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Recommended Citation

Levy, Amnon and Romm, Tsilia, The consequences of mutually secured debts: the case of Israeli Moshavim, Department of Economics, University of Wollongong, Working Paper 91-5, 1991, 21.
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THE UNIVERSITY OF WOLLONGONG
DEPARTMENT OF ECONOMICS

**THE CONSEQUENCES OF MUTUALLY SECURED DEBTS:
THE CASE OF ISRAELI MOSHAVIM**

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Working Paper 91- 5,

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ISSN 1035-4581
ISBN 0-86418-182-5

ABSTRACT

This paper explores the long run consequences of the farm's own debt and the moshav's average debt on the farm household investment in productive capital stock, borrowing and consumption. In particular, the analysis focuses on the financial externalities that may arise from the moshav's organisational principle of mutual responsibility for members' debts. These externalities can have a considerable adverse effect on the capital stock and borrowing of the more efficient farms, and hence on their productive activity. These effects are studied within the framework of an optimal control model and summarised by a number of optimality conditions. The effects of the individual member's position and the moshav's financial position on farm investment and borrowing are estimated and tested in two cross-section regression analyses, which also take into account variations in characteristics among family farms.

I INTRODUCTION

This paper deals with certain externalities which a cooperative organisation imposes on its members. These externalities arise when the cooperative acts as an association of individuals seeking to further their individual interests rather than to achieve a common goal (Cf. Zusman, 1983). Specifically, the present study analyses the economic implications of mutual liability for debts as practiced in Israel's moshavim.

The moshav (singular of moshavim) is a semi-cooperative village consisting of about 70 small family farms, each endowed with an equal land allotment averaging about 10 acres. The moshav's members farm individually, but market their produce collectively. The value of a member's collectively marketed produce is entered as a credit in the cooperative's account, which can be used by the member for purchasing inputs and consumer goods. The cooperative in the moshav also acts as an intermediary between the members and financial institutions. In doing so, it maintains the principle of mutual responsibility for members' debts through mutual co-signing.

Indeed, where institutional arrangements limit the use of land as collateral, credit sharing may be essential in making loans available to small farmers. In any event, financial cooperation can exploit economics of scale and risk-sharing to lower the cost of credit for cooperative members and reduce their administrative costs. (Zusman, 1988). However, financial cooperation may also lead to a 'free-rider' problem characteristic of price pooling: if debt behaviour is uncoordinated and the individual farm units are sufficiently small in size and large in number, farmers will not take into account the effect of their accumulated debt on the terms of credit and resale value of their farms. Consequently, they may leverage their farms more than is optimal.

Since 1921 more than 300 moshavim have been established. In the early stages of Israel's development they played a critical role in providing agricultural goods for the general population; in establishing sovereignty over the country's peripheral regions; and in absorbing many of the immigrants who came as refugees after the establishment of the state of Israel. In those pioneer years the cooperative organisation of the moshav carried substantial benefits for small farmholders, allowing them to exploit opportunities for scale economics by sharing

agricultural equipment; through collective purchasing and marketing; and in credit sharing. Moreover, the implicit and mutual undertaking of moshav members to help each other in difficult times proved invaluable in the early years, allowing many of the moshavim to grow and prosper while maintaining an egalitarian framework.

Economic studies on the moshav have emphasised the aspects of cooperation, capitalisation, efficiency of production and equity. Haruvi and Kislev (1984) suggested that factors such as value of time and credit availability imply a reciprocal interaction between the level of capitalisation of the individual farm and the moshav's level of collective marketing. A possible result of such interaction is a polarisation of moshavim with regard to economic performances. Using mid 1970s data on moshavim Sadan and Weintraub (1980) found that personal characteristics such as experience, schooling and cultural background are significant factors in determining farm income in moshavim. The management quality of farmers in moshavim was found to be a significant factor in Just, Zilberman and Hochman's (1983) micro study on multicrop production functions in two moshavim in the 1970s. Nevertheless, Berck and Levy (1984); who simulated the consequences of different patterns of land allocation with a simultaneous equation system of production and labour supply estimated with the same mid 1970s data used by Sadan and Weintraub (1980); concluded that the costs, in terms of income inequality of allocating land according to efficiency criteria is high, while the gains, in terms of value added, are modest.

During the 1980s, however, many of the less established moshavim have had severe financial difficulties and sunk into large debts. This is reflected in Table 1 below which describes the distribution and composition of debt and real interest rates paid on short-term liabilities in two moshavim which have given us direct access to their ledgers. The very high real interest rates and the large shares of short-term liabilities raise doubts about the ability of these semi-cooperative villages to withstand the financial crisis they are experiencing. There are exogenous reasons for these difficulties: government cuts in subsidies and support for the agricultural sector; a decline in the profitability of exports due to adverse changes in international exchange rates and delayed and insufficient depreciation of the Israeli currency;

uncertainty and confusion which arise from Israel's very high and accelerating rate of inflation which lead to high real interest rates.

But there are possibly significant endogenous reasons too: inefficient management, unduly large allocation of resources to consumption and residential investment, and the 'free-rider' problem that arose from inadequate accounting systems. The very large debts that have resulted from these various factors have become the predominant problem of these semi-cooperative villages and raise doubts regarding the suitability of their organisational structure in present conditions.

Table 1 Debt and Real Interest Rates in Three Moshavim, September 1983

Moshav	Statistical summary of the debt distribution among the moshav's members					Ratio of short-term liabilities to total liabilities	Real interest rate paid on short-term liabilities
	Shape	Mean	Median (in US \$)	Mode	Std.Dev.		
M1	Lognormal	24,216	18,778	22,825	18,529	0.96	34.6%
M2	Lognormal	12,976	11,463	10,317	6,271	0.97	19.1%

The present study attempts to explore the long-run consequences of the farm own debt and the moshav's average debt on farm household investment in productive capital stock and consumption. In particular, the analysis focuses on financial externalities that may arise from the moshav's organisational principles of mutual responsibility. As we shall show, these can have considerable adverse effects on the capital investment and borrowing of the more efficient farms, relative to less efficient farms, especially in periods of recession when the financial position of the moshav is worsened. These effects are studied in section II within the framework of an optimal control model and summarised by a number of optimality conditions. The model's implications with regard to the individual farmer's borrowing, investment and consumption are discussed in section III. The effects of the individual's position, the moshav's position and sociodemographic factors on the individual member's investment and borrowing are estimated in section IV with two different types of data. The first data base provides micro information on 135 farms in two moshavim in 1983, while the second includes aggregate

information on 82 moshavim for the same year. The paper is concluded with a brief summary in section V.

II MODEL

This section presents a simple formulation of the economic behaviour of a family farm in a moshav. The framework is dynamic and takes into account the unique and essential relationships between the single unit and the moshav organisation as regards the principles of mutual responsibility for members' debts, and sharing of collective marketing and financial services provided by a purchasing organisation. A purchasing organisation is common to a number of nearby moshavim typically affiliated to the same ideological movement. In addition to purchasing agricultural products, it provides banking services to the moshavim and plays an important role in Israel's so called "gray credit market". Single farms do not have direct access to the purchasing organisation. They settle their business affairs with the moshav's secretary and accounting offices. These authorised offices deal with the purchasing organisation. Hence, the farm's debt is to the moshav, and the moshav's debt is to the purchasing organisation.

The economic environment of the family farm can be characterised by the motion equations that describe the evolution of its stock of productive capital and debt:

$$\dot{K} = I - \delta K \quad (1)$$

$$\dot{d} \equiv \dot{D} = C + I + i(AD)D - V(K, N) - w(1 - N), 0 < N < 1 \quad (2)$$

where,

- K is the stock of productive capital (constructions, equipment, machines, livestock orchards, etc.) in constant purchasing prices on the farm,
- D is the farm household debt to the moshav ($D \geq 0$),
- I is the farm's current gross investment in productive capital,
- d is the farm's current borrowing,
- δ is the rate of depreciation of capital,
- i is the interest rate set by the purchasing organisation,

- AD is the moshav's average debt (total moshav debt divided by the number of family farm),
- N is the on farm labour supplied by the family household,
- w is the wage rate for off farm employment,
- V is the on farm value added assumed to be an increasing and concave function in both K and N, and
- C is the farm household's consumption.

In this framework, the implications of the moshav's financial structure, and particularly that debts are mutually secured by all members of the moshav, is that the interest rate paid by the individual farm is that which is set by the purchasing organisation for the moshav as a whole, and is thus a function of the moshav's average debt:

$$i = i(AD), \text{ and } i'(AD) > 0.^1 \quad (3)$$

Assuming the farmer's temporal utility can be represented as an increasing, convex function of current consumption, $u(C)$, and that $\lim_{C \rightarrow \infty} u'(C) = 0$, we now postulate the farmer's decision problem as choosing consumption, investment and on farm labour² over a known finite horizon $(0, T)$ so as to maximise the value of the discounted utility stream and the "salvage value" $S(T)$ measured in utilities and associated with the assets of the farm at the terminal time T

$$\max \int_0^T e^{-rt} U(C(t)) dt + S(T) \quad (4)$$

subject to the constraints (1) and (2), $C \geq 0$, $K(0) > 0$ and $K(T) \geq 0$.

The farm's salvage value should incorporate the effects of the members' own debt (D) and the moshav's average debt (AD). Both have a negative effect on the farm's resale value, the latter because of the mutual responsibility for debts and the effect of the moshav's average debt on its cooperative reputation. We therefore specify the farm's salvage value as follows

$$S_T = R(AD_T)K_T - M(AD_T, D_T) \quad (5)$$

where R is a function which translates K (measured as accumulated net investments, at constant prices) to its resale value in utiles. It is assumed that R represents the moshav's reputation and hence decreases with AD_T . M denotes the loss of utility due to the member's liability for his own and the moshav's debt. Because of the mutual co-signing principle, M is assumed to increase with the farm's own debt and the moshav's average debt. Summing up, we assume that

$$\frac{dR}{dAD_T} < 0, \quad \frac{\partial M}{\partial D_T}, \quad \frac{\partial M}{\partial AD_T} > 0 \quad \text{and} \quad \frac{\partial^2 M}{\partial D_T \partial AD_T} \geq 0.$$

The Hamiltonian for the problem specified in (4) is

$$H = e^{-rt} U(V(K, N) + w(1 - N) + d - I - i(AD)D) + \lambda_1(I - \delta K) + \lambda_2 d. \quad (6)$$

The variables K, D, N, C, I, λ_1 and λ_2 must obey the constraints and the auxiliary equations

$$\dot{\lambda}_1 = -e^{-rt} U_C V_K + \lambda_1 \delta \quad (7a)$$

$$\dot{\lambda}_2 = e^{-rt} U_C i(AD) \quad (7b)$$

the optimality conditions for interior solution (i.e., assuming that control constraints are not binding)

$$\frac{\partial H}{\partial N} = e^{-rt} U_C (V_N - w) = 0 \quad (8a)$$

$$\frac{\partial H}{\partial I} = -e^{-rt} U_C + \lambda_1 = 0 \quad (8b)$$

$$\frac{\partial H}{\partial d} = e^{-rt} U_C + \lambda_2 = 0 \quad (8c)$$

and the transversality conditions

$$K(T) \geq 0, \lambda_1(T) \geq R(AD_T)$$

$$K(T) [\lambda_1(T) - R(AD_T)] = 0 \quad (9a)$$

$$\lambda_2(T) = - \frac{\partial M}{\partial D} (D_T, AD_T). \quad (9b)$$

It is important to note that in the derivation of the auxiliary equation (7b) we assume that the single farm considers its effect on the moshav's average debt to be negligible, i.e., $\partial AD / \partial D = 0$. The assumption reflects the 'free-rider' problem characteristic of price pooling. In support of this assumption we mention that a typical moshav consists of about seventy small farms endowed with equal size of land (ten acres) and water allotments.

It is also important to note that the path of AD is only known *ex post*. Thus, the above analysis should be viewed as adopting the common practice to rely on what is called certainty equivalence. This procedure takes the solution to the certainty model and replaces the unknown AD with their conditional expected value given the information available. My impression from working with several of the financially distressed moshavim is that due to an inefficient accounting system the information available to a moshav's member is on the values of AD and D a year ago (AD_{-1} and D_{-1}); and that due to a severe lack of coordination of and information about the allocation of credit, there was a common belief among the moshav's members that the discrepancy between AD and AD_{-1} is nothing but a white noise. Conversely, the empirical analyses in section IV will consider the one-year lags of the state variables as explanatories.

III MODEL'S IMPLICATIONS

In this section we present the model's implications as regards the members' debts, capital stocks and consumption.

A. *Effect of the Moshav Average Debt on the Member's Debt*

From the optimality conditions (8b) and (8c)

$$\lambda_1(t) = -\lambda_2(t). \quad (10)$$

This result and the transversality conditions imply that for $K(T) > 0$

$$R(AD_T) = \frac{\partial M}{\partial D}(D_T, AD_T). \quad (11)$$

Given the expected AD_T , the member's terminal own debt can be found from (11).

The moshav's rule of debt repayment (M) plays an important role in the determination of the members' terminal debts³. Total differential of equation (11) implies

$$\frac{dD_T}{dAD_T} = \frac{\frac{dR}{dAD_T} - \frac{\partial^2 M}{\partial D_T \partial AD_T}}{\frac{\partial^2 M}{\partial D_T^2}} \quad (12)$$

and by our assumptions that $\frac{dR}{dAD_T} < 0$ and $\frac{\partial^2 M}{\partial D_T \partial AD_T} \geq 0$

$$\frac{dD_T}{dAD_T} > 0 \text{ as } \frac{\partial^2 M}{\partial D_T^2} < 0$$

i.e.; given a less restrictive rule of debt repayment $\left(\frac{\partial^2 M}{\partial D_T^2} < 0\right)$, a larger expected terminal moshav's average debt encourages the accumulation of debts. Conversely, given a punitive rule $\left(\frac{\partial^2 M}{\partial D_T^2} > 0\right)$, a larger expected terminal moshav's average debt discourages the accumulation of debts by the moshav's members.

B. *Effect of the Moshav's Average Debt on Capital Stock*

The transversality condition (9a) implies that for $K(T) > 0$

$$\lambda_1(T) = R(AD_T) \quad (13)$$

and since $dR/dAD < 0$, the larger the expected AD_T the lower the shadow price of the farm's capital ($\lambda_1(T)$), and thus, the smaller the terminal stock of capital the member would like to hold. This indicates another possibility which may arise if, as is likely, there are exogenous limits on the amount which may be borrowed, or if the marginal utility of consumption does not vanish asymptotically. Then if AD_T is expected to grow very large there may be no feasible level of consumption, C_T , that satisfies the equation $e^{-rT}U_C(C_T) = R(AD_T)$, implying that $K(T) = 0$. In other words, if other moshav members are accumulating large debts the best course of action may be to liquidate the farm as a productive unit. We should therefore expect to find, in practice, a positive association between the average debt of the moshav and the proportion of its units not in active operation in the long run.

From equation (10) we can further obtain that

$$\frac{\dot{\lambda}_1}{\lambda_1} = \frac{\dot{\lambda}_2}{\lambda_2} \quad (14)$$

and reconsidering (7a), (7b) and (8b) we can show that along the optimal path the marginal product of capital should be equal to the user cost

$$V_K(K, N) = i(AD) + \delta. \quad (15)$$

By totally differentiating equation (15) and the optimality condition (8a) ($V_N(K, N) = w$) and assuming that w remains the same we obtain that

$$dk = \frac{i'(AD)}{V_{KK} - \frac{V_{KN}^2}{V_{NN}}} dAD. \quad (16)$$

Recalling the assumptions that $i' > 0$ and V is concave (i.e., $V_{KK} < 0$, $V_{NN} < 0$ and $V_{NN} V_{KK} - V_{KN}^2 > 0$), an increase in the moshav's current average debt reduces the capital stock the individual farm is willing to hold. Note however that if the credit-sharing system is abolished, farmers whose debt is equal to or greater than the average debt would seek to hold less capital than under credit sharing. This is due to the fact that under private credit arrangement the marginal cost of debt capital includes the effect of incremental debt on the interest rate (i.e., $i + i'(D)D$ and not just i).

To fix ideas and motivate the subsequent empirical analysis let us consider the special case in which V is Cobb-Douglas

$$V = AD^{\alpha_1} N^{\alpha_2}, \quad 0 < \alpha_1, \alpha_2 < 1. \quad (17)$$

In this case equation (16) becomes

$$dK = \left[\frac{i'(AD)}{\alpha_1 (\alpha_1 - 1) - \alpha_1^2 \alpha_2 / (\alpha_2 - 1)} \right] \frac{K^2}{V} dAD \quad (18)$$

or equivalently,

$$\frac{dK}{K} = \left[\frac{i'(AD)}{\alpha_1 (\alpha_1 - 1) - \alpha_1^2 \alpha_2 / (\alpha_2 - 1)} \right] (V/K)^{-1} dAD. \quad (19)$$

In this context, the ratio of value added to capital (V/K) can be viewed as a measure of farm efficiency. Thus, whatever the direction of the debt, less efficient farms may be expected to respond to changes in the current average debt of the moshav by changing their current productive capital stock at a faster rate than more efficient farms.

C. *Effect of the Moshav's Average Debt on Consumption*

By differentiating both sides of the optimality condition (8b) with respect to t we obtain

$$re^{-\pi} U_C - e^{-\pi} U_{CC} \dot{C} + \dot{\lambda}_1 = 0 \quad (20)$$

and substituting (7a) and (8b) for $\dot{\lambda}_1$ and λ_1

$$[r + \delta - V_K(K, N)] U_C - U_{CC} \dot{C} = 0. \quad (21)$$

Recalling (15) and Pratt's (1964) measure of absolute risk aversion $RA = -U_{CC}/U_C$, equation (21) can be rendered as follows:

$$\dot{C} = [i(AD) - r] \frac{1}{RA}. \quad (22)$$

This result implies that

$$\dot{C} \begin{matrix} \geq \\ \leq \end{matrix} 0 \text{ as } i(AD) \begin{matrix} \geq \\ \leq \end{matrix} r.$$

The underlying reason is that the more myopic the member (i.e., the larger r) and the lower the costs of credit, the more will be consumed today and the less in future periods. Since the cost of credit is increasing in AD , the cooperative organisation of the moshav encourages consumption in earlier periods by those members whose debts are greater than the average, vis-a-vis private farming.

IV EMPIRICAL FINDINGS

The empirical analysis presented in this section comprises two parts. The first part (A) tests whether an increase in the moshav's average debt acts to reduce the stock of productive capital, and whether less efficient farms change their capital stock at a faster rate than more efficient farms. The test is based on Equation 19 and is carried out with 135 micro observations on individual farms in two moshavim. The second part (B) of the empirical analysis estimates the investment-borrowing simultaneous equation system which is defined in accordance to the solution to the optimisation problem of section II. In order to avoid the confusion between the effect of the moshav's financial position and a general moshav's effect,

which is inherent in utilising individual farm observations from a small number of moshavim, the estimation of the investment-borrowing system is performed with aggregate observations on 82 moshavim.

A *Empirical Evidence on the Effect of the Average Debt on the Individual Farm Capital Stock*

Our empirical test of the effect of the moshav's average debt on the individual farm's capital accumulation is based on data of two selected moshavim in which the phenomenon of debt accumulation is extremely noticeable. The data were obtained from the moshavim's ledgers and from the Jewish Agency Agricultural-Demographical Annual Censuses, and include observations on capital stock, debt, value added (measured in 10,000 shekels in September 1983 prices) and characteristics of 135 family farms for the years 1982 and 1983. In each moshav the distribution of debts among the members conforms roughly to a lognormal curve, and exhibit substantial inequality. The mean, median and mode of these distributions increase significantly as time progresses.

With these pooled cross-section observations we continue our analysis from section IIIB by testing whether an increase in the moshav's average debt reduces or increases the individual farm's productive capital stock, and whether the rate of change varies with the farm's level of efficiency. We conduct this test within the framework of equation (19) and subject to the simplifying assumption that $i''(AD) = 0$. We also take into account possible variation among the family farms through the inclusion of available characteristics such as farm age (FAGE), family size (SIZE), farmer nativity (ISNT) and off-farm occupation of the head of the family (OFOC). The last two variables are dummy which are defined as follows:

$$ISNT = \begin{cases} 1 & \text{if Israeli born} \\ 0 & \text{if an immigrant} \end{cases}$$

(in our sample all immigrants came to Israel from the Middle East and North Africa subsequent to the creation of the state),

and

$$\text{OFOC} = \begin{cases} 1 & \text{if high skill and professional employment} \\ 0 & \text{other.} \end{cases}$$

The following equation presents the ordinary least squares' estimates of the regression coefficients, and their t-ratios are given in the parentheses:

$$\begin{aligned} \frac{K_t - K_{t-1}}{K_{t-1}} = & -0.03505 - 0.915 \cdot 10^{-8} (V/K)_{t-1}^{-1} (AD_t - AD_{t-1}) \\ & (0.415) \quad (3.201) \\ & - 0.00596 \text{ FAGE} + 0.00323 \text{ SIZE} \\ & (2.121) \quad (0.396) \\ & - 0.03720 \text{ ISNT} - 0.07691 \text{ OFOC} + \text{residual} \\ & (0.397) \quad (0.711) \end{aligned} \quad (23)$$

with $R^2 = 0.133$, $\hat{F} = 3.948$ and 129 degrees of freedom. Although the model explains only a small proportion of the variance of the rate of capital accumulation, the F test shows that the estimates are simultaneously significant.⁴

The significant negative coefficient associated with $(V/K)_{t-1}^{-1} (AD_t - AD_{t-1})$ indicates that an increase in the moshav's average debt acts to reduce the stock of productive capital, and that less efficient farms do indeed change their capital stock at a faster rate than more efficient farms.

The negative and significant estimate associated with FAGE indicates that, *ceteris paribus*, newer farms invest more. Since in the Israeli moshavim farm age and farmer age are positively and highly correlated, this result can be further reasoned by life-cycle arguments. The effect of family size on farm investment may be viewed as the discrepancy between two opposing effects. On the one hand, a larger family, *ceteris paribus*, may have a larger labour force and hence a greater income. On the other hand, a large family spends much on consumption. As the estimate associated with SIZE is not significantly different from zero this may indicate that these effects offset one another. The nativity variable proxies cultural and educational differences between the more westernised Israeli born farmers and the immigrants

from the Middle East and North Africa. The estimation results show that the effect of these differences on investment are insignificant.

Many of the moshavim's members also work off the farm. High skill off-farm employment can successfully compete with income from farming and hence may reduce investment. The estimation result, however, indicates that, *ceteris paribus*, the rate of capital accumulation is insignificantly affected by off-farm employment.

B *Estimation of the Investment-Borrowing Behaviour with Aggregate Data on 82 Moshavim*

The set of the first-order conditions for maximum utility presented in the previous section constitutes a simultaneous equation system in which the control variable I (net investment), d (borrowing) and N (labour) are the dependent variables; and the one-period lagged stated variables D_{-1} , K_{-1} and AD_{-1} are the independent variables. The following estimation of this system is carried out with data provided by the Jewish Agency Agricultural-Demographical Census for 1983 which encompasses 82 moshavim in Israel's Negev (southern) region. This data source does not include information on labour. Under the assumption of equal amount of on-farm work days in all the sampled moshavim, the empirical analysis is restricted to the estimation of the investment-borrowing structural and reduced form parameters. Since each observation refers to a moshav and variation exists in the moshav's number of family farms, D_{-1} , K_{-1} , I and d are taken as average values (in 1983 million shekels), and thus indicate the position and behaviour of the representative member farm.

The analysis also takes into account the effects of the moshav's population structure on investment and borrowing through the inclusion of the rate of Israeli-born farmers (RIBF) and the average farmer age (AGE) in the moshav. The interaction of these sociodemographic variables captures the distinct three-generation's structure which is typical to the moshavim included in the sample. The first generation comprises Jewish refugees from Arab countries who immigrated to Israel in the early 1950's and settled in the newly established moshavim. They had in 1983 an average of 28 years of farming experience, but suffered from lack of country-specific skill and low level of education. The second generation of farmers comprises the younger brothers and the elder sons of the first generation farmers. They had been also

born abroad, but because of their younger age enjoyed Israeli schooling and other benefits associated with growing up in Israel which equipped them with the new country-specific skill. Members of this generation of farmers had in 1983 an average of 18 years of farming experience. The third generation of farmers are the younger Israeli-born sons of the first generation farmers and had a relatively short farming experience of about 5 years in 1983.

It is important to note that with these cross-section data the average debt in a moshav (AD) is now interpreted as the representative farm's debt and hence can no longer be viewed as a source of external effects as indicated in the conceptual analysis. In order to incorporate possible external effects of the financial cooperative's position on the representative member some modification is required. The following regression equations include the moshav debt-capital ratio (leverage) at the end of the last period ($MDCR_{-1}$) as an indicator of the moshav's financial position.

Consequently, the following analysis tests: (1) the effects of the representative member's position as indicated by D_{-1} and K_{-1} on his investment and borrowing; (2) the effects of the demographic structure of the moshav (RIBF and AGE) on investment and borrowing; and (3) the effects of the moshav's financial position as reflected by $MDCR_{-1}$ on the representative member's investment and borrowing. The estimates of these effects and their t-ratios (in parentheses) are presented in Table 2 and Table 3 below. While Table 2 indicates only the direct effects of the exogenous variables, D_{-1} , K_{-1} , RIBF, AGE and $MDCR_{-1}$ on the representative member's current investment and borrowing, the estimated parameters in Table 3 also include the indirect effects and hence exhibit the full effects of the independent variables on the representative member's investment and borrowing. The age variable is excluded from the borrowing equation by the estimation program due to low level of tolerance. Therefore, and in order to obtain identification, this variable is also excluded from the borrowing equation in the three-stage least squares estimation. Furthermore, best estimation results of the structural parameters are obtained when RIBF is omitted from the investment equation.

The estimates in Table 2 and Table 3 indicate that:

Table 2 Three-stage least squares estimates of the investment-borrowing simultaneous equations' structural parameters.

Explanatory variables	Dependent variables	
	I	d
I		1.096 (1.804)
d	2.234 (1.002)	
D ₋₁	0.948 (1.094)	-0.657 (1.954)
K ₋₁	-0.419 (1.989)	0.337 (2.245)
RIBF		0.205 (1.480)
AGE	0.032 (0.786)	
MIDCR ₋₁	-0.797 (0.510)	0.440 (0.542)
Constant	-1.081 (0.626)	-0.388 (1.576)

Table 3 Ordinary Least Squares Estimates of the Investment-Borrowing Reduced-Form's Parameters.

Explanatory variables	Dependent variables	
	I	d
D ₋₁	0.358 (1.399)	-0.436 (2.375)
K ₋₁	-0.230 (5.271)	0.086 (2.612)
RIBF	-0.317 (1.838)	0.169 (2.095)
AGE	-0.022 (2.104)	
MDCR ₋₁	-0.129 (0.197)	0.772 (1.663)
Constant	1.344 (2.468)	-0.120 (1.039)
R ²	0.496	0.130
R ² adjusted	0.463	0.085
F-test statistic	14.972	2.887
Degrees of freedom	76	77

1. Investment and borrowing are mutually dependent — the availability of credit increases investment, which in turn increases borrowing. The former effect is statistically insignificant whereas the latter is significant.
2. The direct and full effects of the representative member's debt on his levels of investment are positive but statistically insignificant, whereas the direct and full effects of the representative member's debt on his borrowing are both negative and statistically significant. The full effect of the representative member's debt on borrowing is moderated by the positive direct effect of the debt on investment, which is transmitted through the positive direct effect of investment on borrowing. These results indicate that in view of their relatively large debts and the high interest rates farmers reduce their current borrowing but not necessarily at the expense of investment in production capital.
3. As can be reasoned by a diminishing marginal product's argument, the direct and full effects of the representative farmer's capital stock on net investment are negative and statistically significant. In contrast, the direct and indirect effects of the representative farm's capital stock on borrowing are positive and statistically significant. A possible explanation is that a larger stock of capital may be associated with a larger production activity which necessitates a larger credit for buying perishable inputs. Note that the full effect of the capital stock on borrowing is moderated by a negative indirect effect which stems from the negative effect of capital stock on investment and the positive effect of investment on borrowing.
4. The estimates associated with RIBF are statistically significant and indicate that, all other things being equal, Israeli-born farmers invest less and borrow more than their immigrant counterparts. The OLS estimation of the reduced form also represents a significant negative effect of age on investment. Since the interaction of RIBF and AGE captures the three-generation structure of the moshav's farmer population, these results can be interpreted as indicating that the less efficient farmers of the first and third

generations 'free ride' on the backs of the more efficient farmers of the second generation by worsening the moshav's financial position as regards debt-capital ratio.

5. The estimates associated with $MDCR_{.1}$ indicate that the moshav's leverage deters individual's investment and encourages further individual's borrowing. It is important to note that only the latter effect is statistically significant. In view of the previous result, the estimates of the effects of $MDCR_{.1}$ confirm the *a priori* expectations of a 'free-rider' problem in Israel's semi-cooperative villages.

V CONCLUDING REMARKS

In this paper the economic implications of mutually secured debts in Israel's semi-cooperative villages were conceptually and empirically analysed. The conceptual model suggested that there should be a negative relationship between the stock of capital the individual farm is willing to hold and the moshav's average debt, and that less efficient farms tend to respond to changes in the moshav's average debt by changing their productive capital stock at a faster rate than more efficient farms. This hypothesis was confirmed by the estimation results which referred to 135 family farms in two financially distressed moshavim.

The conceptual model also suggested that the individual's decision on investment and borrowing are made simultaneously and are affected by the individual member's position as regards debt and capital stock and the moshav's financial position. The estimation of an investment-borrowing simultaneous equation system with aggregate data on 82 moshavim yielded statistically significant and meaningful results. The estimates associated with the sociodemographical variables, included in the analysis to capture the typical three-generation structure of the moshav's farmer population indicated that the less efficient farmers of the first and third generations 'free rode' on the backs of the more efficient farmers of the second generation and increased the moshav's debt-capital ratio. It was found that such an increase deterred investment and encouraged further borrowing and thus perpetuated and intensified the moshav's distress.

Other conclusions that emerged from the conceptual model but were not tested in the empirical analysis are that the level of consumption varies directly with the average debt of the moshav. And in comparison to private farming, the cooperative organisation of the moshav encourages consumption in earlier periods by those members whose debts are greater than the average. Finally, the moshav's rule for setting members' debts affects the impact of the moshav's average debt on the individual member's current debt. If the rule is lenient, a large expected terminal debt will encourage the accumulation of debt by members; while if the rule is punitive, it will discourage debt accumulation.

FOOTNOTES

1. A similar relationship between the interest rate and debt was also assumed by Hochman, Hochman and Razin (1973). For further discussion of the financial aspects in moshavim see Haruvi and Kislev (1984) who specified the interest rate as a function of both borrowing and the moshav's cooperative revenue. For simplicity and as our empirical analysis focuses on moshavim that borrow much more than they earn, we choose to neglect the latter factor.
2. The allocation of time between leisure and labour is disregarded. It is assumed, for simplicity, that a fixed proportion of the time is devoted to work.
3. For further analysis of the selection of repayment rules of members' debt in agriculture cooperative associations and their efficiency and welfare consequences see Zusman (1983 and 1988).
4. A higher R^2 was obtained when equation (18) was fitted to the data. The effect of the moshav's average debt on the desired level of capital stock remained negative and highly significant. The following equation presents the OLS estimates of the regression coefficients, and their t-ratios are given in the parentheses:

$$\frac{K_t - K_{t-1}}{K_{t-1}} = 17760.811 - 0.274 \cdot 10^{-7} (V/K^2)_{t-1}^{-1} (AD_t - AD_{t-1})$$

$$(0.652) \quad (10.151)$$

$$-783.0346 \text{ FAGE} - 3262.837 \text{ SIZE}$$

$$(0.873) \quad (1.238)$$

$$-25815.732 \text{ ISNT} - 55276.278 \text{ OFOC} + \text{residual}$$

$$(0.856) \quad (1.586)$$

$$R^2 = 0.481 \text{ and } \hat{F} = 23.895.$$

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