

PRODUCT INNOVATION IN SERVICES: A FRAMEWORK FOR

ANALYSIS

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ABSTRACT

Services now play a remarkably prominent role in modern economies. Not surprisingly, economists and marketing researchers have begun to turn their attention to the analysis of activities in the so-called tertiary sector. In this chapter we attempt to contribute to the effort of systematizing the analysis of service institutions by integrating perspectives from the economic analysis of institutions and property rights, on the one hand, and the economic analysis of retailing and distribution services, on the other hand. In so doing, we propose a set of evaluative criteria to be applied to the assessment of the evolution of service institutions, as well as a tableau for analyzing the emergence of various institutional forms. The tableau organizes the three primitive economic activities of production, distribution, and consumption on temporal and spatial dimensions. As such, the tableau applies the notion of relational constraints that have the property of reducing uncertainty and transaction costs, thus being welfare enhancing. The tableau and the evaluative criteria enable us to explore a range of issues, such as joint-ness of production and consumption, divided ownership of property rights, and the effects of technological progress that are inherent in the process of product innovation in services.

[Key words: institutions, transaction costs, property rights, services, relational constraints]

JEL Classification: D23, L8; D00, M31.

“...a relevant analytical process cannot be divorced from purpose and, consequently, is itself a primary notion--that is, a notion that may be clarified by discussion and examples but never reduced to other notions by a formal definition...” N. Georgescu-Roegen, **The Entropy Law and the Economic Process**, 1971, p.213.

I. INTRODUCTION

We are living through a moment in history characterized by rapid technical progress and institutional change on a grand scale. For instance, the term information revolution is applied to the current period and comparisons are usually made with major innovations in history such as the printing press, e.g., Drucker (1998). Major institutional changes in terms of economic and political integration (the European Union) and disintegration (the Soviet Union) have taken place in the last two decades. During the past one hundred years, the transformation of the economic activities defining the American economy has been profound. An important aspect of this transformation has been the increasing importance of services in economic activity. For example, in 1960 personal consumption expenditures on services were 25.8 % of U.S. GDP and by 1999 this percentage had increased to 39.5 %, U. S. Statistical Abstract (2000, Table 715). This pattern is not uniquely American, as it is widely acknowledged that the growth of modern developed economies appears to a large extent to be founded on the expansion of the so-called service or tertiary sector, for example Inman (1986) or Griliches (1992).

While the attention of economists and marketing scientists has been progressively directed to the analysis of research questions germane to this sector, a dominant paradigm or framework has yet to emerge in order to discipline or systematize inquiry, thereby to establish convention. Some contributions exist, however, that point to components of such a framework. Nordhaus (1997) proposes and implements a version of the hedonic method for evaluating the services of light throughout history. Oi (1997) discusses the evaluation of major product innovations such as the air conditioner, but does not commit himself to the use of a particular procedure. Wernerfelt (1994)

proposes an efficiency criterion for evaluating marketing designs that requires taking account of any impacts on the pay-off functions of the agents involved, including agents adjacent to the channel where the design is introduced. The property rights literature, for example Barzel (1997), the transaction costs literature, for example Williamson (1985), and more generally the new institutional economics literature, for example Eggertsson (1990), provide a broad basis for additional components. In this paper we integrate these components in an attempt to move toward a framework for the analysis of service institutions.

From the perspective of a ‘consumer’ⁱ, a service can be viewed as the dual of work that the ‘consumer’ might otherwise conduct. This means that if a *market* service reduces work for the ‘consumer’, then the institution providing the market service is likely to be sustained so long as it is not unprofitable for it to do so. Whether or not the institution is efficient is more difficult to determine.ⁱⁱ If one limits the analysis to the set of alternative institutional arrangements between a provider and a ‘consumer’, then Wernerfelt’s efficiency criterion can be applied. More generally, accounting for the system of economic activities that contribute to the ultimate fulfilment of some consumption aim, this criterion may be difficult to apply in practice.

Viewing a market service-- as distinct from a market good--as a commodity supplied purposively to limit or restrict consumption activities, we direct our attention throughout the paper to the level of the institution, rather than to the level of the product or the firm. We subscribe to the definition that an institution is a set of constraints imposed on human interaction, for example, Nabl and Nugent (1989) or North (1990). Thus, *a service institution is a set of constraints imposed on human interactions for the purpose of reducing work that ‘consumers’ would otherwise conduct.*

Since some industries are characterized as service industries, whereas others are not, it would be useful to provide some guide to their classification for purposes of the analysis of any specialized service institution. In most instances, a producer has the option of providing either a good or a service to a consumer. This is true of personal services, as a barber or a doctor, for example, could choose to sell the *instruments* of haircuts [scissors, razor blades, hair dryers, and hair preparations] and medical care [stethoscopes, tongue depressors, thermometers, and medicine] to their customers rather than the haircut or the medical treatment, respectively. This is also true of capital intensive or

extremely technical contexts. For example, Boeing could decide to operate airports and air transportation services connecting airports rather than to sell airplanes. In all of these cases, what is consumed can ultimately be simplified to some kind of service so that the consumption activity can be relatively clearly identified.

Care must be exercised, however, in determining what constitutes the production activity. Undoubtedly, the determination will depend on the context of the analysis. If Boeing is included in the economic context, then the production activity is bounded by culmination of the creation of an airplane not a flight. If Moe the barber or Dr. Welby, M.D. is included in the analysis, then the relevant production activity is the service rendered in either instance and not the creation of the instruments used in the performance of the service. To be sure, economic agents may participate in both kinds of production activities, to wit, General Motors produces cars to which it transfers title to consumers and General Motors rents or leases cars to consumers who engage in limited consumption activities. Thus, the analysis of service institutions in terms of productive activities will be context-specific and, thereby, difficult to use for classification purposes.

Our analysis of service institutions relies on the concept of property rights: namely, the ability to consume, to earn income from, and to exchange assets. Property rights in an economic sense are conceptually distinct from the legal right of ownership or the legal right to use, both typically enforced through legal contracts. For instance, any service not fully charged for on the margin, such as cool air in an air-conditioned store, is a *residual* that is at least partly relinquished to the public domain. Because measurement and enforcement costs combine to make it difficult to delineate property rights completely, wealth maximizing individuals will devote resources to the capture of such residuals. Recognizing the existence of measurement and enforcement costs, service providers will seek novel formats for maximizing profits that restrict consumers in some respects while allowing consumers opportunities for capture in other respects.

We proceed below, in Section II, by drawing upon the notions of household production, e.g., Becker (1965), distribution services, e.g., Betancourt and Gautschi (1988), and the economic analysis of property rights, e.g., Barzel (1997), to generate a framework for the evaluation of product innovation in services through the introduction or elimination of service institutions. The household

production model provides optimizing mechanics and distribution services provide a link to the analysis of property rights and to the outputs of service institutions. The integration of these concepts leads to a mechanism similar to that proposed by Nordhaus (1997) for evaluating the benefits of a particular service institution. Furthermore, the integration suggests the identification of three primitive economic activities: production, distribution, and consumption.

In Section III we propose a novel tableau, separating these primitive economic activities across space and time, that helps systematize our analysis. Among other things the tableau brings out an ignored characteristic of the constraints defining service institutions: namely, they can enhance welfare by reducing uncertainty. Incidentally this characteristic of constraints is not new in economics, since it also appears in the industrial organization literature on vertical restraints, the game theory literature on commitment and the macro literature on coordination failures. What is different in this context is the pervasiveness with which it applies in the tableau. This pervasiveness is explained in terms of the relational constraints of information theory.

Employing the tableau to investigate the nature of different service institutions impels us to confront a range of issues commonly associated with services and that lend a peculiar status to services as distinct from goods. To wit, in Section IV we demonstrate that the often assumed property of joint-ness of production and consumption in services is not a defining characteristic of services. In Section V, we extend the argument to demonstrate that the principal economic function of some service institutions is to accomplish the separation of primitive economic activities across time or space. In Section VI we explore the role of specialized service institutions in fostering or permitting gains from exchange resulting from the division of ownership rights in market transactions. In Section VII we address the influence of technical progress on institutional change, and we grapple with the issue of determination of competitive boundaries in the context of service institutions. Finally, in Section VIII we conclude by bringing together the arguments of the six substantive sections.

II. DISTRIBUTION SERVICES AND PROPERTY RIGHTS: AN INTEGRATION

Our aim in this section is to integrate important insights of two separate bodies of literature: recent literature on the analysis of retail institutions and another literature on the analysis of property rights. We begin by noting that all organizations are institutions, i.e., they impose constraints on human interactions, but all institutions are not organizations, e.g., zoning laws are retail institutions but they are not retail organizations.ⁱⁱⁱ Since retail institutions are intrinsically service institutions, they provide a useful initial reference for the analysis of other service institutions.

The economic function of a retail organization, in general, is to provide explicit market goods or services to final consumers bundled with a set of distribution services that can be classified into five broad categories: accessibility of location, product assortment [depth and breadth], assurance of product delivery [at the desired time or in the desired form], information, and ambiance.^{iv} These distribution services play a fundamental role in all subsequent discussion. For, they play a dual role in linking retailers and consumers. First they operate as fixed inputs in the consumption or purchase activities of consumers, thus as any retail organization increases the levels of distribution services consumers incur lower [distribution] costs in order to attain given levels of satisfaction.^v Second these distribution services operate as outputs of retail organizations, hence when any retail organization increases the levels of distribution services its total costs must rise (or at least not decrease).

From the point of view of the property rights literature, each of these distribution services can be viewed as representing valued attributes of commodities exchanged. These distribution services lower for sellers or buyers distribution or transaction costs associated with exchange.^{vi} Our analysis proceeds by treating transaction costs as mapping into elements of the set of distribution services mentioned above. While these distribution services were identified in the context of retail institutions, they are associated with any exchange (Betancourt, 1993). One characteristic of these distribution services is that, typically, they are not explicitly priced, and as a consequence can present opportunities for wealth capture by third parties. The integration of the analysis of property rights with the role of distribution services in facilitating exchange will reveal how institutions lower

transaction costs and how shifting of these costs through the provision of different levels of distribution services affect the appropriation of the gains from exchange.

Let us consider the convenience store as a retail organization to illustrate the integration of distribution services and property rights. From the perspective of the literature on distribution services the convenience store provides characteristically: low levels of assortment (i.e. narrow and shallow assortment), high levels of assurance of product delivery at the desired time (24 hours a day, for example), and high levels of accessibility of location. From the perspective of the property rights literature, the narrow and shallow assortment of the convenience store represents a restriction that allows divided ownership enhancing gains from exchange. That is, the limit on assortment enhances the gains from exchange for the store by lowering its costs of remaining open long hours; the limit enhances the gains for consumers by lowering their costs of planning and scheduling their purchase activities for certain types of frequently purchased goods and services. Indeed, it is this means of restricting or dividing ownership of the right of patronage that permits the convenience store to lower transaction costs.

In order to evaluate the welfare effects stemming from the existence of an institution, it would be helpful to have a formalization. One way of analyzing this service institution is to look at the exchange gains resulting from its existence. We cast the formalization first from the perspective of the consumer in terms of the cost difference in attaining a given level of utility assuming the institution exists against its not existing. Relying on a household production framework, this can be measured as an expenditure function differential as follows:

$$E_0 = E(p_I^*, p, D_I, Z_I^0) - E(p_{NI}^*, p, D_{NI}, Z_{NI}^0) \quad (1)$$

where p^* represents a vector of retail prices, p represents a vector of other prices facing the consumer, D represents the levels of distribution services and Z^0 the levels of consumption activities that yield utility.^{vii} $E(\cdot)$ is a classical expenditure function that is nondecreasing, linear homogeneous and concave in all prices and nonincreasing in distribution services.

The first function on the right hand side of (1) represents the costs of attaining a given level of utility conditioned on the existence of the institution (I) and the implied levels of prices, distribution services, and consumption activities. The second function represents the costs of attaining the same

level of utility given that the institution does not exist and that the consumer faces the corresponding implied levels of retail prices and distribution services while being able to adjust consumption activities. For an efficient institution to arise or to persist, E_0 , should be nonpositive since the second function represents optimization subject to an additional constraint (namely, that the institution cannot exist) relative to the first one. In terms of the analysis of dissipation in the property rights literature, E_0 , represents the benefits lost by eliminating the institution while allowing producers and consumers to adjust on remaining margins (p^* , D , and Z^0).^{viii}

It is worth clarifying why the expression in (1) may be positive. The emergence and disappearance of institutions need not involve marginal adjustments around an equilibrium. Their evolution may entail the rise and fall of constraints, and the movement from one equilibrium to another. This means that one cannot rule out the possibility of welfare loss in this evolutionary process even if one expects the normal or typical case to be one of welfare gains. An interesting illustration is the development of hypermarkets outside urban areas in France. They arise in the 1950's as a result of restrictions on store size in urban areas (Loi Royer) and they expand rapidly. With the lifting of some of these size restrictions to spur competition, supermarkets expand more rapidly than hypermarkets in France during the 1980's. Interestingly, legal restrictions on store size are reintroduced in France in 1996. It is unlikely that expansion of hypermarkets was welfare improving, nonpositive according to (1), in each of these three very different sets of circumstances.

On the production side the gains from the existence of the institution can be measured as a profit differential associated with the aggregate profits of all agents consuming resources to permit the ultimate fulfilment of some consumption aim, that is,

$$\pi_0 = [p_I^* X_I - C(v, X_I, D_I)] - [p_{NI}^* X_{NI} - C(v, X_{NI}, D_{NI})] \quad (2)$$

where C is a cost function for the retailer, X is a quantity vector of market goods or services produced or provided and v are the input prices faced by the retailer. All other terms have been defined already.^{ix} For an efficient institution to arise or persist, π_0 should be non-negative since the second function entails optimization subject to an additional constraint (namely, that the institution can not exist) relative to the first one.^x

If one assumes the process of entry and exit to lead to zero profits given that the institution exists or not, then (1) also measures the (negative of the) benefits to society from the existence of the institution. If we allow for nonzero profits, then the benefits to society will be measured by $\pi_0 - E_0$.

The following proposition summarizes the argument.

Proposition 1: The benefits to society from the existence of an institution can be measured as the sum

of the change in costs to consumers and the change in profits to producers which result from its

elimination.

The critical role played by distribution services in the analysis of retail institutions underscores the significance of distribution activities as primitive activities distinct from production and consumption activities. The emphasis in the property rights literature on the gains from exchange, many of which accrue due to restrictions that enhance individual rights by allowing divided ownership, suggests that there may be benefits from the separation of these economic activities. The integration of these two literatures has helped to identify the economic function of a very specific service institution, namely, the convenience store. By separating primitive economic activities of any service institution we would seek to identify additional economic functions. We proceed now to introduce such separation systematically.

III. A TABLEAU OF PRIMITIVE ECONOMIC ACTIVITIES: A GUIDE TO ALTERNATIVE SERVICE INSTITUTIONS

In this section we present a simple tool that will enable us to analyze the nature of alternative service institutions. We endeavor to construct a tableau not so much for classifying service institutions as for analyzing their specific economic functions. Features that are often attributed to services, such as difficulties of storage (Lovelock, 1989), quality

measurement (Holmstrom, 1985), joint-ness (e.g., Bawa and Hale, 1995), and non-standardization (e.g., Zeithaml et al, 1985) may be illustrated in specific cells of the tableau and demonstrated not to hold at all in others. We begin by formally designating the three conceptually distinct activities of production, distribution, and consumption as the *primitive economic activities*.

Distribution encompasses all activities associated with conveying a product to market for ultimate consumption, and in conventional economic analysis such activities are often subsumed under production. As our conceptual framework is grounded on the notion of household production, we acknowledge that all economic agents [producers, distributors, and consumers] have production functions. The boundary between production and distribution, especially, is determined in any context by the consumption aim. That is, the output of a production activity is intended to fulfill a consumption aim; the output of a distribution activity is intended to permit such fulfillment.^{xi}

The conceptual distinction of the primitives and the ordered connections between them imply the imposition of certain constraints. But these constraints differ from the conventional constraints used in the machinery of economic optimization. It is necessary to emphasize this point because of the ingrained views of constraints in economics, as limiting possibilities on choices, thereby lowering welfare. Indeed, we have applied this convention in the development of our conceptual framework in Section II. That analysis, however, considers two situations under certainty, and the constraint in that section is the elimination of the service institution. In the analysis of restrictions that permit divided ownership in the property rights literature, the imposition of the restriction lowers overall uncertainty and the associated transaction costs.

Constraints that apply in the tableau, permitting us to distinguish one cell from another, are *relational* constraints in the sense of information theory [Shannon (1948); Shannon and Weaver, (1949)]. Such constraints play a dual role [Gatlin (1972)]. These relational constraints, for example, restrict how a commodity can be consumed and, consequently, have the welfare enhancing effect of reducing uncertainty with respect to the feasibility of alternative consumption procedures. With respect to the primitive economic

activities, a relational constraint is limiting by imposing a particular configuration of activity. Nonetheless, within a given cell and conditioned on a specific consumption activity, the constraint allows the emergence of variety and novelty in organizational forms that can serve that activity. Constraints that have this dual role have been characterized as context sensitive constraints that make complexity possible, for example Juarrero (1999, Ch. 9).

In the same vein the limit on assortment that allows the convenience store to exist can be thought of as a relational constraint. In fact, the reason the emergence of an institution such as the convenience store is welfare enhancing springs from the defining characteristic of a relational constraint, namely, that it lowers uncertainty. In viewing the convenience store as a service institution that imposes a constraint in the form of a restricted assortment permitting divided ownership of the right of patronage, the constraint lowers overall uncertainty and such transaction costs as storage and waiting. Thus, Proposition 1 can also be viewed *ex post* as a mechanism for measuring the benefits of imposing a limit on assortments that allows this service institution to emerge relative to a situation where the absence of limits on assortment prevents the service institution from emerging.^{xii}

Our approach raises an aggregation issue, and we acknowledge that assignment of an institution to a cell in the tableau would be sensitive to the unit of analysis. For example, the institutional structure characterizing the transactions involving a consumer, travel agent, and an airline would depend on whether the relevant economic activity entails production and consumption of a *claim* to a trip or, simply, the production and consumption of a trip. In the former case, we can think of the consumer and distributor of the claim in the same space (the travel agent's office) and of both separate spatially from the producer (airline) while production, distribution and consumption (acquisition) of the claim are joint in time; in the latter case we can think of the distribution services provided by the travel agent in securing the claim to a trip as separate from production and consumption of the trip in space and time.^{xiii} Since such characteristics are sensitive to the purpose of the analysis, the tableau provides a systematic means for conducting the economic analysis. But, as any

given service institution could be assigned to different cells depending on the economic context, the tableau is not intended as a convention for classifying institutions.

In brief, the tableau is constructed on two dimensions: time and space. On each dimension, we identify five different combinations of these three primitive economic activities, depending on whether they are carried out jointly or separately with one another in this dimension. The tableau is, thus, bounded by two cases: joint-ness in time and space of production, distribution, and consumption, at one extreme, and complete separation in time and space of production, distribution, and consumption at the other extreme. All other cases are intermediate cases involving joint-ness or separability to some extent, temporally or spatially. In all, we identify twenty-five distinct configurations of the three primitive economic activities in the context of the tableau. The tableau is presented in Figure 1.

FIGURE 1 ABOUT HERE

In the remaining sections of the paper we address a number of specific issues that acknowledgment of the tableau compels us to identify and resolve. We express the fundamental implications of the tableau of primitive economic activities in the following proposition.

Proposition 2: Assignment of a specialized service institution to a cell in the tableau implies the imposition of a relational constraint on a given consumption activity, at a given level of aggregation, served by a specific configuration of production and distribution activities.

IV. JOINT-NESS

The difficulty in drawing generalizations from the analysis of market services as distinct from market goods has impelled us to adopt the tableau in order to systematize our analysis. In this section we apply the tableau to explore the generality of one purported service characteristic: Namely, a conventional view that joint-ness is characteristic of market

services, as distinguished from market goods, imposes the restriction that production and consumption are non-separable activities. At the extreme this would involve distribution activities, as well. Thus, cell #1 of the tableau is the extreme case of joint-ness in service production. Examples of such extremes abound: a meal consumed at a local restaurant without having reserved a table in advance or attending a live event at a local arena, having paid for admission at the time and site of the event, to name just two. The contextual activities determining the joint-ness are, respectively, consuming a meal out of the home and consuming live entertainment out of the home. The specialized service institutions that produce and distribute their products jointly with consumption in these contexts are the local restaurant and the local arena.

Instances of joint-ness are possible on either the spatial or the temporal dimension at the exclusion of joint-ness on the other, and joint-ness is possible with any pairing of the three primitive activities. Returning to the examples in the preceding paragraph, one could reserve a table in advance of one's arrival at the restaurant, thus separating, in time only, an aspect of distribution from production and consumption of the meal and dining experience that are to be accomplished jointly in time and space [cell #2]. A live prize fight that may be viewed in a specific geographic region only in studios connected to the fight arena by closed circuit TV joins production, consumption, and distribution of the event in time, and joins consumption and distribution in space while keeping production separate in this dimension [cell #16].

Interesting asymmetries among combinations of the three primitive economic activities are possible, as well. Consider the situation of those tourists who ply the streams and slopes of Maine's Baxter State Park, or who ride on the tour buses around Yosemite Valley, or who explore the garden paths and atelier at Monet's Giverny. In each case, significant outputs of the relevant production that now attract the tourists occurred years or even centuries in advance of the tourists' present-day consumption. Moreover, a significant aspect of distribution occurred jointly with production in time: Monet's water lilies still grow in the same manner from the same spot that first inspired him to record his impressions on canvas, some of which still hang in the atelier; El Capitan rises from the floor of Yosemite

Valley where it was first placed eons ago; and the waters of Chimney Pond still bathe the moose in the shadow of Mt. Katahdin as they did even before Percival Baxter gifted the place to the State of Maine. As a consequence of this, tourists are attracted to the precise space where these magnificent outputs were placed or distributed for succeeding generations to consume,^{xiv} [cell#3].

In a sense one could view these natural wonders as durable goods. Such a view would imply that what is consumed is a flow of services, thus joining production and consumption in time and space. Our view is that production--just as distribution-- has many facets, and one important facet is the manufacture or creation of the durable good as a store of services that could flow from it. Here we invoke Georgescu-Roegen's (1971) thesis that reality is a seamless web and, consequently, such analytical categories as the primitive economic activities naturally introduce artificial boundaries.

The service institutions that can be assigned to cell #1 do stand in stark contrast to those that can be assigned to any other cell in the tableau, as all other cells depict situations of some degree of separation of the three primitive economic activities. At the opposite extreme, production, distribution, and consumption can be completely separate in time and space [cell #25], and one need look no further than the quest for a bag of charcoal from the convenience store as one prepares a barbecue at home. In this instance, production is accomplished by a manufacturer remotely located in time and space from the store; distribution is produced by the store; and consumption can only begin to take place upon return home with a bag of charcoal in hand.

These examples are sufficient to establish the following:

Proposition 3: Joint-ness in production, distribution, and consumption is widespread in services markets, but it is neither a necessary nor a sufficient condition to distinguish a service product from any other market product.

V. AN ECONOMIC FUNCTION OF SERVICE INSTITUTIONS

Proposition 3 merely eliminates joint-ness in the primitive activities as a defining characteristic of services. In this section we seek to establish that the removal of joint-ness in the primitive activities is a critical function of many service institutions. We shall attempt to establish this by considering some carefully chosen examples.

Credit cards, such as Visa and MasterCard, present an interesting example of a specialized service institution that serves as a mechanism for separating an aspect of distribution from production and consumption in time and space. A credit card provides a mechanism whereby certain distribution services are explicitly sold to interacting customers. The explicit price the consumer pays for the services of this service institution is a fee for the card; the explicit price the merchant pays for the service institution's services is a percentage of those sales transacted with the card. An important economic function of this service institution is the unbundling of certain distribution services from the explicit goods and services transacted.

From the perspective of the consumer this service institution's economic function is to provide high levels of assurance of product delivery at the desired time in a variety of locations together with information on the availability of this service across space and time. The institution produces these services by evaluating individual consumer's credit worthiness, on the one hand, and by negotiating with merchants to honor the card on the other hand. The institution distributes these services by issuing cards to consumers and signs or decals to merchants. Consumption of these services occurs when the credit card is employed in a transaction. From this vantage point, production, distribution, and consumption of these services are typically separate across space and time [cell #25]. The service institution's economic function from the perspective of the merchant is to provide high levels of assurance of product delivery in the desired form, namely, payment in legal tender and, possibly to a lesser extent, assurance of product delivery at the desired time. Hence from the point of view of the merchant, consumption and distribution of the service occur jointly in time and space [cell #19] when the consumer uses the credit card.^{xv}

As a specialized service institution that separates at least one distribution service from all of the distribution services that are invoked in an economic transaction, the credit card presents a clear illustration of how various kinds of costs may be shifted among the three interacting agents: the consumer, the merchant, and the credit card agency. To enjoy the benefit of greater assurance of product delivery at disparate merchant venues, the consumer willingly incurs the explicit cost of entitlement to the use of the credit card. To produce sufficiently high levels of assurance of product delivery for the subscribers of its services, the credit card agency incurs direct costs of negotiating with many merchants on behalf of subscribing consumers who would desire credit privileges. In doing so the credit card agency enjoys scale and network economies that any individual consumer would be unable to achieve for herself. Similarly, any given merchant who participates in the credit purchase programs of the credit card agency willingly incurs the opportunity cost of a discounted invoice on all credit transactions in order to receive the benefit in the form of high levels of assurance of product delivery. The credit card agency incurs the direct costs of producing this benefit for the participating merchant by handling all billing of subscribing consumers. In doing so, the credit card agency enjoys scale economies that any given merchant would find difficult to realize were he to do this for himself. Such instances of the shifting of costs across the market establishes the grounds for the existence of the service institution as expressed in the expenditure differential of Section II.

Specialized service institutions do not emerge only to accomplish separation of distribution activities from production and consumption activities. For example, the spatial separation of the primitive activities that is characteristic of most of the services produced and consumed in the communications and information services industries are illustrations of the separating of consumption from production. Video-conferencing, a service institution that is gaining prominence in certain settings, has been demonstrated to be a benefit to society in the new area of "telemedicine" by separating activities in space while joining them in time (Gautier, 1995). Such an institution permits physicians located in the emergency room of Massachusetts General Hospital to provide physicians' services to clients entering the aid station at Logan Airport, using the intermediation of para-medics. In this case,

production, distribution, and consumption of the physicians' services take place simultaneously; consumption and distribution occur in the same space, but production is separated from both spatially [cell #16]. It is the separation of primitive economic activities across space that is the main economic function of this specialized service institution. One should note that the technology of video-conferencing does not exclusively enable institutions corresponding to a particular cell. For example, video-conferencing makes possible the production and distribution of a lecture in one locale and its simultaneous transmission to consumers in another locale [cell #11]. Other institutions in the communications domain, such as voice mail and electronic mail, have emerged to allow separation of production from consumption especially in time. In the parlance of property rights, voice and electronic mail services confer on consumers the right to receive [i.e. consume] messages produced and distributed to them by others whenever they want. For instance, use of a voice mail service at the local telephone company, separates production distribution and consumption of phone messages in space while allowing joint-ness in time for production and distribution while keeping consumption separate in time [cell # 23]. If the message is stored in a recorder on the consumer's phone, however, production is separate from distribution and consumption in space, which in turn are joint, while consumption remains separate from production and distribution in time [cell # 18]. Finally, a cell phone allows for space separation and time joint-ness in the production, distribution and consumption of phone messages [cell # 21].

These examples are sufficient to establish the following:

Proposition 4: One of the primary economic functions of service institutions is to separate at least some aspects of production, distribution, and consumption across space and time.

VI. DIVIDED OWNERSHIP AND SERVICE INSTITUTIONS

In his analysis of property rights, Barzel (1997, p.114) reconciles the enhancement of individual wealth with the imposition of restrictions that promote divided ownership of commodities. Such restrictions help delineate rights properly, thus preventing wealth

capture on the part of non-owners of the commodities or of their attributes. These restrictions resulting in divided ownership are relational constraints, as defined in Section III, in that by limiting rights in at least one dimension they lower uncertainty in capturing the full benefits of the exchange in other dimensions.

To illustrate this briefly, we consider again the example of the convenience store. A consumer who is seeking a bag of charcoal for an imminent barbecue dinner could rush to a supermarket. After searching through the extensive assortment, the consumer would then queue at a checkout lane. In the checkout lane, other consumers ahead in line could likely have more items to purchase, more questions requiring immediate answers, and more complex transactions possibly requiring credit approval. In a sense, these consumers, perhaps unwittingly but genuinely, engage in capture of a scarce commodity: the charcoal bag-toting consumer's time. Nevertheless, those consumers who might engage in slow, complex transactions in the supermarket would be unable to exercise such behavior in the convenience store because of the restrictions the convenience store imposes on them. That is, the limited assortment, restricted layout, refusal to honor purchases by check, and so forth all combine to eliminate the opportunities of other consumers to capture the time of the charcoal bag seeking consumer. To put this another way: the restrictions embodied in the convenience store as an institution lower a consumer's uncertainty, below what it would be at the supermarket, with respect to owning her own time while exercising her right of patronage over a limited assortment.

Borrowing an example from Barzel, commercial use of a refrigerator by a consumer is usually prohibited under the conditions of the manufacturer's warranty. This restriction imposed by the warranty allows the manufacturer to lower the consumer's uncertainty of obtaining the full benefits from use of the refrigerator. As Barzel notes, such restrictions delineating rights also facilitate the emergence of institutions that enhance the gains from exchange, such as second hand markets in the case of refrigerators. Reconciliation of welfare gains and the imposition of restrictions is an intriguing and unconventional proposition in economics, and it naturally raises some questions. How might ownership be divided? Why might divided ownership result in gains from exchange?

Let us consider the example of an automatic teller machine [ATM] network. An economic function of this institution is to provide assurance of product delivery at the desired time, an important aspect of distribution, by separating the acquisition of the means of payment for any relevant economic activity from other aspects of distribution, production, and consumption across space and time. That is, the ATM network divides spatially and temporally for each of its users the right to engage in exchange. Moreover, without ATM networks some exchanges by absent-minded or myopic consumers who neglect to carry sufficient cash would not take place at all. Ownership of the right to use the ATM is also commonly divided among consumers by means of a PIN [personal identification number], limiting the right of access to specific agents.

Any specific consumption context that can be assigned to either row 2 or column 2 of the tableau in Figure 1 can be accomplished using an ATM. In principle we can measure the gains from the spatial separation in cell #6, for example, made possible by the ATM network with the framework of Section II. If one assumes that the ATM market is competitive, then profits are zero and the benefits to society facilitated by this institution conforming to the organization of the primitive activities in this row are measured by the reduction in the costs to the representative consumer of attaining a given level of utility from specific consumption activities *with* the ATM network relative to the situation *without* it. This could be aggregated over the number of ATM users and over the set of specific consumption contexts for which cell # 6 can serve as a description. There are many examples, such as attending plays or films, enjoying restaurant meals, etc.

What makes these gains from exchange both feasible and important is that these networks allow divided ownership of the right to use any ATM on the network for all consumers participating on the network. It is also clear from this discussion that the separation of primitive economic activities in cell # 6 made feasible by the ATM network increases society's welfare in part by increasing the number of transactions that can take place.^{xvi} The ATM example illustrates the dividing of ownership over space of each user's right to use the network, as well as the dividing of ownership across consumers. Moreover, there is also dividing of ownership rights over time in the separation of the right to access

cash at any time from the right of access to other bank services, which are available during office hours.

Consider again the example of voice mail. Its economic function is to provide assurance of product delivery at the desired time. This specialized service institution enhances the gains from exchange by allowing consumers to receive messages whenever they want. These gains can be measured in terms of the reduced costs to the representative consumer of having these services relative to the situation without them, assuming profits to be zero for the sake of simplicity. From society's point of view these benefits can be aggregated over all users of the service. Once again without this service institution some exchanges would not take place, so the number and variety of messages transmitted is enhanced by the existence of voice mail.

What's most interesting in this case, however, is that there are two different institutional arrangements for providing voice mail. From the point of view of the consumption activity this service can be provided through an institutional arrangement where the consumer buys a phone with a tape device to store messages [cell #18] or through another where the consumer buys a service from a digital network [cell #23], which is a service institution supported by a telephone company for its subscribers. This is an interesting example where a service provider competes with a manufacturer in satisfying a consumption aim by shifting the costs of the storage function from the consumer to the distributor.^{xvii} In both cases, however, the producer of the tape and the provider of the storage service have access to the consumer through a third party's willingness to restrict its ownership of access mechanisms to the final customer by sharing either the telephone apparatus or the telephone service.^{xviii} Because divided ownership, if feasible, reduces uncertainty for both parties to an exchange it alleviates the problems of adverse selection (hidden information) and moral hazard (hidden action). Consider the instance of commercial software, such as Lotus 123. From the perspective of the producer, a buyer could use the product in ways that could limit the profit to be gained from its sale. For example, a buyer could embed Lotus 123 into software tools that she produces and sells to another buyer. Unless there were some mechanism for metering the use of the embedded Lotus 123 program, Lotus Development Corporation would not receive any rents from the

exchanges that the software developer would engage in with her clients. Consequently, Lotus Development Corporation licences the use of the Lotus 123 program to each user, and prohibits transfer of the use rights of the program to any other potential user. This means that those users who buy the software developer's tools must have engaged in a transaction to acquire the licence to use Lotus 123. This restriction has value to Lotus as it reduces moral hazard, and it has value--although not necessarily the same--to all users.^{xix}

In transferring the right to use Lotus 123 to an individual user, Lotus Development Corporation also imposes another set of restrictions that reduce another aspect of uncertainty from the perspective of the user. Software markets are widely known to be subject to inexorable technical improvement, as new versions or upgrades of existing software packages are announced frequently. The consumer, recognizing that this is the case, may have difficulty knowing when it is best to enter the market. Software producers such as Lotus Development Corporation, can warrant to the adopters of their software that upgrades will be sold to them at discounted prices whenever they are made available to the market. In so doing, the software producer is alleviating an adverse selection problem for the buyer by giving existing consumers privileged access to the rights to use improved forms of the product that will be probably available at some future point in time. Those who have purchased earlier versions of the software, therefore, must be able to distinguish themselves from first-time adopters. They are able to do so, by displaying to the software retailer the registration number of their initial licence. Hence, in the case of software, ownership is divided in rather complex ways across users and across time. In both instances the restrictions dividing ownership (limitations on resale and commitments to discount) enhance the gains from exchange by reducing uncertainty.

These illustrations demonstrate that the phenomenon of increases in individual wealth through restrictions that enhance divided ownership is much more extensive than Barzel may have argued originally. Thus, we have:

Proposition 5: Service institutions enhance the gains from exchange by reducing uncertainty through the promotion of divided ownership by economic agents over assets and services (especially distribution services) across space and time.

VII. TECHNOLOGY, COMPETITIVE BOUNDARIES AND SERVICE INSTITUTIONS

In this section we consider the influence that technology may have on service institutions, and are especially concerned with the issue of how technological progress may induce change in service institutions as economic agents engage in various marginal adjustments in response to a modified technological environment. We adopt an expansive view of technology as a combination of methods, procedures, instruments, knowledge, and skills that may be exploited to accomplish some productive aim.^{xx} At any transaction point, technologies, so defined, exist on both sides of the market and condition the nature of exchange. What is valued by one party to an exchange may depend on that which that party would find difficult to accomplish for himself or herself; hence technological progress for that party may alter the nature of ensuing exchanges.

In section V we argued that an economic function of some service institutions is to separate aspects of primitive economic activities across space and time. This ability to separate activities that previously could not be separated illustrates an important role of technology in product innovation in services: it provides feasibility. Indeed, this role of technology is a well established one and is not limited to modern services. A clear example of its foundation pertains to strategies and conventions of human subsistence.

In agrarian societies that are subject to severe winters, the consumption of specific kinds of fresh fruits and vegetables is likely to take place only during the growing seasons that are of limited duration. Thus, in the summer, a household may consume exceptionally high quantities of strawberries, tomatoes, leafy lettuce, corn, peaches, and so forth. As autumn unfolds, the household's consumption switches to apples, squash, beans, and potatoes. In the depths of winter and in the early spring, the household may consume fruits and vegetables only if it has applied a storage technology of one kind or another that involves altering the chemistry of the food: canning. In any event, in the most primitive

societies, production, distribution, and consumption of foodstuffs are joint in time and space. The application of storage technology based on some preservation method permits production to be separated from consumption in time.

The invention of modern refrigeration methods presents an instance of technological progress that has complex consequences on the evolution of service institutions. A great variety of foodstuffs may be frozen without appreciable deterioration or alteration of the chemical properties of the fresh version. Of course there are exceptions, for example bananas and lettuce. This means that a supplier with access to refrigerated storage technology could bring to market "fresh" oranges or corn in the middle of the summer and in the middle of the winter. The benefit to the consumer is that the variety of meals is enhanced at any point in the year.

Incremental technological advances such as the acquisition of food preservation methods first open new cells of the tableau for organizing the primitive activities temporally. For instance, cells 3 and 5 of row #1 of the tableau represent possible alternative institutional configurations exploiting the advances presented by food preservation technologies that can serve the basic consumption activity of subsisting by separating consumption and production in time. Secondly, within any given cell, the attributes that may be valued in exchange may vary. For example, an agent who purchases large lots of fresh produce from farmers in the summer months and freezes the produce, may specialize in providing assurance of product delivery in the desired form (only tomatoes, for example) throughout the year or assortment depth and breadth (ten different varieties of tomatoes, peaches, oranges, etc.) at any point in the year. In either of these cells, however, a food preservation technology such as cold storage may induce variety in the satisfaction of the basic consumption activity of subsisting.

It is interesting to note that prior to refrigeration, the technology applied to extend the nutritional life of a perishable food involved processing it in some way to preserve at least some of its nutritional qualities over time. Milk was processed to make cheese and yoghurt; fish and meats were cured; fruits and vegetables were canned. These food preservation technologies effectively added a step to the production activity that could be construed as a

distribution service (assurance of product delivery in the desired form). Hence, the technological progress associated with early forms of food preservation constituted an alteration of a service institution, as the relational constraints imposed on the primitive economic activities joined production and distribution in order to unbundle consumption temporally. This technology also abetted the expansion of the agricultural producing unit, enlarging the expanse of the market, permitting realization of scale economies. Using the framework of section II, not only does the consumer receive a benefit as a result of the existence of an institution of food preservation, the supplier is encouraged to expand to enjoy scale economies that present profit potential in conjunction with the exploitation of the technology.^{xxi}

In the present environment, the year long availability of the kiwi fruit in retail markets as far removed as New Zealand and California has resulted from the entrepreneurial activity of someone who has realized the advantages of combining air transport and refrigeration with two different harvesting seasons.^{xxii} A similar story applies to the world-wide distribution of fresh cut flowers from Holland. Thus, in short, the potential consequences of technological progress are to expand the limits of the market in time and in space. This also means, in terms of the tableau, that technological progress presents the opportunity for new institutional configurations of the primitive economic activities to emerge for highly disaggregated consumption activities as the set of choice alternatives is expanded. In the case of refrigeration alone, a perishable commodity is rendered more durable, enabling the temporal separation of consumption and production. In the case of high speed transportation, it is the *perishability* of a commodity that is preserved or rendered more durable, thus reducing the separation of consumption and production in time. In either case, however, there is technological progress that enlarges the boundaries of the market across space and time.

Technological progress has the potential for redrawing competitive boundaries in a variety of ways, and some of these may be difficult to anticipate. For instance, in bygone times a consumer in Paris may have developed some familiarity and appreciation for the kiwi fruit by consuming concoctions made from kiwi extract that complemented other inputs

of meals. Today, the successors of these former consumers can consume the fresh fruit at almost any time of the year, and use it to substitute for other fresh fruits that its extract may have complemented in previous times. Indeed, progress in transportation technology has brought remarkable changes to the retail markets of grocery products, as the assortment of fresh foods has continuously expanded. Thus with respect to the offerings of some fresh foods, a restaurant in the US can compete with a restaurant in Europe regardless of the continental origins of the fresh food. Of course high speed ground transport modes or air transport modes are not only amenable to the transport of fresh food products.

Progress in air transportation and communications technologies has created ever more complex forms of substitution, exacerbating the problem of defining the boundaries of markets. More than one hundred years ago, as railroads were expanding over the globe, communications in the form of postal service were enhanced as a complementary service of this new transportation service. Letters could contain far more content than a telegram, and as transportation technology continued to improve throughout this century letters could be conveyed to their addressees with progressively less delay. Communications technology has progressed to the point now, however, where more information can be conveyed in real time to an addressee by means of the public switched digital network than in a lengthy document conveyed through the postal service or by some other courier service. In fact, the "Reach out and touch someone" advertising campaign of ATT is an attempt to suggest that the institutions of modern telecommunications can substitute in some instances for the institutions of modern transportation. The recognition of such novel sources of competition has prompted Boeing, for example, to buy full-page advertisements in the *Financial Times* depicting situations that are concluded with the tagline "...sometimes there is no substitute for being there."

Because of the geographic expansion of the market for kiwi fruit afforded by technological progress principally in air transport, and the temporal expansion of the market afforded by refrigeration, the supplier of kiwi fruit to the market is able to divide ownership of the right of market access among more than simply those consumers who reside in close proximity to the points of production. Service institutions made possible by these changes

enhance the welfare of consumers and the profits of suppliers as compared to the condition where these institutions do not exist. These institutions, however, emerge, rise, and decline over decades not years. For instance, the introduction of the kiwifruit at the retail level in California took place in 1961 but the California KiwiFruit Commission was not created until 1980. Similarly, it is well known that the provision of information on new products through advertising, for example, is more extensive than for old products, Brozen (1982, p.173).

Most of the characteristics of technological innovation in other sectors also affect or characterize innovation in the service sector but they may be more difficult to identify in a service context. For instance, creative destruction, the distinction between cost-reducing and product innovation, and interdependence of innovations all arise in the context of service institutions. We conclude by illustrating these features.

In the last fifty years the corner grocery store has effectively disappeared in the United States. Instead, the retail landscape is now well represented by convenience stores, supermarkets and even vending machine operations. There is another process of creative destruction in the US retail landscape, however, that is less well known: conventional supermarkets are in the process of being replaced by formats with broader, and in some cases deeper assortments such as superstores. For instance, between 1990 and 1998 the share of sales of supermarkets made by superstores has gone from 34% to 42% while the share of sales by conventional supermarkets has declined from 35% to 19%.^{xxiii} This process also took place during the 1980's.

One of the best examples of a cost-reducing innovation in services is the introduction of the Universal Product Code, which initially allowed the widespread diffusion of scanners in the US grocery trade, spread to other areas of domestic retailing and is by now adopted far beyond the confines of retailing and the US border. From zero registrations of manufacturers in 1970, the Uniform Code Council acknowledged cumulative registrations of 177,000 manufacturer specific numbers by January of 1997. The number of actual products is unknown but undoubtedly larger, since each manufacturer can assign digits to identify

each product after its registration number.^{xxiv} This innovation is also suggestive of the interdependence of innovations in service institutions, since the rapid expansion of formats with broad and deep assortments in grocery retailing would have been far more costly without the economies at the checkout counter and in inventory management made feasible by the U.P.C. Ironically, service institutions characterized by these newer formats with broader and deeper assortments can and in many cases should be viewed as forms of product innovation in services!

One can also ask if our familiar convenience store is an example of a novel service institution that is a product innovation or a cost reducing innovation in services. The answer may be that it illustrates both features. Its characterization in terms of narrow and shallow assortments, extended hours and convenient location suggests that one should view it as a product innovation. On the other hand, since most convenience stores are operated as business format franchises, elements of cost reducing innovations associated with this institutional form are relevant to the economic feasibility of this service institution.

Finally, we consider vending machine operations. They are a service institution that permits the joining of distribution--and in some cases, even aspects of production--and consumption in space and time. Still, the vending machine offers a more restricted assortment than the convenience store, and partly as a result of this, vending machines can be placed in more accessible locations than convenience stores. Moreover, as in the case of the convenience store, the limit on assortment provided by the vending machine is beneficial only when one can divide the right of patronage over many consumers. The more accessible are vending machines, the more pronounced is the separation between production and distribution at least in terms of keeping the machines stocked.^{xxv} The introduction of frozen products in their assortment provides a simple and clear illustration of technological change in the form of a product innovation by a service institution, perhaps in response to competition from convenience stores.

We summarize the arguments of this section in the following proposition.

Proposition 6: Technological change allows the emergence of service institutions that 1) separate primitive economic activities across space and time 2) provide variety and novelty

in satisfying given consumption aims 3) redraw the competitive boundaries of various markets.

VIII. CONCLUDING REMARKS

Our integration of the property rights literature with the analysis of distribution services-- by treating these services as valued attributes of any exchange-- generates two important results. First, it provides a conceptual framework for evaluating the benefits of service institutions comparable to recently developed approaches for products with new service characteristics. Secondly, it leads to the separation of economic activities into three primitive forms: production, distribution, and consumption. A systematic look at all possible configurations of these three primitive forms across space and time yields two immediate results for the analysis of service institutions. It shows that the existence of these institutions implies the imposition of a relational constraint which reduces uncertainty and the associated transaction costs. Moreover, it also shows that the conceptual framework of Section II continues to be applicable for the evaluation of the benefits to society.

Several additional results derive from looking at service institutions from this perspective. First, it becomes clear that joint-ness is not a defining characteristic of services. Second, it also becomes clear that an important economic function of many service institutions is the separation of these primitive economic activities across space or time. Third, the relational constraints implied by the existence of service institutions enhance the gains from exchange by allowing divided ownership of commodities and distribution services by economic agents across space or time. This result extends the analyses in the property rights literature over a much wider domain, and it should facilitate a more systematic application of this idea. Finally, our analysis provides a somewhat different view of the consequences of technical change with respect to the existence of service

institutions, novel forms of organization by these institutions, and the nature of market boundaries.

The topic under analysis is a vast one, and there are many issues that we have either ignored or treated in an incomplete fashion. Nonetheless, we hope to have moved the development of a framework for the analysis of service institutions sufficiently forward so that a rigorous application of these ideas to more narrowly defined topics is, thereby, feasible.

NOTES

1. That is, an economic agent occupying the demand side of a market. Thus, our 'consumer' can be a business firm or a household.
2. In the case of households, it is possible that the work reduced may have yielded satisfaction. For example, restaurant meals reduce work for the household but may reduce the joy of cooking for some of its members.
3. According to North (1989) organizations are differentiated from other institutions, explicitly or implicitly, by their membership.
4. The concepts and how they map into the distribution costs faced by consumers are discussed in more detail in Betancourt and Gautschi (1986, 1988). Empirical measurements at the industry level are developed in Betancourt and Gautschi (1993) and at the store level in Betancourt and Malanoski (1999). A similar classification is provided by Oi (1992).
5. The implications of this characteristic for demand analysis are explored in Betancourt and Gautschi (1990, 1992).
6. For instance, Barzel (1982) defines measurement cost as mapping directly into the costs of providing product information and analyzes its implications. We are merely saying that similar mappings exist for other transaction costs and distribution services. For example, the use of warranties to provide quality assurance is a means of lowering transaction costs due to potential enforcement problems by increasing the distribution service assurance of product delivery in the desired form.

7. This formulation is analogous to the one proposed by Nordhaus (1997) for evaluating a new product with new service characteristics. The narrower one he uses in the case of light is appropriate for evaluating a new product generating existing service characteristics.
8. The adjustment in the vector Z^0 has to be such as to leave the level of utility unchanged.
9. Implicit in our analysis of both consumer and producer benefits is that the first term always pertains to the existence of an institution, even if the institution is infeasible in actual practice, which is what happens in general with market failure.
10. This argument assumes no change in market structure. For instance, if the profits were to arise as a result of a change in market structure from competition to monopoly due to the introduction of the institution, they should be subtracted from, rather than added to, the consumer gains. For an evaluation of welfare gains under imperfect competition in a simpler setting, see Hausmann (1997).
11. One should note that the identification of the three primitive economic activities applies at any level of the marketing system, supply chain or channel configuration.
12. The concepts of vertical restraints in industrial organization, commitment in game theory and coordination mechanisms in macroeconomics generate similar situations. They imply the imposition of constraints, and these constraints enhance welfare by lowering uncertainty and the associated transaction costs.
13. In the tableau, the former case belongs in cell # 16 and the latter case belongs in cell # 7.
14. Because tourists are attracted to the same places in such large numbers, public agencies with the responsibility of preserving the outputs of the production could restrict the spatial joint-ness primarily to production and consumption by limiting the number of tourists who could visit these sites. As such restrictions would likely be implemented at reservation agencies situated closer to the points where tourists reside, a significant aspect of distribution would be separate from production and consumption in space [cell # 8].
15. The discussion reveals one network feature of credit cards as a service institution. Since the services provided are distinct for consumers and merchants, this institution functions as a two-way network in the terminology of Economides (1996). Thus, our analysis is useful in applying his

classification scheme for networks to service institutions. There are other aspects of the network that we ignore here, for example the role of banks in providing short-term credit [Ausubel, 1991].

16. Recently it has been argued that one of the main costs of a lack of impartial third party enforcement is the failure to exist, or operation at very low transaction levels, of markets where transactions are not self-enforcing. Moreover, the deficiencies in these markets have been identified as one of the main reasons for underdevelopment, e.g., Clague, Keefer, Knack and Olson (1999).

17. In practice the institutional arrangement relying on the service provider dominates in office contexts and the one relying on the tape manufacturer dominates in the residential market.

18. This feature also suggests an underlying institutional background in terms of a legal system and contract enforcement mechanisms that can support or retard the development of service institutions which we are not addressing explicitly.

19. If, in the absence of the restriction, the program were not available or were available only at a higher cost, users would be disadvantaged. The benefits of the restriction can be measured with the criterion of Section II. The benefits would differ across users in that those who would want to transfer the program to other potential users would face lower costs without the restriction.

20. This view encompasses the standard economic view of technology, e.g., Salter (1966), as well as the more recent view of technologies as networks, e.g., Scazzieri (1993).

21. The expansion of scale is especially illustrated by the displacement of traditional geographic market boundaries that may have been previously limited by inefficient transportation technologies. For instance during the Renaissance Marco Polo successfully introduced spices from the Orient into the European market, exploiting a combination of improvements in preservation and sea transport technologies. The consequence of this was to extend the limit of the Oriental spice market by spawning an industry, the spice trade, over which wars were fought.

22. For a brief history of the kiwi fruit see the site of the Californian KiwiFruit Commission at <
www.kiwifruit.org>.

23. These figures are calculated from Table 1280 of the US Statistical Abstract (2000).
24. Our discussion of the U.P.C. is based on Brown (1997).
25. There are limits on accessibility, though, as it is not efficient to locate vending machines in consumers' homes.

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FIGURE 1

Tableau of Primitive Economic Activities

Time Space	{P, D, C}	D {P, C}	C {P, D}	P {C, D}	P D C
{P, D, C}	1	2	3	4	5
D {P, C}	6	7	8	9	10
C {P, D}	11	12	13	14	15
P {C, D}	16	17	18	19	20
P D C	21	22	23	24	25

Key: | denotes separation
 {} denotes joint activities
