IS THERE A NEGATIVELY-SLOPED SUPPLY CURVE IN THE LABOUR-MANAGED FIRM?

A. STEINHERR and *J. F. THISSE**

1. INTRODUCTION

Existing theoretical results concerning labour-managed economies point to their general viability; see, e. g., Vanek (1970), Meade (1972) and Dreze (1974). However, a number of odd, if not problematic, features have emerged from the analysis. Among the most pressing difficulties is the one of adjusting labour when market price increases. Ward (1958) was the first to notice that, in this case, the labour-managed firm (LMF) tends of reduce employment and output in the short-run.

This troublesome result and its perverse implications have suscitated two kinds of reactions. One consists in investigating whether this result can be maintained under more general conditions. Domar (1966) and Vanek (1970) have been able to show that certain generalizations (including joint products, complementary inputs and an upward-sloping labour-supply curve to the firm) tend to diminish the severity of the problem. It may even be possible in these circumstances, to obtain a positively-sloped supply curve for the LMF; nevertheless, the elasticity of supply remains below that of the profit-maximizing firm.

A more fundamental criticism was made by J. Robinson (1967). For this author, the above result brings to light the inappropriateness of the objective function by which LMFs are characterized, namely, *the maximization of labour's value-added per capita.* Rather, would not a LMF pursue other objectives such as creating jobs. And if an optimal policy indicates a reduction in employment, how can this reduction be implemented in practice?

In this paper, we intend to approach this problem from the perspective of the internal organization of the LMF. The analyses by Ward and Vanek assume implicitly, on the one hand, the *existence of an exo-*

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genous classification of workers according to which workers are selected for dismissal and, on the other hand, *indifference of remaining workers with respect to the fate of those who are dismissed.*

The first assumption implied in the analyses by Ward and Vanek, is not very satisfactory since there are well-known difficulties for the derivation of an exogenous classification. We propose, in contrast, a well-defined and simple method of selection: layoffs are determined by a random process.

Random selection is, in a certain sense, neutral and less susceptible to manipulation. Each worker has a chance to remain employed which is not the case with non-random selection. It seems therefore that workers will more easily accept random selection than other methods.

In this case, the objective function of the LMF must be modified to integrate the risk for workers to be selected for departure. Indeed, with the Ward—Vanek objective, workers maximize income of those remaining in the firm without taking into account that risk. Clearly, it is not easy to understand why workers would behave like that.

In the spirit of labour management, the second implicit hypothesis in the Ward—Vanek analysis invites an even more fundamental critique of their objective function. Indeed, reducing employment in the firm and neglecting the possible welfare loss of departed members implies selfish behaviour that seems incompatible with the philosophical foundations of labour-management. It appears more acceptable to require a certain degree of solidarity of workers, namely, that they take the welfare losses of departed fellows into account.

Two particular but rather important mechanisms of solidarity are suggested by the welfare theory. The first arises when the welfare of all workers, defined as the sum of the utilities of remaining and leaving workers, is considered as the objective. In the second, the compensation principle is applied: dismissed workers must be compensated for their income losses by those remaining in the LMF. In either case, the objective function of the LMF needs revision.

2. RISK AND THE OBJECTIVE OF THE LABOUR-MANAGED FIRM

The objective function used by Ward (1958), Vanek (1970) and Drèze (1974), among others, can be written[1])

$$y = \frac{pF(L,K) - rK}{L} \tag{1}$$

where

y = labour's value-added (or income) per capita
p = market price for one unit of output

[1])It is assumed here that all capital can be borrowed in a perfect capital market or from a central agency without losing exclusivity of workers' control. Although a standard assumption in the LMF literature, it is not an unproblematic one; see Jensen and Meckling (1977).

F = production function
K = stock of capital
L = employment
r = rental price of one unit of capital.

For our analysis we assume *an initial equilibrium where the average income of workers is equal across all firms.* Denoting the market price and the variables in this initial state with subscript zero, we have:

$$\frac{p_0F(K_0,L_0) - rK_0}{L_0} = w. \tag{2}$$

We now consider the case where market conditions improve, which can be expressed as follows:

$$p_1 > p_0. \tag{3}$$

Given this change, we know that the optimal employment for maximization of

$$\frac{p_1F(K_0,L) - rK_0}{L}, \tag{4}$$

denoted by L_1, is smaller than the initial employment L_0. Furthermore, we also have $\bar{L}(K_0) < L_1$, where $\bar{L}(K_0)$ is such that $F'_L(L,K_0)$ increases on $[0,\bar{L}(K_0)[$ and decreases on $]\bar{L}(K_0),\infty[$. This follows directly from the fact that L_1 maximizes (4).

As discussed in the introduction, we assume that the selection of members to leave is made by some random process. One could imagine that specific probabilities are attached to each worker, determined on the basis of some pre-determined criteria. However, here also the choice of such criteria and the determination of these probabilities may be very difficult in practice. For simplicity, we assume, therefore, that *each worker has the same probability of being dismissed.* Besides simplicity, this system has the further advantage of corresponding to a well-established, albeit particular notion of justice. Acceptance of this rule is therefore likely. Dismissed workers are chosen simultaneously from a lottery (in practice, a computer programme might select randomly a given number of names from the list of workers). Consequently, if L denotes the number of workers remaining in the firm, the probability for a worker to leave the LMF is given by

$$\pi = \frac{L_0 - L}{L_0} \tag{5}$$

while the probability to remain is

$$I = \pi \frac{L}{L_0}. \qquad (6)$$

In contrast to the capitalist firm, where labour is an input among others, it is expected that *the objective of workers incorporates the risk of losing one's job.* Indeed, among the workers who decide to reduce the employment level are those who will have to leave. It is therefore natural that the alternative revenue of dismissed workers is taken into account. This alternative revenue is equal to income from employment in another firm or uneployment benefits. The short-run horizon of our analysis precludes the creation of employment through setting up of new firms. Since we started out from an initial equilibrium situation and then assumed a market improvement, it is most likely that alternative revenues are inferior to the one a worker would have obtained if he had remained within the LMF. In fact, we may make a stronger assumption: alternative incomes are no greater than the initial income w. This can be justified on the following grounds. As market changes affect the entire industry, dismissed workers may find a job in other industries remunerated at w, but not in the one under consideration since all firms adjust their optimal size downwards. If a dismissed worker cannot find a job, he gets unemployment benefits that cannot exeed w. In the following analysis, we assume that alternative income is equal to w. This is not restrictive, however, since the conclusions we are going to derive remain unaltered if alternative revenues are below w.

We are now in a position to rewrite the objective function of the LMF as follows:

$$\max V(L) \quad w.r.t.\ L \in [0, \infty[,$$

where

$$V(L) = \begin{cases} w & \text{for } L = 0 \\ U[y(L)] \,.\, (1-\pi) + U(w) \,.\, \pi & \text{for } 0 < L < L_0 \\ y(L) & \text{for } L_0 < L; \end{cases} \qquad (7)$$

and where U denotes the utility function assumed indentical for all workers. (2) Given the standard assumption of continuity of y(L) and given that y(L) tends to zero when L becomes arbitrarily large, it is easily seen that at least one value of L maximizing the expected utility of income per capita exists; it is denoted by L^*. To characterize L^*, we subdivide the domain of L in disjoint intervals and we show that assuming L^* in each of these intervals leads to a contradiction, except in one case.

[2]) Note that an alternative interpretation of (7) would be as follows: exogenous rules of selection might be so complicated that all workers consider their partnership in the LMF as uncertain. It can then be supposed that workers behave approximately as maximizers of (7).

(i) Assume $L^* \in [0, \bar{L}(K_0)]$. Clearly, L^* differs from zero since workers can always obtain a higher income per capita than w by choosing L_0.

Then consider $L^* \in]0, \bar{L}(K_0)]$. In this case, workers can guarantee themselves a higher value of the objective by taking L_1. Indeed,

$$V(L^*) = U[y(L^*)] \,.\, \frac{L^*}{L_0} + \frac{L_0 - L^*}{L_0} U(w)$$

$$< U[y(L_1)] \,.\, \frac{L_1}{L_0} + \frac{L_0 - L_1}{L_0} U(w) + \frac{L^* - L_1}{L_0} [U(L^*) - U(w)]$$

since $y(L_1) > y(L^*)$

$$< U[y(L_1)] \,.\, \frac{L_1}{L_0} + U(w) \,.\, \frac{L_0 - L_1}{L_0}$$

as $L^* < L_1$

$$= V(L_1).$$

We thus arrive at a contradiction.

(ii) Assume $L^* \in]\bar{L}(K_o), L_o[$. Then L^* must satisfy the first-order condition

$$\frac{dV}{dL} = U'[y(L^*)].[p_1 F'_L(K_0 L^*) - y(L^*)] + U[y(L^*)] - U(w) = 0. \qquad (8)$$

As $L^* < L_0$ and as the marginal productivity of labour is decreasing, we have

$$p_1 F'_L(K_0, L^*) > p_0 F'_L(K_0, L_0).$$

We also have

$$p_0 F'_L(K_0, L_0) = w$$

so that

$$p_1 F'_L(K_0, L^*) > w. \qquad (9)$$

Given (8) and (9), we obtain

$$U'[y(L^*)].[w - y(L^*)] + U[y(L^*)] - U(w) < 0. \qquad (10)$$

Moreover,

$$y(L^*) > w \qquad (11)$$

without which L_0 would be preferred to L^*, which is impossible. We now show that (10) and (11) are incompatible when the utility function is concave. For that, put $a = w$ and $b = y(L^*)$ and rewrite (10) as

$$U'(b)\cdot(a-b) + U(b) - U(a) < 0. \qquad (12)$$

Let $c = \Theta a + (1-\Theta)b$ with $\Theta \in]\,0,1\,[$. As U is concave, we have

$$U(c)\ \Theta U(a) + (1-\Theta)\, U(b)$$

which amounts to

$$\Theta[U(b) - U(a)] \geq U(b) - U(c).$$

Given that

$$\Theta = \frac{b-c}{b-a}$$

we obtain

$$U(b) - U(a) \geq (b-a)\cdot\frac{U(b)-U(c)}{b-c}.$$

Taking the limit for $c \to b$, i. e., $\Theta \to 0$, yields

$$U(b) - U(a) \geq (b-a)\cdot U'(b)$$

that is

$$U'(b)\cdot(a-b) + U(b) - U(a) \geq 0 \qquad (13)$$

which contradicts (12).

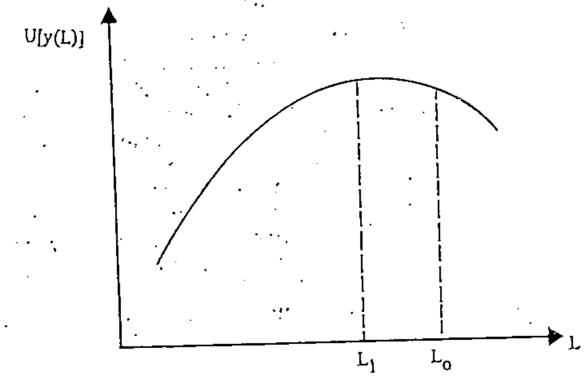
(iii) Assume $L^* \in]\,L_0, \infty\,[$. This means that $V(L^*)$. As the marginal productivity of labour is decreasing on $]\,\bar{L}(K_0), \infty\,[$ and as $\bar{L}(K_0 < L_1$, the income per capita $y(L)$ is also decreasing on $]\,L_0, \infty\,[$. Accordingly, as $L_1 < L_0$, we have $y(L_0) = V(L_0) > V(L^*) = y(L^*)$ which is impossible.

The analysis of these three cases reveals that the optimal solution is unique and given by L_0. In other words, taking into account the risk for *workers to lose their jobs and assuming that workers are risk-adverse implies that the level of employment remains unchanged when market conditions improve.* Interestingly, this property remains valid when expected income, rather than expected utility of income, is maximized. Indeed, no use of the strict concavity of U is made in the above proof.(3)

How can this surprising result be understood? Two comments are in order. First, although objective function (7) implies that each worker is only concerned with his own interest, *the firm actually takes into consideration the income of all initial members;* this is easily revealed by an examination of (7). Thus, a reduction in dismissals appears as a natural result, as shown by (8). Second, that there is in fact, *no reduction at all in employment is the consequence of assuming that workers are not risk-lovers.* This can be seen from the comparison of (12) and (13).

An illustration of this result is contained in figure 1. Selecting U(w) as the origin of the utility function, we consider a reduction of employment by one unit starting from L_0. As $U[y(L)]$ is concave on $]\bar{L}(K_0), \infty\,[$, the utility of income increases less than proportionately. The product, which is equal to the expected utility of income, is therefore decreased.

Figure 1.



3. GROUP OPTIMALITY

In this section, we assume again that a parametric change occurs as in (3) and ask the question: *what would be the optimal solution when the welfare of the group is the prime concern of the workers?* Asking this question obviously implies a certain abandon of individual interests and a certain solidarity among workers.

Again, there is a large variety of schemes through which solidarity can be introduced. Three typical forms can be distilled from various strands of literature.

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3) The assumption that workers can always obtain w outside the firm is obviously crucial for the result. The latter is not necessarily true for alternative incomes higher than w; there exists a value w between w and $y(L_0)$ which corresponds to the highest alternative income for which all workers optimally remain in the firm. A simple expression is obtained for this income when the expected income is maximized in the LMF: $\overline{w} = p_1 F'_L(K_0, L_0)$.

The first one, and perhaps the most popular, is the rule *never to reduce the number of workers.* This suggestion was made by J. Robinson (1967) and can also be encountered regularly in the sociological literature on participation. In this case, adjustment is realized through the number of hours worked by the members. As noticed by Berman (1977), this can give rise to tension within the firm which results from the divergence which may appear between the marginal revenue of a worker and his corresponding contribution to the income of the group. Only a strong cooperation between the workers can guarantee an efficient allocation of labour inside the firm; see Berman (1977). Less rigid mechanisms of solidarity should therefore be sought.

The second archetype consists in *maximization of the sum of the utilities of all initial workers, allowing employment to adjust optimally.* This amounts to maximizing the following particular group utility function:

$$V(L) = \begin{cases} W(w)\cdot L_0 & \text{for } L = 0 \\ W[y(L)]\cdot L + W(w)\cdot L_0 - L) & \text{for } 0 < L < L_0 \\ W[y(L)]\cdot L & \text{for } L_0 \leqslant L \end{cases} \qquad (14)$$

where W denotes the utility function of income, assumed concave and identical for all workers. Clearly the objective function (14) is formally equivalent to (7) the domain] $0,L_0$ [, so that *the optimal employment corresponds*, as in the above section, *to the initial level of employment* L_0. It must be emphasized, however, that the two objective functions are based on *completely different behavioural and organizational assumptions.*

The third form is suggested by the compensation principle: *remaining workers have to compensate dismissed workers for their income losses.* An obvious benchmark for the determination of a transfer would be the difference between the average income in the new state if all workers had remained in the firm and the alternative income w. Lower transfers would not compensate workers entirely, and higher transfers would never be made as will become obvious from the analysis below.

The objective function can now be written as:

$max\ V(L)\ w.r.t. L \in [0,_{\infty}[$

where

$$V(L) = \begin{cases} w & L = 0 \\ y(L) - \dfrac{L_0 - L}{y(L)}[y(L) - w] & 0 < L < L_0 \\ y(L) & L_0 \leqslant L \end{cases} \qquad (15)$$

and where the amount y(L) — w represents the transfer payable to each dismissed worker.

Denote by L** a maximizer of V(L). From the properties of V(L) it is immediately seen that L**exists.
and (iii) $L^{**} \in]L_0,\infty[$. Cases (i) and (iii) can be dealt with as in section
We distinguish three cases: (i) $L^{**} \in [0,\bar{L}(K_0)]$, (ii) $L^{**} \in]\bar{L}(K_0),L_0[$,

2. We still have to consider case (ii). Then L** must verify the first-order condition given by

$$\frac{dV}{dL} = L^{**}p_1F'_L(K_0,L^{**}) - L^{**}y(L^{**}) + L_0[y(L_0) - w] = 0. \qquad (16)$$

As with (9), we obtain

$$p_1F'_L(K_0,L^{**}) > w, \qquad (17)$$

so that

$$L^{**}w - L^{**}y(L^{**}) + L_0[y(L_0) - w] < 0\,. \qquad (18)$$

Denoting by Y(L) the revenue generated by the firm when L workers remain in the LMF, we may rewrite (18) as

$$Y(L_0) - Y(L^{**}) < 0\,. \qquad (19)$$

Consider now the maximizer of Y(L) on $[0,\infty[$, i.e. L. As $L > 0$, we must have

$$p_1F'_L(K,L) = w.$$

Moreover, as $p_1F'_L(K_0,L) > p_0F'_L(K_0,L)$ for any L, we obtain

$$L \geqslant L_0 \qquad (20)$$

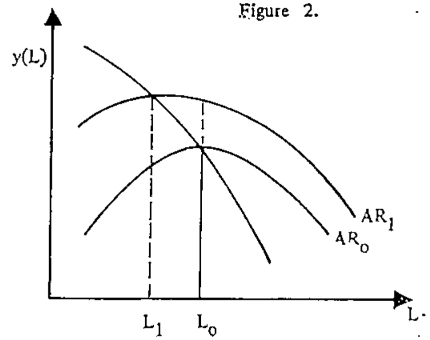
Knowing that Y(L) is strictly concave on $]L(K),\infty[$, it then follows from (20)

$$Y(L^{**}) < Y(L_0) \leqslant Y(L) \qquad (21)$$

which contradicts (19).

Thus, we have demonstrated that *when complete compensation has to be paid for income losses, the LMF never reduces employment.* There is a direct economic interpretation of this result as shown in figure 2 where marginal revenue (for simplicity assumed constant) and average revenue in the initial state (AR_0) and in the new state (AR_1) are depicted.

Figure 2.



The Ward-Vanek firm reduces employment as long as average revenue exceeds marginal revenue: it moves therefore from L_0 to L_1. If the firm has to pay a compensation equal to the difference between AR_0 and AR_1 at L_0, then it never pays to reduce employment. For the marginal worker, the firm is indifferent, *cet. par.* For the second worker, the transfer would already exceed the gain eschewing to remaining workers.

Note that objective functions (14) and (15) are written without specification of any particular selection process, which is left exogenous. In particular, the obtained results apply to a system of seniority (last-in-first-out). On the other hand, the objective functions would have to be modified for endogenous and random selection processes.

5. CONCLUDING REMARKS

One seemingly major problem of labour-managed organizations has disappeared: *the labour-managed firm does not reduce employment and output when the price of output increases, provided the objective function integrates relevant internal decision-making processes.*[4] Obviously, this result can also be obtained for a reduction of the rental price of capital, or for Hicks-neutral technological progress. However, in those cases where Ward and Vanek obtain »perverse« results the LMF still does not increase employment and output as does the profit-maximizing firm. In the short-run, the supply curve is therefore perfectly non-elastic with respect to increases in price. Since the marginal productivity of capital now exceeds the rental cost of capital investment will occur over time to adjust their capital-labour ratio to its optimal level, with employment remaining constant. Clearly, the speed of adjustment, i.e., investment per period of time, will inversely depend on adjustment costs. Thus, *the incentives in our models lead to a long-run increase of the stock of capital and of output, whereas adjustment in the Ward-Vanek firm relies on a reduction of employment and output.*

While other objective functions can be imagined, based on different mechanisms dealing with risk or on other forms of solidarity, our results seem to be fairly general. Only minimal restrictions have been imposed on technology and preferences and the objective functions are quite generally formulated. We also have not neglected in this partial equilibrium analysis constraints arising in the remaining economy as in the Ward-Vanek analysis, by introducing the notion of an alternative income.

[4]) This result is constant with the one obtained be Sertel (1978), who makes use of the idea that rights to participate as worker-partners in a workers' firm are open to negotiation, in a worker-partnership market, between the present members of such a firm and the potential entrants of extants.

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DA LI POSTOJI KRIVA PONUDE SA NEGATIVNIM NAGIBOM U SAMOUPRAVNOM PREDUZEĆU?

A. STEINHERR i J. THISSE

Rezime

U ovom članku autori dokazuju da je maksimiranje per capita dodajne vrednosti rada nepodesno specifikovana funkcija cilja za istraživanje promena u ekonomskom okruženju. Stoga oni predlažu neke alternative koje su po njihovom mišljenju konzistentnije i sa logikom i sa duhom radničkog samoupravljanja.

Prvo pitanje koje oni žele da rasprave jeste: kako odabrati radnike koje treba otpustiti? U Wardovoj i Vanekovoj analizi ovaj je problem izbegnut pretpostavkom o postojanju egzogenog pravila. Međutim, ovo nije sasvim zadovoljavajuće rešenje budući da postoje dobro poznate teškoće oko izvođenja takve klasifikacije.

Autori predlažu, za razliku od Warda i Vaneka, dobro definisani metod izbora: otpuštanje je određeno slučajnim procesom. Funkciju cilja samoupravnog preduzeća tada treba modifikovati tako da obuhvati eksplicitno rizik izbora radnika koje treba otpustiti. Imajući u vidu Ward-Vanekov cilj, radnici maksimiraju dohodak preostalih radnika, ne uzimajući u obzir taj rizik.

This paper attempts to generalize Sertel's approach in another direction to incorporate uncertainty. This is necessary to study the implications of the transfer of risks carried by an entrepreneur in a capitalist enterprise to the workers in a labour-managed firm in an uncertain environment when such an organizational change is designed. We investigate whether the conclusions reached under certainty stand when uncertainty is introduced.

In the next section we describe the environment in which our capitalist and self-managed enterprises operate. In sections 3 and 4, the decision process and optimal outcomes in capitalist enterprises with two regimes are presented. The first regime assumes unlimited liability on the part of the capitalist, while the second considers the possibility of default in wage payments. In section 5, the basic properties of the workers' enterprise used in this paper are introduced. Section 6 covers the equilibrium analysis of the workers' enterprise facing competitive capitalism with unlimited liability, while the last section treats the equilibrium analysis with possibility of default in the capitalist sector.

2. ENVIRONMENT

In this paper we consider enterprises employing two types of productive inputs, capital goods and labour, to produce a single good, Y. The labour contribution of the i^{th} worker is x_i, and the total labour

$$Y = K^{\alpha} L^{\beta} \qquad (0 < \alpha, \beta, \alpha + \beta < 1). \tag{2.1}$$

where K stands for the quantity of capital goods used and L for the total labour input. Labour input is obtained by employing n workers. The labour contribution of the ith worker is x_i, and the total labour input is the sum of all their inputs, i. e.,

$L = \sum_{i=1}^{n} x_i$. The firm rents the capital goods it uses at a rental ρ.

Our specification of uncertainty is quite simple. We assume that the price of the commodity is a random variable, denoted as $\tilde{\Theta}$ with the following properties:

$$\tilde{\Theta} > 0, \; E(\tilde{\Theta}) = 1. \tag{2.2}$$

The value of $\tilde{\Theta}$ is unknown until after output is produced. The revenues denoted by $\tilde{R}$ and labour's value-added denoted by $\tilde{V}$ are also random variables induced by $\tilde{\Theta}$:

$$\tilde{R} = \tilde{\Theta} Y \tag{2.3}$$

$$\tilde{V} = \tilde{R} - \rho K \qquad (\rho > 0) \tag{2.4}$$

The workers all like income and dislike work, exhibiting preferences as represented by the utility function:

$$u_i = y_i - x_i^{\gamma} \qquad (\gamma > 1) \tag{2.5}$$

where y_i is the income of the i^{th} worker. Since we will assume homogeneous work-force, equal compensation and identical preference functions, optimal solutions will be the same for all workers. Therefore, we will not use the subscript i from this point on.

3. COMPETITIVE CAPITALIST ENTERPRISE

(Unlimited Liability)

In the capitalist enterprise, we consider an entrepreneur maximizing expected profit and responsible for decisions concerning the employment of capital goods and labour inputs. Assuming unlimited liability on the part of the capitalist, expected profits are

$$\tilde{\pi} = \tilde{V} - wL, \tag{3.1}$$

where w denotes any positive wage for labour input. The expected-profit-maximizing levels of K at any given w and L is that which maximizes the expected value-added $E(\tilde{V})$. The first order condition for the maximization yields

$$\underline{K} = \left(\frac{\alpha}{\rho} L^{\beta}\right)^{1/(1-\alpha)} \tag{3.2}$$

as the expected profit maximizing quantity of capital goods at rental ρ and the parameters of the production function. By substituting $\underline{K}$ for K into (2.1), (2.4), respectively, we get:

$$\underline{Y} = \left\{\left(\frac{\alpha}{\rho}\right)^{\alpha} L^{\beta}\right\}^{1/(1-\alpha)} \tag{3.3}$$

$$\underline{V} = (\tilde{\Theta} - \alpha)\, \underline{Y} \tag{3.4}$$

If we denote the size of the labour force in the capitalist enterprise as »a«, then the profits of the enterprise, given the optimal utilization of capital goods, can be expressed as:

$$\underline{\tilde{\pi}} = \underline{\tilde{V}} - wax. \tag{3.5}$$

An expected-profit-maximizing entrepreneur facing any given wage w will exhibit the following demand function for labour input:

$$ax = \frac{\beta Y}{w}. \tag{3.6}$$

A typical worker facing a given wage will exhibit a labour supply function which is obtained by maximizing his utility given as

$$u = wx - x^{\gamma} \tag{3.7}$$

assuming unlimited liability. Maximization of (3.7) leads to the following supply function:

$$x = \left(\frac{w}{p}\right)^{\frac{1}{1-\gamma}} \tag{3.9}$$

Equating the supply and demand functions for labour input yields the equilibrium labour input per worker:

$$\underline{\bar{x}} = \left\{\left(\frac{\alpha}{\rho}\right)^{\alpha} \left(\frac{\beta}{\gamma}\right)^{1-\alpha} \left(\frac{1}{a}\right)^{\varepsilon}\right\}^{1/\delta}, \tag{3.9}$$

where $\delta = (1-\alpha)\gamma - \beta > 0$ *and* $\epsilon = 1 - \alpha - \beta > 0.$

Substituting $\underline{\bar{x}}$ in (3.2) and solving yields the equilibrium capital input

$$\underline{\bar{K}} = \left\{\left(\frac{\alpha}{\rho}\right)^{\gamma-\beta} \left(\frac{\beta}{\gamma}\right)^{\beta} a^{\beta(\gamma-1)}\right\}^{\frac{1}{\delta}} \tag{3.10}$$

Substituting $\underline{\bar{x}}$ in (3.3) and solving yields the equilibrium output:

$$\underline{\bar{Y}} = \left\{\left(\frac{\alpha}{\rho}\right)^{\gamma\alpha} \left(\frac{\beta}{\gamma}\right)^{\beta} a^{\beta(\gamma-1)}\right\}^{\frac{1}{\gamma}} \tag{3.11}$$

and the equilibrium wage is found as:

$$\underline{\bar{w}} = \gamma^{\frac{\varepsilon}{\delta}} \left\{\left(\frac{\alpha}{\rho}\right)^{\alpha} \left(\frac{\beta}{\gamma}\right)^{1-\alpha} \left(\frac{1}{a}\right)^{\varepsilon}\right\}^{\frac{\gamma-1}{\delta}} \tag{3.12}$$

With the assumption of unlimited liability on the part of the capitalist, the utility level of a typical worker at the equilibrium level of output, labour input and wage rate can be determined as:

$$\underline{\bar{u}}_c = \left(\beta - \frac{\beta}{\gamma}\right) A \left(\frac{1}{a}\right)^{\gamma\varepsilon/\delta}, \tag{3.12}$$

$$\text{where } A = \left\{\left(\frac{\alpha}{w}\right)^{\alpha\gamma} \left(\frac{\beta}{w}\right)^{\beta}\right\}^{1/\delta}, .$$

4. COMPETITIVE CAPITALIST ENTERPRISE

(Possibility of Default)

In this section, a somewhat different institutional setting is considered. We investigate the possibility of the capitalist's defaulting the wage payments if the firm cannot generate sufficient income. However, it is assumed that the wage payments have a higher priority than rent payments for capital goods services. The analysis of the case where wage payments have lower priority than rentals is straight-forward, but since it does not yield significantly different results, it is not presented here.

We initially assume that the possibility of default is ignored in a sequential decision process when the level of capital and labour inputs are determined, and is taken into account in finding the equilibrium in the share market.

The decision process for this case is the same as explained in the previous section, and the equilibrium solution values for $\underline{\bar{x}}$, $\underline{\bar{K}}$, $\underline{\bar{Y}}$ and $\underline{\bar{w}}$ are identical with (3.9), (3.10), (3.11) and (3.12), respectively. (Since, in choosing input levels, both the capitalist and the workers are assumed to ignore the possibility of default, the levels of the equilibrium decision variables do not change.)

Once the production process is completed and $\tilde{\Theta}$ becomes known, since the capitalist is allowed to default on the wage payments when sufficient revenue is not generated, the utility of a typical worker in the capitalist sector becomes the random variable

$$\underline{\tilde{\bar{u}}}_c = \begin{cases} wx - x^{\gamma} & \text{if } \tilde{R} \geq wax \\ \frac{\tilde{R}}{a} - x^{\gamma} & \text{if } \tilde{R} < wax \end{cases} \tag{4.1}$$

Using the equilibrium conditions in the labour input market, (2.3) and (3.11), (4.13) can be written as:

$$\underline{\tilde{\bar{u}}}_c = \begin{cases} \left(\beta - \frac{\beta}{\gamma}\right) A \left(\frac{1}{a}\right)^{\frac{\gamma\varepsilon}{\delta}} & \text{if } \tilde{\Theta} \underline{>} \beta, \\ \left(\tilde{\theta} - \frac{\beta}{\gamma}\right) A \left(\frac{1}{a}\right)^{\frac{\gamma\varepsilon}{\delta}} & \text{if } \tilde{\Theta} > \beta, \end{cases} \tag{4.2}$$

It is seen from (4.14) that since we consider the possibility of default on wage payments, the income and therefore the utility of a typical worker become random variables, depending on $\tilde{\Theta}$. (In the previous section, this as not true since the capitalist was not allowed to default.) In particular, given the productive input decisions, the utility of a worker in the capitalist firm with default possibility depends on the value of $\tilde{\Theta}$ in the region $\tilde{\Theta} < \beta$. For the region $\tilde{\Theta} > \beta$, the typical worker's income and utility are independent of $\tilde{\Theta}$.

5. THE WORKERS' ENTERPRISE

Now we consider a workers' enterprise in which the workers coincide with the partners. The workers' council has the authority to decide on operating issues. The enterprise rents its capital input services at a rental p. Concerning the internal incentive scheme of the enterprise, we assume that the value-added generated is equally distributed among the members. The members all like income and dislike work, and each exhibits preferences as given by (2.5). It is assumed that the workers' council, in determinig the utilization level of capital goods, attempts to maximize the expected total utility of its members, and each member in determining the level of labour input maximizes his expected utility. Since we assume equal distribution of value added among members and identical utility functions, the optimal decisions of typical members will coincide.

The production technology of the present workers' enterprise is the same as in the capitalist sector. In a workers' enterprise with b members, for which the environment is as described here and partly in Section 2, the utility of a typical member is then

$$\tilde{u} = \frac{1}{b}\tilde{V} - x^{\gamma} \tag{5.1}$$

with the expected value

$$E(\tilde{u}) - \frac{1}{b}\left\{K^{\alpha}L^{\beta} - \rho K\right\} - x. \tag{5.2}$$

The maximization of (5.2) dictates the choice of K precisely in the same fashion as before, again yielding (3.2). Given the expected utility maximizing K, output and value-added are again as in (3.3) and (3.4), respectively. Substituting (3.3) and (3.4) into (5.1), taking expected value and then maximizing the resulting function to determine the optimal labour input utilization yields

$$\underline{\bar{x}} = \left\{\left(\frac{\alpha}{\rho}\right)^{\alpha} \left(\frac{\beta}{\gamma}\right)^{1-\alpha} \left(\frac{1}{b}\right)^{\varepsilon}\right\}^{\frac{1}{\delta}}. \tag{5.3}$$

Comparing (3.9) and (5.3), we see that the optimal level of labour input has the same relationship with the size of the firm as measured by the number of workers or members in the capitalist and the workers' enterprises. To find the optimal utilization of capital input and resulting output, all we have to do is to replace the "a"s which reflect the size of the capitalist enterprise in (3.10) and (3.11), respectively, with "b" which is the size of the workers' enterprise. The relative sizes of the workers' and the capitalist enterprises under the two regimes will be determined in the next two sections.

Given optimal utilization of capital and labour input and the resulting output, the utility of a typical member of the workers' enterprise is a random variable determined as

$$\underline{\bar{\tilde{u}}}_{W} - \left(\tilde{\theta} - \alpha - \frac{\beta}{\gamma}\right) A\left(\frac{1}{b}\right)^{\frac{\gamma\varepsilon}{\delta}}. \tag{5.4}$$

6. WORKERS' ENTERPRISE FACING CAPITALIST ENTERPRISE IN EQUILIBRIUM:

(Unlimited Liability)

This section considers a mixed economy consisting of many workers' enterprises alongside many capitalist enterprises with unlimited liability. We want to study the equilibrium state of the economy which can be described as a position in which no worker or worker-partner has an incentive to switch from one firm to another.

We assume that to join a workers' enterprise, one has to pay an entrance fee or buy a share of the firm. A marginal worker in the capitalist sector who wants to transfer to a workers' enterprise would be willing to make a maximum payment in the amount of the expected increase in utility he can achieve through such a transfer. Therefore, the demand price of a share in the workers' enterprise with size b facing a capitalist enterprise with unlimited liability is determined by finding the difference between the expected values of the utilities given by (5.4) and

$$D(a,b) = E\{\tilde{u}_w(b)\} - \bar{E}\{u_c(a)\} \tag{6.1}$$

$$= A\left\{\frac{\delta}{\gamma}\left(\frac{1}{b}\right)^{\frac{\gamma\varepsilon}{\delta}} - \left(\beta - \frac{\beta}{\gamma}\right) \left(\frac{1}{a}\right)^{\frac{\gamma\varepsilon}{\delta}}\right\}.$$

The joining of a marginal worker in the workers' enterprise will decrease the utility of each of the present b members of the workers' enterprise. All of the existing members would require to be compensated by at least this amount to accept the entrance of the new member. This minimum compensation is called the supply price of a share in the enterprise and can be approximated by

$$S(b) = -b\frac{\delta E(\tilde{u}_w)}{\delta b} = \epsilon A\left(\frac{1}{b}\right)^{\frac{\gamma\varepsilon}{\delta}} \tag{6.2}$$

In order to equilibrate the share market, the demand price of a share should be equal to its supply price, i. e.,

$$D(a,b) = S(b). \tag{6.3}$$

Substituting into (6.3) from (6.1) and (6.2) yields the solution

$$\frac{b}{a} = 1. \tag{6.4}$$

Thus, the enterprise size in the two sectors will be identical when the share market is at equilibrium. In that case, the equilibrium share price for membership in a workers' enterprise is

$$\Omega = \epsilon A\left(\frac{1}{c}\right)^{\gamma\varepsilon/\delta} \tag{6.5}$$

where c is the common enterprise size in the economy. The equilibrium share price of the workers' enterprise is strictly positive.

The table at the end of this paper can be used to compare the equilibrium outcomes of the workers' enterprise and the capitalist enterprise with unlimited liability by setting $\psi = 1$ for entries in the second column of the table. Furthermore, for equilibrium outcomes, 8, 9, 10 and 11, only the upper parts of the entries under the first column should be considered.

The first six outcomes are identical for the two types of enterprise. Worker incomes and utilities are deterministic values for the capitalist enterprise, while they depend on the value of $\tilde{\Theta}$ in the workers' enterprise. While for low values of actual $\tilde{\Theta}$ outcomes in the capitalist enterprise would be higher, taking the expected value of $\tilde{\Theta}$, the workers' enterprise provides greater workers income and utility (since we know that its share price is positive).

7. WORKERS' ENTERPRISE FACING CAPITALIST ENTERPRISE IN EQUILIBRIUM

(Possibility of Default)

This section covers the equilibrium analysis of workers' enterprises facing a capitalist enterprise, taking into account the possibility of default as explained in section 4. The tools of analysis are the same as those used in the last section. The only difference in this section is that in determining the demand price of a share we will use the expected value of the utility (4.14) rather than (3.13). The expected utility of a typical worker in a capitalist enterprise with a possibility of default is expressed as

$$E(u_c) = A\left(\frac{1}{a}\right)^{\frac{\gamma\varepsilon}{\delta}} \{\beta\int_{\beta}^{\infty} P(\tilde{\Theta})d\tilde{\Theta} - \frac{\beta}{Y} + \int_{o}^{\beta}\tilde{\Theta}P(\tilde{\Theta})d\tilde{\Theta}\}. \tag{7.1}$$

Substituting (7.1) into (6.1) and then equating the demand price to the supply price of a share yields:

$$\frac{b}{a} = \{\frac{(Y-1)\beta}{Y} / \{\beta\int_{\beta}^{\infty} P(\tilde{\Theta})d\tilde{\Theta} - \frac{\beta}{o} + \int_{o}^{\beta}\tilde{\Theta}P(\tilde{\Theta})\,d\tilde{\Theta}\}\}^{\frac{\delta}{\gamma\varepsilon}} \tag{7.2}$$

which we denote as ψ.

Now ψ gives us the equilibrium relative enterprise size (b/a) in terms of the basic coefficients of the model and the parameters of the probability distribution of price. Thus, the workers' enterprise varies its size precisely in the same fashion as does a capitalist enterprise.

Now we can address the question of whether at equilibrium the workers' enterprise will be larger or smaller than the capitalist enterprise considered here. It turns out that the equilibrium size of the workers' enterprise will be at least as large as the size of the capitalist enterprise, i. e.

$$\psi \geq 1. \tag{7.3}$$

This can be shown by checking that the limit of the difference between the numerator and the denominator of the ratio within the brackets to equal 0 as $\beta \to \infty$, and then observing that the slope $d\psi/d\beta$ is positive for $\beta > 0$ and vanishes at $\beta = 0$.

Since the sizes of the two enterprises are proportional with the relationship $b = \psi a$, the equilibrium share price for membership in a workers' enterprise is

$$\Omega = \epsilon A\left(\frac{1}{\psi a}\right)^{\frac{\gamma\varepsilon}{\delta}} \tag{7.4}$$

which is always positive.

After determining the equilibrium size of the workers' enterprise relative to that of the capitalist enterprise, it is possible to evaluate and compare the equilibrium outcomes of the two types of enterprise at their equilibrium relative sizes. The following table presents such a comparison.

The workers' enterprise utilizes more capital and aggregate labour input and produces more than its capitalist counterpart. Furthermore, it generates more revenues and value added. The aggregate labour input of the workers' enterprise is more, although the labour input of each worker is less, since it has more workers. Although it is not possible to compare offhand the income and utility provided by the two enterprises, we know that the expected payoffs in the workers' enterprise are greater since it has a positive equlibrium share price.

The workers' enterprise also generates a larger communal surplus. It is easily deduced from the table that the average product of labour is smaller in the workers' enterprise, as is the average product per worker. Furthermore, the workers' enterprise utilizes less capital goods per worker at equilibrium. It is very important to note that the equilibrium average product of capital, Y/K, is the same for the two types of enterprise. Thus, the capital output ratios in the two sectors will coincide at equilibrium.

TABLE: EQUILIBRIUM OUTCOMES OF THE TWO TYPES OF ENTERPRISE AT THEIR RESPECTIVE EQUILIBRIUM SIZES

ENTERPRISE → ↓ EQUILIBRIUM OUTCOME	CAPITALIST ENTERPRISE	WORKERS' ENTERPRISE
1. Capital Goods input K	$K_c = \left\{ \left(\frac{\alpha}{\rho}\right)^{\gamma-\beta} \left(\frac{\beta}{\gamma}\right)^{\beta} a^{\beta(\gamma-1)} \right\}^{1/\delta}$	$K_w = \psi^{\beta(\gamma-1)/\delta} K_c$
2. Labour of a Worker x	$x_c = \left\{ \left(\frac{\alpha}{\rho}\right)^{\alpha} \left(\frac{\beta}{\gamma}\right)^{1-\alpha} \left(\frac{1}{a}\right)^{\varepsilon} \right\}^{1/\delta}$	$x_w = \left(\frac{1}{\psi}\right)^{\varepsilon/\delta} x_c$
3. Aggregate Labour Input L	$L_c = \left\{ \left(\frac{\alpha}{\rho}\right)^{\alpha} \left(\frac{\beta}{\gamma}\right)^{1-\alpha} a^{(1-\alpha)(\gamma-1)} \right\}^{1/\delta}$	$L_w = \psi^{(1-\alpha)(\gamma-1)/\delta} L_c$
4. Total Output Y	$Y_c = A a^{\beta(\gamma-1)/\delta}$	$Y_w = \psi^{\beta(\gamma-1)/\delta} Y_c$
5. Total Revenue R	$\tilde{R}_c = \tilde{\Theta} Y_c$	$\tilde{R}_w = \psi^{\beta(\gamma-1)/\delta} \tilde{R}_c$
6. Value Added V	$\tilde{V}_c = (\tilde{\Theta} - \alpha) Y_c$	$\tilde{V}_w = \psi^{\beta(\gamma-1)/\delta} \tilde{v}$
7. Income per Unit of Labour Input w	$w_c = \beta\left(\frac{\gamma}{\beta}\right)^{1-\alpha} \left(\frac{\rho}{\alpha}\right)^{\alpha} A \left(\frac{1}{a}\right)^{\varepsilon(\gamma-1)/\delta}$	$\frac{1}{\psi}^{\varepsilon(\gamma-1)/\delta} \left(\tilde{\theta}-\alpha\right)\left(\frac{1}{\beta}\right) w_c$
8. Income of a Worker y	$\tilde{y}_c = \begin{cases} \beta(Y_c/a) & \tilde{\theta} \geq \beta \\ \tilde{\theta}(Y_c/a) & \tilde{\theta} < \beta \end{cases}$	$\tilde{y}_w = \left(\frac{1}{\psi}\right)^{\gamma\varepsilon/\delta} (\tilde{\theta}-\alpha)(Y_c/a)$
9. Utility of a Worker u	$\tilde{u}_c = \begin{cases} \left(\beta - \frac{\beta}{\gamma}\right)(Y_c/a) & \tilde{\theta} \geq \beta \\ \left(\tilde{\theta} - \frac{\beta}{\gamma}\right)(Y_c/a) & \tilde{\theta} < \beta \end{cases}$	$\tilde{u}_w = \left(\frac{1}{\psi}\right)^{\gamma\varepsilon/\delta} (\tilde{\theta}-\alpha-\frac{\beta}{\gamma})(Y_c/a)$
10. Total Utility U	$\tilde{U}_c = \begin{cases} \left(\beta - \frac{\beta}{\gamma}\right)Y_c & \tilde{\theta} \geq \beta \\ \left(\tilde{\theta} - \frac{\beta}{\gamma}\right)Y_c & \tilde{\theta} < \beta \end{cases}$	$\tilde{U}_w = \psi^{\beta(\gamma-1)/\delta} \left(\tilde{\theta} - \alpha - \frac{\beta}{\gamma}\right) Y_c$
11. Profit π	$\tilde{\pi} = \begin{cases} (\tilde{\theta}-\alpha-\beta)Y_c & \tilde{\theta} \geq \alpha+\beta \\ 0 & \tilde{\theta} < \alpha+\beta \end{cases}$	$\pi_w = 0$
12. Communal Surplus Z	$\tilde{Z}_c = (\tilde{\theta} - \alpha - \frac{\beta}{\gamma}) Y_c$	$\tilde{Z}_w = \psi^{\beta(\gamma-1)/\delta} Z_c$
13. Share Price Ω	0	$\Omega = \varepsilon A\left(\frac{1}{\psi a}\right)^{\gamma\varepsilon}$

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RADNIČKO PREDUZEĆE U USLOVIMA NEIZVESNOSTI U MEŠOVITOJ PRIVREDI

Işik INSELBAĞ i Murat SERTEL

Rezime

Ward—Domar—Vanekova analiza samoupravnog preduzeća pokazuje da porast u tražnji za proizvodom i u njegovoj relativnoj ceni prouzrokuje u kapitalističkom preduzeću, u kratkom roku, povećanje radnog inputa, veličine preduzeća i proizvodnje; nasuprot ovome, kratkoročni efekat ovog porasta u samoupravnom preduzeću biće smanjenje broja radnika i radnog inputa odnosno outputa. Neke skorašnje studije dovode u pitanje ove dobro poznate implikacije. U ovom se članku izvode rezultati koji podržavaju te studije.

U članku se ispituju osobine opšte ravnoteže u privredi u kojoj radnička i kapitalistička preduzeća koegzistiraju u uslovima neizvesnosti. Pretpostavlja se da radnici mogu slobodno prelaziti iz jedne vrste preduzeća u drugu, u zavisnosti od relativne koristi koju im ta preduzeća osiguravaju. Primećeno je da će, u ravnoteži, cena akcije radničke kooperative ili pristupnina koju treba da plati pridruženi radnik — biti pozitivna, i da će radnička kooperativa biti bar toliko velika koliko i kapitalistička firma. Pored toga, radničko se preduzeće koristi većim kapitalom i agregatnim radnim inputom i proizvodi više nego njegova kapitalistička varijanta. Ono stvara veći prihod i veću dodajnu vrednost. Drugi važan zaključak članka jeste da je ravnotežni prosečni proizvod

kapitala isti za obe vrste preduzeća; stoga se kapitalni koeficienti u dvama sektorima podudaraju.

Članak je podeljen u sedam delova. Posle kratkog uvoda u prvom delu, u drugom se delu opisuje okruženje u kome kapitalistička i radnička preduzeća funkcionišu. U trećem i četvrtom delu prikazani su proces odlučivanja i optimalni rezultati u kapitalističkim preduzećima sa dva oblika rukovođenja. Prvi oblik podrazumeva neograničenu odgovornost kapitaliste, dok drugi oblik dopušta mogućnost neispunjenja obaveza u pogledu isplaćivanja nadnica. U petom su delu predstavljene osnovne osobine radničkog preduzeća korišćene u ovome članku. Šesti deo sadrži analizu ravnoteže radničkog preduzeća koje je suočeno sa konkurentnim kapitalizmom neograničene odgovornosti, dok poslednji deo obuhvata analizu ravnoteže sa mogućnošću neispunjenja obaveza u kapitalističkom sektoru.

ON THE ECONOMICS OF SELF-MANAGEMENT: THE ISRAELI KIBBUTZ AND THE YUGOSLAV ENTERPRISE*

Avner BEN NER *and Egon* NEUBERGER**

I. INTRODUCTION

The Kibbutz (K) and the Yugoslav self-managed enterprise (Y), in their eight and third decades, respectively, are the only long lasting, relatively large scale, institutionalized systems which bring to the level of the workplace the reality of democracy.

Both K and Y consider themselves to be self-managed (S—M) organizations, and both are accepted as such by students of S—M. One purpose of this paper is to find the systemic features common to both K and Y, since these will then form the set of sufficient conditions for the existence of a S—M organization. However, K and Y are only two of a larger set of possible S—M organizations, so these common features need not constitute necessary conditions. Another purpose is to examine the key differences between K and Y that are not related to S—M *per se*, in order to learn more about the specific characteristics of these two important organizations.

Since considerably more attention has been paid to Y than to K in the literature on S—M, our discussion focuses on K, and we present a linear model of K. In discussing the systemic features of K and com-

*) Some of the Dubrovnik Conference participants raised objections to our comparison between a comprehensive socio-politico-economic organization, such as the kibbutz, and a primarily economic organization, such as the Yugoslav enterprise. As we make clear in the paper, and especially in Section II on the objective function, we view the Yugoslav self-managed enterprise as much more than a mere production unit, where members are only seeking to exchange labour for money wages. In the Yugoslav theory of self-management, as well as in Yugoslav practice, members seek to satisfy some of their important political, social, and psychological needs, as well as economic ones. In addition, it is useful to compare two of the most significant examples of self-management; the fact that these two types of self-managed organizations differ significantly in their institutional arrangements, adds rather than subtracts from the importance of the comparison.

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1) In this paper we shall not enter into detailed specifications of each system, or its history. The reader is referred to Barkai (1977), the best single volume on the economy and economics of the kibbutz, and to Darin-Drabkin (1963). For the Yugoslav enterprise see: Adizes (1971), Jan Vanek (1972), and Neuberger and James (1973).