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Abstract

The succession in family farm is a critical issue: it not only involves the transmission of wealth, but also of specific skills and of specific farm management techniques. Since a large share of farmers in Italy are old, the lack of prospective successors in their farms would imply that a change in the farm management will take place. In some cases this could be a beneficial process, leading to the enlargement of neighbouring farms and, hence, to a greater efficiency but in other cases it might lead to the abandonment of farms and to degradation of the territory. It is therefore important to explore the conditions under which a farm household can transmit the farm management within the household itself. In our paper we try to assess which are the determinants of the likely farm succession within the family and we test in a developed country the hypothesis put forward by Rosenzweig and Wolpin (1985) for LDCs that farm-specific knowledge creates an incentive for children to take on the farm. To do this, we exploit a sample of individual farm data in Piedmont Region drawn from the 2000 Agricultural Census. Taking the presence of children and relatives working predominantly or exclusively on the farm as indicators for the presence of prospective successors, we estimate by a multinomial logit its determinants. Explanatory variables include personal characteristics of the operators, including their work status, and farm characteristics. The results suggest that specific knowledge does favour farm succession within the household, along with other variables already considered in the previous literature; nevertheless, the effects of these variables are in general weak, and more research is needed to identify them.

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Introduction

The outflow of labour from agriculture has been a long-lasting feature of the restructuring of the farming sector. It is the result of the increase in labour productivity and of increasing economies of scale under the constraint of land scarcity. From this point of view, the decrease in labour under the form of exits from farming may have a beneficial effect for the general economy, since it may allow an enlargement of the remaining farms and, hence, a greater efficiency. On the other hand, exits from farming can also have detrimental impact on the territory, when exiting farmers are not substituted for by remaining farmers and the effect is abandonment and land degradation, which entail negative externalities.

The problem of farm succession is serious when considering the ageing of agricultural working population. In the Italian Region we consider, Piedmont, the average age of farm operators is 58 years, and 35 percent of them are older than 65 years, and only 14 percent are 40 years or younger. In a short period of time, many operators will be too old to operate a farm, and the destiny of their farms is at stake, if no successor will take on their farms. This is an obvious issue of policy concern.

Most of the farms in developed countries (and, more generally, in the world) are family farms. High supervision costs of hired labour, due to the technical features of agricultural production, have been pointed at to explain this situation: by contrast, family labour does not need supervision, since family members are involved in the income it provides. The linkages within the household also play a role in affecting the succession in operating the farm. Intergenerational implicit agreements have been shown to provide in general the incentive (the prospect of bequest) for the young to support the old when lifetime is uncertain and annuities markets are incomplete (Kotlikoff and Spivak, 1981; for a more general review of the intergenerational transmission issues see Laferrère, 1999); but this does not account for the specificity of farm transfers within families, i.e., why the farm operation, and not only the value of farm assets, is transmitted within families. Rosenzweig and Wolpin (1985) show that the accumulation of farm-specific, experience-based knowledge can explain why transfer within the family is dominant. Their argument is that the accumulation of farm-specific knowledge raises labour productivity, so that for an offspring having worked on the farm and having gained specific knowledge the farm is more profitable and the land is worth more than for anybody else. Therefore, the children have an incentive to work on the farm when young at a lower wage than external labourers and to purchase the farm from their parents.

Rosenzweig and Wolpin's paper focused on less developed countries and its empirical part was based on a particular variant of the specific experience hypothesis (the capacity to cope with losses from weather); as they note, the effects of technological innovations, that reduce the value of accumulated knowledge, should be studied. It is therefore of interest to verify if their argument is still valid in a developed country environment. At first sight, it would be tempting to answer in the negative. Technology is rapidly changing, and farm operation is largely and increasingly based on scientific knowledge rather than on experience. Moreover, increasing incomes in non-agricultural sectors in developed economies make agricultural activity comparatively less attractive for prospective successors, unless it provides comparable incomes. Nevertheless, some elements might support the idea that specific knowledge is important also in developed economies. First, it might be argued that, though based on scientific knowledge, farming skills are still very location and crop-specific, due to the heterogeneity of soils and weather conditions, that require that scientific knowledge be adapted to those specific conditions; this is more true the more diversified is the territory and, from this point of view, Italy offers a large variety of local conditions. Second, the degree of standardization of techniques varies according to the type of production and to the specialization of farms. It is widely acknowledged that certain types of farming require higher technical skills than others, the lower levels being represented by cereals and other field crops, and the higher by animal and tree productions; in the latter types of farming the accumulation of specific knowledge is likely to be still important. Third, market trends in the last decades push towards an increasing quality diversification of food. Diversification of agricultural products requires location-specific technical skills, to exploit the particularities of the geographic, soil and weather conditions that for many products are the core of the diversification process; moreover, marketing skills, and the capacity to implement collective actions for the valorisation of the *terroir* are needed, which again are linked to the specific situation. In summary, how much specific knowledge is a determinant of farm succession is a question to be addressed empirically.

If the above arguments are true, then from a policy perspective exits from farming can have, in addition to those indicated above, a negative effect concerning the loss of idiosyncratic skills, both in technical operation and economic management because, if farming skills are very location and crop-specific, handing over a farm to someone else does not imply the transmission of those skills attached to the specific farm. Moreover, since idiosyncratic skills are accumulated over time, the loss of idiosyncratic human capital is likely to be higher the longer the farmer has operated. If the hypothesis of specific knowledge is true, therefore, there is an reason of policy concern about succession in addition to potential problems of abandonment of the territory.

It is appropriate to separate farm succession in the sense of transmission of parents' assets (heritage) from the transmission of farm management. The transfer of the farm assets, in addition to preferences of the parents, is influenced by heritage laws, that differ across countries; from a theoretical point of view, the literature of the family as an insurance against risk and more generally about intergenerational transmission (Kotlikoff and Spivak, 1981; Laferrère, 1999) is the appropriate reference. The transfer of farm operation is a distinct matter, that needs to be addressed explicitly. Apart from some work of social scientists (Khera, 1973; Errington 1993; Blanc and Perrier Cornet, 1993), only few economic papers deal with this problem and the related problem of exits from farming for developed countries. In the same line as Kotlikoff and Spivak (1981), Pesquin et al. (1999) model the transfer of Israeli farms as a cooperative Nash game, showing that there are surpluses both for parents and for children as compared to the purchase of a pension fund. Using a panel of Upper Austria farm households, Weiss (1999) explores the determinants of farm growth and survival. The explanatory variables of farm survival include the human capital of the farmer and the characteristics of the household, the part-time status of the operator, and a dummy variable indicating whether the farm had a successor in the previous period; he finds that a successor significantly decreases the likelihood of farm exits, and this supports the concern about farm survival when no successor is available. On the basis of the same data, Stiglbauer and Weiss (2000) model the destination of farms within two censuses, including family succession, non-family succession, farm exit and farm continuity; the explanatory variables include operator's characteristics, farm size, area dummies, and the off-farm work status of the operator. Kimhi and Nachlieli (2001) use data from Israeli *moshavim* to identify the determinants of the existence of a designed farm successor; their variables include operator's age and education, the number of children, farm size and dummy variables for different types of farming; the last are taken as indicators of farm profitability and of labour intensity. In none of the above literature is the specific experience taken into consideration.

A long-lasting discussion connected with succession concerns the question whether part-time farming represents a permanent state or a preliminary step to exit from agriculture. This question can be intended with reference to individuals or to farm continuity, though it may often be difficult to separate either problem. The influence of off-farm work of a present operator on his future as an individual concerns his/her decision to continue farming; another (though related) question is whether the present off-farm status of the individual affects the decision of his/her children to take on the farm business and his/her decision to hand it to them. Weiss (1999) finds that the operator working off the farm increases the probability *for the farm* to stop operating. On the basis of the same data, Stiglbauer and Weiss (2000) also find that part-time farmers are significantly less likely

to hand over their farm to family members. On the other hand, Kimhi (2000) argues that the causal relationship runs in the opposite way: it is based on the prediction of their future state that farmers make their off-farm work decisions, and farmers predicting they will stop farming (and this might possibly be because they have no successor) are more likely to be full-time farmers.

The issue of succession therefore still has several open questions. We use cross-sectional data drawn from the 2000 Agricultural Census to explore the factors that influence the probability of family farms to have a successor within the family. Since no succession can be observed in a cross sectional sample, we take as a proxy of a likely successor the presence of family members working exclusively or predominantly on the farm. Though having a family member working on the farm will not necessarily result in the farm handed over to him/her, it undoubtedly raises this possibility: apart from the creation of specific knowledge, it creates trust and collaboration between the present operators and the prospective successors, possibly reinforced by income pooling, and renders more likely an implicit contract among them by which the farm succession obtained by the children is traded off with the commitment to support the parents in old age; it copes with moral hazard and adverse selection problems in evaluating the farm worth; it reduces transaction costs in farm transmission (Bjuggren and Sund, 2002). Unlike Kimhi and Nachlieli (2001), who took a designated successor or a child working on the farm as a proxy for a likely successor, we consider different possibilities, concerning other family members (and not only children) working on the farm as possible successors. We also assume that when parents and those family members working on the farm are also living together on the same farm the likelihood of an intra-family succession is further enhanced; therefore, in this paper not only work choices, but also residence choices are considered for predicting a likely succession.

To assess the effect of specific knowledge, we use a set of farm characteristics, in particular whether if they are specialised in types of farming requiring high skill levels. The assumption is that in these types of farming the effect of specialised knowledge is likely to be higher. In addition, we use other farm and location characteristics and variables concerning the human capital of the farmer.

Theoretical background and empirical approach

From a theoretical point of view, farm succession is a complex issue, since it involves decision-making both by the parents and by the children. Moreover, a decision about succession often not only involves choices concerning work, but also residence. Planning a succession also implies investments in human capital by parents and children (Kimhi, 1995) and the choice of the appropriate timing (Pesquin et al., 1999; Kimhi, 1994 and 1997). Finally, parents' and children's

work choices are interrelated in a complex way. For instance, if one considers the choice for a family member to work off the farm or not and wants to estimate his/her off-farm participation equation, the potential off-farm wage of another family member is only relevant when the latter actually works off the farm (Benjamin, Corsi and Guyomard, 1996; Benjamin and Kimhi, 2003); this creates interrelationships between the work choices of the different family members.

Others explicitly modelled these interrelationships as a Nash game (Pesquin et al., 1999). We do not explicitly address the decision-making process, and we simply assume that a collective decision is made by the family among different alternatives concerning work and residence of family members, so to maximise the expected utility of the household. In this approach, an alternative for the family is defined by the overall choice concerning work and residence of family members; each alternative entails different probabilities that family members take over the farm.

The alternatives considered take into consideration whether the children or other family members (other than the farm operator and the spouse) live or not on the farm and whether they work predominantly or exclusively on the farm or not. The assumption is that working on the farm increases the likelihood that they acquire specific knowledge and that they be prospective successors; living on the farm acts in the same direction. When both conditions apply, the likelihood of a succession within the family is highest. We assume that a particular alternative is chosen when it yields the highest utility for the family. The probability that a household chooses an alternative is also assumed to be influenced by different explanatory variables, that are analysed using a multinomial logit model; the econometric approach is presented in the appendix.

Data

Data are drawn from individual farm records of Piedmont Region of the Agricultural Census held in 2000. A random sample of 10,000 farms was drawn from the farm records; this represents 8.2% of the total number of farms in the Region. Since the interest was in family farms, those farms that were not individual farms or "società semplice" were excluded; also farms reporting sales for less than 4 million Lire (€ 2066) were dropped, to avoid considering hobby or very marginal farms. The total number of farms included after eliminating incomplete records was 8622 (7.1 percent of the total).

The Agricultural Census provides information on the farm, on family members living on the farm and on other relatives not living on the farm but working on the farm. For each individual the Census reports age, gender, professional status, and the indication whether he/she works on the farm and/or off the farm (exclusively, predominantly, or marginally). Unfortunately, the data do not

indicate the kinship of individuals with the operator but for the spouse. Therefore, to identify the children, we had to assume that they are those relatives at least 18 years younger than the operator.

From this information we built the succession alternatives for the family (the dependent variable). We consider as prospective successors those relatives working exclusively or predominantly on the farm. In principle, it would be desirable to have a complete set of alternatives including all combination of individuals working on the farm and living on the farm; considering those living on the farm in two categories (the children and other relatives) would yield a total of six alternatives. But two of them (no child working on the farm and other relatives not living but working on the farm; at least a child living and working on the farm and other relatives not living but working on the farm) had a negligible number of observations (21 and 29, respectively). So they were aggregated and the final list of alternatives is as follows:

1) no relative working exclusively or predominantly on the farm; for brevity, we call this alternative "no successor";

2) no relative living on the farm and working exclusively or predominantly on it, but at least another relative working exclusively or predominantly on the farm. In this case an intra-family succession is more likely and, though it may include situations in which children are living apart but working on the farm, those working on the farm may also be less close relatives; we name this alternative "non-cohabitant successor";

3) at least one relative living on the farm and working exclusively or predominantly on the farm, but no child (i.e., none 18 years younger than the operator). This may be a situation in which collateral relatives are working together: there may also be operator's children, but they do not work on the farm, so we call this alternative "brother-successor";

4) at least one child living on the farm and working exclusively or predominantly on the farm. This is the case with the highest possibility of succession, and we call it "child successor".

The likelihood of an intra-family succession is likely increasing from alternative 1 to 4, though not so clearly between alternatives 2 and 3[1]. The alternative "no successor" covers 81.1 percent of the sample, which gives an idea of the how strong the problem of farm succession is. The alternative "non-cohabitant successor" represents 4.5 percent of the total, and the "brother-successor" alternative 7.1 percent; only 7.2 percent of the retained sample belongs to the group "child successor".

[1] This is why a multinomial logit was used, rather than a model based on a ranking of the alternatives, such as an ordered probit.

The explanatory variables can be divided into different groups. The first one refers to farm characteristics that may favour the accumulation of specific experience. Dummy variables for specialised types of farming were included, based on the FADN classification of farms[2], for animal (dairy, TF 411; cattle raising and fattening, TF 421 and 422) and tree production (fruits, TF 321; quality viticulture, TF 311). Other dummy variables concern organic production, and the farm having agro-tourism activities, other activities (recreational activities, handicrafts, etc.), or making wine on the farm. All these variables are predicted to increase the value of specific knowledge and, hence, the probability of an intra-family succession. To control for the differences among farms when keeping types of farming equal, a measure of farm economic size is needed; a Census question concerned total sales, but the answers might be not too reliable, and we preferred using Standard Gross Margins as calculated for FADN[3].

A second group of variables refers to the operator's characteristics: they include operator's gender, operator's age and a quadratic term to account for non-linearities, education levels, represented by dummy variables (the reference group is those operators with compulsory level or less), and a dummy variable indicating whether he/she followed professional training. The effect of age is a priori uncertain: up to a certain age there is an increasing probability of having children and, hence, prospective successors; when children are adults, they make their work choices and if they start working off the farm, the possibility of coming back to farming might lower; finally, over a certain age, decisions are already made and there is little room for changes. As to formal education, it may increase operator's ability in running the farm and, hence, farm income, thus making succession more attractive for children; on the other hand, it may also raise the potential off-farm wage, thus inducing to part-time farming, that might reduce farm income. So, again, there are no a priori predictions on the signs of the education variables, possibly with the exception of specifically agricultural education; but these cases represent a very little share of the total, since only 0.4 percent of the operators graduated in agriculture, and 2.5 percent have an high school diploma in agriculture. Professional training is a better candidate for representing the accumulation of specific knowledge, since it is more linked to the actual professional activity.

[2] The Farm Accounting Data Network of the European Union defines a farm as specialised in a Type of Farming (TF) if the Standard Gross Margin (SGM) for the particular production covers more than 2/3 of total SGM. Standard Gross Margins are calculated as the balance between a standard value of production and a standard value of certain specific costs, determined for the various crop and livestock characteristics within each region.

[3] Using SGM rather than total sales may also avoid an endogeneity problem, that might raise if succession prospects influence operator's labour effort and, by this way, production and sales. SGM only depends on the area covered by the different crops and on the number of animals. The type of farming is less likely influenced by succession prospects, since it depends to a large extent on natural conditions. Farm physical size might in principle more easily be influenced by succession prospects, which would make SGM endogenous; this problem cannot be addressed with our data but, given the rigidity of the land market in Italy, it should not be too serious.

A third group comprises variables that represent both farm characteristics and human capital of the operator: a dummy variable indicating whether farm accounts are kept, another indicating whether computer and Internet are used, and a third indicating whether the farm belongs to some economic association. Finally, dummies for mountain and hill areas are included. Table 1 presents the definition and the descriptive statistics of the variables.

Results

Table 2 presents the results of the multinomial logit. A likelihood ratio test rejects the hypothesis of no effect of the explanatory variables at any conventional significance level. Nevertheless, the Likelihood Ratio Index is not very high and, though the model overall correctly predicts 81 percent of the actual outcomes, it does a very good job in predicting the alternative of no successor (98.7 percent of correct predictions), but is rather deceiving for the other alternatives (10.4 percent for alternative 3, and 7.4 percent for alternative 4), and does not even predict any case for alternative 2. This is common in other studies on this issue (e.g., Stiglbauer and Weiss, 2000) and may also be due to the very unbalanced proportions of the alternatives in the sample (Greene 1993, p. 652). Anyway, the model underestimates the proportion of likely successions and this suggests that some relevant determinant is missing; this problem will be discussed in the conclusions.

The parameters of a multinomial logit are not easy to interpret, since they represent the marginal change in the logarithm of the odds of each alternative over the reference alternative resulting from a marginal change in the relevant variable. The effects of the explanatory variables are more easily understood using the partial derivatives, that indicate the percentage marginal change in the probability of choosing a particular alternative due to a unit change in the relevant explanatory variable. The partial derivatives depend on the values of the variables, and in Table 3 they are computed at the mean sample values for continuous variables, and at the median for dummy variables. They represent the marginal change in the probability for the former, while for dummy variables they represent the effect of discrete change from the median value to the opposite one[4].

An obvious determinant of succession is farm economic size: the SGM variable is significant for all alternatives, and positive for all alternatives but the "no successor" one. Also Stiglbauer and

[4] Of all dummy variables, only for Gender and Accounts the median was 1. For these variables, therefore, the interpretation is the change in probability due to changing from a male to a female operator, and from keeping to not keeping accounts. For all the other dummy variables, the marginal effects are the change in probability due to assuming the condition (e.g., due to making Fruits as compared to not making).

Weiss (2000) find a positive effect of farm size on succession, unlike Kimhi and Nachlieli (2001), who explain their results by previous investment behaviour in the particular Israeli situation. In general, the prediction is that a larger farm provides higher income and makes working on the farm more attractive for children relative to off-farm work. Nevertheless, the marginal effect of SGM on the probabilities of the different outcomes is not very strong: a 1000 Euro increase in SGM raises the probability of the "child successor" choice by 0.09 percent at the mean values, and decreases the probability of the "no successor" alternative by 0.2 percent.

Among operator's characteristics, gender is significant, and a female operator increases the likelihood of a succession by 2 percent in the case of the "child successor" alternative. This result is consistent with Stiglbauer and Weiss' (2000) finding that a female operator raises the likelihood of family succession. Nevertheless, they also find that the same variable positively affects the likelihood of exits from farming and interpret their results as the effect of women's responsibility for home that pulls them away from business. Since they use panel data and examine actual changes, they likely describe two processes: female operators hand over the farm to their children sooner than their male counterparts; they quit farming more than male operators. We use cross-sectional data and our results probably reflect a situation in which the first process is prevalent, and female operators have not yet handed over the farm to their children but they are going to, if and as soon as this will be possible.

Operator's age significantly affects the probability of the alternatives relative to the reference one, and its effects is curvilinear; the probability of the alternative "child successor" instead of the "no successor" alternative increases with age and reaches a maximum at the age of 72. Considering that this alternative represents most likely an intra-family succession, these results are consistent with Kimhi and Nachlieli's (2001), that also find a positive effect of operator's age on designing a successor, with a maximum from 67 to 82 years, depending on the models, and with Stiglbauer and Weiss' (2000), who also find significant positive and negative parameters, respectively, for age and age squared on realised family succession. The probabilities of alternatives "non-cohabitant successor" and "brother-successor" relative to the "non succession" one are decreasing with age, reaching the minimum at 55 and 76, respectively.

Education variables are in general not significant. Nevertheless, the signs for higher education are negative for alternatives involving higher probabilities of succession. Surprisingly, they are also negative for agricultural education variables (the only significant parameter is the one for high school agricultural diploma). In general, higher levels of education imply greater skills which, if employed for farming, entail a greater farm profitability, that renders farming more attractive

relative to off-farm jobs for prospective successors and therefore raise the probability of a succession. On the other side, greater education may also raise the potential off-farm wage. If, as usually is, parents' education levels are correlated with children's, children of highly educated operators are highly educated too; this may raise their off-farm wage and, hence, may render them less eager to take on the farm. This double effect of education has already been noted with reference to off-farm employment of farmers, and the second has generally been found to prevail (Huffman, 2001), creating a sort of negative selection of human capital in agriculture. The predominance of the off-farm wage effect of education seems to apply to succession in Piedmont; though, this is an empirical matter, and an opposite result has been found for Upper Austria (Stiglbauer and Weiss, 2000) and in Israel (Kimhi and Nachlieli, 2001)[5]. The above argument should not apply for agricultural education, which in general terms should raise farm income and not off-farm income; nevertheless, in our model we find that formal education in agriculture is no different from the corresponding general education. By contrast, having followed agricultural training significantly increases the likelihood of succession (by 1.6 percentage points for alternative "child successor"); we interpret this result in the sense that agricultural professional training is more linked to the specific activity of the operator and, hence, to the accumulation of specific knowledge. Also another variable connected with the accumulation of human capital by the operator, i.e., keeping farm accounts, has a significant positive impact on the alternatives entailing higher probabilities of succession (not keeping accounts decreases the probability of the "child successor" alternative by 3.1 percent). By contrast, though their signs are positive, neither the computer and Internet variable nor the association variables are significant for the "child successor" alternative, but they are for the alternative "brother-successor".

The parameters of the dummy variables for mountain and hill areas are significant and positive, showing that farms located in those areas are more likely to have a successor, ceteris paribus, than farms located in the plains. This may either be the effect of traditions and of farming cultural heritage, stronger in these areas, or of stricter labour and land market conditions, that render it more difficult to find alternative jobs for the successors or to sell the land for parents. At the mean values, the likelihood of the "child successor" alternative is 2.3 percent higher for farms in the mountains, and 1.2 percent higher for farms in the hills, than in the plains.

An important group of explanatory variables, not included in previous studies, are those representing the accumulation of specific knowledge, as measured by farm specialisation in types of

[5] In Kimhi and Nachlieli's interpretation, this may be due to the higher capacity of educated parents of working out a solution to the bargaining game with the potential successor, rather than to different off-farm income of the prospective successor.

farming requiring high skills. Farm specialisation in fruits, quality vineyards, dairy and cattle raising and fattening significantly increases the likelihood of the alternatives with higher probability of succession: for instance, the increase in probability for the "child successor" alternative if the farm is specialised in fruits or quality vineyards is by 2.3 and 1.9 percent at the mean values of the variables, respectively, and the impact is higher for specialised animal types of farming (7.3 and 3.7 percent). The probability of this alternative is also raised if the farm has an agro-tourism activity (5.7 percent) or other activities (2.2 percent). By contrast, making wine on the farm does not significantly affect any alternative. Organic farming has a significant (positive) effect only on alternative 2.

Finally, operator's off-farm work status has complex effects. The likelihood of a "child successor", as well as the likelihood of the "brother-successor" alternative, are significantly lower when the operator works off the farm but keeps farming as his/her main occupation. The opposite holds for the alternative "no successor". If the operator has a an off-farm job as his/her main occupation, the effect on "child succession" is positive, though not significant; the relevant parameter is significant and negative for the "brother successor" alternative, positive and significant and for the "non-cohabitant successor". There is therefore no consistent pattern relating the operator's degree of part-time farming and the probability of succession. Stiglbauer and Weiss (2000) found that if the operator was not a full time farmer the likelihood of a family succession was significantly lower, and argued that if the farm does not allow the farm operator and his spouse to work full time then the potential successor too has probably to work off the farm, which decreases his interest in taking on the farm. By contrast, a result similar to ours (a positive influence of an operator's predominantly external employment on succession) was found by Kimhi and Nachlieli (2001) and in their case too the result was not statistically significant. Our results differentiating operator's off-farm work status between main and secondary occupation suggest that the interrelationships between off-farm work choices of the operator and the potential succession are more complicated than hypothesised by Stiglbauer and Weiss. A parent with a successor might mainly work off the farm exactly because he has someone substituting for him on the farm and wants to leave him more responsibility in running the farm; while an operator with no successor might work mainly off the farm as a prelude to exiting from farming. In the same way, the finding that secondary off-farm work is inversely related to succession probabilities might hide different phenomena. This problem cannot be addressed with our data, and more research is needed on this issue, possibly considering off-farm work choices as a joint decision with succession.

Conclusions

In this paper the issue of intra-family succession of family farms has been examined and a multinomial logit model of the determinants of succession for a sample of Piedmont farms was estimated. In addition to other determinants already considered in previous studies, we were interested in testing in a technologically advanced country the hypothesis, put forward by Rosenzweig and Wolpin (1985) for LDCs, that the accumulation of specific knowledge creates an incentive for intra-family succession. This is of interest since market trends favour quality diversification of agricultural products and, hence, location-specific and farm-specific knowledge is likely to be increasingly important. Intra-family succession can help transmitting specific knowledge from one generation to another.

In our model, the variables representing specific knowledge do significantly affect the probability of a succession. Therefore the results suggest that also in developed economies the accumulation of specific knowledge plays a role in creating incentives to intra-family transmission of farm operation. Nevertheless, their impact, as well as the impact of other explanatory variables, is not very strong. This suggests that the influence of specific knowledge in determining farm succession in developed countries is less marked than in developing countries, due to technological progress and to standardized and formal knowledge, and that other variables, not considered in the studies up to now, might affect the succession in family farms. One obvious determinant might be children's individual tastes for farming, including professional pride, tradition and cultural heritage. If they like the profession, they might accept taking on the farm even when it provides a lower income than the one they could gain from alternative jobs, which might explain the weak effect of farm economic size on succession. Recently Fall and Magnac (2004) have shown that personal tastes may account for an appreciable portion of the gap between agricultural and non-agricultural income in European countries; the same might apply for prospective successors. Identifying this determinant is obviously impossible with a cross-section sample, but it might be difficult even with panel data, given the long-term nature of the succession process.

Another direction to explore concerns the conditions of local labour markets. In a child's decision whether to take on the farm or not, there is a trade-off between the expected utility from working on the farm and the expected utility from working off the farm. In both, one important argument is expected income, which in turn depends on income levels and on their probability: while farm income is known to a candidate successor, his off-farm income is uncertain and is contingent on the probability of finding a job, so that individuals with the same characteristics and facing similar farms might make different choices depending on the conditions of local labour markets. The positive and significant effect of the location in mountain and hill areas on farm

succession might then be explained along this line: the stricter labour market conditions in these areas may push children to take on the family farm rather than looking for uncertain jobs.

A third direction of further research is the relationship between parents' off-farm work choices and succession. In the previous literature the results in this respect are mixed, and our results suggest that complex relationships are involved between the operator's off-farm work choice and succession. There seems to be no monotonic pattern between the degree of part-time farming and the probability of succession. This suggests that choices of off-farm work might be made differently according to the prospects of farm succession the specific operator is facing. If this is the case, then off-farm work choices and succession are a joint decision, to be modelled accordingly; this issue deserves further research.

Finally, as a general picture, it is comforting that a core of strong, specialised farms has good perspectives of going on with the new generation. On the other hand, for the large majority of farms there are gloomy continuity prospects. It is easily predictable that in a short term agriculture will undergo deep changes in property structures and in farm operations. This change should be governed, on one side to facilitate the consolidation and enlargement of remaining farms, and on the other side to avoid the territory degradation induced by a too rapid depopulation.

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Table 1- Definition and descriptive statistics of the variables

Symbol	Definition	Mean	Std.Dev.
Explanatory variables			
GSM	Gross Standard Margin (thousand €)	14.024	26.812
Fruits	=1 if specialised in Fruits	0.100	0.300
Quality viticulture	=1 if specialised in Qualty viticulture	0.112	0.315
Cattle	=1 if specialised in Cattle raising and fattening	0.028	0.166
Dairy	=1 if specialised in Dairy	0.041	0.198
Agro-tourism	=1 if with an agro-tourism activity	0.006	0.076
Wine-making	=1 if making wine	0.084	0.278
Organic	=1 if organic farming	0.021	0.144
Other activities	=1 if with other activities (recreational, handicrafts, etc.),	0.185	0.389
Accounts	=1 if farm accounts are kept	0.531	0.499
Computer	=1 if computer or Internet is used	0.016	0.124
Association	=1 if the farm belongs to economic associations (co-operatives, consortia, etc.)	0.251	0.434
Mountain	=1 if in mountain area	0.149	0.356
Hill	=1 if in hilly area	0.559	0.497
Gender	=1 the operator is male	0.715	0.451
Age	Operator's age	57.77	14.465
Graduate agriculture	=1 if the operator graduated in agriculture	0,004	0,064
Graduate other	=1 if the operator graduated in other fields	0,015	0,121
High school agriculture	=1 if the operator has an high school diploma in agriculture	0,025	0,156
High school other	=1 if the operator has an high school diploma in other fields	0,124	0,329
Professional training	=1 if the operator followed professional training courses	0.079	0.270
Minor PT	= 1 if the operator works off the farm as the minor occupation	0.018	0.133
Main PT	= 1 if the operator works off the farm as the main occupation	0.143	0.350
Dependent variable			
Succ = 1	“no successor”	0.812	0.391
Succ = 2	“non-cohabitant successor”	0.045	0.207
Succ = 3	“brother-successor”	0.071	0.257
Succ = 4	“child successor”	0.072	0.259

N = 8622

Table 3 - Results of the multinomial logit

	Succ = 2		Succ = 3		Succ = 4	
	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio
Constant	0.8907	1.539	1.9771	4.030	-10.0562	-10.997
GSM	0.0188	9.701	0.0130	7.358	0.0208	12.528
Fruits	0.2222	1.238	-0.2536	-1.449	0.3953	2.564
Quality viticulture	0.4502	2.718	0.4070	2.840	0.3835	2.754
Cattle	0.5965	2.135	0.3895	1.790	1.0322	4.967
Dairy	-0.3110	-1.083	0.2569	1.320	0.6067	3.290
Agro-tourism	-1.1169	-1.065	-0.1174	-0.237	0.8005	1.784
Wine-making	0.0707	0.302	0.0558	0.275	-0.1093	-0.562
Organic	0.6595	2.295	0.6923	2.833	-0.3088	-0.914
Other activities	0.3994	2.253	0.1662	1.174	0.4086	2.923
Accounts	0.5083	3.722	0.3167	2.516	1.0501	8.818
Computer	-0.3837	-0.893	0.4674	1.848	0.4030	1.316
Association	0.1041	0.825	0.2790	2.750	0.1337	1.331
Mountain	0.6499	3.384	0.4345	2.680	0.4579	2.875
Hill	0.4091	2.840	0.3028	2.595	0.2688	2.370
Gender	-0.3697	-3.032	0.6555	5.263	-0.3868	-3.767
Age	-0.1876	-9.485	-0.1743	-9.296	0.1882	6.181
Age squared	0.0017	9.851	0.0012	6.335	-0.0013	-5.127
Graduate agriculture	-0.0114	-0.016	-0.4411	-0.752	-1.5707	-1.415
Graduate other	-0.0245	-0.056	-0.1436	-0.361	-0.1982	-0.448
High school agriculture	-0.2376	-0.723	-0.1291	-0.609	-0.8070	-2.017
High school other	0.0690	0.429	-0.1261	-0.921	-0.2297	-1.433
Professional training	-0.1165	-0.578	0.0844	0.592	0.2903	1.986
Minor PT	-0.3971	-0.917	-0.5494	-1.995	-1.0052	-1.928
Main PT	0.4749	2.746	-0.4360	-2.869	0.2615	1.458
N. Obs	8622					
Log Likelihood	-5138.83					
Restricted (slope=0) LL	-5923.62					
Likelihood Ratio test of no effect of the variables: Chi-squared (df)	1569.58 (72)					
Likelihood Ratio Index	0.1325					

Table 3 - Marginal effects of the explanatory variables on the probabilities of the alternatives

	SUCC=1	SUCC=2	SUCC=3	SUCC=4
Constant	0.3258	0.0335	0.1187	-0.4780
GSM	-0.0019	0.0004	0.0005	0.0009
Fruits	-0.0165	0.0060	-0.0121	0.0225
Quality viticulture	-0.0522	0.0126	0.0208	0.0187
Cattle	-0.1038	0.0159	0.0152	0.0727
Dairy	-0.0407	-0.0080	0.0118	0.0370
Agro-tourism	-0.0313	-0.0181	-0.0072	0.0566
Wine-making	0.0002	0.0019	0.0029	-0.0051
Organic	-0.0511	0.0218	0.0445	-0.0152
Other activities	-0.0393	0.0112	0.0064	0.0216
Accounts	0.0522	-0.0096	-0.0115	-0.0311
Computer	-0.0385	-0.0092	0.0265	0.0212
Association	-0.0223	0.0022	0.0145	0.0056
Mountain	-0.0650	0.0205	0.0217	0.0229
Hill	-0.0388	0.0116	0.0148	0.0124
Gender	-0.0094	0.0114	-0.0246	0.0225
Age	0.0039	-0.0049	-0.0086	0.0095
Age squared	0.0000	0.0000	0.0001	-0.0001
Graduate agriculture	0.0532	0.0013	-0.0160	-0.0385
Graduate other	0.0145	-0.0002	-0.0060	-0.0082
High school agriculture	0.0355	-0.0048	-0.0043	-0.0264
High school other	0.0126	0.0023	-0.0053	-0.0096
Professional training	-0.0156	-0.0033	0.0035	0.0155
Minor PT	0.0571	-0.0075	-0.0194	-0.0301
Main PT	-0.0112	0.0156	-0.0183	0.0139

Note: Marginal effects are evaluated at the mean values of the continuous variables and at the median values of the dummy variables.
Gender and Accounts were set at the median value =1. All the other dummy variables were set at the median value = 0.

Appendix

The utility that the household obtains from each alternative concerning the succession is assumed to have a deterministic component in a set of explanatory variables; adding an alternative-specific random error to each of the alternative utility equations results in a probability model. Call V_{ij} the indirect utility that household i attains when choosing alternative j (j = 1,…,n). V_{ij} is thus assumed to be a linear function of a set of explanatory variables $\mathbf{X}_i$ and of a random term $\boldsymbol{e}_{ij}$. The indirect utility of each alternative is not observable, but the household choice is. Then, alternative j is chosen if:

$$V_{ij} > V_{ik} \quad " \; k \neq j \tag{1}$$

$$\boldsymbol{b}'_j \boldsymbol{X}_i + \boldsymbol{e}_{ij} > \boldsymbol{b}'_k \boldsymbol{X}_i + \boldsymbol{e}_{ik} \tag{2}$$

$$(\boldsymbol{b}'_j - \boldsymbol{b}'_k)\, \boldsymbol{X}_i > + \boldsymbol{e}_{ik} - \boldsymbol{e}_{ij} \tag{3}$$

If the errors are assumed to have identical and independent Gumbel distributions, the difference $\boldsymbol{e}_{ik} - \boldsymbol{e}_{ij}$ has a logistic distribution and the choice model is a multinomial logit (Maddala 1983; Greene, 1993). If a dummy variable S_{ij} is defined, equal to 1 if the alternative j is chosen, i.e., if $V_{ij} > V_{ik}$; $" \; k \neq j$, and 0 otherwise, then:

$$\Pr(S_{ij} = 1) = \frac{e^{b'_j X_i}}{\sum_{k=1}^{n} e^{b'_k X_i}} \quad \text{for j = 1, 2, ….,n} \tag{4}$$

where the $\boldsymbol{b}$ are the parameters to be estimated and n is the number of alternatives. The multinomial logit does not yield the probability of a particular alternative, due to identification restrictions. Only the probability of choosing a particular alternative relative to a reference one can be estimated. The reference alternative we choose is the one with no relative (living on the farm or not) working exclusively or predominantly on the farm.

The marginal effects of a continuous variable x_i on the probability of alternative j are calculated as:

$$\frac{\partial P_j}{\partial x_i} = P_j \left[b_j - \sum_k P_k b_k \right]$$

The marginal effects of a dummy variable are calculated as:

$$\Pr(S_{ij} = 1 \mid x_i = me) - \Pr(S_{ij} = 1 \mid x_i = 1 - me)$$

where me indicates the median.