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OFF-FARM WORK DECISIONS OF FARMERS OVER THELIFE CYCLE: EVIDENCE FROM PANEL DATA

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by

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Summary

One of the main questions regarding the phenomenon of part-time farming is whether it is a stable situation or a temporary stage before quitting farming altogether. A conclusion may be reached by examining the structural state dependence of farmers' discrete choices regarding off-farm work over time. A dynamic programming model of utility maximization in which current work decisions affect future utility is developed, and an estimation strategy based on the Hotz-Miller Multinomial Logit framework for panel data is suggested. The model is estimated using Israeli census-panel data and the hypothesis that state dependence is not important is strongly rejected. In particular, the results indicate that farmers choose to work off the farm if it leads to lower prospects of a future exit. Hence, it may be concluded that Israeli farmers do not see the off-farm work option as a step on the way out of agriculture, but rather as a preferred long-run choice in combination with farming.

1. Introduction

Farmers often divide their time between farming and off-farm activities. In surveys from many countries, from one- to two-thirds of the farmers report some level of off-farm employment. Part-time farming is one of the channels via which labor is moving out of agriculture. Traditionally, this transition has been identified with migration (Mazumdar 1987). In fact, according to Mundlak (1989), the relevant concept is **occupational migration** rather than residential migration, especially in developed economies. Empirically, it is not easy to distinguish between part-time farmers and those who have left farming for good, if they do not move out of the farm residence.

Part-time farming is a special case of multiple-job-holding, which is not so common outside of agriculture (Shishko and Rostker, 1976). The theory of specific human capital generally implies that specialization in one occupation is optimal. Weiss (1971) reached this conclusion by assuming a learning-by-doing technology.[1] Occupational-choice models often use linear earning functions, and in this way rule out the possibility of multiple-job-holding. Heckman and Sedlacek (1990), for example, state that "Indifference (between jobs) occurs on a set of measure zero..." (page S347). Gronau (1977) used decreasing "wages" in home production to explain women's time allocation between home production and market work.

Farm-household models (Singh et al. 1986) are very useful in analyzing farmers' behavior. The typical part-time farming version of these models assumes a decreasing marginal product of labor on the farm, and the availability of off-farm jobs and hired farm work for a fixed wage, which is equivalent to Gronau's (1977) formulation. The result is that, with the exception of corner solutions, the farmer will divide his time between leisure, farming and off-farm work.

Many empirical studies of farmers' time allocation have used

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[1] Levhari & Weiss (1974) contradicted this argument when they considered the risk associated with specialization in an uncertain environment. Rosen (1983) suggested other reasons for accumulating more than one type of specific human capital.

this framework and more recent developments in labor economics. Sumner (1982) studied the time-allocation patterns of a sample of Illinois farmers. He stressed the dependence of both the marginal product of farm labor and external wages on sector-specific human capital. Huffman (1980) presented a similar theoretical model, and used county average data from the U.S. Census of Agriculture for several states. He estimated the labor-supply decisions of farm operators but also considered the effects of their spouses. Huffman and Lange (1989) estimated a joint off-farm labor-supply model of farm operators and spouses and found the jointness assumption to be important. The same holds for Kimhi and Lee (1996), who also considered the farm labor-supply decisions to be endogenous.

All these studies, however, ignore the possible effect of life-cycle considerations on current time-allocation decisions, which was found significant among non-farmers (e.g., Macurdy, 1981; Altonji, 1986). Pfeffer (1989) found that part-time farmers in Germany had lower expectations of continuing to farm in the future. The question here is, what is the direction of causality? It could be that those expecting to exit for other reasons are choosing to work part-time in order to make their exit gradual. The existing evidence is mixed on this point. Bollman and Kapitani (1981) found that the probability of exiting from farming is decreased by working off the farm, but given that the farmer is working off the farm, it is increased by working more days off the farm. On the other hand, Roe (1995) found that working off the farm increases the probability of exit, whereas Weiss (1996) found positive effects of both the existence and the amount of off-farm work on the exit probability. It should be emphasized that all of these analyses ignored the possible endogeneity of the off-farm work decision.

Gould and Saupe (1989) were the first, to the best of my knowledge, to use longitudinal data in a part-time farming analysis. They estimated separate Probit equations for "exit" from and "entry" to the off-farm labor market. Thus, they accounted for the state dependence by estimating two different equations, and correcting for sample selection bias. Weiss (1994) also followed this approach and found evidence of state dependence in farmers' off-farm work decisions. This paper suggests a structural approach to the estimation of the state dependence of off-farm labor-supply decisions of farmers over the life cycle, using Israeli census data. Section 2 presents a theoretical model of discrete labor-supply choices over the life cycle, and section 3 outlines the empirical framework, which is based on the Hotz and Miller (1993) approach. Section 4 describes the panel data set used for the estimation, and presents the results. Section 5 concludes.

2. Theory

The theoretical framework used for the analysis is a dynamic programming model of indirect utility maximization over a discrete set of choices. Suppose there are J possible choices of off-farm labor supply. At one extreme there is the choice of not working off the farm, and at the other there is the migration choice, in which the farmer leaves the farm or stops operating it.[2] If choice j is selected at time t, then the dummy variables d_{ts} (s=1...T) are defined such that $d_{tj}=1$ and $d_{tk}=0$ for all $k \neq j$.

Assume further that there is an indirect utility level associated with each state in every time period. It depends on an observed set of state variables and includes an additive stochastic component. The current-period stochastic component is observed by the farmer before making the choice but is unobserved by the researcher. The utility associated with choice j at time t, given the state vector H_t is:

$$(1)\quad u_{tj} = u^*_t(H_t) + \epsilon_{tj}.$$

The farmer chooses $\{d_{tj}\}_{t=1...T,j=1...J}$ so as to maximize the discounted expected present value of current and future utility levels (with a rate of time preference equal to β), given by the value function:

[2] In the Israeli case, living on a farm and operating it are two different issues. See section 4 for more details.

$$(2) \quad V_t = E \left[\Sigma_{s=t}^{T} \beta^{s-t} \cdot \Sigma_{j=1}^{J} d_{sj} \cdot u_{sj} \right].$$

3. Empirical Framework

The estimation procedure suggested here is based on the Hotz and Miller (1993) Multinomial Logit framework,[3] which uses consistent nonparametric estimators of conditional choice probabilities to proxy for individual valuations of discrete alternatives. This framework requires several relatively strong assumptions regarding the distribution of the stochastic elements and the nature of the structural state dependence. In particular, it is assumed that the ϵ_{tj}'s have a type I extreme value distribution, and are independently and identically distributed over time, choices and individuals. Structural state dependence exists if H_t includes a subset of $\{d_{t-i,j}\}_{i=1...t-1,j=1...J}$. It is assumed, in order to be consistent with the data limitations (see section 4), that only last period's choices affect current utility, so that H_t includes only $\{d_{t-1,j}\}_{j=1...J}$. However, $\{d_{tj}\}_{j=1...J}$ is not included in H_t, so current utility does not depend on the current choice, and that's why u^* is not indexed by j.

It is assumed that choice J is a terminal one: if $d_{tJ}=1$, then for all $\tau=t+1...T$, $d_{\tau J}=1$. This is rationalized by the existence of the migration option, which is assumed to be irreversible, perhaps because of the prohibitively large fixed cost that is associated with the establishment of a farm business.

Once the ϵ's are revealed, the farmer picks the choice in which the sum of current utility and the value function of the next period conditional on the current choice, is maximized. That is, if choice k is made in period t ($d_{tk}=1$), then:

$$(3) \quad u_{tk} + v_{tk} \geq u_{tm} + v_{tm} \qquad \text{for all } m=1...J, m \neq k$$

where:

$$(4) \quad v_{ti} = E \left[\Sigma_{s=t+1}^{T} \beta^{s-t} \cdot \Sigma_{j=1}^{J} d_{sj} \cdot u_{sj} \mid d_{ti}=1 \right].$$

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[3] Eckstein and Wolpin (1989) survey other possible procedures.

Using (1), (3) can be rearranged to get the optimization conditions in terms of the stochastic components:

(3)' $\epsilon_{tm}-\epsilon_{tk} \leq v_{tk}-v_{tm}$ for all $m=1...J, m\neq k$.

In addition, (4) can be decomposed into:

$$(4)' \quad v_{ti} \equiv \beta\cdot v^1_{ti} + \beta\cdot v^2_{ti} \equiv$$
$$\equiv \beta\cdot E[\Sigma_{j=1}^J d_{t+1,j}\cdot u_{t+1,j}|d_{ti}=1]+\beta\cdot E[\Sigma_{s=t+2}^T \beta^{s-(t+1)}\cdot \Sigma_{j=1}^J d_{sj}\cdot u_{sj}|d_{ti}=1].$$

Using (1):

$$(5) \quad v^1_{ti}= u^*_{t+1}(H_{t+1}{}^i) + \Sigma_{j=1}^J E[d_{t+1,j}\cdot \epsilon_{t+1,j}|d_{ti}=1]=$$
$$= u^*_{t+1}(H_{t+1}{}^i) - \Sigma_{j=1}^J p_{t+1,j}(d_{ti}=1)\cdot [\ln p_{t+1,j}(d_{ti}=1)-\gamma]$$

where γ is Euler's constant ($\approx.57721$), $p_{\tau j}=Prob(d_{\tau j}=1)$, and $H_\tau{}^i$ is H_τ in which $d_{\tau-1,i}=1$.[4]

It is easily seen that:

$$(6) \quad v^2_{ti} = E[\Sigma_{j=1}^J p_{t+1,j}\cdot v_{t+1,j}|d_{ti}=1] \equiv v^3_{ti} + v^4_{ti} \equiv$$
$$\equiv E[\Sigma_{j=1}^{J-1} p_{t+1,j}\cdot (v_{t+1,j}-v_{t+1,J})|d_{ti}=1] + E[v_{t+1,J}|d_{ti}=1].$$

Using (4), the assumed nature of state dependence and the fact that J is a terminal choice, we get:

$$(7) \quad v^4_{ti} = E[\Sigma_{s=t+2}^T \beta^{s-(t+1)}\cdot E(u_{sJ}|d_{t+1,J}=1)|d_{ti}=1] =$$
$$= \Sigma_{s=t+2}^T \beta^{s-(t+1)}\cdot E(u_{sJ}|d_{t+1,J}=1,d_{ti}=1] =$$
$$= \Sigma_{s=t+2}^T \beta^{s-t-1}\cdot E[u^*_s|d_{t+1,J}=1].$$

By the distributional assumptions regarding the ϵ's, and (3)', it can be shown that (McFadden 1981):

$$(8) \quad p_{sl} = \exp[-\ln\Sigma_{j=1}^J \exp(v_{sj}-v_{sl})]$$

and hence:

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[4] See Hotz and Miller (1993) for the derivation of (5). The probabilities are conditioned on $d_{ti}=1$.

$$(9) \quad v_{sj}-v_{s1} = ln(p_{sj}/p_{s1}).$$

Therefore:

$$(10) \quad v^3_{ti} = \Sigma_{j=1}^{J-1} p_{t+1,j}{}^{i}\cdot ln(p_{t+1,j}{}^{i}/p_{t+1,J}{}^{i})$$

where $p_{\tau j}{}^{i}$ is $p_{\tau j}$ conditional on $d_{\tau-1,i}=1$.

Using (4)', (5), (6), (7) and (10), the conditional next-period value function can be written as:

$$(4)'' \quad \beta^{-1}\cdot v_{ti} = u^*_{t+1}(H_{t+1}{}^{i}) - \Sigma_{j=1}^{J} p_{t+1,j}{}^{i}\cdot [ln(p_{t+1,j}{}^{i}) - \gamma] + \\ + \Sigma_{j=1}^{J-1} p_{t+1,j}{}^{i}\cdot ln(p_{t+1,j}{}^{i}/p_{t+1,J}{}^{i}) + \Sigma_{s=t+2}^{T} \beta^{s-t-1}\cdot E(u^*_s|d_{t+1,J}=1].$$

The optimization criterion (3)' involves only conditional value function differences such as:

$$(11) \quad \beta^{-1}\cdot (v_{tk}-v_{t1}) \equiv \mu_{t,k-1} + \omega_{t,k-1} \equiv [u^*_{t+1}(H_{t+1}{}^{k}) - u^*_{t+1}(H_{t+1}{}^{1})] + \\ + [\Sigma_{j=1}^{J-1} p_{t+1,j}{}^{k}\cdot ln(p_{t+1,j}{}^{k}/p_{t+1,J}{}^{k}) - \Sigma_{j=1}^{J-1} p_{t+1,j}{}^{1}\cdot ln(p_{t+1,j}{}^{1}/p_{t+1,J}{}^{1}) - \\ - \Sigma_{j=1}^{J} p_{t+1,j}{}^{k}\cdot ln(p_{t+1,j}{}^{k}) + \Sigma_{j=1}^{J} p_{t+1,j}{}^{1}\cdot ln(p_{t+1,j}{}^{1})]$$ [5]

which depend on the next period's utilities ($v^*_{t,k-1}$) and probabilities ($\omega^*_{t,k-1}$) only, respectively. Therefore, the log-likelihood function of the model, using (8) and (11) and omitting the time subscript, is:

$$(12) \quad lnL = \Sigma_{n=1}^{N} \Sigma_{j=1}^{J} d_{nj}\cdot lnp_{nj} = -\Sigma_{n=1}^{N} \Sigma_{j=1}^{J} d_{nj}\cdot ln\Sigma_{i=1}^{J} \exp(v_{ni}-v_{nj}) = \\ = \Sigma_{n=1}^{N} \Sigma_{j=1}^{J} d_{nj}\cdot ln\Sigma_{i=1}^{J} \exp\{\beta\cdot [\mu_{n,j-i} + \omega_{n,j-i}]\}$$

where observations are indexed by n across time periods and individuals.[6]

By (11), ω depends only on the next period's conditional probabilities. If consistent estimators for these probabilities existed, the parameters of utility contained in μ could be

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[5] The other terms cancel because of the assumptions regarding the form of the state dependence.

[6] According to this specification, observations on the same person during two time periods are not distinct from observations on two different individuals. This should be changed if person-specific or period-specific parameters are to be identified. In the current application this does not matter because only two time periods are used.

estimated by Multinomial Logit, conditional on these estimators.[7] The probabilities can be consistently estimated nonparametrically by relative frequencies of observed choices in cells defined according to the state variables.

The remaining task is to parameterize the utility differences in μ. A linear formulation of utility is adopted here:

$$(13)\quad u^*_t(H_t^k) = X_t \cdot \alpha_k + \delta_k$$

where X is a vector of socioeconomic and market variables, α_k is a vector of coefficients, and δ_k is a scalar intercept; the latter two are state-specific.

From (11) it is obvious that not all the coefficients are identified. A normalization such as $u^*_t(H_t^J) = 0$ is necessary, and then the estimated coefficients can be interpreted as differences from the coefficients of choice J. β is also unidentified, and at this point it will be assumed that $\beta=1$.

4. Data and Results

The data set used in this research includes matched observations from the two most recent agricultural censuses in Israel, 1971 and 1981. Only data on family farms from moshavim (cooperative villages) were used, since these represent the majority of family farms in Israel, and data on family farms in other sectors were much less reliable. It should be emphasized that despite the cooperative nature of moshavim, each farmer makes his own decisions with regard to production and consumption, and with regard to time allocation in particular.[8] The 1981 census data set included 28,566 observations, versus 20,848 in the 1971 census data set, since inclusion criteria were more liberal in 1981. Of these, 20,186 observations were

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[7] Hotz and Miller (1993) prove consistency and asymptotic normality for these estimators and derive their asymptotic covariance matrix.

[8] The cooperative structure does have some impact, though, on time-allocation decisions (Kimhi 1993).

identified as representing the same physical farm units in the two census years, but only 84% of those (16,908) were recognized as matched observations, i.e. operated by the same family. Hence, the remaining 3278 observations are treated as those who exited between 1971 and 1981.[9]

The definition of exit from farming is a little problematic, though (Gale and Henderson 1991). During the process of matching the two census data sets, a successful match was defined as a farm which remained in the operation of the same family. Hence, the exiters are defined as those who sold their farm outside the family between 1971 and 1981. I denote this as the conservative exit definition. The problem with this definition for the purpose of this research is that if a different family member is operating the farm in 1981, one cannot treat the two observations on off-farm labor supply as coming from panel data. Hence, I define exit from farming more liberally by including among the exiters the farmers for whom the birth-year differential between the entries in the 1981 and 1971 data sets was larger than five years in absolute value.[10]

Descriptive statistics of the data set, as well as variable definitions, are reported in Table 1. In particular, we can see at the top of the table that close to 60% of the farmers in the sample did not work off the farm in 1971, about 30% worked full-time off the farm, and a little over 10% worked part-time off the farm.

Dealing with a panel of two periods only, one can estimate the off-farm decisions in the first period alone, taking into

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[9] The matching rate is pretty high, in part due to the institutional structure which prevents farmers from dropping out of the farm population even if they stop farming altogether. However, it is clear that some of the matched farms were actually operated by different operators in 1971 and 1981, even though they belonged to the same family (Kimhi 1994, used this data set to study intergenerational succession). Hence, this is the lower bound of the number of exiting farmers.

[10] I had the possibility of inspecting the names of the farmers in a subsample of about 400 farms. There seemed to be birth-year differentials even when it was clearly the same respondent in the two census years. Hence, the liberal definition of exit could create errors in both directions.

account the effects of all possible realizations in the second period. From (11) it can be seen that $\omega_{71,k-1}$ reduces to $\ln(p_{81,J}^{1}/p_{81,J}^{k})$ in this case. Since state J stands for exit between 1971 and 1981, the meaning is that all future choices are represented in the estimated equation for state k relative to state 1 by the ratio of the probability of exit given state 1 in 1971 and the probability of exit given state k in 1971.

The conditional exit probabilities were estimated using a simple nonparametric method. The sample was first divided into cells according to age, farm-work status, diversification, major output, and, of course, off-farm-work status. Then, the probability of exit in each cell was estimated by the frequency of exits in that cell, and each observation in the cell was assigned this same probability.[11]

At the bottom of Table 1 we have the average conditional exit probabilities. We can see that for both exit definitions, the probability of exiting is highest for those farmers who don't work off the farm. This may be because those who do not work off the farm are near retirement so they are more likely to exit from farming as well.[12] It may also be due to the fact that those who do not work off the farm are subject to a larger farm-related income risk, and this may force some of them to exit in the future, whereas working off the farm stabilizes the farmer's income . One could expect that the probability of exiting is higher for those who work full-time off the farm than for those who work part-time off the farm, because the former are probably less attached to the farm than the latter. However, the two exit definitions gave opposite results for the full-time/part-time differences in probability of exit, and the difference was quite small in both cases, so the raw data do not support this expectation.

The Multinomial Logit results are reported in Table 2. Three versions of the model were estimated. The conservative exit

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[11] Of course, more sophisticated nonparametric methods such as kernel methods could have been used. I chose the simpler method since here the estimates only serve as instruments.

[12] This can be tested by controlling for age.

definition was adopted initially, and this model was estimated twice, first without correction for the life-cycle decisions (myopic model) and then including the exit-probability ratios (life-cycle model). Then the life-cycle model was estimated again, using the liberal exit definition.

One can immediately observe that the coefficients of the exit-probability ratios ($\omega_{71,k-1}$) in the last two versions (life-cycle models) are strongly significant, and hence the nested hypothesis of myopic behavior of farmers is statistically rejected by the likelihood-ratio test at all reasonable significance levels.

In addition, the coefficients of explanatory variables differ remarkably in the first two versions (conservative exit definition). Although none of the statistically significant coefficients changed signs by moving from the myopic model to the life-cycle model, quite a few of them lost or gained significance, and also varied in size. For example, look at the coefficients of Land and Capital. In the part-time equation, the coefficient of Land is negative and significant in the myopic model, and becomes practically zero in the life-cycle model. The coefficient of Land in the full-time equation comes out significantly negative in the two models, but in the myopic model it is almost twice as large in absolute value as in the life-cycle model. The coefficient of Capital exhibits the same features in the full-time equation, but the opposite ones in the part-time equation: it is not significant in the myopic model and is significant in the life-cycle model. These and other features can be observed in the coefficients of the other variables as well. Another example is the coefficient of Div3 (see Table 1 for a definition) in the full-time equation, which is negative and significant in the myopic model, and positive and significant in the life-cycle model.

What can we learn from the life-cycle model about the off-farm work decisions of farmers? To answer this, we need to look at the results of the life-cycle model using both exit definitions, so that our conclusions are not dependent on any one arbitrarily chosen exit definition. For this purpose, Table 3 reports the signs of the coefficients which are consistent in the two exit definitions.

Let's focus first on the life-cycle effect itself. The coefficients of the exit-probability ratios ($\omega_{71,k-1}$) are large and positive in the two equations. For both exit definitions, the life-cycle effect is different in the part-time and full-time equations, but the direction of the difference is not the same for the two exit definitions, so we will not treat this as a reliable result. Recall that the life-cycle effect is the ratio of the probability of exit conditional on not working off the farm in 1971 and the probability of exit conditional on working. Therefore, the coefficients indicate that the tendency of a farmer to work off the farm in 1971 is higher if he is less likely to exit from farming given that he decides to work off the farm, and if he is more likely to exit given that he decides not to work off the farm. Exit from farming seems to be conceived as a "bad" outcome and, contrary to other findings (Roe 1995), off-farm work seems to be associated with higher prospects to remain on the farm in the long run.[13]

Second, we examine the decision to work off the farm versus not working.[14] We can see that off-farm work first increases and then decreases with age. This is a common result in off-farm work studies (Lass et al. 1991). Off-farm work is more likely in larger families. This is consistent with the results of Kimhi (forthcoming). However, off-farm work declines with the number of family members working full-time on the farm. Perhaps the latter is a proxy for farm profitability which is expected to have a

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[13] Bollman and Kapitani (1981) found that working off the farm decreases the exit probability, but given that the farmer works off the farm, working more off the farm increases the exit probability. The first result is consistent with the Israeli results, whereas for the second, the two exit definitions give conflicting results.

[14] For this purpose only, we could have estimated a model that pools the off-farm participants into one group. However, the distinction according to the extent of work is important, at least for some of the variables. The coefficients that are not significantly different in the two equations are marked in table 2.

negative impact on the motivation to work off the farm. The diversification dummies show mixed results: off-farm participation seems to rise with increased diversification and eventually fall. Among the major output categories, we can note especially that field-crop, vegetable, and flower growers, as well as operators of livestock farms other than poultry, are less likely to work off the farm, whereas fruit growers are more likely to do so. Off-farm participation is also more common in villages established prior to 1950.

Turning to the full-time/part-time decision, we have already seen that Land and Capital decrease the tendency to work full-time off the farm. Moreover, the number of family members working full-time on the farm is associated with a lower tendency to work full-time off the farm relative to part-time. Vegetable, flower, and livestock farms are associated with a higher tendency to work part-time versus full-time off the farm. Except for the most recently established villages, all other establishment-year groups of villages are associated with a higher tendency to work full-time versus part-time off the farm.

5. Conclusions

The main purpose of this paper was to claim that off-farm work decisions of farmers take into account future implications of these decisions. This claim is strongly supported by the data, as the myopic decision model was rejected in favor of the life-cycle model. Moreover, the effects of explanatory variables on the off-farm work decision have been found to be biased when the life-cycle effect is ignored. The results indicate that farmers choose to work off the farm when it reduces the prospects of a future exit from farming. This implies that farmers view part-time farming as a stable long-run objective rather than as a step on the way out of agriculture.

References

Altonji, Joseph G., "Intertemporal Substitution in Labor Supply: Evidence from Micro Data," *Journal of Political Economy*, June 1986, Vol. 94, No. 3, Pt. 2: S176-215.

Bollman, Ray D., and Kapitani, Marilyn, *Entry and Exit Functions for Farmers*. Paper presented to the Annual Meeting of the Rural Sociology Society, Guelph, Ontario, August 1981.

Gale, Fred, and Henderson, David, *Estimating Entry and Exit of U.S. Farms*. Staff Report AGES 9119, U.S. Department of Agriculture, Washington, DC, March 1991.

Gould, Brian W. and Saupe, William E., "Off-Farm Labor Market Entry and Exit," *American Journal of Agricultural Economics*, November 1989, *71(4)*: 960-9.

Gronau, Reuben, "Leisure, Home Production, and Work - the Theory of the Allocation of Time Revisited," *Journal of Political Economy*, December 1977, *85(6)*: 1099-123.

Heckman, James J., and Sedlacek, Guilherme L., "Self-Selection and the Distribution of Hourly Wages," *Journal of Labor Economics*, January 1990, *8(1), Pt. 2*: S329-63.

Hotz, V. Joseph, and Miller, Robert A., "Conditional Choice Probabilities and the Estimation of Dynamic Models," *Review of Economic Studies*, July 1993, *60(3)*: 497-529.

Huffman, Wallace E., "Farm and Off-Farm Work Decisions: the Role of Human Capital," *Review of Economics and Statistics*, February 1980, *LXII(1)*: 14-23.

______**, and Lange, Mark D.**, "Off-Farm Work Decisions of Husbands and Wives: Joint Decision Making," *Review of Economics and Statistics*, August 1989, *LXXXI(3)*: 471-80.

Kimhi, Ayal, *Institutional Environment, Ideological Commitment, and Farmers' Time Allocation: the Case of Israeli Moshavim*. Mimeo, Department of Agricultural Economics and Management, The Hebrew University, Rehovot, Israel, 1993.

______, "Optimal Timing of Farm Transferal from Parent to Child," *American Journal of Agricultural Economics*, May 1994, *76(2)*: 228-36.

______, "Demographic Composition of Farm Households and its Effect on Time Allocation," *Journal of Population Economics*, forthcoming.

______**, and Myoung-jae Lee**, "Off-Farm Work Decisions of Farm Couples: Estimating Structural Simultaneous Equations With Ordered Categorical Dependent Variables," *American Journal of Agricultural Economics*, 1996 (forthcoming).

Lass, Daniel A., Findeis, Jill L., and Hallberg, Milton C., "Factors Affecting the Supply of Off-farm Labor: a Review of Empirical Evidence." In M.C. Hallberg, J.L. Findeis and D.A. Lass, eds., *Multiple Job-holding among Farm Families*, Ames: Iowa State University Press, 1991.

Levhari, David and Weiss, Yoram, "The Effect of Risk on the Investment in Human Capital," *American Economic Review*, December 1974, *64(6)*: 950-63.

Macurdy, Thomas E., "An Empirical Model of Labor Supply in a Life-Cycle Setting," *Journal of Political Economy*, December 1981, *89(6)*: 1059-85.

Mazumdar, D., "Rural-Urban Migration in Developing Countries." In E.S. Mills, ed., *Handbook of Regional and Urban Economics*, North-Holland, 1987, *2*: 1097-128.

McFadden, Daniel, "Qualitative Response Models." In Charles Manski and Daniel McFadden, eds., *Structural Analysis of Discrete Data with Economic Applications*, MIT Press, Cambridge, 1981.

Mundlak, Yair, *Agriculture and Economic Growth: Lecture Notes*, The University of Chicago, 1989 (Chapter 9).

Pfeffer, M.J., "Part-Time Farming and the Stability of Family Farms in the Federal Republic of Germany," *European Review of Agricultural Economics*, 1989, *16(4)*: 425-44.

Roe, Brian, *A Study of U.S. Farm Exits with Evidence from the Panel Study of Income Dynamics: 1968-89*. Unpublished manuscript, Department of Agricultural and Resource Economics, University of Maryland, College Park, MD, August 1995.

Rosen, Sherwin, "Specialization and Human Capital," *Journal of Labor Economics*, January 1983, *1(1)*: 43-9.

Shishko, Robert, and Rostker, Bernard, "The Economics of Multiple Job Holding," *American Economic Review*, June 1976, *66(3)*: 298-308.

Singh, I., Squire, L., and Strauss, J., "The Basic Model: Theory, Empirical Results and Policy Conclusions." In I. Singh, L. Squire and J. Strauss, eds., *Agricultural Household Models: Extensions, Applications and Policy*, The John Hopkins University Press, 1986.

Sumner, Daniel A., "The Off-Farm Labor Supply of Farmers," *American Journal of Agricultural Economics*, August 1982, *64(3)*: 499-509.

Weiss, Christoph R., *Do They Come Back Again? State Dependence and Reversibility of Off-Farm Employment*. Unpublished manuscript, University of Linz, Austria, 1994.

_____, *Exits from a Declining Sector: Econometric Evidence from a Panel of Upper-Austrian Farms 1980-1990*. Working Paper No. 9601, Department of Economics, University of Linz, Linz, Austria, February 1996.

Weiss, Yoram, "Learning By Doing and Occupational Specialization," *Journal of Economic Theory*, June 1971, *3*: 189-98.

Table 1. Variable Definitions and Descriptive Statistics

Variable	Definition	Sample Mean
Wmnot	Not working off the farm in 1971	0.5903
Wmpart	Working part-time off the farm in 1971	0.1056
Wmfull	Working full-time off the farm in 1971	0.3040
Age	Age of farmer in years	47.4725
Family	Number of family members	5.2031
Ftfam	Number of family members working full-time on the farm	0.7462
Land	Number of dunams (0.25 acre) used	28.1401
Capital	Value of capital stock ($1000, 1981)	6.4211
Div1	Major output consists of over 90% of total	0.2110
Div2[a]	Major output consists of 75%-90% of total	0.3547
Div3	Two major outputs consisting of over 80% of the total, each over 20%	0.2954
Div4	Three major outputs consisting of over 85% of the total, each over 10%	0.0764
Div50	All other nonspecialized farms	0.0625
Anaf1	Major output is citrus fruits	0.0952
Anaf2	Major output is other fruits	0.0513
Anaf3	Major output is field crops	0.0365
Anaf4	Major output is livestock-feed crops	0.0283
Anaf5	Major output is vegetables	0.1466
Anaf6	Major output is flowers	0.0258
Anaf7	Major output is milk and beef	0.2073
Anaf8[a]	Major output is poultry	0.4000
Anaf9	Major output is other livestock	0.0090
Sh1	Village established before 1936	0.1499
Sh2	Village established 1936-1947	0.0719
Sh3	Village established 1948-1949	0.2308
Sh4[a]	Village established 1950-1952	0.3448
Sh5	Village established 1953-1956	0.1569
Sh67	Village established after 1956	0.0457
<u>Exit probabilities, conservative definition</u>[b]		
Pexnot	Probability of exit in 1981 given Wmnot	0.1790
Pexpart	Probability of exit in 1981 given Wmpart	0.1355
Pexfull	Probability of exit in 1981 given Wmfull	0.1479
<u>Exit probabilities, liberal definition</u>[c]		
Pexnot	Probability of exit in 1981 given Wmnot	0.4613
Pexpart	Probability of exit in 1981 given Wmpart	0.3424
Pexfull	Probability of exit in 1981 given Wmfull	0.3355

[a] this largest category was excluded from the empirical analysis.
[b] only those who were not observed in 1981 are considered exiters.
[c] in addition to those who were not observed in 1981, farm operators with birth-year differentials of more than 5 years in absolute value between 1971 and 1981 are considered exiters.

Table 2. Multinomial Logit Results

	Conservative Exit Definition				Liberal Exit Definition	
	Myopic Model		Life-Cycle Model		Life-Cycle Model	
Variable	Part-Time	Full-Time	Part-Time	Full-Time	Part-Time	Full-Time
$\omega_{71,k-1}$[b]			12.0675 (48.57)	11.3458 (47.99)	16.7583 (39.39)	19.9850 (46.40)
Intercept	-5.0208 (-12.77)	-3.2293 (-10.44)	-4.5017 (-9.66)	-2.5517 (-6.56)	-4.4118 (-9.25)	-3.8603[a] (-8.13)
Age	0.2826 (15.41)	0.2995[a] (20.55)	0.2233 (10.24)	0.2370[a] (13.05)	0.2574 (11.36)	0.2823[a] (12.33)
Age squared	-0.0036 (-17.97)	-0.0041 (-25.31)	-0.0032 (-13.25)	-0.0036 (-17.86)	-0.0037 (-14.58)	-0.0044 (-16.81)
Family	0.0532 (4.91)	0.0375[a] (3.94)	0.0673 (5.16)	0.0539[a] (4.60)	0.0606 (4.64)	0.0442[a] (3.24)
Ftfam	-2.3014 (-40.01)	-3.1114 (-60.12)	-2.3930 (-33.39)	-3.2777 (-49.07)	-2.5631 (-35.55)	-3.3392 (-43.52)
Land	-0.0046 (-2.46)	-0.0097 (-5.69)	-0.0001 (-0.06)	-0.0053 (-2.84)	-0.0010 (-0.54)	-0.0050 (-2.28)
Capital	0.0019 (0.38)	-0.0416 (-6.58)	0.0071 (2.34)	-0.0280 (-4.31)	0.0056 (1.72)	-0.0165 (-2.30)

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Table 2. (continued)

Variable	Conservative Exit Definition				Liberal Exit Definition	
	Myopic Model		Life-Cycle Model		Life-Cycle Model	
	Part-Time	Full-Time	Part-Time	Full-Time	Part-Time	Full-Time
Sh1	0.0679 (0.57)	0.3517 (3.65)	0.1092 (0.81)	0.3713 (3.27)	0.0589 (0.43)	0.3550 (2.61)
Sh2	0.3432 (2.38)	0.7206 (6.07)	0.2389 (1.43)	0.5735 (4.02)	0.0527 (0.30)	0.2761[a] (1.57)
Sh3	0.2247 (2.99)	0.4805 (7.39)	0.2462 (2.72)	0.4876 (6.00)	0.2426 (2.64)	0.5240 (5.52)
Sh5	-0.4244 (-4.90)	-0.2442 (-3.40)	-0.2914 (-2.86)	-0.1431 (-1.62)	-0.3472 (-3.46)	-0.1183 (-1.18)
Sh67	0.1797 (1.35)	-0.1580 (-1.33)	-0.0444 (-0.27)	-0.3828 (-2.47)	-0.0449 (-0.28)	-0.4583 (-2.68)
Div1	0.0746 (0.91)	0.0600[a] (0.86)	-0.0952 (-0.94)	-0.1074[a] (-1.20)	0.0167 (0.17)	-0.0164[a] (-0.16)
Div3	0.0848 (1.17)	-0.1339 (-2.15)	0.5681 (6.51)	0.3008 (3.88)	0.1002 (1.15)	0.1792[a] (2.02)
Div4	0.0990 (0.86)	-0.2261 (-2.17)	0.5102 (3.81)	0.1719 (1.40)	0.0864 (0.65)	0.0826[a] (0.60)
Div50	-0.6104 (-4.10)	-0.4174[a] (-3.70)	-1.7265 (-8.68)	-1.3958 (-8.27)	-1.0958 (-5.72)	-0.9688[a] (-5.24)

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Table 2. (continued)

Variable	Conservative Exit Definition				Liberal Exit Definition	
	Myopic Model		Life-Cycle Model		Life-Cycle Model	
	Part-Time	Full-Time	Part-Time	Full-Time	Part-Time	Full-Time
Anaf1	-0.3745 (-2.87)	0.2157 (2.19)	-0.3110 (-2.06)	0.3683 (3.06)	0.1418 (0.91)	1.0434 (7.05)
Anaf2	-0.0397 (-0.31)	-0.0099[a] (-0.09)	0.2872 (1.95)	0.3716[a] (2.85)	0.6857 (4.68)	1.1006 (7.49)
Anaf3	-0.3138 (-1.93)	-0.2580[a] (-2.00)	-0.7268 (-3.79)	-0.5496[a] (-3.46)	-0.1513 (-0.80)	0.0642[a] (0.36)
Anaf4	-0.2252 (-1.15)	0.1923 (1.30)	-0.2414 (-1.08)	0.2543 (1.42)	0.2443 (1.04)	0.8364 (3.80)
Anaf5	-0.5245 (-5.51)	-1.2726 (-14.92)	-0.3148 (-2.84)	-1.0010 (-9.83)	-0.1177 (-1.07)	-0.4408 (-3.80)
Anaf6	-0.8754 (-4.70)	-1.5205 (-8.89)	-0.5923 (-2.79)	-1.1459 (-6.10)	-0.3652 (-1.82)	-0.5867[a] (-2.77)
Anaf7	-0.3424 (-3.92)	-0.7537 (-9.58)	-0.1680 (-1.62)	-0.6303 (-6.54)	-0.2366 (-2.19)	-0.6158 (-5.37)
Anaf9	-0.7412 (-2.64)	-1.0095[a] (-4.38)	-0.6177 (-1.74)	-0.9356[a] (-2.98)	-0.8844 (-2.33)	-1.3186[a] (-3.35)
2*Log-likelihood	-23149		-17748		-15441	

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Table 2. (continued)

Notes:
20,122 observations.
t-ratios in parentheses.
coefficients of regional dummies are not reported.
[a] the difference between the coefficients is not significant.
[b] the index k in the two equations is the part-time/full-time decision, respectively, and the index l is the not-working decision.

Table 3. Signs of Coefficients Which are Consistent Across Exit Definitions

Variable	Part-Time	Full-Time
$\omega_{71,k-1}$	+	+
Intercept	-	-
Age	+	+
Age squared	-	-
Family	+	+
Ftfam	-	--
Land	?	-
Capital	+	-
Sh1	?	+
Sh2	?	+
Sh3	+	++
Sh5	--	-
Sh67	?	-
Div1	?	?
Div3	+	+
Div4	+	+
Div50	-	-
Anaf1	?	+
Anaf2	+	+
Anaf3	?	?
Anaf4	?	+
Anaf5	-	--
Anaf6	-	--
Anaf7	-	--
Anaf9	-	--

Notes: A plus (minus) sign indicates a coefficient which is consistently positive (negative) in the two exit definitions. A double plus or minus means a significant and consistent difference in this coefficient between the full-time/part-time equations. It does not intend to compare coefficients of different explanatory variables. A question mark indicates a coefficient which is insignificant or changes sign in the two exit definitions.

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