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Family farm dynamics in Canada and Israel: the case of farm exits

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Abstract

Canada is one of the few countries for which data exist on individual family farms over time. Using these data, researchers have been able to show that much of the microdynamics of family farms in Canada (e.g. changes in size distribution) can be attributed to farmer entry and exit. However, the behavioral aspects of the exit decision received little attention in the literature. A comparison of Canadian and Israeli data could help us understand these behavioral aspects because of the vast institutional differences between the farm sectors in the two countries, and the possible effect of the institutional setup on exit decisions. Comparison of exit patterns may enable us to identify the dependence of farmers' mobility on the institutional setup. This may also have policy relevance. In both Canada and Israel, exit probability decreases with the extent of off-farm work. We conclude that off-farm work is complementary rather than a substitute for farm work, perhaps due to its less volatile nature. Both, Canadian and Israeli farmers over a certain age are more likely to exit as they become older, which is a natural result, but exit probability in Canada rises much faster with age than in Israel. The major difference between Canadian and Israeli farm-exit patterns lies in the farm size. Farm size decreases exit probability in Canada but increases it in Israel. Perhaps this is because Israeli farm exits are less planned in advance than Canadian exits. Institutional constraints on land transactions in Israel may also play a role.

Keywords: Farm exit; Off-farm work; Farm size; Institutional setup

1. Introduction

Much of the microdynamics of family farms in Canada, such as changes in the size distribution and other characteristics of farms, has been attributed to farmer entry and exit (Bollman and Steeves, 1982; Ehrensaft et al., 1984; Shapiro et al., 1987; Ehrensaft and Bollman, 1990). However, most of the analyses of this observation have been descriptive in nature, and the behavioral aspects of the exit decision have received little attention in the literature (an exception is the paper by Bollman and Kapitany, 1981). The most obvious reason for this is lack of adequate data. Longitudinal data sets of farms are not available in most countries. The two exceptions are Canada and Israel. A comparison of Canadian and Israeli census data may shed light on the issue of farm exits, because Israeli and Canadian farmers operate in very different institutional environments. The institutional environment is likely to affect the exit decision. Comparing the exit patterns of Canadian and Israeli farmers may enable an identification of the dependence of farmers' mobility on the institutional setup. This may be

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important to policy makers wishing to alter the natural rate of farm exits, as is the case in many countries.

Although farmers are known to be emotionally attached to their farms (Friedberger, 1988), the studies quoted above indicate that there is in fact significant mobility out of agriculture, at least in Canada (although most of the movement is among small farms). Farmers choose to exit at or prior to retirement. In both cases, the alternative utility must be greater than the on-farm utility, by a factor large enough to cover the psychic cost of exit. Exit is almost inevitable in old age because of health problems and a decline in the ability to perform physical tasks, but it may also be a consequence of poor ability to run a farm, or simply bad luck. Hence, the decision to exit is in part planned ahead, and in part a consequence of revealed poor farm performance. In addition, exit can be gradual, implying that farmers may reduce farm activity, perhaps shift to part-time off-farm work, and eventually exit. Hence, in order to identify the determinants of farm exit, one has to understand the dynamics of this decision.

The exit decision strongly depends on the income-age profile of farm firms.[1] We hypothesize that income first increases with age and eventually decreases (Evans, 1987). The theoretical model of Kimhi (1994) assumes this profile, but explains planned exits only, since this model is based on perfect foresight. The model is designed as a planning problem in which the farmer decides when he wants to quit during the planning period. The model of Diamond and Hausman (1984) adds the possibility of unexpected forced exit, but treats its probability as known in advance. If new information is revealed over time, this decision can be altered. In this case, the exit decision will also depend on information observed after the initial planning period. This enables one to measure the relative importance of planned and unplanned exits to explain the dynamics of the farm population.

The difference between planned and forced exits can be captured to some extent by the type of farm exit. If an exit occurs in the form of within-family intergenerational succession, it is unlikely to be a forced exit, because children will be less willing to succeed on a failing farm (Kimhi et al., 1995). However, selling a farm outside the family may be due to either type of exit. Unfortunately, the Canadian data set does not differentiate between exit types.

The main objective of this research is to compare the time patterns of exit decisions among farm operators in Canada and Israel, using longitudinal data sets. This is done by estimating the probability of farm exit in each country as a function of conditioning variables, including age, which represents the stage in the life cycle. The estimates are used to indirectly evaluate the relative importance of planned and unplanned exits. This will have implications for the ability to forecast future changes in the composition of farm households in the two countries.

Section 2 outlines a theoretical framework which leads to a specification of the tendency to exit farming during a given time period. For the empirical model, a first-order approximation of this tendency is expressed as a linear function of the conditioning variables, and this leads to a probit model assuming normally distributed approximation errors. Because the theoretical framework is quite general, it is not easy to predict the directions of the effects of most conditioning variables on the exit probability. Section 3 describes the panel data sets and provides some preliminary comparisons of exit probabilities by farm size and by off-farm work status in the two countries. Section 4 includes the results of estimating the exit probability using the probit model in each country, and a discussion of the differences between the Canadian and Israeli results. Section 5 provides a summary and conclusions.

2. Theory and empirical model

Assume that for each time period, the farmer (or farm family) maximizes the present value of future utilities, and that utility in each period is a function of consumption and leisure. Specifically, in period t the farmer maximizes

$$V_t = \sum_{\tau=t}^{\infty} \beta_{\tau|t} U(C_\tau, L_\tau) \tag{1}$$

where C_τ is the consumption, L_τ the leisure, and $\beta_{\tau|t}$ the discount factor from period τ to period t, and as

[1] In small family businesses and, in particular, family farms, the life-cycle of the firm is closely linked to the life-cycle of the owner-operator. Hence, we allow ourselves to carry logical arguments from one to the other.

such includes the probability of survival to period τ. We consider all decisions, including time allocation, consumption, and exits, as made at the beginning of each period. Hence, without loss of generality, we can assume that $\beta_{t|t} = 1$. However, the exit takes place at the end of a given period. More explicitly, the farmer decides at the beginning of each period whether he will exit at the end of that period. Utility is also implicitly conditioned on a set of shifters such as location-specific and institutional factors, and personal attributes. V_t is maximized subject to an intertemporal budget constraint of the form

$$\sum_{\tau=t}^{\infty} R_{\tau|t} C_\tau = \sum_{\tau=t}^{\infty} R_{\tau|t}(W_\tau(1 - L_\tau) + F_\tau) + A_t \quad (2)$$

where A_t is the value of assets at the planning time t, F_τ the net farm income, W_τ the off-farm wage rate, and $R_{\tau|t}$ the market discount rate from period τ to period t. Several simplifying assumptions have been implicitly made in the formulation of Eq. (2). First, total time available for work or leisure is fixed at one unit. Second, net farm income is derived by subtracting the alternative cost of the farmer's own labor input, which is the off-farm wage rate multiplied by the time worked on the farm. Third, the off-farm wage is known even for farmers who do not currently work on the farm, and is equal to the wage the farmer will get if he exits the farm.

Conditional on staying on the farm or exiting, the farmer may have a different maximization problem. It is obvious that the budget constraint differs in the two situations (e.g. farm income will be zero after exiting), and hence the choices of consumption and leisure will be different. Exiting the farm often involves residential relocation which may change some of the conditioning variables in the utility function, and even the survival probabilities may differ. Given an exit at the end of period $t - 1$, and assuming (throughout the analysis) that exits are irreversible (this is reasonable, given the definition of exit as ceasing to own the farm), the maximized value of Eq. (1) subject to Eq. (2) in which F_τ is set to zero, is denoted by V_t^E. Given that a farmer decided not to exit at the end of period $t - 1$, the present value of his utility must take into account the possibility of an exit in each future time period. Following Kimhi (1995) and Pesquin et al. (1999), we use a dynamic programming formulation to model the exit decision. The farmer decides to exit at the end of period $t - 1$ if V_t^E exceeds V_t^S, the present value of utility given a decision not to exit at the end of period $t - 1$, which is defined as the maximized value of

$$U(C_t, L_t) + \beta_{t+1|t} \max(V_{t+1}^S, V_{t+1}^E) \quad (3)$$

subject to Eq. (2).

Both V_t^E and V_t^S are assumed to have a reduced-form representation in which each is a function of the conditioning variables: those affecting farm income and off-farm income in all present and future time periods, and utility shifters. As a result, the difference $W_t = V_t^E - V_t^S$ is also a function of all the conditioning variables. W_t can be defined as the tendency to exit in period t. It will be negatively related to variables which increase present or future on-farm utility, and positively related to variables which increase present off-farm utility. It will also be negatively related to variables which increase future off-farm utility.

From the foregoing it is clear that the direction of the effect of most conditioning variables on the tendency to exit cannot be determined in advance. Take for example personal attributes which stand for human capital variables, such as health or education: these affect utility in all situations and time periods. Alternatively, consider variables that affect mostly off-farm utility, such as labor-market conditions: these affect both present and future off-farm utility and, hence, have an ambiguous effect on the tendency to exit. Even farm attributes associated with higher farm incomes, which have a negative direct effect on the tendency to exit, may have a positive indirect effect through the income effect of past farm performance on present off-farm utility. As a result, we will not try to make ex-ante predictions on the effects of different conditioning variables. Rather, we will use the results to determine which of the opposite effects dominates the others in the exit decision.

In the empirical analysis, we want to use data on actual exits in certain farm families as a proxy for the unobserved tendency to exit. The actual exit and the tendency to exit are linked according to the definition of the following index function:

$$I_t = \begin{cases} 1 & \text{if } W_t > 0 \text{ (farmer decides to exit in period } t) \\ 0 & \text{otherwise (farmer decides not to exit in period } t) \end{cases} \quad (4)$$

Specifying the first-order approximation of W_t as $X_t\beta + \varepsilon_t$, where the matrix X includes a unit vector

and all the conditioning variables assumed to affect the tendency to exit, and assuming a certain probability distribution of the approximation error ε, we can derive the likelihood function of the model-given observations on I_t and X_t. For example, given a set of N observations on the exit/non-exit of farmers in a given time period t, and assuming that ε_t is distributed as a standard normal random variable, the log-likelihood function is that of the simple probit model:

$$\ln \ell = \sum_{n=1}^{N} \{I_n \ln [1 - \Phi(-X_n\beta)] + (1 - I_n) \ln \Phi(-X_n\beta)\} \tag{5}$$

where $\Phi(\cdot)$ is the cumulative distribution function of a standard normal random variable:

$$\Phi(-X\beta) = \int_{-\infty}^{-X\beta} (2\pi)^{-1/2} \exp(-t^2/2)\, dt \tag{6}$$

In Eqs. (5) and (6), we have deleted the time subscripts for simplicity. Note that the assumption of unit variance of ε is not necessary. Alternatively, if the variance is σ^2, then the identified coefficient vector is β/σ. The probit model can be estimated by maximum-likelihood methods. Alternatively, the normality assumption can be relaxed by using semi-parametric estimation methods (e.g. Gabler et al., 1993), but this is beyond the scope of this paper.

3. Data and preliminary observations

The panel data sets from Canada and Israel used in this research were both derived from agricultural censuses. In each country, the panel structure of the data is based on a name and address match of farm operators in two consecutive agricultural censuses, conducted by the relevant statistical authority (Statistics Canada, and the Central Bureau of Statistics in Israel). In Canada, this is also the way in which an exit is recorded: if there is no match between a farm operator in a given census and the list of farm operators in the next census, it is recorded that this farm operator has exited at some point in time between the two census years. In Israel, matching was performed between *farm families* rather than between *farm operators* as in Canada. As a result, we can differentiate between farmers who transferred the farm within the family through intergenerational succession and those who sold the farm outside the family. On the other hand, in the case of within-family succession, the definition of an exit has to be based on personal characteristics of the farm operator, namely age. We decided to allow a maximum five-year difference in ages before deciding that a farm was transferred to a child between the two census years. Other than that, and a few differences in variable availability and definitions, the two data sets are very similar.

The Canadian panel data starts with the 1966 census, and goes through the next censuses up to 1991. However, in this research we used data from the first two censuses only, namely 1966 and 1971. We also restricted the analysis to farms from the Atlantic provinces only (Prince Edward Island, Nova Scotia, and New Brunswick; Newfoundland was excluded due to its small number of family farms), so that the data are not subject to the vast changes in the wheat-marketing policy during that period, which affected mostly prairie farmers. The Israeli panel data covers the last two agricultural censuses only, namely 1971 and 1981. Table 1 includes a comparison of key variables in the Canadian and Israeli data sets. According to the definition above, 40% of the Israeli farmers exited between 1971 and 1981, whereas around 50% of the Canadian farmers exited between 1966 and 1971. Note that this last exit rate is for the Atlantic provinces only; the exit rate for Canada as a whole was 35.5% during that period (Bollman and Steeves, 1982).

The difference between these exit rates should be evaluated with respect to the prevailing market conditions in the two countries during the relevant time periods. While the 1970s were relatively stable and promising years for Israeli farmers, the Atlantic provinces of Canada experienced relatively low unemployment rates in the second half of the 1960s. This may have contributed to the higher exit rates observed in the Canadian data set relative to the Israeli data set.[2]

One of the key variables that is supposed to affect the exit decision is farm size. The direct effect of farm size on the probability of exit is negative because it

[2]It is also worth mentioning that agricultural employment in Canada stabilized in the beginning of the 1970s, following decades of continuous decline.

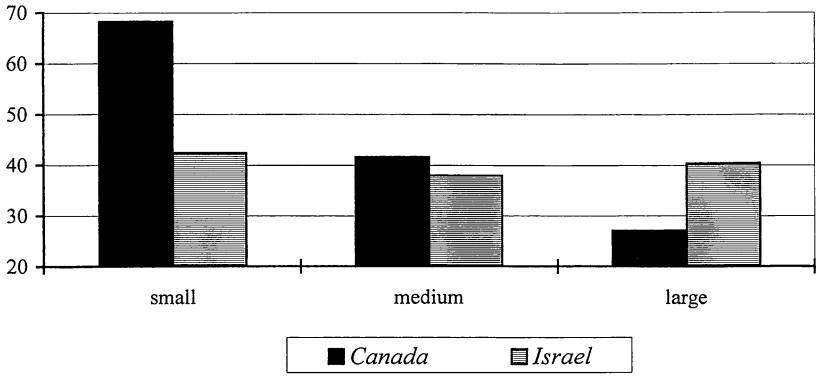
Table 1
A comparison of Canadian and Israeli data sets

	Canada	Israel
Coverage	24 288 observations from the 1966 census of agriculture in three Atlantic provinces	20 122 complete records from the 1971 census of agriculture
Location	Observations are divided by province and county	Observations are divided among 10 administrative regions. Farms are identified by village, and the establishment year of the village is identified as one of seven categories
Personal characteristics	Farm operators reported their age as one of eight categories, and whether they reside on the farm	Farm operators reported their actual age (47.5 years on average). They also reported family size (5.2 on average) and the number of family members working full-time on the farm (0.75 on average)
Off-farm work	Farm operators reported their annual days of off-farm work (71.4 on average)	Farm operators reported whether they work part-time (10.6%) or full-time (30.4%) off the farm
Farm type	Reported as one of 12 categories	Reported as one of nine categories
Farm size	Land owned (165 ac on average) and rented (9), farm value ($ 153 539 on average), and total sales ($477 147)	Land owned (7 ac on average) and capital stock (US$ 6421 on average, 1981 prices)
Other farm attributes	Number of male (0.30 on average) and female (0.06) hired workers employed during the year, number of hired workers on a year-round basis (0.11 on average), and wages paid ($ 54 388 on average)	Farms are divided into four diversification levels

affects net farm income positively. There can also be an indirect positive income effect, because a higher farm income may induce farmers to retire earlier via its positive effect on future off-farm utility. Fig. 1 shows the exit rates of Canadian and Israeli farmers in terms of different farm sizes. In Canada, exit rates are clearly inversely related to farm size, and, hence, we can conclude that the direct effect dominates. On the other hand, the relationship between exit rates and farm size in Israel is very weak, indicating that the direct and indirect effects may be canceling each other out.

Another important conditioning variable is the off-farm work status of the farm operator. Again, its effect on the exit probability is ambiguous. On the one hand, farmers who have an off-farm job may find it easier and less painful to exit prior to retirement. In addition, these farmers are perhaps farming less intensively than full-time farmers, and therefore give up a smaller farm income for a given farm size upon exiting. On the other hand, many researchers claim that modern farming and an off-farm job can in fact be complementary, since off-farm income serves as a stabilizer for the farm-income volatility experienced by farm sectors throughout the western world (Mishra and Goodwin, 1997).

Fig. 2 shows very different net effects in Canada and in Israel. In Canada, farm operators without off-farm jobs are less likely to exit than those who work off the farm. In fact, the difference vanishes if only those who work part-time off the farm are considered: only a full-time off-farm job makes the farm operator more likely to exit. This is consistent with the first argument, that an off-farm job makes it easier to exit farming. In Israel, on the other hand, the reverse is true: farmers without an off-farm job are more likely to exit than those who work off the farm. There is no substantial difference in exit probability between those who work full-time and those who work part-time off the farm. This is consistent with the second

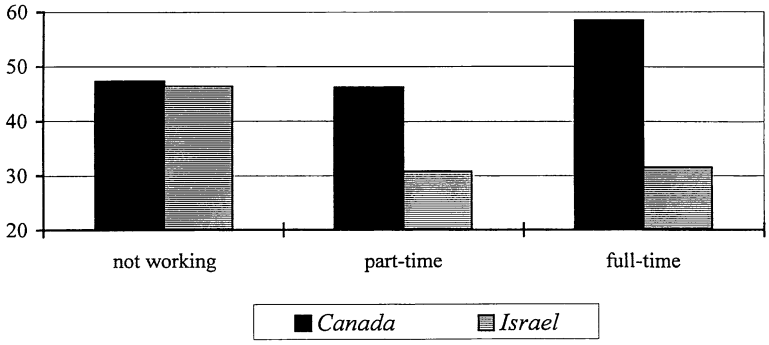


Notes:
Size is determined by the $ value of capital stock (for units see table 1), according to the following categories:

Country	Canada	Israel
Small	under 9950	under 3000
Medium	9950-24949	3000-9999
Large	24950 and over	10000 and over

Fig. 1. Exit rates by farm size.

argument, that an off-farm job is a complement to farming and may stabilize total family income. This result is also documented in more detail in Kimhi (1996). If this view is correct, we may conclude that Canadian farmers' exits are planned whereas Israeli farmers' exits are forced. It makes sense that a farmer who plans to exit will first seek an off-farm job, and this contradicts the Israeli findings. On the other hand, it could be that the Canadian exits are unplanned as well, if those who work off the farm actually neglect the farm to an extent that forces them to exit. This argument is less convincing because it implies somewhat irrational behavior on the part of the farmer. Perhaps this issue could be examined more deeply if



Notes:
In Canada, full-time off-farm work is defined as reporting more than 150 days of off-farm work. In Israel, the categories are as defined in the raw data.

Fig. 2. Exit rates by off-farm work status.

we controlled for the farmer's age prior to the exit, because it could be that older Israeli farmers exit from the no-off-farm-work state, whereas younger Canadian farmers exit from the off-farm-work state. This issue is examined when we discuss the results of the multivariate analysis.

4. Empirical results

We estimated a probit model to explain the farmers' tendency to exit between the two relevant census periods by maximizing the log-likelihood function given in Eq. (5), for each country separately. The results are reported in Table 2. Exact definitions of the explanatory variables can be found in Appendix A for Canada and Appendix B for Israel. Note that the coefficients are estimates of the partial derivatives of the *tendency* to exit with respect to each of the explanatory variables. A straightforward calculation can be used to produce the partial derivatives of the exit *probability*. This is not done here because we are mainly interested in the signs and relative magnitudes of the effects.

In order to verify the preliminary observations reported in the previous section, we first look at the effects of farm size and off-farm work. In Canada, farm size is proxied by land owned and rented, farm value, total value of sales, the variables measuring the amount of hired labor and wages paid. Lands owned and rented have very similar coefficients, both negative and significant. The same is true for farm value. Hence, farm size measured by these variables clearly reduces the tendency to exit, as is expected, and shown in Fig. 1. On the other hand, holding other variables constant, farm operators employing a larger number of year-round hired workers are more likely to exit. This could be due to the differences in labor intensities among otherwise similar farms, or differences in the availability of family labor. The coefficients of the other relevant variables are not significant. In Israel, farm size is proxied by land owned and capital stock, and to some extent the number of family members who work full-time on the farm. Of these, only land owned had a significant coefficient at the 5% level, and it turned out positive. It seems, therefore, as in Fig. 1, that size is not a major factor influencing the exit decisions of Israeli farmers, and if it does have an effect, operators of larger farms are more likely to exit in a given period. Perhaps this is where the distinction between planned and unplanned exits plays a role. If some farmers are forced to exit because of unexpectedly large losses, and if risk is positively related to size, then the tendency to exit may rise with farm size. Hence, perhaps the difference between Canadian and Israeli results with respect to the effect of farm size is due to the fact that the exits observed in Canada are planned to a larger extent than those observed in Israel.

The next set of explanatory variables we want to look at are the off-farm work variables. In the Canadian data set, we have a dummy for farmers who reported any extent of off-farm work (Work off), which did not turn out to be statistically significant. In addition, we included the number of days spent in off-farm work during the year (Days off). The coefficient of this variable turned out to be negative and significant, which means that the tendency to exit is lower for farmers who work more off the farm, other things being equal. In the Israeli data set, we have two dummy variables, one for part-time off-farm work (Work part off) and the other for full-time off-farm work (Work full off). The coefficients of both dummy variables turned out to be negative and significant, leading to the same conclusion as in the Canadian case. Returning to the raw results in Fig. 2, one can see that the Israeli results are consistent with the figure while the Canadian results contradict it. The conclusion is that in both countries, off-farm work stabilizes the farm household and allows the family to remain in farming while enjoying the extra income derived from off-farm jobs. The opposite raw result for Canada is due to other conditioning variables which are not controlled for in the raw data but are controlled for in the empirical analysis, such as age and farm size.

The effect of age is to decrease the exit tendency at younger ages and increase it at older ages. This is true in both countries. In Canada, the minimum tendency to exit occurs between the ages of 35–44 years. In Israel, however, it occurs around the age of 35, which is mostly outside the sample range. Moreover, the tendency to exit rises faster with age in Canada than in Israel. In Canada, we see that non-resident farm operators (Not residing) are more likely to exit, and in Israel we see that heads of larger families (Family

Table 2
Probit results of the tendency to exit

Name	Canada		Israel	
	coefficient	*t*-value	coefficient	*t*-value
Intercept	−0.4380	−14.58 [b]	1.5303	12.44 [b]
Age			−0.0916	−16.75 [b]
Age squared			0.0013	21.58 [b]
Age 0–35	−0.0505	−1.840 [a]		
Age 35–44	−0.0971	−4.179 [b]		
Age 55–59	0.1170	4.631 [b]		
Age 60–64	0.2350	8.944 [b]		
Age 65–69	0.3138	10.84 [b]		
Age 70+	0.3588	13.35 [b]		
Not residing	0.1365	3.219 [b]		
Land owned	−0.4101	−7.674 [b]	0.0010	2.143 [a]
Land rented	−0.4285	−1.944 [a]		
Farm value	−0.2502	−11.62 [b]		
Capital stock			−0.0007	−0.503
Total sales	0.0065	0.712		
Hired males	−0.0146	−1.287		
Hired females	−0.0095	−0.674		
Hired year-round	0.1234	5.541 [b]		
Wages	−0.0453	−0.635		
Work off	−0.0227	−0.987		
Days off	−0.0008	7.127 [b]		
Work full off			−0.1006	−3.656 [b]
Work part off			−0.1163	−3.340 [b]
Full-time family			−0.0073	−0.442
Family size			−0.0188	−4.817 [b]
Cattle farm	0.0860	3.891 [b]		
Dairy farm			0.0086	0.284
Hog farm	0.1182	2.843 [b]		
Poultry or mixed farm	0.0577	2.256 [a]		
Other livestock farm			−0.0720	−0.701
Field-crop farm	0.0167	0.434	0.2271	4.122 [b]
Feed-crop farm			−0.0733	−1.183
Fruit/vegetable farm	0.1892	4.839 [b]		
Citrus farm			−0.0388	−0.977
Other fruit farm			0.2296	4.880 [b]
Vegetable farm			0.0127	0.372
Flower farm			−0.1377	−2.101 [a]
Specialty farm	0.0367	0.612		
Mixed-livestock farm	−0.0889	−2.524 [b]		
Other mixed farm	0.1050	2.910 [b]		
Diversification 1			−0.0447	−1.558
Diversification 3			−0.0580	−2.264 [a]
Diversification 4			−0.1464	−3.570 [b]
Diversification 5			0.0384	0.827
Region 1	0.1962	5.257 [b]	−0.6381	−13.16 [b]
Region 2	0.1818	4.391 [b]	−0.5558	−14.31 [b]
Region 3	0.0227	0.935	−0.3438	−7.105 [b]
Region 4	0.0459	1.738 [a]	−0.2976	−7.913 [b]
Region 5	0.0957	3.840 [b]	−0.3378	−7.998 [b]
Region 6	0.0673	2.688 [b]		
Region 7	0.0800	1.906 [a]	−0.2335	−4.384 [b]

Table 2 (*Continued*)

Name	Canada		Israel	
	coefficient	*t*-value	coefficient	*t*-value
Region 8			−0.4068	−8.270 [b]
Region 9			−0.2987	−7.004 [b]
Region 10			−0.3192	−5.857 [b]
Establishment Year 1			−0.1174	−3.217 [b]
Establishment Year 2			−0.2555	−5.559 [b]
Establishment Year 3			0.0750	2.805 [b]
Establishment Year 5			0.1034	3.387 [b]
Establishment Year 6–7			−0.2562	−4.725 [b]

[a] Coefficient significant at the 5% level.
[b] Coefficient significant at the 1% level.

size) are less likely to exit, and that the tendency to exit increases with the level of farm specialization (Diversification 4 being the least specialized group). Relative to dairy farmers, Canadian farmers have a higher tendency to exit if they operate cattle farms, hog farms, poultry farms, mixed-crop farms, fruit and vegetable farms, or other mixed farms, and a lower tendency to exit if they operate mixed livestock farms. Israeli farmers have a higher tendency to exit if they operate fruit (excluding citrus) farms or field-crop farms, and a lower tendency to exit if they operate flower farms. Regional variations in exit tendencies are observed in both the countries, and the Israeli data also shows variation according to village-establishment year.

5. Summary and conclusions

We estimated equations explaining the tendency to exit farming, using panel data sets from Canada and Israel, in the hope that a comparison of the results would shed light on the behavioral aspects of the exit decision. The major difference between the exit patterns of Canadian and Israeli farm operators was in the dependence of the tendency to exit on farm size. Canadian operators of larger farms tended to have a lower tendency to exit, all other things being equal, whereas the reverse was true among their Israeli counterparts. The source of the difference might be that farm exits in Israel are unplanned to a larger extent than in Canada. With respect to the dependence of the tendency to exit on the off-farm-work status, we found that off-farm work reduces the tendency to exit in both countries, although the raw results in Fig. 2 showed the contrary in the case of Canadian farmers. The tendency to exit increases with age in both countries except, not surprisingly, for the younger age groups. However, this increase is more rapid among Canadian farm operators. The rest of the conditioning variables were not precisely comparable.

The difference between the effects of farm size in the two countries may be due to institutional differences. By law, Israeli farmers cannot sell parts of their farm land and cannot buy extra land. As a result, farm size in Israel is exogenous to a larger extent than in Canada, where these limitations do not exist. Hence, one might conclude that the dependence of exit rates on farm size in Canada is due to the fact that Canadian farmers who plan a future exit can reduce their farm activity gradually. The fact that our Israeli results do not show this could be due to either the institutional constraints or the unplanned nature of farm exits in Israel.

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Appendix A

Definitions of explanatory variables, Canada

Name	Variable definition
Age xx-yy	age of the farm operator in 1966
Not residing	dummy for farm operators who did not reside on their farms in 1966
Land owned	land owned by the farm operator in 1966 (1000 ac)
Land rented	land rented by the farm operator in 1966 (1000 ac)
Farm value	value of farm land, buildings, equipment, and livestock in 1966 ($ 10^6)
Work off	dummy for farm operators who worked off the farm in 1966
Days off	days of off-farm work by the farm operator in 1966
Hired males	number of male hired workers during 1966
Hired females	number of female hired workers during 1966
Hired year-round	number of hired workers employed on a year-round basis in 1966
Wages	total wages paid to hired workers in 1966 ($ 10^6)
Total sales	value of agricultural products sold during 1966 ($ 10^6)
Dairy/grain farm	dummy for farmers operating dairy or grain farms (left-out category)
Cattle farm	dummy for farmers operating cattle farms
Hog farm	dummy for farmers operating hog farms
Poultry/mixed farm	dummy for farmers operating poultry or mixed-crop farms
Field-crop farm	dummy for farmers operating other field-crop farms
Fruit/vegetable farm	dummy for farmers operating fruit and vegetable farms
Specialty farm	dummy for farmers operating miscellaneous-specialty farms
Mixed-livestock farm	dummy for farmers operating mixed-livestock farms
Other mixed farm	dummy for farmers operating mixed-other farms
Region 1	County 1 in Province 0
Region 2	counties 2–10 in Province 0
Region 3	counties 1, 2, 5–7, 11, 13, 14, 16, 18 in Province 2
Region 4	counties 3, 4, 8–10, 12, 15, 17 in Province 2
Region 5	counties 1, 3, 5, 6, 9, 12, 14 in Province 3
Region 6	counties 2, 4, 7, 8, 10, 13 in Province 3
Region 7	counties 11, 15 in Province 3
Region 0	Province 1 (left-out category)

Appendix B

Definitions of explanatory variables, Israel

Name	Variable definition
Age	age of farm operator in 1971
Age squared	age squared
Land owned	total land owned by the farm in 1971
Capital stock	value of farm buildings, equipment, and livestock in 1971
Work full off	dummy for farmers working full-time off the farm

Appendix B (*Continued*)

Name	Variable definition
Work part off	dummy for farmers working part-time off the farm
Family size	number of family members in 1971
Full-time family	number of family members working full-time on farm in 1971
Dairy farm	dummy for farmers operating dairy farms
Poultry farm	dummy for farmers operating poultry farms (left-out category)
Other livestock farm	dummy for farmers operating other livestock farms
Field-crop farm	dummy for farmers operating field-crop farms
Feed-crop farm	dummy for farmers operating feed-crop farms
Citrus farm	dummy for farmers operating citrus farms
Other fruit farm	dummy for farmers operating other fruit farms
Vegetable farm	dummy for farmers operating vegetable farms
Flower farm	dummy for farmers operating flower farms
Diversification 1	diversification Level 1 (most specialized)
Diversification 2	diversification Level 2 (left-out category)
Diversification 3	diversification Level 3
Diversification 4	diversification Level 4 (most diversified)
Diversification 5	unknown diversification level
Region 1–10	nine regional dummy variables (No. 6 is left out)
Establishment Year 1	village established prior to 1936
Establishment Year 2	village established between 1936 and 1947
Establishment Year 3	village established between 1948 and 1949
Establishment Year 4	village established between 1950 and 1952 (left-out category)
Establishment Year 5	village established between 1953 and 1956
Establishment Year 6–7	village established after 1956

References

Bollman, R.D., Kapitany, M., 1981. Entry and exit functions for farmers. Paper presented to the Annual Meetings of the Rural Sociology Society, Guelph, Ontario.

Bollman, R.D., Steeves, A.D., 1982. The stocks and flows of Canadian census farm operators, 1966–1976. Can. Revi. Soc. Anthropol. 19, 576–590.

Diamond, P.A., Hausman, J.A., 1984. Individual retirement and savings behavior. J. Public Econ. 23, 81–114.

Ehrensaft, P., Bollman, R.D., 1990. The microdynamics and farm family economics of structural change in agriculture. Paper presented at the Annual Research Conference, United States Bureau of the Census, Washington, DC.

Ehrensaft, P., LaRamee, P., Bollman, R.D., Buttel, F.H., 1984. The microdynamics of farm structural change in North America: the Canadian experience and Canada–USA comparisons. Am. J. Agr. Econ. 66, 8–823.

Evans, D.S., 1987. Tests of alternative theories of firm growth. J. Polit. Econ. 95, 657–674.

Friedberger, M., 1988. Farm Families and Change in Twentieth-Century America. The University Press of Kentucky, Lexington, KY.

Gabler, S., Laisney, F., Lechner, M., 1993. Seminonparametric estimation of binary-choice models with an application to labor-force participation. J. Bus. Econ. Statist. 11, 61–80.

Kimhi, A., 1994. Optimal timing of farm transferal from parent to child. Am. J. Agr. Econ. 76, 228–236.

Kimhi, A., 1995. Differential human capital investments and the choice of successor in family farms. Am. J. Agr. Econ 77, 719–724.

Kimhi, A., 1996. Off-farm work decisions of farmers over the life-cycle: evidence from panel data. Paper presented at the Sixth Biennial International Conference on Panel Data, Amsterdam, The Netherlands.

Kimhi, A., Kislev, Y., Arbel, S., 1995. Intergenerational succession in Israeli family farms: 1971-1988. In Intergenerational Transfers of Farmers in Different Institutional Environments, BARD Final Report No. IS-1845-90. pp. 275–289.

Mishra, A.K., Goodwin, B.K., 1997. Farm income variability and the supply of off-farm labor. Am. J. Agr. Econ 79, 880–887.

Pesquin, C., Kimhi, A., Kislev, Y., 1999. Old age security and intergenerational transfers of family farms. Eur. Rev. Agr. Econ. (forthcoming).

Shapiro, D., Bollman, R.D., Ehrensaft, P., 1987. Farm size and growth in Canada. Am. J. Agr. Econ. 69, 477–483.