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Family Composition and Off-Farm Participation Decisions in Israeli Farm Households

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ABSTRACT

This paper studies the dependence of the off-farm participation behavior of farm operators and their spouses on the demographic composition of the household. Specifically, we focus on farm families without parents, siblings or partners, and examine the effects of the existence and work decisions of elderly children of the farm couple. We find that both the father and the mother tend to reduce their participation in off-farm work as the number of elderly children rises. This result holds even after controlling for observed characteristics. We also find that the effect of elderly children stems from considerations related to both farm production and household production.

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Introduction

The time allocation decision of farmers has long attracted researchers because many farmers divide their labor supply between farm work and off-farm work, a phenomenon that is rarely observed in other sectors of the economy (Shishko and Rostker 1976). Other than the scientific attractiveness of multiple job-holding among self-employed farmers, understanding this phenomenon is important for the design of agricultural policy, and, more generally, rural policy. Many policy instruments are aimed at improving farm income or reducing its variability. Policy makers often do not fully appreciate the importance of earnings from off-farm sources that supplement farm income and serve as a buffer against farm income fluctuations. Moreover, any farm-related policy should take into account the ability of farmers to act on the extensive margin between farming and off-farm activities in addition to their actions on the intensive margin between different farm activities. Understanding how farmers allocate their time between farming and off-farm occupations is therefore crucial for designing successful farm policies.

The empirical attempts to analyze farmers' time allocation decisions have thus far been limited to husband and wife only because of two main reasons. One is the lack of sufficient data on the time allocation of other family members. The other is the limitation imposed by the availability of suitable econometric techniques. As family farming is still dominant in agricultural sectors all over the world, data on farm households are readily available in many countries. This research will use data from a detailed family farm survey conducted in Israel, which include the time allocation patterns of all farm-family members older than 14 years. Econometric tools such as quasi-maximum likelihood estimation (Kimhi 1994), and minimum distance estimation (Kimhi and Lee 1996), enable the joint estimation of a large number of participation and labor supply equations. Hence the purpose of this research is to extend the time allocation analysis to other members of the farming family.

Previous research (Kimhi 1996) has found that household composition affects the tendency of different household members to provide off-farm labor. This is explained by the differential income effects resulting from the household's joint budget constraint, and by the time and money costs imposed by different household members. In particular, farm couples are more likely to work off the farm when the number of other adults in the household increases. This paper builds on the previous work and modifies it in several directions: (a) a more recent data set is used; (b) we focus on farm families without parents, siblings or partners, so the only other adults in the household are the immediate descendents of the farm couple (and the descendents' spouses); (c) we estimate the off-farm participation equations of the descendents jointly with the off-farm participation equations of the farm couple.

We find that the effect of household composition on the off-farm participation behavior of the farm couple is completely different than the behavior indicated by the previous results. In particular, we find that the farm couple is less likely to work off the farm as the number of adult children in the household rises. We also explore two possible reasons for this behavior, one related to complementarity of farm labor inputs of different family members, and another related to the time burden in household production imposed by adult children. Both reasons are supported by the empirical results.

The following section starts with a survey of previous literature. Then we present a theoretical model of time allocation and off-farm labor participation in a household context. After that we discuss the empirical methods we adopt for this analysis. The following sections present the data, descriptive statistics, and empirical results. The last section provides a summary and conclusions.

Background and Previous Results

The literature is rich in applications of the agricultural household model to time allocation problems. The traditional approach has been to estimate off-farm participation equations and labor supply equations of farm operators (e.g., Sumner 1982). In the last decade, researchers have moved to estimate two-equation models in which the off-farm labor supply equations of husbands and wives are jointly determined (e.g., Huffman and Lange 1989; Tokle and Huffman 1991; Lass and Gempesaw 1992). The results of these studies indicated that off-farm labor supply of husbands and wives are positively correlated. Recently, this approach has been extended to include farm work participation equations (Kimhi 1994) and labor supply equations as well (Kimhi and Lee 1996). Buttel and Gillespie (1984) have also found that men's and women's farm and off-farm labor supply decisions are correlated.

However, farm families are not made of a husband and a wife only. On the contrary, farm families are often larger than non-farm families, including several generations who function as an extended family. The importance of within-family succession serves as an incentive for adult children to work together with their parents on the family farm (Kimhi 1995). Blanc and Perrier-Cornet (1993) found that European successors often work as laborers for their parents for ten years or more before receiving ownership. Hence, the existence of other family members allows the farm operator and spouse to have more flexibility in their time allocation decisions.

This claim is supported by the empirical results of Kimhi (1996), who studied the effect of family composition on the labor participation decisions of Israeli farm couples. Children under 3 years of age decreased the tendency of spouses to participate in either farm work or off-farm work, decreased operators' farm participation but increased their off-farm participation. Older children (up to 18 years of age) increased farm participation and decreased off-farm participation of both adult family members. The number of other adults (19 to 51 years old) increased (decreased) off-farm (farm) participation of both spouses. It seems that other adults are net substitutes in farm work. Further, a measure of other adults' farm work was included as an explanatory variable, and the results did not change much, though the coefficients tended to be larger in absolute value. This variable had a strong positive (negative) effect on farm (off-farm) participation probability. Finally, the joint participation model was estimated separately for households with and without other adults. The results implied that the time allocation of farm operators and their spouses depends strongly on the existence of other adult household members.

Overall, these results indicate that there are substitutability and complementarity relations between the labor supplies of different household members to the two sectors. Hence, a joint estimation is desirable.

Theory

Up to the present, the time-allocation decisions in family farms were modeled as if they are derived from a joint household utility model, that is, each and every family member acts so as to maximize a utility function defined over consumption and leisure of all family members. This is the framework used by Huffman (1991) in his comprehensive theoretical survey of the farm-household models. Kimhi (1994) suggested a slight modification of the theory to allow for zero farm work. The resulting model is outlined in short below.

Assume that household utility (U) is a function of household consumption (C) and the vector of household members' home time, $\mathbf{T}_h$ (housework and leisure). Each household member can use his time endowment (T) for farm work (T_f), market work (T_m), and/or home time. Hence, the time constraint is (in vector notation):

$$\mathbf{T}_f + \mathbf{T}_m + \mathbf{T}_h = \mathbf{T}. \tag{1}$$

Non-negativity constraints are imposed on market work and farm work of each household member: $\mathbf{T}_f \geq \mathbf{0}$ and $\mathbf{T}_m \geq \mathbf{0}$. Consumption is constrained by household income, which is composed of: (i) farm income (Y_f), which is a function of each household member's farm labor supply; (ii) off-farm labor income, which is the sum of off-farm earnings of all household members (Y_{mi}); and (iii) other income (Y_o). The resulting budget constraint is:

$$(2) \qquad C = Y_f(\mathbf{T}_f ;\mathbf{Z}_f)+ \Sigma_i Y_{mi}(T_{mi} ;\mathbf{Z}_{mi})+ Y_o.$$

The household optimization problem is to maximize $U(C, \mathbf{T}_h; \mathbf{Z}_u)$ subject to the time, budget, and non-negativity constraints, where $\mathbf{Z}_j$ are exogenous shifters of function j. The optimal solution is characterized by the Kuhn-Tucker conditions, which are the first-order conditions for maximizing the Lagrange function:

$$(3) \qquad U(C ,\mathbf{T}_h; \mathbf{Z}_u) + \lambda\cdot[Y_f (\mathbf{T}_f; \mathbf{Z}_f) + \Sigma_i Y_{mi} (T_{mi}; \mathbf{Z}_{mi}) + Y_o - C] + \\ + \boldsymbol{\mu}_t\cdot[\mathbf{T} - \mathbf{T}_f - \mathbf{T}_m - \mathbf{T}_h] + \boldsymbol{\mu}_f\cdot\mathbf{T}_f + \boldsymbol{\mu}_m\cdot\mathbf{T}_m$$

over $\{C, \mathbf{T}_h, \mathbf{T}_f, \mathbf{T}_m\}$ and minimizing it over $\{\lambda, \boldsymbol{\mu}_t, \boldsymbol{\mu}_f, \boldsymbol{\mu}_m\}$. The farm work and off-farm work participation conditions are, respectively, a subset of the Kuhn-Tucker conditions:

$$(4) \qquad \partial Y_f /\partial \mathbf{T}_f \leq \boldsymbol{\mu}_t /\lambda$$

$$(5) \qquad \partial \mathbf{Y}_m /\partial \mathbf{T}_m \leq \boldsymbol{\mu}_t /\lambda$$

(in vector notation), where $\boldsymbol{\mu}_t = \partial U/\partial \mathbf{T}_h$ and $\lambda = \partial U /\partial \mathrm{C}$. Participation (an internal solution) occurs when the equality holds.

If an interior solution occurs for all choices (all household members work both on and off the farm), the participation equations and all the constraints can be solved for endogenous variables $\{C, \mathbf{T}_h, \mathbf{T}_f, \mathbf{T}_m, \lambda, \boldsymbol{\mu}_t, \boldsymbol{\mu}_f, \boldsymbol{\mu}_m\}$ as functions of all the exogenous variables $\mathbf{Z}_u$, $\mathbf{Z}_f$, $\mathbf{Z}_m$, Y_o, and $\mathbf{T}$. This is the reduced-form solution. Using this solution in the participation equations, we can then determine which of the labor participation conditions is satisfied. If n is the number of potential workers in the household, there are 2n participation equations, taking the forms:

$$(4)' \qquad f_j (\mathbf{Z}_u, \mathbf{Z}_f, \mathbf{Z}_m, Y_o, \mathbf{T}) \leq g (\mathbf{Z}_u, \mathbf{Z}_f, \mathbf{Z}_m, Y_o, \mathbf{T}), \qquad j=1...n;$$

(5)’ $h_j\,(\mathbf{Z}_{mj}) \leq g\,(\mathbf{Z}_u, \mathbf{Z}_f, \mathbf{Z}_m, Y_o, \mathbf{T})$, j=1...n.

The model can easily be extended to include housework as an activity separate from leisure, as well as non-agricultural self-employment activities of the household. The results of this model could hold even if the strong assumption of a single household utility function is relaxed. According to Becker's (1991) "Rotten Kid Theorem", if each household member maximizes his own utility function, but one member is sufficiently altruistic towards the others, and this member controls a sufficient amount of resources, the behavior of all household members will be similar to the case of a single joint utility function.

Equation (5)’, the off-farm labor participation equation, is of most interest for our purposes. We can see that each household member’s off-farm participation decision depends on the characteristics of all other household members, through the right-hand side of (5)’. It is this dependence that we examine in this paper.

Empirical Methods

Off-farm participation models with up to two participation equations were modeled by maximum likelihood models in most of the studies of joint husband-wife work decisions. The quasi maximum likelihood approach can be used for more than two equations. The following description of the quasi maximum likelihood method is based on Kimhi (1994).

Using a first-order approximation of (5)’, and adding stochastic terms for the approximation errors, we can write a generic empirical off-farm participation equation as a linear function of the explanatory variables:

(5)’’ $\boldsymbol{\beta}_{uj}\mathbf{Z}_u + \boldsymbol{\beta}_{fj}\mathbf{Z}_f + \boldsymbol{\beta}_{mj}\mathbf{Z}_m + \beta_{oj} Y_o + \boldsymbol{\beta}_{tj}\mathbf{T} + \varepsilon_j \leq 0$ (j=1...n),

where the β's are unknown parameters. Strict inequality indicates nonparticipation. If $\varepsilon_j \sim N(0,1)$, each equation can be estimated by probit. Assuming a general correlation structure between the equations necessitates a joint estimation procedure in order to exploit all available information and provide efficient estimators. This correlation structure could result, for example, from unobserved household-level variables that are common to all equations.

Multivariate probit ML estimation of more than two equations requires more than two levels of numerical integration, making the task impractical. Instead, in the Quasi-ML method, restrictions are imposed on the parameters in order to simplify the likelihood function. The restrictions are chosen such that the restricted model satisfies the orthogonality conditions, which are equivalent to the first-order conditions of the restricted ML model. The simplest version of this class is estimating each equation separately by probit, then estimating the cross-equation correlation coefficients in a second stage by using bivariate probit on each possible pair of equations, replacing the $\boldsymbol{\beta}$ parameters by their first-stage estimators.

The method is illustrated here for the case of four equations. Let the probit equations be $\boldsymbol{\alpha}_i \cdot \mathbf{X}_i + v_i \leq 0$ (i=1,2,3,4), where strict equality indicates participation. Assume the first stage probit estimators are $\boldsymbol{\alpha}^*_i$ (i=1,2,3,4). The second stage involves maximizing a bivariate probit log-likelihood function of the form $£_{ij} = \Sigma \ln B(d_i\boldsymbol{\alpha}^*_i\mathbf{X}_i, d_j\boldsymbol{\alpha}^*_j\mathbf{X}_j, d_{ij}\rho_{ij})$, with respect to ρ_{ij}, for each possible (i,j) $\in$ {(1,2), (1,3), (1,4), (2,3), (2,4), (3,4)}. Summation is over individuals; B is the bivariate normal probability function; ρ_{ij} is the correlation between v_i and v_j; I_k equals one if participation occurs, zero otherwise; and $d_i=2I_i-1$ and $d_{ij}=d_id_j$. Since maximizing $£_{ij}$ for each possible (i,j) is equivalent to maximizing $£ = £_{12} + £_{13} + £_{14} + £_{23} + £_{24} + £_{34}$, $£$ can be maximized over all the parameters in one stage. This is the most efficient QML estimator subject to the condition that the level of integration is not higher than two. The method is appropriate for any number of equations. The true covariance matrix of the estimators should be calculated as $H^{-1}WH^{-1}$ where H is the matrix of second derivatives of quasi-likelihood function $£$ and W is its gradient outer-product matrix.

Data

The data come from a farm survey that was conducted in Israel in 1995 (State of Israel, Central Bureau of Statistics 1998). The survey encompassed a representative 10% sample of farms, and included approximately 3000 farms of various kinds. Three separate sectors were surveyed: Moshavim (cooperative villages), other Jewish localities, and Arab localities. Note that despite the cooperative structure of Moshavim, these farms can be treated as private family farms for all practical purposes.[1] Sampling in each sector was conducted in two stages: localities were sampled in the first stage out of all localities in the sector. Then, individual farms were sampled in the second stage. Each sample was stratified according to farm size, branch, and region, and an appropriate weight was attached to each observation.

The survey questionnaire included very detailed questions about farm production activities, both in 1995 and in 1990, as well as personal and family characteristics (age, education, tenure, ethnic origin). Regarding time allocation, each family member was asked if he/she engaged in agricultural activities on the farm up to 1/4 of a full-time job, up to 1/2, 3/4, full time, or not at all. A similar question was asked about non-agricultural farm activities, and about off-farm work.

We use only a small subset of the variables in this data set. Among the time allocation variables, we only use a dummy for working/not working in each sector, and ignore the level of work. This is because the vast majority of those who work off the farm do it on a full-time basis. Also, we add together those who work off the farm and those who participate in non-agricultural activities on the farm, because the latter are a very small group. Other personal characteristics that we use are age, a dummy for being born in Israel, a dummy for having an ethnic origin in Asia or Africa (this relates to the respondent or his/her father), and three educational dummies: one for finishing high school, one for having more than high school education, and one for having some kind of agricultural education. The latter dummy variable is independent of the former two dummies, in the sense that finishing agricultural high school qualifies for both the first and the third dummies.

Family-related variables include two locality-type dummies (private-Jewish and Arab, excluded group is Moshavim), two location dummies (north and south, excluded location is center), the number of children up to age 14, the number of adolescents up to age 21, and dummies for the number of adults in the household: group=1 is for husband and wife only, group=2 is for husband, wife, and one adult child, group=3 is for husband, wife, and two adult children (or an adult child and his/her spouse), and group=4 is for husband, wife, and more than two adult children or spouses. An adult child is a child older than 21 years.[2] Other types of households, including single-parent households, households with elderly parents, and other forms of extended families, were excluded from the current analysis. There were 1949 families left in the data set comprising of groups 1 to 4.

Variables related to the farm operator include tenure, which is the time since the current owner operates the farm, and two dummies for method of receiving the farm, one for succession and one for purchase (the excluded group includes those who received the farm through the settlement agencies). Variables related to farm production include level of specialization, land, capital, and types of products. Level of specialization includes two dummy variables: one for specialized farms, in which one branch accounts for at least 90% of total value added,[3] and another for diversified farms, which include all other farms with positive production. The excluded group includes inactive farms. Land size includes all the land that is permanently held by the farm.[4] Capital stock is the value of buildings, machinery, equipment, and livestock.[5] We also include dummy variables indicating production in each of the following branches: flowers and nurseries, poultry, field crops and vegetables, and cattle.[6]

Descriptive Statistics

Table 1 includes descriptive statistics of the personal characteristics of the different household members.[7] We can see that overall, 55% of the operators and 46% of the spouses work off the farm, while 69% of oldest children do so. However, the fraction of operators and spouses who work off the farm declines with the number of adult children in the household, while that of the oldest children rises. This could very well be an age effect. As can be seen from the table, the ages of operators, spouses, and oldest children rise with the number of adult children, reflecting life-cycle effects. While the parents are already in the age range in which the tendency to work off the farm declines with age, the children are not. Opposite to the results of Kimhi (1996), we do not find that adult children substitute for their parents' farm labor. On the contrary, fathers' farm labor participation rises with the number of adult children, while that of the mother doesn't change monotonically. This could be due to several reasons. First, Kimhi (1996) treated all adult household members equally, while here we only deal with immediate descendents. Second, only 24% of oldest children work on the farm, reflecting the highly diminished role of agriculture in rural Israel in 1995 relative to 1981. Finally, these are only raw results; we have to see whether they still hold after we control for observed differences among the groups of households, especially age.

The fraction of operators and spouses who were born in Israel declines sharply as the number of adult children increases, and so does the fraction of those of Asian or African origin. This is most likely a reflection of the age pattern, as well, since most immigration to Israel, and especially from Asia and Africa, occurred in the early 1950s. Among adult children, these variables do not vary systematically across the groups of households. Education does not vary systematically across the groups for males and children, but declines with the number of adult children for females. This is likely to be a cohort effect. Agricultural-specific education does not seem to be very common in this sample. It is interesting to note that 69% of adult children are males. This could be due to two reasons. First, children's spouses are also included when present, and male spouses of female children are likely to be older. Second, there could be a higher tendency for male children to live on the family farm alongside their parents, for farm succession purposes.

Table 2 includes descriptive statistics of the operator, family, and farm variables. We can first observe that private Jewish farm families are less likely to have adult children on the farm, while Arab farm families are more likely to have three or more adult children on the farm. This probably reflects a lower incentive for farm succession in private Jewish family farms on one hand,[8] and the different fertility and marriage behavior in Arab families on the other hand. The majority of groups 1 and 2 are found in the north and south of the country, while the majority of groups 3 and 4 are found in central locations. This can be explained by the residential value of living on the farm, which is much higher in central regions due to higher housing prices. The number of adolescents goes up from group 1 to group 2 and then declines, while the number of younger children goes down from group 1 to group 2 and then rises. This reflects the fact that households with a single adult child are in a more advanced stage in the life cycle than households without an adult child, as we have learned from the age statistics.[9] The opposite is observed when moving from group 2 to groups 3 and 4. Here the increase in the number of young children is perhaps due to the third generation.

Average tenure increases monotonically from group 1 to group 4, again reflecting the stage in the life cycle. The fraction of operators who have succeeded their parents on the farm does not change much with the number of adult children, while the fraction of operators who have purchased their farms from previous owners declines monotonically from group 1 to group 4. This perhaps reflects the fact that most Moshavim have been established between the late 1940s and the early 1950s, so older operators are more likely to have obtained their farms directly from the settlement institutions.

The fractions of specialized and diversified farms do not change monotonically from group 1 to group 4, but the fraction of inactive farms (the excluded category) decreases monotonically. It could be that inactive farms are less attractive to adult children for succession purposes, and it could also be that farms without successors become inactive. The causality is not clear here. Landholdings don’t change much from group 1 to group 4. Capital stock, on the other hand, rises. This difference is due to the fact that landholdings, at least in Moshavim, were determined at time of establishment, while capital stock was gradually accumulated over the years since establishment. The positive association between capital stock and number of adult children residing on the farm can be explained similarly to the explanation of the level of inactivity above, again without the ability to determine causality. Regarding the branch dummies, we do observe variations across the groups of households. Group 4, for example, has more field crops and less flowers than the other groups. Group 1 has less poultry and group 3 has flowers. We do not good explanations for these variations.

Results

We first apply the quasi-maximum likelihood estimation of the off-farm participation equation to the whole sample, allowing for different intercepts for the different groups of households. The model includes 3 different equations: for the male operator or spouse, for the female operator or spouse, and for the oldest adult child. We tried to add an equation for a second adult child, but the model did not converge, probably because the number of observations with more than one adult child was not large enough. The estimation was performed using Gauss.[10] The procedure accounts for the different probability weights attached to different households, and for missing values. Most cases of missing values were in the work participation variables: many respondents did not answer these questions. While we believe that a large fraction of those thought the questions were not relevant for them because they did not work at all, there is no way to confirm this, and hence we exclude these individuals from the model by attaching zero weights. A few additional observations were excluded because of missing schooling data.[11]

The results are in table 3. We first observe that the three off-farm participation equations are positively correlated. This could be due to two reasons. First, it could be that unobserved household-specific components are important determinants of off-farm labor participation, even after controlling for all the observed attributes. Second, it could be easier for other household members to work off the farm when one member already does so, for various reasons.[12] The group dummies have negative coefficients in the males' equation, but only the coefficient of group 4 is statistically significant. On the other hand, all of the group dummies have significantly negative coefficients in the females' equation, implying that the tendency of farm women to work off the farm is smaller when adult children are present. This is similar to the raw statistics in table 1. The tendency of the oldest adult child to work off the farm increases with the number of adult children, but, as in the case of the father, only the coefficient of group 4 is statistically significant.

Age has a typical inverted U effect on participation probability. Females are more likely to work off the farm if they were born in Israel. This variable is considered as a proxy for country-specific human capital that affects potential earnings positively. Ethnic origin has a significant effect in the children's equation only. Children with Asian or African origin are more likely to work off the farm. Education has a positive effect on males' participation, as expected, but does not affect off-farm participation of females or children. Participation is lower in northern and southern regions, as in the raw statistics. Both north and south dummies are significant in the females' equation, while only the south dummy is significant in the males' equation. None of the regional dummies was significant in the children's equation. The number of children has a negative effect on participation, but the effect is significant only for females. This is similar to the result of Kimhi (1996) that children impose a time cost on the family members, especially the mother. The number of adolescents did not have significant effects in any of the equations.

Tenure does not have a significant effect on the off-farm labor participation decision. Participation is more likely in farms purchased from a previous owner, except for the case of females. This hints to the existence of a phenomenon of purchasing farms for residential purposes. The level of farm specialization does not seem to have an effect on the off-farm participation decision, but the male operators of active farms are much less likely to work off the farm than the male operators of inactive farms. This is a natural result stemming from the lower value of reservation wage on inactive farms. Landholdings have a significantly positive effect on the female's probability of working off the farm. This is a surprising result. If land were important as a factor of production, we would have expected the opposite. It may be that land-intensive farms do not provide employment opportunities for females. Capital stock, on the other hand, has a significantly negative effect on the off-farm participation probabilities of all household members, as expected. Males' participation was lowest in the presence of field crops or vegetables, the second lowest in flower farms, the third – in poultry farms, and the fourth – in cattle farms This is compared to fruit farms. The same rankings are observed for females, except for the fact that cattle farms are not significantly different from fruit farms. None of the branch dummies was significant in the children's equation.

Male operators of private Jewish farms are less likely to work off the farm than those in Moshavim. This is attributed to the institutional link between farm residence and farm operation in Moshavim (Kimhi 1998) that counts people in Moshavim as farm operators even when the farm is inactive. When we repeat the estimation with active farms only, the coefficient of private Jewish farms is no longer significant.[13] In Arab farm families, females and children are less likely to work off the farm. This may be due to differences in cultural tradition but also to off-farm labor market discrimination.

Next, we want to examine the importance of the constraint imposed on the previous model, that the participation equations in the different groups of households are only different in their intercepts. For this, we estimate the model separately in each of the groups of households. The model of group 1 includes only two equations, so it is in fact a bivariate probit model. The model of group 4 did not converge, probably due to the relatively small number of observations. Hence we estimated the model for groups 3 and 4 together, allowing for a different intercept for each of the groups, as before. The results are reported in table 4. A quick look at the table reveals that the coefficient estimates vary considerably across the groups of households. One interesting change is that agricultural education significantly decreases the tendency of adult males to work off the farm, except for farmers of group 1. All the correlation coefficients are still positive and significant, indicating the importance of a joint analysis of the participation decisions of household members.

In order to check whether the differences in off-farm participation probabilities across the groups of households remain after allowing for different coefficients, we compare in table 5 the predicted probabilities of the off-farm labor participation in the different models. The table also includes the actual frequencies. The predicted probabilities are derived from the two models. "Joint estimation" is the model with equal coefficients for the different groups of households except for the intercepts (table 3). "Separate estimation" is the model with all the coefficients different (table 4). For each of the models, we also calculate the probabilities at the sample means of the explanatory variables, where the means are taken over the whole sample. This last calculation allows us to isolate the effect of the group alone, without the effects of the different variable means across groups.

For both males and females, the predicted frequencies follow a pattern similar to that of the actual frequencies, namely a general decline with the number of adult children. This is true for the joint estimation as well as the separate estimation. The decline is somewhat less moderate than in the actual frequencies. The predicted frequencies of adult children's off-farm work participation are higher than the actual frequencies, and do not follow a particular pattern.

When using the sample means of the explanatory variables to generate predicted frequencies, the trend changes somewhat, but it is qualitatively similar. In general, the decline in both males' and females' predicted participation frequency with the number of adult children is more moderate when using the sample means. This means that the decline in the farm couples' off-farm work participation with the number of adult children is due in part to the changes in explanatory variables and in part to genuine effects of the adult children.

Discussion and Additional Results

We found evidence for the existence of a genuine negative effect of the number of adult children in the household on the tendency of the parents to work off the farm. As discussed by Kimhi (1996), this effect could be related to farm production considerations and/or to household production considerations. As an example to the farm-related considerations, it could be that adult children satisfy the need of the household for additional income and the diversification of income, so that the parents do not have to split their time and can concentrate on their farm work. As an example to the household-related considerations, it could be that the adult children impose time costs on the parents in household production so that their tendency to work off the farm is reduced. In the following paragraphs, we will try to test these possibilities.

To start with the household-related considerations, we try to examine whether the number of adult children matters less if they maintain a separate consumption unit. In particular, we interact the group dummies in the "joint estimation" model with a dummy variable that indicates whether the household includes more than one consumption unit. The results (table 6) are strikingly supportive of the hypothesis that the effect of children is related to household production considerations: the negative effects of the number of adult children on the parents' tendency to work off the farm are statistically significant only when the children live with the parents in the same house and do not maintain separate consumption units.[14]

Moving to the farm-related considerations, we first try to examine whether the number of adult children matters more in active farms. We now interact the group dummies with a dummy variable for active farms. The results (table 6) show that the negative effects of the number of adult children on the parents' tendency to work off the farm are statistically significant only in active farms.[15] In addition, we interact the group dummies with a dummy variable indicating whether at least one adult child is working on the farm. We use active farms only, and because of the apparently high negative correlation between participation decisions on farm and off the farm for the adult children, we drop the children's equation and estimate a bivariate probit model of the two parents only. The results (table 6) show that the negative effects of the number of adult children on the parents' tendency to work off the farm are statistically significant only in families with at at least one adult child who is working on the farm. These last two results are clearly in support of the hypothesis that the effect of children is related to farm production considerations as well.

Summary and Conclusions

This paper takes a deeper look at the phenomenon observed in previous research, that the off-farm labor participation behavior of farm operators and their spouses depends on the demographic composition of the household. Using data from a 1995 family farm survey, we estimate jointly the off-farm participation equations of the farm operator, his or her spouse, and their eldest adult child. We find that the number of adult children has a statistically significant negative effect on the off-farm participation of farm couples, especially on that of the female. An analysis of the predicted frequencies of off-farm labor participation revealed that for both males and females, the variation across the groups of households defined by the number of adult children is due in part to observed differences across the groups, and in part to genuine effects of the number of adult children. We also find support to the hypothesis that this negative effect is related to household production considerations as well as farm production considerations.

These conclusions contradict the results of previous research, but only under several qualifications. First, previous research looked at the effects of the number of all adults in the household, not only children, and included different forms of extended households, other than the relatively simple households considered here. Second, the previous research looked at the joint farm and off-farm labor participation decisions, while here we only examined off-farm participation. Finally, it could be that the effects of household composition changed directions and importance from 1981 to 1995. While all these qualifications could and will be studied in future research, the last one is perhaps the most interesting and deserves more attention.

Another point that should be kept in mind for future research is that the number of adult children living with the parents may be endogenous. It could be that adult children choose to live with their parents on the farm in a way that depends on the parents' labor decisions. For example, mothers who do not work off the farm are more available for child care services that are demanded by the adult children. Prospects for farm succession could also play a role here. As family history is not available in this data set, it is difficult to account for this possible endogeneity. However, we expect to be able to match at least part of the sample with the 1981 data, and this may enable to trace, at least in part, children who left the family farm between the two periods.

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Table 1. Descriptive Statistics of Personal Variables

Variable	All	Group 1	Group 2	Group 3	Group 4
Male Operator or Spouse					
WORKS ON FARM	0.68	0.63	0.70	0.75	0.79
WORKS OFF FARM	0.55	0.60	0.55	0.46	0.35
AGE	52.85	48.92	56.86	58.88	59.81
BORN IN ISRAEL	0.57	0.67	0.44	0.43	0.39
ASIA/AFRICA ORIGIN	0.23	0.28	0.19	0.18	0.07
HIGH SCHOOL	0.49	0.49	0.51	0.54	0.42
HIGHER EDUCATION	0.14	0.13	0.16	0.12	0.17
AGRICULTURAL EDUCATION	0.07	0.07	0.10	0.05	0.06
Female Operator or Spouse					
WORKS ON FARM	0.39	0.26	0.34	0.31	0.33
WORKS OFF FARM	0.46	0.51	0.44	0.45	0.24
AGE	48.79	44.78	52.46	55.00	56.41
BORN IN ISRAEL	0.60	0.70	0.52	0.45	0.42
ASIA/AFRICA ORIGIN	0.27	0.29	0.27	0.27	0.14
HIGH SCHOOL	0.48	0.49	0.48	0.47	0.43
HIGHER EDUCATION	0.13	0.14	0.13	0.11	0.13
AGRICULTURAL EDUCATION	0.05	0.05	0.04	0.05	0.07
Oldest Adult Child or Spouse					
WORKS ON FARM	0.24		0.23	0.22	0.29
WORKS OFF FARM	0.69		0.64	0.73	0.72
MALE	0.69		0.64	0.71	0.72
AGE	28.88		25.79	29.52	32.72
BORN IN ISRAEL	0.95		0.96	0.93	0.95
ASIA/AFRICA ORIGIN	0.39		0.41	0.36	0.42
HIGH SCHOOL	0.53		0.48	0.55	0.57
HIGHER EDUCATION	0.16		0.15	0.18	0.13
AGRICULTURAL EDUCATION	0.05		0.05	0.05	0.06
OBSERVATIONS	1949	1052	344	328	225

Note: off-farm work includes on-farm non-agricultural activities.

Table 2. Descriptive Statistics of Family, Operator, and Farm Variables

Variable	All	Group 1	Group 2	Group 3	Group 4
PRIVATE	0.08	0.09	0.08	0.07	0.03
ARAB	0.20	0.21	0.17	0.16	0.27
NORTH	0.29	0.29	0.36	0.26	0.27
SOUTH	0.24	0.27	0.23	0.16	0.18
ADOLESCENTS	0.80	0.75	1.03	0.90	0.64
CHILDREN	1.50	1.89	0.68	1.05	1.31
TENURE	28.50	26.10	28.99	33.14	34.42
SUCCEEDED	0.31	0.31	0.28	0.29	0.34
PURCHASED	0.28	0.31	0.27	0.22	0.19
SPECIALIZED	0.49	0.50	0.44	0.47	0.54
DIVERSIFIED	0.25	0.21	0.31	0.31	0.27
LAND	29.78	29.31	31.58	29.00	30.65
CAPITAL	99.58	89.94	101.39	123.22	116.34
FLOWERS	0.09	0.10	0.08	0.13	0.05
POULTRY	0.16	0.13	0.20	0.23	0.20
FIELD CROPS	0.27	0.24	0.28	0.28	0.39
CATTLE	0.08	0.09	0.06	0.06	0.08
OBSERVATIONS	1949	1052	344	328	225

Table 3. Quasi-Maximum Likelihood Estimation Results

	Adult Male		Adult Female		Oldest Child	
Variable	Estimate	t-statistic	Estimate	t-statistic	Estimate	t-statistic
CORR. WITH FEMALE	0.2653	5.0970 **				
CORR. WITH CHILD	0.2266	4.6850 **	0.3797	6.6580 **		
CONSTANT	0.1721	0.1640	-3.3368	-2.4980 **	-2.5188	-1.6090
GROUP 2	-0.0208	-0.1700	-0.3213	-2.3060 *	0.1770	1.1190
GROUP 3	-0.1616	-1.2060	-0.2471	-1.7150 *	0.0662	0.3550
GROUP 4	-0.3991	-2.5440 **	-0.5791	-3.1950 **	0.3390	2.5100 **
AGE	0.0898	2.1850 *	0.2235	3.9220 **	0.2065	2.1450 *
AGE SQUARED	-0.0013	-3.3420 **	-0.0027	-4.8460 **	-0.0030	-2.1230 *
BORN IN ISRAEL	0.0136	0.1240	0.1973	1.9380 *	0.0005	0.0020
ASIA/AFRICA ORIGIN	-0.0778	-0.7340	-0.0385	-0.3810	0.2846	1.8840 *
HIGH SCHOOL	0.3633	3.4100 **	-0.0515	-0.4630	0.1132	0.7890
HIGHER EDUCATION	0.6395	4.7050 **	0.0174	0.1230	-0.0472	-0.2390
AGRIC. EDUCATION	-0.2571	-1.4450	0.0590	0.3240	-0.0717	-0.2860
NORTH	0.0976	0.8310	-0.2565	-2.1710 *	-0.0939	-0.6100
SOUTH	-0.3402	-2.6220 **	-0.3408	-2.5430 **	-0.0781	-0.4290
ADOLESCENTS	0.0442	0.9590	-0.0418	-0.7620	0.0311	0.4810
CHILDREN	-0.0365	-1.5170	-0.0526	-1.6760 *	-0.0233	-0.6180
TENURE	0.0001	0.0330	0.0015	0.3620	0.0015	0.3650
SUCCEEDED	0.0423	0.3030	0.0165	0.1230	0.2259	1.0330
PURCHASED	0.3100	2.5900 **	0.0728	0.6130	0.3757	2.0400 *
SPECIALIZED	-0.7794	-5.2360 **	-0.1745	-1.2430	-0.3812	-1.5690
DIVERSIFIED	-0.6913	-3.8140 **	0.0750	0.4600	-0.4434	-1.6120
LAND	0.0034	1.6300	0.0075	3.7900 **	-0.0035	-1.1500
CAPITAL	-0.0016	-4.9240 **	-0.0007	-2.7190 **	-0.0017	-5.0990 **
FLOWERS	-0.5972	-4.4950 **	-0.2496	-1.7310 *	-0.1628	-0.9750
POULTRY	-0.3976	-2.9540 **	-0.4561	-3.2950 **	-0.1652	-0.9050
FIELD CROPS	-0.6820	-6.0410 **	-0.4203	-3.5840 **	-0.1367	-0.9410
CATTLE	-0.3846	-2.1180 *	-0.1579	-0.7430	0.1687	0.7670
PRIVATE	-0.4519	-2.5140 *	-0.2401	-1.4530	-0.1001	-0.3860
ARAB	-0.0932	-0.5310	-2.0098	-8.5100 **	-0.6444	-2.4970 **

* coefficient significant at 5%.
** coefficient significant at 1%

Table 4. Off-Farm Participation Results by Groups of Households

Variable	Group 1 Estimate	Group 1 t-statistic	Group 2 Estimate	Group 2 t-statistic	Groups 3-4 Estimate	Groups 3-4 t-statistic
CORR. MAL/FEM	0.2373	3.3540 **	0.3749	3.4120 **	0.2332	2.1770 *
CORR. MAL/CHI			0.2392	1.9840 *	0.3814	3.6030 **
CORR. FEM/CHI			0.2315	1.9380 *	0.2729	2.6180 **
Male Operator or Spouse						
CONSTANT	-0.0648	-0.0500	6.4253	1.3690	-11.8167	-2.5990 **
AGE	0.0924	1.7940 *	-0.1296	-0.8330	0.5311	3.3770 **
AGE SQUARED	-0.0013	-2.6200 **	0.0005	0.4050	-0.0052	-3.8600 **
BORN IN ISRAEL	-0.0673	-0.4620	0.1513	0.6030	0.0201	0.0900
ASIA/AFRICA ORIGIN	0.0048	0.0350	-0.3206	-1.2620	0.0530	0.2100
HIGH SCHOOL	0.2952	2.0780 *	0.5562	2.2200 *	0.3735	1.7430 *
HIGHER EDUCATION	0.8062	4.3030 **	0.4722	1.5680	0.5292	1.8780 *
AGRIC. EDUCATION	0.0400	0.1530	-0.6227	-1.9220 *	-0.8651	-2.3960 **
NORTH	0.2657	1.5830	-0.2232	-0.8970	0.0109	0.0450
SOUTH	-0.1670	-0.9240	-1.0321	-3.7140 **	-0.2203	-0.8910
ADOLESCENTS	0.0351	0.5640	0.2101	2.1800 *	0.0343	0.3660
CHILDREN	-0.0354	-1.1570	-0.1351	-1.3950	-0.0274	-0.4580
TENURE	-0.0012	-0.3740	0.0081	1.0380	-0.0037	-0.6270
SUCCEEDED	0.0696	0.3700	-0.0676	-0.1930	0.2765	1.0780
PURCHASED	0.4106	2.6070 **	0.2952	1.0610	0.2316	0.9150
SPECIALIZED	-0.6853	-3.3950 **	-1.1115	-3.2960 **	-1.0198	-3.3120 **
DIVERSIFIED	-0.7431	-3.1720 **	-0.5110	-1.2610	-0.8297	-2.1370 *
LAND	0.0023	0.8020	0.0215	3.8610 **	-0.0046	-1.0340
CAPITAL	-0.0018	-4.6950 **	-0.0019	-3.0170 **	-0.0013	-2.0220 *
FLOWERS	-0.6591	-3.9510 **	-1.0171	-3.3110 **	-0.1633	-0.6160
POULTRY	-0.3314	-1.7190 *	-0.7211	-2.3270 **	-0.3870	-1.4140
FIELD CROPS	-0.6866	-4.4180 **	-1.5880	-6.0310 **	-0.3902	-1.7310 *
CATTLE	-0.4392	-1.8090 *	-0.4089	-1.0040	-0.4731	-1.1800
PRIVATE	-0.4830	-1.9090 *	-1.0747	-2.7100 **	0.0719	0.1740
ARAB	0.0519	0.2300	0.2647	0.5680	-0.5307	-1.4370
GROUP 4					-0.1669	-0.8850

Continued on next page

Table 4. (continued)

Variable	Group 1 Estimate	Group 1 t-statistic	Group 2 Estimate	Group 2 t-statistic	Groups 3-4 Estimate	Groups 3-4 t-statistic
Female Operator or Spouse						
CONSTANT	-3.2078	-2.2870 *	-21.5404	-3.5940 **	-15.2294	-2.6450 **
AGE	0.2068	3.3010 **	0.8940	3.9790 **	0.6737	3.1480 **
AGE SQUARED	-0.0026	-4.0290 **	-0.0088	-4.2070 **	-0.0069	-3.4570 **
BORN IN ISRAEL	0.1615	1.1590	0.1840	0.7010	0.4381	2.0050 *
ASIA/AFRICA ORIGIN	-0.0847	-0.6350	-0.1250	-0.5240	0.2529	1.1550
HIGH SCHOOL	0.0228	0.1530	0.1317	0.4760	-0.4156	-1.8180 *
HIGHER EDUCATION	-0.1131	-0.6000	0.5009	1.4530	-0.2292	-0.7700
AGRIC. EDUCATION	0.3942	1.6220	0.1429	0.3130	-0.5191	-1.5510
NORTH	-0.2262	-1.4650	0.0165	0.0560	-0.7171	-2.9290 **
SOUTH	-0.1705	-0.9540	-0.8114	-2.6050 **	-0.5932	-2.0920 *
ADOLESCENTS	0.0190	0.2670	0.0213	0.1760	-0.2378	-1.8980 *
CHILDREN	-0.0636	-1.5100	0.1656	1.8230 *	-0.0304	-0.5030
TENURE	0.0061	1.2560	-0.0091	-1.2580	-0.0063	-0.7610
SUCCEEDED	0.0943	0.5480	-0.6563	-1.9460 *	0.0089	0.0320
PURCHASED	0.1958	1.2560	-0.4618	-1.5690	-0.0568	-0.2320
SPECIALIZED	-0.2773	-1.5330	-0.3146	-0.8790	0.2812	0.9290
DIVERSIFIED	0.1155	0.5390	0.0208	0.0490	0.1688	0.5130
LAND	0.0069	2.7860 **	0.0108	2.1560 *	0.0164	3.8080 **
CAPITAL	-0.0008	-2.4720 **	-0.0001	-0.1140	-0.0016	-2.8860 **
FLOWERS	-0.1286	-0.6960	-0.8675	-3.1400 **	-0.4040	-1.4410
POULTRY	-0.2491	-1.3350	-1.0459	-3.0030 **	-0.6429	-2.3700 **
FIELD CROPS	-0.3046	-1.9480 *	-0.8033	-2.9380 **	-0.6411	-2.6400 **
CATTLE	-0.1393	-0.4210	0.3797	0.7960	-0.5049	-1.3660
PRIVATE	-0.0144	-0.0640	-0.0005	-0.0010	-1.2088	-2.5980 **
ARAB	-2.3819	-9.2190 **	-1.4724	-2.7250 **	-2.2574	-4.5600 **
GROUP 4					-0.4698	-2.3070 *

Continued on next page

Table 4. (continued)

Variable	Group 1 Estimate	Group 1 t-statistic	Group 2 Estimate	Group 2 t-statistic	Groups 3-4 Estimate	Groups 3-4 t-statistic
Oldest Adult Child or Spouse						
CONSTANT			-2.5711	-1.0520	-3.3091	-1.4990
MALE			0.1789	0.7990	0.4098	2.3570 **
AGE			0.1976	1.3410	0.2637	1.9490 *
AGE SQUARED			-0.0030	-1.3280	-0.0037	-1.8910 *
BORN IN ISRAEL			0.4261	0.9250	-0.1246	-0.3420
ASIA/AFRICA ORIGIN			0.5250	1.9080 *	0.1929	1.0370
HIGH SCHOOL			0.2139	0.8960	0.0488	0.2690
HIGHER EDUCATION			-0.0105	-0.0320	-0.0950	-0.3690
AGRIC. EDUCATION			-0.3896	-0.8790	0.0094	0.0310
NORTH			-0.0536	-0.2030	-0.1794	-0.8920
SOUTH			-0.0689	-0.2140	-0.1556	-0.6910
ADOLESCENTS			0.0285	0.2700	0.0550	0.6210
CHILDREN			-0.0962	-1.0620	-0.0205	-0.4810
TENURE			0.0008	0.1210	0.0017	0.3370
SUCCEEDED			0.0639	0.1690	0.3888	1.4810
PURCHASED			0.0037	0.0120	0.7188	3.1800 **
SPECIALIZED			-0.6171	-1.6240 *	-0.1654	-0.4930
DIVERSIFIED			-0.4650	-1.0510	-0.4228	-1.1210
LAND			-0.0019	-0.3390	-0.0040	-1.0170
CAPITAL			-0.0012	-2.1190 *	-0.0021	-4.4610 **
FLOWERS			-0.4133	-1.4950	-0.1402	-0.6330
POULTRY			-0.5100	-1.4990	-0.0683	-0.3010
FIELD CROPS			0.0455	0.1780	-0.2946	-1.5720
CATTLE			0.1194	0.2930	0.2529	0.9420
PRIVATE			0.0261	0.0700	-0.4836	-1.3970
ARAB			-0.4018	-0.9070	-0.8511	-2.6350 **
GROUP 4					-0.1424	-0.8230

* coefficient significant at 5%.
** coefficient significant at 1%.

Table 5. Comparing Actual and Predicted Off-Farm Participation Frequencies

	Group of Households				
	1	2	3	4	All
Males					
Actual frequency	0.602	0.553	0.456	0.354	0.547
Joint estimation					
Predicted	0.674	0.624	0.433	0.324	0.593
At the means	0.483	0.475	0.419	0.330	0.453
Separate estimation					
Predicted	0.657	0.582	0.464	0.321	
At the means	0.426	0.468	0.293	0.238	
Females					
Actual frequency	0.510	0.441	0.451	0.240	0.463
Joint estimation					
Predicted	0.659	0.517	0.502	0.186	0.563
At the means	0.486	0.361	0.389	0.269	0.421
Separate estimation					
Predicted	0.638	0.474	0.460	0.220	
At the means	0.420	0.183	0.207	0.099	
Children					
Actual frequency		0.641	0.725	0.715	0.691
Joint estimation					
Predicted		0.797	0.896	0.842	0.844
At the means		0.610	0.676	0.635	0.640
Separate estimation					
Predicted		0.811	0.860	0.787	
At the means		0.605	0.657	0.604	

Note: the actual frequencies are somewhat different from those reported in table 1 because of the different treatment of missing values.

Table 6. Selected Additional Results

Variable	Adult Male Estimate	Adult Male t-statistic	Adult Female Estimate	Adult Female t-statistic	Oldest Child Estimate	Oldest Child t-statistic
Multiple consumption units						
GROUP 2	0.5521	0.988	-0.0923	-0.168		
GROUP 3	-0.2510	-1.170	-0.0990	-0.427	0.2292	1.009
GROUP 4	-0.0714	-0.319	-0.3402	-1.475	0.3639	1.555
Single consumption unit						
GROUP 2	-0.0429	-0.349	-0.3328	-2.364 **		
GROUP 3	-0.1235	-0.796	-0.3004	-1.841 *	0.1844	1.085
GROUP 4	-0.6118	-3.111 **	-0.8413	-3.240 **	-0.0988	-0.464
Active farm						
GROUP 2	-0.0807	-0.597	-0.3689	-2.430 **		
GROUP 3	-0.1687	-1.136	-0.2278	-1.438	0.2507	1.479
GROUP 4	-0.4262	-2.518 **	-0.6730	-3.484 **	-0.0041	-0.021
Inactive farm						
GROUP 2	0.3050	1.026	-0.1899	-0.682		
GROUP 3	-0.1387	-0.496	-0.3263	-1.161	-0.1980	-0.484
GROUP 4	-0.2784	-0.731	-0.2846	-0.705	3.9430	10.799 **
Active farm/children working						
GROUP 2	-0.3060	-1.273	-0.9497	-3.867 **		
GROUP 3	-0.5017	-1.881 *	-0.4018	-1.746 *		
GROUP 4	-0.4667	-1.751 *	-0.8447	-3.025 **		
Active farm/children not working						
GROUP 2	-0.0909	-0.612	-0.1756	-0.981		
GROUP 3	0.1249	0.646	-0.1098	-0.538		
GROUP 4	-0.3315	-1.410	-0.4953	-1.850 *		

* coefficient significant at 5%.
** coefficient significant at 1%.

Notes

[1] Kimhi (1998) provides a detailed description of the historical institutional structure of Moshavim. However, by 1995 most Moshavim had very little cooperation left.

[2] It is important to note that the number of adult children include only those who are currently residing on the farm, either as part of the parents' household or as a separate "succeeding" household, hence it has nothing to do with the number of children the parents ever had.

[3] Value added is "normative", meaning that it was calculated using weights attached to physical measures of production, such as size of crop areas and number of animals.

[4] This could be larger or smaller to the size of land that is actually operated. This variable could easily be thought of as exogenous or at least predetermined (Kimhi 1998).

[5] The use of capital stock as an explanatory variable could be problematic, due to possible endogeneity (Ahituv and Kimhi, forthcoming).

[6] Although a farm could have production in more than one branch, we exclude the dummy for fruits in order to avoid collinearity with the specialization dummies through the inactive farms.

[7] We do not show the statistics for adult children other than the oldest, since they will not be included in the estimated model, as will be explained below.

[8] Farm succession in Moshavim has the incentive of obtaining a permit to build another house on the farm, while this is not necessarily the case in private family farms (Kimhi and Nachlieli 2001).

[9] On the other hand, group 1 can include elderly households in which children have grown up and left.

[10] The code is available from the corresponding author upon request.

[11] It should be emphasized that when data were missing for an individual we excluded that individual only, not the whole household.

[12] To test these two explanations, a panel data set with at least three periods is necessary (Ahituv and Kimhi, forthcoming).

[13] These results are available from the corresponding author upon request.

[14] We only list the coefficients of the group dummies. Full results are available from the corresponding author upon request.

[15] The large and significant coefficient of group 4 in the sample of inactive farms is because of the small number of observations in that category and should not be interpreted as is.