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SHARING SOME THOUGHTS ON WEITZMAN'S THE SHARE ECONOMY

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This paper draws on a series of conversations, held during the Cowles Coffee Hour, with my collegues at Yale University as well as the spirited discussion during a conference held at Yale on Martin Weitzman's The Share Economy. I am particularly grateful to Bill Nordhaus and Andrew John for their comments and suggestions on earlier versions of this tale. The paper was written while I was participating in the National Bureau of Economic Research Summer Institute. I thank participants in that seminar series for their helpful questions and comments. The research reported here is part of the NBER's research program in Economic Fluctuations. Any opinions expressed are those of the author and not those of the National Bureau of Economic Research.

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ABSTRACT

This paper explores the positive and normative aspects of share contracts. In particular, the paper explores the properties of a share system as advanced by Martin Weitzman in The Share Economy. The model employed highlights a "macroeconomic externality" created in a multi-sector economy with imperfect competition. The introduction of share contracts is shown to influence the comparative static properties of the model economy and in some cases to lead to Pareto superior outcomes.

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Sharing Some Thoughts on Weitzman's The Share Economy

I. Motivation

In a series of recent publications, Weitzman (1983, 1984a) has strongly advocated the construction of a system of share contracts to mediate transactions in the labor market. Under such a system, workers' compensation would fall with increases in employment. These contracts, Weitzman argues, would provide the correct incentives at the micro-level, so that workers and firms would act to reduce macroeconomic fluctuations. Weitzman [1984a] says that,

> "The lasting solution to stagflation requires going inside the workings of a modern capitalist economy and correcting the underlying structural flaw directly at the level of the individual firm by changing the nature of labor renumeration. An alternative payment system where it is considered perfectly normal for a worker's pay to be tied to an index of the firm's performance, say a share of its revenue or profits, puts in place exactly the right incentives automatically to resist unemployment and inflation."

The response to this challenging proposal has been mixed. At one extreme, The New York Times, in an editorial entitled, "Best Idea Since Keynes," extolled a number of virtues associated with Weitzman's proposal. The Times warned that "ideas that promise so much usually succumb to general skepticism," and noted that "the idea needs testing for analytic errors and practical examination. . ."

Always willing to provide general skepticism, most academic economists have been less enthusiastic about the proposed reform. The reason for this somewhat cool reception is not all that difficult to understand. Although Weitzman's proposal is a creative one, his ideas have not been formulated in a complete model.[1] Without such a representation of these ideas, it is difficult to undertake serious debate about the virtues and vices of a share economy.

The present paper is an attempt in this direction. I will analyze an explicit model economy for the purposes of comparing and contrasting the positive and normative properties of the two compensations schemes highlighted in Weitzman's work: a fixed wage system and a share system. The basic structure of the model will reflect my interpretation of the fundamental aspects of a share system. The paper is not an attempt to formalize every element of Weitzman's argument. This interpretation of Weitzman's argument is set forth in the next section of this paper.

The formal model is presented in Section III and its business cycle and welfare properties are displayed in Section IV. The structure of the model reflects the importance of a "macroeconomic externality" stemming from imperfect competition in a multi-sector economy. A share system is shown to change the comparative static properties of the model and, in some cases, to moderate fluctuations in output and employment in the face of adverse shocks to the system. Section V contains some critical comments on the exercise performed in this paper and some ideas for future research in this area.

II. Overview and Interpretation of the Share System

This section is devoted to an intuitive discussion and interpretation of Weitzman's argument in favor of a share economy. These remarks reflect my interpretation of these issues and hence may differ from other analyses.

Weitzman contrasts the behavior of a macroeconomy under two modes of transacting labor services: a wage system and a share system. In a wage system, a worker's real wage rate is set, ex-ante, by competitive forces but, ex-post, is inflexible and hence independent of random disturbances affecting the economy. A share contract, in its simplest form, is characterized by two parameters: a constant transfer term ($\tilde{\omega}$) and a share coefficient (λ). The contract also specifies some index of firm activity such as profits per worker, revenues per worker, etc., to which compensation is linked. This index is assumed to be a <u>decreasing</u> function of the level of activity at the firm so that compensation per worker falls (assuming $\lambda>0$) as the firm expands. Under either of these compensation systems, firms are given the latitude of choosing employment, ex post.

In a world of certainty, both of these compensation schemes can be shown to support the same labor allocation (see Proposition 1, Weitzman (1983)). However, there is a critical difference between the two systems. In a wage system, the labor market equilibriates at zero excess demand. In a share system, however, firms offering share contracts will have an incentive to increase their workforce further (at the equilibrium allocation) to take advantage of reductions in average wages associated witn higher employment levels. Firms are prevented from expanding in this way by the existence of competing offers by wage firms. Hence, as Weitzman puts it, share firms are in a state of excess demand for labor in the certainty equilibrium of the share economy (Section III elaborates on this point).

Weitzman then proceeds to investigate the comparative static properties of these two economies. Wage firms tend to respond to demand fluctuations by varying employment levels. This response in quantities, through the circular flow of income, tends to create a multiplier effect that exacerbates the effects of the initial shock on real variables.

Weitzman (1984a, p. 46) contends that,

> "The current wage system of compensating labor is a perilous anachronism that needs to be replaced. For when a contractionary impulse hits, not only is the initial response of a wage economy to throw people out of work, but a wage system can deepen a recession, multiplying its adverse consequences until the economy is trapped in a vicious cycle of persistent involuntary underutilization of the major factors of production. This public cost of the wage system - its "macroeconomic externality" of misbegotten unemployment spawning further unemployment - is a

pollutionlike consequence that private agents have little incentive to consider."

The share economy operates quite differently in the face of fluctuations in demand. Since share firms are in a state of excess demand for labor, they are willing to employ those workers laid off by wage firms. This reduces fluctuations in employment and will eliminate the smaller shocks altogether. Weitzman [1984a] argues that,

> "A share system looks very much like a "labour shortage" economy. Firms cruise around like vacuum cleaners on wheels, searching in nooks and crannies for extra workers to suck in at existing compensation parameter values. Such an economy is inherently recession resistant."

The upshot of this comparison is that a share economy is better able to absorb shocks without causing unemployment in labor markets. This, Weitzman argues, means that a share system socially dominates a wage system. Weitzman acknowledges that the wage system privately dominates the share system for workers and firms so that a tax and transfer system will be necessary to induce those agents to trade labor services through socially superior share contracts.

A number of questions come to mind about this line of reasoning:

i) Why is the wage system socially suboptimal?;

ii) What is the source of this "macroeconomic externality" described above?; and,

iii) Under what conditions and by what criteria will a share economy dominate the wage system?

With regard to the first question, it is important that the wage system be privately optimal. If not, then the wage system is trivially socially suboptimal. Thus, it is critical to use a model which predicts that the wage system will arise and, for which, the share system is feasible. Unfortunately, the microeconomic rationale for the wage system, as Weitzman points out, has long eluded economists. For the most part, this analysis will also take the wage system as institutionally given and evaluate a share system as a viable alternative. The possible problems with this approach are discussed in Section IV.

Leaving this issue aside, it is also critical to Weitzman's argument that the "macroeconomic externality" he alludes to be explicated in the model. Presumably, this is not unlike the "macroeconomic externality" that has been responsible for underemployment equilibria and that economists do not firmly grasp either. Without understanding this externality, it is impossible to evaluate proposals to internalize it. The model of this "macroeconomic externality" is presented in the next section and follows Cooper-John (1985). The approach stresses the importance of strategic complementarity in generating underemployment equilibria and multiplier effects.

With regard to the last question, the share economy differs from the wage economy in a number of ways, including the magnitude of fluctuations in wages, prices, employment and profits. One way to compare the systems is to calculate the expected utilities of the individuals in the alternative economies. This paper follows Weitzman and views the shocks as surprises in a certain world. The systems are compared by looking at the magnitudes of employment, output and utility fluctuations. We comment on the appropriateness of this approach later.

This paper is best viewed as an attempt to model Weitzman's argument and to specify an explicit economy with a multiplier process, that exacerbates shocks and creates large movements in unemployment rates under a wage system. We then show that a share system changes the response of the economy to shocks in a way that supports Weitzman's statements. Thus, the framework focuses explicitly on the second question raised above. The comparison of the two systems and the comparative statics analysis follows Weitzman's outline fairly closely.

III. The Basic Model

The modelling approach taken here to compare wage and share systems draws on a series of recent papers by Hart (1982), Weitzman (1982), Heller (1984), Roberts (1984), and Cooper-John (1985). These models, in one way or another, stress the importance of imperfect competition in understanding certain key Keynesian features including multiple equilibria, inefficient allocations and multiplier effects. Crucial to these model economies is the circular flow of income created by specifying particular patterns of production and consumption in a multi-sector economy. In particular, producing agents are viewed as specialists in their production activity and generalists in consumption. These two ingredients--imperfect competition and a circular flow of income--lead to situations in which quantities fluctuate widely relative to prices and in which multiplier effects tend to propagate shocks at the micro-level. We specify a model of this type below to capture the "macro externality" implicit in Weitzman's discussion. We can then investigate its properties as we vary the exogenously given compensation system.

Consider an economy with 2 sectors indexed by $i = 1,2$ producing distinct commodities. In each sector, there are F firms indexed by $f = 1,2,\ldots,F$. The number of firms in each sector is fixed exogenously. There are also 2N identical workers who can work in either of the two sectors. Assume there is a total of three commodities in the economy: the two produced goods and one non-produced commodity. The non-produced commodity could be viewed as a proxy for money but, given the static nature of the model, such an interpretation could be misleading. The non-produced good will serve as numeraire.

Each firm is endowed with $\bar{m}$ units of the non-produced good and has, at its disposal, a linear technology converting labor into output on a one-for-one basis. Letting the subscript "fi" denote firm f of sector i, profits for this firm (Π_{fi}) are given by

$$\Pi_{fi} = (p_i - w)q_{fi} = (p_i - w)\ell_{fi}$$

Here p_i and w are the sector output price and wage respectively, q_{fi} is the firm's output and ℓ_{fi} is the level of employment.

The firm (equivalently its owner) spends its total income of $\Pi_{fi} + \bar{m}$ on two commodities: the non-produced good (m) and the produced good from the <u>other</u> sector (c_{-i}). The firm's preferences are given by $U(c_{-i}^{\alpha}m^{1-\alpha})$ where $0 < \alpha < 1$ and $U(\cdot)$ is strictly increasing and concave. Firm's demands for c_{-i} and m are given

$$c_{-i} = \frac{\alpha}{p_{-i}}(\Pi_{fi} + \bar{m}),\ m = (1 - \alpha)(\Pi_{fi} + \bar{m}).$$

Here, as stated above, the subscript in c_{-i} and p_{-i} refers to the sector in which the firm is a consumer. This structure of production and consumption highlights the circular flow of income and expenditures. The introduction of the non-produced good creates a leakage from this stream and avoids the prediction of a continuum of equilibria as in Cooper-John (1985).

Workers are endowed with a unit of leisure time that they supply inelastically to the firm. An employed worker in sector i receives compensation w and consumes some of the non-produced good and some of the good produced in the <u>other</u> sector. This worker's preferences are represented by $V(c_{-i}^{\beta}m^{1-\beta})$ where $V(\cdot)$ is strictly increasing and concave with $0 < \beta < 1$. The demand functions are given by

$$c_{-i} = \frac{\beta}{p_{-i}}w,\ m = (1 - \beta)w.$$

An unemployed worker receives zero compensation and has utility of V(0) = 0.

With this structure of preferences, endowments, and technology, one can consider a wide variety of market structures. Randomness in endowments and preferences can be introduced as well to investigate the comparative statics properties of the decentralized economy. The emphasis here is on the implications of alternative schemes for trading labor services on the form of fluctuations stemming from shocks.

Given the symmetry in the problem, it is easy to compute the competitive equilibrium for this economy:

$$p_1^* = p_2^* = w^* = \frac{F}{N}\left(\frac{\alpha m}{1-\beta}\right) \text{ and } q_1^* = q_2^* = N/F.$$

In this equilibrium, wages and prices are equal across sectors and we have full employment. Fluctuations in firms' endowments in one or both sectors create fluctuations in prices and in the distribution of workers across sectors.[2] The economy remains at full employment.

This competitive system has neither of the key ingredients in Weitzman's formulation: wage rigidities and some form of imperfect competition. We next consider the consequences of imperfect competition under three alternative compensation systems: flexible wages, fixed wages, and share contracts.

a) The Wage System

To begin, we outline the imperfectly competitive equilibrium for an arbitrarily chosen wage, $\bar{w}$. The 2F firms play a non-cooperative game using quantities of output (equivalently employment) as strategy variables. We then discuss the determination of $\bar{w}$ in this imperfectly competitive system and begin our study of the comparative static properties of alternative compensation schemes.

We focus on the decisions of firm f in sector i and use the symmetry of the agents to describe the symmetric Nash equilibrium. This firm chooses its output level, q_{fi}, to maximize Π_{fi} subject to

$$p_i = \frac{R_{-i}}{q_{fi} + \sum_{k \neq f} q_{ki}} \quad (1)$$

Here p_i is the prevailing price in sector i where R_{-i} denotes the total amount of numeraire to be spent by sector -i agents on sector i output. From the preference structure described earlier,

$$R_{-i} = F\{\alpha \bar{m}_{-i} + q_{-i}(\alpha p_{-i} - \bar{w}(\alpha - \beta))\},$$

where q_{-i} is the level of output for each firm in sector -i. Note that the Cobb-Douglas preferences imply that the share of income being spent on sector -i is <u>independent</u> of the price prevailing in that sector. This greatly simplifies the analysis (see Hart (1982) as well on the role of this structure).

The solution to the firm's optimization problem yields

$$(p_i - \bar{w}) + q_{fi}\frac{\partial p_i}{\partial q_{fi}} = 0. \quad (2)$$

In a symmetric Nash equilibrium, we find that

$$q_i = \frac{R_{-i}\,\eta}{\bar{w}F} \quad (3)$$

where $\eta \equiv \frac{F - 1}{F}$. Substituting this into (1) yields an equation for the sector i price, i.e.,

$$p_i = \bar{w} / \eta. \quad (4)$$

Because of the strong assumptions on preferences, prices here have the property that they are independent of the output levels in either of the sectors.

Substituting (4) into (3) yields a useful relationship between the level of activity per firm in sector i (q_i) for a given level of activity per firm in the other sector (q_{-i}),

$$q_i = \bar{A}_{-i} + \gamma q_{-i} \tag{5}$$

This "reaction curve" for sector i has a positive intercept of $\bar{A}_{-i} \equiv \frac{\eta\alpha\bar{m}_{-i}}{\bar{w}}$ and a slope of $\gamma \equiv (\alpha - \eta(\alpha - \beta))$.[3] With α, η, β all between zero and one, we know that $0 < \gamma < 1$.

This curve is graphed in Figure 1. Again, invoking symmetry, there is an analogue to (5) giving q_{-i} as a function of q_i. This is shown in figure 1 as well. The symmetric Nash equilibrium (q^*) is then given by the intersection of these curves,

$$q^* = \frac{\bar{A}}{1 - \gamma}, \text{ with } \bar{A} \equiv \frac{\eta\alpha\bar{m}}{\bar{w}}. \tag{6}$$

So, given $\bar{w}$, it is straightforward to determine the equilibrium for this economy.

If $\bar{w} = w^c \equiv \frac{F\eta\bar{m}\alpha}{N(1-\gamma)}$, the equilibrium will be one of full employment. This would be the case if there was an auctioneer controlling the real wage to ensure that the labor market cleared. If $\bar{w} > w^c$, we have an underemployment equilibrium. For $\eta < 1$ (i.e., $F < \infty$), $w^c < w^*$. To keep the imperfect competition equilibrium at full employment requires a lower real wage as an inducement for the firms to increase output.

With this structure in mind, we can begin our analysis of the comparative statics properties of this economy. The previously cited comment by Weitzman

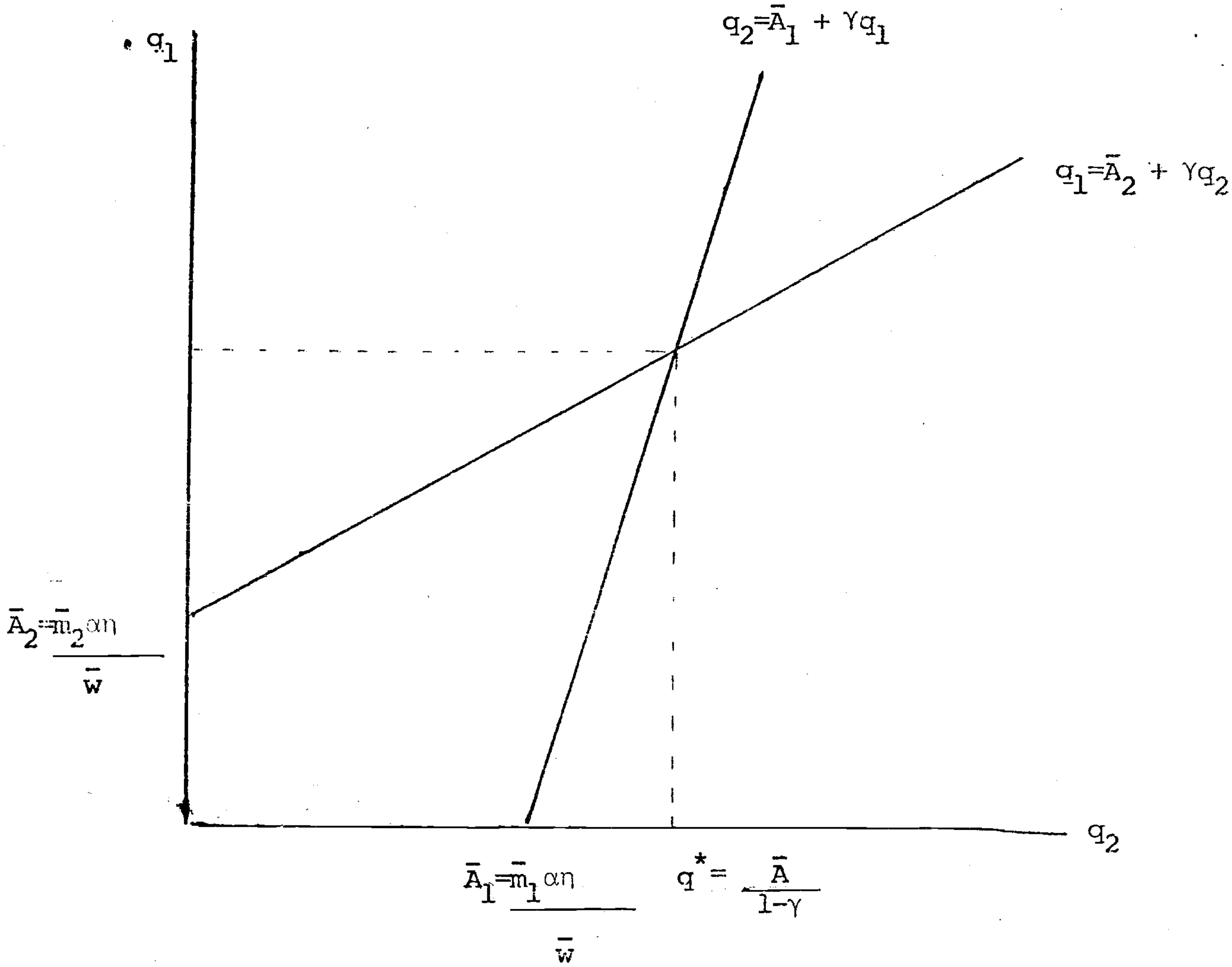


Figure 1

on the "vicious cycle of persistent involuntary underutilization of the major factors of production" stands out in this model. As Figure 1 illustrates, the positively-sloped reaction curves of the identical firms generate a multiplier effect from shifts in these curves due to exogeneous changes.[4]

Suppose, as Weitzman suggests, that the economy is characterized by a wage system where we start with $\bar{w} = w^c$ (as in the perfectly competitive, flexible wage case). We comment, in the next section, on possible sources for this rigidity. Taking $\bar{w} = w^c$ as given, how does the imperfectly competitive economy respond to shocks?

Suppose, for example, there is a decrease in the endowment of sector 2 firms, $\bar{m}_2$. Starting at the full employment, symmetric Nash equilibrium, the changes in the <u>equilibrium</u> levels of output are:

$$\frac{dq_1}{d\bar{m}_2} = \frac{\frac{\eta}{\bar{w}}\alpha}{1-\gamma^2} \; ; \; \frac{dq_2}{dm_2} = \frac{\gamma\frac{\eta}{\bar{w}}\alpha}{1-\gamma^2} \qquad (7)$$

The numerator in the $dq_1 / d\bar{m}_2$ expression is the change in autonomous expenditures ($\bar{A}_2$) on sector 1 due to a reduction in $\bar{m}_2$. The denominator, $1-\gamma^2$, lies between zero and one and reflects the multiplier interaction between the two sectors. Output in sector 2 is reacting to sector 1 output reductions so that $dq_2 / d\bar{m}_2 = \gamma dq_1 / dm_2$. This process can be seen directly from Figure 1 by considerating a shift in the q_1 "reaction curve."

Hence employment fluctuations tend to feed on each other so that an initial shock to the system can create fairly large employment fluctuations. From the assumed rigidity of wages, unemployed workers wish to be working but the imperfectly competitive firms have no incentive to hire them given the downward sloping demand curves they face.

The magnitude of this multiplier effect depends, ultimately, on γ. As α and β increases, more of an extra dollar of income (for either the firm or worker) is "returned" to the system so that leakages are reduced and the multiplier effect is increased. As the number of firms increases, η tends to 1. This influences the magnitude of the multiplier if there is a difference in consumption patterns between firms and workers. As $F \to \infty$, $\eta \to 1$ and $\gamma \to \beta$. Later, we shall see how the existence of share contracts can produce results that resemble these implications of $F \to \infty$.

If wages were flexible, then $\bar{w}$ could be adjusted to equilibrate the labor market given the labor demand functions reported by the firms. In this case, the interaction between sectors would take the form of price rather than quantity movements as was the case in the competitive model. Thus the fixed wage assumption is critical since it leads to price inflexibilities and large output/employment fluctuations. This illustrates a point made by Hart (1982) that the underemployment and multiplier results in these models depend more on the presence of some imperfections in the labor market than on imperfectly competitive firms. Given the presence of fixed real wage contracts, Weitzman's point about large movements in real quantities is substantiated in the model.

b) The Share System

We now consider a system with share contracts as an alternative to the wage system. Suppose that ρF of the firms in sector 1 offer workers share contracts while all the other firms in sector 1 and all the sector 2 firms continue to trade with fixed wage contracts. This structure allows us to evaluate the importance of the proportion of share firms on the magnitude of fluctuations in sectors 1 and 2 as we vary ρ between zero and one.

Weitzman's argument is that the presence of share firms will reduce employment fluctuations in sector 1 since these firms are always on the hunt for unemployed workers. Because of the "macroeconomic externality" across sectors of the economy, stabilization of output and employment in sector 1 may help stabilize sector 2 as well. To see this, we begin with a statement of equilibrium in an economy with share firms.

As mentioned in Section II, a share contract stipulates that wages depend inversely on some measures of firm activity. For simplicity, we take revenues per worker as that index which, given the firm's technology, is simply the price of output. Letting $w^s(p_1)$ be the wage paid to a worker at a share firm when the price is p_1,

$$w^s(p_1) = \tilde{w} + \lambda p_1 \ , \ 0 < \lambda < 1. \tag{8}$$

The share contract is characterized by a constant payment of $\tilde{w}$ and a share coefficient λ. The contracting process with share firms will determine $(\tilde{w},\lambda)$, just as $\bar{w}$ is determined for the wage firms. Share contracts, though, do allow movements in the wage rate in response to price changes.

To characterize the equilibrium, we have to consider the behavior of three classes of firms: share firms in sector 1, wage firms in sector 1, wage firms in sector 2. A share firm takes the decisions of all other firms as given and solves

$$\max_{q_1^s} (p_1(1-\lambda)-\tilde{w})q_1^s$$

where p_1 is the price which clears the market for sector 1 output. Note too that $(\tilde{w},\lambda)$ are taken as given by the share firm. The experiment we are conducting is to investigate the effects on fluctuations in the economy of alternative (exogenously determined) contracts.

The solution to the share firm's optimization problem is

$$p_1(1-\lambda)-\tilde{w} \;+\; q_1^s(1-\lambda)\frac{\partial p_1}{\partial q_1^s} = 0 \tag{9}$$

This first-order condition looks similar to (2) though the inclusion of $\lambda > 0$ is critical. Using (1), (9) can be rewritten as:

$$\frac{R_2(1-\lambda)}{F(\rho q_1^s + (1-\rho)q_1^w)}\left(1 - \frac{q_1^s}{F(\rho q_1^s + (1-\rho)q_1^w)}\right) = \tilde{w} \tag{10}$$

This equation implicitly defines the optimal quantities of the share firms as a function of the wage firm's output and the amount of spending by the other sector R_2.[5]

The reaction curves by the wage firms is given by

$$\frac{R_2}{F(\rho q_1^s + (1-\rho)q_1^w)}\left(1 - \frac{q_1^w}{F(\rho q_1^s + (1-\rho)q_1^w)}\right) = \bar{w} \tag{11}$$

This equation comes directly from (2). These two equations combined with (1) for i = 1 completely describe quantities and the price in sector 1. The behavior of the sector 2 firms is given by (3) and (4) with i = 2.

To finish the statement of an equilibrium, we need to describe the behavior of workers in terms of their choice of employer. In particular, something needs to be said about workers' evaluation of consumption risks associated with being employed by the different types of firms. At this stage, Weitzman argues that the shocks to the system are completely unpredictable and constitute uncertainty as opposed to risk. Hence agents in this economy completely ignore these shocks and evaluate the compensation schemes offered by alternative firms as if they lived in a world of certainty.[6] So, to describe the equilibrium, we need to determine the level of compensation which clears the labor market given agents' beliefs that they face no risks.

Take, as a benchmark, the full-employment equilibrium with $\bar{w} = w^c$ and p_1 and $p_2 = p^{**}$. Call the corresponding output level q^{**} which is determined from (6) with $\bar{w} = w^c$. Furthermore, assume that $(\tilde{w},\lambda)$ satisfy

$$w^s(p^{**}) = \tilde{w} + \lambda p^{**} = \bar{w} = w^c \qquad (12)$$

Hence, workers are indifferent between being employed by share or wage firms at the full employment allocation.

The full employment allocation will be an equilibrium for all combinations of $(\tilde{w},\lambda)$ satisfying (12). This is Proposition 1 in Weitzman (1983).

To see this, suppose that $q_1^w = q_2 = q^{**}$ and $p_1 = p_2 = p^{**}$. This will be an equilibrium if share firms choose to set $q_1^s = q^{**}$ as well. Inserting (12) into (9) and evaluating this at $q_1^s = q^{**}$ yields

$$(p^{**} - \bar{w}) + q^{**}(1-\lambda)\,\frac{\partial p_1}{\partial q_1^s} \qquad (13)$$

Since, by construction, q^{**} solves (2) for $p_i = p^{**}$, (13) cannot equal zero if $\lambda > 0$. Share firms wish, in fact, to expand output beyond q^{**} since they share the loss of a lower price with their workers. However, if one of them did, p_1 would fall below p^{**} and $w^s(p_1)$ would fall below $\bar{w}$. Share firms would then be unable to attract any workers.

This point is shown in Figure 2. Given $\bar{w}$, wage firms select q^{**} as their desired level of output and employment. A share contract satisfying (12) is depicted as well. The desired level of output and employment by a share firm is given by $\tilde{q}_1^s > q^{**}$. Share firms are limited to producing only q^{**} by

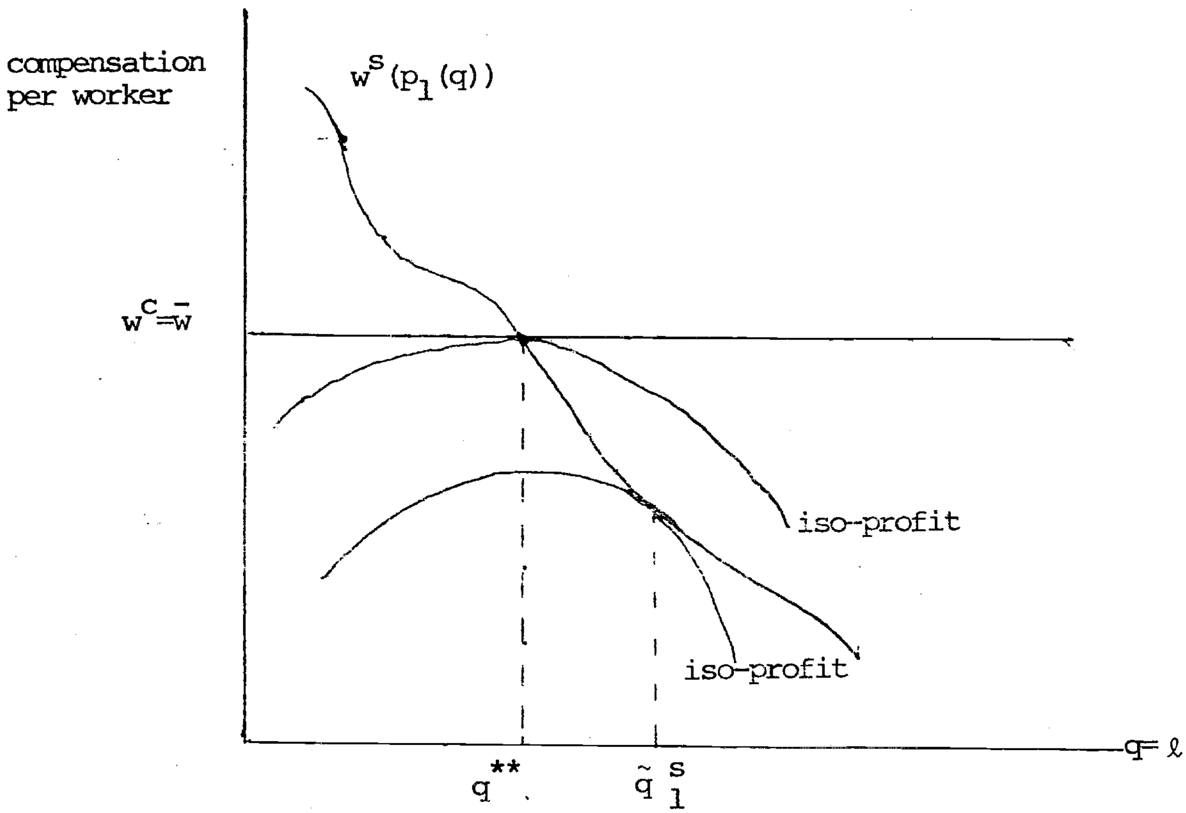

compensation
per worker
$w^s(p_1(q))$
$w^c=\bar{w}$
iso-profit
iso-profit
q^{**}
$\tilde{q}_1^s$
$q=\ell$

Figure 2

(12). (Note that the iso-profits curves are drawn for given levels of output by all other firms.)

Hence q** is an equilibrium in which share firms find that (12) acts as a binding constraint on their output/employment choice. In this equilibrium, share firms are in a state of excess demand for workers.

With this full-employment equilibrium as a benchmark, we can repeat our earlier experiment and consider the response of this economy to a reduction in $\bar{m}_2$. Intuitively, the wage firms will reduce their employment and output. Share firms will hire the unemployed workers to take advantage of the reduction in compensation from an increase in output. Due to (assumed) mobility costs, the workers at the share firms will not be able to find employment at the wage firms. For small enough reductions in $\bar{m}_2$, there will be no unemployment in sector 1 though prices will fall. This price reduction <u>will</u> influence the demand curve facing sector 2. Hence, the externalities associated with contractions in one sector leading to contractions in the other sector are not avoided in the share economy. A share system changes the nature of these spillovers but does <u>not</u> eliminate them. Nonetheless, a share system will be more stable under certain parameter restrictions. Thinking of Figure 1, the share system can lead to a flatter reaction curve in sector 1 and hence a reduction in the multiplier effects described earlier.

To formalize this intuition, we need to characterize the Nash equilibrium after the realization of a low $\bar{m}_2$. Once we assume immobile labor, ex post, share firms will be able to hire any available labor without fear of losing their current work force. These workers will not leave because they will be unable to locate employment elsewhere. Let $\tilde{q}_1^s(q_1^w, R_2)$ solve (9) with equality. This is the level of output share firms wish to produce given (q_1^w, R_2). The actual level of share firms output is given by

$$\hat{q}_1^s\ (q_1^w,\ R_2) \;=\; \min\ \left(\tilde{q}_1^s(q_1^w, R_2)\ ,\ \frac{N-(1-\rho)q_1^w F}{\rho F}\right) \tag{14}$$

This expression is the short-run reaction curve for share firms. The first term on the right side is the desired level of output for these firms. The second term is the number of workers available in sector 1 per share firm after the wage firms have determined their employment level. At the full employment equilibrium (our benchmark) the second term is less than the first. This will continue to be the case for small enough reductions in $\bar{m}_2$ below $\bar{m}$. Hence, the share firms employ all of the workers in the sector not employed by the wage firms. We assume that, ex post, workers in sector 2 are not able to migrate to sector 1. So, together, (11) and (14) describe the distribution of workers between share and wage firms for given levels of R_2.

For small enough fluctuations in $\bar{m}_2$, the reaction of sector 1 will be solely in terms of prices since, by (14), share firms ensure that q** is the average level of output in the sector. Sector 1 price, p_1, is determined from

$$p_1 = \frac{R_2}{Fq^{**}} \tag{15}$$

The behavior in sector 2 is characterized by (3) and (4) and this determines R_2. Differentiating the conditions for equilibrium with respect to $\bar{m}_2$, we can derive that (the superscripts indicates that these conditions hold for the share system):

$$\Delta q_2^s \;=\; \frac{\eta}{\bar{w}F}\ \Delta\ R_1^s \tag{16}$$

$$\Delta R_1^s \;=\; F\phi q^{**}\Delta p_1^s \tag{17}$$

$$\Delta p_1^s \;=\; \frac{1}{q^{**}}\ \left(\frac{\bar{w}}{\eta}\ \gamma\ \Delta\ q_2^s + \alpha\ \Delta\bar{m}_2\right) \tag{18}$$

Equation (16) is the quantity response function in sector 2 to a change in expenditures on that sector. Eqution (17) relates the change in expenditures to the change in the sector 1 price. The variable $\phi \equiv \alpha - \rho\lambda(\alpha-\beta)$ and lies between zero and one. Finally, (18) describes a change in the sector 1 price due to the exogenous change in sector 2 endowments and the endogenous change in sector 2 output. Recall that $\lambda \equiv \alpha - \eta(\alpha-\beta)$. Since $p_2 = \bar{w}/\eta$ and $\rho q_1^s + (1-\rho)q_1^w = q^{**}$, this completes the description of the comparative statics effects of a reduction in $\bar{m}_2$.

Substituting (18) into (17) and (17) into (16) yields:

$$\frac{\Delta q_2^s}{\Delta \bar{m}_2} = \frac{\eta\phi\alpha/\bar{w}}{1-\gamma\phi} \quad \text{and} \tag{19}$$

$$\frac{\Delta p_1^s}{\Delta \bar{m}_2} = \frac{\alpha/q^{**}}{1-\gamma\phi} \tag{20}$$

Equations (19) and (20) are the counterparts to (7) for the share economy. In comparing (19) and (20) with (7), we note that fluctuations in the share system take the form of both price and quantity movements. The share sector responds to shocks through relative price changes and these produce movements in sector 2's output and employment level. To stress an important point, share contracts do not eliminate spillover effects across sectors of the economy. Instead, they alter the form of these interactions. With these comparative static results in mind, we now turn to a welfare evaluation of the share system.

IV. Welfare Properties of the Share System

A full welfare evaluation of the share system should start with a complete statement of the primitives for our economic model. One could ideally proceed to a comparison of the decentralized allocation with the set of Pareto optimal allocations.

Our evaluation of the share system falls short of this methodology in a number of important respects. First, our comparison is between the wage and share systems. We have not argued that the wage system is a privately optimal contracting arrangement for this economy. Nor will we assert that a share system can support a Pareto optimal allocation. Instead, the argument for this comparison has been that the wage system is both close to what we observe and possibly responsible for magnifying shocks to the economy. Consequently, it is useful to see how that system compares with alternatives such as the share system.

This approach is potentially dangerous in that the ultimate argument to support the wage system (assuming it is empirically relevant) may impose constraints which make the share system more costly to implement. Without a theory predicting the wage system, it is impossible to gauge the importance of this concern. We nonetheless proceed with this comparison and discuss some approaches to understanding the wage system in the conclusion.

A second issue concerns the treatment of uncertainty and risk sharing in the model. In specifying preference, both workers and firms were allowed to be risk averse. The actual economic behavior described so far has avoided any discussion of risk sharing issues. This is consistent with Weitzman's view that the randomness affecting the macroeconomy is totally and completely unpredictable so that agents behave as if they lived in a world of certainty. Consequently (12) is the appropriate equilibrium condition. If we had addressed the issues of risk sharing directly, then (12) would be replaced by an expected utility equality for workers. Part of the cost of share contracts could be their inferior allocation of risk relative to the wage system.[8] Again, in keeping with Weitzman, we ignore these (potentially important) issues for now and assume that both U(·) and V(·) are linear.

Without completely characterizing the planning problem and without a complete treatment of uncertainty, it is still possible to investigate some of the welfare properties of the two systems. Our approach will be to look at changes in utility levels for firms and workers due to reductions in $\bar{m}_2$ across the two systems.

To begin, we consider the effects of changing from a wage system to a share system in sector 1 on the magnitude of fluctuations in sector 2. As noted earlier, in selecting compensation schemes and employment rules, agents will not take into account the effects of their contracting structures on the rest of the economy. Hence it is important to see whether there are any external benefits to sector 2 agents from having share contracts in sector 1.

Letting superscripts denote the system (s for share, w for wage), we can compare the equilibrium changes in sector 2 output and employment across the two systems from:

$$\Delta \equiv \frac{\Delta q_2^w}{\Delta \bar{m}_2} - \frac{\Delta q_2^s}{\Delta \bar{m}_2} = \frac{n\alpha}{\bar{w}} \left[\frac{\gamma}{1-\gamma^2} - \frac{\phi}{1-\gamma\phi}\right] \qquad (21)$$

Equation (21) implies that $\gamma > \phi$ is necessary and sufficient for output in sector 2 to be more stable in a share economy than in a wage system. From the definitions of γ and ϕ, $\gamma > \phi$ means that

$$\eta(\alpha-\beta) < \rho\lambda(\alpha-\beta) \qquad (22)$$

Proposition 1: If $\alpha > \beta$, share contracts help stabilize sector 2 output as long as $\rho\lambda > \eta$. If $\alpha \leq \beta$, share contracts are destabilizing.

Proof: Direct from (21) and (22).

The point of the share contracts, it seems, is to exact a redistribution of income from workers to firms in economic downturns. If $\alpha > \beta$, firms tend to "recycle" more income than workers so that the leakage effect in downturns is reduced under the share system. So one interpretation of this is that share contracts act as an automatic stabilizer.

The workers in sector 1 also appear to be better off under a share system in the sense that their employment is stabilized. This is true even if the conditions for Proposition 1 don't hold. Hence, if we focus exclusively on fluctuations in employment and output, the share system is welfare improving for workers in sector 1.

This concentration on quantity fluctuations, however, misses some of the costs of the share system. From the viewpoint of a worker at a share firm, the price fluctuations induced by the share system implies that, wages fall in downturns. It is not obvious that workers prefer the employment security of share contracts to the wage security and employment risk of the wage system. To understand this tradeoff between employment compensation and price risk better, we need to evaluate the utility changes of the agents in question.

Looking first at workers, we can consider the changes in utility levels from changes in $\bar{m}_2$ across the two systems for three types of workers: sector 1 workers at wage firms, sector 1 workers at share firms, and sector 2 workers. A sector 1 share worker is always worse off in low $\bar{m}_2$ states than a sector 1 worker at a wage firm since the latter have a chance of a job at $\bar{w}$ while the former always face reductions in compensation when $\bar{m}_2$ falls. Hence, if we can show that share workers in a share system and sector 2 workers do better under a share system, then we can conclude that all workers do better in a share system.

a. Sector 1 Workers

The change in the utility of a sector 1 worker in a wage system due to a change in $\bar{m}_2$ is given by:

$$\frac{\Delta V_1^W}{\Delta \bar{m}_2} = \frac{\mu \eta F}{N p_2^\beta} \left[\alpha + \frac{\bar{w}\gamma}{\eta} \frac{\Delta q_2^W}{\Delta \bar{m}_2}\right] \tag{23}$$

where $\frac{\Delta q_2^W}{\Delta \bar{m}_2}$ is the equilibrium change in sector 2 output from decreases in $\bar{m}_2$ in a wage system (see (7)) and $\mu \equiv \beta^\beta (1-\beta)^{1-\beta}$. Equation (23) utilizes the assumption that each worker faces an equal chance of being laid off under a wage system.[9]

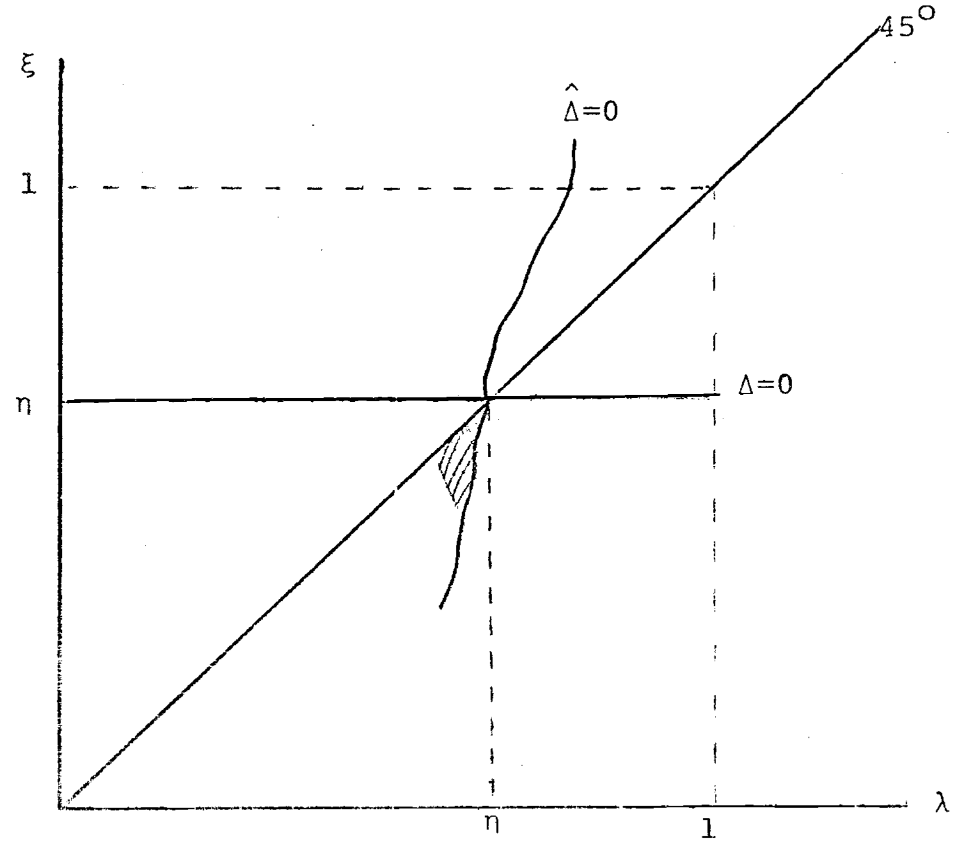
The change in the utility of a sector 1 worker for a share firm in a share system is given by

$$\frac{\Delta V_1^S}{\Delta \bar{m}_2} = \frac{\mu \lambda F}{N p_2^\beta} \left(\alpha + \frac{\bar{w}\gamma}{\eta} \frac{\Delta q_2^S}{\Delta \bar{m}_2}\right) \tag{24}$$

where $\frac{\Delta q_2^S}{\Delta \bar{m}_2}$ is given by (19). Denote by $\hat{\Delta}$ the difference between (23) and (24).

Comparing (23) and (24), workers under either system benefit if the equilibrium output responses to a reduction in $\bar{m}_2$ are small. For the calculation in (23), low levels of $\Delta q_2^W/\Delta \bar{m}_2$ help stabilize sector 1 employment. From (18), we see that changes in p_1 due to Δm_2 are smaller if $\Delta q_2^S/\Delta \bar{m}_2$ is smaller. Share workers thus gain from stabilizing $\Delta q_2^S/\Delta \bar{m}_2$ since price reductions lower compensation if $\lambda > 0$. For a given level of $\Delta q_2^S/\Delta \bar{m}_2$, share workers prefer lower values of λ. If $\lambda = \eta$ and $\rho = 1$, then from (21), we know that (23) and (24) are equal and $\hat{\Delta} = 0$.

We can think of policy-makers having control over two variables ρ and λ, with $\tilde{w}$ adjusting so that (12) holds. Given the importance of $\rho\lambda$ as a product in ϕ and hence in (19) and (22), consider $\xi \equiv \rho\lambda$ and λ as the policy variables. The horizontal line in Figure 3 at $\xi = \eta$ ensures that



<u>Figure 3</u>

$\Delta q_2^W/\Delta\bar{m}_2 = \Delta q_2^S/\Delta\bar{m}_2$, or $\Delta=0$ from (21). Note too that since $\rho \leq 1$, $\xi \leq \lambda$, we are restricted to combinations of λ and ξ on or below the 45° line. The line labeled $\hat{\Delta}=0$ contains the combination of (λ,ξ) such that (23) and (24) are equal. This curve goes through the point (η,η) as shown in Figure 3. From (23) and (24), it can be shown that the $\hat{\Delta}$ curve has a slope exceeding one in the neighborhood of (η,η). This is depicted in Figure 3 as well. Above the $\hat{\Delta} = 0$ curve, we find that $\Delta V_1^W/\Delta\bar{m}_2 > \Delta V_1^S/\Delta\bar{m}_2$ so that the share system provides better protection for sector one workers against adverse $\bar{m}_2$ shocks.

b. Sector 2 workers

For sector two workers,

$$\frac{\Delta V_2^W}{\Delta\bar{m}_2} = \frac{\mu F}{p_1^{\beta} N}\,\bar{w}\,\frac{\Delta q_2^W}{\Delta\bar{m}_2} \tag{25}$$

and

$$\frac{\Delta V_2^S}{\Delta\bar{m}_2} = \frac{\mu F}{p_1^{\beta} N}\,\bar{w}\,\frac{\Delta q_2^S}{\Delta\bar{m}_2} - \frac{\mu\bar{w}\beta}{p_1^{\beta+1}}\,\frac{\Delta p_1}{\Delta\bar{m}_2} \tag{26}$$

where ΔV_2^i is the change in sector 2 workers' utility under compensation scheme i. The important difference between (25) and (26) is that sector 2 workers benefit from sector 1 price reductions in a share system when $\bar{m}_2$ falls (i.e. $\Delta p_1/\Delta\bar{m}_2 > 0$). Hence, even if $\alpha = \beta$ or $\eta = \rho\lambda$ (so $\Delta q_2^W/\Delta\bar{m}_2 = \Delta q_2^S/\Delta\bar{m}_2$ from (21)), sector 2 workers still prefer a share system in sector 1.

The gains or losses for sector 2 workers from a share system can be seen from Figure 3 as well. Along the line $\Delta=0$, we know that (25) exceeds (26), since $\Delta p_1/\Delta\bar{m}_2 > 0$. So, $\Delta V_2^W/\Delta\bar{m}_2 > \Delta V_1^S/\Delta\bar{m}_2$ for combinations of (λ,ξ) slightly below the line (by continuity).

Looking at Figure 3, any combination of (λ,ξ) in the shaded region (i.e. close to (η,η) with $\xi \leq \lambda$) will determine a share contract in which workers in both sectors are better off than in the wage system. Since we are below the

Δ=0 line, fluctuations in sector 2 output are actually larger in the share system than in the wage system (if $\alpha > \beta$). Sector 2 workers are compensated for this by reductions in sector 1 output prices when $\bar{m}_2$ is low. Sector 1 workers have their employment stabilized and their compensation destabilized. Above the $\hat{\Delta} = 0$ line, λ is low enough, relative to ξ, that sector 1 workers are better off with slightly destabilized compensation. Workers, then, are in agreement about the merits of stabilizing the system through share contracts, i.e., both groups of workers benefit from large values of ξ. Sector 1 workers, of course, prefer that this be accomplished by making all firms share firms (i.e. ρ=1) rather than through large λ. Given this, we let ρ=1 for the remainder of the analysis since our ultimate goal is to show there exists a share system preferable to the wage system.

c. Sector 1 Firms

With regard to firms, we first look at those in sector 1. Under a wage system,

$$\frac{\Delta U_1^w}{\Delta \bar{m}_2} = \frac{\Psi}{p_2^\alpha}(1-\eta)(\alpha + \frac{\bar{w}\gamma}{\eta}\frac{\Delta q_2^w}{\Delta \bar{m}_2}) \tag{27}$$

where $\Psi \equiv \alpha^\alpha (1-\alpha)^{1-\alpha}$. In a share system, we use (18) to calculate that

$$\frac{\Delta U_1^s}{\Delta \bar{m}_2} = \frac{\Psi}{p_2^\alpha}(1-\lambda)(\alpha + \frac{\bar{w}\gamma}{\eta}\frac{\Delta q_2^s}{\Delta \bar{m}_2}). \tag{28}$$

So, like their workers, sector 1 firms benefit from stabilizing fluctuations in sector 2 output. These firms, however, prefer that λ be large so that they do not have to absorb profit reductions in bad states.

Define $\tilde{\Delta}$ as the difference between (27) and (28). The combinations of (λ,ξ) such that $\tilde{\Delta}$=0 are shown in Figure 4. Note that this curve goes through

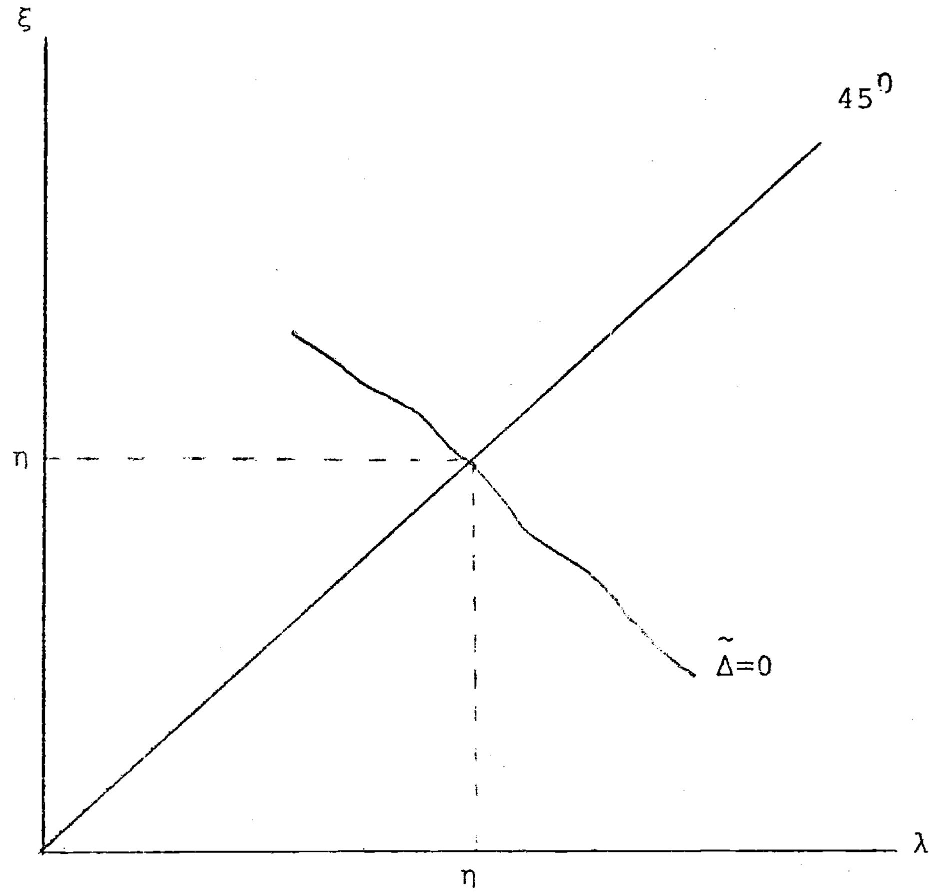


Figure 4

the point (η,η) as well. In contrast to $\hat{\Delta}$, $\tilde{\Delta} = 0$ is negatively sloped which reflects firms' preference for higher λ, given ξ. Comparing $\tilde{\Delta} = 0$ to $\hat{\Delta} = 0$, we see that there are no combinations of (λ,ξ) with $\xi \leq \lambda$ such that all sector 1 agents are better off with share contracts. At the point (η,η) both sector 1 workers and firms are indifferent between the two systems.

d. Sector 2 Firms

Finally, the utility changes for sector 2 firms due to reductions in $\bar{m}_2$ are given by:

$$\frac{\Delta U_2^W}{\Delta \bar{m}_2} = \frac{\Psi}{(p_1)^\alpha}\left(1 + \frac{(1-\eta)\bar{w}}{\eta}\frac{\Delta q_2^W}{\Delta \bar{m}_2}\right. \tag{29}$$

and

$$\frac{\Delta U_2^S}{\Delta \bar{m}_2} = \frac{\Psi}{(p_1)^\alpha}\left(1 + \frac{(1-\eta)\bar{w}}{\eta}\frac{\Delta q_2^S}{\Delta \bar{m}_2} - (\Pi_{f2} + \bar{m}_2)\frac{1}{p_1}\frac{\Delta p_1}{\Delta \bar{m}_2}\right). \tag{30}$$

As was the case for sector 2 workers, these firms gain from stabilizing their output and from reductions in p_1 when $\bar{m}_2$ is low. For (λ,ξ) sufficiently close to (η,η), (29) will exceed (30).

These calculations make quite clear that all agents in the economy benefit from the stabilization of output in both sectors (assuming that Proposition 1 holds) associated with a share system. The potential losers from the share system are sector 1 workers who bear the burden of compensation reductions in bad states. Is it possible to devise a share contract such that the share system dominates the wage system?

Proposition 2: Agents' utility losses when $\bar{m}_2$ falls are less under a share system with $\rho=1$ and $\lambda=\eta$ than under a wage system.

Proof: With $\rho=1$ and $\lambda=\eta$, $\xi=\eta$ as well. Hence, from (21), $\Delta=0$ (regardless of the sign of $\alpha-\beta$). At $\lambda=\eta$ and $\rho=1$, all sector 1 agents suffer identical utility losses, when $\bar{m}_2$ is low, in the two systems. At $\lambda=\eta$ and $\rho=1$, sector 2 agents are better off with the share system since $\Delta=0$ and $\Delta p_1/\Delta\bar{m}_2 > 0$.

In thinking about this proposition, note that at $\lambda=\eta$ and $\rho=1$, fluctuations in sector 2 output are identical under the two systems. The gains from the share system come from the stabilized employment of sector 1 agents and hence the enhanced consumption of sector 2 agents.

The proposition tells us about the welfare properties of the two systems when $\bar{m}_2$ is lower than $\bar{m}$. If $\bar{m}_2$ is unexpectedly high, then the two systems will generate the same outcome since, at the benchmark allocation described by (6) with $\bar{w} = w^c$ and $\bar{m}_1 = \bar{m}_2 = \bar{m}$, we are at full-employment. Hence by setting $\rho=1$ and $\lambda=\eta$, the share system generates an allocation which stochastically dominates (first-order) the allocation supported by the wage system. So that, even if we allowed agents to be risk averse, the share system would be better than the wage system.

V. Concluding Comments

The main point of this exercise has been to establish a framework for evaluating Weitzman's proposal for the imposition of a share system. The model has sought to highlight the multiplier effects in quantity responses under a wage system. Following the arguments in Cooper-John (1985), these multiplier effects were driven by strategic complementarities across sectors of the economy. From this perspective, the value of share contracts is their potential for altering the form and magnitude of these intersectoral linkages. In this model, share contracts in one sector have positive external benefits for other sectors.

One of the most discomforting features of this exercise is the lack of a firm theoretical or empirical basis for the wage system. As a consequence, a share contract might appear to be simply a "back-door" way of reintroducing the wage-price flexibility that has been assumed away at the start.

To address this criticism, one needs to develop a theory which predicts the wage system as a privately optimal contracting structure, perhaps for insurance reasons. In such a setting, there would be a private cost to wage flexibility from insurance losses. Nonetheless, as this analysis points out, there may be a social benefit associated with more wage flexibility which is not internalized by the contractants. In fact, one can interpret the $\tilde{w}$ term of a share contract as an insurance term and the λ term as an "employment incentive" term. The best share contract balances private insurance needs with the social costs of large employment fluctuations and hence sets a higher value of λ than is privately optimal.

Unfortunately, contracting theories which predict fixed wages as an optimal insurance arrangement also predict full severance pay <u>and</u> a separately negotiated employment rule. These are not features of the wage system explored in this paper. Whether or not models with private information (or alternative models) can rationalize the wage system remains an open and intriguing question.[11]

FOOTNOTES

[1]After writing the first draft of this paper, I received Weitzman [1984b] which provides more details on the share system without the stress, given here, to flows across sectors of the economy.

[2]As indicated by the equilibrium conditions, prices may fluctuate a lot in the face of endowment shocks due to the structure of demands. The point of focusing on imperfect competition and wage/price inflexibility is to generate more quantity fluctuations.

[3]This is not a proper reaction curve in that it incorporates the conditions for a Nash equilibrium in sector i given q_{-i}. Still, it indicates the reaction of sector i, in equilibrium, to changes in output of the other sector. We use the term reaction curve loosely.

[4]Hence the economy will exhibit behavior similar to the strategic complementarities investigated in Cooper-John (1985). For this model, there is a unique Nash equilibrium. The importance of the strategic complementarities becomes clear in the comparative static properties of the model.

[5]We are assuming here that all wage firms and all share firms produce the same levels of output: q_1^w and q_1^s respectively.

[6]This treatment of uncertainty is discussed in the next section.

[7]Whether or not this is an appropriate view of business cycle fluctuations is arguable.

[8]One common argument for fixed wage contracts is risk sharing.

[9]The probability that an arbitrary sector 1 worker is employed is given by $\frac{Fq_1}{N}$, where q_1 is the average employment level.

[10]It is, of course, critical that ρ be large relative to the size of $\Delta\bar{m}_2$ so that $\frac{N-(1-\rho)q_1^w F}{\rho F}$ is the minimum in (14).

[11]Because of the imperfect competition in this model, the contracting structure seems a bit richer than in the contract models with price-taking behavior. One can view firms as contracting with both customers and workers with informational asymmetries possibly existing in each of these contracts. I am currently working on the implications of these models for prices, wages, output, and employment.

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