Succession in Agriculture:

A Probit and a Competing Risk Analysis

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Selected paper for the annual Meeting of the American Agricultural Economist Association (AAEA) in Denver, 2004

Abstract:

The present study examines family and farm characteristics affecting the choice and the timing of intergenerational farm transfers. Using survey data which are linked to accounting data for 272 farms in Northern Germany, we use a probit approach to examine whether specific farm and family characteristics are related to the likelihood of succession within a given period. We go beyond the existing literature by applying a competing risk approach to study the process and thus the timing, respectively of the two competing events – succession or exit from farming. We find that farm characteristics significantly influence succession considerations to the extent that they affect the value of the farm for the potential successor.

I. Introduction and Literature

The analysis of intergenerational transfers has received considerable attention in economics during the last two decades. This literature addresses a wide range of issues and focuses on different types and forms of transfers. Private transfers are usually differentiated with respect to their timing. While gifts (or transfers inter-vivos) are given during the donor's lifetime, bequests are transfers given after the donor's death. Focusing on the type of transfer, Nerlove et al. (1984) differentiate between transfers of human and physical capital. The later category again is composed of liquid and illiquid assets. Investigating transfers of illiquid assets is particularly interesting when they are indivisible and constitute a large proportion of family wealth (Mishra, et al. 2004). A good example of this situation are family firms. The family business typically constitutes an important fraction of family wealth and it is illiquid and indivisible to a large extent.

Analysing family firms and succession in family firms also deserves attention from the importance of this form of organisation in capitalist economies. Most firms in the world are family firms. Gersick et al. (1997) report that family firms account for 65-80% of all worldwide business, and for about 40% of the Fortune 500 companies. Although many family firms are small, in aggregate they represent about half of the U.S. gross domestic product (Aronoff et al. 1997) and employ over 80% of the work force (Neuberg and Lank, 1998). It thus comes as no surprise that succession in family firms has recently received growing attention in different fields of economics. Based on the well established microeconomic theory of family and altruism, as well as the agency literature, some recent theoretical studies aim at providing a theory of family business by exploring the interaction between the family and the firm (Chami, 2001; Burkart, Panunzi and Shleifer, 2003). Burkart et al. argue that "a crucial issue in the discussion of family firms from the perspective of corporate governance and finance is succession" (p. 3). The circumstances of family succession are of great

importance not only for the family members directly involved but also (per definition) for the long-run survival and success of family firms. In an extensive review of the existing research, Handler (1994) finds: "researchers in the field of family business agree that succession is the most important issue that most family firms face" (p. 133).[1]

By studying occupations of different family members (grandfathers, fathers, and sons), Laband and Lentz (1983) find that farmers' are nearly five times more likely to have followed in their fathers' footsteps than non-farm proprietors. Despite the importance of (family) succession in the farm sector, little theoretical and empirical work has been devoted to this issue in agricultural economics so far. Pesquin et al. (1999) point out that intra-family succession enables the family to realize benefits from intergenerational risk-sharing when annuity markets are incomplete. It provides an often implicit contractual insurance arrangement since the generations overlap and share income. The authors mention additional advantages of intra-family farm succession such as 'smooth' transition, reduction in transfer cost, and lower transfer taxes. By focusing on the transfer of human capital across generations, Laband and Lentz (1983) as well as Rosenzweig and Wolpin (1985) add that the existence of returns to land-specific experience creates incentives for children to work on the family farm when young. Alternative explanations emphasize that the succession process can be viewed as a 'web of exchange relationships' (Kennedy, p. 478), where the successor benefit through the transfer of physical assets while the parents may gain in a number of ways. That is, in exchange for the transfer of land and production rights the parents may negotiate a number of services. Finally, maintaining family control has a symbolic importance to many farm households and thus, the transfer of the farm to the next generation is often seen as a key objective of farmers (Gasson and Errington 1993; Blanc 1993).

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[1] Succession is so central that Ward (1987) chooses to define family firms in terms of the potential for succession: "we define a family business as one that will be passed on for the family's next generation to manage and control" (p. 252)

Since the end of the last century, some empirical work was done examining various factors affecting the probability and the timing of family takeover. Analyzing actual farm successions on the basis of census data for Upper Austria, Stiglbauer and Weiss (2000) find the probability of farm succession to be significantly influenced by farm, as well as, personal characteristics. Their results suggest that an increase in farm and family size, as well as a higher degree of on-farm diversification, raises the probability of farm succession within the family. Similar results are reported in Glauben, Tietje, and Weiss (2002) for Austrian survey data. By focusing on the timing of farm succession, Kimhi (1994) examines actual farm transfers on the basis of census data for Israel. The author finds that the transfer time varies systematically with family and farm characteristics. Transfer time decreases with parents' age and with a child's educational level, but increases with parents' experience. Using survey data for 469 Maryland farmers, Kimhi and Lopez (1997) also find that farm owners' plans with respect to the timing of retirement are systematically related to farm and household characteristics. Older farm operators plan to retire later, as do more educated and wealthier farmers. On the basis of the same data set, Kimhi and Lopez (1999) investigate the importance of succession considerations for retirement plans of farmers. Glauben, Tietje, and Weiss (2002) additionally find that the time of succession is delayed as the age of the farm operator increases.

The present study investigates the choice and the timing of intergenerational farm transfers using survey data which are linked to accounting data for 272 farms in Northern Germany. While we use a probit approach to examine whether specific farm and family characteristics are related to the likelihood of succession within a given observation period, we go beyond the existing literature by applying a competing risk approach (Kalbfleisch and Prentice 1980) to study the process and thus the timing, respectively of the two competing events – succession or exit from farming. The data are described in section 2, section 3 presents the methodology and the empirical results and section 4 concludes.

II. Data

The analysis of inter-generational succession is based on a survey of 272 Northern German farm households in 2003 that are linked to individual accounting data, whereby only (full-time) farm operators aged 45 or above have been surveyed. The farm owners were asked about their farm transfer plans and several personal and household characteristics. Further, detailed information regarding farming and intra-family successions were collected.

In particular the respondents were asked to report on two main aspects of their succession plans. First, they indicated whether they plan to transfer the farm within the family, and second they reported the planed timing of retirement. More specifically, they indicated which of the following alternatives best describes their actual plans: (a) succession is very likely, (b) succession is rather likely, (c) indecision/indifference, (d) succession will likely not take place, and (e) succession will definitely not take place. In addition, farmers reported in how many years (from 2003) they plan to retire. To econometrically analyze the likelihood of succession and the timing of retirement we summarize these statements into two competing events (see below), that is 'farm succession' versus 'no farm succession'.

As mentioned above, the surveyed data also include information on personal and household characteristics such as the farm operators' age (*AGE*), education (*EDUC*), number of children (*CM, CF*), as well as the number of generations the farm has been in 'the hand' of the family. Moreover, several subjective assessments were condensed into a few variables via a factor analysis (see Annex Tables A1 and A2 for the attitudes that included in the factor values). We expect to find that a close "tie to the farm" (*BOND*) and a good financial situation (*FINAN*) may stipulate transferring the farm within the family, whereas a negative attitude towards 'being a farmer' (*FARM*) as well as exogenous restrictions of farm growth (*GROW*) might induce the opposite. Similar, some subjective personal characteristics (*PERS*), as for example the health of the owner, or some subjective attitudes to the succession process itself

(*SUCC*) might influence the timing of retirement, that is the planed time to hand down the farm within the family or close down the farm and exit from farming (see below).

In contrast to other empirical studies analyzing the determinants of family succession either on the basis of accounting and census data (such as Kimhi 1994, and Stiglbauer and Weiss, 2000) or survey data (as Glauben, Tietje, and Weiss 2002) this study drive an advantage form the fact that the survey data linked to individual accounting data. Thus, we used the accounting data to get information about farm characteristics with might contribute to the explanation of farmers succession behavior. We use average value of the yearly variables from 1999 to 2002 or their development within the periods. The "annual farm profit" (*PROF*) measures the annual income capacity from farming. The variable "owned farm land" (*OWN*) is used as a measure of the farms assets and the value of the farm. The "land rent per hectare" (*RENT*) measure the price per hectare leased in land and should be an indicator for the marginal returns of land. The variables "change of farm land" (*CHFL*) and "net borrowed capital" (*NBC*), respectively account for recent developments in the land endowment and a "well-defined" capital endowment (leverage-effect of borrowings). Finally, "technical efficiency" (*TEFF*) is an index that, roughly spoken, account for the management quality of the farm operator, which was calculated by Data Envelopment Analysis (Coelli et al. 1998).

Table 1 reports descriptive statistics of all variables used in the analysis. Unfortunately, only 209 of the 272 farm operators have reported the planed time of retirement. Thus the sample for the estimations regarding the timing equations is slight different but not selectivity biased (Annex Table A3 provide the sample statistics for the analysis of timing)

Include table 1

III. Methods and empirical results

Probit apprach

As mentioned above, we apply a standard probit analysis on the likelihood of succession over the whole observation period. Therefore, we summarize the statements (a) and (b) as 'family succession is likely/exit is unlikely" (*FAMSUC* = 1) and the statements (c) to (e) as 'family succession is unlikely/exit is likely" (*FAMSUC* = 0). Note, that almost 70% of all respondents reported, that family succession is likely, while 30% chose closing down the farm when they retire.[2]

The results of the econometric analysis are shown in **Table 2.** The estimated model is statistically significant at 1% level or better, as measured by the likelihood ratio test. The model correctly classifies 86.6% of all observations, whereby 86.5% of all cases with "family succession is likely" and 80.0% of the observations with "family succession is unlikely" are correctly classified. Over all, the results in **Table 2** suggest that the probability of succession is significantly influenced by a number of personal, household, and farm characteristics as well as by farm operator attitudes to farming and succession (factor values).

Include table 2 around here

According to **Table 2**, more profitable farms (*PROF*) report a significantly higher probability of being transferred within the family. These farms hold the best prospect of providing the succeeding child a reasonable and secure income in future. This result confirms with Hennessy (2002), who reports a positive correlation between income and the probability of farm succession. Similarly, Kimhi and Nachlieli (2001), and Glauben et al. (2002) report that

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[2] One might argue, that category (c) "remain undecided" may be a own an third option, that is postponing the choice. Thus we additionally estimate a multinomial logit model, where statements (a) and (b), and (d) and (e) are summarized and evaluated against alternative (c). We use a Wald Category Test **(**Long and Freeze 2004**)** and find the probit specification to be the most appropriate specification.

the likelihood of succession increases with farm Standard Gross Margin, which these authors interpret as a measure of farm income.

For a given profitability, the probability of succession significantly increase with the amount of own farm land (*OWN*). Land assets reflect the value of the farm and thus that of the (inter-general) transfers. Further, more land also makes it easier to overcome borrowing constraints and thus reduces development restrictions in future. Thus, the higher the amount of land, the larger will be the willingness of the potential successor to take over the farm.

Previous farm growth (*CHFL*) is positively related to the likelihood of succession. There is however a problem distinguishing cause and effect with respect to this variable. A farm, for example, that has invested in land in the past might be more attractive for a potential successor, increasing the likelihood of succession. Yet, the causation could also be reversed. Sociological studies as well as Kimhi et al. (1995) suggest that farm operators, who plan to transfer the farm within the family, have an incentive to expand their enterprise. Farm growth and the likelihood of succession would also be positively related. Differentiating empirically between the two explanations would require analyzing individual farms over a longer time period, which is not possible on the basis of our data set, unfortunately.

At first glance it might be surprising, that a high rental price (*RENT*) paid per hectare significantly increase the probability transferring the farm within the family. However, as mentioned above, a high price for leased in land is an indication for high productivity (high marginal returns to land).

Table 2 includes variables measuring the amount of debt in a non-linear fashion (*NBC*, NBC^2). The probability of succession first significantly increases with the amount of loan capital, and the decline again. A negative relationship between loan capital and the likelihood of succession at an advanced amount of borrowings might indicates an increasing probability of bankruptcy, which would reduce the attractiveness of taking over of the farm for the child.

Since the second effect is not of statistical significance, one might conclude that most farms in the sample are not over-borrowed.

Given that more efficient and better educated farmers, as measured be farms technical efficiency (*TEFF*) and farm operators schooling (*EDU*), will be able to run their farm more successfully, we would expect to find the willingness of a successor to take over this farm to increase as well. For a given age of the farm operator an increase in the farmer's education significantly increases the likelihood of succession, while the technical efficiency variable does not significantly contribute to the succession plan.

With regard to the socio-economics of the farm operator and his or her family, the age of the farm operator (*AGE*) turns out to be of particular importance. The probability of succession first increases with the farm operator's age, reaches its maximum at 60 years of age and then declines again. A number of studies support this non-linear impact of age on succession considerations (Laband and Lentz, 1983; Stiglbauer and Weiss, 2000; and Kimhi and Nachlieli, 2001, Glauben et. al 2002). As the age of the farm operator increases, he will be more aware of the need to make succession plans, thus the positive 'age/succession' relationship. The negative relationship between age and the probability of succession at advanced ages of the farm operator might indicate that a farmer, who postpones succession will have more difficulties in finding a successor within the family since his or her children will have started looking for alternative employment in the non-farm economy (Kimhi, 1994).

Following previous empirical studies (Pfeffer, 1989; Stiglbauer and Weiss, 2000, Glauben et al. 2002), we find the number of family members living on the farm to significantly influence succession considerations. The probability of succession is positively related to the number of sons (*CM*) but negatively related the number of daughters (*CF*). This might be due to the concept of sons as "preferred successors" (Kimhi and Nachlieli, 2001, p. 49).

Laband and Lentz (1983, 1990) argue that the choice of becoming a farmer is strongly influenced by family traditions. Tradition also plays an important role in farm succession considerations in Germany. Farms that have been "in the hand" of the same family (*GEN*) for at least five generations show a significantly higher probability of being transferred to the next generations within the same family.

Finally, different (subjective) attitudes of the farm operators towards farming and family succession, that are condensed in the factor values mentioned above significantly contribute the explanation of the succession decision. As expected a closer "tie to the farm" (*BOND*) and a higher contentedness with the financial situation (*FINAN*) significantly increases the likelihood or family succession, while a negative attitude towards being a farmer (*FARM*) significantly decreases the probability that the farm will be transferred. Neldert et al. (1981) argue that parents' attitudes influence their children attitudes. Similarly, if further farm growth (*GROW*) is not considered to be restricted family succession will become more likely.

Competing risk approach

The preceding analysis seeks to identify factors influencing the farmers' decision to transfer the farm within the family. In the following section, we apply a competing risk analysis to examine the factors' related to the timing of farmer's retirement decision and thus the timing of either succession or exit from farming. In this case we are facing a situation with two possible events. According to Kalbfleisch and Prentice (1980) and Lancaster (1990), the analysis of the functions associated with each of the possible events can be conducted similarly to the previous analysis, considering that all observations referring to the events distinct from that being analyzed should be treated as censored. Thus, in the case when analyzing those farmers who plan a family succession, the information about the timing of all other farmer will be censored. The same treatment will be given when analyzing the timing of exits (Kalbfleisch 2002).

Thus, in our analysis we summarize statements (a) and (b) (family succession is likely/exit is unlikely) to the group of farmers that opt for succession, and treaded the information of all other respondents with the statements (c)-(e) as censored. Analyzing the timing of exit, the respondents of statements (d) and (e) (family succession is unlikely/exit is likely) are grouped as farmers that opt for closing down the farm and the information of all other respondents ((a)-(c)) will be censored. Information of those respondents with statement (c) (remain undecided) will be censored in both cases, since also those farmers reported their planed retirement time.

Duration or competing risk models are often specified as cause specific hazard models (Kalbfleisch and Prentice 1980, p. 168) in particular proportional hazard models (Cox and Oakes, 1984; Montoya Diaz, 1999). The concept of analyzing competing survival and failure time data, respectively can be illustrated in the following simple form: $\lambda_j(t;x) = \lambda_{0j}(t)\exp\left[x\beta_j\right]$. Here $\lambda_{0j}(t)$ is the hazard of an event *j*, say farm succession or exit, over time under the condition $\exp\left[x\beta_j\right]=1$, that is no heterogeneity among the individuals. Heterogeneity of individuals for example reflected by differences in characteristics (*x*) might change the individual hazard. Here the multiplicative effect of the covariates (*x*) has a clear and intuitive meaning. Without any restriction on $\lambda_{0j}(t)$, however, this model postulates no direct relationship between *x* and *t* itself. If $\exp\left[x\beta_j\right]>1$, then the risk of the event *j* for this individual would increase over the whole period, and if $\exp\left[x\beta_j\right]<1$ the opposite holds. Thus, hazard models are used gaining insights into the risk process, that is the hazard function $\lambda_j(t;x)$, that causes failure and gaining insights into how the risk changes with the covariates (βx).

Since we are mainly interested in the analysis of the failure times of both events (succession and exit), and not of their risk processes, we specify the competing risk approach

as an “accelerated failure time” (AFT) model. In this case, the cause specific hazard functions can be written as $\lambda_j\left(t_j;x\right)=\lambda_{0j}\left\{t_j\exp\left[-x\beta_j\right]\right\}\exp\left[-x\beta_j\right]$, where *j* denotes the respective event (Kalbfleisch and Prentice 1980, p. 170). Rearranging this equation gives a better understanding of the effects of the covariates. We normalize the “observed” hazard rate according the following expression: $\frac{\lambda_j\left(t_j;x\right)}{\lambda_{0j}}\exp\left[x\beta_j\right]=t_j\exp\left[-x\beta_j\right]\Leftrightarrow\tau_j=t_j\exp\left[-x\beta_j\right]$.

As can easily be seen, this model specifies the effect of the covariates to be multiplicative on *t* rather than on the hazard function. That is, we assume a baseline hazard function to exist and that the effect of the regression variables is to alter the rate at which an individual proceed along the time axis. That is, if $\exp\left[x\beta_j\right]=1$ then $\tau_j=t_j$ and time passes at its “normal” rate. If $\exp\left[x\beta_j\right]>1$, then time is accelerated and the failure would be expected sooner. If $\exp\left[x\beta_j\right]<1$, the opposite holds.

If we rearrange $\tau_j=t_j\exp\left[-x\beta_j\right]$ into $t_j=\tau_j\exp\left[x\beta_j\right]$, we can directly suppose that the role of *x* is to accelerate or decelerate the predicted time of failure of an event *j*. That is a positive coefficient of β_j increases the expected value of failure time and a negative coefficient decreases it. It often turns out to be more convenient (Cleves et al. 2004) to estimate the following log-linear specification of the ACT-Model:

(1) $\ln\left(T_{ij}\right)=X_{ij}\beta_j+\ln\left(\tau_j\right);\ j=\left(succession;exit\right)$

Here, T_{ji} denotes the expected failure time, measured in years until the event occur. X_{ij} are the event-specific variables mentioned above and β_j are the parameter to be estimated. We test (AIC) several distribution of the random “quantity” τ_j and find Weilbull as the most appropriate distribution, thus $\tau_j\sim pt_j^{\,p-1}e^{\alpha}$. Again treating the failure time other than *j* as censored we can separately estimate the failure time of each event *j* (Prentice (1979, p. 168).

The results of the econometric analysis for the timing of succession as well as the timing of closure the business are reported in **Table 3** and **Table 4.**

Include tables 3 and 4 around here

Both estimation models are significant at the 1% level or better as measured by the F-Test. As expected, when comparing the results reported in **Table 3** and **Table 4** we find different variables to be related to the timing of both competing events.

The age of the operator (*AGE*) turns out to be of particular importance for the failure time of both events. While we find a significantly non-linear relationship of farm operator's age and the timing of succession, the timing of closing the firm shows a significant linear relationship to farmers' age. The non-linear pattern on succession time indicates that succession is first accelerated as the age of the farmer increase, and than delayed. A similar pattern is reported in Glauben et al. (2002). This might be the result of bargaining between the farmer and the potential successor. The farmer has an incentive to indicate his willingness to hand over at an relatively early age to lure the successor into waiting, but later he can delay his retirement decision since the successor is already committed. The timing of closure does not involve such bargaining processes and no non-linear relationship could be identified.

In contrast to other studies, we find several firm characteristics to influence succession (**Table 3**). For a given age of farm operator, farm succession is significantly accelerated as the profit (*PROF*) and the marginal returns of land (*RENT*) increase. Similarly, those farmers with a relatively high level of debt (*NBC*) and a farm growth rate in the past (*CHFL*) tend to transfer the farm earlier. Successful farms clearly hold out the best prospects of providing the successor with a high and secure income. One should thus expect the willingness of the heir to take over the farm as soon as possible to increase. On the other hand, it is at least plausible – though hardly a tight deduction – that a healthy financial performance of the farm is an indication of a good farm operator who would not tend to delay the transfer decision.

Finally, if the farm operator attaches high importance to factors characterizing his personal situation (*PERS*), such as his own health status, he tends to delay handing over the farm. In contrast, if the operator attaches more weight to the successor's situation (*SUCC*), such that the successor insists to take over the farm, farm succession will be accelerated.

Further, the timing of closing down and exiting from the farm business is also significantly related to farm characteristics and personal attitudes (**Table 4**). As expected, farm owners' of large farms (*FL*) as well as farms characterized by a high level of technical efficiency (*TEFF*) tend to retire later. As argued in Miljkovic (2000), efficient farmers tend to suffer less from "harm of work" and thus retire later. Further retirement is accelerated for relatively specialized enterprises, as cash-crop and cash crop/pig production farms (*CCRC, CCPIG*). To be successful, specialized farms usually need more modern technical know-how, and the willingness to acquire this know-how tends to decline with age. Finally a low value for the farmer's subjective affection to the farm (*BOND*) significantly reduces the time until retirement. On the other hand, a high agreement of the respondents with some survey personal statements (PERS) would enforce farmers to retire later. Finally, a high contentedness with the financial situation (*FINAN*) induces later retirement.

IV. Summary

A distinguishing feature of agriculture is the predominance of family business and the way in which this structure is replicated by the transfer of farms between generations of the same family. Whereas researches in the field of family business agree, that the intergenerational transfer decision is one of the most important issue that family firms face, only few studies are devoted to this issue in agricultural economics so far. This work examines family and farm characteristics affecting the choice and the timing of intergenerational farm transfers using survey data which are linked to individual accounting data for 272 farm household in Northern Germany. We firstly use a probit approach examining whether specific farm and

family characteristic as well as some subjective attitudes are related to the likelihood of succession within a given observation period. In a second step, we go beyond the existing literature by applying a competing risk approach which is specified as an “accelerated failure time” model to study the timing of farmers’ retirement decision and thus the timing of either succession or exit from farming.

Farm characteristics significantly influence succession considerations in the way that they affect the value of the farm for a potential successor. The likelihood of succession increases with the profitability and the amount of own farm land. Further, the number of household members living on farm also significantly influences succession plans. The probability of succession first increases with the age of the operator and then decline again. Tradition also plays an important role in farm succession considerations in Germany. Farms that have been “in the hand” of the same family for at least five generations show a significantly higher probability of being transferred to the next generations within the same family. Finally, different (subjective) attitudes of the farm operators towards farming and family succession that are condensed in the factor values significantly contribute the explanation of the succession decision.

Regarding the timing of farm operator’s retirement, we find characteristics are different related to the two competing destinations of retirement that is either succession or exit from farming. While, for example, we find a significantly non-linear relationship of farm operator’s age and the timing of succession, the timing of closing the firm shows a significant linear relationship to farmers’ age. The non-linear pattern on succession time indicates that succession is first accelerated as the age of the farmer increase, and than delayed. For given age of farm operator, farm succession is significantly accelerated as the profit and the marginal returns of land increase, while farm owners’ of large farms as well as farm characterized by a high technical efficiency tend to close down the business later.

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Tables

Table 1. Definitions and Descriptions of Variables

Variable	*SYMBOL*	Mean	Std.dev.	Min.	Max.
Dummy variable for farm succession (1 = farm succession is very likely or likely , 0 = else)	*FAMSUC*	0.669			
Timing of succession (years until planned transfer)	*TSU*	7.219	4.558	1	25
Timing of exit (years until planned exit)	*TEX*	10.364	6.953	2	25
Profits from farming (1000 EUR)	*PROF*	59.493	52.954	-64.734	409.736
Farmed land (ha)	*FL*	105.969	79.875	14.590	661.210
Change in farmed land (ha)	*CHFL*	1.233	4.648	-21.920	27.610
Owned farmed land (ha)	*OWN*	56.361	44.193	0.000	347.670
Land rent (EUR/ha)	*RENT*	297.627	396.595	0.000	5588.333
Net borrowed capital (1000 EUR)	*NBC*	127.363	168.304	-307.707	1095.646
Dummy variable cash crop farms with mainly root crops	*CCRC*	0.169			
Dummy variable farms with cash crops and pig production	*CCPIG*	0.063			
Technical Efficiency (0-1)	*TEFF*	0.873	0.110	0.530	1.000
Farmer's age	*AGE*	52.445	7.021	34.000	73.000
Number of daughters	*CF*	1.313	0.926	0	4
Number of sons	*CM*	1.040	0.914	0	3
Land farmed from farmer’s family… (1= farmed since 5 generations or more, 0= else)	*GEN*	0.279	0.450	0	1
Farmer's education (1-5, 1= lowest level, 5=highest level)	*EDUC*	1.746	0.994	1	4
Factor value "bond to farm"	*BOND*	-0.074	0.979	-2.447	2.484
Factor value „financial situation“	*FINAN*	0.031	1.022	-2.123	2.625
Factor value "attitudes towards being farmer"	*FARM*	0.022	1.012	-2.673	2.828
Factor value "restrictions of further growth"	*GROW*	0.011	1.005	-3.181	2.163
Factor value „personal criteria“	*PERS*	0.041	1.019	-2.114	2.206
Factor value „successor’s criteria“	*SUCC*	-0.009	1.025	-2.402	2.651
Factor value „tax criteria“	*TAX*	0.032	0.995	-2.554	1.988

Table 2: Results of the econometric model on the probability of succession

Variable	*SYMBOL*	Param.	(z-value)
Profit / 100	*PROF*	0.766	(2.43)
Change in farmed land	*CHFL*	0.076	(2.72)
owned farmed land / 100	*OWN*	0.888	(2.44)
Land rent / 100	*RENT*	0.162	(2.51)
Net borrowed capital / 100	*NBC*	0.447	(3.04)
Net borrowed capital² / 1000	*NBC2*	-0.261	(-0.87)
Technical efficiency	*TEFF*	0.504	(0.47)
Number of sons	*CM*	0.240	(1.98)
Number of daughters	*CF*	-0.346	(-3.01)
Farmers age	*AGE*	0.414	(2.68)
Farmers age² / 100	*AGE2*	-0.340	(-2.31)
Land farmed since 5 generations	*GEN*	0.468	(1.99)
Farmers education	*EDUC*	-0.243	(-2.19)
Bond to farm	*BOND*	-0.321	(-2.96)
Attitudes towards being farmer	*FARM*	0.220	(2.23)
Growth restrictions	*GROW*	0.175	(1.75)
Constant		-13.579	(-3.24)
LogL:	-109.770	RLogL:	-172.666
LR(DF):	125.791 (16)	N:	272
R^2_{MF}:	0.364	R^2_{MF}:	0.266
R^2_{ML}:	0.370	R^2_{CU}:	0.515
AIC:	0.932	BIC:	-1209.939
		% Correct predictions	84.56
	% Correct predictions of “ones” (“zeros”)		86.46 (80.00)

Table 3. Results of the Econometric Model on the Timing of Succession

Variable	*SYMBOL*	Param.	(z-value)
Farmers age	*AGE*	1.557	(4.03)
Farmers age² / 100	*AGE2*	-3.313	(-4.56)
Farmers age³ / 1000	*AGE3*	0.218	(4.83)
Profits	*PROF*	-0.002	(-2.14)
Change in farmed land	*CHFL*	-0.021	(-2.51)
Net borrowed capital	*NBC*	-0.001	(-2.97)
Land rent	*RENT*	-0.002	(-3.09)
Successor's criteria	*SUCC*	0.082	(1.83)
Personal criteria	*PERS*	-0.109	(-2.72)
Tax criteria	*TAX*	0.012	(0.32)
Constant	α	-19.403	(-2.86)
	p	2.289	

LogL:	-163.505	RLogL:	-263,145
LR(DF):	199.281 (10)	N:	209
R^2_{MF}:	0.379	R^2_{MF}:	0.333
R^2_{ML}:	0.615	R^2_{CU}:	0.668
AIC:	1.679	BIC:	-725,431

Table 4: Results of the econometric model on the timing of closure

Variable		*SYMBOL*	Param.	(z-value)
Farmer's age		*AGE*	-0.064	(-5.38)
Number of daughters		*CF*	-0.141	(-2.11)
Farmed land		*FL*	0.013	(5.80)
Cash crop farms (root crops)		*CCRC*	-0.635	(-3.64)
Cash crop – pig production farms		*CCPIG*	-0.490	(-2.80)
Technical Efficiency		*TEFF*	2.581	(4.75)
Personal criteria		*PERS*	0.202	(2.62)
Tax criteria		*TAX*	-0.083	(-1.31)
Bond to farm		*BOND*	-0.232	(-3.02)
Financial Situation		*FINAN*	0.231	(3.86)
Constant		α	3.494	(4.36)
		p	4.106	
LogL:	-27.657		RLogL:	-69.295
LR(DF):	83.276 (10)		N:	209
R^2_{MF}:	0.601		R^2_{MF}:	0.428
R^2_{ML}:	0.329		R^2_{CU}:	0.678
AIC:	0.379		BIC:	-997.126

Appendix

Table A1. Surveyed Attitudes and Resulting Factors

Close bond to farm (*BOND*)	Negative attitude towards being farmer (*FARM*)	Financial situation (*FINAN*)	Restrictions of further farm growth (*GROW*)
Farmer by tradition +	Too much work on farm +	Reasonable income from farming +	Leasing contracts missing +
Would like to stay on farm +	Successor can't find a partner +	Difficult financial situation +	Conditions restrict farming +
Old age support important +		Investments necessary +	
Farm should stay within family +			

Table A2. Surveyed Criteria for the Timing of Succession and Resulting Factors

Personal criteria (*PERS*)	Successors criteria (*SUCC*)	Tax criteria (*TAX*)
Own age +	Successor's age +	Income tax +
Own health +	End of apprenticeship +	Gift tax +
Don't like to farm anymore +	Successor insists on transfer +	
Criteria for pension payment +	Successor's family circumstances +	
	Young farmer programs +	

Table A3. Definition and Description of Variables – AFT-Model

Variable	*SYMBOL*	Mean	Std. Dev.	Min	Max
Timing of succession (years until planned transfer)	*TSU*	7.219	4.558	1	25
Timing of exit (years until planned exit)	*TEX*	10.364	6.953	2	25
Farmer's age	*AGE*	53.000	6.819	34	73
Profits from farming (1000 EUR)	*PROF*	59.629	51.550	-64.734	409.736
Farmed land (ha)	*FL*	109.771	84.892	14.590	661.210
Change in farmed land (ha)	*CHFL*	1.444	5.024	-21.920	27.610
Net land rent (EUR/ha)	*RENT*	308.403	440.920	0.000	5588.333
Net borrowed capital (1000 EUR)	*NBC*	130.687	171.578	-307.707	1095.646
Technical efficiency (0-1)	*TEFF*	0.873	0.112	0.530	1.000
Dummy variable cash crop farms with mainly root crops	*CCRC*	0.177			
Dummy variable farms with cash crops and pig production	*CCPIG*	0.067			
Number of daughters	*CF*	1.033	0.917	0	3
Factor value „successor's criteria“	*SUCC*	-0.110	0.964	-2.005	2.144
Factor value „personal criteria“	*PERS*	-0.110	1.022	-2.402	2.651
Factor value „tax criteria“	*TAX*	-0.061	1.012	-2.554	1.988
Factor value „bond to farm“	*BOND*	-0.095	0.970	-1.919	2.484
Factor value „financial situation“	*FINAN*	-0.008	1.048	-2.123	2.625