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HIERARCHIC RATIONING AS THE VALUE ALLOCATION OF TEMPORARY EQUILIBRIUM*

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ABSTRACT

This paper considers the allocation of excess supply among agents on the long side of the market from the standpoint of cooperative game theory. Under the no-forced-trading hypothesis, supply actually traded equals market demand. Suppose a winning coalition of sellers can fulfill their desired sales, up to the limit of market demand. The main results characterize the value allocations of the ensuing market rationing games. In particular, the endogenous hierarchic rationing mechanism of Heller and Starr arises when power is distributed evenly among sellers.
I. Introduction

Consider a labor market in temporary equilibrium at a fixed wage \( w \). The supply of workers, \( n \), exceeds the demand for workers, \( D \). If there is no forced hiring, the number of workers hired will be \( D \). How should the available jobs be rationed?

One way to answer this is via a social welfare function. Suppose that jobs are indivisible, but that lotteries are allowed. Let \( x_i \) be the probability that worker \( i \) gets a job. Normalize utility so that \( u_i(w) = 1 \), \( u_i(0) = 0 \) for all workers \( i \). Then expected utility, \( u_i(x_i) \), satisfies

\[
(1) \quad u_i(x_i) = x_i u(w) + (1-x_i) u(0) = x_i.
\]

Let \( \lambda_i \) be the distributional weight assigned to worker \( i \) in the social welfare function \( W \):

\[
(2) \quad W = \sum \lambda_i u_i.
\]

Now if each worker holds at most one job, then jobs should be rationed to maximize (2), subject to (1) and the constraints

\[
(3) \quad 0 \leq x_i \leq 1, \quad \sum x_i = D.
\]

To take some examples, if the distributional weights are monotone decreasing \( \lambda_1 > \ldots > \lambda_n \), then the first \( D \) workers will be hired and none of the rest. Such would be a typical hierarchic outcome. Again, if every worker has the same distributional weight, then any feasible solution is optimal. The unique symmetric solution in this case will be \( x_i = D/n \) for all \( i \).
For any given vector of distributional weights, one can thus answer the question of how to ration the jobs. What is unsatisfying about the answer however is that the distributional weights are imposed at the outset, rather than being part of a larger equilibrium outcome. One might expect that the distributional weights are endogenous, being in fact determined by the same process that determines the form rationing takes as well. Aumann [1] has stressed the importance of such an equilibrium concept for general equilibrium. This paper begins the analogous construction for temporary equilibrium as well.

The next section formalizes market games based on temporary equilibrium markets. Certain coalitions on the long side of the market, called winning coalitions, have the power to determine the rationing. Applying the λ-transfer value of Shapley [12] to these games, one gets simultaneously a rationing equilibrium and a set of distributional weights. Section 3 characterizes the λ-transfer value allocations for the labor market model just considered. Section 4 considers the most general situation, where different traders have different desired trades. The main result of this section is the following: if every seller is equally likely to belong to a winning coalition, then the rationing equilibrium is hierarchic rationing with endogenous hierarchy introduced by Heller & Starr [7]. Unequal distributions of market power generate other varieties of hierarchy. Some suggestions for further work conclude the paper.
II. Rationing Market Games

This paper considers markets with demand $D$ less than supply $Z$ at a fixed price. Analogous results obtain for the excess demand case. Let there be $n$ sellers, indexed by $i$, $i = 1, \ldots, n$. Each seller desires to trade an amount $z_i$, with total supply $Z$ satisfying

$$\sum z_i = Z. \quad (4)$$

Under the no-forced-trading hypothesis, the amount actually traded by each seller, $x_i$, satisfies the restrictions

$$0 \leq x_i \leq z_i, \quad \sum x_i = D. \quad (5)$$

Utility $u_i$ of seller $i$ is normalized so that $u_i(0) = 0$. Furthermore, each seller is assumed to be risk neutral. Thus, a seller is indifferent between selling $z_i$ with probability $1-p$ and nothing with probability $p$, and selling $x_i$ for sure when $x_i = (1-p)z_i$. This assumption is substantive; aversion to risk affects the results.

Trading is organized as follows. A group of suppliers $S$ is winning if it controls access to buyers completely. Such a coalition has total market power. A winning coalition structure $\Gamma$ is the collection of all winning coalitions of sellers:

$$\Gamma = \{ S \subset N : S \text{ winning } \}. \quad (6)$$

Any winning coalition structure is assumed to obey the following conditions:

$$S \in \Gamma, \text{ then } N-S \notin \Gamma. \quad \text{No winning coalition's opposition can be winning.} \quad (7)$$
S \in \Gamma. If T \supset S, T \in \Gamma. Winning is monotone.

N \in \Gamma. The set of all sellers is winning.

Under these conditions, the cooperative game

\begin{equation}
 v_i(S) = \begin{cases} 1 & \text{if } S \in \Gamma \\
 0 & \text{otherwise}
\end{cases}
\end{equation}

is a proper, superadditive, simple game.

Many economic situations answer to such a trading framework. In an employment context, if there is a union shop, then the union controls access to jobs. Under the spoils system, belonging to the winning political party is essential to accessing the spoils of political patronage. In a market with a dominant firm, the survival of a small competitor depends on being at least tacitly an ally of its giant rival. Even in academic departments, an entrant must round up a winning coalition before landing a job.

A seller i has veto power if he is a member of every winning coalition. The strongest form of veto power is dictatorial power, where i alone is winning. Seller i has power if there exists a losing coalition S such that S \cup \{i\} is winning. In this last event, one says that i is pivotal. A seller who has no power is powerless. Such a seller is never pivotal.

In this paper, power is measured by the Shapley value \( \phi \) of the game \( v_i \). \( \phi v(i) \) is the probability that i is pivotal in a random ordering of N, when any random ordering is equally likely. The Shapley value of a dictator is 1, whereas for a powerless seller it is 0. The distribution of market power arising from the winning coalition structure proves central to characterizing a rationing equilibrium.
A winning coalition $S$ can trade as much as its members desire and demand allows. This is reflected in the rationing market game $v_{II}$ as follows:

$$(9) \quad v_{II}(S) = \left(u_i(x_i), i \in S: 0 \leq x_i \leq z_i\right) \quad S \text{ winning}$$

$$\sum_{i \in S} x_i = \min\{D, \sum_{i \in S} z_i\} \quad S \text{ winning}$$

vector 0, otherwise.

$v_{II}$ is a no-sidepayments game. This paper studies it by means of the $\lambda$-transfer value allocation. This solution concept has proved useful in various other economic contexts, such as general equilibrium [1] and taxation [2, 6], and it leads to results here as well. A $\lambda$-transfer value allocation is a pair of vectors $(x, \lambda)$ satisfying the following conditions:

$$(10) \quad \lambda_i > 0, \text{ all } i, \text{ with at least one } \lambda_i > 0$$

$$\left(u_i(x_i)\right) \in v_{II}(N)$$

and $\lambda_i u_i(x_i) = \psi_{v_{\lambda}}(i)$, where

$$v_{\lambda}(S) = \max \sum \lambda_i u_i(x_i) \text{ over } v_{II}(S).$$

In particular, $v_{\lambda}(N)$ is a social welfare function with distributional weights $\lambda$. At the same time, the $\lambda$'s serve as utility exchange rates, allowing one to interpret $v_{\lambda}$ as a side-payments game when computing its Shapley value. However, at a value allocation, no side payments of utility are actually required.

Shapley [12] proves the existence of $\lambda$-transfer value allocations. The next two sections characterize these allocations for rationing market games.
The results in this section depend on the restrictive assumption that desired supply \( z_i = 1 \) for all \( i \): one worker per job, at most one job per worker. The following section relaxes this assumption. The demand for workers \( D \) lies between 0 and \( n \).

**Proposition 1.** Let seller \( i \) have power, and \( D > 0 \). Then a value allocation \( (x_i(D), \lambda_i(D)) \) corresponding to \( D \) has \( x_i(D) > 0, \lambda_i(D) > 0 \).

**Proof.** For \( D = 1 \), \( \lambda_i(1) = 1 \), all \( i \) with power, and \( x_i(1) = \phi v_i(i) \), \( \lambda_i(1) = 0 \), all \( i \) without power is the value allocation. In this case, \( v_\lambda = v_I \), so that \( \phi v_\lambda = \phi v_I \).

For \( S \) winning, \( v_\lambda(S) \) is nondecreasing in \( D \) and \( \lambda \). Let \( s^{\text{min}} \) be the smallest winning coalition. When \( D \) exceeds 1, the Shapley value of powerful seller \( i \) is at least as great as

\[
(11) \quad \lambda_i x_i(D) = \phi v_\lambda(i) \geq \phi v_I(i) v_\lambda(s^{\text{min}}) > 0.
\]

The reason for this is that \( i \) is pivotal with probability \( \phi v_I(i) \), in which case his marginal contribution is at least \( v_\lambda(s^{\text{min}}) \). The above expression (11) is evaluated at \( \lambda_i = 1 \) until the constraint \( x_i = z_i \) is binding, at which point \( \lambda_i > 1 \).

Let \( s_I \) be the number of powerful sellers in the coalition structure \( \Gamma \). The next result is

**Proposition 2.** For any powerless player, and any \( D < s_I \), \( x_i(D) = \lambda_i(D) = 0 \) at a value allocation.
Proof. From proposition 1, \( \lambda_i > 0 \) for powerful i. Moreover, \( v_\lambda(N) \) is only attained at \( x_1 \) corresponding to positive \( \lambda_i \). Powerless i is never pivotal. Moreover, even when he joins a group S winning, \( v_\lambda(S \cup \{i\}) \) will be achieved by allocating a job slot to a powerful player. Hence, for every coalition S, player i's marginal contribution is 0, so that

\[ \phi v_\lambda(i) = 0 = \lambda_i(D) x_i(D). \]

It is only when D exceeds \( s_1 \) that the constraint (3) forces \( x_i(D) \) to be positive for some powerless i.

Propositions 1 and 2, taken together, show that every powerful worker is fully employed before any powerless worker has even a chance of being employed. The powerless workers thus represent the bottom of a hierarchy, the first fired when D falls and the last hired when D rises. In other contexts, such a group has been called an Industrial Reserve Army[9].

The next proposition considers workers at the very top of the hierarchy. Let \( s_2 \) equal the number of members of the smallest winning coalition \( S^{\text{min}} \).

Then one has

Proposition 3. Suppose seller i has veto power. Then \( x_i(D) = 1 \) for all \( D \geq s_2 \).

Proof. Suppose first that \( \lambda_i = 1 \) for all powerful i. Then \( v_\lambda(S) = \min(s, D) \) if S is winning and has s members. Whenever seller i with veto power is pivotal, his marginal contribution is

\[ v_\lambda(S \cup \{i\}) - v_\lambda(S) \geq s_2. \]
The probability of i's being pivotal, $v_{i}(i) > 1/s_2$, the equality holding only when $s_2$ players have veto power. Seller $i$'s expected marginal contribution $v_{i}(i)$ satisfies

$$v_{i}(i) > v_{i}(i)s_2 > 1.$$  

Since $x_{i}(D)$ can be at most 1, i is fully employed for $D > s_2$. If the inequalities in (12) are strict for $\lambda_1 = 1$, then the value allocation must have $x_{i}(D) = 1$, $\lambda_1(D) > 1$. In either case, veto seller $i$ is fully employed.

The bound in proposition 3 is tight in the case of dictatorship or oligarchy. In a dictatorship $s_2 = 1$ and the dictator is fully employed for $D > 1$. In an oligarchy with $s_2$ oligarchs, each oligarch is fully employed for $D > s_2$. When $s_2 = n$, every player has a veto power. In this case, rationing is uniform: $x_{i}(D) = D/n$ for all $i$. Indeed, uniform rationing occurs whenever the distribution of market power is equal.

The bound in proposition 3 need not be tight in the case of collegial polities [4]. In a collegial polity, there are players with veto power, but these players are not by themselves winning. Suppose $n = 10$ and any group of 5 or more sellers which contains seller 1 is winning. Thus $s_2 = 5$. The probability that seller 1 is pivotal is .6, so that he is already fully employed when $D = 2$. In general, $s_1 < s_2$, with equality only in the case of oligarchy. The following characterization of the rationing equilibrium then emerges, as $D$ increases. Beginning with $D = 1$, and continuing until veto sellers become fully employed, the probability of getting a job is proportional to market power.
The proportionality constant is the market demand $D$. Once the veto players are fully employed (not later than $D = s_1$), their distributional weights exceed 1. One then proceeds through the power hierarchy until all powerful players are fully employed ($D = s_2$). Finally, as $D$ approaches $n$, even the powerless get jobs. Figures 1 and 2 illustrate these results for some 3 and 4-seller rationing market games.

Taken together, these results have the following implication. Heller and Starr [7, Theorem 2] have shown that fixprice markets can be equilibria in the sense that even agents who are aware of the consequences of their actions will not change their behavior in an attempt to clear the market. Indeed, suppose a wage cut is required to restore full employment. Such a move will surely be opposed by veto power sellers and other powerful sellers who are already fully employed. If in the ensuing struggle between the higher and lower echelons of the hierarchy, the higher echelon wins, there is no force within the market to drive the wage towards its Walrasian level. In this way, wage rigidities tend to be self-sustaining.
Figure 1a. Probability of employment for the 3-player, majority-rule game.

Figure 1b. Probability of employment for the 3-player, majority-rule game, with 1 veto player.
Figure 1c. Probability of employment for the 3-player majority rule game with 2 veto players.
Figure 2a. Employment probabilities, \( \{1,2\} \) and \( \{1,3,4\} \) minimal winning.

Figure 2b. Employment probabilities, \( \{1,3,4\} \) and \( \{2,3,4\} \) minimal winning.
A situation which occurs often in practice is one in which there are two groups of sellers, neither of which has veto power, but one of which has more market power per seller than the other. To formalize this situation, denote the two distinct classes by $N_1, N_2$. The proportion of each class in the total selling population is

$$1 = \mu(N) = \mu(N_1) + \mu(N_2).$$

The voting strength $w$ of each class satisfies

$$1 = w(N) = w(N_1) + w(N_2).$$

Every group of sellers $S$ is therefore characterized by its size $\mu(S)$ and its voting strength $w(S)$. Suppose a coalition is winning if its total vote $w(S)$ satisfies

$$w(S) = w(S \cap N_1) + w(S \cap N_2) \geq q,$$

for a fixed quota $q > 1/2$. This general situation can be depicted by means of a Lorenz curve. Figure 3 depicts a situation where $\mu(N_1) > \mu(N_2)$, while $w(N_1)/\mu(N_1) < w(N_2)/\mu(N_2)$. Here class 2 is both more numerous and relatively stronger in voting.

For $n$ very large, one can approximate the value allocations of these market rationing games by the methods of large games [3]. For example, the distribution of power $\phi v_1$ is equal to the distribution of voting weights. To characterize the value allocation based on this distribution of market power, consider first the case where $D$ is sufficiently small that $\lambda = 1$ for all sellers. Then the market rationing game is the side-payments game.
Figure 3. Lorenz Curve for 2-class Model
Denote by \( x(S) \) the jobs allocated to \( S \) at the value allocation; \( x(S) \leq \mu(S) \) and \( x(S) = \psi v_{II}(S) \). Applying the argument of [2] yields

**Proposition 4.** Given \( \lambda = 1 \) for all sellers. Then at a value allocation

\[
x(S) = w(S) \min(q, D) + \mu(S) \max(D - q, 0).
\]

The solution with \( \lambda = 1 \) terminates when \( x(N_1) \) reaches \( \mu(N_1) \), if \( N_1 \) is relatively most powerful:

\[
D = 1 + q - q w(N_1) / \mu(N_1)
\]

is the critical value of \( D \) beyond which \( N_1 \) is fully employed. For \( D \) larger than this, \( N_2 \) receives the residual employment

\[
x(N_2) = D - \mu(S_1).
\]

Define the unemployment rate for group \( S \) to be

\[
U(S) = 1 - x(S) / \mu(S).
\]

In the region where \( D \) exceeds \( q \) but still \( \lambda = 1 \), both groups still suffer from unemployment, and the unemployment rate differentials are

\[
U(N_1) - U(N_2) = q \left( w(N_2) / \mu(N_2) - w(N_1) / \mu(N_1) \right),
\]

from (13), (14).
As an illustration of (15), take the Soviet Union during the 1920's, where there was considerable unemployment both among workers belonging to the Party, $N_1$, and among workers with no political affiliation, $N_2$. According to data from [10,11], $U(N_1) = 1\%$ in 1925 and $4\%$ in 1927, the latter being a year of considerably greater overall unemployment. Corresponding figures for $N_2$ are $9\%$ and $12\%$ respectively. An individual party member was thus about $8\%q$ more powerful than his unaffiliated counterpart. For $q$ ranging from $1/2$ to $1$, this suggests a power differential of about $8 - 16\%$. 
IV. Hierarchic Rationing in General Markets

The results in the previous section depended on the fact that desired supply was the same for all sellers. This section lifts that restrictive assumption: a seller can have any desired supply. The assumption that sellers are risk neutral is retained.

Heller and Starr [7] define a hierarchic mechanism with endogenous hierarchy as follows:

In this allocation function, the short side is allotted precisely what it offers. Offers on the long side are arranged in order of size, smallest (in absolute value) first (a tie-breaking rule is of course needed). They are then fulfilled, within the limits of available short side offers, in that order.

The major result of this section is that whenever market power is equally distributed on the long side of the market, the value allocation that results is a hierarchic mechanism with endogenous hierarchy.

Proposition 5. Let desired supplies of the sellers be arranged as

\[ z_1 < z_2 < \ldots < z_n \] (sellers are relabeled if necessary).

Demand \( D \) satisfies \( 0 < D < \sum z_i \), and market power is evenly distributed. Then the value allocation is a hierarchic mechanism with endogenous hierarchy.

Proof. The proof here will be for the case of the Pareto extension rule, where \( N \) is the only winning coalition. The proof for other forms of equally distributed power is similar.
A player is pivotal in a random ordering only if he is last, in which
even his marginal contribution is \( v_\lambda(N) \). Since he is last with probability
1/n, at the value allocation

\[(16) \quad \lambda_1 x_1 = \psi v_\lambda(1) = 1/n \cdot v_\lambda(N). \]

For \( D \leq n z_1 \), \( \lambda_1 = 1 \), \( x_1 = D/n \) for all \( i \) is the value allocation,
since in this case \( v_\lambda(N) = D \).

For \( n z_1 < D < z_1 + (n-1) z_2 \), \( \lambda_1 = (D - z_1)/(n-1) z_1 \), \( x_1 = z_1 \),
\( \lambda_2 = 1 \), \( x_2 = (D - z_1)/(n-1) z_2 \), and for all other \( i \) \( \lambda_1 = 1 \), \( x_1 = (D - z_1 - z_2)/(n-1) \)
is the value allocation. In this case, \( v_\lambda(N) = n(D - z_1)/(n-1) \).

Hence,

\[1/n \cdot v_\lambda(D - z_1)/(n-1),\]

and (16) is satisfied for all \( i \).

For \( z_1 + (n-1) z_2 < D < z_1 + z_2 + (n-2) z_3 \), \( \lambda_1 = (D - z_1 - z_2)/(n-2) z_1 \), \( x_1 = z_1 \),
\( \lambda_2 = (D - z_1 - z_2)/(n-2) z_2 \), \( x_2 = z_2 \), and for all other \( i \) \( \lambda_1 = 1 \), \( x_1 = (D - z_1 - z_2)/(n-2) \)
is the value allocation. In this case, \( v_\lambda(N) = n(D - z_1 - z_2)/(n-2) \).

Proceeding inductively, for

\[j = 1 \quad \sum_{k=1}^{j} z_k + (n-j+1) z_j < D \leq \sum_{k=1}^{j} z_k + (n-j) z_{j+1}\]

one has

\[\lambda_1 = (D - \sum_{k=1}^{j} z_k)/(n-j) z_1 \quad x_1 = z_1 \quad \text{for } i \leq j\]

\[\lambda_1 = 1 \quad x_1 = (D - \sum_{k=1}^{j} z_k)/(n-j) \quad \text{for } i > j.\]
In this way, a hierarchic mechanism with endogenous hierarchy emerges.

Analogues of propositions 1 - 4 continue to hold in this more general setting. Indeed, propositions 1 and 2 go through without any alteration. All powerful agents' trades are filled before any powerless agents' trades are. The analogue of result 3 in this setting goes as follows. Denote by $z_{\text{min}}$ the min of $Z(S)$ over all winning $S$. Let $s_2$ again be the cardinality of the smallest winning coalition. Then one has

**Proposition 6.** Let seller 1 have veto power, and $z_1 < z_{\text{min}}/s_2$. Then $x_1(D) = z_1$ for all $D > z_{\text{min}}$.

The proof follows precisely the pattern of proposition 3.

When the condition on $z_1$ is not satisfied, even a seller with veto power may have to wait for higher levels of demand before fulfilling his desired trade. For example, suppose $z_1 = 6$, $z_2 = z_3 = 2$. Seller 1 has veto power, and any majority containing 1 wins. Notice that $z_1 = 6 > z_{\text{min}}/s_2 = 8/2 = 4$, so that the hypothesis of the proposition fails. A routine calculation shows that $\lambda_1 = 1$, all $D$ and

\[
\begin{align*}
&\text{for } D \leq 8, \quad x_1 = 2D/3, \quad x_2 = x_3 = D/6 \\
&\text{for } D > 8, \quad x_1 = (D+8)/3, \quad x_2 = x_3 = (D+2)/6
\end{align*}
\]

is the value allocation. Even though the veto player is not completely fulfilled, it is still the case that a larger proportion of his desired trade is satisfied than for the other traders.
Finally, to generalize proposition 4, suppose each member of class 1 wishes to sell $z_1$, while each member of class 2 wishes to sell $z_2$. Desired sales of coalition $S$ then are

$$z(S) = z_1\mu(S \cap N_1) + z_2\mu(S \cap N_2).$$

Thus, if $\lambda = 1$ for all traders, one has the market rationing game

$$v_\lambda(S) = \begin{cases} 
\min(z(S), D) & \text{if } S \text{ winning} \\
0 & \text{otherwise.}
\end{cases}$$

The value allocation is then given by proposition 7:

Proposition 7. The value allocation for the 2-class model with general demands is $\lambda = 1$,

$$(17) \quad x(S) = w(S)\min(nz(N), D) + z(S) \max((D-cz(N))/z(N), 0),$$

as long as $x(S) \leq z(S)$ for all $S$.

Which class is satisfied first depends both on market power $w$ and desired trade $z$. The class with the highest ratio of market power to desired trade, $w(N_1)/z(N_1)$, will be completely employed at the level of demand $D$ equating $z(N_1)$ to $x(N_1)$ in (17).
V. Conclusion

This paper has characterized the value allocations of market rationing games under excess supply. The results show how pervasive is the role of hierarchic rationing at such value allocations. The restriction to excess supply is not crucial: the results go through without change when excess supply is changed to excess demand and winning coalitions of buyers are studied. A more substantive restriction has been the assumption of risk-neutrality. In general, a risk-averse trader in such a situation will do worse than his risk-neutral counterpart. Indeed, it will be in the best interest of a risk-averse to conceal this fact from the rest of the market [8]. Finally, all the results have been framed in the context of a single market. It would be nice to have the general equilibrium analogues of these results in a general equilibrium context. A promising attack on this problem would be to relate the rationing observed to the coupon equilibria of Drèze and Müller [5].

There are other possible applications of these results, in particular, the distribution of bads. In the employment model of section III, suppose that the employment is forced labor, which nobody wants to perform. If resistance to the system of forced labor is futile, then the results can be reinterpreted to show that agents with veto power are the last to be forced to work for instance, when $n$ workers must be drafted. However, if resistance to such a system is possible (draft resistance, work stoppages), then a different characterization of the market rationing game is needed, along the lines of Aumann-Kurz tax theory [2]. Even here, market power helps determine the resulting value allocation.
REFERENCES


