A General Equilibrium Model of the Three-Sector Competitive Economy

by S.Y. Wu

Abstract

The presence of externality, indivisibility, and uncertainty destroys the market's ability to coordinate production. Entrepreneurs rise to organize production by assuming a part of the allocative role traditionally reserved exclusively to the market. Assume that there are three classes of entrepreneurs: profit-oriented, nonprofit oriented and public entrepreneurs. These entrepreneurs cooperate with their own type to organize, respectively, the for-profit and nonprofit firms, as well as local communities. They do so by playing a society-wide cooperative game. At the conclusion of this game, not only firms and communities come into existence, production and exchange also take place at competitive equilibrium prices. This equilibrium is pareto optimal.

1. Introduction

The fundamental concern of economics is the efficient and equitable allocation of scarce resources to the many competing ends. Generally, the economic activities and the allocative consequences are affected by the constraints imposed upon the economy under the various social, legal, and economic institutions. In a private enterprise economy where property rights are well-defined and protected, economic activities

revolve around the production, exchange, and consumption of property rights embodied in commodities. It is through these activities that an individual's self-interest is expressed and his incentive manifested. Given the appropriate assumptions about the consumer preferences, production technologies, and the market structure, we are able to ascertain the market outcome and then render a judgment on whether this outcome is efficient and equitable. The conclusion reached in the literature is well-known; namely, activities motivated by self-interest taking place in a set of complete and competitive markets do lead to a pareto optimal state of equilibrium. Moreover, an equitable pareto optimal state of equilibrium, however identified, can be achieved as a competitive equilibrium provided that the initial endowments are appropriately distributed.

The attainment of this desirable outcome depends crucially on the satisfaction of the assumptions that all property rights are well-defined and that the markets are complete and competitive. Typically, the property rights over a commodity are unambiguously defined whenever the consumption of one unit of this commodity by any individual will preclude all others from consuming it and that the marginal cost of supplying this commodity to any individual is nonzero. Under these circumstances, the demand and supply of this commodity is clearly identified and so is its price. Commodities satisfying these properties are referred to as private goods.

Two factors contribute to the creation of ambiguities regarding property rights over commodities and, thus, cause the market to function inefficiently. They are the presence of externality and indivisibility. Externality exists whenever an increase in the consumption of a commodity by one consumer will increase or decrease the utilities of other consumers or an increase in the level of production by one producer will increase or decrease the production costs of other producers. For example, the expansion of a bee farm increases the output of a neighboring apple orchard. Owing to the market's inability to appropriate the increased apple output to the bee farmer, the property rights over the apples are ill-defined. Under this obscured property rights system, the market fails to allocate its resources optimally. Specifically, the inability to compensate the bee farmer for his contribution to the apple production leads to an overexpansion of the apple orchard and an underproduction of honey.

Perhaps, the most widely discussed market failure is associated with the indivisibility of public goods. A public good has the property that its consumption by one individual does not diminish the amount available to other individuals and that the marginal cost of serving an additional individual is zero. Since it costs nothing to serve any additional individual, once a public good has been constructed, then it makes no sense to exclude anyone in the community from consuming it. For example,

both Bill and John enjoy the city park. Suppose John pays for its construction. Then, Bill can free-ride. Self-interest impels us to conclude that no egotistically rational individual would be willing to pay for the park's construction and allow others to free-ride. Consequently, even though all citizens desire the service of a park, the park will, nonetheless, not be built. In other words, the market fails to allocate public goods optimally.

In sum, if property rights are not clearly defined in a private enterprise economy, then decentralized activities guided by individuals' self-interests will not lead to a socially optimal outcome. One way to remedy this situation is by conferring all ambiguous property rights to a collective body, say the government.[1] By placing a commodity with externality under collective ownership, externalities are internalized and the market's ability to allocate the integrated-supplied good is restored. On the other hand, by placing a public good under a collective ownership, appropriate mechanisms can be designed in order to ensure that all public goods are supplied in optimal quantities.[2]

Although the above-mentioned goods are frequently provisioned collectively by governments, it does not mean that they are never supplied by firms in the private sector. As a matter of fact, some public goods and goods exhibiting externality are more aptly supplied by private non-profit firms.

If non-profit firms do provide these under-supplied goods and services, because the free-ride is a problem, these firms will expect insufficient funding. The difference will have to be made up through charitable givings. Therefore, the hallmark for the nonprofit sector is "volunteerism, charity, and community."[3] Based upon the social ethics, members of the community voluntarily organize nonprofit firms in an altruistic manner in order to provide goods and services not adequately provided by the for-profit sector but are deemed necessary for the goodness of the society. However, charitable giving requires the assurance that the donors' contributions do not end up enrich the producers. In order to provide such a guarantee to the potential donors, the non-profit firms are organized under the statutory restrictions prohibiting anyone from appropriating surplus generated by the firm. This nondistribution does not mean that a nonprofit firm is forever barred from making a surplus. It means only that distribution of surplus is prohibited; any surplus must be retained by the firm for its own use.

Thus stated, it is evident that the modern economy is composed of three overlapping sectors: the private for profit, the private nonprofit, and the public sector. All production units in these sectors must compete in the factor markets for inputs, use the same pool of capital to finance production, and compete in the output markets for the consumer's purchasing power. In order to understand the nature of resource allocation

in this complex economy, we must first examine the general equilibrium of this economy. Only when the nature of this general equilibrium is understood will we be able to ascertain the allocative efficiency of this economy.

Although there has not been any attempt to investigate the general equilibrium of any economy involving all three sectors, there does exist a large body of literature investigating a private ownership economy with public goods. The central concern of this literature is whether by grafting a public sector onto the intrinsically efficient private sector the allocative efficiency of the economy can be preserved.[4] Since the public sector emerged as a result of market failure, it is not surprising for the literature to reach the conclusion that, in general, the presence of public goods in the economy diminishes the efficiency of the market and tends to cause an undersupply of public goods.[5] Only under very special conditions will the allocation of this two-sector economy be pareto optimal.[6] Presumably, it is possible to further graft the private nonprofit sector onto the above-mentioned two-sector economy and investigate whether the resulting three-sector economy is efficient. Under the prevailing methodology, since the appearance of the nonprofit sector is also due to market failures, it is a foregone conclusion that the three-sector economy must also be generally inefficient and that only under

very special conditions can a pareto efficient allocation emerge in this economy.

In this paper, we shall not follow the traditional line of inquiry but will adopt a different perspective and reach a much different conclusion. This perspective has to do with the observation that the private-for-profit sector also suffers market failures.[7] Recently, the present author has studied an economy where the presence of uncertainty causes the market to be incomplete and the incomplete market, in turn, destroys the market's ability to coordinate production [Wu, 1989; Wu and Qin, 1994]. Entrepreneurs rise to organize production by assuming a part of the allocative role traditionally reserved exclusively to the market. With the help of the entrepreneurs, the functioning of the market in the for-profit sector is restored. Following this line of reasoning, it is natural to postulate that entrepreneurs can also be relied upon to restore production in the public and nonprofit sectors. Thus, in our perspective, we do not treat the non-profit and the public sectors as appendages to the for-profit sector; instead, we treat all three sectors as equals and study how the three-sectors jointly allocate resources.

Let us, for simplicity, assume that entrepreneurs are divided into three distinct groups: the profit-oriented, the nonprofit-oriented, and the public entrepreneurs. They organize, respectively, for-profit and non-profit firms and local

communities. Owing to the fact that the entrepreneurs face different social, economic, and legal constraints in these three sectors, the characteristics of the production entities in these sectors will be different. These differences notwithstanding, our task at hand is to explain how the various sectors come into a mutually consistent state of equilibrium and to examine the property of this equilibrium.

The model we select to carry out this task is a two-period temporary equilibrium model. We use it to describe the nature of decisions made by all agents in the economy as well as the combined market and nonmarket process which brings the economy into a state of general equilibrium. There are two sets of activities in this economy. First, both the consumer and the producer use the market to trade consumption goods. In addition, a tradeable resource owner also uses the market to carry out his consumption-investment activities and to convert directly in the market his endowment into income. Second, the entrepreneur's activities on the production side are nonmarket in nature; he does not sell his services in the market. Instead, he derives his income indirectly from the net residual of the firm or of the community which he helps to organize. Thus, the activities in the economy include simultaneously the consumption-investment activities of the consumers, the coalition formation activities of the entrepreneurs, and the production activities of the for-profit and nonprofit firms as well as the local communities. As

these activities interact to bring the economy into a state of general equilibrium, not only are prices of the commodities determined and resources channeled into production, we also see that the firm's structure in the profit and nonprofit sectors and the community structure in the nation being selected. Consequently, the formation of the firms and the local communities, and the production and exchange of goods and services are all an integral part of the same combined market and nonmarket process.

The above exposition suggests that we shall restrict our present analysis to a competitive economy. The economy is said to be competitive whenever all three sectors are competitive. The for-profit and non-profit sectors are competitive whenever consumers and firms in these sectors are price takers. In order to make the public sector competitive, we must exclude from our analysis an entire class of public goods supplied by the federal government. The public goods included in our analysis are those known as the Tiebout public goods supplied by the local communities (Tiebout, 1956). By imposing this restriction, the public sector becomes competitive in the following sense. Assuming that the consumers are completely mobile, even though citizens in each community must consume the same amount of a public good, competition among communities will lead consumers to gravitate to the community of their choice. This competition among communities in the public sector, as shall be shown later,

is analogous to competition among firms in the other two sectors.

This paper is composed of three additional sections. Section 2 presents the model, section 3 discusses the implications of the model, and section 4 suggests some possible extensions.

2. The Model

The basic model is a two-period general equilibrium model with finite many agents denoted by N. Let period 1 denote the present and period 2 the future. For our purpose, the N agents may be classified into two groups: He is either an entrepreneur or not an entrepreneur. Let the set of entrepreneurs be denoted by N_e, where $N_e \subset N$.

There are four types of commodities: the set of all self-employed entrepreneurial services L and the set of market-traded commodities M. The traded commodities M, in turn, can be divided into three subcategories: the public goods M_3, the goods produced in the non-profit sector M_2, and the remainder M_1 which include all products produced for profits and all endowed tradeable commodities. We assume that $M = M_1 \cup M_2 \cup M_3$ and $L \cap M = \phi$.

In this production economy, the agent, in order to sustain consumption in the second period, must convert his current resources into future income. He does so by participating in production. The owners of the traded endowments will sell their services in the factor markets. The owners of entrepreneurial

services, on the other hand, will convert these services into income indirectly through non-market means; that is, by organizing production and then claim a share of the profit derived from selling the products in the commodity markets.

The special feature of this production economy is that there exist simultaneously non-cooperative and cooperative behaviors among agents. All agents behave non-cooperatively in a market context, while all entrepreneurs behave cooperatively in production. The model is intended to describe the market and the non-market (entrepreneurial) activities which lead to a general equilibrium in the current period. In order to start the process, we first identify the various elements of the model.

2.1 The Agents

2.1.1 Every Agent is a Resource Owner.

At the beginning of period t, t =1,2, agent $j \in N$ holds a marketable commodity bundle and some non-tradeable entrepreneurial talents. Let X denote the set of for-profit commodities and entrepreneurial services, Y the set of charitable commodities, Z the set of public goods and G the monetary contribution to charities. The commodity bundles at the disposal of agent j are:

$$X^{1j} \in \mathbb{R}_+^{M1} \times \mathbb{R}^{L} \qquad \text{for } j \in N_e$$

$$X^{1j} \in \mathbb{R}_+^{M1} \times \mathbf{0} \quad \text{where} \quad \mathbf{0} \in \mathbb{R}^{L} \qquad \text{for } j \in N \backslash N_e$$

$$X^{2j} \times Y^j \times Z^j \times G^j \in \mathbb{R}_+^{M1} \times \mathbb{R}_+^{M2} \times \mathbb{R}_+^{M3} \times \mathbb{R}_+ \; e_2$$

for $j \in N$

The symbol e_2 will be defined shortly. The first two statements reflect the assumption that there are no endowments of charitable and public goods and the last statement reflects the assumption that there is no production in the second period.

2.1.2 Every Agent is a Consumer.

The characteristics of consumer $j \in N$ are described by

1. his consumption possibility set:

$$X^{1j} \times X^2{}_j \times Y^j \times Z^j \times G^j$$

2. his von Neumann-Morgenstern Utility Function

$$u^j: X^1{}_j \times X^2{}_j \times Y^j \times Z^j \times G^j \to \mathbb{R}^1$$

3. his initial endowments $(\omega^{1j}, \tau^1 j) \in X^1 j$, where ω and τ, respectively, denote tradeable and the entrepreneurial endowments.

2.1.3 Every Agent is an Investor.

Let $\mathcal{F}_1$ (to be defined shortly) be a set of for-profit firms in the economy. A portfolio of agent $j \in N$ is a point $(S_j, B_j) \in \mathbb{R}_+^{\#\mathcal{F}_1} \times \mathbb{R}^1$ where S_j and B_j are, respectively, the vector of stocks and bond that agent j owns.

2.1.4 The Entrepreneurs.

There are three classes of entrepreneurs, N_{e1}, N_e2 and N_e3. Members in each class enter into agreement with each other to form, respectively, for-profit firms, non-profit firms, and local communities. We assume that
$N_{e1} \cup N_e2 \cup N_e3 = N_e$ and $N_e1 \cap N_e2 = N_e2 \cap N_e3 = N_e3 \cap N_e1 = \phi$.

2.2 Production Entities

A production entity is a coalition of entrepreneurs. These entrepreneurs enter into a cooperative agreement and commit themselves to a joint policy.

Let a set of F entrepreneurs ($F \subset N_e$) form the production entity F. There are potentially $(2^{N_e} - 1)$ such entities denoted by $_e$. A coalition structure $\mathcal{F}$ is a partition of N_e. Where $\mathcal{F}$ prevails, the firms $(F|F \in \mathcal{F})$ co-exist. Because of social, legal and economic restrictions, not every potential production entity is allowed to be formed. Let $\mathcal{F}_{\sim}$ denote the admissible coalition structures. Since only entrepreneurs belonging to N_{e1}, N_{e2}, N_e3 can form, respectively, for-profit firms, non-profit firms, and local communities, $\mathcal{F}_{\sim} = \{\mathcal{F}_{\sim 1}, \mathcal{F}_{\sim 2}, \mathcal{F}_{\sim 3}\}$. A hierarchical

coalition structure $\mathcal{H}_i$ takes into account of the internal relationship among the $|F_i|$ entrepreneurs. Specifically, let the set of admissible internal structures among the F_i entrepreneurs be denoted by Π^{F_i} with the generic element π^{F_i}, i=1,2,3; then $H_i = (F_i, \pi^{F_i})$ and $\mathcal{H}_i := \{(F_i, \pi^{F_i}) | F_i \in \mathcal{F}_{\sim i}$ and $\pi^{F_i} \in \Pi^{F_i}\}$. Let the set of all permissible hierarchical coalition structures be denoted by $\mathcal{H}_{\sim i}$ where

$$\mathcal{H}_{\sim i} := \{(F_i, \pi^{F_i})_{F_i \in \mathcal{F}_i} | \pi^{F_i} \in \Pi^{F_i} \text{ and } \mathcal{F}_i \in \mathcal{F}_{\sim i}\},$$

i=1,2,3.

Then, $j \in H_i(j) \in \mathcal{H}_i$ signifies that the entrepreneur j plays a specific role in the production entity $H_i(j)$ of F_i entrepreneurs. $\mathcal{H}_i$ induces a partition of $N_e i$ and the production entities $(H_i | H_i \in \mathcal{H}_i)$ co-exist.

Let the inputs be a commodity-entrepreneur bundle $q = (q_{M_1}, q_L)$. The producer's ability to convert inputs into outputs depends on it's production technology, its internal organization, and its capacity to secure funds to finance production. Specifically, let H_i be a coalition of F_i entrepreneurs in N_{ei} organized in the hierarchical form π^{F_i}. H_i's production set is $Q(H_i) \subset \mathbb{R}^{M_1 \cup L}_+ \times [(\mathbb{R}^{M_i}_+)]^{\#H_i}$ where $(\mathbb{R}^{M_i}_+)$ is a probability measure, one for each entrepreneur. Let its production activities be denoted by $(q, \xi) = (q, (\xi_j)_{j \in H_i}) \in Q(H_i)$, where ξ_j

is a generic element of $(\mathbb{R}_+^{M_i})$. The F_i entrepreneurs in N_{ei} organized in the hierarchical form H_i controls the inputs and determines the policy of the production entity. It is important to note that this choice of policy is influenced indirectly by the producer's ability to raise funds which is, in turn, determined by the type of the production entity.

2.2.1 The For-Profit Firm

Let a set of F_1 entrepreneurs in N_e1 form the for-profit firm H_1 where $H_1 = (F_1, \pi^{F_1})$. These entrepreneurs seek to create a surplus from the production activities and then claim a share of the profit derived from this surplus in the second period. They do so by choosing a production policy which generates the production activities $(q,\xi) = (q,(\xi^j)_{j\in H_1}) \in Q(H_1)$. The choice of a production policy is indirectly influenced by the firm's financing policy (S^{H_1},B^{H_1}), where S^{H_1} denote the amount of the firm's equity and B^{H_1} the amount of its debt. Thus, $(S^{H_1} + B^{H_1})$ is firm H_1's budget constraint and B^{H_1}/S^{H_1} its debt-equity ratio.

The coalition of entrepreneurs faces the choice of how much to borrow and from which source. First, because entrepreneurs are risk averse, they are reluctant to finance the firm's production through either debt or equity alone; they must choose an optimal debt-equity arrangement. Second, there exists a cost of borrowing to the entrepreneurs. In order to maximize the cooperative entrepreneurs' own objectives from production, they must limit the total amount borrowed. Let firm H_1's net revenue

(revenue less production cost) be denoted by $V(H_1)$. $V(H_1)$ is divided in three ways: $(1+r)B^{H_1}$ goes to the bondholders and the remainder, $[V(H_1) - (1+r)B^{H_1}]$ referred to as the net residual is divided between the entrepreneurs (inside shareholders) and the outside shareholders.[8] Let the proportion of the firm's net residual claimed by the entrepreneurs be denoted by β^{H_1}, which is referred to as the bonus share. $\beta^{H_1}[V(H_1) - (1+r)B^{H_1}]$ is the pure profit which is distributed to the cooperative entrepreneurs by the sharing rule determined through bargaining. The sharing rule is described by the bonus rate set $b^{H_1} := \{b \in \mathbb{R}_+^{\#H^1} \mid \sum_{j \in H_1} b_j^{H_1} = 1\}$. Accordingly, the entrepreneur $j \in H_1$ receives the bonus income $b_j^H \beta^H [V(H_1) - (1+r)B^{H_1}]$. Finally, $(1-\beta)[V(H_1) - (1+r)B^{H_1}]$ is the dividend income, which is distributed to the outside shareholders

according to the proportion of shares purchased by each shareholder $\theta_j^{H_1}$, where $\theta_j^{H_1} = S_j^{H_1} / \sum_{k \in N} S_k^{H_1}$.

Owing to the fact that $V(H_1)$ is divided into three ways, it is evident that even though entrepreneurs must borrow in order to make production possible, there exists a trade off between the amount borrowed and the portion of $V(H_1)$ that the entrepreneurs can retain for themselves. The entrepreneurs will only borrow to the extent that their own interests are best served.

In sum, the for profit firm H_1 is formed whenever (1) a set of F_1 entrepreneurs agrees to organize themselves in the hierarchical form $H_1 \in \mathcal{H}_1$, (2) they agree to adopt a strategy $[(q^{H_1}, \xi^{H_1}), b^{H_1}, \beta^{H_1}, B^{H_1}, S^{H_1}]$, and (3) the firm can acquire the necessary financing. Moreover, if the hierarchical coalition structure $\mathcal{H}_1$ prevails, then the firms $(H_1 | H_1 \in \mathcal{H}_1)$ co-exist.

2.2.2 The Non-Profit Firm

Let a set of F_2 non-profit seeking entrepreneurs ($F_2 \subset N_e 2$) organize the non-profit firm H_2 where $H_2 = (F_2, \pi^{F_2})$. H_2's production activity is $(q, \xi) = (q, (\xi^j)_{j \in H_2}) \in Q(H_2)$, it is influenced by the firm's internal organization, its financing policy and reward structure $(B^{H_2}, d^{H_2}, w^{H_2})$, where $d^{H_2} = \{d \in \mathbb{R}_+^{\#H_2} | \sum_{j \in H_2} d_j^{H_2} = 1\}$ is the deficit sharing rule for the entrepreneurs in H_2. The rewards to the non-profit seeking entrepreneurs is described by the salary structure w^{H_2}, with generic element $w_j^{H_2}$. The salaries are determined in the first

period. For two reasons, we are not concerned about the moral hazard issues here. First, the members in N_{e2} cannot claim profit and are assumed to be altruistic, therefore, are not apt to behave opportunistically. Second, the entrepreneurs in H_2 are responsible for making up deficits incurred in production in period 2 according to the deficit sharing rule d^{H_2} determined in period 1. Let this deficit be $\min\{0,[V(H_2) - (1+r)B^{H_2} + \sum_{j\in N} g^{j,H^2}]\}$ where g^{j,H^2} is the amount of donations collected from agent j by H_2 in the second period. The presence of this potential deficit inhibits shirking.

Again, when a set of F_2 non-profit entrepreneurs comes together agreeing to organize in the hierarchical form $H_2 \in \mathcal{H}_2$ and to adopt a given set of policies $[(q^{H_2},\xi^{H_2}),B^{H_2},d^{H_2},w^{H_2}]$, which include a feasible financing policy, the non-profit firm H_2 is formed. If the hierarchical coalition structure $\mathcal{H}_2$ prevails, the firms $(H_2|H_2 \in \mathcal{H}_2)$ co-exist.

2.2.3 The Local Community

Let a set of F_3 public entrepreneurs ($F_3 \subset N_e3$) organize the local community h_3. They form the government $H_3 = (F_3,\pi^{F_3})$ which controls the community's production policy for public goods and generates activity $(q,\xi) = (q,(\xi^j)_{j\in H_3}) \in Q(H_3)$. The choice of this activity is influenced by the government's internal organization π^{F_3}, its financing policy and the entrepreneurs' reward structure. The reward to the public entrepreneurs are described by salary structure w^{H_3} with the generic element $w_j^{H_3}$. The salaries are,

for simplicity, distributed in period 1. H_3's financing policy is represented by (B^{H_3}, t^{H_3}) where t^{H_3} is its tax structure. Let us assume that entrepreneurs borrow $B^{H_3} = Pq_{M_1}^{H_3} + \sum_{j \in H_3} w_j^{H_3}$ in period 1 to organize the community h_3 by purchasing $q_{M_1}^{H_3}$ in order to construct a set of public goods z^{H_3}. The cost of z^{H_3} is, therefore, $pq_{M_1}^{H_3}$. The community h_3 then must pay this debt in the second period by collecting taxes from its citizens. Both the level and the composition of z^{H_3} as well as the tax structure t^{H_3} affect the size and the complexion of the community; they either attract citizens to

or discourage them from the community. For simplicity, we assume that a uniform tax rate t^{H_3}/dollar of income (or equivalency t^{h_3}/dollar of income) is levied on each citizen in the community h_3. Accordingly, the community h_3's budget constraint in the first period is $pq_{M_1}^{H_3} + \sum_{j \in H_3} w_j^{H_3} = B^{H_3}$ and its projected tax revenue in the second period is $(1+r)B^{H_3} = \sum_{j \in h_3} t^{H_3} \hat{I}_j$, where $\hat{I}_j$ is agent j's expected income in the second period.

Again, when a set of F_3 public entrepreneurs come together, agreeing to organize in the hierarchical form $H_3 \in \mathcal{H}_3$ and to adopt a given set of policies $[(q^{H_3}, \xi^{H_3}), B^{H_3}, t^{H_3}, w^{H_3}]$, the community h_3 is formed provided that its financing policy is feasible. If the hierarchical structure $\mathcal{H}_3$ prevails at equilibrium, the communities organized by the governing bodies $(H_3 | H_3 \in \mathcal{H}_3)$ co-exist.

2.3 Endogenous Variables

The model under construction is intended to formulate market and non-market mechanisms which determine the values of the following first period endogenous variables:

The hierarchical coalition structures: $(\mathcal{H}_1, \mathcal{H}_2, \mathcal{H}_3) \in \tilde{\mathcal{H}}$

The market prices and interest rate: $(\mathbf{P}, r) \in \Delta^{M_1} \times \mathbf{R}_+^1$

The consumption-investment bundles: $(x^{1j}, S_j, B_j)_{j \in N} \in \prod_{j=1}^{N} (X^1{}_j \times S_j \times B_j)$

The input-output bundles: $(q^H, \xi^H) \in Q(H)$ for $\forall\, H \in \mathcal{H}$

77

The entrepreneurial returns and commitments:

$$b^{H_1} \in \Delta^{H_1} \text{ and } \beta^{H_1} \in [0,1] \qquad \text{for } \forall\, H_1 \in \mathcal{H}_1$$

$$d^{H_2} \in \Delta^{H_2} \text{ and } w^{H_2} \in \mathbb{R}_+^{H_2} \text{ for } \forall\, H_2 \in \mathcal{H}_2$$

$$t^{H_3} \in \mathbb{R}_+^{1} \text{ and } w^{H_3} \in \mathbb{R}_+^{H_3} \text{ for } \forall\, H_3 \in \mathcal{H}_3$$

Which satisfy the conditions:

(1) $$\zeta_{M_1}^{1j} + \sum_{H_1 \in \mathcal{H}_1} S_j + \sum_{H \in \mathcal{H}} B_j^{H} \leq \begin{cases} (1-t^{H_3(j)})P\omega^{1j} & \forall j \in N \setminus N_{e_2} \cup I \\ (1-t^{H_3(j)})[p\omega^{1j} + w_j^{H_2}] & \forall j \in N_{e_2} \\ (1-t^{H_3})[p\omega^{1j} + w_j^{H_3(j)}] & \forall j \in N_{e_3} \end{cases}$$

(2) $$Pq_{M_1}^{H_1} \leq B^{H_1} + S^{H_1} \qquad \forall\, H_1 \in \mathcal{H}_1$$

$$S^{H_1} = \sum_{j \in N} S_j^{H_1}$$

$$q_L^{H_1} \leq \sum_{j \in H_1} \tau^{1j}$$

(3) $$Pq_{M_1}^{H_2} + \sum_{j \in H_2} w_j^{H_2} \leq B^{H_2} \qquad \forall\, H_2 \in \mathcal{H}_2$$

$$q_L^{H_2} \leq \sum_{j \in H_2} \tau^{1j}$$

(4) $$Pq_{M_1}^{H_3} + \sum_{j \in H_3} w_j^{H_3} \leq B^{H_3} \qquad \forall\, H_3 \in \mathcal{H}_3$$

$$q_L^{H_3} \leq \sum_{j \in H_3} \tau^{1j}$$

(5) $$\sum_{j\in N} x_{M_1}^{1j} + \sum_{H\in\mathcal{H}} q_{M_1}^{H} \le \sum_{j\in N} \omega^{1j}$$

$$P\left(\sum_{j\in N} x_{M_1}^{1j} + \sum_{H\in\mathcal{H}} q_{M}^{H} \right) = P\left(\sum_{j\in N} \omega^{1j} \right),$$

(6) $$\sum_{j\in N} B_j^H = B^H \qquad \forall\, H \in \mathcal{H}$$

These variables are determined jointly by the entrepreneurs who act cooperatively with each other, by consumers, investors and firms who act non-cooperatively, and by the price adjusting mechanism of the market. In order to analyze the agents' behaviors, both cooperative and non-cooperative, one must discuss the incentive of each agent. However, before doing so, we need to identify the firm sector structure.

2.4 Firm Sector Structure

A <u>firm sector structure</u> Ξ_f is a list of specific values of the endogenous variables which describe the activities and the financial structure of the realized firms, and the current price-interest rate vector. Symbolically,

$$\Xi_f = ((\mathcal{H}_1,\mathcal{H}_2,\mathcal{H}_3),\{(q^{H_1},\xi^{H_1}),S^{H_1},B^{H_1},\beta^{H_1},b^{H_1}\}_{H_1\in\mathcal{H}_1},$$

$$\{(q^{H_2},\xi^{H_2}),B^{H_2},w^{H_2},d^{H_2}\}_{H_2\in\mathcal{H}_2},(q^{H_3},\xi^{H_3}),B^{H_3},w^{H_3},t^{H_3}\}_{H_3\in\mathcal{H}_3},P,r).$$

Marks may be used to distinguish a particular firm sector structure from another. For example, $\bar{\Xi}_f$ stands for the prevailing firm sector structure.

2.5. Agent's Choice Problems

Since our primary objective is to determine the equilibrium values for the endogenous variables in the first period, we need to obtain the derived utility function for each agent. For this purpose we first describe the formation of each agent's expectations about the second period prices and outputs, and then describe the agent's second period decision problem. Both of these problems depend crucially upon whether the agent is or is not an entrepreneur.

2.5.1 Agents as Non-Entrepreneurs

An agent $j \in N\backslash N_e$ is a price taker and is incapable of affecting the firm sector structure. As such, agent j perceives that anything he does will not affect the market environment. Consequently, in making his future choices, agent j will take $\bar{\Xi}_f$ as given and will passively form a subjective belief about the future prices and outputs (p^2,m^2), where $p^2 \in \mathbb{R}_+^{M_1}$ and $m^2 \in M$ is the vector of outputs in the three sectors. The function

$$\hat{\mu}^j : [\bar{\Xi}_f] \to (\Delta^{M_1} \times (\mathbb{R}_+^{M})^{\#\mathcal{H}}) \qquad \text{for } j \in N\backslash N_e$$

describes the formation of j's belief. This function is an exogenously given datum of the model.

In order to obtain agent j's derived utility function, we need also to describe his second period decision problem. Given his choice $(x_{M_1}^{1j},S_j,B_j)$ made in the first period, $t = (t^{H_3})_{H_3 \in \mathcal{H}_3}$ announced by the various communities in the first period, and the realized (p^2,m^2) in the second period, the non-entrepreneur agent j will choose the second

period consumption bundle from the budget set which offers him the highest satisfaction. Let the charitable commodities prices be denoted by the vector p_{M_2}, and let the variables with "^" denote its expected value and with "—" denote the value at which it is held constant. Assuming that the prices of the charitable commodities are fixed exogenously at $\bar{P}_{M_2}$, a non-entrepreneur's second period choice problem becomes choosing $(x^{2j}, y^j, g^j, h_3(j)) \in X^2j \times Y^j \times G^j \times Z^j$

$$\text{to} \quad \max \quad u^j(x^1j, x^2j, y^j, g^j, z^{h3(j)})$$

$$\text{s.t.} \quad P^2 x^{2j}_{M_1} + \bar{P}_{M_2}\, y^j + \sum_{H_2 \in \mathfrak{H}_2} g^{j,H_2} \leq (1-t^{h_3(j)})\hat{I}2j$$

where $h_3(j)$ denote the community that j chooses to reside in and

$$\hat{I}^{2j} = \left\{ \sum_{H_1 \in \bar{\mathfrak{H}}_1} \theta_j^{H_1}(1-\beta^{H_1}) \left[p^2 x^{2H_1}_{M_1} - B^{H_1}(1+\bar{r})\right] + \sum_{H \in \bar{\mathfrak{H}}} B_j^H(1+\bar{r}) \right\},$$

The above maximization problem yields $\hat{x}^{2j}(x^1j, \hat{I}2j)$, $\hat{y}j(x^1j, \hat{I}2j)$, $\hat{g}^j(x^1j, \hat{I}2j)$, and $h_3(j)(x^1j, \hat{I}2j)$. With these solutions in hand, agent j's derived utility function can be written as

$$\hat{U}^j(x^{1j}, S_j, B_j; \bar{\Xi}_f) = \int_{<p^2, m^2>} u^j(x^{1j}, \hat{x}^{2j}, \hat{y}^j, \hat{g}^j, \hat{z}^{h_3(j)},) d\hat{\mu}^j[\bar{\Xi}_f](p^2, m^2).$$

2.5.2 Agents as Entrepreneurs

The derivation of the derived utility function for an entrepreneur is more complex. This complexity stems from the fact that the formation of expectations by the entrepreneur and the resulting entrepreneurial behavior may affect firms' choice of

strategies and the firm sector structure. These changes, in turn, affect the agent's expectations about the future variables. Owing to the fact that there exists a difference in the expectation formation between entrepreneurs in the for-profit sector, non-profit sector, and the public sector, we shall divide this section into three subsections.

Agents as For-Profit Entrepreneurs: Suppose entrepreneurs in some $H_1 \in e^1$ reject the prevailing coalition structure and want to form a firm of their own. In order to calculate whether such a move is desirable, each conspiring entrepreneur in H_1 must estimate his resulting income caused by such a move. This involves the estimation of the outsider's reaction to this move and requires the formulation of subjective probabilities on the future events. Suppose the conspiring entrepreneurs propose a joint strategy $(S^{H_1}, B^{H_1}, \beta^{H_1}, b^{H_1})$. Each entrepreneur $j \in H_1$ must form expectations on other agents' reactions to the income determining variables. For each $j \in H_1$, these expectations are postulated as follows:

(a) $(\hat{\mathcal{H}}_1^{(j,H_1)}, \mathcal{H}_2^{(j,H^1)}, \mathcal{H}_3^{(j,H^1)}), : (S^{H_1}, B^{H_1}, \beta^{H_1}, b^{H_1}; \bar{\Xi}_f) \to \mathcal{H}$;

For $\forall H_1' \in \hat{\mathcal{H}}_1^{(j,H_1)}$.

(b) $\hat{b}^{H_1'(j,H^1)} : (S^{H_1}, B^{H_1}, \beta^{H_1}, b^{H_1}; \bar{\Xi}_f) \to \Delta^{H_1'}$;

(c) $\hat{\beta}^{H_1'(j,H^1)} : (S^{H_1}, B^{H_1}, \beta^{H_1}, b^{H_1}; \bar{\Xi}_f) \to [0,1]$;

(d) $\hat{S}^{H_1'(j,H^1)} : (S^{H_1}, B^{H_1}, \beta^{H_1}, b^{H_1}; \bar{\Xi}_f) \to \mathbb{R}_+^1$;

(e) $\hat{B}^{H_k(j,H_1)} : (S^{H_1},B^{H_1},\beta^{H_1},b^{H_1};\ \bar{\Xi}_f) \to \mathbb{R}^1_+$, where k=1,2,3;

(f) $\hat{t}^{H_3(j,H_1)} : (S^{H_1},B^{H_1},\beta^{H_1},b^{H_1};\ \bar{\Xi}_f) \to \mathbb{R}^1_+$.

Although it is perfectly alright for agents in H_1 to hold different expectations about other firms' choices which may affect each of their income determining parameters, however, in order to arrive at a cooperative choice of the input bundle for H_1, all entrepreneurs in H_1 must hold consistent expectations about variables in (b) - (e). Accordingly, we impose the following consistency conditions: For all $j \in H_1$,

C.1 $\hat{\square}^{H_1(j,H_1)} = \square^{H_1}$ where $\square = b,\beta,B,S.$

If these expectations lead to a higher expectation in income for all $j \in H_1$, then the entrepreneurs in H_1 would bargain for a joint strategy $(S^{H_1},B^{H_1},\beta^{H_1},b^{H_1},(q^{H_1},\xi^{H_1}))$. After this strategy is chosen, each entrepreneur in H_1 forms his subjective expectation on the probability distribution of the future events. These expectations are postulated by

$$\hat{\mu}^{(j,H_1)} : (S^{H_1},B^{H_1},\beta^{H_1},b^{H_1},(q^{H_1},\xi^{H_1});\ \bar{\Xi}_f) \to (\Delta^{M_1} \times (\mathbb{R}^M_+)^{\#\mathcal{H}^{(j,H_1}})).$$

Again, given j's choice of (x^{1j},S_j,B_j) in the first period, the expected tax rates $t = (\hat{t}^{H_3(j,H_1)})_{H_3 \in \mathcal{H}_3}$ of the various communities in the first period, and (p^2,m^2) realized in the second period, j will

choose a feasible consumption bundle and a community $(x^{2j}, y^j, g^j, h_3(j)) \in X^{2j} \times Y^j \times G^j \times Z^j$,

$$\text{to Max} \quad u^j(x^1{}_j, x^2{}_j, y^j, g^j, z^{h_3(j)})$$

$$\text{s.t.} \quad p^2 x^{2j}_{M_1} + \bar{p}_{M_2} y^j + \sum_{H_2 \in \mathcal{H}_2^{\wedge}(j, H_1)} g^{j, H_2} \leq (1 - t^{\wedge h_3(j, H^1)}) I^{\wedge}_{2j}$$

where

$$\hat{I}^{2j} = \sum_{H_1 \in \hat{\mathcal{H}}_1^{(j,H_1)}} \theta_j^{H_1}(1-\beta^{H_1})\left[p^2 x_{M_1}^{2H_1} - B^{H_1}(1+\bar{r})\right] + b_j^{H_1(j)}\beta^{H_1(j)}\left[p^2 x_{M_1}^{2H_1(j)} - B^{H_1(j)}(1+\bar{r})\right] + \sum_{H \in \hat{\mathcal{H}}}$$

The above maximization problems yield the solutions $\hat{x}^{2j}(x^1j,\hat{I}2j)$, $\hat{y}2j(x^1j,\hat{I}2j)$, $\hat{g}j(x^1j,\hat{I}2j)$, and $z^{h_3(j}(x^1j,\hat{I}2j)$ for $j \in N_{e1}$. Accordingly, agent j's derived utility function becomes:

$$\hat{U}^{(j,H_1)}(x^{1j}, S_j, B_j, S^{H_1}, B^{H_1}, \beta^{H_1}, b^{H_1}, (q^{H_1}, \xi^{H_1}); \bar{\Xi}_f)$$

$$= \int_{<p^2, m^2>} u^j(x^{1j}, \hat{x}^{2j}, \hat{y}^j, \hat{g}^j, \hat{z}^{h_3(j)}) d\hat{\mu}^{(j,H_1)}[\bar{\Xi}_f](p^2, m^2).$$

Agents as Non-Profit Entrepreneurs: Assume the entrepreneurs in some $H_2 \in e^2$ rejects the prevailing coalition structure and wish to form a non-profit firm of their own. In order to calculate whether such a move is desirable, each $j \in H_2$ must estimate his expected income following such a move. As in the previous case, this calculation involves j's estimation of the outsiders' reactions to this move and requires the formation of his subjective joint probability distribution over the future events (p^2, m^2). Suppose the conspiring entrepreneurs propose a joint strategy $(B^{H_2}, d^{H_2}, w^{H_2})$. Each entrepreneur $j \in H_2$ must form

expectations on other agents' reactions which affect his own income in the second period. For each $j \in H_2$, these expectations are:

(a') $(\hat{\mathcal{H}}_1^{(j,H_2)}, \hat{\mathcal{H}}_2^{(j,H^2)}, \hat{\mathcal{H}}_3^{(j,H^2)}) := (B^{H_2}, d^{H_2}, w^{H_2}; \bar{\Xi}_f) \to \tilde{\mathcal{H}}$;

(b') $\hat{b}^{H_1(j,H^2)} : (B^{H_2}, d^{H_2}, w^{H_2}; \bar{\Xi}_f) \to \Delta^{H_1}$

(c') $\hat{\beta}^{H1(j,H_2)} : (BH_2, dH_2, wH_2; \bar{\Xi}_f) \to [0,1]$

(d') $\hat{S}^{H_1(j,H^2)} : (B^{H_2}, d^{H_2}, w^{H_2}; \bar{\Xi}_f) \to \mathbb{R}^1_+$;

(e') $\hat{B}^{Hk(j,H_2)} : (BH_2, dH_2, wH_2; \bar{\Xi}_f) \to \mathbb{R}^{1}_{+}$ where k=1,2,3,;

(f') $\hat{t}^{H_3(j,H^2)} : (B^{H_2}, d^{H_2}, w^{H_2}; \bar{\Xi}_f) \to \mathbb{R}^1_+$

(g') $\hat{d}^{H2(j,H_2)} : (BH_2, dH_2, wH_2; \bar{\Xi}_f) \to \Delta^{H_2}$

In addition, since H_2 is the sole producer of y^{H_2}, each $j \in H_2$ must also form an expectation on the demand for his own firm's output:

(h') $\hat{y}^{H_2(j)} : (B^{H_2}, d^{H_2}, w^{H_2}; \bar{\Xi}_f) \to \mathbb{R}^1_+$

and on the amount of donations that H_2 will collect in the second period,

(i') $\hat{D}^{H_2(j)} : (B^{H_2}, d^{H_2}, w^{H_2}, g^{j,H_2(j)}, (q^{H_2}, \xi^{H_2}); \bar{\Xi}_f) \rightarrow \mathbb{R}^1_+$

where $g^{j,H_2(j)}$ denote entrepreneur j's donation to his own firm.

In order to make cooperation possible all entrepreneurs in H_2 must expect that there exist sufficient funds to finance the production of y^{H_2} and must hold consistent expectations about (e'), (g'), (h') and (i'); i.e.,

C.2 $\hat{\square}^{H_2(j,H_2)} = \square^{H_2}$ for $\square$ = B, d, y, and D.

If these expectations lead to a favorable result on income for all $j \in H_2$, then the cooperative entrepreneurs in H_2 will bargain for a joint strategy $(B^{H_2}, d^{H_2}, w^{H_2}, (q^{H_2}, \xi^{H_2}))$. After this strategy is chosen, each entrepreneur $j \in H_2$ forms his subjective expectations on the probability distribution of the future events. These expectations are postulated by:

$$\hat{\mu}^{(j,H_2)} : (B^{H_2}, d^{H_2}, w^{H_2}, (q^{H_2}, \xi^{H_2}); \bar{\Xi}_f) \rightarrow (\Delta^{M_1} \times (\mathbb{R}^M_+)^{\#\mathcal{H}(j,H_2)})$$

Given entrepreneur j's choice of (x^{1j}, S_j, B_j) in the first period, the expected rate $t = (\hat{t}^{H_3(j,H^2)})_{H_3 \in \mathcal{H}_3}$ of the various communities in the first period, and (p^2, m^2) realized in the second period, j will choose a feasible consumption bundle $(x^{2j}, y^j, g^j, h_3(j)) \in X^{2j} \times Y^j \times G^j \times Z^j$

$$\text{to max} \quad u^2(x^1j, x^2j, y^j, g^j, z^{h_3(j)})$$

$$\hat{t}^{h_3(j,H^2)} \text{ s.t. } p^2 x^{2j}_{M_1} + \bar{p}_{M_2} y^j + \sum_{H_2 \in \hat{\mathcal{H}}_2(j,H_2)} g^{j,H_2} \leq (1-$$

$$t^{\hat{}h_3(j,H^2)})\hat{I}^{2j}$$

where

$$\hat{I}^{2j} = \sum_{H_1 \in \hat{\mathcal{H}}_1(j,H_2)} \hat{\theta}_j^{H_1(j,H^2)}(1 - \hat{\beta}^{H_1(j,H^2)})[p^2 x^{2H_1}_{M_1}$$

$$- (1+\bar{r})\hat{B}^{H_1(j,H^2)}] + \sum_{H \in \hat{\mathcal{H}}(j,H_2)} (1+\bar{r})\hat{B}^{H(j,H^2)}_j$$

$$(1+\bar{r})\hat{B}^{H_2(j}, 0\}. + \hat{d}^{H_2(j}_j) \text{ Min}\{\hat{D}^{H_2(j)} + \bar{P}_{M_2} \text{ Min}(\hat{y}^{H_2(j}), y^{H_2}) -$$

The above maximization problem yields the solution $\hat{x}^{2j}(x^{1}j,\hat{I}2j)$, $\hat{y}j(x^{1}j,\hat{I}2j)$, $\hat{g}j(x^{1}j,\hat{I}2j)$ and $\hat{z}^{h_3(j}{}_{)}(x^{1}j,\hat{I}2j)$. Accordingly, entrepreneur j's derived utility function becomes

$$\hat{U}^{(j,H_2)}(x^{1}j,S_j,B_j,B^{H_2},d^{H_2},w^{H_2},(q^{H_2},\xi^{H_2});\ \bar{\Xi}_f)$$

$$= \int_{<p^2,m^2>} u^j(x^{1}j,\hat{x}2j,\hat{y}j,\hat{g}j,\hat{z}^{h_3(j}{}_{))}d\mu^{(j,H^2)}[\bar{\Xi}_f](p^2,m^2)$$

Agents as Public Entrepreneurs: Suppose entrepreneurs in some $H_3 \in e^3$ reject the prevailing coalition structure and want to form a community of their own. In order to calculate whether such a move is desirable, each conspiring entrepreneur in H_3 must estimate his resulting income by such a move. Again, the calculation involves j's estimation of the outsiders' reactions to the move and requires the formation of his subjective joint probability distribution over the future events. Suppose the conspiring entrepreneurs agree on a joint strategy $(B^{H_3},t^{H_3},w^{H_3})$. Each entrepreneur $j \in H_3$ must form expectations on other agents' reactions which affects his own income in the second period. For each $j \in H_3$, these expectations are

(a") $(\hat{\mathcal{H}}_1^{(j,H_3)},\mathcal{H}_2^{(j,H^3)},\mathcal{H}_3^{(j,H^3)}) : (B^{H_3},t^{H_3},w^{H_3};\ \bar{\Xi}_f) \to \tilde{\mathcal{H}}$

(b") $\hat{b}^{H_1(j,H^3)} : (B^{H_3},t^{H_3},w^{H_3};\ \bar{\Xi}_f) \to \triangle^{H'}$

(c") $\hat{\beta}^{H_1(j,H_3)} : (B^{H_3}, t^{H_3}, w^{H_3}; \bar{\Xi}_f) \to [0,1]$

(d") $\hat{S}^{H_1(j,H_3)} : (B^{H_3}, t^{H_3}, w^{H_3}; \bar{\Xi}_f) \to \mathbb{R}^1_+$

(e") $\hat{B}^{Hk(j,H_3)} : (BH_3, tH_3, wH_3; \bar{\Xi}_f) \to \mathbb{R}1_+$, where $k=1,2,3$

(f") $\hat{t}^{H_3(j,H_3)} : (B^{H_3}, t^{H_3}, w^{H_3}; \bar{\Xi}_f) \to \mathbb{R}1_+$

In addition, all entrepreneurs in H_3 must form expectations about the amount of taxes that will be collected in h_3

(g") $\hat{T}^{h_3(j)} : (B^{H_3}, t^{H_3}, w^{H_3}, (q^{H_3}, \xi^{H_3}); \bar{\Xi}_f) \to \mathbb{R}^1_+$

Again, all entrepreneurs in H_3 must expect that there exist sufficient funds to finance the production of z^{H_3} and that (e"), (f") and (g") satisfy the following consistency condition

C.3 $\hat{\square}^{H_3(j,H_3)} = \square^{H_3}$ for $\square$ = B, t and T

If these expectations lead to favorable results on income for all $j \in H_3$, then the cooperative entrepreneurs in H_3 will bargain for a joint strategy $(B^{H_3}, t^{H_3}, w^{H_3}, (q^{H_3}, \xi^{H_3}))$. After this strategy is chosen, each entrepreneur $j \in H_3$ forms his subjective probability distribution of future events:

$$\hat{\mu}^{(j,H_3)} : (B^{H_3}, t^{H_3}, w^{H_3}, (q^{H_3}, \xi^{H_3}); \bar{\Xi}_f)$$
$$\to (\Delta^{M_1} \times (\mathbb{R}^M_+)^{\#\hat{\mathcal{H}}(j,H_3)})$$

Given entrepreneur j's choice of (x^{1j},S_j,B_j) and $t^{H_3(j}$) in the first period and (p^2,m^2) realized in the second period, j will choose a feasible consumption bundle $(x^{2j},y^j,g^j) \in X^2{}_j \times Y^j \times G^j$

$$\text{to max} \quad u^2(x^1{}_j,x^2{}_j,y^j,g^j,\bar{z}^{H_3(j)})$$

$$t^{h_3(j}{}_{))}\hat{I}^{2j} \text{s.t. } p^2x^{2j}_{M_1} + \bar{p}_{M_2}y^j + \sum_{H_2\in\mathcal{H}_2}\hat{}(j,H_3) \; g^{j,H_2} \leq (1-$$

where

$$\hat{I}^{2j} = \sum_{H_1 \in \hat{\mathcal{H}}_1(j,H_3)} \hat{\theta}_j^{H_1(j,H^3)} (1-\hat{\beta}^{H_1(j,H^3)}) \, [p^2 x^{2H_1}_{M_1} - (1+\bar{r})\hat{B}^{H_1(j,H^3)}] + \sum_{H \in \hat{\mathcal{H}}(j,H_3)} (1+\bar{r}) B_j^{H(j,H_3)}$$

The above maximization problem yields the solution $\hat{x}^{2j}(x^1j,\hat{I}2j)$, $\hat{g}j(x^1j,\hat{I}2j)$ and $\hat{y}j(x^1j,\hat{I}2j)$. Accordingly, entrepreneur j's derived utility function becomes

$$\hat{U}^{(j,H_3)}(x^1j,S_j,B_j,B^{H_3},t^{H_3},w^{H_3},(q^{H_3}(j),\xi^{H_3}); \bar{\Xi}_f)$$

$$= u^j(x^1j,\hat{x}2j,\hat{y}j,\hat{g}j,\int_{H_3(j)} z^2(p^2,m^2))d\mu^{(j,H^3)}[\bar{\Xi}_f](p^2,m^2)$$

2.6 The Economy

In this section, we state explicitly the endogenous data of the model and the equilibrium conditions for the Three-Sector Economy.

Definition 1: The Three-Sector Economy $\mathscr{E}$ is a list of specific data:

$$\{N, N_{e1}, N_{e2}, N_{e3}, \{X1j, X2j, Yj, Gj, Zj, uj, \omega 1j\}_{j \in N}, (\tau j)_{j \in N_e}, (\mu j)_{j \in N},$$

$$\{Q(H)\}_{H \in \tilde{\mathcal{H}}}, \bar{P}_{M_2}\}$$

The endogenous variables of the model are given in Section 2.3. In this section, we present the economic mechanisms which determine the equilibrium values of these variables.

Definition 2: An equilibrium of the economy $\mathscr{E}$ is a six-tuple

$$(\mathcal{H}_1^*, \mathcal{H}2^*, \mathcal{H}3^*) \in \tilde{\mathcal{H}}$$

$$(P^*, r^*) \in \Delta^{M_1} \times \mathbb{R}_+^1$$

$$(x^{1j*}, S_j^*, B_j^*) \in X^1_j \times \mathbb{R}_+^{\mathcal{H}_1^*} \times \mathbb{R}^1 \qquad \text{for } j \in N$$

$$((q^{H_1^*}, \xi^{H_1^*}), b^{H_1^*}, \beta^{H_1^*}, B^{H_1^*}, S^{H_1^*}) \in Q(H_1) \times \Delta^{H_1} \times [0,1] \times \mathbb{R}_+^1 \times \mathbb{R}_+^1 \qquad \text{for } H_1 \in \mathcal{H}_1^*$$

$$((q^{H_2^*}, \xi^{H_2^*}), d^{H_2^*}, B^{H_2^*}, w^{H_2^*}) \in Q(H_2) \times \Delta^{H_2} \times \mathbb{R}_+^1 \times \mathbb{R}_+^{H_2} \qquad \text{for } H_2 \in \mathcal{H}_2^*$$

$$((q^{H_3^*}, \xi^{H_3^*}), {}^{t}H_3^*, B^{H_3^*}, w^{H_3^*}) \in Q(H_3) \times [0,1]^{R_{H_3}} \times \mathbb{R}_+^{R_{H_3}} \qquad \text{for } H_3 \in \mathcal{H}_3^*$$

which

(i) satisfy the conditions (1) - (6)

(ii) for any non-entrepreneur $j \in N \backslash N_e$ and any $(x^{1j}, S_j, B_j) \in X^1_j \times \mathbb{R}_+^{\mathcal{H}^*1} \times \mathbb{R}^1$ satisfying the budget constraint

(1) $P^* x^{1j}_{M_1} + \sum_{H_1 \in \mathcal{H}_1^*} S_j^{H_1} + B_j \leq (1 - t^{h_3(j)}) P^* \omega^{1j}$

it follows that

(*) $\hat{U}^j(x^1j, S_j, B_j; \Xi^* f) \leq \hat{U}j(x^{1j}*, S^*j, B^*j; \Xi^* f)$.

(iii) For any $j \in H_1^* \in \mathcal{H}^*1$, any $(x^1j, S_j, B_j) \in X^1j \times \mathbb{R}_+^{\mathcal{H}1} \times \mathbb{R}^1$ and any

$((q^{H_1}, \xi H_1), bH_1, \beta H_1, BH_1, SH_1) \in Q(H_1) \times \Delta H_1 \times [0,1] \times \mathbb{R}_+^1 \times \mathbb{R}_+^1$

satisfying

(1) $P^* x^{1j}_{M_1} + \sum_{H_1 \in \mathcal{H}_1} S_j^{H_1} + B_j \leq (1 - t^{h_3(j)}) P^* \omega^{1j}, \qquad j \in H_1$

(2) $P^* q^{H_1}_{M_1} \leq S^{H_1} + B^{H_1}$

$$S^{H_1} = \sum_{j \in N} S_j^{H_1}$$

$$q_L^{H_1} \leq \sum_{j \in H_2} \tau^{1j}$$

it is not true that

(*) $\hat{U}^{(j,H_1)}(x^{1j},S_j,B_j,S^{H_1},B^{H_1},\beta^{H_1},b^{H_1},(q^{H_1},\xi^{H_1});\ \Xi^*f)$

$>$

$\hat{U}^{(j,H_1^*(j))}(x^{1j*},S_j^*,B_j^*,S^{H_1^*(j)},B^{H_1^*(j)},\beta^{H_1^*(j)},b^{H_1^*(j)},$

$(q^{H_1^*(j)},\xi^{H_1^*(j)});\ \Xi_f^*)$

where $H_1^*(j) \in \mathcal{H}1^*$ with $j \in H1^*(j)$.

(iv) For any $j \in H_2^* \in {}^{\mathcal{H}*}{}_2$, any $(x_{1j},S_j,B_j) \in {}^{X_{1j}} \times I_+^{R\mathcal{H}_1}$

$\times\ \mathbb{R}_+^1$

$((q^{H_2},\xi^{H_2}),B^{H_2},d^{H_2},w^{H_2}) \in Q(H_2) \times \mathbb{R}_+^1 \times \Delta^{H_2} \times \mathbb{R}_+^{H_2}$

satisfying

(1) $P^* x_{M_1}^{1j} + \sum_{H_1 \in \mathcal{H}_1} S_j^{H_1} + B_j \le (1-t^{h_3(j)})\,(P^*\omega^{1j} + w_j^{H_2})$

(3) $P^* q_{M_1}^{H_2} + \sum_{j \in H_2} w_j^{H_2} \le B^{H_2} \qquad \forall\ H_2 \in \mathcal{H}_2$

$q_L^{H_2} \le \sum_{j \in H_2} \tau^{1j}$

it is not true that

$$(*)\quad \hat{U}^{(j,H_2)}(x^{1j},S_j,B_j,B^{H_2},d^{H_2},w^{H_2},(q^{H_2},\xi^{H_2});\ \Xi^*_f)$$
$$> \hat{U}^{(j,H^*(j))}(x^{1j*},S^*_j,B^*_j,B^{H^*_2(j)},d^{H^*_2(j)},w^{H^*_2(j)},$$
$$(q^{H^*_2(j)},\xi^{H^*_2(j)});\ \Xi^*_f)$$

where $H^*_2(j) \in \mathcal{H}^*2$ with $j \in H^*2(j)$.

(v) For any $j \in H^*_3 \in \mathcal{H}^*3$, any $(x^1j,S_j,B_j) \in X^1j \times \mathbb{R}_+^{H_1} \times \mathbb{R}^1$ and any

$((q^{H_3},\xi^{H_3}),B^{H_3},t^{H_3},w^{H_3}) \in Q(H_3) \times \mathbb{R}^1_+ \times [0,1] \times \mathbb{R}_+^{H_3}$

satisfying

$$(1)\quad P^* x^{1j}_{M_1} + \sum_{H_1 \in \mathcal{H}_1} S_j^{H_1} + B_j \le (1-t^{h_3(j)})(P^*\omega^{1j} + w_j^{H_3})$$

and

$$(4)\quad P^* q^{H_3}_{M_1} + \sum_{j \in H_3} w_j^{H_3} \le B^{H_3} \qquad \forall\ H_3 \in \mathcal{H}_3$$

$$q_L^{H_3} \le \sum_{j \in H_3} \tau^{1j}$$

it is not true that

$$(*)\quad \hat{U}^{(j,H_3)}(x^1j,S_j,B_j,B^{H_3},t^{H_3},w^{H_3},(q^{H_3},\xi^{H_3});\ \Xi^*f)$$
$$> \hat{U}^{(j,H^*3(j)}(x^{1j^*},S^*_j,B^*_j,BH^*3(j),tH^*3(j),wH^*3(j),$$

$$(q^{H^*_3(j)}, \xi^{H^*_3(j)}); \Xi^*_f)$$

where $H^*_3(j) \in \mathcal{H}^*3$ and $j \in H^*3(j)$.

The right hand side of the inequality (*) in (ii), (iii), (iv), and (v), respectively, is the expected utility level that agent j currently enjoys as a non-entrepreneur and as an entrepreneur, respectively, in the profit, non-profit and public sector. Condition (ii) thus states that the non-entrepreneur j cannot improve his expected utility by altering his own consumption-investment behavior. The left hand side of (*) in (iii), (iv), and (v), respectively, represents the expected utility level that the entrepreneur j in the profit, non-profit and public sector would get should he participate in a new coalition and agree to a different strategy. The (*) in (iii), (iv), and (v) state that no such new coalition among entrepreneurs in the profit, non-profit and public sector can improve each of their expected utility.

The economic mechanism formulated here reflects a mixture of market and non-market forces. First, each agent as a consumer and as a owner of tradeable resources must take the market prices (P,r) and tax rate t as given and chooses his strategy non-cooperatively so that the condition (ii) in definition 2 is satisfied. Second, entrepreneurs in the profit, non-profit and public sectors play the economy-wide cooperative game by forming firms and local communities. Given any price vector (P,r), stable core strategies, i.e., firms and communities as well as their production and financing policies including tax rates,

emerge as an outcome of this game satisfying conditions (iii), (iv) and (v). Finally, firms and local communities are demanders of resources and suppliers of goods and services. The resource owners, on the other hand, are demanders of goods and services and suppliers of inputs. The demand and supply interact in each market to determine commodity prices p and interest rate r. The economy reaches an equilibrium when no non-entrepreneur agent can improve his current activities by changing his own consumption and investment and no entrepreneur can improve his current activities by forming a new firm or community. The profit, non-profit and the public sectors co-exist under this equilibrium.[9]

3. Welfare Implications

We have presented a model which describes how different production entities are organized and how the three sector economy comes into a state of equilibrium. It is now possible for us to investigate whether this equilibrium outcome is efficient and equitable.

3.1 The Issues Concerning Efficiency

The traditional view is that the nonprofit and the public sectors are inherently inefficient. The inefficiency of the nonprofit sector stems from the belief that efficient allocation of resources can result only when the production entities strive to maximize profits by minimizing their costs of production. Since the nonprofit firms pursue objectives other than profits and face constraints which do not require cost minimization, it

is then natural to conclude that no one will assume the responsibility to police and discipline these firms' operations; hence, the nonprofit firms will necessarily function inefficiently.[10] This assessment is tempered somewhat by the presence of uncertainty and information asymmetry. It is argued that the existence of information asymmetry between buyers and sellers tends to enhance the efficiency of the nonprofit firms.[11] Specifically, the presence of information asymmetry induces the for-profit firms, operating under the cost constraint, to use its private information as a tool to exploit the consumers by lying about the quality of their products. However, the nonprofit firms, operating under the nondistribution constraint, will have less pressure to do the same and, hence, are more truthful about the quality of their products. By eliminating exploitive elements of information asymmetry between buyers and sellers, the allocative efficiency in the non-profit sector is necessarily higher than that in the for-profit sector. Despite this countervailing argument, it is fair to say that the prevailing view remains that the nonprofit firms, which seek objectives other than profits, are ungenial to efficient allocation of resources.

The inefficiency of the public sector, on the other hand, stems from the fact that public goods are indivisible and that this indivisibility discourages preference revelation. If the amount of tax paid by each individual to finance the production of a public good is based upon his revealed preference for it, then the individual will have the tendency to understate his true

valuation of that public good. As a consequence, the supply of public goods will be less than optimal. This proposition is true even when the public goods in question are local public goods. As long as the number of consumers exceeds the number of communities and the members' preferences in each community are not homogeneous, the above-mentioned proposition continues to hold and the incentive for free riding remains valid.

Given that both the nonprofit and the public sectors are inherently inefficient, it may be argued that even by grafting these two sectors onto an

efficient private for-profit sector, the resulting three sector equilibrium is, in general, inefficient. In order to restore efficiency, additional constraints, such as the incentive compatible constraint and the efficiency constraint, must be imposed on individual behaviors. As a consequence of these added constraints, it should not be surprising to find that the conditions required to attain an efficient three sector general equilibrium are indeed stringent.

For two reasons, the aforementioned causes of allocative inefficiency in the traditional economy do not play a role in the entrepreneur-centered economy. First, in the entrepreneur-centered economy, the issue of the firm's objective is irrelevant since all production entities are coalitions of entrepreneurs. As such, the firm does not have a "pre-determined objective" but merely serves as a vehicle for the entrepreneurs to pursue each of their own self-interests. Second, the free rider problem in the public sector is circumvented because each individual's true preference for a set of local public goods is revealed by his choice to reside in a specific community.

In order to assess whether the entrepreneur-centered economy is allocatively efficient, we briefly recount the three sets of activities that take place simultaneously in this economy: the trading activities of all agents, the coalition formation activities of the entrepreneurs, and the equilibrating activities of the market process. The allocative efficiency of the economy depends qualitatively on all these activities.

First, each agent, when buying or selling a traded commodity in the market, acts non-cooperatively. He takes the coalition structure, market prices, interest rate, the vector of public goods, and the vector of community tax rates as given and chooses the best alternative subject to his budget constraint. Specifically, his choices in the for-profit and non-profit sectors are routine. He equates the marginal rate of substitution of each pair of commodities in the for-profit and non-profit sectors with their price ratio. His choice of public goods involves moving to a specific community. Given the spectrum of public good bundles and tax rates offered by the various communities, each agent chooses to live in the community where his marginal rate of substitution between public and private goods is commensurate with the tax that he pays. He is not willing to move either to a community that offers a more desirable bundle of public goods since he must pay a higher tax or to a community that levies a lower tax because it offers a less desirable bundle of public goods. As a consequence, by choosing a community to live in, each individual reveals his true preference for the public goods and thus prevents the free rider problem from surfacing. All told, the agents' market activities determine (reveal truthfully) their demand for goods and services in the for-profit, non-profit and public sectors as well as their supply of inputs.

Second, in order to convert entrepreneurial talents into income, each entrepreneur must participate in organizing a production entity and contribute to its management. Recall that

there are three distinct groups of entrepreneurs, namely, for-profit, not-for-profit, and public entrepreneurs. Given the market prices and the interest rate, entrepreneurs play an economy-wide cooperative game to form for-profit firms, non-profit firms, and local communities. At the conclusion of this game, not only the coalition structure of the economy is determined, the entrepreneurs in each production entity will also have agreed upon a production policy, a financing policy, and a sharing rule. Thus, at the conclusion of the game, a spectrum of private and public goods is determined. The production of any private goods satisfies the condition that the marginal cost of producing the good is equal to its price while the production of public goods in each community satisfies the condition that the sum of the individuals' marginal rate of substitution between public and private goods is equal to the marginal rate of transformation between these goods.

Finally, through interaction between demand and supply the market mechanism works to adjust prices and interest rate so that all markets are cleared and each community's expected tax revenue is equal to the cost of producing its public goods.

In sum, we see that there are simultaneously non-cooperative and cooperative behaviors in the entrepreneur-centered economy. Agents as buyers and sellers of tradeable commodities trade with each other in a non-cooperative manner while entrepreneurs act cooperatively with each other to form firms or communities. These activities interact to bring the three sector economy into a state of equilibrium. This equilibrium is described as a

solution to the associated non-side payment cooperative game. In this paper, we adopt the concept that a solution of the game exists whenever the core is not empty; that is, whenever there exists a set of feasible and stable utility allocations to the agents. Because the existence of a core implies that no other allocation is capable of improving any agent's utility allocation without hurting at least one other member of the society, we therefore conclude that the allocation in the entrepreneur-centered economy is Pareto efficient.

3.2 The Issues Concerning Equity

In the above section, we concluded that there exists an equilibrium in the three-sector economy whenever the core of the associated non-side payment game is not empty. However, from the ethical point of view, not all elements in the core are equally desirable. The concern about social optimality demands that something be said about the issue of equity.

In the neo-classical economy, not only consumption and production decisions can be made separately but, according to the second fundamental theorem of welfare economics, the issues concerning efficiency and equity can also be dealt with independently. The question of efficiency is tied directly to the competitiveness of the market while the ethical criteria must be determined outside the market. Suppose a set of such criteria has been selected and the most desirable outcome identified. This desired outcome can always be achieved by the competitive market after an appropriate lump sum transfer of initial endowments has been carried out. The belief that it is possible to deal with efficiency and equity issues separately serves as the guiding principle by which much of today's public policies are formulated.

In the entrepreneur-centered three-sector economy, not only is there a mutual dependence between production and consumption, the efficiency and equity issues also becomes inseparable. First of all, the provision of public goods necessarily implies redistribution of income provided that the consumers' preferences for the level of public goods are not correlated with their

incomes. Under this proviso, consumers with similar preferences but with different incomes will gravitate to the same community. Since the same bundle of public goods is consumed by all of those living in the same community but is paid for more by the rich and less by the poor, the end result is a more equitable sharing of the society's outputs. However, if the proviso is violated, consumers with relatively homogeneous tastes and income tend to live in the same community; segregation of communities by income will result and the re-distribution effect will be absent.

Likewise, the presence of the nonprofit sector also promotes more equitable distribution of the society's outputs. Specifically, in the nonprofit sector, benevolent entrepreneurs, workers, capitalists and other resource owners contribute their services to production at a sacrifice in pay, and the public also contributes to nonprofit producers in the form of charitable giving and tax exemption. All of these actions contribute to a more equitable distribution of real income. In addition, the dependence of utility on the amount of charitable givings also has the desirable tendency to shrink the core. For example, let the society be composed of two individuals, whose preferences are represented by u^1 and u^2, respectively, in the egotistic society and by v^1 and v^2 in the ethical society. In Figure 1, the pareto frontiers associated with the egotistic and ethical societies are labeled PP and P'P' respectively. The slope of PP is everywhere negative reflecting the selfishness of the individuals. A redistribution of the initial wealth from one individual to the other invariably decreases the utility of the former and

increases the utility of the latter. In contrast, the slope of P'P' is positive in some ranges and negative in others, reflecting that the individuals' utility are dependent upon each other's consumption of goods and services. Charitable giving is impelled by the feeling that when individual 1 is rich and individual 2 is poor, individual 1's utility increases if he gives part of his initial endowment to individual 2. Thus, P'A is positively sloped (the positively sloped range of P'B is similarly explained). However, charity has a limit. When 2's consumption of goods and services, with 1's help, exceeds a certain level, a further increase in the consumption of these goods and services by 2 will cause 1's indignation, and thus will reduce his utility. In terms of Figure 1, this critical level is reached at the income level associated with the point A for individual 1 and the point B for individual 2. Hence, the slope of P'P' in the range of AB becomes negative. Since the core of the game is composed of only the negatively sloped portion of the pareto frontier, it is evident that the core associated with the ethical society is smaller than that associated with the egotistic society.

Since, in Figure 1, the distribution represented by the arc AB belonging to the pareto frontier P'P' dominates the distribution represented by the arc A'B' belonging to the pareto frontier PP, the foregoing discussions also suggests that a society may improve its social welfare by shifting some of its resources, especially the entrepreneur resources, from the for-profit sector to the nonprofit and the public sectors, and also

by promoting altruistic ethics among its members. A formal verification of this proposition requires careful and systematic analysis; it is outside the scope of this paper. However, one thing is certain. Since efficient allocation of resources requires that the equilibrium outcome lands on the arc AB belonging to P'P' instead of belonging to PP, it is evident that the market institution alone can no longer guarantee this desired outcome. In order to attain a socially desirable outcome in a three-sector economy, social, economic, and ethical issues can no longer be dealt with in a disjointed manner. Consequently, all complementary social, ethical and economic institutions must be in place and work in sync with each other before an efficient and equitable outcome can ever become a reality.

4. Some Concluding Remarks

In this paper, we have presented a three-sector economy under the rubric of the entrepreneur-centered economy model where entrepreneurs take the responsibility to organize for-profit and nonprofit firms as well as local communities. Based upon Wu and Qin [1994] we surmise the existence of a competitive equilibrium in this economy. Under the assumption that all transaction costs associated with buying, selling, and moving are zero, we have shown that this equilibrium is pareto efficient. A distinguishing feature of this economy is that policies relating to consumption and production as well as policies directed to improve efficiency and equity are all mutually dependent. The recognition of this interdependence naturally leads to a change in the perception of what constitutes a sound policy and how policies should be designed. However, owing to a meager understanding of the entrepreneur-centered economy, it is premature for us to use the present model as a guide to formulate and evaluate public policies. Much more about the entrepreneur-centered economy needs to be understood. To do this, we need to expand the scope of the basic model presented in this paper. Three project come to mind immediately. First, we need to abandon the competitive structure of the economy assumed in this paper and build a model which includes public goods provisioned by the monopolistic central government. Second, the two-period temporary equilibrium model must be expanded to include several periods. This extension is important, for it will enable us to examine the issues associated with the long-run equilibrium,

reorganization of production entities, and bankruptcy. Finally, in the present model the number of entrepreneurs in the three sectors is assumed to be given exogenously. In order to fully understand the functioning of the entrepreneur-centered economy, we must investigate how the entrepreneurial factor comes into being and in what way entrepreneurs are distributed in the three sectors of the economy. Only with a clear understanding of this process will we be in a position to deal with important public policy issues in this economy. These are unquestionably challenging projects. In the meantime, we do hope the readers will agree with us that the basic model presented in this paper does provide a natural and fruitful framework which can be relied upon to build more elaborate and policy relevant models.

Endnotes

1. The collectively supplied private goods administered by the government include notably education, public health, etc.
2. For the nature of this problem see (Hurwicz, 1979).
3. Dennis Young (in Rose-Ackerman, 1986).
4. For a survey of this literature see Groves-Ledyard (1987).
5. This conclusion is, however, debatable. There is ample evidence to support the assertion that there are oversupply of national defense, highways, etc.
6. See Groves-Ledyard (1987) and Laffont-Maskin (1987).
7. In the presence of uncertainty, the firm cannot ascertain its shareholders' implicit prices and hence, will not be able to calculate the market value of its production plan. This inability leads to a failure in production in the private for-profit sector. In the case of the public goods, the community cannot ascertain the consumer's marginal benefit derived from consuming the public goods. This inability also leads to a failure of production in the public sector. As observed by Hurwiez (1972) and Dreze (1974), there exists a similarity between these market failures.
8. The difference between the inside and the outside shareholders is that the former are also entrepreneurs of the firm while the latter are not.
9. The existence of an equilibrium can be established by following the procedure introduced in Wu and Qin (1994).
10. See Alchian and Demsetz (1972).

11. See Easley and O'Hara (1983).

References

Alchian, A. and H. Demsetz (1972), "Production Information Costs and Economic Organization," American Economics Review,62, 777-95.

Dreze, J. H. (1974), "Investment Under Private Ownership: Optimality, Equilibrium and Stability." In J. H. Dreze (ed.), Allocation Under Uncertainty: Equilibrium and Optimality. New York: Halstead Press, 129-66.

Easley, D. and M. O'Hara (1983), "The Economic Role of the Non-Profit Firm," Bell Journal of Economics, 14, 531-8.

Greenberg, J. and S. Weber (1986). "Strong Tiebout Equilibrium Under Restricted Preferences Domain," Journal of Economic Theory, 38, 101-17.

Groves, T. and J. D. Ledyard (1987), "Incentive Compatibility Since 1972." In T. Groves, R. Radner and S. Reiter (eds.). Information, Incentives and Economic Mechanisms: Essays in Honor of Leonard Hurwiez, Minneapolis, MN: University of Minnesota Press.

Hausmann, H. (1987), "Economic Theories of Non-Profit Organization." In W. W. Powell (ed.), The Non-Profit Sector, New Haven, CT: Yale University Press.

Hurwicz, L. (1972), "On Informationally Decentralized System. In Decision and Organization: A volume in Honor of Jacob Marshek, ed. C.B. McGuire and R. Radner, 247-336. Amsterdam: North-Holland Publishing Co.

Hurwicz, L. (1979), "Outcome Functions Yield Walasian and Lindahl Allocations at Nash Equilibrium Points." Review of Economic Studies, 46, 217-25.

Laffont, J. J. and E. Maskin (1989), "The Theory of Incentive: An Overview," in Advances in Economic Theory, 31-94. Cambridge: Cambridge University Press.

Rose-Ackerman (ed.) (1986), The Economics of Non-Profit Institutions. New York: Oxford University Press.

Samuelson, P. A. (1954), "The Pure Theory of Public Expenditure," Review of Economics and Statistics, 36, 387-89.

Stiglitz, J. E. (1977), "Theory of Local Public Goods," in The Economies of Public Services, M. Feldstein and R. Inman (eds.). New York: MacMillian, 274-333.

Tiebout, C. (1956), "A Pure Theory of Local Expenditures," Journal of Polical Economy, 64, 416-24.

Weisbrod, B. A. (1986), "Toward a Theory of the Voluntary Non-Profit Sector in a Three Sector Economy," In S. Rose-Ackerman (ed.), The Economics of Non-Profit Institutions. New York: Oxford University Press.

Wooders, M. (1980), "The Tiebout Hypothesis: Near Optimality in Local Public Goods Economics," Econometrica, 48, 1567-1485.

Wu, S. Y. (1989), Production, Entrepreneurship and Profits. New York: Basil Blackwell.

Wu, S. Y. and C. Z. Qin (1994), "Existence of Competitive Equilibrium in the Entrepreneur-Centered Economy," Department of Economics Working Papers, University of Iowa.