THE ROLE OF SERVICES IN PRODUCTION AND INTERNATIONAL TRADE: A THEORETICAL FRAMEWORK

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The Role of Services in Production and International Trade: A Theoretical Framework

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1. Introduction

International trade in services is currently the subject of intense scrutiny among academics. Whereas most contemporary discussions of services attempt to uncover an all-encompassing definition of tertiary activities, in the present paper we deliberately pass on this issue, asking instead what services do. We share in common with other observers the conviction that it is important to liberalize regulations covering services and international trade, but depart from the dominant focus on establishing the determinants of comparative advantage in services. Instead of trying to ascertain which countries will end up exporting or providing services, we concentrate on the manner in which developments in the service sector have encouraged and promoted the general level of international trade in goods.

In asking what services do, we acknowledge the importance of retail activities in facilitating the absorption of the nation's output by its consumers. Other activities such as those provided by the medical and legal

professions link in a more direct fashion producers and consumers of services. In the present paper we shift attention from these consumption activities to the way in which services are involved in the production process. Two key concepts are introduced: production blocks and service links. The paper discusses how, with growth of a firm's output level, increasing returns and the advantages of specialization of factors within the firm encourage a switch to a production process with fragmented production blocks connected by service links. These links, consisting of bundles of activities requiring coordination, administration, transportation, and financial services, are increasingly demanded when the fragmentation of the production process allows joint use of production blocks located in different regions.

Such fragmentation spills over to international markets. The greater disparity in productivities and factor prices found between countries (as compared to within a country) may encourage, via the Ricardian doctrine of comparative advantage, the use of several international locations for production blocks comprising a given production process. This dispersion is aided and abetted by the possible existence of increasing returns within production blocks.

It seems to us that one of the stylized facts characterizing recent developments in world trade is the fall in relative prices of many services, especially those found in the transportation and communication sectors. This relative price change further encourages the process of fragmentation, whereby increasing use is made of disparate locations in which parts of the production process take place, with more intensive use required of connecting service links. Furthermore, it can be argued that technological advances in the provision of services lower especially the relative costs of international

coordination and communication. As services become cheaper, service links at the international level become more frequently and intensively utilized as integral ingredients in the production process.

Section 2 introduces our framework in the context of an economy trading only final commodities. The use which can be made of international markets earlier in the production process and the importance of recent developments in major service industries is spelled out in more detail in sections 3 and 4. In section 5 we relate our framework to Vernon's concept of the product cycle (1966), the importance of national and international returns to scale analysed in two basic papers by Ethier (1979, 1982), as well as to a recent contribution by Markusen (1986) applying Ethier's model to the issue of trade in services. In our concluding section we discuss a number of policy issues: liberalization under the Uruguay Round, fragmentation and North-South trade, and the role of services in promoting intra-industry trade. Furthermore, we comment upon some characteristics of services which may tempt countries to view this sector as being of strategic importance.

2. Services in the Process of Expansion and Fragmentation

Our framework is best revealed by considering an initial early stage in a production process, in which an integrated activity exists in a single location. Figure 1a depicts this early mode as a single production block. The use of service inputs is not absent at this early stage; they are required to coordinate activities within the production block as well as to connect production and consumption via distribution and marketing operations.

We assume that technology within the production block contains elements of increasing returns to scale. Although such scale economies may take many forms, we shall assume in our diagrammatic exposition that productive activities require fixed, or set-up, costs, and that marginal costs of operation are constant. Thus in Figure 2, line 1 depicts the manner in which total costs expand with scale of output. Vertical intercept Oa represents set-up and other fixed costs associated with the production block while the slope of line 1 shows marginal costs of the production run.

As production expands, alternative techniques embodying a greater division of labor may emerge as superior. Increased specialization of productive tasks and division of labor of the kind envisaged as early as Adam Smith could result in a fragmentation of the production block as illustrated in Figure 1b. We assume that such fragmentation alters the trade-off between fixed and variable costs; lower marginal costs of output are obtained at the expense of a greater total sum of fixed costs in the pair of production blocks. An illustration of the relationship between total costs and output for this fragmented technology is depicted by line 2 in Figure 2.

At this stage a new role emerges for service activities. The two production blocks pictured in Figure 1b need to be co-ordinated and linked by use of service resources. The activites of the two production blocks cannot be combined without cost. Service links are required to join production blocks. These may include transportation costs if the separate physical location of production blocks warrants. At the minimum, there is a need to plan and synchronize the two streams of production with respect to timing, size and quality. These service links represent inputs additional to any service resources required within each production block. The total costs of

production with fragmented technology, represented by line 2 in Figure 2, need to be augmented by the costs of the service link joining the two production blocks (to yield total cost line 2'). In Figure 2 we have illustrated these service costs as being somewhat independent of the scale of output (the vertical intercept is shifted from Ob to Oc and line 2' is parallel to line 2). However, if the costs of the service link are driven up with the level of production, line 2' could be drawn steeper than line 2. Marginal costs inclusive of services are still assumed to be lower than with the more concentrated techniques (1).

The process represented in Figure 2 can be repeated to higher orders (see Figure 3a), creating an increasing number of production blocks and connecting service links. Indeed, the process of industrial development has been historically documented to be one of increasing specialization and division of labor, resulting in a growing degree of fragmentation and an increasing role for producer services. Numerous patterns of interdependence among production blocks and service links can be envisaged. Figure 1c represents a production process whereby each production block utilizes as inputs the outputs of the preceding block. Figure 1d illustrates an alternative grouping: the simultaneous operation of a pair of production blocks, the outputs of each requiring an assembly process at the final stage of fabrication.

This process of development, as illustrated in Figure 3 over several stages of fragmentation, embodies two sources contributing to continously decreasing average costs. For any degree of fragmentation the combination of fixed costs and (fairly) constant marginal costs within production blocks (coupled with a heavy fixed cost component in each service link) ensures that average costs decline with output. This rate of decline is accelerated at every point at which a switch is made to technologies incorporating a higher degree of fragmentation.

Figure 4 illustrates the dependence of marginal cost upon output as production growth encourages a switch to more fragmented technologies. Assuming production remains within the confines of a single firm and that market demand is less than infinitely elastic, the firm would maximize profits by selecting an output level at which marginal revenue equals marginal costs. However, there may be multiple intersections for any given marginal revenue curve. Consider that demand has grown sufficiently to support the MR_1 curve in Figure 4. Point b shows marginal revenue equal to marginal cost, but is a point of local profit minimization - a small contraction or expansion of output would increase profits. The contenders are points a and c. Profits at a are clearly superior to those at c - a movement from a to c involves primarily marginal losses as marginal costs exceed marginal revenue with the lower order of fragmented technology, and fall short of marginal revenue only for the small stretch (from b to c) where the firm adopts the more fragmented technology.

If we envisage a smooth growth of demand, and with it an associated growth in marginal revenue schedules, at the critical MR_2 curve (when shaded area c equals area f) the firm could produce either q_0 or q_1. For a slightly higher level of demand, output level slightly exceeds q_1. The range q_0q_1 is never observed. That is, a smooth growth of demand leads to gradual transitions to more fragmented technologies, but the price drops corresponding to such transitions lead to jumps in output volumes. Such jumps are more noticeable if marginal revenue (and associated demand) are more elastic.

Little has been said so far about the role of firms and the relationship between the number of production blocks and service links and the number of firms. The evolution of the production process, with its increasing

complexity, opens up the possibility of vertical specialization and the appearance of new firms. In the limit every production block and service link might represent a separate firm. The producer of the final good located at the end of a production chain might rely completely on the market to supply necessary intermediate products and services.

The process of spinning off new firms could be re-enforced if various production blocks and service links can be utilized by more than one sector. Telecommunication services, with high fixed costs, provide a good example of an activity which would be too costly to develop by a single firm in a different industry. The firm would rely on the market. It is, on the other hand, possible that the emerging new production blocks and service links will be retained within the firm.

In our view the process of increasing fragmentation and use of service links is consistent either with patterns of development involving a greater scope of activity by a single firm or with heavier reliance upon the market to co-ordinate activities of newly emerging independent firms. For example, Stigler (1961) cites the case of the small-arms industry in Birmingham in 1860. The master gun-maker engaged in market transactions with independent manufacturers, each performing separate, differentiated tasks. An alternative is exemplified by a typical large U.S. corporation, with its own legal department, a fleet of corporate jets, publishing facilities and an internal transportation network. Even such a large corporation, however, is likely to rely on the market for some major inputs such as telecommunications and financial services.

3. International Markets and the Production Process

International markets have not been excluded from the account of the development process described in the preceding section. Heretofore we assumed that goods appearing at the completion of the production process were traded on world markets, but that intermediate products and service inputs were not. The array of goods selected for production at home already reflected positions of comparative advantage and the further bias towards concentration encouraged by increasing returns to scale. As compared with complete autarky, the extent of specialization brought about by allowing free trade in final goods itself promotes welfare gains; the cut-back in the number of different production processes undertaken allows a higher degree of fragmentation in each.

The new possibility for international trade which we now wish to consider involves the role of services in linking production blocks across national boundaries. If the assumed overall position of comparative advantage in a particular good does not imply lower national costs for each production block and service link used, efficient production processes may involve a mixture of domestic and foreign activities.

Figure 5 displays cost comparisons for the same degree of fragmentation - two production blocks connected by a service link. Line H shows fixed and variable costs when both production blocks are located at home, and H' adds in the costs of the required service link. Suppose that in comparing each production block separately, the foreign country would have a lower marginal cost for the second block and the home country for the first. The combination of home first production block and foreign second block is represented by line M, and we assume the same fixed costs are involved as for line H. However, we

also assume that the service costs of linking a domestic and a foreign production block are greater than those required if both blocks are nationally based. (In Figure 5 distance ca exceeds distance ba.) The possibility of service inputs linking internationally dispersed production units lowers the best cost-output line from beH' (i.e. line H') to broken line beM'.

In our framework, production blocks are each located entirely at a single location, but service links may involve inputs from more than one country, or, indeed, inputs from a third country. (Lloyd's of London could provide insurance for shipments of automobile parts from Canada to the United States.) In our illustration (Figure 5), we have assumed that the fixed costs associated with domestic production blocks are equivalent to those found abroad. This assumption was purely arbitrary. If the foreign country possesses a cost advantage in the second production block, it might have been embodied in elements of fixed costs as much as in variable costs. What is less arbitrary is the assumption that the service cost of linking production blocks in more than one country exceed those involved in purely domestic links. However, even in this respect there could be exceptions. In the case of Canada, for example, connecting production blocks in British Columbia and Ontario may involve higher-priced service links, e.g. transportation, than required for British Columbia and the State of Washington.

Further insights into the manner in which international trade involving fragmented production blocks yields extra gains to producers can be obtained by looking at two basic models of trade, viz, Ricardo and Heckscher-Ohlin.

(i) A Ricardian Framework:

In the Ricardian context suppose that initially the home country uses two production blocks with the marginal labor input coefficients in each block

denoted by a_{Li}. (Comparable input coefficients abroad are denoted by a^*_{Li}). Assume that units of output in the two blocks must be matched 1-for-1 to obtain a unit of final output. Further assume that fixed costs within production blocks and between countries are identical. If no trade in producer components were allowed, let us assume that the home country possesses an overall comparative advantage in producing this commodity. Letting $\underline{w}$ and $\underline{w}^*$ represent wage rates in the two countries, such a ranking according to comparative advantage implies that:

$$\frac{a^*_{L1} + a^*_{L2}}{a_{L1} + a_{L2}} > \frac{w}{w^*}.$$

Our assumption of the foreign country's superiority in the second block, and the home country's in the first block, is captured by the Ricardian inequality,

$$\frac{a^*_{L1}}{a_{L1}} > \frac{w}{w^*} > \frac{a^*_{L2}}{a_{L2}}.$$

Allowing the foreign country to take over production of the second block would lower marginal costs and thus allow gains. For such rationalization of

production to be undertaken, the scale of output would have to be sufficiently large that lower variable costs outweigh the extra costs of international service links.

(ii) A Heckscher-Ohlin Model:

Whereas a Ricardian framework allows us to focus on the possibility that the relative efficiency of labor varies among countries and commodities and, further, from one production block to another, a Heckscher-Ohlin framework recognizes the use of many factors in the production process. The factor intensities required in one production block may differ from those in another. (We ignore, here, the further possibility that service links as well require factor proportions which might differ from country to country. Indeed, one possibility is that service links are provided by the lowest-cost source in world markets).

To take a concrete example, suppose that the first of a two-part fragmented technology for producing a certain commodity is more capital-intensive than the second. Factor endowments differ between countries, and suppose the foreign country is relatively so well endowed with labor that even with free trade allowed in parts of the production process factor prices are not equalized. If international service links can be forged, relatively cheap labor abroad and cheap capital at home could establish the basis for an internationally mixed production process. The international market place, with its variety of factor productivities (Ricardo) and factor prices and factor intensities (Heckscher-Ohlin) provides the richer possibilities associated with trade in production blocks according to comparative advantage to add gains to those associated with increasing returns and fragmentation as the scale of output expands.

Whatever the sources of comparative advantage, the possibility that separate production blocks can be dispersed in their geographical location increases the chances for less developed countries to participate to some extent in the industrialization process. In a world in which all production blocks must be located in a single country in an integrated process, less developed regions always have a comparative advantage in some commodities. But these may represent agricultural or raw-material extraction activities in which, we suppose, labor does not possess the opportunity to acquire sets of skills which are associated with certain types of learning-by-doing. The role of services in fostering the fragmentation of the production process over a number of different countries becomes important. Through such fragmentation countries may partake in some part of industrial activity even when a comparative advantage in the integrated process is still out of reach.

4. Price Changes and the Role of Services in Trade

Recent decades have witnessed a technological revolution in service sectors. This would certainly have surprised Adam Smith. The very man who brought us the concept of gains from the division of labor viewed services as being "unproductive of any value". A more muted modern view would still claim that services tend to get left behind in society's steady march on the technological front. The source for such a view stems in large part from

identifying service activities as extremely labor intensive. Furthermore, services tend to be associated with sheltered non-traded sectors.[1]

The type of inputs required for service links in the production process shares few of these characteristics. Foremost among these inputs must be ranked telecommunications and financial services. Rapid technological change has increased the ease and reduced the cost of linking different production blocks. Furthermore, domestic deregulation pursued by governments in countries such as the United States, Canada, and the United Kingdom has accelerated the pace of these cost reductions.

Economies in the cost of providing service links promote the process of fragmentation. Total production costs fall for any given level of output, and a switch to a more diversified production process can be attained at lower levels of output. This is illustrated in Figure 2. Lower service costs shift line 2' downwards, moving switch-point d southwestwards along line 1.

We would argue that the type of technological breakthroughs and innovations that has characterized sectors such as telecommunications, transportation and financial services has had especially pronounced effects in reducing the relative costs of international service links. A bank manager in New York can communicate with an associate in Hong Kong as rapidly and almost as cheaply as he can with a colleague in Chicago. National boundaries scarcely impede transmission of large bodies of data. By utilizing recent innovations such as FAX machines, a fashion designer in Paris can transmit graphic details and instructions to cutting-room floors in Taipei instantly and at a fraction of the costs of international courier service.

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[1]See Balassa (1964) and Bhagwati (1984), as well as the literature on the so-called Scandinavian model of inflation.

Service links have benefitted from learning-by-doing at the international level. Decades of rapid growth of international trade and expansion of foreign investment resulted in an accumulation of a wealth of knowledge about foreign countries, their markets, and their political systems. Business firms are especially concerned with property rights and procedures for contract enforcement available to non-nationals. The legal climate in which international transactions are undertaken now seems less hostile and more predictable.

As a consequence of these developments, the scope for international participation and interpenetration of markets at the production level has been greatly expanded. The reduction in the cost of services generally has fostered increased fragmentation and division of labor in production; the greater relative cost reductions for services linking international operations have had a profound effect in stimulating the use of international markets at every stage of the production process. This, we would claim, is the primary connection between services and international trade. One of the stylized facts of international commerce is the increasingly large share of trade represented by exchanges of producer goods and middle products.

We emphasize that, just as in the domestic sphere, the process of increasing fragmentation and use of international markets does not preclude a variety of organizational structures for firms. Although it may be in the firm's interest to avoid arms-length international transactions in favor of establishing a multi-national presence, our framework encompasses as well inter-connected production processes involving many firms. Certainly many of the service links could be provided by outside suppliers, perhaps some of them multi-nationals in their own right.

5. Comparison with Alternative Models

Currently it is fashionable in discussions of international trade theory to elevate the phenomenon of increasing returns to scale to the level of importance at least equal to that of comparative advantage in explaining sources of gains from trade. We have described a framework which highlights the role of services in encouraging international trade. In this framework the traditional grounds for international trade based on the doctrine of comparative advantage have been supplemented by two ways in which production processes exhibit decreasing costs. Our treatment of increasing returns to scale owes much to Ethier's (1979, 1982) fundamental papers. However, we have pursued a less formal modelling strategy and differ in some respects in the manner in which we interpret the relationship between international trade and increasing returns.

National increasing returns to scale in Ethier's 1982 paper are embodied in cost functions which relate bundles of factors linearly to levels of national output. These functions can be interpreted as combining elements of fixed and variable costs, a procedure we adopted in modelling increasing returns within a production block.[2] Each such process yields as output a "component" which differs from any other "component", albeit produced in an entirely symmetrical fashion. These components, some of which (in a trading context) will be produced abroad, are combined in a production function for "finished manufactures" which allows for increasing returns from the use of a larger array of components. The form of this latter function is similar to

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[2]Earlier use of this simple method of capturing increasing returns to scale can be found in Krugman (1979).

that presented by Dixit and Stiglitz (1977) in a different context - one showing how an individual can benefit from having access to a wider variety of consumer goods.[3] Ethier's production function for finished manufactures expresses what he labels international returns to scale.

There is no analog in Ethier's formulation to the role of services in linking production blocks, with or without international trade. Instead, his components are costlessly assembled. International increasing returns are introduced by allowing trade in components, thereby increasing the variety of components available to any given producer at any output level. By stark contrast, in our framework it is an expansion in the scale of output encouraged by growth in demand (whether domestic or international) which leads to an increased degree of fragmentation in the production process. Such fragmentation, switching production techniques to a greater number of production blocks and connecting service links, corresponds to Ethier's expanding menu of components. The possibility of services linking production blocks between countries introduces gains from trade associated with the doctrine of comparative advantage, a feature absent in Ethier's model.

Markusen (1986) builds directly upon the Ethier framework in his discussion of services and trade. If trade in producer goods is allowed, it must be trade in services, for the "components' in the Ethier model are re-defined as producer services. This interpretation of the role of services differs sharply from ours. In the present paper services may or may not be traded; their main function in trade is in allowing fragmentation over production blocks located both at home and abroad.

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[3]Romer (1987) gives a continuum version of the Dixit-Stiglitz function and applies it to growth in a closed-economy context.

Some of the concepts underlying the "product cycle" introduced by Ray Vernon (1966) are present in our formulation. Early stages in the cycle of development of a product are located in a country having available a host of potentially usable factors and skills, because the techniques required in product development are still uncertain. As this uncertainty gets resolved, and production techniques simplified, the location of production may shift abroad if a foreign source has a comparative advantage with the new, simplified, techniques.[4] Like our treatment, Vernon allows for the international relocation of a production process. Missing, however, is the same use of comparative advantage to argue that part of the production process be located at home and part abroad. Our framework, focussing on the development of separate production blocks connected by service links, opens up a scenario in which the production process can be finely divided into stages. The international location of each block (or stage) is heavily influenced by international comparisons of factor prices and productivities, with the scale of output indicating the extent to which the entire process can be fragmented.

6. Policy Implications

Our framework can shed some light on issues under discussion in the Uruguay Round and in particular on consequences of international trade liberalization in services for North-South trade. One of the fears expressed

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[4] It is perhaps tempting to use the Dixit-Stiglitz formulation to model the advantages which having a wide array of productive factors available conveys when uncertainty exists as to technology.

by developing countries, voiced in particular by India and Brazil, is that free trade in services and freedom of establishment would further marginalize developing countries in international commerce.

Even if one is willing to assume that the most efficient providers of service links are all located in the developed countries, it has to be realized that liberalization of services and a subsequent fragmentation of production could result in a finer international division of labor in which developing countries could actively share. Certain production blocks, especially the ones requiring labor intensive techniques, could be more cheaply produced in LDCs. The gains from liberalization of trade in services could then manifest themselves in a greater participation of developing countries in goods trade. It is therefore important that the participants in the Uruguay Round see gains and losses in the overall context rather than in the context of service sectors alone.

Service link can be important not only in production of traded but also non-traded goods. A better international allocation of factors specialized in production of services, could lead to an improved domestic division of labor. Consumers of non-traded goods would stand to benefit from this process.

Our framework also suggests that the process of development encourages intra-industry trade in goods. At an early stage of development, with no or limited fragmentation of the production process, international commerce is bound to be dominated by trade in final goods. Fragmentation opens new avenues for trade in intermediate products, including mutual interpenetration of similar types of producer goods.

It is also possible to envisage an expansion of trade in final differentiated products. A good example is provided by the computer industry.

Both the United States and Japan produce different types of home computers (IBM, Apple, Toshiba, Canon, to mention just a few) and engage in two-way trade. The computer producers share at least one production block - memory chips. The process of fragmentation and specialization resulted in Japan becoming a global producer of memory chips. it can be argued that, as a result, not only Japanese but also American computer makers were able to reduce production costs and increase their sales of certain types of computers at home and abroad. With strong economies of scale in production of computer chips, lower costs of providing international service links could increase two-way trade in computers between Japan and the United States.

Our previous discussion suggests that in as much as service links are provided for the market and the same links are used in various sectors of the economy, a single and powerful supplier of a particular class of services may emerge. Electricity or telephone services produced under conditions of high fixed costs and constant or declining marginal costs are often cited as examples of natural monopoly. Their strategic importance in the economy is emphasized by their wide scope of application in various industries. It is for this reason that governments may wish to, and often indeed do, regulate service industries.

While it is not the purpose of this paper to dwell upon issues of regulation, we wish to point out that there exists a relationship between market structure, government intervention, and efficiency. This relationship, in itself worthy of study, becomes even more important in our framework, where developments in service industries may encourage, or discourage as the case may be, expansion of international trade.

It is also worth stating that the process of service de-regulation

undertaken unilaterally in a number of countries, as well as international negotiations on liberalization of trade in services, may well result in greater competition, with an attendant lowering of cost of domestic and international services. Thus the process of fragmentation of production, which has been a central concern of our paper, could be further stimulated in years to come. However, for this process to take place would require governments to think in terms of efficiency and disregard strategic and non-economic objectives.

Our discussion of deregulation, market structure and strategic importance of services leads us to the following policy conclusions:

1. Domestic deregulation of services can be pro-trade biased. Changes in relative prices of service links may well result from breaking down national monopolies and replacing them with more competitive market structures.

2. The existence of economies of scale in production of services and the possibility of using a particular service in various industries suggests that policies aimed at reducing in-house provision of services, to be replaced by reliance on large national and international firms, can accelerate the process of fragmentation.

3. Public provision of certain services and pricing policies practiced by governments bring up the question of strategic behavior and temptations to influence comparative advantage. Recent disagreements between the United States and the European Economic Community concerning prices of Boeing planes and Airbuses boil down to the cost of providing financial and research and development costs.

We conclude by emphasizing what we stated at the outset. We are concentrating on one of the things which services <u>do</u> in the production

process: Service links have the function of connecting production blocks in separate locations, perhaps among several countries. But other roles are available for services. Aside from those mentioned earlier, whereby services are utilized within production blocks and aid in marketing the product for consumption, we should note the role of services in research and development. More broadly interpreted, services may be used to explore future possibilities for fragmentation and re-alignments within the production process, in a manner going beyond their operational role in bilaterally linking pairs of production blocks. In all these uses, services are important for the manner in which international commerce is encouraged, whatever their direct status in trade.

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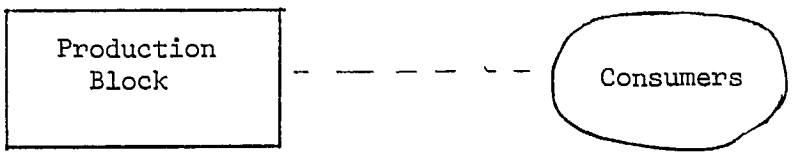

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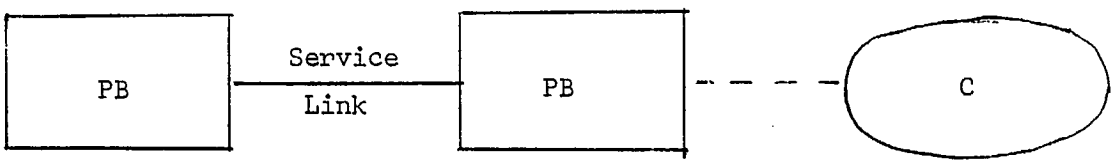

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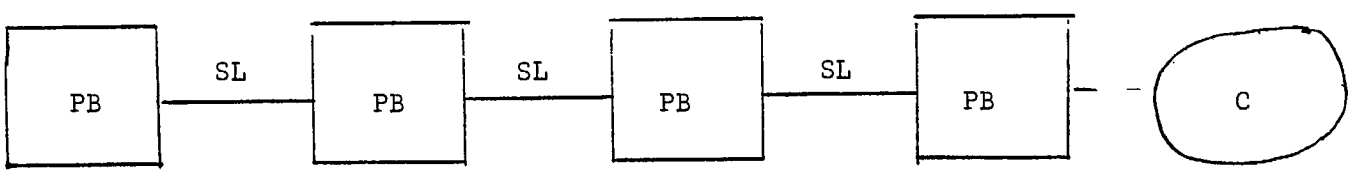

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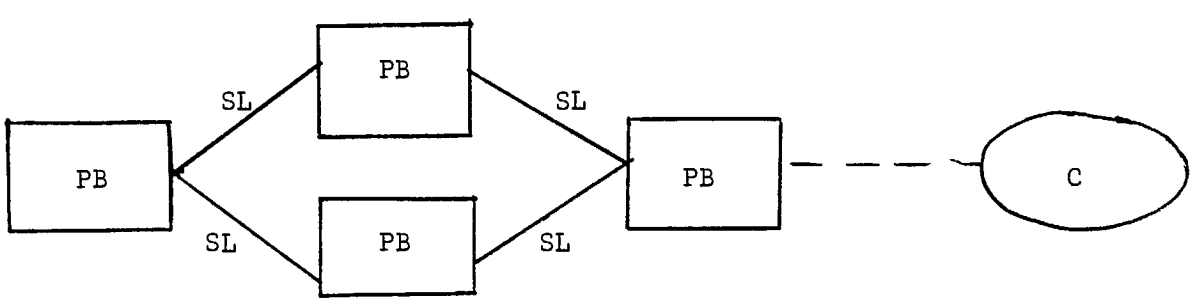

Figure 1

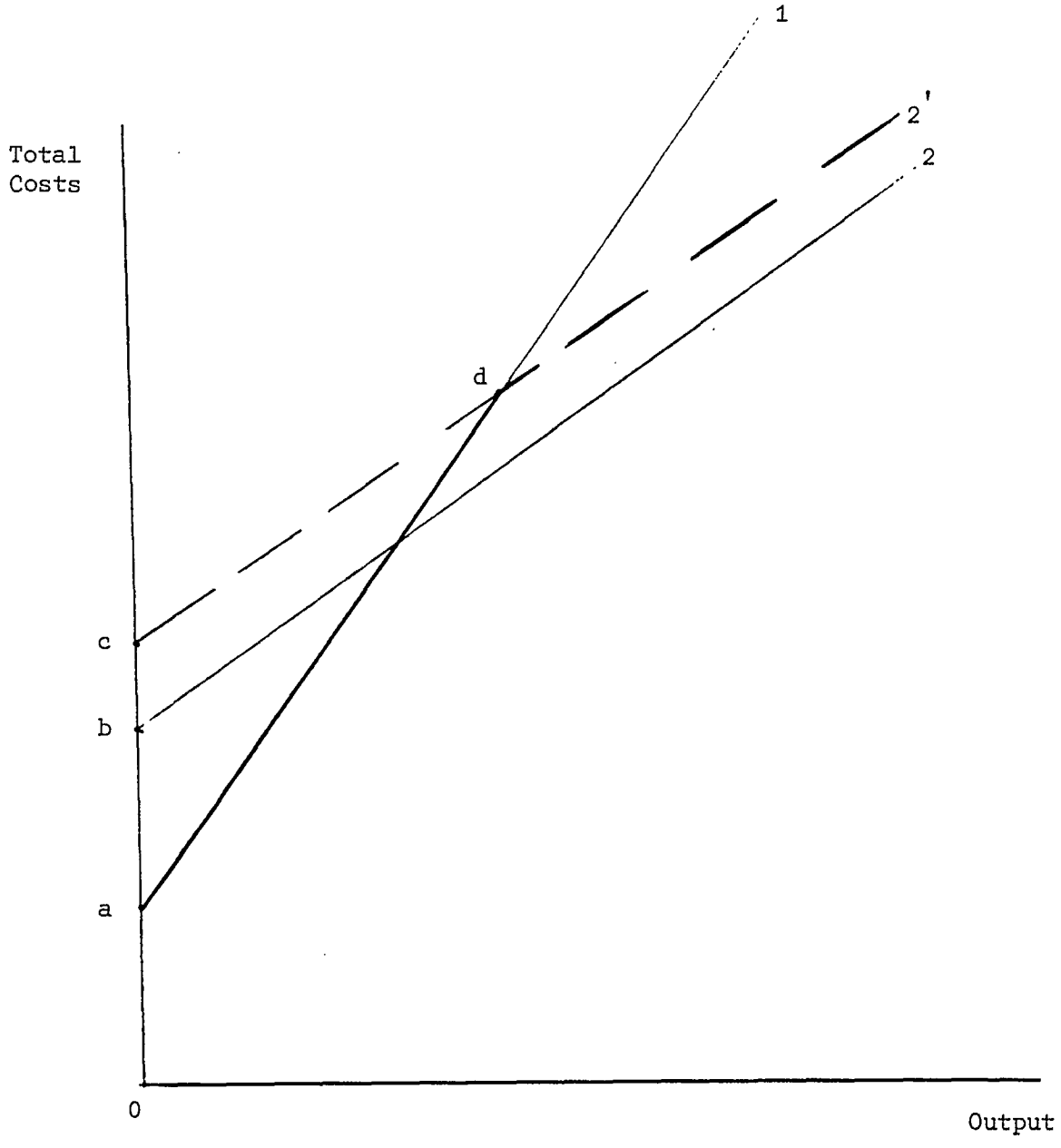

Figure 2

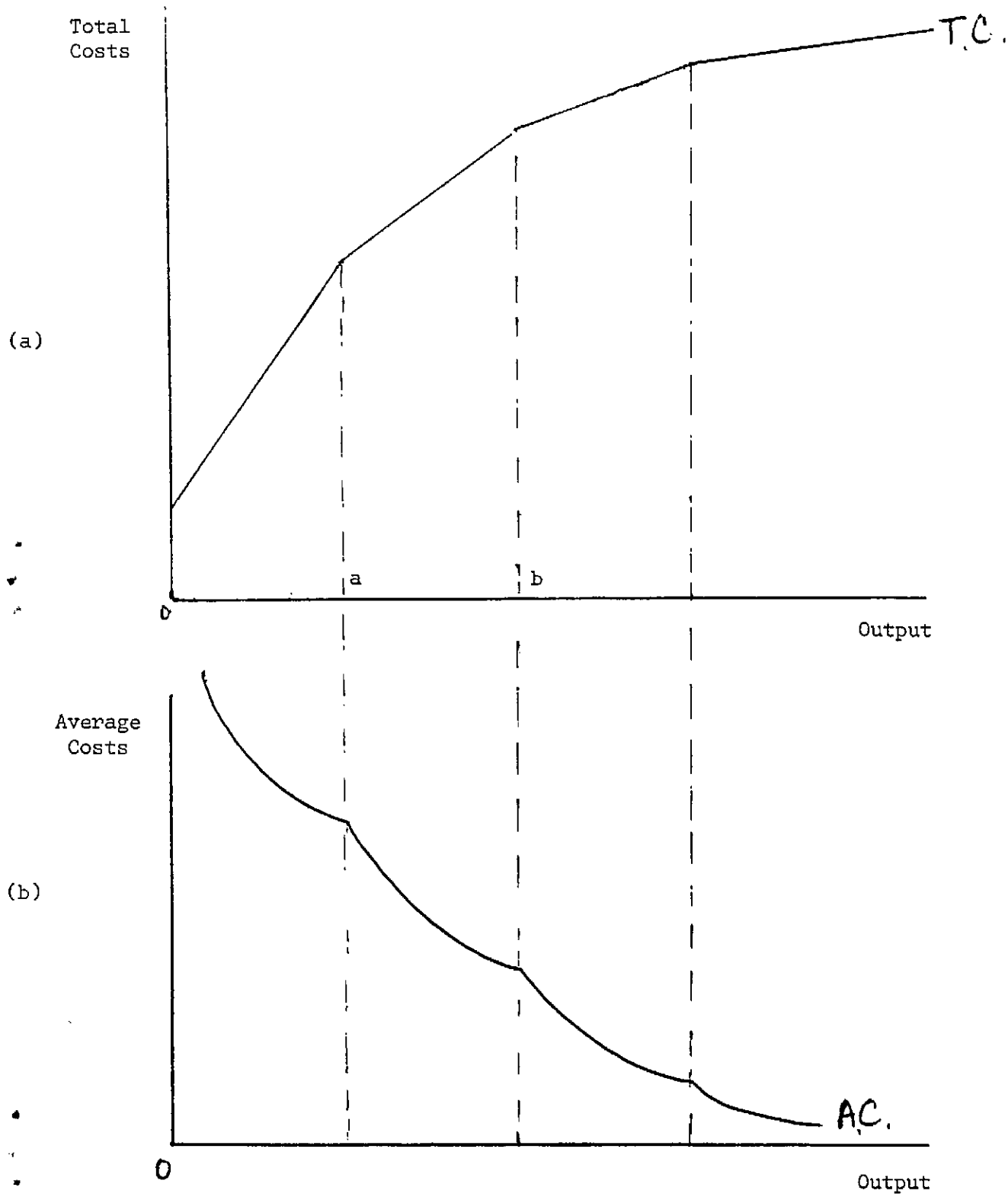

Figure 3

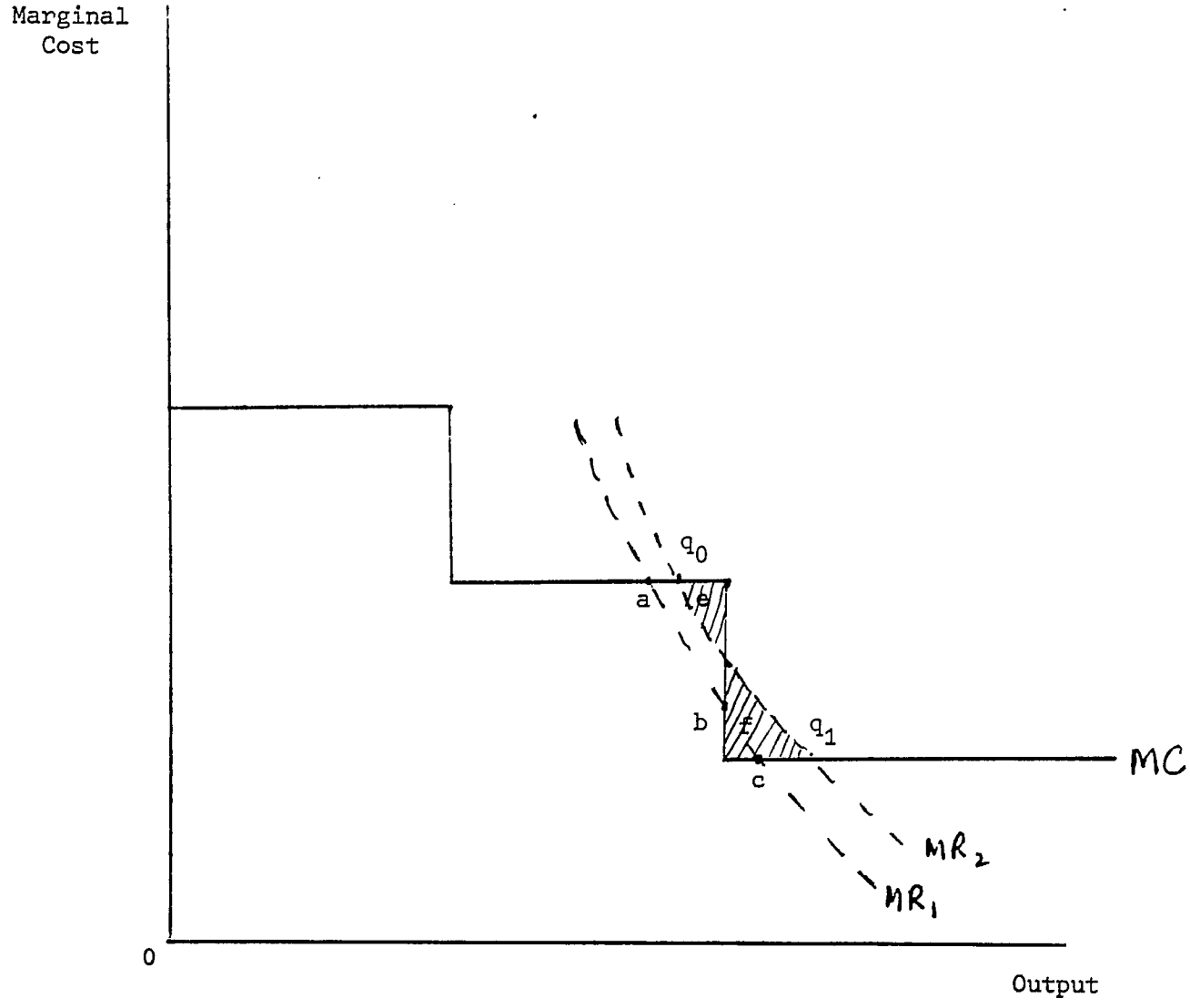

Figure 4

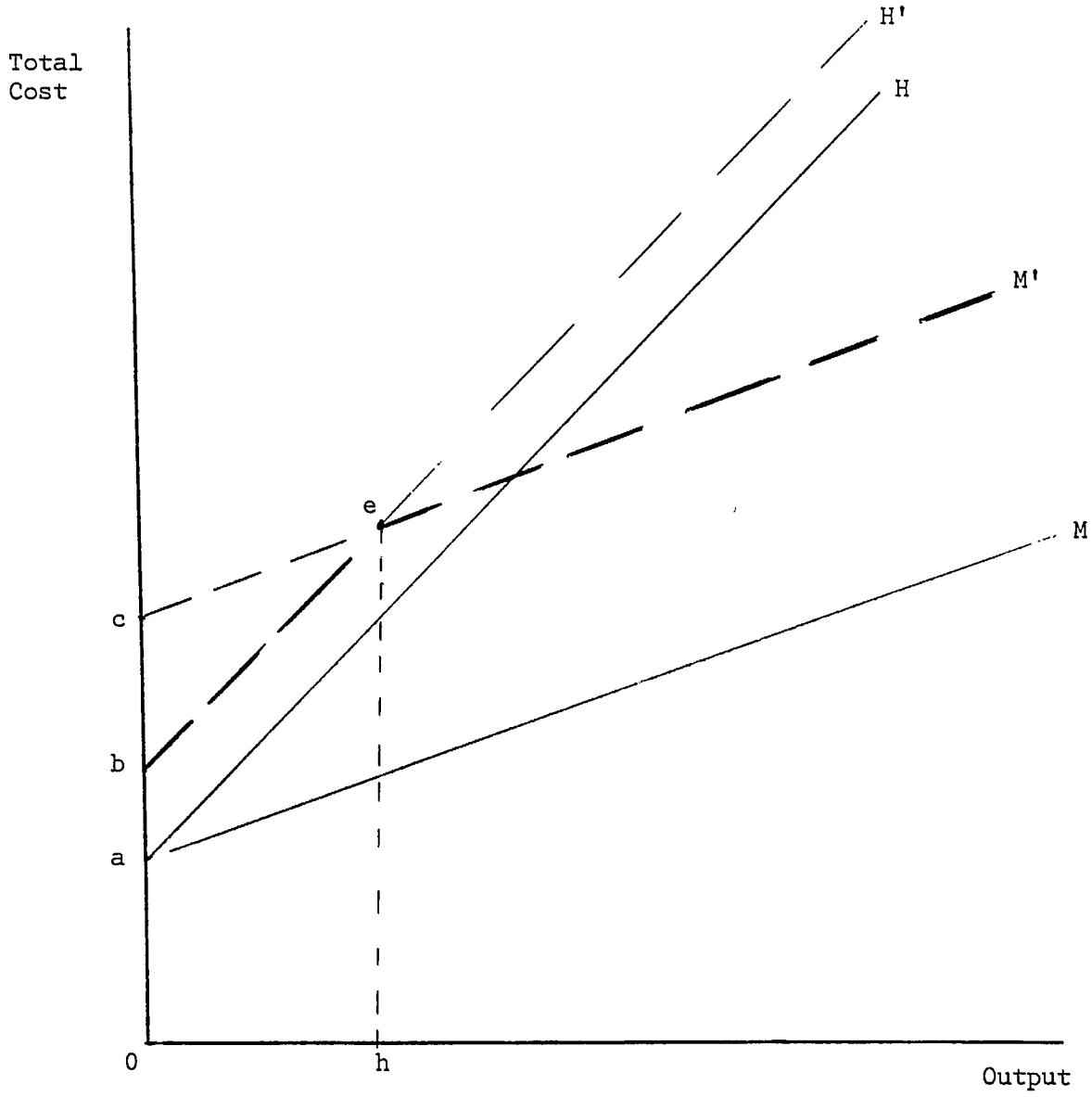

Figure 5

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