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Abstract

A service is a value-creating interaction between individuals, each in the role of either a performer or a receiver. A service is represented by a network on the set of individuals. There are many service networks possible, which all belong to the service network possibility set. The service structure consists of this set and a value function on the service networks. Specialization of individuals leads to separating the performer interaction from the receiver interaction in the service structure. The service concept is thus extended to a stratified service with interactive groups on each level, represented by two hierarchical graphs. The main idea behind this paper is that services cannot be rendered unless they are managed. So a governance structure is introduced with agents who obey specific rules of management. There are two types of agents, managers - both for a performers organization and for a receivers organization - and consumers. An equilibrium for an economy with managed stratified services is defined and shown to exist for a market economy with rather strong conditions on both the service structure and the governance structure. It is shown to be a generalization of a neoclassical general equilibrium.

Keywords: Service economy, management of cooperation, general equilibrium, corporate governance, organization theory, and network industries.

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1 Introduction

The service economy as introduced here involves some hard problems. Some are too hard to solve for the moment. A service is rendered between individuals, but economic services are closely tied to and identified by the institutions rendering those services. The term 'institution' has, however, two meanings: (i) that of an entity rendering a service or (ii) a set of institutional arrangements governing a variety of social interactions, which meaning is called here a governance. As Hurwicz (1994, p.11) remarked, "institutional arrangements are what one may call 'categorical', in the sense that they apply to a category of situations and/or agents, rather than to specific cases and places. This amounts to regarding institutional arrangements as particular kinds of game forms, rather than arbitrary ones." The approach introduced here focuses on roles people and institutions play in relation to other people, and on the relational characteristics of services, rather than on the input and output characteristics. This is completely in line with Hurwicz's observation that "as for the property of categoricity, it is characteristic of legal or customary rules that they are formulated for persons in certain roles, say buyer, seller, parent, spouse, etc." (1994, p.11). Following the lead of Williamson (1967) and Keren and Levhari (1979), van den Brink and Ruys (1996) have applied the role approach in a partial equilibrium framework. They achieved determining the (hierarchical) structure of an organization endogenously rather than it being imposed exogenously. Later, they introduced cultural traits in organizations and framed the partial model in a market equilibrium (Ruys e.a., 2000).

Many authors have written about the service economy[1], but the service concept has not been defined formally in a general equilibrium framework This paper introduces such a framework. A service is introduced as a value-generating interaction between agents. A network describes the interactions between the agents. The value-creating properties of this interaction are carried by the relation or by the network of the service. That generalizes the concept of a commodity, where the attractive properties are embodied in an object, represented by a point in the Euclidean space. It follows, however, that the aggregation of services will be much harder to define than the aggregation of commodities. Only similar networks can be added, so networks have to be made similar. That is achieved by the role approach and by distinguishing receivers from performers of a service. An economic service is characterized by the possibility of substitution between services and between individuals. If an individual is involved in a service, he or she is playing an economic role as a performer or as a receiver of that service. Performers are specialized and cooperate, which features are present in the given service network. The service opportunity structure provides a large but manageable variety of service networks. Since there are more service networks possible than can be realized, a selection

[1] Consider, for example, the description given by Giarini and Stahel (1993). They observe that in the Service Economy people are buying functioning systems, not tools or products. Services mean performances, in real periods of time, which means that values must be based on probabilities. They describe the relevance of these notions, but don't present them in a coherent model.

and organization process has to be designed. That is the task of agents and managers, whose behavior is described by the governance structure of the society. Both structures together constitute a *service society.*

The management of a service society is based on the capability of individuals to engage in transactions. The individual becomes an agent. Some agents will become manager of a performers organization, called a provider; some will become manager of a receivers organization, called a procurer. All agents are consumers who demand a managed service and supply their labor service to some organization. An *economic service* is defined as a monetary transaction between two agents concerning a value-generating interaction between receivers and performers of that service. The service society becomes a *service economy.* All agents are maximizing specific behavioral rules, which allows for defining a Nash-equilibrium. The governance aims at coordinating decisions of agents such that expected values are managed and realized. In equilibrium the agents meet again as performer or as receiver. So the equilibrium concept manages the risks due to interdependencies via institutional cooperation. This view is in line with the findings of sociologists like Coleman (1988, 1990) and Granovetter (1985), who maintain a simple behavioral theory of rational choice, and focus attention on the impact of social conditions, such as institutional cooperation or embeddedness of interactions, on individual behavior.

In order to arrive at operational results, rather strong conditions are imposed on the service opportunity structure and the governance structure. One is that the size of an organization can be controlled by a single parameter: the depth or length of an organization. The equilibrium concept will eventually be restricted to a market economy, which governance is well known. This excludes institutions that describe cooperation among receivers, imply social choices or procure public services and therefore require another type of governance.

Organization theory focuses on the interaction between roles that agents play. It comes in several forms. The currently dominating paradigm sees organizational forms as responding to a variety of incentive problems in which agents act strategically, see, e.g., Calvo and Wellisz (1979). An alternative view is to consider the organization as solving an information processing problem, see, e.g., Marschak and Radner (1972), Keren and Levhari (1979), or more recently, Bolton and Dewatripont (1994) and van Zandt (1997). A third view is to consider the organization as solving a coordination problem by assigning tasks to members of the organization, see, e.g., Williamson (1967, 1979), Alchian and Demsetz (1972), and Rosen (1982), or in terms of delegation of authority, see, e.g., Hart and Moore (1999). This paper presents a model of governance along the latter lines. It contributes to the question of boundaries, as Holmstrom (1999) has named it: the boundary between the internal organization of the firm and the operation of markets, which is part of the external organization of the firm. Ichiishi (1993) has explored cooperation in a general equilibtium context. Aoki (2001) identifies an institution as a self-sustaining system of collectively shared beliefs about non-technical, self-enforcing rules of the game that governs the strategic interactions of the agents. His approach applies to some concepts used in this paper. The network approach, as introduced by a.o. Jackson and Wolinsky (1996), is fundamental for the design developed here.

The paper is organized as follows. The next section presents the conceptual framework of the service opportunity structure. The management of services and the equilibrium concept is introduced in Section 3. Section 4 concludes.

2 The service opportunity structure

2.1 The set of possible value-generating networks

A *service* is defined as a value generating interaction between one or more performers and one or more receivers. A set $M = \{1, \ldots, m\}$ of individuals are connected in a reciprocal network relationship, modeled as a nondirected graph. Individuals are the nodes in the graph and links indicate bilateral relationships between individuals. Thus, a *network* z is simply a list of which pairs of agents are linked to each other. Consider a pair of individuals i and j, then $\{i, j\} \in z$ indicates that i and j are linked under the network z. The relation is bilateral and requires consent of both parties. More formally, let z^M denote the set of all subsets of M of size 2. Then $Z = \{z \subset z^M\}$ denotes the set of all possible networks or graphs on M, with z^M being the full or complete network.

Different network configurations lead to different values of overall production or overall utility to a society. These various possible valuations are represented via a *value function* $w : Z \to \mathbb{R}$, with $w(\emptyset) = 0$. Let $\mathcal{W}$ denote the set of all possible value functions. Jackson (2001), from whom this section draws, notes that different networks connecting the same individuals may lead to different values. This makes the value function a much richer object then a characteristic function used in cooperative game theory. A value function keeps track of how total societal welfare varies across different networks. The allocation or distribution of this value among the individuals forming the network will eventually be defined by an *allocation rule,* $d : Z \times \mathcal{W} \to \mathbb{R}^M$, which can be defined for any game $(M, v_{z,w})$ with the characteristic function $v_{z,w}(S) = w(z \mid S)$, for $S \subset M$. This function depends both on the network z and the value function w, where $z \mid S$ means that only those parts of the network z are considered in which the individuals belong to the coalition S. The allocation rule may assign, for example, a Shapley-value with $d(z, w) = \varphi^S(M, v_{z,w})$. The distribution of a value can only take place within a governance framework. That concept is specified below in Section 3.

The triple (M, Z, w) is the primitive of the model and describes the set of possible value-generating networks. So a non-directed network represents here the value-generating interaction between two or more individuals. This interaction between individuals is therefore symmetric and both sides of the relation assign the same value to that interaction. These properties erode when specialization occurs and relations become more anonymous. The step that transforms a service into an economic service is set next.

2.2 Stratification of services by performers and by receivers

The interaction between individuals is the cornerstone of value-generation. Individuals in an economy are building on this cornerstone to increase the value generated by specialization. Three developments in social behavior describe this specialization. Firstly, certain types of interaction are aggregated into a category of interactions that have approximately the same content, which category is called a service or a service sector. One may think of the financial services, care, or agricultural services. Secondly, an individual may adopt one of two roles, the role of performer in some service or the role of receiver of some service. This distinction is comparable to an individual being a producer or a consumer. The set of possible service networks is so rich that any individual in the economy can serve as a performer and as a receiver for any service. Value is always generated between some pair of a performer and a receiver, but the height of value will vary greatly among these pairs, of course. A selection from these networks will eventually be made by means of the rules of management.

So the individuals in the set of possible value-generating networks (M, Z, w) are being identified as a performer of a service and as a receiver of a service. A finite set N of services is given, indexed by $j = 1, \dots, n$. Each individual $i \in M$ may assume the role of performer of a service, denoted by $i \in M_j^P$, and the role of receiver of a service, denoted by $i \in M_j^R$. So a possible network for some service, z_j, is now a subset of $M_j^P \times M_j^R$ instead of the set $M \times M$. If $(f, g) \in z_j$, then $f \in M_j^P$ and $g \in M_j^R$. The set $Z = Z_1 \times Z_2 \times \dots \times Z_n$ is the set of possible service networks. The value function is still defined on Z, with $w(\emptyset) = 0$. Since $z \subset M_j^P \times M_j^R$ is a bipartite graph, only the interaction between one or more performers and one ore more receivers generates value. A bipartite service network is represented in Figure 1.

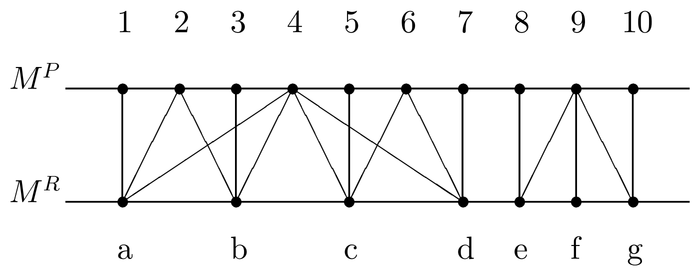

Figure 1: A bipartite service network with 2 connected sub-networks

Thirdly, people specialize again in the performance or in the reception of a service. Consider first the case of performance. A performer may receive support from other performers to render the service more efficiently: the case of vertical interaction between performers. Or performers may cooperate between each other to increase the value generated by the group: the case of horizontal interaction. For example, the interaction between a teacher and her students –the service-relation between a performer and a set of receivers– is part of a service-network rendered by a team of school teachers, which team is in turn assisted by a school organization. This last service-network is part again of the whole service-network that is called the 'education-service'. So a hierarchy emerges in the set of roles of a service network, which can be described by a directed graph. Some roles are reserved for performers who directly interact with receivers: those are the *front roles* of a service-network. Consider the smallest set of horizontally interacting front roles. Some performer is coordinating these front-performers on a vertically higher level, and so on. These covering or succeeding performers have indirect performers roles. So the roles in a performers' service-network are vertically composed of various layers or *strata* from the front roles up, each of which is specialized in rendering a more abstract part of the composite service. Each stratum is horizontally partitioned in groups of interacting performers. A performer on a higher level of the service network coordinates each such group.

For each service, such a hierarchical interaction structure of performers is described by the graph-theoretical concept of a forest. That concept is introduced as follows. Given a network $z \in Z$ a *path* between i and j is a sequence $i_1, \ldots, i_K$ of individuals such that $(i_k, i_{k+1}) \in z$ for each $k \in \{1, \ldots, K-1\}$, with $i_1 = i$ and $i_K = j$. A *cycle* is a path between i and j with $i = j$ and containing at least one link. A *tree* is a connected graph $z' \subset z$ that contains no cycles. A set of trees is a *forest*. Any two individuals in a tree are connected by exactly one path in the tree, and there is no path connecting any two individuals in different trees. Both conditions define a component of a network. So a tree is component of a stratified performers' network. A tree is also *partially ordered*, denoted by $(M^T, \preceq^T)$, if the relation $\preceq^T$ on M^T is reflexive, antisymmetric and transitive. Individual j *succeeds* or *coordinates* individual i in the tree T if $j \succ^T i$. If j coordinates i and there is no h in M^T such that $j \succ^T h \succ^T i$, then j coordinates i directly. A partially ordered tree has a unique top individual coordinating all other individuals. The set of individuals coordinating nobody in the tree is called the set of pendants or *front individuals* of the tree and is denoted by $M(T)$.

Definition 2.1:

Given a set of possible service networks (M, Z, w), a finite set of services N, and, for each service $j \in N$ with service network z_j, a set of performers $M_j^P \subset M$ and a set of receivers $M_j^R \subset M$. Then a *stratified performers' network* (M_j^P, z_j^P) is a forest in which each tree is partially ordered by a coordination relation that is derived from the service network. Some individual performer is said to *coordinate* a set of directly preceding performers if these performers interact or cooperate horizontally according to a criterion in which the succeeding performer plays a distinctive role. Similarly, a *stratified receivers' network*

(M_j^R, z_j^R) is a forest in which each tree is partially ordered by a coordination relation.

So both performers and receivers in a stratified service network assume specialized roles that are horizontally comparable and vertically ordered. Horizontal interactions within a stratum arise when performers cooperate to serve a receiver. Such a set of interdependent performers with an internal horizontal interaction is called a *group*. Think of a medical team assisting a surgeon who performs a surgery on a patient. Vertical externalities emerge when a service to be rendered requires a complementary infrastructure service. So a service is decomposed into sub-services, which are integrated into a service. The medical team needs the support of a hospital, and the hospital is embedded in a health system. The supply of electricity at home requires an ordered set of complementary sub-services that are vertically integrated. Similarly, from the point of view of the receivers of a service, children receiving education belong to some family, which family cares for a school and itself belongs to a community that establishes an education system, etceteras. Examples of vertical complementarities are abundant. So each stratified service can be decomposed into partially ordered sets or groups of interacting performers, with groups on the same level rendering the same (sub) service.

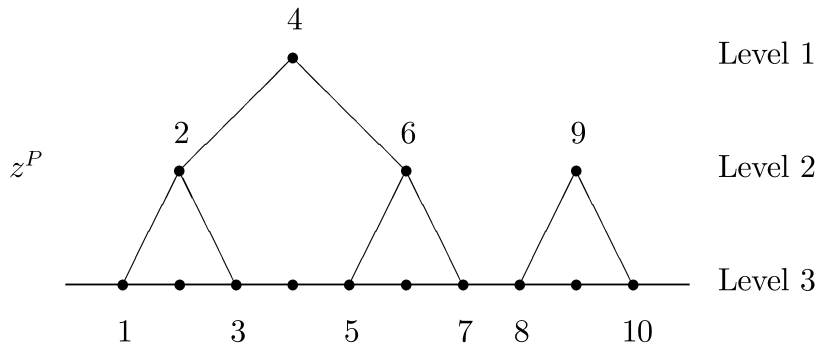

Figure 2: A stratified performers' network

The stratified performers' network in Figure 2 corresponds with an underlying bipartite service network in Figure 1. This can be seen as follows. The performers who serve only one receiver can only be front-performers (the performers 1, 3, 5, and 7). The front performers 1 and 3 interact in serving receivers a and b because a coordinating performer 2 is also serves a and b. The front-performers 5 and 7 also interact and are coordinated by performer 6. Finally, the performers 2 and 6 interact because the coordinator 4 covers their receivers. It is understood that the performer who covers front-performers serves their receivers indirectly. The value of this covering relation between performers is derived from the basic value-generating interaction between the front-performer and the receiver of the service.

The stratified services in the service structure and their value are potential services. They need to be realized by managers who themselves are ruled by a governance to be specified in the next Section. In this section the service structure will be specified further to obtain the concept of a manageable stratified service.

2.3 Valuation of stratified services

The value of interaction within each type of service network is defined as follows. A performer forest interacts with some receiver forest if the individuals on the front positions of both forests interact and generate welfare for those involved according to the social welfare function. Since all individuals involved are playing either the role of performer or the role of receiver, one individual may substitute another in some role. This assumption is a kind of anonymity condition, which is fundamental for the institutional approach developed in the next section. It is in contrast to the case of reciprocal exchange, where the individual cannot be substituted by another (see Kranton, 1996). So the social welfare generating capacity of interacting *individuals* in networks may be replaced by the interaction between *roles* in a performer forest and roles in a receiver forest. Then, given a receiver forest, the value of some performer forest can be derived from the social welfare function, as well as the value of a receiver forest follows from the social welfare function, given some performer forest. This is done as follows.

A value function w is given and defined on the set of possible (bipartite) networks for all services, Z. The function $w : Z \to \mathbb{R}$ assigns a value $w(z)$ to each interaction structure between performers and receivers as described by the network z in Z. This value is generated by the interaction between one or more performers and one ore more receivers, including those in the front roles, of the stratified services represented by z.

Consider a service $j \in N$ with a stratified performer' network (M_j^P, z_j^P) and a stratified receivers' network (M_j^R, z_j^R). So the service network $z_j \in Z_j$, from (M, Z, w), the set of possible value-generating networks, is decomposed into two forests z_j^P and z_j^R. The value function w, however, is defined on the whole set $z \in Z$. Both decomposed sets are 'glued' together by the following operation.

A forest z_j^P in Z_j^P is decomposed by a set of connected components, called trees, $\{z_j^{P,1}, z_j^{P,2}, \ldots, z_j^{P,t}\}$. Each tree $z_j^{P,k} \subset M_j^{P,k} \times M_j^{P,k}$, is a directed graph for $k = 1, 2, \ldots, t$. Let $[M_j^P]$ denote the partition of the performer set M_j^P into subsets of performers within some tree, $\{M_j^{P,1}, M_j^{P,2}, \ldots, M_j^{P,t}\}$. Similarly, a receivers' forest z_j^R can be decomposed on the set M_j^R of receivers. The set $[M_j^R]$ represents the partition of the receiver set into subsets of receivers within a tree. Both the value function on the set of performer forests and the value function on the set of receiver forests can now be derived from a well-chosen social welfare function $w \in \mathcal{W}$.

Let $\zeta_j = [M_j^P] \times [M_j^R]$ denote the complete[2] bipartite network between the tree populations. The service network in Z_j that is generated by some performer tree z_j^P and some receiver tree z_j^R, denoted by $z_j^P \otimes z_j^R \subset M_j^P \times M_j^R$, is defined as follows. For

[2] Completeness implies that all performer trees are substitutes for a receiver tree, and vice versa. Reciprocal exchange between individuals would require additional restrictions on this network.

each $(g,h) \in \zeta_c$, if $p \in M_j^{P,g}$ and $r \in M_j^{R,h}$, then $(p,r) \in z_j^P \otimes z_j^R$. Let $z = (z_j, z_-j)$. The value of the performer forest z_j^P is a function $v_j : Z_j^P \times Z_j^R \times Z_{-j} \to \Re$, defined by:

$$v_j(z_j^P|z_j^R, z_{-j}) = \max_{z_j \in Z_j}\{w(z_j, z_{-j})|z_j \subset z_j^P \otimes z_j^R\}.$$

The value of a performer forest is thus contingent on the realization of a corresponding receiver forest for the same service and on the realization of specific networks of the other services. Although this realization is crucial for the valuation of the forest, it falls outside the scope of the individuals within the forest. That is expressed by saying that the value v_j implies that the individuals concerned *believe* for some reason that the networks (z_j^R, z_{-j}) will be realized. Later, when selected networks are managed, this belief is transformed into an expectation, based on the probability of realization as determined by the governance structure. Similarly, it is assumed that the value-enhancing interaction between receivers, which is also implicitly given in the social welfare function, can be made explicit. The utility or user value of some receiver forest is defined by:

$$u_j(z_j^R|z_j^P, z_{-j}) = \max\ _{z_j \in Z_j}\{w(z_j, z_{-j})|z_j \subset z_j^P \otimes z_j^R\}.$$

If beliefs fully match, that is, if z_j^P in the performers function equals the conditional z_j^P in the receivers function, and z_j^R in the receivers function equals the conditional z_j^R in the performers function, then $v_j(z_j^P|z_j^R) = u_j(z_j^R|z_j^P)$. The value of the performers' forest for all services is conditional on the receivers' forest for all services:

$$v(z^P|z^R) = \max_{z \subset\ z^P \otimes z^R}\ w(z).$$

Similarly,

$$u(z^R|z^P) = \max_{z \subset\ z^P \otimes z^R}\ w(z).$$

So in equilibrium, $v(z^P|z^R) = u(z^R|z^P) = w(z)$, which shows consistency between these concepts. They have an independent meaning in the planning procedure, when beliefs are not (yet) realized and an imperfect match may be planned. This implies that somewhere services become scarce due to a managerial misfit, which scarcity is eventually balanced by the price mechanism in the equilibrium concept.

So the value of cooperation between performers (or the value of integration within a performer forest) can be derived from the value of interaction between performers and receivers. That last type of interaction is fundamental in the model, the first type, the interaction between performers themselves, is instrumental and its value is derived. The same is true for cooperation between receivers.

2.4 Manageable stratified services

The stratification of performers in a service network is characteristically determined by the content of the service. A health service, for example, has other chains of support than a transport service. The same observation can be made about the stratification of receivers in a receiver' network. A service that is a public service (a public good), for example, has at the receivers' side a coordinator at the top who coordinates, possibly indirectly, all members of the society. So two dimensions characterize a service: its content and its form, both on the receivers' side and on the performers' side. When the demand for a service varies, that will affect its size, but not its content and its form. So a concept or a rule has to be developed that allows for changing the size of a forest and the set of receivers, but that leaves characteristic elements of its form invariant. A general rule for contracting or expanding networks leaving its interaction or cooperation characteristics (represented by dependent sets) intact is given by the concept of a partially ordered antimatroid[3]. A simpler rule is proposed below.

Definition 2.2:
The set $\mathcal{P}_j$ of *manageable performers' networks for service j* contains all and only forests $P_j = (M_j^P, z_j^P)$ that are *congruent*, that is, have similar interaction or cooperative properties that are characteristic for the j^{th} service. Similarly, the set $\mathcal{R}_j$ of *manageable receivers' networks for service j* contains all and only congruent forests $R_j = (M_j^R, z_j^R)$.

For simplicity, it is assumed here that removing a layer of front-positions in a manageable component of a network, which makes the succeeding layer a layer of front-positions in that component, is an admissible expansion or contraction rule for a manageable service network. A forest P_j in $\mathcal{P}_j$ is decomposed by a set of connected components, called trees, $\{P_j^1, P_j^2, \ldots, P_j^t\}$. Each tree P_j^k is a directed graph, represented by a set of nodes in M_j^P and a set of arcs in z_j^P, that is, $P_j^k = (M_j^{P,k}, z_j^{P,k})$, with $z_j^{P,k} \subset M_j^{P,k} \times M_j^{P,k}$, for $k = 1, 2, \ldots, t$. Since there is a unique path from each front-position to the top-position in a tree it can be assigned length $\ell(p, P_j^k)$.

In order to simplify the analysis further, the trees in each forest P_j or R_j are assumed to be isomorphic. So for each forest the length of all its trees is equal and $\ell(p, P_j^k) = \ell(P_j)$, for all k. A similar assumption is made for the receivers' side of a manageable service network, so $\ell(r, R_j^k) = \ell(R_j)$, for all k. It follows that both networks are indexed by their length or depth. The number of performers' trees in the forest is equal to $|P_j, (\ell_i^P)|$. Similarly, the receivers forest with depth ℓ_j^R is given by $R_j(\ell_j^R)$, where ℓ_j^R is a real number denoting the number of levels.

Since for each service, the variable ℓ_j parameterizes both the performers' forest and the receivers' forest, the value functions mentioned above can be redefined in terms

[3] The concept of a poset-antimatroid (see Bilbao, 2000) describes the desired structure in a more general way. The purpose is to describe a structure that allows for contraction or expansion of a service network leaving its interaction or cooperative characteristics (represented by dependent sets) intact.

of this parameter: $u_j(\ell_j^R|P_j, z_{-j}) = u_j(R(\ell_j)|P_j, z_{-j})$. Let $R(\ell^R) = (\mathrm{R}_1(\ell_1^R),\ R_1(\ell_2^R),\ ,\ R_1(\ell_n^R))$ and $\ell^R = (\ell_1^R, \ell_2^R, \ldots, \ell_n^R)$; a similar convention applies for $P(\ell^P)$ and ℓ^P. Then the performers value function for service j is:

$$v_j(\ell_j^P|\ell_j^R, \ell_{-j}) = v_j(P_j(\ell_j^P)|P_{-j}(\ell_{-j}^P), R(\ell^R)) \tag{2.1}$$

and the receivers value function for service j is:

$$u_j\left(\ell_j^R|\ell_j^P, \ell_{ij}\right) = u_j\left(R_j\left(\ell_j^R\right)|R_{-j}\left(\ell_{-j}^R\right), P\left(\ell^P\right)\right) \tag{2.2}$$

Both functions are derived from the underlying welfare function w, so their properties can in principle be derived from this function. Both functions are supposed to be continuous and monotonously increasing in ℓ. This assumption is needed to prove existence, but implies that the number of levels is also a continuous variable. This methodological assumption is not unusual for network models, see Keren and Levhari (2002). It is not so strong an assumption if the variety of networks for some stratified service is large. The receivers value function u is quasi-convex, the performers value function v is quasi-concave. The variable ℓ refers to the depth of a service and therefore to its quality of a service rather than to the quantity of a commodity, which is the usual domain of a utility function. This quality is a potential and the optimum quality will be determined by the tradeoff between its benefits and costs, included its costs of governance.

Finally, assume that only the front-performers of a performer tree interact with only the front-receivers of a receiver tree and generate value from interaction. This implies that all the value added by increasing the length of the path is discounted in the front-subservice.

Definition 2.3:
The series $S = (M, N, (\omega_0^i)_{i\in M},\ \{\mathcal{P}_j(\ell_j^P),\ v_j(\ell^P|\ell^R\}_{j\in N},\ \mathcal{R}_j(\ell_j^R), u_j(\ell^R|\ell^P)\}_{j\in N}, w)$, consisting of a set of individuals M, a set of services $N = \{0, 1, \ldots, n\}$, with a vector $(\omega_0^i)_{i\in M}$ of labor-service resources, a set of manageable performers' networks with corresponding service-value functions $\{\mathcal{P}_j(\ell_j^P), v_j(\ell^P|\ell^R)\}_{j\in N}$, a set of manageable receivers' networks with corresponding service-value functions $\{\mathcal{P}_j(\ell_j^R), u_j(\ell^R|\ell^P)\}_{j\in N}$, and a social welfare function w on Z, describes a *society with a manageable service opportunity structure.*

This structure still offers a large variety of value-generating service networks. The agents and managers of the society will select some of these, empowered by the governance structure of the society.

3 The governance structure

The basic idea in this paper is expressed by the assumption that a service cannot be rendered unless it is managed. People can choose from a large variety of potential services, much larger than can be realized. A choice from these alternatives has to be made. Any individual has a variety of potential services at her disposal, from which she has to select and to realize an optimal one. Realization of a service usually means the management of transactions to arrive at a reciprocal exchange. This feature is modeled in the service economy. An *agent* in the service society is an individual capable of making a choice and of entering into a transaction with other agents. An *economic service* is defined as a monetary transaction embodying a value-generating interaction between receivers and performers of that service.

In a service economy, adequate institutions have been developed to choose and to manage potential services. Institutions are based on roles or positions and on relations between these positions. Individuals assume certain roles. Principal-agent contracts govern the relations. This methodological device does not imply that role characteristics are more important than individual characteristics, but it focuses attention on the systematic aspects of the interaction between the roles in organizations. An adequate and well-defined governance structure is required to facilitate and coordinate management. An *organization* is a set of *positions* connected by contractual *relations* describing task and competence of each pair of positions, aimed at realizing some stratified service. It is represented by a directed graph. The governance structure distinguishes between the internal organization of decision units buying and selling services and the external organization between decision units coordinating their decisions. This section introduces two internal organizations. The only external organization in this paper is the market, introduced in Section 4.

3.1 The provider of a service

An agent in the service economy becomes a *manager of a performers' service network* if, in the process of transforming (values from) interactions into (values from) transactions, he establishes an organization that supports a performers' service network, which is called a *provider* of the service. Let a set $\mathcal{P}_j(\ell_j^P)$ of performers' service networks for service j be given. The set of suitable performers' organizations $\mathcal{F}_j$ is specified as follows. Each organization $F_j = (M_j^F, L_j^F)$ in $\mathcal{F}_j$ is a hierarchy with a nodes representing a role or position in the organization and an arc $(i,j) \in L^F$ representing a principal-agent relation with principal i and agent j. The principal-agent relations in a provider's organization are top-down oriented. It follows that any principal is a coordinator of a set of cooperating or interacting agents. The principal at the top $t(F)$ is the manager of the provider. An agent in the set $x(F_j)$ of performers who have no agents in the organization and who interact directly with the receivers, assumes a front-position in the organization and is called a *front-worker*. There is a unique path (t,f) from the manager to each front-worker $f \in x(F_j)$ with length ℓ_j^F.

Since the manager wants to support a performers' service-network in $\mathcal{P}_j(\ell_j^P)$, he will restrict the set of suitable performers' organizations to those organization-networks that are isomorphic to $\mathcal{P}_j(\ell_j^P)$. This set is denoted by $\mathcal{F}_j(\ell_j^F)$. Each organization in $\mathcal{F}_j(\ell_j^F)$ is then identified by its length $\ell_j^F = \ell(F_j)$.

The number of agents that are directly connected with a principal is called the *coordination-span* or *scope*. Since this scope is assumed to be uniform for the organization and characteristic for the stratified service, it can be denoted by κ. A second parameter characterizing the provider's organization is the X-inefficiency or the cost of the organization. This is expressed by assuming that each layer in the organization absorbs a uniform share (1-μ) of the value added, with $0 < \mu < 1$, the organizational slack. For reasons of simplicity, this value is equal for all organizations providing the same service and is given. So μ_j is the indicator of the X-inefficiency or quality of the organization.

The transaction value of the service provided is given by the performers value function (2.1), conditional on the realization of the plans of all other managed services in the economy. Although in equilibrium all these plans have to be realized, the manager has to make a decision possibly outside a state of equilibrium. The valuation of a stratified service has been based in Section 2.3 on a belief about the realization of the other stratified services. Such a belief can be transformed into an expectation if a probability can be attached to the realization of the different manageable service networks, which probability distribution has to be determined by the governance of the economy. That problem, however, goes beyond the scope of this paper, so the expected values are introduced as an assumption and become redundant in a state of equilibrium. The provider therefore knows service value function $v_j(\ell_j, \mathcal{E}(\ell_j)) = v_j(\ell_j^F | \ell_{-j}^F, \ell^R)$, where $\mathcal{E}(\ell_j)$ is the vector of expectations of the other managed services than service *j*, which he needs to know to decide. The expectations are realized in a state of equilibrium.

The service value function $v_j(\ell_j,\ \mathcal{E}(\ell_j))$ gives the external value of the provider's service, which is enhanced by the internal organization of cooperation between performers. The internal distribution of this value among the performers is determined by an allocation rule $d_j(\ell_j)$: $F_j(\ell_j) \times v_j(\ell_j, \mathcal{E}(\ell_j)) \rightarrow \mathbb{R}^{M(F(j))}$, which rule[4] assigns to any performer i in the set of performers $M^{F(j)}$ a value $d_j^i(F_j(\ell_j)\times\ v_j(\ell_j,\ \mathcal{E}(\ell_j))=d_j^i(\ell_j^F)$. One may observe that the assumptions on the model make the distribution rule dependent only on the parameter that determines the length of the organization F_j. The distribution function is derived from a game $G(M^F, v_j)$ on the positions in the organization by extending the value function over all possible coalitions and by restricting the value of coalitions according to the specification of the principal-agent relations in the organiza-

[4]This function can be defined for any game $(M^F,\ v_{F,v})$ with the characteristic function $v_{F,v}(S) = v(F|S)$, for $S \subset M^F$ and depends both on the network F and the value function v, where $F|S$ means that only those parts of the network F are considered in which the performers belong to the coalition S. The allocation rule may assign, for example, a Shapley-value with $d(z,\ w) = \varphi^S(M, v_{z,w})$. The distribution of a value can only take place within a governance framework.

tion. The rules of the game G are invariant for the size of the organization F_j and may generate the permission value proposed by van den Brink and Gilles (1996) and van den Brink (1997), which satisfies the properties of budget neutrality, structural monotonicity, and symmetry. Budget neutrality means that the budget is balanced, that is, the sum of budgets (wages) allocated to all positions in the firm equals the value generated, $\sum_i d_j^i(\ell_j^F) = v_j(F_j(\ell_j^F)|\mathcal{E}(\ell_j))$. Structural monotonicity means that a principal does not receive a lower wage than his agent does. Symmetry means that the function assigns the same income to all positions within the same level of the organization. Let $d_j^{i,s}(\ell_j^F)$ be the *positional wage* of a performer i at level s. Homogeneity implies that all wages are equal on the same level, so the internal wage distribution is given by $d_j^s(\ell_j^F)$, s=1,2, , ℓ_j*, where ℓ_j^* is the optimal length for service j. The wage at the top-position $d_j^0(F_j(\ell_j^F))$ is the manager's income. In van den Brink and Ruys (1996) it is shown that for any constant elasticity of substitution performers' value function $v_j(\ell_j, \mathcal{E}(\ell_j))$, given the distribution game $G(M^F, v_j)$, there exists a size ℓ_j^* of the provider that maximizes the income of the top-position. This size is increasing with the degree of substitution in the value function v_j, representing the degree and the shape of internal interaction among the performers in the provider.

The optimal size ℓ_j^* is also increasing, however, with the value v_j of the service j relative to the values of the other services, as is shown in Ruys and van den Brink (1999). This effect of the external value of the service on the size of the provider, taking into consideration the internal effect, is expressed by the function $\ell_j^* = \lambda_{j,k}(p_j)$, where $p_j = v_j(\ell_j^*|\ell_{-j}^F, \ell^R)$ equals the value based on the plans of other managers in the economy. That leads to the following definition.

Definition 3.1:
The manager of provider k of service j *maximizes profits* by choosing the size $\ell_{j,k}^*$ of an organization in $\mathcal{F}_j(\ell_j^F, \kappa_j, \mu_j, d_j)$ such that the residual income of the top-position d_j^0 is maximized. The function $\ell_j^* = \lambda_{j,k}(p_j)$, where $p_j = v_j(\ell_j^*|\ell_{-j}^F, \ell^R)$ is called the *price effect* on the optimal size of the provider. So the *supply of service j by provider k* to its receivers is given by the three set-functions of front-workers $x_{j,k}(F_j(\ell_{j,k}^*)) = x_{j,k}(\lambda_{j,k}(p_j)) = x_{j,k}(p_j)$, with changing domains of definition.

When the service of front-performers is homogeneous, the set function $x_{j,k}(p_j)$ becomes a real function with a value that is equal to the value of the scope parameter κ_j taken to the power $\ell^*= \lambda_{j,k}(p_j)$. In that case, services become similar to commodities and the relation between individual receivers and individual performers can be broken. Also, the *demand of labor-input* is a real function $x_{0,j,k}(p_j)$, which is equal to the sum of labor over all the levels, $q = 0, 1, \ldots, \ell^*$; the amount of labor needed for level q is equal the value of the scope parameter κ_j to the power q.

3.2 The procurer of a service

An agent in the service economy becomes a *manager of a receivers' service network* if, in the process of transforming (values from) interactions desired by the receivers' service network into (values from) transactions, she establishes an organization that supports a receivers' service network, called a *procurer* of the service. The procurer aims at organizing the social choice about which stratified service to be provided (or ordered) and how it should be financed, in short, the procurement[5] of a stratified service by receivers. Let a set $\mathcal{R}_j(\ell_j^R)$ of receivers' service networks for service j be given. The set of suitable receivers' organizations $\mathcal{H}_j$ is specified as follows. Each organization $H_j = (M_j^H,\ L_j^H)$ in $\mathcal{H}_j$ is a hierarchy with a nodes representing a role or position in the organization and an arc $(i,j) \in L^H$ representing a principal-agent relation with principal i and agent j. The principal-agent relations in a procurer's organization are bottom-up oriented. It follows that any agent is a representative or coordinator of a set of cooperating or interacting principals. The final principals or *voters* are at the bottom of the procurer in the set $y(H_j)$, and at the top $t(H_j)$ is the *representative* agent of the procurer, who is also the manager of the procurer. A representative may of course be a Board of Representatives. There is a unique path (t,f) from the representative at the top to each voter $f \in y(H_j)$ with length ℓ_j^H.

Since the manager wants to support a receivers' service-network in $\mathcal{H}_j(\ell_j^R)$, she will restrict the set of suitable performers' organizations to those organization-networks that are isomorphic to $\mathcal{R}_j(\ell_j^R)$. This set is denoted by $\mathcal{H}_j(\ell_j^H)$. Each organization in $\mathcal{H}_j(\ell_j^H)$ is then identified by its length $\ell_j^H = \ell(H_j)$.

The number of agents that are directly connected with a coordinating agent of interacting principals is called the *coordination-span* or *scope*. Since this scope is assumed to be uniform for the organization and characteristic for the stratified service, it can be denoted by κ,. Given the length ℓ_j of the organization and the scope κ_j, the size of the service demanded can be determined. A second parameter μ_j that characterizes the provider's organization is the X-inefficiency or the cost of the organization.

The Representative in the top position represents, facilitates and imposes the social choice made by the principals of the organization, that are, the voters. She assumes therefore two roles, the representative and the manager of the procurer. If the Representative cannot arrive at a solution or a decision, the manager may expand or contract the procurer organization until a feasible size of interaction is obtained[6].

The transaction value of the service procured is given by the receivers value function

[5]The term 'public procurement' or 'public tendering' usually means the purchase of goods and services by public or private enterprises by means of a tender or auction. Efficient public procurement involves choosing the supplier who can supply the desired goods and services at the lowest price (or, more generally, the best "value for money"). The procurement concept introduced here generalizes upon the public procurement concept.

[6]If the rules of a Prisoners' Dilemma are understood as coming from a procurer, it shows that non-cooperative rules, which are based on separable individual decisions, usually preclude the attainment of the highest payoff for interacting agents (see Blonsky and Spagnolo, 2001).

(2.2), conditional on the realization of the plans of all other managed services in the economy. Although in equilibrium all these plans have to be realized, the manager has to make a decision possibly outside a state of equilibrium. The valuation of a stratified service has been based in Section 2.3 on a belief about the realization of the other stratified services. Again, the expected values are introduced here as an assumption and become redundant in a state of equilibrium. The procurer therefore knows service value function $u_j(\ell_j, \mathcal{E}(\ell_j)) = u_j(\ell_j^H|\ell_{-j}^H, \ell^P)$, where $\mathcal{E}(\ell_j)$ is the vector of expectations of the other managed services than service j, which she needs to know to decide. The expectations are realized in a state of equilibrium.

The service value function $u_j(\ell_j,\ \mathcal{E}(\ell_j))$ gives the external value of the procurer's service, which the set of receivers is willing to pay for the service j. It is made cheaper by the internal organization of cooperation between receivers. The internal allocation of contributions needed to raise this value among the receivers is determined by an allocation rule or *contribution function* $c_j(\ell_j)$: $H_j(\ell_j)\times\ u_j(\ell_j,\ \mathcal{E}(\ell_j)) \rightarrow \mathbb{R}^{M(H(j))}$, which rule assigns to any receiver i in the set of receivers $M^{H(j)}$ a value $c_j^i(H_j(\ell_j)\times\ u_j(\ell_j,\ \mathcal{E}(\ell_j))$ $= c_j^i(\ell_j^H)$. One may observe that the assumptions on the model make the contribution rule dependent only on the parameter that determines the length of the organization H_j. The contribution function is derived from a game $G(M^H, u_j)$ on the positions in the organization by extending the value function over all possible coalitions and by restricting the value of coalitions according to the specification of the principal-agent relations in the organization. The rules of the game G are invariant for the size of the organization H_j and may generate the permission value proposed by van den Brink and Gilles (1996) and van den Brink (1997), which satisfies the properties of budget neutrality, structural monotonicity, and symmetry.

The optimal size ℓ_j^* is decreasing with (i) the degree of substitutability among receivers, and (ii) the willingness to pay expressed by the value u_j of the service j relative to the values of the other services. This effect of the external value of the service on the size of the procurer, taking into consideration the internal effect, is expressed by the function $\ell_j^* = \lambda_{j,k}(p_j)$, where $p_j = u_j(\ell_j^*|\ell_{-j}^H, \ell^P)$ equals the value based on the plans of other managers in the economy. That leads to the following definition.

Definition 3.2:

The manager of procurer k of service j *minimizes contributions of voters* by choosing the size $\ell_{j,k}{*}$ of an organization in $\mathcal{H}_j(\ell_j^H,\ \kappa_j,\ \mu_j,\ c_j)$ such that the residual contribution of the bottom-position c_j^0 is minimized. The function $\ell_j{*} = \lambda_{j,k}(p_j)$, where $p_j = u_j(\ell_j{*}|\ell_{-j}^H,\ \ell^P)$ is called the *price effect* on the size of the procurer. So the *demand of service j by procurer k* is given by the three set-functions of front-receivers $z_{j,k}(H_j(\ell_{j,k}{*})) = z_{j,k}(\lambda_{j,k}(p_j))$ $= z_{j,k}(p_j)$, with changing domain of definition. When labor is homogeneous, the set function $z_{j,k}(p_j)$ becomes a real function that is equal the value of the scope parameter κ_j to power $\ell{*}= \lambda_{j,k}(p_j)$.

4 An economy with marketable stratified services

4.1 A service economy

A *service society* $\mathcal{S} = (\mathcal{N}_S, \mathcal{G}_S)$ consists of two concepts: a service opportunity structure, defined in Section 2.4:

$$\mathcal{N}_S = (M, N, (\omega_0^i)_{i\in M}, \{\mathcal{P}_j(\ell), v_j(\ell^P|\ell^R)\}_{j\in N}, \{\mathcal{R}_j(\ell), u_j(\ell^R|\ell^P)\}_{j\in N}, w),$$

and a governance structure, with the internal governance defined in Section 3:

$$\mathcal{G}_S = (M^C, N, \{M_j^F, \mathcal{F}_j(\lambda; \mu, \kappa, d)\}_{j\in N}, \{M_j^H, \mathcal{H}_j(\lambda; \mu, \kappa, c)\}_{j\in N}, \mathcal{T}(N^F \times N^H)).$$

The external governance of the service society is represented by the set of allocation mechanisms $\mathcal{T}(N^F \times N^H)$ that are suited for the type of providers and procurers active in a service sector. The service society $\mathcal{S}$ is transformed into a *service economy* $\mathcal{E}$ if all transactions are monetary transactions. In an *economy marketable stratified services (EMSS)* the only external organization is the market system. That restricts the economy drastically, of course, because a mechanism to process social demand is not present in the economy. It excludes, for example, public services. Cooperation in supply is only realized if the provision marketable stratified services is profitable. In an *EMSS*, the length of any procurer organization equals 0 and each receiver is its own manager.

Managers in M^F and M^H assume a specialized role in the economy. Consumers in M^C are agents who integrate again their roles of performer and receiver by force of the budget constraint. The consumer also assesses the various services by the choice of a bundle of these services.

A *state* of the service society is a series of managed stratified services by providers and procurers and an allocation of services $(x^f,\ y^h)$ to individual performers and receivers of services, with $k\in M$, the set of consumers:

$$(\{F_j(\lambda), H_j(\lambda)\}_{j\in N}, , \{(x^f, y^h)\}_{f\in M, h\in M}\ ,).$$

This state is *feasible* if all agents assume a managed position and if the expectations of all managers concerning the other organizations are realized, so $F_j(\ell_j,\ \mathcal{E}(\ell_j)) = F_j(\ell_j^F|\ell_{-j}^F,\ \ell^H)$ and $H_j(\ell_j,\ \mathcal{E}(\ell_j)) = H_j(\ell_j^H|\ell_{-j}^H,\ \ell^F)$, for all services j. This implies that demand equals supply for all services. A feasible state is *optimal* if no agent can improve upon its position unless at the cost of another agent. This implies that no manager can improve upon managing its service.

4.2 General equilibrium for an EMSS

In the economy with marketable stratified services the front performers providing the stratified services are homogeneous. The equilibrium concept is based on the formation of prices in the markets. The price vector p is defined by $p_j = v_j(\ell_j{}^*|\ell^F_{-j},\, \ell^R)$ in Section 3.2, with $\sum_j p_j = w$ if all manager's choices lead to a state of equilibrium. In case of disequilibrium, excess demand will raise this price, as expressed by the function $\lambda^F_j(p)$ and the function $\lambda^H_j(p)$, introduced in Section 3.

The assumptions introduced above simplify the various concepts drastically. Since for each service there is one representative provider that is parametrized by its length, and the representative procurer has no function any more in a market economy, the state $(\{F_j(\lambda^F),\, H_j(0)\}_{j\in N},, \{(x^f,\, y^i)\}_{f\in M,\ h\in M})$ of the economy is reduced to:

$$(\{t_j, \ell_j\}_{j\in N}, \{x^i\}_{i\in M,}),$$

where t_j indicates the number of providers for service j and ℓ_j the size (length) of this provider, and x^i the consumption bundle of consumer i. The manager of any provider chooses the length such that his positional budget, which is the residual income d^0_j of the firm, is maximized over the provider set $\mathcal{F}_j(\lambda;\, \mu,\, \kappa,\, d)$. Managers are assumed to be price takers, so the optimal length $\ell_j{}^*$ and the optimal number of providers $t_j{}^*$ are functions of prices.

Definition 4.1:
A *General Equilibrium* for an Economy with Marketable Stratified Services *(EMSS)* is a state $(\{t_j{}^*,\, \ell_j{}^*\}_{j\in N},\, \{x^{i*}\}_{i\in M})$ and a price vector p^* of marketable services such that:

- Each performer-manager of the stratified service j chooses a size $\ell_j{}^*$ for the organization $F_j(\ell_j)$ from the set $\mathcal{F}_j(\lambda;\, \mu,\, \kappa,\, b)$, such that its profits $d^0_j(\ell_j)$ are maximized.

- Each agent i chooses a managed performer position in some $F_j(\ell_j{}^*)$ such that its positional wage $d^i_j\ (\ell_j{}^*)$ is maximized.

- Each agent i chooses a consumption bundle x^{i*} of marketable services that maximizes its utility under the income constraint.

- At price p all markets clear.

So the supply function of the homogeneous service $x_{j,jk}$ rendered by provider k of service j is:

$$S_{j,jk}\,(p) = (\kappa_j)^{\lambda(p)} = x_{j,jk}\,(p)\,,$$

with value $p_j x_{j,jk}\,(p)$.

Given homogeneity of labor, the labor demand by provider k at price p is:

$$D_{0,jk}(p) = \sum_{s=1}^{\lambda(p)} (\kappa_j)^s = x_{0,jk}(p).$$

Let the income distribution within the provider organization be egalitarian[7] , so $b_j^s = b_j$, for each position on level s. Then the budget restriction of the provider reads as follows:

$$p_o x_{o,jk}(P) \leq p_j x_{j,j}(p)/t_j = p_j x_{j,jk}(p) \qquad (3.1)$$

The net supply functions are composed to vector-valued functions.

$$S_j(p) = \sum_{k=1}^{t_j} S_{jk}(p) = (\ -x_{0,jk}(p), 0, ..., x_{j,jk}(p), ..., 0)^T.$$

Consumer i has one divisible unit of labor-service available and maximizes income by choosing a position in a provider of the service j in which his positional budget $d_j^i(\lambda_j(p)$ per unit amount of time spent is highest, irrespective of the agent's actual time spent on labor. The choice about the actual time spent on a position, which choice determines actual income, is derived from his maximizing utility on the set of alternatives. So the agent i chooses an optimal composite service bundle $x^i = (x_0^i, x_1^i, x_2^i, \ldots, x_n^i)$, with $x_0^i =$ 1-x^i, by maximizing $u_i(x^i)$ over his budget set:

$$\sum\nolimits_j p_j x_j^i \leq b_j^i(\lambda_j(p)) = p_0 x_{0,j}^i. \qquad (3.2)$$

So consumer i^{th} net-demand function for services is, with initial labor resource ω_0^i=1, for all $i \in M$:

$$D^i(p) = \left(x_0^i - 1, x_1^i, x_2^i, ..., x_n^i\right)^T(p) = x^i(p).$$

The aggregate excess demand vector-function is:

$$Z(p) = \sum_{i \in M} D^i(p) - \sum_{j \in N} S_j(p) \leq 0.$$

This aggregate excess demand function is homogeneous of degree zero and satisfies Walras' Law, that is, $p.z(p) = 0$, for all p positive. For, summing inequality (3.1) over all providers of the same service and over all services:

$$\sum\nolimits_j p_o x_{o,j} \leq \sum\nolimits_j p_j x_j,$$

[7] This is a strong assumption that affects the valuation function in the service structure. The distribution function should follow from the performer interaction as determined by the valuation function. Following that course, however, would make the proof very intricate.

and summing inequality (3.2) over all consumers and services:

$$\sum_j \sum_i p_j x_j^i \leq \sum_j \sum_i p_0 x_{0,j}^i,$$

shows that the value of aggregate cost of provision equals the value of provision, which again equals total income. The aggregate demand function is bounded from below. Furthermore, assume that the utility functions and valuation functions are regular, implying that the demand of a service is sufficiently sensitive for a decline of its price and that the aggregate demand function is continuous. These conditions are sufficient for the existence of a Walras equilibrium.

Theorem 4.1:
Let the economy satisfy the set of conditions mentioned above. Then there exists a general equilibrium for an *EMSS*.

Since all expectations are fulfilled in a *EMSS*, it is by definition effective. This property becomes interesting only in a dynamic context with a procedure comparable to the well-known tatonnement process, which procedure also leads to an effective outcome. It is also efficient, because managers can only choose from optimal groups. This property is interesting only if the managers in the model are allowed to make mistakes and have a wider set of choices than assumed here for reasons of simplicity.

Finally, one may observe that if all for all services, receivers can be separated from performers, then the service reduces to a commodity and the number of performers of that service can be identified with the quantity of that commodity. The state of the economy is then expressed in terms of quantities $\{x^i\}$, rather than relations $\{(x^f, y^f)\}$. In that case, the market economy for managed stratified services reduces to a neoclassical market economy. So the economy with managed stratified services is a genuine generalization of a neoclassical commodity economy.

4.3 The management of services: conclusions

There are many open problems left in this paper. One is that a general equilibrium is not a competitive equilibrium. In order to achieve competitiveness, the organizations have to be able to split up such that the corresponding distribution functions are remunerating positions with equal requirements competitively. I think that some tools needed to further analyze the unbundling of an organization are being developed, see for example Herings e.a. (2001). This also applies to the problem of the boundary of the firm, to which problem the approach of this paper contributes. The managerial interpretation of the efficiency and the effectivity concepts improves their usefulness, in my opinion.

Value is generated only by the interaction between receivers and performers. Value is cashed by the interaction between providers and procurers. When individuals make plans for the future, they look at the roles they can play or at the positions they can assume, anticipating on the managing decision of selecting the network in which they will participate. A teenage girl may want to become a nurse without knowing a priori whom she will care, but a posteriori she will know him or her and will generate the expected value. The more effective a governance is, the more predictable is the behavior of agents and the higher is the probability of occurrence of predicted and expected outcomes. So the expectation of these values depends on a probability distribution that is eventually determined by the governance. Deriving this probability may be of great help for people making their dreams come true. The Walrasian tatonnement procedure, for example, is implicitly based on expectations. High rates of adjustment however, may lead to cycles and chaotic behavior: see Weddepohl (1999).

Another open problem is the description of the management of markets. The external organization has not been developed beyond the neoclassical assumption that prices will emerge. The main economic policy problem at the moment is: which services should fall under which external organization regime. This paper contributes to that issue, but the model for non-market regimes has to be formalized yet.

Finally, the network approach allows for introducing cultural aspects in organizations. This also promises to be a fascinating development.

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