

# Old age security and inter-generational transfer of family farms

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## Summary

This paper offers an economic analysis of the intra-family insurance aspect of farm transfer. Sharing of farm income by retired parents with their succeeding children may act like a pension fund. A theoretical model is adopted and a bargaining game suggested to formulate this inter-generational contract. The model is illustrated with data for family farms in a co-operative village in Israel, and the effect of farm-specific parameters (size, risk aversion, sale value of the farm) on the inter-generational distribution of farm wealth is demonstrated.

**Keywords:** family farms, old-age security, inter-generational surplus, Nash solution

**JEL Classification:** Q12, D13, J26

## 1. Introduction

Most old people face the economic problem of providing for retirement. Uncertain length of life creates a special difficulty: either accumulated savings may be exhausted in their lifetime, leaving the retired persons short of resources, or, with conservative use of the nest egg, the standard of living in retirement may be too low and funds designated for consumption are left behind. Social security and pension funds operate as inter-generational insurance schemes; they insure 'against' longevity. Retired farmers often rely on income generated by the farm; indeed, the majority of farms in most countries are transferred to the farmer's children and in many cases the parents stay with their successors on the farm.

There are many advantages to within-family farm transfer: smooth transition, reduction in transfer costs, benefits from the comparative advantages farm children have in running the enterprise they are familiar with and, in some instances, lower transfer taxes. In this paper we take these advantages as given and concentrate on the inter-generational insurance element of the farm transfer.

Living together, the generations overlap and share income (Blanc and Perrier-Cornet, 1993; Gasson and Errington, 1993). The livelihood of the retirees may thus be assured in an (often implicit) contractual insurance arrangement. The parents give up an asset for the promise of provision for retirement, and the successor receives productive assets, an operating

business, and often also a house, together with the obligation to care for the elderly parents. We offer a conceptual framework for the analysis of the old age insurance component of farm transfers. Our starting point is the model developed by Kotlikoff and Spivak (1981), who termed intra-family insurance 'incomplete annuity markets'. The model is adapted to the particular characteristics of farm transfers and illustrated within a bargaining framework (Kimhi, 1995) with data for a co-operative village in Israel.

By necessity, the analysis is simplified in several ways. In particular, transfer of a farm to a child, with parents staying to share its future income, usually encourages investment and expansion. This aspect is not treated explicitly in the analysis, which is conducted for a set of given farm sizes. Moreover, to reduce complexity and save space, only limited aspects of uncertainty and risk are covered in the formal analysis and its illustration. In addition, as we focus on inter-generational insurance, and as farm transfers are exempt from tax in Israel, estate tax considerations are not incorporated into our analysis (we comment on taxes in the concluding section of the paper).

The next two sections present a theoretical outline of the intra-family insurance model and the bargaining model. Then follow sections offering factual background and calculation of consumption streams and farm wealth. The assessment of these values is based on the theoretical model of the paper and on estimates (presented in the Appendices) of an income-generating function and a cost of capital coefficient. We show that inter-generational co-operation adds to the wealth of the parents and their successors. The additional wealth is termed here the inter-generational surplus. The illustration presents alternative divisions of the inter-generational surplus between the parents and the succeeding family.

## 2. The economics of intra-family old age insurance

Kotlikoff and Spivak's (1981) analytical framework of mutual old age insurance of a husband and a wife is described in this section, together with several extensions. The expected discounted utility of the individual is

$$EU = \sum_{t=0}^T P_t U(C_t) \alpha^t \quad (1)$$

where  $U$  stands for the utility function,  $C_t$  is consumption in year  $t$ ,  $T$  is the last year of the analysis (for retirees it will be the last probable year of life),  $P_t$  is the probability of survival to year  $t$  conditional on living in year 0 ( $P_0 = 1$ ,  $P_t < 1$  for  $t > 0$ , and  $P_t = 0$  for  $t > T$ ), and  $\alpha$  is the subjective time discount factor (in general,  $0 < \alpha < 1$ ).

A single individual retiring at  $t = 0$  with wealth  $W_0$ , in cash or in discounted future receipts, allocates his or her wealth over time by maximising  $EU$  in (1)

subject to the budget constraint

$$\sum_{t=0}^T C_t R^{-t} = W_0 \quad (2)$$

where  $R$  is the relevant interest coefficient ( $R = 1 + r$ , for interest rate  $r$ ). A single individual will almost always not fully realise their planned consumption, as some money has to be left for the possibility of longer life. If, however, the individual is offered an actuarially fair annuity, the budget constraint becomes

$$\sum_{t=0}^T P_t C_t R^{-t} = W_0. \quad (3)$$

As  $P_t < 1$  for all  $t$  except  $t = 0$ , (3) is less constraining than (2). On average, an individual with a fair annuity consumes more than one who has to provide for retirement solely on the basis of their personal saving. Consequently, the maximum expected utility in equation (1) is higher for a retiree with a fair annuity than for a single individual constrained by (2).

Because of mutual insurance of its members, a pension fund can operate as a fair annuity (disregarding administrative costs). Members who die early leave part of their wealth in the fund, financing the retirement benefits of longer living members. A family of two, sharing wealth and consumption, functions as an incomplete annuity arrangement because of the positive probability that one of its members will die before the other. The probable early death of one of a pair enables both to allocate more to consumption in the early retirement years than they could as single individuals with the same amount of initial wealth divided between them.

For a pair, a plausible maximand is the family welfare function

$$EF = EU^H + \lambda EU^S \quad (4)$$

where  $H$  stands for the husband,  $S$  for the wife, and  $\lambda$  is the differential weight in the family function ( $\lambda = 1$  is possible). The expected utility values on the right-hand side of (4) are for individuals in a family. The wealth constraint is now

$$\sum_{t=0}^T (C_t^H + C_t^S) R^{-t} = W_0 \quad (5)$$

where the wealth  $W_0$  stands for the pooled resources of the couple. Given the model's parameters, an optimal consumption path can be calculated using dynamic programming, not detailed here.<sup>1</sup>

1 Because the maximisation of the expected utility in the model does not involve ranking or compounding of lotteries, it is not subject to the difficulties raised by Krautkraemer *et al.* (1992).

The utility of an individual in a pair (a component of the right-hand side of (4) for a self-insured pair) is exemplified here by the utility of the husband<sup>2</sup>

$$\begin{aligned}
 EU^H &= \sum_{t=0}^T g_{t+1}^S \left[ \sum_{j=0}^t U^H(C_j^H) P_j^H \alpha^j + P_{t+1}^H H_{t+1}(W_{t+1}) \right] \\
 g_t^S &= P_{t-1}^S - P_t^S \\
 P_{T+1} &= H_{T+1} = 0.
 \end{aligned} \tag{6}$$

In (6),  $g_t^S$  is the probability that the wife dies between  $t-1$  and  $t$ ,<sup>3</sup>  $C_j^H$  is the consumption of the husband when living with the wife,  $H_{t+1}(W_{t+1})$  is the present value utility of the husband surviving his wife with wealth  $W$  at  $t+1$ , and  $EU^H$  is the expected utility of the husband in a pair, discounted to time  $t=0$ . The husband's horizon is divided in (6) into two parts: before the wife dies he shares resources with her, and after her death he uses the remaining wealth for the rest of his life. The two terms inside the inner brackets represent these two periods and they are summed conditionally on the wife's death.

Retired parents may share the income of the farm with the next-generation successors. Then, even if the two families keep separate households, they are together subject to the same budgetary constraints and the decisions on the consumption path of the parents and the young family are made simultaneously. In this way, like a pair retiring with a joint fund, the two families mutually insure each other. The economics of such a family can be represented as a direct extension of the above two-member family model. A welfare function will then represent the 'social' welfare of the extended family with appropriate weights assigned to the utility of each of its members. But, consistently with modern trends in family economics (e.g. Lundberg and Pollak, 1996), we prefer to formulate the determination of the succession parameters as a bargaining game. Thus we extend the theoretical framework of Kimhi (1994).

### 3. Monetary value of pension and intra-family bargaining

In this section, we deal with three points: (i) the fund needed to provide the parents with a pension plan is smaller than the utility-equivalent monetary value of farm sale; (ii) accepting the responsibility for the parents' livelihood in their old age, the succeeding family also accepts risk it could have avoided had it been possible to purchase for the parents membership in a pension fund; (iii) the parent-child bargaining can be formulated as a Nash (1950) co-operative game.

2 This expression is not presented explicitly in Kotlikoff and Spivak (1981).

3 The probability of death,  $g_t^S$ , is calculated with respect to  $t=0$  in the same way that  $P_t$  is the probability that a person living at  $t=0$  will survive to the year  $t$ .

Regarding the first point, let us consider an individual about to retire with wealth  $W$ ,<sup>4</sup> contemplating future consumption streams. We denote the maximum expected utility of equation (1) under the constraint in (2) as  $EU(S, W)$  and the maximum under the constraint in (3) as  $EU(F, W)$ , where  $S$  and  $F$  stand, respectively, for self reliance and fair annuity. The monetary value of access to a fair annuity is the magnitude  $M > 0$  satisfying the equality

$$EU(F, W - M) = EU(S, W). \quad (7)$$

That is, a person joining a pension fund buys for  $W - M$  the same level of utility that a self-relying person can secure by allocating the larger sum  $W$ .

The assumption in the illustration below is that the young couple provides the parents with a pension-like income stream. The alternative for the parents is to sell the farm and live off the proceeds. If the value of the sale is  $W^{Pr}$ , the reservation utility of the parents is  $EU(S, W^{Pr})$ . The sum  $W^{Pr}$  is the minimum amount the parents will require as their share in the farm if they leave; we term it the reservation wealth. However, if the parents stay, the young family has to allocate only  $W^{Pr} - M$  to maintain the parents on their reservation utility. Thus, in addition to other intra-family benefits of farm transfer, the parent-child co-operation in the provision of old age insurance creates an economic surplus, the sum  $M$ , which we call the gross pension surplus.

Concerning the second point, the succeeding family, by taking upon itself the provision of the pension-like payments, faces risk which it would not have to face if membership in a pension fund could be purchased. The risk is associated with the survival of the parents. If the parents die early, the total of the payments received from the succeeding family is less than expected. If they live longer than the average, the cost to the succeeding family exceeds the value of membership in a pension fund. To be concrete, if parents receive just their reservation utility (one of the cases illustrated below), what is the utility of the succeeding family? The answer is computed in two steps. First, we calculate the fair annuity consumption stream of the parents with utility equal to their reservation utility, and call that consumption stream  $C_t^P$  for  $t = 0, \dots, T$ , where  $C_t^P = C_t^H + C_t^S$ . Second, we calculate the optimal consumption stream and utility of the succeeding family  $C_t^D$ ,  $EU^D$ , given the farm's initial wealth and the planned consumption stream of the parents,  $C_t^P$ . These steps were followed in preparing the illustrations in Tables 3 and 4 below.

Associated with the consumption streams of the two families is a risk premium. The premium is calculated similarly to the magnitude  $M$  in (7) and it is the amount worth paying, over the present value of a fair annuity, for membership in a pension fund.

As indicated, intra-family transfer creates an economic surplus of which the surplus as a result of inter-generational insurance is only a part. We view the

4 The wealth parameter is not indexed here with zero as  $W_0$  will be used below for the initial wealth of both generations, the parents and the succeeding family.

division of the surplus (and the risk premium) as determined by bargaining between the old and young families. In the illustration, the bargaining process is modelled as a co-operative game and the surplus is divided according to the Nash (1950) solution to such games. Formally, we let  $W_0$  be the initial wealth for both families on the farm;  $EU^{pr}$  and  $EU^{dr}$  stand for the reservation utilities of the parents and the succeeding family, respectively;<sup>5</sup> and we let  $EU(W^p)$  and  $EU(W_0 - W^p)$  be the utility of the two parties when the parents receive  $W^p$ , not necessarily their reservation wealth. Then the Nash (1950) solution is a value  $W^{p*}$  satisfying (8):

$$W^{p*} = \arg \max_{W^p} [EU(W^p) - EU^{pr}][EU(W_0 - W^p) - EU^{dr}]. \quad (8)$$

This concludes the summary of the analytical framework.

#### 4. The setting

The analytical approach is illustrated with data for family farms in a moshav. The Israeli moshav (plural, moshavim) is a co-operative village of 50–100 families, each running its own farm privately (Zusman, 1988). The co-operative association of the village provides marketing, inputs, accounting, and other services.<sup>6</sup> Retiring farmers may sell their farm and leave. If they choose to transfer the farm to their offspring, they are constrained by law and by the regulations of the co-operatives, which dictate that only one child may succeed the parents on the farm. Once a succeeding child is chosen and accepted for co-operative membership, he may build an additional house on the farm plot. Other adult children are not supposed to stay on the farm: in some cases they purchase a different farm in the same moshav; otherwise, they leave the village. Given this legal structure, farm transfer with parents staying with the succeeding young family is probably more prevalent in Israel than in some countries, but this form of transfer is found in many other places.

Another factor increasing the importance of intra-family farm succession in Israel has been the restriction of the country's pension funds to hired employees; farmers, being independent operators, could not join. The situation is changing as insurance companies are now entering the market; but private programmes are expensive, they have to cover significant marketing costs, and are relevant only for today's young people. We therefore disregard these possibilities in the analysis.

Naturally, parents invest also in non-succeeding children. In addition to investment in human capital, farmers in moshavim sometimes draw on the financial savings they have accumulated to assist non-succeeding children;

5 The reservation utility of the parents is  $E(S, W)$  where  $W$  is the sale value of the farm. The reservation utility of the succeeding child is determined by their alternative opportunity; in the illustration we assume it to be off-farm employment.

6 Although co-operation has diminished markedly in the moshav sector in the last few years, the legal framework has remained intact.

it is also customary that these children receive, as their share of the inheritance, whatever is left of the financial savings after the parents die. In this way, the family capital is divided – even if not equally – between all children. As information on financial savings and transfers was not available, our analysis is limited to farm transfer and is conducted for families for which the farm may be separated from other intra-family transactions.

As in most co-operative villages in Israel, land in the sample moshav is equally distributed; every family has an area of 5.5 hectares of land, used for farm, fields and dwellings. Farms are, however, not identical; because of ability, choice and luck, they vary in structure and income. In comparison with many other moshavim, the sample village is well-to-do. The main source of income is the dairy enterprise, which together with cattle (mostly male dairy calves) comprises 75 per cent of farm income in the village. Sixty per cent of the farms in the moshav produce milk, beef or both. Poultry enterprises are second in importance, and many of the growers produce breeding material. A small number of farmers, most of whom do not operate a dairy enterprise, suffered from low and relatively unstable income in the last decade as a result of market vagaries.

## 5. Estimation of income and its variance

Farm transfer is illustrated using data from the sample moshav. The period of analysis is 30 years. The retirees are taken to be a pair of farmers (the parents) both 65 years old who could, by a simplifying assumption, live at most to the age of 95. The parents are succeeded by a young family aged 35. For simplicity, we treat the young family as if it were a single person, and assume that it will survive for 30 years with probability one. The survival probabilities of the parents are the regular age-specific probabilities (modified slightly to end at 95).

With these assumptions, one may visualise the parents as if purchasing with their share of the farm a membership in a fair annuity-pension fund. The young family, which is, by assumption, certain to live to the age of 65, has no need for old age insurance during the 30 year period of the analysis. The succeeding couple will enjoy pension-like benefits in its turn, when it transfers the farm to its offspring.

The empirical analysis was conducted in four parts: (i) estimation of farm income and its variance; (ii) simulation of farm income; (iii) computation of value of the constraint  $W_0$ ; (iv) division of the inter-generational surplus between the generations. Income estimates are presented in Appendix A; Appendix B reports the construction of the coefficient for the cost of capital (discount factor) used in discounting farm income streams. We turn now to the simulation.

## 6. Simulated farm income

Three farm types represent the major groups in the village. Table 1 reports structure and simulated income calculated by multiplying the enterprise sizes in the table (for example, 45 cows in the dairy enterprise of Farms A

**Table 1.** Annual income and outlays by farm type

	Type A (milk)	Type B (mixed)	Type C (poultry)
<i>Farm enterprise</i>			
Dairy (cows)	45	45	
Cattle (calves and heifers)	50	100	
Hatching eggs (thousand layers)		1500	1500
Field crops (dunams <sup>a</sup> )	35	15	10
Fruits (dunams)		20	40
Flowers (dunams)		10	
<i>Income and outlays (NIS)<sup>b</sup></i>			
Standard deviation <sup>c</sup>	20,092	35,510	27,862
Income <sup>c,d</sup>	107,334	152,363	56,740
Depreciation	(20,000) <sup>e</sup>	(30,000)	(15,000)
Labour <sup>f</sup> (operator)	(40,000)	(40,000)	(40,000)
Labour (help)		(20,000)	
Service of business debt			(40,500)
Income tax <sup>g</sup>			
Assessment	(28,373)	(47,549)	
Tax shield	6,910	13,277	
Credit points	7,332	7,332	
Net income <sup>h</sup>	33,203	35,423	(38,760)

<sup>a</sup>1 dunam = 1/10 hectare.

<sup>b</sup>Monetary values – in CPI-corrected December 1992 NIS (New Israeli Sheqels; US\$ 1.00 = NIS 2.764).

<sup>c</sup>Income and standard deviations were calculated using the coefficients reported for the third and the second stage regressions, Appendix A.

<sup>d</sup>Income is gross value added.

<sup>e</sup>Values in parentheses were treated as negative magnitudes when summing to compute net income.

<sup>f</sup>Labour (operator) is opportunity cost of operator's labour on farm. Labour (help) is cost of hired labour employed part time after 10 years. The assigned value is average salary per employee in the country for 1992.

<sup>g</sup>Income tax: tax shield is depreciation times the marginal tax rate; credit points are for two families. The amount paid is assessment minus tax shield and credit points.

<sup>h</sup>Net income was calculated by deducting from gross income: depreciation, labour, and income tax; tax shield and credit points were added.

and B) by the corresponding coefficients of the third stage regression from Table A1 in Appendix A and adding the intercept of that regression.<sup>7</sup> The standard deviation was similarly calculated by computing the 'predicted' value of the second line of equation (A1).

The simulated values in Table 1 reveal substantial differences between farm types. Farms A and B enjoy secured income thanks to the dairy enterprise; the industry has always been 'planned' and protected more than other lines of

7 The estimate of the intercept was first multiplied by the standard deviation because, to correct for heteroscedasticity, the regression was estimated with the variables divided by this magnitude.



agricultural production. Type A farms are usually operated by a single elderly farmer, often with some help from the spouse. A succeeding child, if such was designated, is in most cases working off the farm, expecting to join it when the parents retire. For the elders this is a risky situation—the child may develop a career elsewhere and not be available when the need arises. We do not consider this risk explicitly here. Farm B is larger, with several additional activities. Consequently, this farm provides employment and earning opportunities for one and a half family workers. Its annual income, NIS 152,363, is 42 per cent higher than that of type A and, as its larger size is due to non-dairy enterprises, the variability of its income is also higher (the coefficient of variation is 19 per cent and 23 per cent for type A and B, respectively).

Farm C is relatively poor, representing operations with no dairy activity. In the last decade, many of these farms have suffered significant falls in income and economic standing because of worsening terms of trade in a large number of agricultural activities and a severe financial crisis. Losing money, farm C will not be able to accept a succeeding family. It was introduced here for completeness but will be dropped from the presentation in the following sections.

The opportunity cost of labour in Table 1 is for an operator and, in Farm B, an assistant (the person with half a 'position'). By assumption, assistance is provided by family members: the parents contribute half a day on the farm for the first 10 years after transfer, and then the children of the succeeding family join the farm labour force. Income tax calculation is reported in some detail as its components are capitalised below (in Table 2) at different discount rates. Depreciation was calculated to represent cost of capital in the computation of annual income and to assess income tax (in this last function, depreciation enters the calculations in the table in the form of a tax shield). Net income reported in Table 1, NIS 35,423 (US\$ 12,816) in Farm B, is value added minus depreciation, imputed cost of labour and income tax.

## 7. Initial and reservation wealth

A distinction is made between the initial wealth,  $W_0$  as in equation (2), and the value of the farm as an asset. The initial wealth, which constrains consumption over the 30 years of the analysis, is the present value of farm income including returns to own labour. The asset value of the farm is net of the opportunity cost of family labour and includes the residual value of the farm transferred to the third generation, to the grandchild of the current parents. This section presents the calculation of the initial wealth; the computation of the value of the asset (not shown here) is available from the authors.

The magnitudes calculated in this section are capitalised values. In general, the discount factor of an economic enterprise is a weighted average of the cost of equity and the cost of borrowed funds. However, the typical farms we consider here, like many of the farms in the sample village, had no business debt. Future income was, therefore, capitalised using the cost of equity capital as the discounting factor (Appendix B).

**Table 2.** Initial and reservation wealth (December 1992, NIS)

	Farm type A	Farm type B
Cost of equity	0.0415	0.0473
Net income <sup>a</sup>	563,834	561,707
Labour <sup>b</sup>		
Young	679,256	634,285
Parents		156,480
Residence <sup>c</sup>	239,170	239,170
Initial wealth ( $W_0$ )	1,482,260	1,591,642
Reservation wealth		
Parents <sup>d</sup>	350,000	500,000
Young <sup>e</sup>	735,682	735,682
Farm inter-generational surplus	396,578	355,960

All magnitudes in the table are present values capitalised over 30 years, except parents' labour which is capitalised over 10 years.

<sup>a</sup>Net income from Table 1, discounted at the cost of equity.

<sup>b</sup>Returns to family labour from Table 1 discounted at the cost of equity.

<sup>c</sup>Value of residential services. Annual flows are 3.5 per cent of value of land and houses, capitalised at 3.5 per cent for 30 years.

<sup>d</sup>Sale value of the farm, market assessments.

<sup>e</sup>Opportunity cost of off-farm employment capitalised at 3.5 per cent.

The initial wealth of the farm is calculated in Table 2 as the present value of net income plus returns to family labour of the succeeding young couple and the retiring parents. Consistent with the practice in many family farms of rewarding youngsters for farm work, labour contributed by the children of the succeeding family of Farm B is seen as hired help: it is not taken as part of farm income and its value is not capitalised in Table 2. Initial wealth also includes services of the residential assets on the farm.

Farm transfer with cohabitation and income sharing is a long-run transaction. Benefits will be assessed in monetary terms below; the costs to the parties to the transaction are the opportunities foregone. The parents could have sold the farm. By our assessment, based on market valuation, Farm A could be sold for NIS 350,000 and Farm B for NIS 500,000. Our assumption that the parents cannot find employment off the farm after retirement reflects reality in Israel. The young couple, however, could find employment elsewhere. The value of their alternative labour earnings, NIS 40,000 for 30 years, capitalised at 3.5 per cent, is NIS 735,682. These magnitudes are, therefore, the reservation wealth values for the old and the young families; neither party would enter the transfer deal unless it receives the reservation wealth or its equivalent.

Deducting the reservation wealth for both generations from the initial wealth, the farm inter-generational surplus in Table 2 is NIS 396,578 and 355,960 for Farms A and B, respectively. In each case, this magnitude is the residual left after each generation receives its reservation wealth. It is

due to the co-operative transfer to the offspring of an operating farm and also (in Farm B) to the assistance of the parents. The surplus amounts to more than a quarter of the initial wealth. The surplus will be modified below when the contribution of intra-family old age insurance and the risk premium of the young family are added in the next section.

## 8. Total inter-generational surplus and its division

This section and Table 3 present further analysis for Farms A and B. We expand to farms with other parametric values in Section 9 (Table 4).

In addition to the benefits mentioned above, staying on the farm with the young family is, for the parents, equivalent to joining a pension fund (currently not possible for retirees who sell their farm in Israel). Given the relevant parameters, the welfare of the parents can be calculated by maximising (4) subject to (5) with  $W_0$  equal to their reservation wealth (NIS 350,000 and 500,000). The expected utility thus computed is the reservation utility of the parents. In a bargaining context, they will insist on receiving at least this

**Table 3.** Division of the surplus between the generations in Farms A and B (December 1992 NIS)

	Farm A	Farm B
Initial wealth	1,482,260	1,591,642
<i>Succeeding family takes all</i>		
Parents receive	303,949	434,212
Young's monetary share	1,178,311	1,157,430
Gross pension surplus	46,051	65,788
Risk premium	73,005	111,351
Net pension surplus	-26,953	-45,563
Young's utility equivalent	1,105,307	1,046,079
<i>Parents take all</i>		
Parents receive	565,225	631,578
Young's monetary share	917,035	960,064
Risk premium	181,353	224,382
Young's utility equivalent	735,682	735,682
<i>Nash solution</i>		
Parents receive	441,627	548,763
Young's monetary share	1,040,633	1,042,879
Risk premium	113,055	147,455
Young's monetary equivalent	927,578	895,424

Detailed calculations of the entries in the table are available from the authors upon request (contact Yoav Kislev at [kislev@agri.huji.ac.il](mailto:kislev@agri.huji.ac.il)).

level of utility (in game-theoretic terminology, this is their participation constraint). The succeeding family, as it provides the parents with pension-like assured income, may secure for them their reservation utility at less than their reservation wealth. However, accepting the obligation to support the parents, the young family also accepts risk that offsets, or more than offsets, the pension gain. We turn now to a detailed account.

The utility function adopted for the illustrative analysis maintains CRRA (constant relative risk aversion), the same function for the husband, the wife, and the young family

$$U_i(C_t) = \frac{C_t^{1-\gamma}}{1-\gamma}. \quad (9)$$

The values of the parameters in planning the consumption streams were  $R = 1.035$ ,  $\alpha = 0.95$ , the risk aversion parameter  $\gamma = 0.75$ , and  $\lambda = 1$ . The probabilities of survival were calculated from demographic tables in the *Statistical Abstract of Israel 1993* (State of Israel, Central Bureau of Statistics, 1993). Identical survival probabilities were assumed for the husband and the wife (adapted to reflect a 95 year maximum). The succeeding family was assumed to survive for the entire planning period of 30 years with probability one.

Three alternative solutions to the parent-child bargaining game are presented in Table 3. The entries in the table were calculated in dynamic programming models. Two of the solutions are corner solutions and they define the boundaries of the range of settlements likely to be reached. In the first, the parents receive only their reservation utility and the succeeding family receives the rest ('takes all'). In the second corner solution, the young family receives just its reservation utility and the parents receive whatever is left of  $W_0$ . These solutions, as well as the Nash (1950) solution to the game, depend on the reservation utilities of both families and on the risk premium.

For the parents, the reservation utility translates the reservation wealth into the minimum wealth that will keep them on the farm. The reservation wealth ( $W^{pr}$ ) is the amount the parents would obtain by selling the farm, using self-insurance to attain their reservation utility (equations (4) and (5)). On Farm B, by (7),  $E(S, W^{pr}) = E(S, 500,000)$  and this is equal to  $E(F, 434,212)$ . The sum NIS 434,212 is the expected present monetary value of the consumption stream the parents will receive when staying on the farm with the young family and being limited to their reservation utility. Accordingly, the value  $M$  (see equation (7)) is NIS 65,788 ( $= 500,000 - 434,212$ ). This is the gross pension surplus and is added to the farm inter-generational surplus of Table 2. The corresponding entries for Farm A have similar interpretations.

Continuing with the example of Farm B and the first corner solution, the monetary share of the young family is NIS 1,157,430 ( $= 1,591,642 - 434,212$ ). Now, we recall that the succeeding family carries the risk associated with securing pension-like payments for the older couple. With this risk, the monetary equivalent of the young family's utility on the farm is NIS 1,046,079 (calculated by dynamic programming). The

difference between the share in the wealth and the monetary utility equivalent is NIS 111,351 ( $=1,157,430 - 1,046,079$ ), which is the risk premium. The premium is the amount the succeeding family would be willing to give up to be relieved of the burden of the risk associated with the parents' consumption.

Thus, the farm's initial wealth is divided between the expected monetary present value of what the parents receive and the initial wealth of the succeeding family. However, the young family's utility is impaired by having to accept the risk associated with financing the parents' consumption. Consequently, the young family's utility is lower (by the amount of the risk premium) than it would be if there was no risk involved with the pension arrangement. The monetary value of this smaller utility is their utility equivalent. In the second corner solution, the parents 'take all' and the succeeding family receives its reservation utility. Now the risk effect is turned around. The reservation wealth of the young family is NIS 735,682 (the present value of their alternative earnings) but, as they face risk, their monetary share (the sum allocated to secure their reservation utility) is NIS 960,064. The parents' share is the remaining value of the farm's initial wealth. In this corner solution, the parents receive much more than their reservation wealth or its utility equivalent, but they now carry the risk premium. If membership in a pension fund could be purchased and the young family relieved of the risk, the parents' share would have been greater. (The risk premium is greater here than in the first solution because the amount the parents receive is now larger.)

The third alternative is the Nash (1950) solution to the bargaining process, by which the division of the surplus maximises the product of the additional utilities (equation (8)). An internal solution is assured because of the convexity of the CRRA utility function. In this solution, the parents in Farm B receive NIS 548,763 and the succeeding family receives NIS 1,042,879, but because of the risk premium their equivalent money-metric utility is only NIS 895,424.

## 9. Other cases

The farm types in Table 1 are typical for the sample moshav but other farms may be of different size and structure. In Table 4 we record Nash solutions for several alternative values of key parameters that may represent other farms, all on the basis of Farm B. Where a parameter is modified in the table, the other parameters are set at their Farm B, Table 3, values.

The first parameter to be examined is risk aversion. As we increase the level of risk aversion relative to that in Table 3, the share the parents receive in the Nash solution decreases from NIS 548,763 to NIS 420,771. Risk aversion increases the value of secured annuities and comparatively more risk averse retirees will settle for smaller annuities (holding reservation wealth constant). Increasing risk aversion affects the young in two opposite ways: it reduces their welfare for given wealth and commitments, but it also reduces their commitments to the older generation. Hence, the risk premium does not move

Table 4. Alternative farm parameters, Nash solution

Examined parameter and case	Parameter value	Solution		Risk premium	Difference	
		Parents	Young		Examined parameter	Young
<i>Gamma</i>						
Table 3	0.75	548,763	895,424	147,455		
	1.25	520,461	901,444	169,738	0.5	6,020
	1.75	420,771	1,032,594	138,277	0.5	131,150
<i>Initial wealth</i>						
Threshold +halfway Table 3 +halfway	1,286,281	434,212	735,682	116,387		
	1,438,961	491,787	815,280	131,894	152,681	79,598
	1,591,642	548,763	895,424	147,455	152,681	80,144
	1,744,323	605,387	975,446	163,489	152,681	80,022
<i>Reservation wealth—parents</i>						
Low	350,000	481,620	986,188	123,834		
Table 3	500,000	548,763	895,424	147,455	150,000	−90,763
High	650,000	612,959	805,189	173,495	150,000	−90,235

Entries, except for gamma values, are in December 1992 NIS. The young family's share is its utility equivalent.

monotonically with  $\gamma$ . For the cases analysed in Table 4, the young's utility equivalent share in wealth increases with risk aversion (utility comparisons are here meaningless as the functions differ). On another issue, the threshold wealth for the sample village farms with the given parameters is NIS 1,286,281. Farms with the reservation wealth values, for the parents and the succeeding family, as in Farm B and with wealth below the threshold level, will not find a feasible inter-generational co-operative agreement.<sup>8</sup> The effect of increasing wealth is examined in Table 4 by modifying  $W_0$  by steps of NIS 152,681, half the distance between the threshold level and the level of  $W_0$  in Table 3. As  $W_0$  increases, both the share of the parents and that of the young family increase; however, not all the additional wealth is distributed to the parties to the agreement; part of it goes to compensate for the increasing risk of a larger on-farm pension fund.

It is often stated that parents invest in anticipation of a successor joining the farm 'to prepare employment and income sources for the children'. Our examples indicate that in this way they may also increase their own retirement benefits.

The last three rows in Table 4 illustrate the parents' increasing bargaining power as their reservation wealth increases from NIS 350,000 to 650,000. Naturally, parents' reservation wealth increases their Nash solution share in the farm income and reduces the share of the young.

Considering bargaining positions, one may add that parents are often thankful for being given the opportunity to help on the farm, even if only part-time, but some may require compensation.<sup>9</sup> In this case, they will insist on an appropriately modified division of the surplus.

## 10. Concluding remarks

A succeeding family receives an operating business, the farm, plus land and dwellings together with the obligation to provide the parents with secured income for the rest of their lives. In the farms we analysed, and with a Nash solution (Table 3), the standard of living of the succeeding family (i.e. the present value of future consumption) is more than 20 per cent higher than what mere labour earning could provide. This additional income is due to intra-family co-operation: old age insurance of the parents, the transfer of the farm to a son or daughter who grew up on it and understands its functioning better than an outside buyer, and in one case, labour contributed by the parents for 10 years.

The illustration should be qualified in several ways. For many farmers, our illustration overestimates the benefits of inter-generational transfer. For example, although 60 per cent of the farms in the sample village operate a (generally profitable) dairy enterprise, the country-wide average for all moshavim is only 10 per cent. In some cases, represented by the type C

8 The examination of the threshold wealth was suggested by the Editor.

9 We are indebted to a referee for this point.

farm in Table 1, farms are abandoned or sold for residential use. For fortunate farmers, close to metropolitan areas, this is the preferred alternative. Rising urban demand has increased the value of their property in the last few years and, even if today's income from agriculture is low, they may expect to be able to retire in comfortable conditions.

Another qualification concerns the structural assumptions of the analysis. Of particular significance is the assumption that the parents do not assign any weight in their utility to the bequest which may be left to their heirs should they die relatively early. It is this assumption that distinguishes sharply between self insurance for old age and a fair annuity arrangement. Even if parents are loving and benevolent, they may well draw the line somewhere and reserve a certain sum for their own old age. Our formulation is based on this premise (an even stronger position emerges from the finding of Altonji *et al.* (1997) that altruism is rejected as the major motive for inter-vivos parental transfers).

By another simplifying assumption, the young couple was certain to live at least to the age of 65 with essentially a constant and risk-free farm income stream. In reality, farm families cannot assume such certainties, but incorporating more realistic assumptions into our analysis would have severely complicated the presentation without adding significantly to the contents of the discussion.

Where applicable, taxes are the major consideration in farm transfer and families devote substantial efforts to their minimisation. Inheritance or sales taxes would have affected the economics of the analysed farms in two ways. First, the net value of the farm to the parents would have been lower and their reservation utility smaller. The obvious implications are a reduced farm surplus and smaller than no-tax values for both generations, particularly the parents. The analysis in the paper would have been modified only quantitatively. Second, taxes may affect the mode and timing of transfer; an example is the incorporation of the farm with gradual transfer of ownership. These possibilities are outside the scope of the present analysis.

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## References

- Altonji, J. G., Hayashi, F. and Kotlikoff, L. J. (1997). Parental altruism and inter vivos transfers: theory and evidence. *Journal of Political Economy* 105(6): 1121–1166.
- Blanc, M. and Perrier-Cornet, P. (1993). Farm transfer and farm entry in the EC. *Sociologia Ruralis* 33(3–4): 319–335.
- Gasson, R. and Errington, A. (1993). *The Farm Family Business*. Wallingford, UK: CAB International.



- Just, R. E. and Pope, R. D. (1979). Production function estimation and risk related considerations. *American Journal of Agricultural Economics* 61(2): 276–284.
- Kimhi, A. (1994). Optimal timing of farm transferal from parent to child. *American Journal of Agricultural Economics* 76(2): 228–236.
- Kimhi, A. (1995). Differential human capital investments and the choice of successor in family farms. *American Journal of Agricultural Economics* 77(3): 719–724.
- Kislev, Y., Lerman, Z. and Zusman, P. (1991). Recent experience with cooperative farm credit in Israel. *Economic Development and Cultural Change* 39(4): 773–789.
- Kotlikoff, L. J. and Spivak, A. (1981). The family as an incomplete annuity market. *Journal of Political Economy* 89(4): 372–391.
- Krautkraemer, J. A., van Kooten, G. C. and Young, D. L. (1992). Incorporating risk aversion into dynamic programming models. *American Journal of Agricultural Economics* 74(4): 870–878.
- Lieberman, D. (1992). Profitability and risk characteristics of agriculture in capital asset pricing model framework. M.Sc. Thesis, The Hebrew University, Rehovot (in Hebrew).
- Lundberg, S. and Pollak, R. A. (1996). Bargaining and distribution in marriage. *Journal of Economic Perspectives* 10(4): 139–158.
- Nash, J., Jr (1950) The bargaining problem. *Econometrica* 18(2): 155–162.
- State of Israel, Central Bureau of Statistics (1993). *Statistical Abstract of Israel 1993*. Jerusalem.
- Zusman, P. (1988). *Individual Behaviour and Social Choice in a Cooperative Settlement, the Theory and Practice of the Israeli Moshav*. Jerusalem: Magnes Press.

## Appendix A

Data were collected in the co-operative's accounting office of the sample village. Complete data sets were available for 30 family farms for the 6-year period 1987–1992. The information we used was on income (value added: farm revenue minus purchased inputs) and on enterprise size measured by land area or by units of livestock. The contribution to income and to its variance of each of the lines of production was estimated by the procedure suggested by Just and Pope (1979). The regression estimating the income-generating function was formulated as

$$Y_{it} = \alpha_0 + \sum_{k=1}^K \alpha_k X_{kit} + e_{it}^* \quad (A1)$$

$$|e_{it}^*| = \left( B \prod_{k=1}^K X_{kit}^{\beta_k} \right)^{1/2} e_{it}$$

where  $X_{kit}$  is the size of the enterprise  $k$  (measured in units of livestock or area of land) in farm  $i$  for year  $t$  and  $\alpha_k$  is the constant income coefficient.

As proposed by Just and Pope (1979), the estimation was conducted in three stages (Table A1): (i) expected income (first line of equations (A1)); (ii) contribution of farm enterprises to variance of income (second line); (iii) second estimate of expected income with correction for heteroscedasticity. Year dummies were included in the regression for the first and the third stage but the year effects were disregarded in the calculation of the residuals for the second stage (the regression explaining  $e_{it}^*$ ), implying the assumption that these effects are part of the risk creating variability in income.

The explanatory variables in (A1) and in the regressions in Table A1 are measures of the size of farm enterprises and not, as in the original Just and Pope (1979) formulation, factors

**Table A1.** Estimated regressions of farm income

	First stage	Second stage	Third stage
Dependent variable	Income	Residuals	Income
Intercept	-14786 (0.930)	9.067 (21.057)	-0.321 (0.435)
Dairy	2470 (9.300)	-0.253 (1.552)	2136 (9.189)
Cattle	152 (1.554)	0.295 (1.595)	175 (1.684)
Layers	-3.530 (0.494)		-2.309 (0.384)
Hatching eggs	3.992 (0.926)		6.010 (1.546)
Field crops	99 (0.419)	0.420 (2.110)	252 (0.944)
Fruits	1322 (3.109)	0.371 (2.649)	1354 (2.230)
Vegetables	1307 (1.552)		877 (1.276)
Flowers	-75 (0.053)		875 (0.623)
Adjusted $R^2$	0.599	0.064	0.557
F-statistic	23.242	4.046	19.769

Units: dairy and cattle – heads; poultry – 1000 heads; field crops, fruits, vegetables, and flowers – dunams (1 dunam = 1/10 hectare). Income is gross value added (farm revenue minus purchased inputs) per farm in December 1992 New Israeli Sheqels (NIS 2.764 = US\$ 1.00). The estimated regressions were equations (A1) with 180 observation (30 farms for 6 years). Year dummy variables were included in the regression for the first and the third stage (not reported). The coefficients of the first and the third stage were estimated in linear regressions, the second stage regression was double log (the reported intercept is  $\ln B$ ). Variables with insignificant coefficients were excluded from the second stage regression.  $t$  values are in parentheses.

of production. By the structural assumption of (A1), value added is additive and a linear function of size. The variance, the second line of (A1), is treated differently. We have assumed that risk (unexplained variability) may increase or decrease with size and that covariance between enterprises need not be zero. An example of increasing risk is when a comparatively larger enterprise is more easily afflicted by pests or disease; and an example of decreasing risk is when operators with larger enterprises pay more attention to the minute details of animal husbandry or agricultural needs. Similarly, with limited entrepreneurial energy, the size of one enterprise may affect variability on the other lines on the farm. By the findings in Table A1, the dairy enterprise reduces the unexplained variability of total farm income, whereas field crops and fruit increase it.

## Appendix B

The magnitudes reported in Tables 3 and 4 in the text are capitalised values. In general, the discount factor of an economic enterprise is a weighted average of the cost of equity and the

cost of borrowed funds. However, typical farms we examined in the sample village had no business debts. Future income was, therefore, capitalised using the cost of equity capital as the discounting factor. This cost was calculated from outside information in two stages. In the first, the rate of return on equity was estimated from aggregate industry level data in the equation

$$k_i = \alpha + \tau(sd/V)_i \quad (B1)$$

in which  $k_i$  is cost of equity and  $(sd/V)_i$  is the coefficient of variation of income in industry  $i$ . (The data were from Lieberman (1992); they covered eight non-agricultural industries and the observations were annual averages, for the period 1977–1988, of returns and their variability by industry in Israel.) The estimated  $\tau$  was 0.2592 ( $t = 2.22$ );  $\alpha$  was estimated as  $-1.64$  ( $t = -0.21$ ), which may well have reflected negative real interest rates in the period of accelerating inflation for which the data were available (Kislev *et al.*, 1991). It was therefore replaced in equation (B2) below by the average real yield on index-linked government bonds: 0.035 (3.5 per cent).

In (B1),  $V$  is the capitalised value of the firms in the industry and  $sd$  is the standard deviation of annual net earnings. This value is calculated as  $V = E/k$ , where  $E$  is the annual net earning stream, assumed constant. Substituting into (B1) yields

$$k = \frac{\alpha}{1 - \tau sd/E} \quad (B2)$$

The cost of equity capital,  $k$  in (B2), was calculated for the farm in the simulation from earnings and variability data in Table 1 in the text using the estimated  $\tau$  parameter of equation (B1), with  $\alpha$  set equal to 0.035. The resulting  $k$  value was 4.73 per cent and it is shown also in the first line of Table 2.