product.
- **Stage 1:** Firms simultaneously choose technology platforms.
- **Stage 2:** After choosing technology they compete in prices.
- Consumers are distributed over the interval [0,1] in each country. Consumer type denoted by θ. Continuum of types. The technology platform lies outside the residential area, i.e. outside the interval of consumer types.
- Consumers have preference for certain quality (i.e. proxied here by technology T).
- We compare the results before and after trade.

[9] For a single market framework with technology platforms see Sarkar, 2003.

The closed economy:

We assume that both countries have consumer type's spread over the same interval [0,1] in each country. We take the example of country A under autarky.

(T_1) 0 |———————————| 1 (T_2)

when consumers in country A prefer higher quality product i.e. T_1 then they have utility

$u = K(1-\theta)$, where K is a technology parameter.

when consumers in country A prefer lower quality product i.e. T_2 then they have utility

$u = K\theta$

Monopolist in country A, i.e. firm 1 can choose only one technology, say it chooses T_1. Then there will be some consumers in country A, who will not buy. This is because they prefer to buy lower quality (cannot afford the higher quality). Thus firm 1 cannot cover the entire market.

We define the marginal consumer as $\theta_A = D_1(p_1, 0)$ (1)

i.e. the consumer type who is indifferent between buying from firm 1 or not buying .

$$K(1-\theta_A) - p_1 = 0$$
$$or, \theta_A = 1 - \frac{p_1}{K} \qquad (2)$$

The profit function for firm 1 is $\pi_1 = (p_1 - c_1)D_1(p_1, 0)$ (3)

From the F.O.C. we get the equilibrium price as $p_1{}^* = \frac{1}{2}(K + c_1)$

Similarly, assume that firm 2 chooses T_2 for country B[10] (due to the assumption of symmetry), we have the marginal consumer as $\theta_B = D_2(0, p_2)$.

[10] if firm 2 also chooses T_1 in country B we get the same result as wedreived for 1. this assumption is not a restrictive assumption as such, but it keeps the exposition simple.

Therefore we get on solving $\theta_B = \frac{p_2}{K}$.

$$\pi_2 = (p_2 - c_2)D(0, p_2)$$

$$p_2{}^* = \frac{c_2}{2}$$

After Trade:

This can be modelled by spreading the consumer types in both countries over the interval [0,2]. The intervals in both countries have been assumed to be [0,1]. Symmetric assumption gets us this [0,2] interval.

There can be two possible scenarios —

i. both firms choose the same technology

ii. both choose different technologies.

We model (ii), where they choose different technology. The reason being that if they choose the same technology, they have a Bertrand competition and price comes down to marginal cost. It is easy to prove that both are worse off, this implies that similar technology types won't trade in vertically differentiated products.

The interval now looks like

the consumers who prefer (T_1) have utility $u = K(2-\theta)$, and

those who prefer T_2 have utility $u = K\theta$.

Let the marginal consumer be $\theta^* = D_1(p_1, p_2)$

Therefore we have, $K(2-\theta^*) - p_1 = K\theta^* - p_2$

This yields $\theta^* = 1 + \frac{p_2 - p_1}{2K}$

$\pi_i = (p_i - c_i)D_i(p_i, p_j)$; $i = 1,2.i \neq j$

The F.O.C.'s yields

$p_1 = K + \frac{p_2}{2} - \frac{c_1}{2}$, this is the reaction function for firm 1........ (4)

similarly for firm 2, $p_2 = K + \frac{p_1}{2} + \frac{c_2}{2}$, this is the reaction function for firm 2........ (5)

Solving, we get the Nash equilibrium prices of the posterior game :

$$p_1^N = 2K + \frac{1}{3}(2c_1 + c_2)$$

$$p_2^N = 2K + \frac{1}{3}(c_1 + 2c_2)$$

thus we get that $p_1^N > p_2^N$. This further implies that the higher cost technology (i.e. the higher quality) is priced above the lower cost technology (i.e. the lower quality).

This result is in line with Stiglitz (1987) — price reflects quality. Here the higher quality has a higher price.

Also we have, $\pi_1{}^* = \frac{1}{18K}(6K + c_2 - c_1)^2$.

Also it is easy to check that $\pi_i{}^*|_{trade} > \pi_i{}^*|_{autarky}, i = 1,2.$

Core economic implications of the results are as follows:

- both firms earn higher profit after trade when they sell different quality.
- Consumers get their preferred quality, before trade some consumers in both countries did not buy anything.
- The most interesting implication for trade can be constructed from this model. We can interpret the firms (located in different countries) having separate technology platforms as being representative of a real life observation. Casual empiricism

suggests that generally higher technology production processes are to be found in capital abundant countries (this can be assumed in the model, but has not been explicitly modelled here), which produce higher quality products. Firms, which produce lower quality do so generally because they lag in technology. This kind of scenario is typical for a developing countries firm. Even, without this story we get the main result of this model — *trade in vertically differentiated products take place between dissimilar trading partners who adopt different technology platforms.* (The results are similar to the empirical observations, which we shall deal with in the next chapter).

Further extensions of this model are possible, which can deal with asymmetric information and sequential entry.

Chapter V

The Empirical Dimensions of New Trade Theory: Measurement of Intra-Industry Trade and Case Studies.

The theoretical models of new trade theory have been dealt with in the previous three chapters. The results, which have emerged as a result of the theoretical models, have laid the methodological foundations used in building new trade theory. The question which remains, however, is the empirical validity of such claims. Historically we have seen that one of the most important empirical finding in the field of international trade was that of two-way trade among similar products and countries, which exposed the unrealistic claims of the traditional neoclassical theory. Thus it becomes all the more interesting to check the empirical validity of new trade models — more specifically we intend to cover the various empirical dimensions required to estimate intraindustry trade. Apart from this, we briefly discuss the typical cases which arise in the real world, i.e. trade between similar countries and dissimilar ones. Of significance is the trade taking place between advanced capitalist countries (North-North type) and the dissimilar ones (i.e. the North-South type).

The first studies on the topic [Grubel and Lloyd (1975), Balassa (1975)] revealed that there was a steady long run increase in the levels of intra-industry trade (henceforth IIT) flows across industrialized economies (North-North type) during the postwar period (50s and 60s). This phenomenon of simultaneous exports and imports of goods belonging to the same industry is known as IIT. These results questioned the claims of neoclassical trade theory, which is based on factor endowments being the source of comparative advantage, gives rise only to interindustry trade. The Hecksher-Ohlin-Samuelson (H-O-S) model predicts the following:

- Trade takes place between dissimilar countries
- The composition of trade should reflect the sources of comparative advantage — factor endowment.
- Factor-price equalization.

The empirical evidence revealed a clear departure from the main postulates of the H-O-S model. The testing of the H-O-S postulates went on to become one of the classic debates that triggered a huge body of research in the theory of international trade. Clearly, an alternative explanation was sought to explain IIT. The corpus of research on IIT has proceeded along two lines — first, theoretical models based on increasing returns and imperfect competition, which came to be known as New Trade Theory (the focus of our study in this dissertation). The second approach dealt with cross-sectional studies at the industry and country levels, which explored the relationship between IIT and industry and country characteristics. These empirical studies found a positive correlation between the trend and average level of IIT flows and the following variables:

i. Per capita income and degree of development
ii. Economic distance and integration
iii. Foreign investment
iv. Oligopolistic and segmented markets
v. Increasing returns and technological factors
vi. Product differentiation

Originally, this empirical evidence had given support to a rejection of traditional theories of international trade based on the concept of comparative advantage: if countries export and import products belonging to the same industry, the specialization process might not be the core phenomenon of internationalization. With the methodology implemented in pioneering studies, the bulk of trade among industrial countries was IIT. As a result of a debate concerning the measurement of the phenomenon on the one hand, and its determinants on the other hand, the original opposition between specialization and IIT has been smoothed:

- correcting the shortcomings of calculating original methods, the share of IIT in total trade has been largely reduced, while in addition IIT itself has been divided into two parts: IIT in horizontally differentiated products and IIT in vertically differentiated products;
- models of IIT, originally fed by the reference to the former type of differentiation, have rapidly turned towards the latter one, accounting for specialisation along ranges of quality spectrum within industries (Falvey, 1980).

Meanwhile, a synthesis of determinants of IIT and inter-industry trade seems to be accepted by economists. It is based on the view that monopolistic competition and (internal) increasing returns lead to IIT, while the old comparative advantage holds for countries separated by a large difference in factor endowments. Thus it becomes possible to have a Heckscher-Ohlin view of interindustry specialization on one hand, and a scale economy view of IIT[1] on the other. But, basically, the bulk of empirical work is still based on the methodology introduced by Balassa and Grubel-Lloyd. We briefly look at

[1] see Helpman and Krugman, 1985.

the different IIT indices used to measure the two types of differentiation, i.e. both horizontal and vertical.

Defining Industry:

The debate over the use of proper methods to measure IIT started in the 70's — the foremost problem centering around a proper definition of an industry. The SITC (Standard International Trade Classification) has gained acceptance among economic theorists as the ideal indicator of an industry. The SITC classification, adopted by countries, follow identical descriptions for the documentation of trade figures at the 1-, 2-, 3-, and 5-digit level. The Grubel-Lloyd (1975) technique of selecting industries at the 3-digit level of SITC classification had generally been accepted as the ideal. The Indian trade data follows the HS classification principle. Under the HS classification, the commodities and sub-industries are defined at the 8-digit and 4-digit levels respectively. The industries are defined at 2-digit level and there are 99 HS-industries. Also, the commodities in the HS system are distributed in twenty one sections (section I-XXI).

Different IIT indices:

The different indices used for ***measuring horizontal differentiation*** are as follows:

Balassa (1987):

The IIT index for industry i in trade between country j and k, is defined as

$$IIT_{jki} = 1 - \frac{\left| X_{jki}/X_{jki} - M_{jki}/M_{jk} \right|}{\left| X_{jki}/X_{jki} + M_{jki}/M_{jk} \right|}$$

X stands for exports and M for imports. If the index takes value 0 only interindustry trade occurs, if it is 1, then only IIT occurs. The problem is due to the absence of a mechanism to correct trade imbalance. Another conceptual problem is that the Balassa indicator —of which the GL and related indicators are derived— is used in the literature both as an indicator of IIT and of "revealed comparative advantages".

Grubel Lloyd (1975):

The IIT index of country j for industry i, also known as GL (U) (uncorrected index of Grubel Lloyd) is

$$\hat{B}_i = \frac{\sum_i (X_{ij} + M_{ij}) - \sum_i |X_{ij} - M_{ij}|}{\sum_i (X_{ij} + M_{ij})} \times 100$$

It can be rewritten as

$$\hat{B}_i = \frac{\sum_i \left[(X_{ij} + M_{ij}) - |X_{ij} - M_{ij}|\right]}{\sum_i (X_{ij} + M_{ij})} \times 100$$

The GL indicator is generally considered for empirical calculations. However, some limitations of the G-L index are as follows:

- the IIT measurements are sensitive to the level of aggregation, which could yield misleading results. In that sense, it might be counting interindustry flows as IIT, when each category i can be broken in several subgroups. In fact, IIT indices are higher (lower) when more aggregate (disaggregate) are the divisions within a commodity standard classification. There is a need to distinguish between the uses of SITC versus ISIC classifications. SITC is *product-based*, which in some cases includes commodities that have different capital-labor ratios within a given group. ISIC is *process-based*, which takes into account input-output processes in their aggregation, but its divisions are much more aggregated than SITC groups.
- the IIT indices are not an accurate indicator for product differentiation, because they are not able to distinguish the type of dissimilarity among commodities

within a given group. IIT indices assume that all varieties are differentiated disregarding their sources. Varieties mainly are *horizontally* or *vertically* differentiated. The former refers to differences in packing, external designs or brands, while the latter emphasizes in differences in *quality* among products within a given group.

- the overall trade disequilibria might bias the IIT indices coming from formula. The reason for incorporating trade balance adjustment is that the value of IIT index is always less than one irrespective of the pattern of exports and imports in presence of trade imbalances [Grubel (1975)].

Hence, the trade balanced corrected GL index for IIT is

$$\hat{B}_i = \frac{\sum_i (X_{ij} + M_{ij}) - \sum_i |X_{ij} - M_{ij}|}{\sum_i (X_{ij} + M_{ij}) - |\sum_i X_{ij} - \sum_i M_{ij}|} \times 100$$

The interpretation of the Grubel & Lloyd indicator poses additional analytical problem:

- Explanations of international trade have been inspired by the decomposition of total trade in *trade overlap* (representing IIT) and the *imbalance* (inter-industry trade). In this case, the flows related to inter-industry trade remain largely explained by traditional theory, whereas IIT is explained by the new trade theory. This helps to reconcile two incompatible paradigms (Helpman and Krugman, 1985), but raises the problem that there are two different explanations for the same (majority) trade flow, one being under perfect competition, the other under imperfect competition.

Aquino index (1978)

Aquino criticized the GL index on two counts — first, the overall trade imbalance may not have any imbalancing effect on the trade flows of single commodities, and, second, the imbalancing effect would appear at the highest level of industry aggregation[2]. Aquino's index proposes to calculate the theoretical values of estimated export and import from the actual values based on the equiproportionality assumption, denoting a superscript 'e' to them,

$$X_{ij}^{e} = X_{ij} \cdot (1/2) \cdot \sum_i \left(X_{ij} + M_{ij}\right) / \sum_i X_{ij}, \text{ and}$$

$$M_{ij}^{e} = M_{ij} \cdot (1/2) \cdot \sum_i \left(X_{ij} + M_{ij}\right) / \sum_i M_{ij}$$

it is evident that $\sum_i X_{ij}^{e} = \sum_i M_{ij}^{e} = (1/2) \cdot \sum_i \left(X_{ij} + M_{ij}\right)$

The Aquino index is

$$Q_i = \frac{\sum_i \left(X_{ij} + M_{ij}\right) - \sum_i \left|X_{ij}^{e} - M_{ij}^{e}\right|}{\sum_i \left(X_{ij} + M_{ij}\right)} \times 100$$

There are certain shortcomings of the Aquino index — the equiproportionality assumption can only hold if the price and income elasticities of demand for all imports and exports are identical and there is infinitely elastic supply both at home and abroad. Also, the absence of a full structural model for the appropriate level of disaggregation means that there is no direct way of measuring the nature of diffusion of any macro economic effect.

[2] see Aquino, (1978).

Michaely and Aquino index:

$$\text{Michaely and Aquino}_k = 1-\frac{1}{2}\sum_i \left| \frac{X_{ik}}{\sum X_{ik}} - \frac{M_{ik}}{\sum M_{ik}} \right|$$

The Michaely indicator, however, is generally used to compare trade composition, i.e. similarity of export and import. By construction, this indicator evacuates trade imbalances by reasoning in relative terms, i.e. comparing the share of elementary exports in total exports and the share of elementary imports in total imports: finally it is no longer related to the pattern of trade (Vona, 1990).

This is one of the reasons why most economists prefer the unadjusted Grubel & Lloyd indicator to (Grubel & Lloyd- or Aquino-) adjusted measures. In that case, considering the trade imbalance as part of inter-industry trade flows reduces trade flows to only two categories: interindustry trade and IIT.

Similarly, the different indices used for ***measuring vertical differentiation*** are as follows:

- **End use method**

The trade pattern is differentiated in terms of the composition of traded products. The stage of production at which the commodity is placed can be identified on the basis of end-use. The stage of production could denote any of the three — raw material, intermediate or finished product.

- **Unit Price method**

The differences in unit values (UV) of the commodities can be assumed to denote quality difference. Let, UV^X and UV^Y represent the unit values of export and import of an industry respectively. Then, trade is horizontal if the ratio of the unit values differ by less than $\alpha\%$, and vertical otherwise. Therefore, for trade to be horizontal, the following condition must hold:

$$1-\alpha \leq \left(UV^{X}/UV^{M}\right) \leq 1+\alpha$$

Otherwise, trade is considered to be in vertically differentiated products. The arbitrary parameter, α, can take different values. The literature on horizontal and vertical IIT uses two specific values — 15% and 25%. When price differences reflect only quality differences (based on assumptions of perfect competition, i.e. consumers donot purchase similar or lower quality at higher prices), the 15% threshold is used. In case of imperfect competition (e.g. where branding could give rise to price differences), the 25% threshold is used. The UV method assumes perfect information — since, relative prices reflect relative qualities[3].

Inspite of the debate among theoreticians regarding the usage of IIT indices, a synthesis of determinants of IIT and inter-industry trade has been attained over the years. New trade theory is a theory, which is in search of an appropriate empirical methodology. The contemporary theoretical synthesis is based on the widespread view that monopolistic competition and (internal) increasing returns lead to IIT between similar countries, whereas the old comparative advantage is still be at work for countries separated by a high economic distance, i.e. a large difference in factor endowments, technology levels etc. These studies consider products to be horizontally differentiated: products are available to consumers in different varieties, and international trade, as it increases the size of the market, simply leads to a greater variety of goods and possibly to the achievement of economies of scale. Here, the economic distance increases inter-

[3] Even under imperfect information, prices generally tend to reflect quality – for details see Stiglitz (1987).

industry trade and conversely reduces IIT. But products are not only (horizontally) differentiated by secondary attributes, but also differ by quality and price: this is a case of *vertical* product differentiation. Such a distinction modifies the theoretical framework: using the "integrated equilibrium" approach, the economic distance between countries is no longer the basis for specialization between industries along a comparative advantage scheme only, but also the basis for a 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 — yields the following central result —

Dissimilar countries will engage in IIT in vertically differentiated products whereas similar ones will engage in IIT in horizontally differentiated products. (Note that the results are in line with the results of our models derived in the previous chapters).

Here, the economic distance - here the difference among countries in the allocation of specific resources along the quality spectrum - is compatible with IIT in vertically differentiated products. Contrasting with an increasing complexity of models of trade under imperfect competition, the bulk of empirical work still uses Grubel and Lloyd-type indicators, based on the *degree of overlap* in trade. General shortcomings of such indicators can easily be corrected, e.g. using a strict bilateral basis at the most detailed level of sectoral breakdown, eventually distinguishing between horizontal and vertical differentiation. However some specific shortcomings of indicators remain due to its very construction.

Fontagné and Freudenberg (1997) have proposed a new methodology for measuring trade in differentiated products by breaking down total trade into three trade types:

i. two-way trade in similar products,

ii. two-way trade in vertically differentiated products,

iii. or one-way trade.

Both exports and imports being part of the same type, a single explanation is associated to each flow registered, offering a guaranty of coherence between theoretical insights and empirical measurement.

Whatever the methodology implemented is, a distinction between horizontal and vertical differentiation of products traded has to be made, since determinants of both types of IIT are controversial: a monopolistic competition framework based on a two stage budgeting (quality/variety) yields a negative relationship between the economic distance, proxied by the concentration of resources, of two countries and the share of overlap in trade of similar qualities. Traditional measures and this approach are supplementary rather than substitutes, since each one tries to answer a specific question. Grubel and Lloyd related indicators yield information on the *intensity of overlap* in trade, whereas the approach proposed by Fontagné and Freudenberg measures the *relative importance of each of the three trade types in all trade.*

Fontagné and Freudenberg (1997) used a data set embodying data flows of 11 European countries facing 10 partners for around 10,000 products. This methodology points out that the recent increase in IIT in Europe is entirely due to a trade in vertically differentiated products. To better apprehend the countries' specialisation along the quality ranges, it is assumed that differences in prices reflect quality differences. Thus, flows for the same product with a given trade partner can exist in three different price/quality ranges: up-, middle- or down-market, depending on the difference to the European average price. The specialisation of each country is then characterised. Finally trade types and price/quality ranges are two distinct and strictly independent notions, despite their common use of unit values.

For our purpose we briefly look at two typical case studies, which are of theoretical interest — trade between advanced capitalist countries (North-North type) and trade between the developed and the developing (North-South type). Finally, we consider India's IIT.

I. Case study — North-North trade:

The measurements of global IIT indices reported in the study of Grubel and Lloyd for ten OECD countries (the sample of countries used by Grubel and Lloyd was Australia, Belgium, Canada, France, Germany, Italy, Japan, Netherlands, United Kingdom and United States) proved that the share of IIT flows as a percentage of total trade rose steadily from 36% in 1959 to 47% by 1967. Later studies done by Globerman and Dean (1990) (using the same sample of Grubel and Lloyd study), found that the average of IIT indices for manufactured goods was 61% in 1970. Similarly, Stone and Lee (1995) showed a mean for 1970 of 59%. Balassa also predicted that the IIT would increase as with trade liberalization.

Case study — North-South trade:

The study by Clark and Stanley (1999) employed variables suggested by models of North-South trade to identify country and industry-level determinants of the extent of IIT between the U.S. and developing countries. Their main findings are reported below:

- IIT declines with greater differences in relative factor endowments (proxied by differences in per capita GDP) between the North and South.
- Size of the trading partner influences IIT in a positive way (findings are consistent with predictions of Helpman and Krugman's (1985) theoretical model).
- Economic distance influences IIT in a negative way.
- Trade orientation of the developing country exerts a positive effect on IIT.
- Theoretical models of North-South trade have viewed IIT as a consequence of vertical product differentiation based on quality differences rather than as a result of scale economies or horizontal product differentiation. There exists a positive relationship between IIT and advertising intensity, thus lending support to the role of vertical product differentiation (Type II models as discussed in chapter 2). Scale economies have no role in determining the extent of IIT[4].
- Factor intensity of an industry influenced the range of qualities produced. The scope for vertical product differentiation is found to be greater when goods are produced with labour-intensive production techniques.
- There exists a negative relationship between North-South IIT and the industry capital-labour ratio. The North exports the high quality capital-intensive products to the South in exchange for lower quality labor intensive products falling under the same industry classification.

[4] A possible explanation for this phenomenon could be due to the fact that low-technology products assembled in developing countries are not easily produced using large scale automated manufacturing processes.

- Offshore assembly provision use (which Clark and Stanley use as proxy for the globally integrated nature of an industry), is found to exert a positive influence on the extent of IIT, thus lending support to the role of vertical product differentiation in determining North-South IIT.
  - U.S. industries engaged in production sharing operations were found to export high and intermediate technology products and components and import labour-intensive lower-technology varieties within those groups. A considerable share of trade in manufactured goods between the U.S. and developing countries consists of IIT.
- Clark and Stanley predict that as trade liberalization continues the share of IIT in total trade can be expected to grow. IIT will be greater as countries become more similar both in relative factor endowments and economic size. More IIT will occur in vertically differentiated, nonstandard, made-to-order products produced by large, globally integrated industries.

III. Case study of India[5]:

Traditionally India has had a large volume of trade with developed countries. Even after opening up it's economy, in the decade of the nineties, India's trade continues to be largely of the interindustry type. India's IIT is largely due to it's primary goods, unlike the advanced nations where trade in manufacturing is more important. India's imports consisted of certain finished products, while it exported primary and intermediate products. The proportion of export in final commodities has been rising in the last decade. India's IIT can be explained by the H-O-S framework, since India imports

[5] For a detailed study of India's IIT experience (pre-reform and post-reform) see Chakraborty, (unpublished M.phil dissertation, "India's Intra-Industry Trade: An analysis of the pre-reform and post-reform trends", Jawaharlal Nehru University, International Trade and Development Division, 2002).

technologically superior products from the developed nations and exports the domestic variety to less developed ones. This happens because of quality considerations (developed nations generally have better quality products) arising out of technological gaps (where, the South typically trails the North). The main export items for India are primary commodities like textile products (section[6] XI), gems and jewelry (section XIV), chemical products (section VI), vegetable products (section II). All these primary commodities employ labour-intensive light manufacturing production processes.

If we look at the import shares we find that petroleum, machinery, gems and jewelry make up for the highest shares. The reasons for India's overall and bilateral IIT with various partners being low are not difficult to find. At the policy level, India is in the last stages of phasing out — thus it exports but does not import similar goods. For example, if we consider the case of Indian textiles, which fall under WTO's Multi Fibre Agreement (MFA), we find that India (being a developing nation) has import restrictions on textiles till 2005. India engages in a large volume of multilateral IIT rather than bilateral IIT, which makes it more difficult to measure. As Chakraborty (2002) has shown India's IIT is largely in vertically differentiated products. Chakraborty (ibid.) shows using the unit price method that the unit price of imports is significantly higher than those of export items in almost all cases. Finally, Chakraborty's results point out to the fact that trade liberalization has not resulted in a substantial increase in IIT[7].

The results clearly support the theoretical models of new trade theory. However, there is still a large gap between theoretical models and it's empirical testing. This gap is

[6] Section here refers to HS code.
[7] this result is contradictory to Balassa's prediction regarding trade liberalization and increased IIT.

especially true in the case of developing countries, where the lack of a concrete theoretical structure coupled by lack of data aggravates the problem further.

Conclusion

In the previous chapters we have dealt at length, various issues ranging from methodological approaches, which have established new trade theory as a more realistic approach to trade. Apart from this, we discussed in brief the empirical dimensions of new trade theory — which also lends support to the results of the theoretical models. What can be the possible policies, which can be derived from new trade theory? Traditional neoclassical theory would of course pitch in for a world where 'free-trade' would lead countries to paradise! New trade theory however, does not lend itself to such sweeping policy prescriptions. The policy measures available would of course depend on the nature of market imperfections present in those countries. Here, we would try and outline some of the possible policy prescriptions, which a government (which are members of WTO) can undertake. These can be at two levels — country level (i.e. trade promotion policies, protection policies etc.) and industry level (i.e. preveting discriminatory practices of firms etc.)

Policy Prescriptions:

Country level policy →

What theory and evidence clearly highlight is that dissimilar countries trade in vertically differentiated products while similar ones trade in horizontally differentiated products. All labour surplus economies should concentrate on exporting lower quality products using labour-intensive production facilities to capital abundant countries and import higher quality products (which, generally use capital-intensive production processes). The Indian case would call for a policy to facilitate export growth in labour-intensive light manufacturing items. Also, being lower down in the quality ladder makes India vulnerable to possibilities of dumping by other nations selling lower quality products.

Industry level policy →

Consumer welfare and the role of anti-trust policy:

The welfare enhancing potential of free trade in traditional trade models bear testimony to the fact that consumer welfare has been an object of overriding 'concern' for the neoclassical trade theorists. Consumer welfare in the neoclassical models (based on the theory of general equilibrium and the assumption of perfect competition) is derived from the theorems of welfare maximization, which results in price being equal to marginal cost. Typically, social welfare is taken to be the sum of consumers' surplus and producers' surplus, i.e. $W = S + \Pi$, where S is consumer surplus and Π is profits[1]. It is, in fact, unconstrained social welfare maximization, which, results in the equalization of price and marginal cost. This in turn can imply any one of the following:

i. zero profits when marginal costs are constant.
ii. negative profits when marginal costs are decreasing.
iii. positive profits when marginal costs are increasing.

The ultimate objective of anti-trust policy is to prevent monopolization by firms, thereby improving consumer welfare. However, increasing consumers' welfare would mean eroding producers' profit margins. In the light of trade models under imperfect competition it is interesting to analyse the role of anti-trust policy.

[1] In general, the maximum of a sum of functions is not the sum of their maxima — which is the case in the neoclassical trade models. Thus, maximum social welfare, as defined, is not the sum of the highest possible consumer surplus and the highest possible profits.

Any anti-trust authority has to identify[2] and prosecute cases of alleged collusion or predation among firms and impose penalties. Thus the anti-trust authorities would have to maximize W, the social welfare function. The strategies available to the anti-trust authorities are:

- induce firms to adopt Bertrand strategies (price undercutting would result in price equal to marginal cost). However, Phillips (1993) and d'Aspremont and Motta (1994) recommend that anti-trust authorities should leave aside firms using quantity strategies even though Cournot equilibrium price is above marginal cost. The reason being that the generalized product differentiation model derived by d'Aspremont and Motta (ibid.) point out to the fact that Cournot competition (rather than Bertrand competition) allows a larger number of firms to operate in the industry.
- price wars among firms, should in general, be ignored by anti-trust authorities as rational firms would not pull prices below marginal costs. Also price wars would erode profit margins of existing firms.
- all kinds of pricing schemes, i.e. parallel pricing, best-price clauses and all spatial pricing schemes (apart from f.o.b. mill pricing) should be disallowed — since all these lead to price discrimination.

[2] see Baker and Bresnahan (1992) and Bresnahan (1989) for the standard empirical methods of identifying and measuring possible cases. The former uses game theory, while the latter uses the theoretical concept of general eqilibrium (i.e. deviation of price from marginal cost) to detect possible cases of collusion. Bresnahan's technique of defining market refer to substitute goods, but not with reference to strategic complementarity or substitutability between rivals. We can deal with strategic complementarity / substitutability using the theory of supermodular games.

Thus, the role of anti-trust authorities assumes greater importance once we accept that a large volume of trade occurs due to the strategic multimarket oligopolistic interaction among firms selling differentiated products.

Shortcomings of New trade theory:

Even though new trade theory has succeeded in modelling international trade under imperfect competition, there are certain issues on which it has been strangely silent — especially when it comes to policy prescriptions. New trade theory establishes that imperfections form the base on which the narrative of trade is constructed — imperfections, which would typically call for an interventionist trade policy. These imperfections can be distributional or informational in nature. Proponents of free trade (specially under the WTO regime) argue that such imperfections, especially the informational asymmetries, would be too costly for the government to handle. But such a situation (i.e. government possesses less information than the private players) is akin to the classic principal-agent problem, where, there exists a trade off between lesser information and the players' motives. Brianard and Martimort (1997) have shown that to reach the informationally constrained social optimum a complicated menu of contracts (that combine per unit subsidies and lump sum transfers) needs to be devised[3] — which, in other words, requires an interventionist trade policy.

Apart from this the empirical studies have lagged behind the theoretical developments — empirical studies like that of Bresnahan (1989) have their intrinsic problems (refer footnote 8 of this chapter). When product differentiation is the major source of market power, Berry (1994) and Berry, Levinsohn and Pakes (1995) have measured the degree of product differentiation under the assumption of Bertrand (one-

[3] see Brainard and Martimort (1997).

shot) multiproduct competition using discrete choice theory, advanced econometric techniques and the static pricing assumption. This measurement is of relevance to the world of trade in differentiated products that we've studied.

Problems of modeling imperfect competition in general:

The lack of any unified theoretical approach to imperfect competition makes modeling all the more difficult. Also the plethora of models, which deal with imperfect competition, may at times bring forth contradictory results. It is, in that sense, easier to model perfect competition as it is a special case of market reality, wherein agents are assumed to possess no market power. All other alternative forms of markets come under the rubric of imperfect competition — that it lacks a general theory should not be surprising. Game theory has emerged as the most reliable of all the different approaches to market imperfections in the last few decades. The problem with game-theoretic models is either the non-existence of equilibria or the existence of multiple equilibria. By way of example, the Hotelling models of spatial competition cannot give a general conclusion regarding the degree of product differentiation. To be more specific, firms in Hotelling's Main Street locate closer to their rivals' (the principle of minimum differentiation) when faced with linear transport costs. When the costs are assumed to be quadratic, the reverse conclusion holds. Game theory uses the concept of mixed strategies to get around the problem of non-existence of pure strategy equilibria. Alternatively, it uses refinement mechanisms to select among multiple equilibria. The shortcoming of these methods is that it becomes difficult to interpret the economic significance of such mechanisms.

Market imperfections can arise both out of demand and supply conditions. Most strategic interaction among firms is a result of the interdependence of demand. The firm can either set prices and hence the quantities demanded or it can change quantity supplied and manipulate prices. On the other hand, technological conditions may give rise to market power — the resulting imperfections are supply-driven. Increasing returns to scale prevent realization of strictly positive profits for each player and hence ensure the existence of few firms. Imperfect competition has not yet been able to provide a clear analysis of price formation (the digression at the end of chapter 2 is an attempt by theorists to provide a plausible explanation based on observable pricing schemes in various industries), although the incorporation of strategic interaction has provided sharper analysis of markets when compared to the assumption of the 'Walrasian auctioneer'. Inspite of it's drawbacks, the theory of imperfect competition has armed economics with more sophisticated tools of analysis thus drawing theorists into a more realistic debate regarding the market; and perhaps, has succeeded in restricting the scope of the unrealistic models of perfect competition to the confines of the classroom.

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