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Agricultural Production Cooperatives:
Factors Affecting Performance

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Claudia Parliament

Abstract

A key problem that hampers production within agricultural settlements is insufficient contribution of labor to the cooperative activity. This research analyzes the factors affecting members' labor supply. A theoretical model is developed based on expected utility maximizing behavior. Members are assumed to allocate labor between private and cooperative production. The model includes behavioral interaction of members, variation in income distribution rules and income uncertainty. The effect of a change in several cooperative parameters such as member cohesion, rules of income distribution, cooperative income variability, and income correlation is analyzed using comparative statics. The results indicate there are no simple, direct incentives to affect participation in an uncertain environment. Neither an increase in member cohesion nor an increase in the distribution of income based on participation will guarantee an increase cooperative labor. Similarly, cooperative participation will not necessarily decline with either an increase in cooperative income variability or an increase in cooperative and private income correlation.

Labor supply data was collected from members of an Israeli Kibbutz. Because there is no private production on this type of cooperative, the effects of income variability and correlation cannot be tested. It is possible, however, to isolate the effect of member cohesion. Tobit and Heckman estimation procedures were used to determine factors affecting

members' supply of extra hours of labor. Member cohesion is found to be a significant factor in both procedures which confirms the importance of behavioral interaction in models of cooperative labor supply. Given the rules of income distribution on a Kibbutz, the non-pecuniary factors which affect a members' labor supply can also be tested. The statistical results appeal to our intuition because the decision whether or not to work over time is significantly influenced by attitudes but not by work activities, while the number of extra hours voluntarily worked is strongly influenced by work activities.



In Memory of My Beloved Parents

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Chapter 1: Introduction

1.1. Problem Definition

Over the past 40 years, governments and international organizations have made significant efforts to organize and support production cooperatives in agriculture. These cooperatives are frequently promoted in developing countries to address the objective of expanding agricultural output while achieving an equitable income distribution.¹ Agricultural output can be increased because cooperatives eliminate fragmentation, encourage specialization, and pool scarce resources. Yet unlike large privately owned farms, cooperatives promote equitable income distribution because members, as owners, receive a return on their labor investment. In addition to promoting efficiency and equity, cooperatives reduce risk for members. Cooperatives can provide each member with a diversified income base and a mutual aid structure for economic support during personal emergencies. These inherent organizational benefits stand, however, in contrast to the disappointing performance of agricultural production cooperatives (Laidlaw, 1977).

The term production cooperative applies to a wide variety of organ-

¹ Cooperative farms in developing countries can be classified according to the government's initial purpose. Colonization cooperatives are established when the State wants to develop sparsely populated or marginally productive regions (Israel, Sri Lanka, Nigeria). Land reform cooperatives arise when the State is committed to equitable redistribution yet does not want to lose the economies inherent to large estates (Peru, Chile, Nicaragua). Village cooperatives are found where peasant farmers are working the land individually and the State encourages cooperativization of some aspect of production (Tanzania, Taiwan). The government must act as the initiator and supporter during the early stages of formation because these cooperatives are often composed of disenfranchised or impoverished members of society.

izations from fully collectivized farms where members produce all commodities jointly to groups of independent farmers that combine purchase of inputs and sale of output. Most agricultural production cooperatives, however, have both private and common plots. A key problem that hampers the performance of such cooperatives is insufficient contribution of work by the membership to the public plot.

The purpose of this research is to analyze theoretically and empirically the parameters affecting member's allocation of labor. The next section contains a brief review of earlier work analyzing labor allocation by members of agricultural cooperatives. In Chapter 2 a model of labor supply under uncertainty is developed to analyze factors affecting participation. Labor quotas are discussed in Chapter 3. The empirical results obtained with data collected from an Israeli cooperative are in Chapter 4, and the conclusions are found in Chapter 5.

1.2. Literature Review

Early analysis of cooperative labor supply assumed cooperatives were centralized decision-making firms with the objective of maximizing net returns to members (Ward, 1958; Domar, 1966; and Oi and Clayton 1968). Sen (1966) was the first to establish members rather than managers as the labor allocation decision-makers by modeling cooperatives as a group of utility maximizing individuals.

The literature has focused generally on the effects of output price, fixed charges, and production quotas on labor allocation. The effect of a change in these parameters varies depending on whether or not members are assumed identical and whether or not total labor time is

assumed fixed. Bradley (1971) assumes all members are identical and demonstrates cooperative labor supply will increase with an increase in cooperative output price, a reduction in private output price, or an increase in fixed cooperative labor costs. Cameron (1973) argues, however, that only when members are not assumed identical will fixed cooperative costs affect cooperative labor supply. By allowing labor time to vary, Bonin (1977) demonstrates that an increase in cooperative output price has an ambiguous effect on cooperative labor supply.

Income distribution systems, member interaction, and uncertainty have also been identified as affecting labor allocation. Israelson (1980) demonstrates that cooperatives with income distributed according to labor shares provide more incentives to cooperative labor than cooperatives based on equal income distribution. Bradley (1971) acknowledges cooperative members evaluate the labor responses of other members when determining labor allocation, but does not incorporate this interdependence in his model. Bonin (1977) incorporates behavioral interdependence in his model, but in the analysis assumes identical members which nullifies the impacts of member interaction. Chinn (1979) demonstrates that members' interdependence affects the labor allocation responses when members are not identical, and both Chinn (1980) and Putterman (1980, 1981) have addressed the game theoretic aspects of member interaction. Bonin incorporates production uncertainty on the collective plot and price uncertainty on the private plot and demonstrates that the labor allocation response to government policies under uncertainty differs from the response in a certain world.

The theoretical aspect of this research builds upon these earlier

models by including behavioral interaction of members and variation in the income distribution system. Bonin's (1977) work is expanded here by not limiting the source of uncertainty in each mode of production. The approach is to treat labor allocation as a portfolio selection problem. Members allocate their labor between production processes with correlated returns and differential uncertainties. In addition, because identical members are not assumed, individual members are allowed to have different behavioral assumptions about other members' labor response. The focus is the labor allocation effects of changes in cooperative parameters rather than government policy instruments. The analysis will determine the effect of labor allocation for changes in cooperative income variability, private and cooperative income correlation, behavioral interdependence, and rules for income distribution.

Chapter 2: Theory of Cooperative Labor Supply

2.1. The Model

Consider a producer cooperative consisting of N members. Each member, i , allocates time between work on the collective plot, h_i^C , and work on his/her private plot, h_i^P . If the total work time is normalized to one, work allocation is specified as:

$$h_i^C + h_i^P = 1.$$

Member i 's net income consists of two parts: net income from the private plot, y_i^P ; and income from the cooperative activity, $y_i^C = A_i Y^C$. The total cooperative net income is Y^C ; A_i is member i 's share, which is assumed to be a linear combination of a portion based on member i 's relative supply of cooperative labor and a portion based on equal shares. With H^C representing the total labor allocation to the cooperative and α representing the weight given to relative labor supply, the formula for member i 's share of cooperative net income is:

$$A_i = \alpha \frac{h_i^C}{H^C} + \frac{1-\alpha}{N} \quad 0 \leq \alpha \leq 1.$$

If $\alpha = 1$, a member's cooperative income is proportional to his/her labor contribution to the cooperative; if $\alpha = 0$, each member receives an equal share.

When member i determines labor input to the cooperative plot, his/her perception of other members' behavior is used in the decision. Therefore, the values of A_i and H^C used in member i 's decision reflect ex-ante perceptions. The sum of the members' labor allocation, H^C , can be decomposed into the contribution of member i , h_i^C , and the other

members' cooperative labor supply, H_{-i}^C . Each member takes into account the effect of his/her labor supply on the other members' labor supply. Thus, for member i , the other members' cooperative labor supply, H_{-i}^C , is a function of member i 's cooperative labor:

$$H^C = \sum_i h_i^C = h_i^C + H_{-i}^C(h_i^C).$$

Bonin(1977) incorporated member interaction into a labor elasticity measure,

$$\eta = \frac{\partial H^C}{\partial h_i^C} \frac{h_i^C}{H^C}.$$

To stress the subjective aspect of this measure, η will be called a member's cohesion conjecture. The value of the cohesion conjecture is assumed between h_i^C/H^C and 1. If each member acts as if his marginal behavior has no affect on other members or if no one follows, the cohesion conjecture takes the lower bound; if there exists perfect cohesion or total emulation, the conjecture equals 1. The cohesion conjecture, η , varies among members, is subjective, and is assumed positive.

Assuming income uncertainty from both private and cooperative production and using the Just-Pope(1978) formulation, private and cooperative net income are represented:

$$\bar{y}_i^P = y_i^P(h_i^P; s_i) + g_i^P(h_i^P; s_i)e^P \quad i=1,2,\dots,N$$

$$Y^C = Y^C(h_i^C + H_{-i}^C(h_i^C); S^C) + g^C(h_i^C + H_{-i}^C(h_i^C); S^C)e^C.$$

This income specification allows for differential mean and variance effects for input factors. The deterministic sections of private and

cooperative net income are, respectively, y_i^D and Y^C ; the stochastic portions are $g^D e^D$ and $g^C e^C$. With this specification, the marginal effect of labor on income variability, g^C and g^D , can be increasing, decreasing, or constant. For example, fertilizer application increases variance while irrigation decreases variance. The vector s_i consists of the socioeconomic characteristics of the i^{th} member, and the economic characteristics of the private production process. Similarly the vector S^C consists of the cooperatives socioeconomic and production process characteristics. Both of these vectors reflect such factors as experience, education, economies of scale, and crop choice. The pure random terms, e^D and e^C , have zero mean and covariance $\sigma_{pc} = \rho \sigma_p^2 \sigma_c^2$ where ρ is the correlation coefficient between cooperative and private income, and σ_p^2 and σ_c^2 are, respectively, private and cooperative income variability. For the effect of the inputs on income variability we assume without loss of generality that $g_i^D \geq 0$, and $g^C \geq 0$.²

Members are assumed to allocate time between private and cooperative production in order to maximize expected utility:³

$$\text{Max } E\{U(\bar{y}_i)\},$$

$$h_i^C$$

subject to

$$\bar{y}_i = y_i^D + g_i^D e^D + A_i \{Y^C + g^C e^C\}$$

$$1 = h_i^D + h_i^C$$

² Let $\bar{\epsilon} = g^k e^k$ with $k = c, p$. Then, $E(\bar{\epsilon}) = 0$ and $\text{var}(\bar{\epsilon}) = g^2 \sigma^2$. The sign of g does not affect the mean or variance.

³ The arguments of the functions are dropped for clarity.

$$0 \leq h_i^c \leq 1.$$

Consider a first-order Taylor series approximation of U_y about the deterministic portion of income, $\bar{y} = y^p + AY^c$.⁴

Then

$$U_y = \bar{U}_y + \bar{U}_{yy}(g^p e^p + Ag^c e^c),$$

where \bar{U}_y and \bar{U}_{yy} are the first and second partials of U evaluated at mean income, \bar{y} . We assume a member is risk averse with $U_y > 0$, $U_{yy} \leq 0$. Further, let the Arrow-Pratt measure of absolute risk aversion be denoted by $R(Y) = -U_{yy}(Y)/U_y(Y)$ so that, at mean income, $\bar{R} = R(\bar{Y}) = -\bar{U}_{yy}/\bar{U}_y$. Using these substitutions and assuming an interior solution exists ($0 < h_i^c < 1$), the first-order condition is approximated:⁵

$$\frac{1}{\bar{U}_y} \frac{\partial EU}{\partial h^c} = (1-\eta) d \frac{y^c}{H^c} + \eta [d + (1-d) \frac{\hat{h}^c}{h^c}] \frac{\partial y^c}{\partial h^c} - \frac{\partial y^p}{\partial h^c}$$

$$-\bar{R} \left[\frac{g^c}{H^c} (g^p \sigma_{pc} + Ag^c \sigma_c^2) (d(1-\eta) + (d+[1-d] \frac{\hat{h}^c}{h^c}) \eta \theta^c) - \theta^p \frac{g^p}{h^p} (g^p \sigma_p^2 + g^c \sigma_{pc}) \right],$$

where \hat{h}^c represents the average cooperative labor supplied by members as perceived by member since $\hat{h}^c = \frac{H^c}{N}$. The value of $\frac{\hat{h}^c}{h_i^c}$ categorizes members into types of workers. Member i is an individualist, typical worker, or cooperativist depending on whether $\frac{\hat{h}^c}{h_i^c}$ is greater than, equal to, or less

⁴ The accuracy of such an approximation depends on the size of the errors relative to the deterministic portion, y . For an example of this approach see Just and Zilberman (1983).

⁵ The subscript i is dropped for convenience.

than one respectively,⁶ ϕ^p and ϕ^c are income variability elasticities with

$$\phi^c = \frac{\partial g^c}{\partial H^c} \frac{H^c}{g^c} \quad \text{and} \quad \phi^p = \frac{\partial g^p}{\partial h^p} \frac{h^p}{g^p}$$

The first order condition can be divided into two parts: the mean income effect and the variability effect. The average cooperative income term and the marginal cooperative and private income terms will be referred to together as the mean income effect. All the factors that are multiplied by the absolute risk aversion measure will be referred to as the variability effect, and all the factors affecting variability are within this term.

In general, the solution to the maximization problem, h_i^{c*} , is a function of the parameters of the model including: the income distribution rule, α ; private and cooperative income variability, σ_p^2 , σ_c^2 , and their covariance, σ_{pc} ; efficiency of the production process reflected in the deterministic portion of the net income, y_i^p and Y^c ; the structure of the g functions; a member's cohesion conjecture, η ; and a member's attitude toward risk, $R(Y)$. The effect of a change in some these parameters on cooperative labor supply will be examined in the next subsection.

⁶ Various names have been given to these types of workers. Chinn(1980) refers to them as lazy and industrious, and Putterman(1981) refers to them as shirkers and zealots. As our labels indicate the members' cooperative labor supply relative to the average, we refrain from applying pejorative labels.

2.2. Comparative Static Propositions

The impacts of changes in the cohesion conjecture, the income distribution rule, income correlation, and cooperative income variability on cooperative labor supply are stated in the following propositions followed by a table summarizing the results. A discussion of each of the relevant comparative static equations is found in Appendix 1.

Proposition 1: AN INCREASE IN THE COHESION CONJECTURE DOES NOT NECESSARILY INCREASE A MEMBER'S COOPERATIVE LABOR SUPPLY

This ambiguity arises because an increase in other members' cooperative labor has both an income effect and a relative labor share effect. The income gain due to increased production is offset by a decline in a member's relative labor share. Thus, the labor allocation response to an increase in the cohesion conjecture is strongly related to the income distribution rule.

The following results hold for an increase in the cohesion conjecture if the mean income effect dominates the variance effect or if the member is risk neutral.

1.a(1) If cooperative income is divided equally, a member will increase cooperative labor in response to an increase in the cohesion conjecture.

With equal sharing, everyone benefits from the increased production because the decline in relative shares does not affect the distribution of the increased income.

1.a(2) If cooperative income is distributed only according to relative labor shares, a member will decrease cooperative income in response to

an increase in the conjectural cohesion.

The decline in a member's relative labor share caused by the increase in the cohesion conjecture outweighs the potential increase in income if the cooperative is operating in the efficient zone where average product is greater than marginal product.

1.a(3) Individualists will be more likely than cooperativists to increase cooperative labor for increases in the cohesion conjecture when a portion of cooperative net income is distributed equally.

Because individualists contribute less than average, they free ride if a portion of the net income is divided equally. Thus, an increase in response of other members always increases the benefits of an individualist and is a mixed incentive for cooperativists. The closer cooperative income comes to being shared equally the more the cooperativists support individualists. The larger the value of d , the less likely a cooperativist will increase labor for an increase in the cohesion conjecture.

If the variance effect is greater than the mean income effect, then the following results hold for an increase in the cohesion conjecture.

1.b(1) If cooperative labor is risk reducing, a member will increase cooperative labor for increases in the cohesion conjecture.

When the variability effect dominates the mean income effect, the possible loss in relative labor shares is overshadowed by the desire to reduce variability. A member will increase cooperative labor supply if more members will follow since the increased participation reduces vari-

ability.

1.b(2) If marginal cooperative labor increases risk and cooperative income is divided equally, a member will decrease cooperative labor in response to an increase in the cohesion conjecture.

With variability dominating mean income, the increased risk due to increased participation overshadows potential income gain. A member will reduce cooperative labor to minimize risk.

1.b(3) If marginal cooperative labor has a positive but less than average effect on variability and if cooperative income is only distributed according to relative s , then a member will increase cooperative labor for increases in the cohesion conjecture.

With an increase in the cohesion conjecture, a member's relative labor share is reduced which spreads risk to other members. Even though marginal labor is risk increasing, the relatively small increase in risk is spread so a member will increase cooperative labor.

1.b(4) If marginal cooperative labor has positive and stronger than average affect on variability then a member will reduce their cooperative labor for increases in the cohesion conjecture.

The strong risk impact overshadows any risk spreading possible with the increased participation. The results of proposition 1 are summarized in Tables 1a and 1b.

Proposition 2: AN INCREASE IN THE PROPORTION OF COOPERATIVE INCOME DISTRIBUTED ACCORDING TO WORK SUPPLIED WILL NOT NECESSARILY INCREASE A MEMBER'S COOPERATIVE LABOR ALLOCATION.

Table 1a

Cooperative Labor Response to an Increase in the Cohesion Conjecture When The Mean Effect Dominates.

Distribution Rule	Cooperative Labor Response
$\alpha = 0$	+
$0 < \alpha < 1$?
$\alpha = 1$	-

Table 1b

Cooperative Labor Response to an Increase in the Cohesion Conjecture When Variance Effect Dominates.

Distribution Rule	Cooperative Labor Response	
	$g^{c'} \leq 0$	$g^{c'} > 0$
$\alpha = 0$	+	-
$0 < \alpha < 1$	+	?
$\alpha = 1$	+	?

The labor response strongly depends on worker type. Members whose supply to the cooperative is less than average generally do not respond to greater weight being placed on relative shares. In addition, the increase in direct rewards for increased labor does not always offset the possible increased risk due to increased labor.

If the mean effect is greater than the variance effect or if a member is risk neutral, the following results hold for an increase in the weight given to relative participation.

2.a(1) Cooperativists and average workers will increase cooperative labor as the weight given to relative shares increases.

Assuming the mean effect dominates risk factors, members will respond to being rewarded according to their contribution.

2.a(2) Individualists with high levels of conjectural cohesion will decrease cooperative labor for increases in weight given to relative labor shares.

These members realize that any benefit from the increase in weight given to relative participation will be offset by the loss in relative shares with so many members following their increase. Because individualists are below average in participation with more weight given to a lower relative share, they can lose income.

If the variance effect is greater than the mean income effect then the following results hold for an increase in the weight given to relative labor shares.

2.b(1) If marginal cooperative labor is risk increasing, cooperativists

and average workers will reduce cooperative labor for increases in weight given to relative labor shares.

With variance dominating mean income effects, risk aversion dominates potential income benefits due to increased weight given to increased labor participation. Individualists may increase cooperative labor in this case because they do not carry their share of the increased risk burden for increases in labor.

2.b(2) If marginal cooperative labor is risk reducing, individualists and average workers will reduce cooperative labor for increases in the weight given to cooperative labor shares.

With variance dominating mean income effects, members with low or average relative labor shares will not respond to rewards based on participation even when their labor reduces risk. Cooperativists may increase cooperative labor since their labor both reduces risk and is more directly rewarded by the increase in labor supply share in cooperative income. The results of Proposition 2 are summarized in Tables 2a and 2b.

Proposition 3: AN INCREASE IN INCOME CORRELATION DOES NOT NECESSARILY REDUCE A MEMBER'S COOPERATIVE LABOR ALLOCATION.

Because an increase in correlation increases risk, a member will increase labor to the activity with the least impact on risk.

3.1 If the income variability elasticities are equal and risk increasing, a member will increase cooperative labor for increases in correlation.

Table 2a

Cooperative Labor Response to an Increase in the Relative Labor Share Basis for Income Distributor when the Mean Effect Dominates.

Type of Worker	Cooperative Labor Response
Cooperativist	+
Average	+
Individualist	?

Table 2b

Cooperative Labor Response to an Increase in the Relative Labor Share Basis for Income Distributor when the Mean Effect Dominates.

Type of Worker	Cooperative Labor Response		
	$g^{c'} < 0$	$g^{c'} = 0$	$g^{c'} > 0$
Cooperativist	?	-	-
Average	-	-	-
Individualist	-	-	?

An hour contributed to the cooperative is less risk increasing than an hour contributed to private production since the increased risk is shared by other members.

3.2 If the income variability elasticities are equal and risk decreasing, a member will decrease cooperative labor for increases in correlation.

An hour contributed to private labor reduces risk more than an hour contributed to the cooperative since the decrease in risk is not diluted through sharing.

3.3 If the income variability elasticities have the opposite effect, a member will increase the labor activity which reduces variability with increases in correlation.

3.4 When both labor activities have the same effect on risk but are unequal, the labor allocation response depends on the relative magnitudes of the income variability elasticities.

If both labor activities increase risk, members will spread risk by increasing cooperative labor for increases in correlation as long as marginal cooperative labor is relatively less risk increasing. This condition is represented by:

$$\phi^c < \frac{1}{\eta(\alpha + (1-\alpha)h^c/h^p)} \left\{ \phi^p \frac{h^c}{1-h^c} - \alpha(1-\eta) \right\}.$$

Similarly, if both labor activities decrease risk, members will decrease cooperative labor for increases in correlation as long as private labor has the relative advantage in reducing risk. This condition is represented by:

$$|\delta^c| < \frac{1}{\eta(\alpha + (1-\alpha)h^c/h^c)} \left\{ |\delta^p| \frac{H^c}{1-h^c} + \alpha(1-\eta) \right\}.$$

Proposition 4: AN INCREASE IN COOPERATIVE INCOME VARIABILITY DOES NOT NECESSARILY REDUCE A MEMBER'S COOPERATIVE LABOR SUPPLY.

An increase in the cooperative income variability increases the riskiness of both private and cooperative activity as long as the correlation is positive. Thus, the labor allocation response to an increase in cooperative variability depends on the marginal labor effects on risk and income correlation.

The following results hold when marginal cooperative labor reduces risk and income correlation is zero.

4.a(1) If income is divided equally, members will increase cooperative labor when there is an increase in cooperative variability.

With the risk of increased variability shared equally, members will increase their cooperative labor since it reduces risk.

4.a(2) If income is divided according to relative shares, members will increase cooperative labor if the cooperative income variability elasticity is greater than $(1-\eta)/\eta$.

Members with high cohesion conjectures are more likely to increase cooperative labor with increases in cooperative variability. Even though marginal cooperative labor reduces risk, members will only increase cooperative labor when they believe a high proportion of other members will follow their lead. With many members increasing cooperative labor the risk of increased cooperative variability is shared.

4.b If income correlation is zero and marginal cooperative labor increases risk, members will always decrease cooperative labor. No one will add to the increased riskiness.

4.c If income correlation is positive and both labor activities decrease risk, members will decrease cooperative labor as long as private labor has the relative advantage in reducing risk.

This condition is represented by:

$$\phi^c < \frac{1}{\eta[d + (1-d)h^c/h^c]} \left\{ d(1-\eta) + \frac{g^p \sigma_p \rho H^c |\phi^p|}{(g^p \sigma_p \rho + 2Ag^c \sigma_c)(1-h^c)} \right\}$$

4.d If income correlation is positive and both labor activities increase risk, members will increase cooperative labor as long as cooperative labor is relatively less risk increasing than private labor.

This condition is represented by:

$$|\phi^c| < \frac{1}{\eta[d + (1-d)h^c/h^c]} \left\{ \frac{g^p \sigma_p \rho H^c \phi^p}{(g^p \sigma_p \rho + 2Ag^c \sigma_c)(1-h^c)} - d(1-\eta) \right\}.$$

The results of Propositions 3 and 4 are summarized in Table 3.

2.3 Summary

The comparative statics demonstrate that changes in cooperative parameters which appear to be natural labor inducements do not guarantee increased cooperative participation. Cooperative labor will increase with increases in the cohesion conjecture only if income is divided equally and either cooperative labor reduces risk or the member is risk neutral. Similarly, only risk neutral members contributing at least the average will respond with increased cooperative labor for increases in

Table 3

Cooperative Labor Response to an Increase in
Cooperative Income Variability and Correlation.

Income Variability Elasticities	Cooperative Labor Response	
	$\frac{\partial h^c}{\partial \sigma_c^2}$	$\frac{\partial h^c}{\partial \rho}$
$\sigma^c = \sigma^D$ and > 0	+	+
$\sigma^c = \sigma^D$ and ≤ 0	-	-
$\sigma^c \neq \sigma^D$ but both > 0	?	?
$\sigma^c \neq \sigma^D$ but both < 0	?	?
$\sigma^c \geq 0, \sigma^D \leq 0$	-	-
$\sigma^c < 0, \sigma^D > 0$	+	+

payment based on relative labor shares. If the magnitudes of the income variability elasticities are not known, the only guaranteed increase in cooperative labor for decreases in income correlation will occur when marginal cooperative labor decreases risk and marginal private labor increases risk. On the other hand, increased cooperative income variability will increase cooperative labor when marginal cooperative labor reduces risk and cooperative income is divided equally and is not correlated to private income.

Chapter 3: Cooperative Labor Quotas

In many situations cooperative activities can only be sustained if the total cooperative labor supply is above some critical level. Cooperatives may, therefore, require members to supply a minimum amount of labor to cooperative activities. This minimum quota, \bar{h}^c , becomes another parameter characterizing a cooperative. In this section we will investigate how such a quota affects participation.

With voluntary membership, a labor quota raises the possibility of members choosing to leave. Previously a member could retain membership and only engage in private production. This is represented by $h^c = 0$. With a labor quota a member has two decisions to make: whether to retain membership and how to allocate time between private and cooperative production. Our maximization problem is now represented by:

$$\begin{aligned} & \text{Max}_{h^c, d} E\{dU(Y|h^c \geq \bar{h}^c) + (1-d)U(Y|h^c = 0)\} \\ \text{s.t.} \quad & d = \begin{cases} 1 & \text{if stay} \\ 0 & \text{if leave} \end{cases} \end{aligned}$$

$$0 \leq h^c \leq 1$$

The solution for a member staying is denoted \bar{h}^{c*} .

If h^{c*} represents a member's choice of cooperative labor without a quota, then a member's cooperative labor allocation when there exists a required minimum can be represented by:

$$\bar{h}^{c*} = \text{Max}(h^{c*}, \bar{h}^c).$$

Let h^{ce} represent the cooperative labor level at which a member

becomes indifferent between staying or leaving. Formally h^{ce} is defined by the indirect expected utility conditions:

$$V(h^c = h^{ce}) = V(h^c = 0)$$

$$V'(h^{ce}) < 0.$$

If there exists no h^c satisfying the indirect utility condition then $h^{ce} = 1$.

The three possible cases of member's indirect utility with respect to h^c are represented in Figures 1-3. An individual represented by Figure 1 will never retain membership since his/her indirect utility is always higher without cooperative participation. At the other extreme a member with the indirect utility represented in Figure 2 will always retain membership because his/her indirect utility is always higher as a member. A member represented by Figure 3 will leave the cooperative if the minimum quota becomes too high. This type of member will stay only if $\bar{h}^c \leq h^{ce}$. The discrete choice of membership can be simply represented by:

$$d^* = \begin{cases} 1 \text{ (stay)} & \text{if } h^{ce} \geq \bar{h}^c \\ 0 \text{ (leave)} & \text{otherwise} \end{cases}$$

A cooperative considering a labor quota as a means of increasing cooperative participation will have to estimate if the labor gained from members forced beyond their unconstrained allocation and the labor lost from members who exit as a result of the quota. The members which do not change their participation with a quota, $\bar{h}^c < h^{c*}$, will not affect the calculation. A cooperative consisting of members with few viable economic alternatives to cooperative membership, may be able to success-

Figure 1

Labor Quota Causes Exit

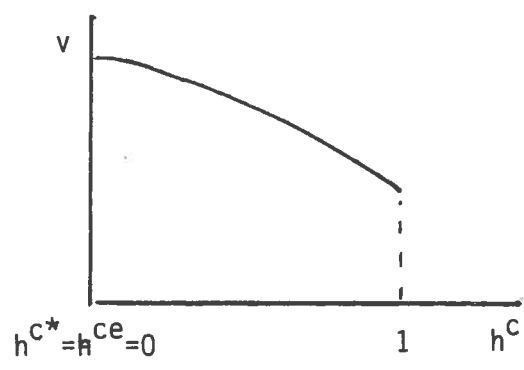


Figure 2

Labor Quota Never Causes Exit

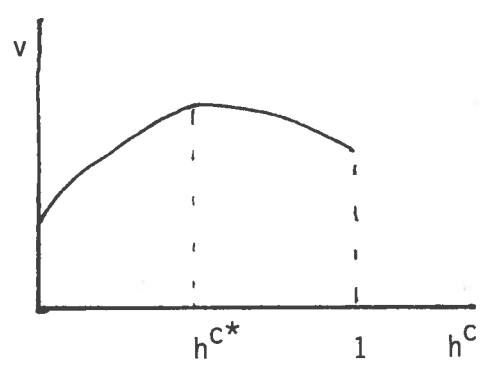
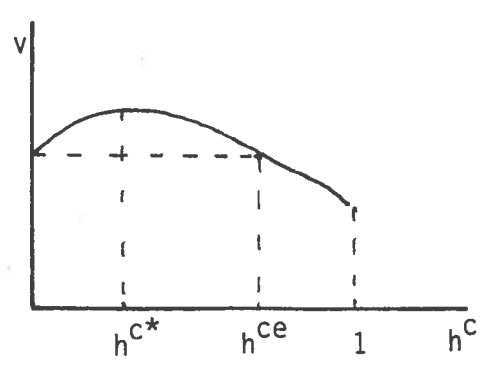


Figure 3

Level of Labor Quota Determines Exit



fully use labor quotas to increase cooperative participation because these members are less likely to exit as a result of quota. Similarly, a cooperative which is able to provide members with a high income will also be able to successfully use labor quotas because the cooperative is probably the best alternative and members will not exit with a quota. It can be argued that either prosperous cooperatives or cooperatives consisting of members with low levels of human capital will be able to successfully use labor quotas as a policy to increase cooperative participation.

Chapter 4: Empirical Application

4.1. Israeli Production Cooperatives

Because Israeli agriculture is predominately based on production cooperatives, it is a logical place to consider for an application of the theoretical model. The historic evolution in Israel has shown that various forms of production cooperatives have been successful even under the difficult conditions of scarcity of both arable land and water for irrigation. For this research the chosen unit of analysis is the kibbutz, the earliest type of production cooperative established in Israel. Other forms of Israeli cooperative farms include moshavim and moshavim shitufi. A brief description of these two forms of organization will precede the more detailed description of the kibbutz.

A moshav is a cooperative in which land is parceled out equally to member families and most production activities are individually determined and executed. Cooperative production is found, however, in those sectors where individual production is not profitable. Examples include grain production, fruit plantations, cattle pastures, and fishponds. All marketing is carried out through the moshav. Each member delivers his/her produce to the moshav and the moshav then deals with a marketing company as a collective unit. After the moshav receives payment, the proceeds are distributed among the members according to the quantity and quality of the goods supplied. Each moshav also has a communal supply service where a member can buy goods. In addition, the moshav supplies productive services such as heavy machinery, incubators, preparation of concentrated feed, water supply, and professional instruction. Mutual aid and responsibility are another principle of the moshav. Apart from

financial aid, the moshav helps members in case of illness, death, and other emergencies. Using the notation from our model, a moshav would be characterized by income distributed according to relative cooperative labor shares, $\alpha = 1$, and a high level of private production, h^p .

Another Israeli cooperative settlement is the moshav shitufi. This form of production cooperative is based on the principles of collectivism in property and production, equality of income, and individualism in consumption and family household. The land is not divided into individual plots but is farmed cooperatively. A comprehensive regime of work is established. Men are required to work 8-10 hours a day on the village farm; the women, in addition to their household work, are given a quota of hours on the farm. The wage which a member receives is not fixed according to performance or type of work, but according to the size of the family. Using the notation from our model, a moshav shitufi would be characterized by minor private production, labor quotas, and equal income distribution, $\alpha = 0$.

A kibbutz is a cooperative based on communal property and communal consumption. The collective consumption is the unique feature of the kibbutz organization. The cooperative undertakes to provide members with food, clothing, housing, and necessary services. The members on the other hand submit to the decisions of the cooperative concerning the standard of living and the quantity and quality of the services provided. Members relinquish any right to private economic activity. The kibbutz does not acknowledge a claim to a higher standard of living because of better work performance or type of work done. The kibbutz takes care of each member's children no matter how many, and a sick

member is looked after, no matter how great the cost. Expenses per member are larger only if needs are greater. Members receive no wages for their work, but obtain all they need from the special services established by the kibbutz. In every kibbutz there is a communal kitchen and dining hall. Almost all the members take three meals a day together so that the dining hall and common meal have become the basic characteristic of kibbutz life. There is a common laundry and sewing room which cleans, mends, and manufactures garments. Most kibbutzim also have a dentist, medical doctor, hairdresser, and nurse. Each member lives in a dwelling built and furnished by the kibbutz. A new member pays no admission fee and once accepted as a member, becomes an equal partner in the kibbutz. On the other hand, a member leaving the kibbutz does not receive a proportionate part of the property accumulated during his or her stay.

The kibbutz has a more diversified economy than either of the other cooperative forms of organization. While agriculture is still a significant branch of the kibbutz economy most kibbutzim have established industrial plants as a source of income and employment. The advantages accruing to the kibbutz from the combination of agriculture and industry are considerable. The development of factories enables the kibbutz to diversify income, increase earnings from a fixed land base, provide employment for less physically able members, and provide a wider variety of employment opportunities for all members. Of course the agricultural sector of the kibbutz is also diversified to assure more even seasonal distribution of labor demands, more efficient utilization of machinery, and less income risk.

Work is compulsory for both men and women and members are required to work a certain number of hours per day depending on their age. The kibbutz provides work for the older members and most members work until they are incapacitated. Each member's primary work activity is usually determined according to his personal wishes and abilities. Members have the choice of working in the industrial, agricultural, or service sector. The service sector includes such areas as the kitchen/dining hall, nursery, elementary school, laundry, medical services, equipment repair shop, clothing production, landscape, construction, member's store and the administrative office. The possible branches within the agricultural sector ranges over animal husbandry, field, fruit, and industrial crop cultivation. The industrial sector usually includes at least two light industries with a managerial staff. Examples of kibbutz industrial products include jewelry, plywood, farm implements, and optical goods. Other non-agricultural operations engaged in by kibbutzim include guest houses and kiosks at tourist attractions. Members who work away from the kibbutz do so with the consent of the kibbutz.

Kibbutz society is based on democratic procedures such as general meetings, elections, maximum consideration for the wishes of the members, and lack of a privileged class. The general meeting constitutes the forum where any member may express his/her opinion and participate in the decisions pertaining to the economic or social life of the kibbutz. The general meeting elects all the various committees, approves their decisions, and decides on personal problems of members such as permission to work or study outside the kibbutz. The Secretariat is the executive body of the kibbutz and consists of the treasurer, the economic secretary, and the secretary of internal affairs. In order to

ensure active participation on the part of members the kibbutz establishes a considerable number of functional committees. In every kibbutz there is an economic committee composed to discuss current economic problems. Another important committee is the members committee whose role is to look after the special requirements of members, fair distribution of housing, annual vacations, and any social problem which might arise. Labor problems outside the daily work distribution are within the domain of the labor committee which discusses the monthly and annual work schemes, the admittance of members to various occupations, and any complaints or conflicts pertaining to the distribution of work. Other important committees are the education committee, handling educational and child care problems; the security committee responsible for security and defense. A prominent role is also played by the branch committees which comprise the regular workers of the respective economic branches such as dairy, field crops, nursery.

With respect to our theoretical model a kibbutz is a production cooperative characterized by equal sharing of the net cooperative income, $d = 0$, and no private production, $h^P = 0$. Since there is no private production and the income distribution weight is fixed on a kibbutz, we can not test the effects of changes in d , income correlation or variance on labor allocation by examining a kibbutz. However, by collecting data from a kibbutz it is possible to isolate the importance of the effect of the cohesion conjecture on labor supply. If adequate data is collected we can also determine the characteristics of members who contribute more than the required level of labor. This is of interest since on a kibbutz there is no direct financial inducement for additional work. The empirical application will determine the non-pecuniary

factors which affect a member's labor supply. It will be possible to test if the belief other members increase their work in response to your own work increase affects a member's willingness to contribute beyond the required work. In the next section the survey of kibbutz members is described.

4.2. Data Collection Procedures

Data was collected from members of Degania Bet, a kibbutz located in Northern Israel just south of the Sea of Galilee (Lake Kinneret). This kibbutz is one of the oldest and was founded in 1920 by Russian immigrants which were later reinforced by newcomers from Canada, and Poland. Degania Bet has a little over 400 adult members, and approximately 200 children. The main agricultural activities include dairy, bananas, cotton, and melons. The main industrial product is crop sprayers for both the domestic and export market. Degania Bet's revenues are distributed approximately equal between agriculture and industry.

The data collection process was supported by the University Research Expeditions Program of the University of California. They recruited three participant/donors to assist in data collection. The author trained the research team, made all the arrangements, and supervised the field research. The four member research team worked on Kibbutz Degania Bet for one month. During the day the team volunteered work to the kibbutz and in the evening collected data.

The author developed the questionnaire and arranged for its translation into Hebrew by an ex-member of Degania Bet. The English version

of the questionnaire is found in Appendix 2, and a brief description of the questions is located in the next section. The questionnaire was first pretested on ex members of kibbutzim currently living in the United States and then on members of Kibbutz Gat in Israel.

4.3. Questionnaire Description

To collect data on labor supply members were asked whether or not they contributed hours beyond what was required; and if they did contribute extra hours, what was their additional contribution in hours per week. With respect to the cohesion conjecture, members were asked: "If you increase your contribution of time and effort in your work, do the members you work with increase their contribution?" This question was immediately followed by: "If yes, how many members increase their contribution?" We also asked, "If you increase your time and effort in your work, do the other members you work with decrease their contribution? If yes, how many members would decrease their contribution?" In order to differentiate quantity and quality of labor, we asked members to rank themselves as to how hard they worked in comparison to other members.

The questionnaire collected from each member the basic socioeconomic data of gender, age, marital status, place of birth, years of experience on a kibbutz, number of children, number of children that have become members, primary work activity, entry mechanism to the kibbutz, highest level of education attained, and committee responsibilities. An index of leadership was constructed based on their level of decision-making responsibilities. If a member had ever been a member of the executive body they were ranked the highest on the leadership scale.

If they had ever been a branch head, but not a member of the executive body they received the second highest rank. If a member had been a committee head, but neither a branch head or a member of the executive committee then they received the third highest rank. The next leadership rank was for those members that had only been a committee member, and the lowest leadership rank went to those members that did not participate in any committee responsibilities.

The questionnaire also included attitudinal questions. Members were asked how satisfied they were with their work, their standard of living, and the kibbutz social life. Members were asked to compare the kibbutz standard of living with their expected standard of living if they left the kibbutz. They were also asked to compare how hard they expected they would have to work if they left the kibbutz in order to obtain the kibbutz standard of living. In addition, each member was asked to rank how important the economic security provided by the kibbutz was in their decision to remain a member. An attempt was made to measure a member's time horizon by asking how they would allocate unexpected earnings of the kibbutz between an investment in industry and raising the current standard of living. They were allowed to allocate all to industry, most to industry, half to industry and half to raising the standard of living, most to increasing the standard of living, or all to raising the standard of living. Industrial investment was used to indicate future consumption as compared to raising the current standard of living. An attempt was also made to measure a member's attitude toward risk. Members were asked how they would vote to allocate unexpected earnings of the kibbutz between an investment in an industry with an unstable income but a very high potential profit or an industry with a stable

income but a low potential profit. In order to measure a members commitment to equality of consumption members were asked how strongly they felt about members having the right to private wealth separate from that which is earned as a member. Members were also asked to categorize identified problems as not important, of minor importance, or of major importance. Members were asked to categorize the importance not joining the kibbutz, member's leaving the kibbutz, unwillingness on the part of some members to contribute to community life, and not enough opportunities to develop your own skills. Finally members were asked to indicate the reasons they thought industry was developed on the kibbutz.

4.4. Questionnaire Summary Statistics

Before presenting the statistical analysis of the factors affecting a member's decision to work beyond the required hours, a brief summary of the questionnaire responses is included. We collected 234 completed questionnaires from a total available membership of 304, almost a 77% response rate. Not all of the members were available due to overseas travel, active military service, education leave, and assignment off the kibbutz. The response was high for several reasons. The questionnaire did not ask for identification by name, and was clear and concise. The team's persistence and willingness to volunteer work probably also predisposed members to cooperate with the research.

Of the members responding to the questionnaire 46% are female and 31% were born on a kibbutz. With respect to work activities 18% of the members work in agriculture, 15% in industry, 59% in the service sector, and 8% work off the kibbutz. With respect to committee responsibilities 11% of the respondents admit to being a member of the executive body,

43% a branch head, 49% a committee head, and 78% a committee member.⁷ The age distribution is: 8% under 30, 38% between 30 and 40, 16% between 41 and 50, 13% between 51 and 60, and 25% over 60. With respect to labor supply, 59% of the respondents claim to work additional hours and their additional contribution is on average 7.8 hours per week. When asked if other members will increase their labor supply in response to their own increase in labor supply, 40% of the respondents answer in the affirmative. Only 8 members claim other members would work less if they increase their own work.

The responses to the attitudinal questions dispelled a few kibbutz myths. It appears that communal living may involve a high degree of social dissatisfaction. Only 33% of the members are satisfied with the social and cultural life on the kibbutz, and 42% admit dissatisfaction. The remaining 25% are not sure. Our questionnaire also revealed social pressures and disharmony are the major reasons for member's leaving Degania Bet. The close social environment of the kibbutz leaves little privacy, and the need for official approval for many individual endeavors strains interpersonal relationships.

This social dissatisfaction, however, is mixed with strong sense of economic well being. Only 2% of the members are dissatisfied with the standard of living with 94% of the members satisfied and 4% unsure. The standard of living achieved at Degania Bet is relatively high. The apartments are well furnished, high quality food is prepared daily, and several members at a time pursue post secondary education. Every family

⁷ Respondents are those members answering that particular question.

is entitled to a trip abroad every seven years, and each family has their own color television. The majority of the members felt if they left the kibbutz they would have to work harder to maintain the same standard of living.

One implication is the kibbutz standard of living is the factor which retains members. Kibbutz life is not the preferred social arrangement, but it does provide a very satisfactory standard of living. A relatively high standard of living may be a necessary but not sufficient condition for membership retention on a kibbutz.

Our survey also challenges the kibbutz myth of sexual equality. Given the founding principles of equality, we were surprised to find such traditional work assignments. Women were not assigned to the management or production aspects of industry, and men were not involved with child care, food preparation, or the cleaning, mending, or ironing of clothes. It is not surprising that there is a gender gap with respect to work satisfaction. Eighteen percent of the women are dissatisfied with their work while only seven percent of the men are dissatisfied.

4.5. Statistical Analysis - Tobit

A censored regression model, or tobit, is used to determine the factors affecting a member's supply of work hours beyond what is required. In a censored regression model, data is available on the independent variables for all observations while for the dependent variable, y , the exact values are only known for a portion of the observations. For the remaining y observations the data only indicates whether

or not y is above or below a certain threshold.⁸ The tobit model is defined:

$$y_i = \begin{cases} \beta' X_i + e_i & \text{if } y_i > 0 \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

where β is a vector of unknown parameters; X_i is a vector of known constants; and e_i is the residual which is independently and normally distributed with mean zero and common variance. Equation 1 may be rewritten:

$$E(y_i | X_i, y_i > 0) = \beta' X_i + E(e_i | e_i > -\beta X_i) \quad (2)$$

For our analysis the dependent variable is the number of extra hours worked by member i . There are no observations on the dependent variable for values less than the threshold of minimum required hours because members were not asked to disclose if they worked less than required. The vector of known constants includes the socioeconomic and attitudinal variables collected from each member. These variables include gender, work sector assignment (agriculture, industry, or service), level of work satisfaction, educational level attained, the leadership index, the belief that other members will respond to your increases in labor supply (the cohesion conjecture), preferences for spending windfall profits on investment or consumption (time horizon), and the importance of the problem of members not meeting their work obligations (free rider problem). Our analysis deleted the observations

⁸ Truncated regressions should not be confused with censored regression models. In truncated regression models data is not available on either the explained or the explanatory variables if the value of y is above (or below) some threshold.

of members over age sixty since we felt that group was not representative of the labor pool of the kibbutz.

Likelihood ratios were used to determine the variables which significantly contribute to the explanatory power of the tobit model. The improvement in the likelihood ratio was used to determine if each of the variables significantly contributed to the model as they were sequentially included. No other variables were found to significantly improve the model. Table 4 lists the selected variables with their estimated coefficients and t ratios. The results indicate that educated, work satisfied members who play a leadership role contribute larger amounts of additional labor. Gender is also a significant determinant of additional work. Attitudes associated with extra hours of labor include the belief other members will follow work increases, the acknowledgment that not everyone carries their share of the work load, and the preference for investing unexpected profits rather than raising the current standard of living. An agricultural work assignment is found to negatively affect the number of additional hours supplied.

The education, work satisfaction, gender and agricultural work variables all have t ratios significant at the 5% level; time horizon and leadership have t ratios significant at the 10% level. Although the cohesion conjecture and free rider belief variables do not have high t ratios they add significantly to the explanatory power of the model. When either variable is added last to the model the chi square statistic is significant at the .005 level.

The t ratio of the gender coefficient indicates that women work significantly more hours. This result can be a reflection of the fact

Table 4
Tobit Results

Variable	Coefficient	T ratio
Constant	6.62	1.40
Gender	3.64	2.17**
Education	1.36	2.36**
Agriculture	-4.35	-2.19**
Work Satisfaction	2.65	3.59***
Cohesion Conjecture	1.84	1.28
Leader	1.15	1.89*
Free Rider Belief	1.68	1.47
Time Horizon	1.46	1.88*

*** significant at the 1% level
** significant at the 5% level
* significant at the 10% level

that women generally work in areas that frequently demand additional hours -- kitchen and nurseries. These areas are always overloaded during the frequent holidays and celebrations (weddings, bar mitzvahot, b'ritot). None of the men work in the nurseries and only one man works in the kitchen.

The significant negative effect of an agricultural assignment on labor supply can be a reflection of local conditions at Degania Bet. The fields are located at some distance from the living area and therefore transportation constraints preclude additional labor. When the truck leaves, field workers leave too or else face a long walk home. Although this transportation constraint does not affect dairy workers, they are few in number.

It is not surprising that work satisfaction is a significant factor affecting labor supply. When there are no direct financial rewards for overtime work, job satisfaction becomes an intrinsic motivation to contribute additional hours.

A member's preference for investment over current consumption can be interpreted as a willingness to sacrifice for the future well being of the cooperative. It would be consistent for these member to contribute more than required. The significance of the time horizon variable supports this characterization.

Members with high levels of committee responsibilities can be characterized as committed members. The significance of the leadership variable which is an index of committee responsibility supports the assertion these members are willing to contribute more than is required.

The significance of the cohesion conjecture indicates a member's labor supply is affected by his/her perception of the responsiveness of other members. Because all members benefit from any one member's overtime, it is not surprising a member's labor contribution is affected by the belief other members will respond in kind.

4.6. Statistical Analysis - Logit

Another approach is to use a logit model to determine factors affecting a member's decision of whether or not to work additional hours. The dependent variable is the yes or no response to "Do you work additional hours beyond what is required?". The results of the logit estimation are listed in Table 5.

The only variable which has a significant t ratio in both the logit and tobit estimation procedures is work satisfaction. The signs of the coefficients are the same in both the tobit and logit models except for the variables of gender and agriculture.

Although gender significantly affects the number of additional hours worked, it is not significant in the discrete decision to work additional hours. The negative sign on the gender coefficient in the logit estimation supports the earlier assertion women work significantly more hours because of their work assignments and not because they are inherently inclined to work more hours than men. The insignificance of the gender coefficient demonstrates gender can not be used as an indicator of whether a member will work additional hours.

The insignificant coefficient on both industry and agriculture in the logit model indicates that work sector assignment does not

Table 5
Logit Results

Variable	Coefficient	T ratio
Constant	1.63	1.08
Work Satisfaction	1.00	4.20***
Cohesion Conjecture	1.11	2.29**
Gender	-.39	-.67
Education	.34	1.72*
Industry	.61	.79
Agriculture	.122	.18
Leader	.31	1.64
Free Rider Belief	.68	1.97*
Time Horizon	.17	.66

*** significant at the 1% level

** significant at the 5% level

* significant at the 10% level

significantly affect a member's choice to work additional hours. Although agriculture has a significant and negative affect on extra hours worked, the positive coefficient on agriculture in the logit model indicates agriculture workers do not have an aversion to additional work. The change in sign on the agriculture variable in the tobit and logit estimations supports the assertion that transportation constraints and not agricultural worker characteristics inhibit additional work in agriculture.

Time horizon is the only variable other than gender and agriculture which significantly affects the number of extra hours supplied but does not significantly affect the decision to work additional hours. This result can be interpreted as members with a commitment to the future may not prefer to work but will if they perceive a need.

Education and Leadership do not have significant t ratios in the logit model, but were found to significantly add to the explanatory power of the model when log likelihood ratios were used in a chi square test. Both of these variables were significant in the tobit model. Similarly the free rider belief and the cohesion conjecture significantly affect the discrete choice, but do not have a significant t ratio in the tobit model, but the chi square test indicates these variables add to the tobit model explanatory power.

4.7. Statistical Analysis - Heckman

The most general theoretical approach to censored data would assume the observed independent variable is only observed when another random variable crosses a threshold. This general case is depicted as:

$$y_{1i} = \beta_1' X_{1i} + e_{1i}$$

$$y_{2i} = \beta_2' X_{2i} + e_{2i}$$

Generally y_{2i} is not observed, but y_{1i} is observed when y_{2i} crosses some threshold. In this case regression equation 2 is rewritten:

$$E(y_{1i} | X_{1i}, y_{2i} \geq 0) = \beta_1' X_{1i} + E(e_{1i} | e_{2i} \geq -\beta_2' X_{2i}) \quad (3)$$

The disturbance e_{1i} is a function of the variables X_2 . Thus variables in X_2 which do not belong in the regression function for y_{1i} may appear significant if included. Note that the tobit model is a special case with $e_{1i} = e_{2i}$.

If we assume the joint density of e_{1i} and e_{2i} is bivariate normal then a two stage procedure suggested by Heckman can be used. His procedure is based on the censored regression model being rewritten as follows:

$$E(y_{1i} | X_{1i}, y_{2i} \geq 0) = \beta_1' X_{1i} + \frac{\sigma_{12}}{(\sigma_{22})^{1/2}} \lambda_i \quad (4)$$

$$E(y_{2i} | X_{2i}, y_{2i} \geq 0) = \beta_2' X_{2i} + \frac{\sigma_{22}}{(\sigma_{22})^{1/2}} \lambda_i \quad (5)$$

where $\lambda_i = \frac{f(\phi_i)}{1 - F(\phi_i)}$, $\phi_i = \frac{-\beta_2' X_{2i}}{(\sigma_{22})^{1/2}}$ and $f(\phi_i)$ and $F(\phi_i)$ are respectively

the density and distribution functions of a standard normal random variable evaluated at ϕ_i . Since ϕ_i and λ_i are not known, Heckman suggests estimating ϕ_i using probit analysis which in turn can be used to estimate λ_i . More specifically, Heckman suggests the following:

1) Define a dummy variable as follows:

$$I_i = \begin{cases} 1 & \text{if } y_{1i} > 0 \\ 0 & \text{otherwise} \end{cases}$$

2) Use the probit model to obtain consistent estimates of $\beta_2/(\sigma_{22})^{1/2}$.

3) Estimate ϕ_i and λ_i using $\beta_2/(\sigma_{22})^{1/2}$.

4) Estimate equation 4 by OLS using the estimate of λ_i .

The Heckman procedure can be interpreted as a discrete/continuous choice model. With respect to the labor supply analysis presented here, the model estimates simultaneously the discrete choice of whether or not to work extra hours and the continuous decision of how many extra hours to contribute. A probit model is used for the discrete choice estimation and OLS is used for the continuous decision estimation. The results of the Heckman estimation procedure is reported in Tables 6 and 7.

The only factors positively and significantly affecting a member's discrete choice of whether or not to contribute extra labor are work satisfaction and the cohesion conjecture. The variables which positively and significantly affect the number of extra hours are gender and work satisfaction. Agricultural work negatively and significantly affects the number of extra hours contributed.

The Heckman procedure supports the earlier assertion that gender and agriculture significantly affect the number of hours worked, but not the willingness to work. Notably, only the attitudinal variables of cohesion and work satisfaction significantly affect the willingness to work extra hours. Work Satisfaction is the only variable which

Table 6
Heckman Results-Probit

Variable	Coefficient	t ratio
Intercept	.93	1.25
Work Satisfaction	.59	4.23***
Cohesion Conjecture	.58	1.99**
Free Rider Belief	.29	1.34
Leader	.17	1.46
Ed	.17	1.47

*** significant at the 1% level

** significant at the 5% level

Table 7
Heckman Results - OLS

Variable	Coefficient	t ratio
Intercept	3.84	.77
Gender	4.33	2.57**
Work Satisfaction	1.46	2.02**
Agriculture	-3.66	-1.83*
Ed	.96	1.35
Time	.78	1.00
Leader	.33	.46
Cohesion Conjecture	-.67	-.40
Free Rider Belief	.86	.97

** significant at the 5% level
* significant at the 10% level

significantly affects both decisions.

4.8. Summary

The cohesion conjecture is found to be a significant factor in both the tobit and Heckman estimation procedures. The expectation of a labor response from other members positively and significantly affects a member's labor supply. This result confirms the need to include behavioral interaction in models of cooperative labor supply.

Work satisfaction is also found significant in both the tobit and Heckman procedures. The importance of job satisfaction is well documented by this study. An essential inducement for participation in an environment without wages is a satisfying job.

Perhaps the most interesting statistical result is the separation of variables affecting the two decisions made by members. The Heckman procedure demonstrates that only attitudinal variables affect the decision to work additional hours, while job assignment variables only significantly influence the number of additional hours supplied. Only job satisfaction and cohesion were significant in the probit estimation. Thus only attitudes significantly affect a member's decision to work extra hours. If gender is a proxy for kitchen and day care work, then work assignment variables only significantly affect the number of extra hours worked since gender and agriculture are significant in the OLS but not the probit estimation. This interpretation of our results has intuitive appeal. Work activities influence the actual number of extra hours worked, while the decision to work additional hours is a reflection of attitude.

Chapter 5: Conclusion

This research demonstrates that there are no simple, direct incentives to increase cooperative labor supply in an uncertain environment. Neither an increase in member cohesion nor an increase in the distribution of income based on participation will guarantee an increase in cooperative labor. Similarly, cooperative participation will not necessarily decline with either an increase in cooperative income variability or an increase in private and cooperative income correlation. Only a careful analysis of the specific conditions of a cooperative will determine the changes in a cooperative's parameters that will increase the labor supply. Perhaps the lack of clear-cut recipes for increasing participation contributes to the malaise of production cooperatives.

Bradley, Bonin, Chinn, and Putterman have each asserted the important affect of behavioral interaction on a member's cooperative labor supply, but no one has tested its existence or significance. The data collected as part of this research confirms the existence of member interaction. Forty percent of the members gave an affirmative answer to the question, "If you increase your contribution of time or effort, do the members you work with increase their contribution?". Although data on the value of each member's cohesion conjecture was not attainable, the dummy variable indicating a member's positive perception was significant in all the estimation procedures used to measure factors affecting labor supply.

The empirical results also imply a cooperative can increase participation by investing in education, spreading committee responsibilities, and maximizing job satisfaction. The cooperative should invest in

production processes with few menial tasks and a variety of skill levels. It is important members have the potential for a wide range of job possibilities as well as the opportunity for ever increasing skill levels. A cooperative will have difficulty encouraging members to supply labor if there is only one work task and it is menial. One of the strengths of the kibbutz has been its addition of industry to its agricultural base which created work diversity.

Although the theoretical framework presented here expands on the existing literature, two extensions are especially pertinent. Total labor time is assumed constant which ignores the work/leisure tradeoff. The analysis should expand to allow variability among members' labor time to reflect taste and endowment differences. If leisure is included in the model presented here, the effect of a change in parameter is ambiguous without specifying functional forms. To maintain the most general model, total labor was assumed constant.

As the model presented here is a partial equilibrium model, it does not explicitly consider equilibrating forces within cooperatives. Moreover, issues of existence and stability of equilibrium positions need to be analyzed. General equilibrium conditions are especially important when member interaction is included.

The natural empirical extension is to test the effects of income variability and correlation on cooperative labor allocation. This can be done if data is collected from a cooperative with both private and cooperative production. Data should also be collected from a variety of cooperative structures to test the significance of income distribution rules on cooperative labor supply.

The dynamic implications of member's exiting also deserve further attention. If individuals who have few alternative opportunities are more likely to join or remain a member, then over a period of time the cooperative can lose its most skilled members and be left with members with lower human capital. To keep members with high levels of human capital, the cooperative must provide opportunities that are unavailable to individuals acting alone. Since a cooperative is built on economies of scale there are possibilities for skill specialization that a farmer working alone can not afford. A cooperative can also lure skilled members by its ability to develop or experiment with innovative processes. If a cooperative's income base is highly diversified, the cooperative can afford to take risks which are too great for an individual farmer.

The main purpose of a cooperative should not be to address income distribution disparities. Although a more egalitarian society is achievable through cooperatives, altruistic, idealistic, or broad societal goals will not insure the cooperative's existence. Because the long term viability of cooperatives depends on its ability to retain members, the motivating force should be to provide the best alternative for members. This goal is attainable since cooperatives are in a position to both capture the benefits of economies of scale and diversify individual risk.

Appendix 1: Comparative Static Equations

1. The directional effect of a change in η on cooperative labor supply is obtained from the following comparative static equation:

$$\frac{dh^c}{d\eta} \cong -\alpha \frac{Y^c}{H^c} + (d+[1-d]) \frac{\hat{h}^c}{h^c} Y^{c'} - R(g^p \sigma_{pc} + Ag^c \sigma_c^2) \left((d+[1-d]) \frac{\hat{h}^c}{h^c} g^{c'} - d \frac{H^c}{g^c} \right).$$

If the mean income effect dominates the variability effect, the direction of the cooperative labor response to an increase in η is strongly influenced by the rules that govern the distribution of cooperative income. With equal income distribution, $d = 0$, the positive marginal income term dominates, and members increase their cooperative participation [result 1.a(1)]. When d equals one, the negative average income term dominates since the cooperative is assumed to be operating in the efficient production zone where $\frac{Y^c}{H^c} > Y^{c'}$ [result 1.a(2)]. Result 1.a(3) follows because the coefficient on the marginal income term is less than, equal to, or greater than one depending if the worker is a cooperativist, average, or individualist. With a small coefficient on the marginal income term, the average income term will dominate at lower values of d , and cooperative labor will decrease. Each member has a critical value for d above which he/she decreases cooperative labor for increases in η . This critical value is:¹

$$d = \frac{\hat{h}^c/h^c}{\frac{Y^c}{H^c} / Y^{c'} - 1 + \hat{h}^c/h^c}.$$

The critical d value is smaller for cooperativists ($\hat{h}^c/h^c < 1$) than for

¹ We assume the cooperative is operating in the efficient zone where $\frac{Y^c}{H^c} > Y^{c'}$.

individualists ($\hat{h}^c/h^c > 1$). Thus, for any given value of $d < 1$, cooperativists are more likely to decrease cooperative labor for increases in the cohesion conjecture.

If the variability effect dominates the mean income effect, the direction of the cooperative labor response to an increase in η is strongly influenced by the marginal effect of labor on income variability, $g^{c'}$. If $g^{c'}$ is negative, marginal labor is risk reducing, the whole variability term is positive, and members will increase cooperative labor [result 1.b(1)]. If $d = 0$, the marginal effect of labor on variability dominates; if $g^{c'}$ is positive, members will decrease labor [result 1.b(2)]. If $d = 1$, and $g^{c'}$ is positive, the cooperative labor response depends on the relative size of the marginal and average effect of labor on variability. If $g^{c'}$ is smaller than $\frac{g^c}{H^c}$, the second bracketed variability term will be negative, and members will increase cooperative labor supply [result 1.b(3)]. If $g^{c'}$ is larger than $\frac{g^c}{H^c}$, the second bracketed term will be positive, and members will decrease labor [result 1.b(4)].

2. The directional effect of a change in d on cooperative labor supply is obtained from the following comparative static equation:

$$\begin{aligned} \frac{dh^c}{dd} \cong & (1-\eta) \frac{Y^c}{H^c} + (1 - \frac{\hat{h}^c}{h^c}) \eta Y^{c'} \\ & - R[(g^p \sigma_{pc} + Ag^c \sigma_c^2) (\frac{g^c}{H^c} (1-\eta) + (1 - \frac{\hat{h}^c}{h^c}) \eta g^{c'}) \\ & + (\frac{\hat{h}^c}{H^c} - \frac{1}{N}) (d (1-\eta) \frac{g^c}{H^c} + (d + [1-d] \frac{\hat{h}^c}{h^c}) \eta g^{c'})]. \end{aligned}$$

If the mean effect dominates the variance effect, cooperativists and average workers will increase cooperative labor since both mean effect terms are positive [2.a(1)]. For average workers, the marginal income term is zero, but the positive average income term dominates. For individualists, the coefficient on the marginal income term is negative, and their labor response is unclear. However, if η is large, the negative marginal income term dominates so individualists will decrease cooperative labor [2.a(2)].

If the variance effect dominates the mean income effect, only the bracketed term is considered. As $(\frac{h^c}{H^c} - \frac{1}{N})$ approaches zero, the associated relevant term can be disregarded. If $g^{c'}$ is positive, the total variance effect is negative for average members and cooperativists since $1 - \frac{\hat{h}^c}{h^c}$ is positive [result 2.b(1)]. If $g^{c'}$ is negative, the total variance effect is negative with $(1 - \frac{\hat{h}^c}{h^c})$ nonpositive for individualists and average workers [result 2.b(2)].

3. The directional effect of a change in correlation on cooperative labor is obtained from the following comparative static equation:

$$\frac{dh^c}{d\phi} \stackrel{s}{=} -Rg^p g^c \sigma_c \sigma^p \frac{1}{H^c} [\alpha(1-\eta) + (\alpha + (1-\alpha)\frac{\hat{h}^c}{h^c})\eta\phi^c - \frac{H^c}{1-h^c} \phi^p].$$

The coefficient on ϕ^p is $\geq H^c$ and is much larger than the coefficient of ϕ^c . If ϕ^c and ϕ^p are equal, the effect of the private income variability elasticity will dominate. If both income variability elasticities are equal and positive, the bracketed term is negative and members will increase cooperative labor (result 3.1). If both income

elasticities are equal and negative, the bracketed term is positive, and members will decrease cooperative labor (result 3.2). If $\phi^C \leq 0$ and $\phi^D \geq 0$ or $\phi^C > 0$ and $\phi^D < 0$, the bracketed term is negative, and members will increase cooperative labor (result 3.3). Result 3.4 is obtained by setting the bracketed term to zero and solving for ϕ^C when $\phi^C, \phi^D > 0$ and $\phi^C, \phi^D < 0$.

4. The directional effect of a change in cooperative income variability on cooperative labor is obtained from the following comparative static equation:

$$\frac{dh^C}{d\sigma^C} \cong -R \frac{g^C}{H^C} [(g^D \sigma_{p^D}^D + 2Ag^C \sigma_c^C) (\alpha(1-\eta) + (\alpha + (1-\alpha) \frac{h^C}{h^C}) \eta \phi^C) - \phi^D g^D \sigma_{p^D}^D \frac{H^C}{1-h^C}].$$

With $\alpha = 0$, $p = 0$, and $\phi^C < 0$, the term within the brackets is always negative, and members will increase cooperative labor [result 4.a(1)]. With $\alpha = 1$, $p = 0$, and $\phi^C < 0$, the bracketed term will be negative only if the absolute value of ϕ^C is greater than $(1-\eta)/\eta$ which implies that cooperative labor will increase [result 4.a(2)]. With $p = 0$, and $\phi^C > 0$, the bracketed term is always positive which implies cooperative labor will decrease (result 4.b). Result 4.c is obtained in a manner similar to result 3.4.

Appendix 2: Kibbutz Member Questionnaire

Please write an "x" to the left side of the appropriate response.

1. Sex: ___Male ___Female

2. Age: ___Under 30 years old
 ___31 to 40 years old
 ___41 to 50 years old
 ___51 to 60 years old
 ___Over 60 years old

3. Martial Status: ___Single
 ___Married
 ___Other(Widowed,seperated, divorced)

4. Place of Birth: ___Israel
 ___Outside of Israel

5. Were you born on this kibbutz? ___Yes ___No
 If "NO", how did you come to this kibbutz?
 ___Marriage ___To join my family
 ___Gareen Movement ___By myself
 ___Nachel ___Other(please specify)
 ___Foster parent _____

6. How many years have you spent on this or any other kibbutz?
 ___years

7. Do you have any children?
 ___Yes.....How many? _____
 ___No

8. Do you have any children who have completed Army service?
___Yes.....How many? ___
___No
9. Do you have any children above 21 who are members of this kibbutz?
___Yes.....How many? ___
___No
10. What is the highest level of education that you have received?
___Part of high school
___Completed high school
___Institute above high school
___Some University studies
___Academic degree
11. Have you ever been or are you now the secretary, financial manager
or economic planner?
___Yes ___No
12. Have you ever been or are you now the head of a committee?
___Yes ___No
13. Have you ever been or are you now a branch head?
___Yes ___No
14. Have you ever been or are you now a member of a committee?
___Yes ___No

15. Select from the following: What is your main work?

- | | |
|--|---|
| <input type="checkbox"/> Agriculture | <input type="checkbox"/> Clothing |
| <input type="checkbox"/> Industry | <input type="checkbox"/> Laundry |
| <input type="checkbox"/> Kitchen/Dining | <input type="checkbox"/> Office/Administration |
| <input type="checkbox"/> Store/Supermarket | <input type="checkbox"/> Off the kibbutz(part time) |
| <input type="checkbox"/> Medical | <input type="checkbox"/> Off the kibbutz(full time) |
| <input type="checkbox"/> Education | <input type="checkbox"/> Other(please specify)_____ |

16. Do you work beyond the time required?

- Yes No

If "YES", approximately how many additional hours per week?

_____additional hours per week

17. If you increase your contribution of time and effort in your work,
do the members you work with increase their contribution?

- Yes No

If "YES", how many members increase their contribution?

_____members increase their contribution.

18. If you increase your contribution of time and effort in your work,
do the members you work with decrease their contribution?

- Yes No

If "yes", how many members would decrease their contribution?

_____members decrease their contribution.

19. Please rate yourself: Relative to other members how hard do you work?

Much harder than average

Harder than average

About average

Less hard than average

20. If you left the kibbutz what do you expect your standard of living would be compared to your current standard of living?

Much higher

Higher

About the same

Lower

Much lower

21. If you left the kibbutz in order to obtain the same standard of living you now have you would have to work:

Much harder

Harder

About the same

Less hard

22. Assume at the end of the treasury year the kibbutz has an unexpected additional \$100,000. How would you use this amount between developing industry or raising your current standard of living? Choose one of the following:

Invest all in industry

Spend most in raising the standard of living

Invest half in industry, half in raising the standard of living

Spend most in raising the standard of living

Spend all in raising the standard of living

23. Assume the kibbutz has two industries--A and B. Industry's A current income is unstable but has a high potential profit. Industry B's income is safe and stable but has a low potential profit. How would you vote to invest the \$100,000?

Invest all in Industry A

Invest most in Industry A

Half in Industry A and half in Industry B

Invest most in Industry B

Invest all in Industry B

24. Members would have the right of private wealth separate from that which is earned as a member: Do you agree or disagree?

Strongly agree

Agree

Neutral or not sure

Disagree

Strongly disagree

25. Please rank how important the economic security provided by the kibbutz is to you in your decision to remain a member.

Most important

Very important

Important

Not important

No opinion

26. How satisfied are you with the kibbutz standard of living?

Very satisfied

Satisfied

Neutral or not sure

Dissatisfied

Very Dissatisfied

27. How personally satisfied are you with your work on the kibbutz?

Very satisfied

Satisfied

Neutral or not sure

Dissatisfied

Very Dissatisfied

28. How satisfied are you with the social and cultural life on the kibbutz?

Very satisfied

Satisfied

Neutral or not sure

Dissatisfied

Very Dissatisfied

29. In your opinion which of the following issues are a problem on your kibbutz? Please check if it is not a problem, or if it is a minor or major problem:

	Not a Problem	Minor Problem	Major Problem
Children of members not joining	_____	_____	_____
Members leaving	_____	_____	_____
Not enough opportunities to develop your own skills	_____	_____	_____
Unwillingness on the part of some members to contribute to community	_____	_____	_____
Some members not fulfilling their work obligations	_____	_____	_____

30. Why do you think members leave the kibbutz? _____

31. The kibbutz has developed industry for several reasons. From the following list choose the two main reasons for developing industry in your opinion.

- ___ Industry can provide income without using land
- ___ Industry has higher profits than agriculture
- ___ The income from industry is less variable than agriculture
- ___ Industry creates attractive jobs
- ___ Industry creates jobs for older members

THANK YOU FOR YOUR TIME AND ATTENTION.

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