Determining Factors of Farm Exit in Agriculture in Switzerland

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Abstract

Over the past 30 years, the number of farms in Switzerland decreased by an average of almost 2% per annum. The average area per farm rose from 10 ha to over 19 ha. In order to analyse the forces driving farm exits, this study uses data from the Swiss Farm Structure Survey (FSS) between 2001 and 2011. These data are used in binary logistic regression models to estimate exit probabilities and determining factors of structural change.

The logit results show that the probability of farm exit decreases for younger but increases for older operators. Organic farming, farm size, number of manpower units per hectare and farming full-time are also found to have a significant negative influence on exit. By contrast, work intensity and sex of the farm operator positively influence farm exits.

Keywords*: farm exit, structural change, logistic regression, farm survey.*

Introduction

Switzerland has seen significant structural change in the agricultural sector over the past few decades. Between 1980 and 2013 the number of farms in Switzerland fell by almost 50%, i.e. by an average of 1.9% per annum (FSO, 2014). A temporary rise of the exit rates between 1995 and 2000 may be due to the agricultural policy reform which started in 1993 with the reduction of market support and the introduction of general direct payments. Despite this, the more favourable agricultural-policy framework conditions in Switzerland have served to lessen the blow somewhat compared to neighbouring countries (Eurostat, 2012). The average cultivated area per farm is constantly increasing, with no levelling off of this trend being noted to date. With 19 ha per farm in 2013, the average size is less than half of the size in Germany and France, but larger than in Italy. Compared to Austria, where the natural conditions are similar, the average size is slightly lower in Switzerland. Whereas structural change was similar in all regions of Switzerland, it was lower in the mountain regions than in the valley regions of Austria, due to specific policy measures in favour of the mountain areas and pressure from urban centers (Streifeneder, 2009). The structural change has changed the shares of farm sizes: Whereas the number of farms of up to 10 ha in size has fallen by 70%, the number of farms over 50 ha in size has almost quadrupled. Concentration processes of different intensities were to be found among the various production activities, with a particularly sharp drop in the number of farms with pig and poultry production and with vegetable and potato farming. By contrast, the number of individual farm types such as

suckler-cow farms has actually increased. The family farm continues to be the predominant form of enterprise, sometimes accompanied by a secondary source of income. The number of those employed in agriculture fell to approximately the same extent as the number of farms. Hence, the average farm cultivates an ever-increasing area with the same-sized workforce.

Structural change in agriculture covers several characteristics such as land use, ownership, and distribution of farm size. This paper focuses on the farms exiting from the agricultural sector and the factors influencing this exit. To analyse exit probability, the logistic regression method is used by using the Farm Structure Survey (FSS). FSS covers almost all Swiss farms but contains no economic data.

This paper is organised as follows. The first section provides an overview of the determining factors for farm exit identified in the literature. The second section outlines the methods and the underlying data used. The last two sections contain the results of the analysis and some concluding remarks.

Overview of the literature

Decisive factors for structural change have already been the subject of numerous investigations (Baur, 1999; Hofer, 2002; Mann, 2003; Bragg and Dalton, 2004; Foltz, 2004; Snell, 2005; Hoppe and Korb, 2006; Juvancic, 2006; Key and Roberts, 2006; Weiss, 2006; Kirner and Gazzarin, 2007; Rossier, 2007; Meier et al., 2009; Pushkarskaya and Vedenov, 2009; Petrick and Zier, 2011). According to this literature, factors affecting structural change can be grouped under human capital, farm structure, structural environment and socio-economic categories (Table 1).

First, the important characteristics of human capital themselves are their age, education, the number of children the farmer has, Presence of family successor and the genre of the farmer. In all of the investigations, the age of the farm manager proves to be a highly significant factor in farm exit (Baur, 1999; Hofer, 2002; Bragg and Dalton, 2004; Juvancic, 2006; Weiss, 2006; Meier et al., 2009). Not surprisingly, older farmers have higher exit rates (Gale, 2003). Thus, the causes suggested for farm exit are loss of physical ability to work, the farmers' awareness of limitations in his ability to operate the farm, and unexpected incidents (Kimhi and Bollman, 1999). University education has a significant impact on exit from farming (Stiglbauer and Weiss, 2000). In contrast, the number of children or family members slows down the exit of farm (Kimhi and Bollman, 1999; Stiglbauer and Weiss, 2000; Väre, 2006). However, the presence of a farm successor acts as a significant inhibitor of farm exit (Hofer, 2002; Rossier, 2007). The marital status is related to farm exit. Being married induces old farmers to exit from farming (Pietola et al., 2003; Juvancic, 2006, Weiss, 2006), whilst when they are younger it hinders them from exiting from farming (Stiglbauer and Weiss, 2000; Väre, 2006).

In terms of farm structural characteristics, and in line with expectations, larger farms are less at risk of exit than smaller farms. The size of the area cultivated and the value of the farmland are inversely related to early farm exit (Kimhi and Bollman, 1999; Stiglbauer and Weiss, 2000; Glauben et al., 2003; Röder and Kilian, 2008). However, according to Kimhi and Bollman (1999), farm size is not the main factor determining the tendency in farm exit. A larger area per labour unit has a positive effect on farm exit

(Baur 1999; Meier et al. 2009). According to Gasson (1986) and Pfeffer (1989), farmers who have been farming part-time will tend to exit from farming earlier. Therefore, part-time farmers are less likely than full-time farmers to persist in maintaining and developing their farmland (Weiss, 2006). In addition, the organic farming system affects the tendency in farm exit (Hofer, 2002).

External structural variables and socio-economic factors which researchers have argued affect farm exit and farm transfer can be categorized into socio-cultural, economic, and institutional ones. First, the socio-cultural variables are the unemployment rate, Regional wage level, the disadvantaged region and the population density. According to Hofer (2002) and Foltz (2004), a high unemployment rate has a negative effect on decisions concerning farm exit because it decreases opportunity costs. This is consistent with the argument that a lower unemployment rate will facilitate the exit of farmers because of the increase in opportunity costs and the wages of employees (Goetz and Debertin, 2001; Mann and Mante, 2004). However, Juvancic (2006) argued that a higher unemployment rate would facilitate farm exit. In contrast, when the regional economy is brisk, this will reduce the probability of exit from farming due to the increase in off-farm job opportunities (Mann, 2003; Juvancic, 2006). Rossier and Weiss (2006) and Väre (2006) argue that farmers who live in less populated areas tend to exit from farming earlier.

Finally, the socio-economic factors like agricultural income level as well direct payments affect farm exit in different ways. First, the effect of government policy on farm exit was widely investigated. For example, exit rates were found lower in regions with higher subsidy payments from the government in Western Europe (Breustedt & Glauben, 2007). An increase in the amount of direct payment for early retirement is not likely to change the timing of old farmers' exit (Barkely, 1990; Pietola et al., 2003); or it is likely to keep farmers in farming (Mann and Mante, 2004), instead of speeding their departure. Income from agriculture seems to have only a minor influence on the exit rate, whilst contradictory directions of causality were determined for level of additional income.

The degrees of explanation for the probability of exit are consistently low in the studies, with R^2 values ranging around the 25% mark. Accordingly, other socio-economic factors such as intrinsic value, or events characteristic of the individual farm but which are particularly difficult to collect from the farmers ceasing production, and on which less of an influence can be exerted (such as accidents or illnesses), seem to have a major impact on the decision to exit. Consequently, a better understanding of the effect of the economic characteristics of the farm would be of particular interest for forecasting future structural change. These characteristics, however, are not contained in the farm-structure surveys (FSS) (cf. last column of Table 1).

Material and methods

Data sources of factors influencing structural change

In order to identify and better understand the factors influencing structural change the Farm Structure Survey (FSS) data sources are used. This data includes all farms in Switzerland, and has enabled the assessment and monitoring of Swiss agriculture (FSO, 2012). FSS provides detailed insight into the structural, technical and socio-demo-

Table 1: *Factors identified by the literature as affecting structural change*

Factors stimulating (+) or inhibiting (-) farm exit			Sources	in FSS[1]
Human capital	Operator age	+	Baur (1999), Kimhi and Bollman (1999), Hofer (2002), Gale (2003), Bragg and Dalton (2004), Juvancic (2006), Weiss (2006), Meier et al. (2009)	yes
	Agricultural education	-	Baur (1999), Juvancic (2006)	-
	University education	+	Stiglbauer and Weiss (2000), Weiss (2006)	-
	Female operator	+	Weiss (2006)	yes
	Married operator	+ -	Pietola et al. (2003), Juvancic (2006), Weiss (2006) Stiglbauer and Weiss (2000), Väre (2006)	-
	Presence of family successor/children	-	Kimhi and Bollman (1999), Stiglbauer and Weiss (2000), Hofer (2002), Väre (2006), Rossier (2007)	-
	Family size	-	Weiss (2006)	yes
Farm structure	Farm size (area, LU)	-	Baur (1999), Kimhi and Bollamn (1999), Stiglbauer and Weiss (2000), Hofer (2002), Glauben et al. (2003), Snell (2005), Juvancic (2006), Weiss (2006), Skolrud et al. (2007), Röder and Kilian (2008), Meier et al. (2009), Pushkarskaya and Vedenov (2009)	yes
	Growth (area, LU)	-	Weiss (2006)	yes
	Area per worker	+	Baur (1999), Meier et al. (2009)	yes
	Percentage of leased area	+	Hofer (2002), Baur (1999)	-
	Stocking density (LU/ha)	+	Mann (2003)	yes
	Full-time farm	-	Gasson (1986), Pfeffer (1989), Baur (1999), Juvancic (2006), Weiss (2006)	yes
	Organic farm	-	Hofer (2002)	yes
	Diversification	+ -	Bragg and Dalton (2004) Skolrud et al. (2007)	yes
	Share of perm. cultures	-	Röder and Kilian (2008)	yes
Structural environment	Unemployment rate	- +	Goetz and Debertin (2001), Hofer (2002), Foltz (2004), Mann and Mante (2004) Juvancic (2006)	-
	Regional wage level	- +	Juvancic (2006) Hofer (2002)	-
	Disadvantaged region	- +/- +	Baur (1999), Juvancic (2006), Weiss (2006), Röder and Kilian (2008) Hofer (2002)	yes
	Population density	+ -	Juvancic (2006) Rossier and Weiss (2006), Väre (2006)	-
Socioeconomic factors	Agricultural income	- +/-	Mann (2003; 2006), Bragg and Dalton (2004) Kirner and Gazzarin (2007)	-
	Off-farm income	+ -	Bragg and Dalton (2004), Loughrey et al. (2013) Mann (2003)	-
	Direct payments	- +/- +	Barkely (1990), Hofer (2002), Mann (2003; 2006), Foltz (2004), Mann and Mante (2004), Key and Roberts (2006), Breustedt and Glauben (2007), Pietola et al. (2003) Hoppe and Korb (2006), Petrick and Zier (2011)	-
	Direct payments per area	-	Hofer (2002)	-

[1] Data available in Farm Structure Survey

graphic situation of almost all Swiss farms on an annual basis. The current investigation is based on the FSS's from 2001 and 2011 covering a total population of 68784 farms in the year 2001.

Structural variables influencing farm exit

The literature on structural change is used to select the variables of the model (Table 2). The dependent variable (FARMEXIT) represents whether a farm exits the agricultural sector during the period 2001 to 2011. The variable FARMEXIT is equal to 1 when a farm (i) leaves the sector between 2001 and 2011, or (ii) is merged with another farm, or (iii) is handed over to a new farm operator who is not a member of the family.

The characteristics and associated variables influencing structural change are partly real numbers and partly dichotomous values. No 'omitted variable' process was conducted. The selection of correlated variables, e.g. surface area and livestock numbers, was avoided. Some of the hypothesised characteristics and associated variables influencing structural change are squared, since their impact on farm exit showed a squared relation in the literature (e.g. Weiss, 2006).

Several ratios of single variables are included in the model: a high number of workers per area (WORKLAND) is a measure for a labour-intensive farm, which could trigger farm exit. If the calculated working time for the farm activities is high relative to the number of workers (CALCWORK), the farm is likely to be labour-efficient, which may result in a lower probability of exit; on the other hand, the workload may be grounds for exit.

Some selected figures for exiting and non-exiting FSS farms are shown in Table 3. The data for 2607 farms was incomplete, and thus not taken into account in the analysis. Of the remaining 66,177 farms in 2001, 14,716 were no longer part of the database by 2011. This corresponds to an exit rate of 22.2%. About 6,000 new farms (e.g. farms that were taken over by an operator outside of the former operator's family) entered the sector during this time period. These new farms were not taken into account in the analysis. The differences between the exiting and the non-exiting group are significant at the 5% level for all variables. As expected, the mean utilised agricultural area and total livestock numbers are considerably lower for the exiting farms, whilst the average age of the operator is over eight years higher.

Modelling farm exit

Two main categories of models emerge from the literature can be used to analyze the exit behavior: econometric models and simulation models as well multi-agent model (for a review see Zimmerman et al., 2010). In order to analyze the factors actually affecting the exit behavior most of the literature uses an econometric framework as it allows some sort of statistical validation of results. Among all the available econometric approaches, the Markov chain analysis has been justified by many previous researchers examining the changing nature of agricultural production and estimating the probability of movement from one state of nature to another over time. The main reasons why a Markov Chain model is not appropriate for the research questions addressed in this paper. The limited details available in the FSS data it is not possible to develop a model that allows movement between all states of structural change; that is, a matrix of transition probabilities for all (n=66177)*n*t(11 years) cells cannot be estimated. The

Table 2. *Definition of variables used in the 'exit of/entry to agricultural sector' model*

Variables	Description	Supposed impact
Dependent variable		
FARMEXIT	1=The producer exits the agricultural sector (or his ID number changes); 0=The farm exists from the beginning to end of the time period	
Explanatory variables		
AGE AGE^2	Age of the producer (years; recorded in 2001) Square of the age of the producer (years^2)	positive
FEMALE	1=The producer is female; 0=Male	positive
FAMILY	Number of workers belonging to the family (No.)	negative
EMPLOYEES	Number of employees (No.; Part-time employees weighted according to hours worked)	negative
LAND $LAND^2$	Utilised agricultural area (ha) Square of the utilised agricultural area (ha^2)	negative
GROWTH	1=mean (LAND t+1- LAND t) is greater than 1 ha; 0=Otherwise	negative
LULAND $LULAND^2$	Livestock units per area (LU/ha) Square of livestock units per area ((LU/ha)^2)	positive
FULLTIME	1=Full-time farm; 0=Part-time	negative
ORGANIC	1=Organic farm; 0=Non-organic	negative
WORKLAND	Number of workers (family members and employees) per area (No./ha; Part-time workers weighted according to hours worked)	positive
CALCWORK	Calculated working hours required for crops and livestock, per number of workers (hours/No.; Part-time workers weighted according to hours worked)	negative
CALCBENEFIT	Standardised contribution margin per area (CHF 1000 /ha; standard values per crop and livestock unit)	unknown
TYPCROP	1=Crop farm (Open arable land accounts for over 70% of total area); 0=Otherwise	unknown
TYPSPECIAL	1='Special crops' farm (Special crops account for over 10% of total area); 0=Otherwise	
TYPMILK	1=Dairy farm (Cattle account for over 75% of livestock, of which at least 25% are dairy cows); 0=Otherwise	
TYPSUCKLER	1='Suckler cow' farm (Cattle account for over 75% of livestock, of which at least 25% are suckler cows); 0=Otherwise	
TYPCATTLE	1='Other cattle' farm (Cattle account for over 75% of livestock, of which fewer than 25% are cows); 0=Otherwise	
TYPHORSE	1=Horse, sheep or goat farm (Horses, sheep and goats account for over 50% of livestock); 0=Otherwise	
TYPPIGPOUL	1=Pig or poultry farm (Pigs and poultry account for over 50% of livestock); 0=Otherwise	
TYPCOMBCROP	1=Combined farm with crops (Other farms, open arable land account for over 40% of total area); 0=Otherwise	

econometric estimation of farm exit probabilities is hampered by data availability. The farm accountancy data network (FADN), which provides extensive information on the economic performance of farms, is organized as a rotating panel, and does not allow determining whether a farm exits the survey due to the closing down of the farm or other reasons. The farm structural survey on the other hand provides information on farm exits but does not include information on the economic performance. Data protection rules prevent a linking of the data on single farm level (the identification of exiting farms in FADN). Given these difficulties, it was decided to move away from a Markov Chain type methodology and instead to develop a logit model of farm exit.

In order to explore the determinants of the probability of farm exit (P) during the period 2001-2011 we estimate a dichotomous choice logit model over the whole sample of Swiss farms. We assume that the probability of observing the exit of farm in the year is dependent on a vector **x** of farms' structural and economic characteristics and this probability is distributed logistically according to the law:

$$\log\left\{\frac{P_j(Y=1)}{1-P_j(Y=1)}\right\} = a + \sum_{i=1}^{k} \beta_i x_{ji} + \varepsilon_j$$

Where log is the natural logarithm, X_{jk} is a vector of exogenous variables (e.g. various farm and operator characteristics) for the j_{th} farm in time period t, β_k is a vector of parameters to be estimated, and ε_j is a stochastic error term. Coefficients in logistic regressions (the β parameters) tell us the extent to which a change in an independent variable alters the log of the predicted odds ratio $[P_j/(1-P_j)]$. To overcome the complexities of result interpretation, we use a logit framework, where the dependent variable represents the log of the odds ratio of farmer's plan to shift out of agriculture. The odd is defined here as the ratio of probability that farmers will make a choice to shift out of agriculture to that he remains in agriculture.

***Table 3**: Descriptive statistics for selected key structural factors of exiting/non-exiting farms in FSS database between 2001 and 2011*

Factor[1]	Unit	Exiting farms 14,716 holdings		Continuing farms 51,461 holdings		*p*
		mean	*CV*	mean	*CV*	
AGE	years	54.3	0.24	45.6	0.22	0.000
FAMILY	No.	2.00	0.47	2.50	0.38	0.000
Employees (unweighted)	No.	2.41	1.04	2.95	0.66	0.000
EMPLOYEES	No.	1.34	1.36	1.89	0.72	0.000
LAND	ha	10.4	1.20	17.6	0.72	0.000
Total livestock	LU	10.7	1.41	20.9	0.83	0.000
LULAND	LU/ha	0.97	0.96	1.25	0.67	0.000
WORKLAND	No./ha	0.29	1.98	0.16	1.42	0.000
CALCWORK	hours/No.	1.75	0.63	1.96	0.49	0.000
CALCBENEFIT	CHF 1000 /ha	6.29	1.07	5.37	0.84	0.000

[1] Variables used in the logistic model are written all in CAPS.

Six logit models were estimated for the sample as a whole and 5 models for selected farm types. The most frequent farm type in Switzerland is the dairy farm, reaching a share of 30% of all farms. The model results of this farm type are compared to crop farms (6% of all farms) and to three further livestock farm types: Suckler-cow farms (3%), Other-cattle farms (9%) and Horse/sheep/goat farms (9%). We use farm typology which was developed based on the FADN data.

Results and discussion

The results of all six logit models and corresponding odds ratios are presented in Table 4. This Table provides information on the overall fit of the model. Since an R^2 does not accurately measure the fit of a logit model, a pseudo-R^2, the likelihood ratio, is calculated. The pseudo-R^2 ranged between 0.196 and of 0.34 represents a relatively good fit for a logit model (Hensher and Johnson). The logit model based on the FSS database is statistically significant at the 5% level or better as measured by the likelihood ratio test. The predictive power of the model for explaining actual classifications into the two categories differs substantially between the individual categories. Of a total of 66177 observations, 82.1% are correctly classified by the econometric model, whilst the percentage of correctly classified farm exits between 2001 and 2011 is substantially lower at 30.6%. As expected, the most difficult task is to predict farm exit. The odds ratio for a continuous explanatory variable represents the amount of change in the odds caused by a unit change in that explanatory variable with all other explanatory variables held at their means. Interpretation of the odds ratios related to the dummy variables in the model is straightforward, and provides important information.

According to Table 4, the probability of farm exits is significantly influenced by characteristics such as farm size, previous farm growth, and farm type (as an index of on-farm diversification). Farm size and size squared are significant in all analysed logit models.

Coefficient signs of the two farm-size variables indicate a complex nonlinear relation between farm size and exit. The amount of utilised farmland has increased, presumably reducing the likelihood of exit, at least until threshold size is reached. From the threshold-size point onwards, farms are less likely to exit as farm size increases. This relationship between farm size and exit probability may be explained through scale economies and fixed-asset hypothesis. Scale economies (or returns to scale) refer to the change in output resulting from a proportional change in all inputs. Scale economies typically increase along with an increase in farm size (i.e. increasing returns to scale). Conversely, an expanding scale of production indicates that the farmer in question has an incentive to increase output and stay in farming. A reasonable assumption can therefore be made that operators of large farms enjoy competitive advantages in agriculture and have less of an inclination to exit.

In addition to these farm characteristics, Table 4 suggests a number of personal characteristics of the farm owner which have a significant influence on farm succession and exit. In particular, a significant life-cycle pattern can be observed in the farmer's succession and exit behaviour. The effect of age (AGE) on the probability of farm exit is negative for young farmers, becoming positive when AGE exceeds 38 years, which is somewhat below the average age of farmers (44 years). The negative relationship re-

***Table 4**: Parameter estimates for the FSS model per farm type*

	All farms		Crop farms		Dairy farms	
	Coefficient	**Odds ratio**	**Coefficient**	**Odds ratio**	**Coefficient**	**Odds ratio**
Constant	2.509 ***	12.288	2.507 ***	12.268	4.137 ***	62.638
FEMALE	0.198 ***	1.220	0.126	1.134	0.271 *	1.311
EMPLOYEES	0.032 ***	1.032	-0.195	0.823	0.081	1.085
FULLTIME	-0.611 ***	0.543	-0.463 ***	0.629	-0.511 ***	0.600
ORGANIC	-0.357 ***	0.700	0.179	1.196	-0.518 ***	0.596
WORKLAND	0.261 ***	1.299	1.884	6.578	1.107 **	3.026
CALCWORK	-0.112 ***	0.894	-0.158 **	0.854	-0.042	0.959
CALCBENEFIT	-0.008 *	0.992	-0.069	0.934	-0.015	0.985
FAMILY	-0.364 ***	0.695	-0.387 ***	0.679	-0.474 ***	0.623
AGE	-0.134 ***	0.875	-0.130 ***	0.878	-0.192 ***	0.826
AGE^2	0.002 ***	1.002	0.002 ***	1.002	0.003 ***	1.003
LAND	-0.037 ***	0.963	-0.028 ***	0.972	-0.048 ***	0.953
$LAND^2$	0.020 ***	1.021	0.014 *	1.014	0.037 ***	1.038
LULAND	-0.277 ***	0.758	-1.670 ***	0.188	-0.707 ***	0.493
$LULAND^2$	0.041 ***	1.042	1.865 ***	6.455	0.124 ***	1.132
GROWTH	-0.553 ***	0.575	-0.700 ***	0.497	-0.644 ***	0.525
TYPCROP	0.129 **	1.138				
TYPSPECIAL	0.084	1.087				
TYPMILK	0.156 ***	1.168				
TYPSUCKLER	-0.160 **	0.852				
TYPCATTLE	0.183 ***	1.200				
TYPHORSE	0.234 ***	1.264				
TYPPIGPOUL	-0.060	0.941				
TYPCOMBCROP	-0.087	0.917				
R^2	**0.296**		**0.342**		**0.235**	

	Suckler-cow farms		Other-cattle farms		Horse/sheep/goat farms	
	Coefficient	**Odds ratio**	**Coefficient**	**Odds ratio**	**Coefficient**	**Odds ratio**
Constant	2.558 **	12.912	2.716 ***	15.124	2.244 ***	9.427
FEMALE	-0.043	0.958	0.396 ***	1.486	0.004	1.004
EMPLOYEES	-0.023	0.977	0.042	1.043	-0.292 **	0.747
FULLTIME	-0.339	0.712	-0.485 ***	0.616	-0.317 ***	0.728
ORGANIC	0.102	1.107	-0.346 **	0.708	-0.131	0.877
WORKLAND	2.374 *	10.745	2.311 ***	10.081	0.724 ***	2.063
CALCWORK	-0.183	0.832	0.105 *	1.110	-0.117 ***	0.889
CALCBENEFIT	-0.232	0.793	-0.401 ***	0.670	-0.092 **	0.912
FAMILY	-0.550 ***	0.577	-0.411 ***	0.663	-0.316 ***	0.729
AGE	-0.146 ***	0.864	-0.135 ***	0.874	-0.107 ***	0.898
AGE^2	0.002 ***	1.002	0.002 ***	1.002	0.001 ***	1.001
LAND	-0.040 **	0.960	-0.063 ***	0.939	-0.066 ***	0.936
$LAND^2$	0.017 **	1.017	0.066 ***	1.069	0.055 ***	1.057
LULAND	0.151	1.163	-0.065	0.937	0.006	1.006
$LULAND^2$	-0.080	0.923	0.056	1.058	0.031 **	1.032
GROWTH	0.016	1.016	-1.055 ***	0.348	-0.532 **	0.587
R^2	**0.210**		**0.299**		**0.196**	

* indicates statistical significance at the 10%-level

** indicates statistical significance at the 5%-level

*** indicates statistical significance at the 1%-level

ported for farm operators at younger ages may be explicable in terms of learning effects and the acquisition of experience (Jovanovic, 1982). Furthermore, switching from farming to a non-farm job becomes a less viable option as the individual ages, since specific human-capital investments are involved, and the time to retirement over which these investments can be recouped is shorter for older farmers. On the other hand, and almost by definition, we expect the probability of farm exit to increase as the farm operator grows older, especially for farms where succession is unlikely. By contrast, the probability of family succession initially increases with the farm operator's age, then decreases again. Note, too, that the relative importance of family versus non-family succession changes with the farm operator's age, as shown in Figure 1.

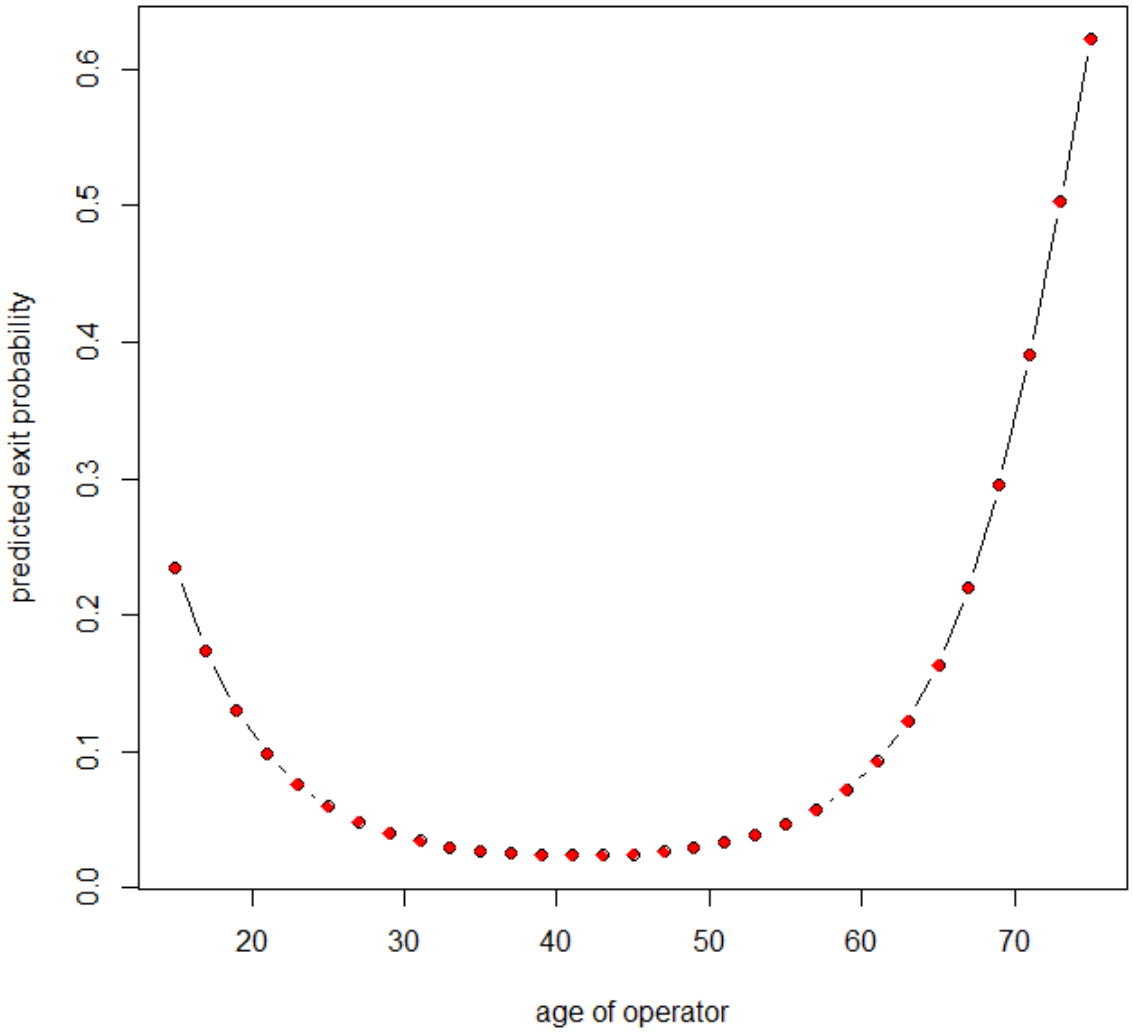

Fig. 1: *Effect of age on the exit probability based on the logit model*

The size of the farming family (FAMILY) is another important factor for determining farm succession and exits. A highly significant and negative impact on farm exit is reported in Table 4 for farms with larger families. For a hypothetical farm household, an increase in family size (FAMILY) by one standard deviation reduces the probability of failure by 1.44 (1/0.695) per cent points. These results are not surprising, since family members provide both an incentive and the necessary labour resources for continuing

the family-farm business. Similar, one standard deviation increase in previous growth rates lowers the probability of farm exit by 1.7 (1/0.575) time compared the farm with negative farm size growth.

The coefficient estimate for gender is only positive and significantly different from zero in Dairy (TYPMILK) and Other Livestock (TYPCATTLE) farms and all farm-type columns. All else being equal, farms operated by a woman (FEMALE = 1) are 1.22 times more likely to exit than farms operated by a man. Sociological studies point to women's primary responsibility for the home which pulls them away from the business and thus represents an additional major factor that places women at a disadvantage relative to men (Goldberg, 1984, and Watkins and Watkins, 1983). In Table 4, we also observe highly significant parameter estimates for FULLTIME. If the farm manager spends over 1500 working hours on the farm (FULLTIME = 1), the probability of exit decreases by almost 50% relative to a part-time farm.

Exit may differ among types of farm businesses. Diversification of farm has been controlled for by using several farming-type dummy variables (TYPCROP, TYPMILK etc.). Table 4 shows the probability of farm exit increases if farms are specialized in the production crops, dairy and cattle. Diversification thus is a successful strategy to reduce the risk of failure in the farm business. One thing that stands out here is that each of these commodities (crops, cattle and dairy) produce low value outputs and has a high risk and require large capital investments. Further, specialized farms are perceived as a relatively not stable source of income compared to some combined farm types. The probability of exit plan is highest for horse, sheep or goat farms (about 1.26 times more often than a combined farms), followed by cattle farms (approximately 1.12 times more) and dairy farms with 1.17 times more often than combined farms to exit. Table 4 also reports a significant impact of on-farm specialisation on farm exits. Farm-type dummy variables prove to be significant when explaining farm differences in exit behaviour, but seem to be less important in combined farms.

Generally speaking, the explain factors considered across farm type affect the decisions of farmers exit in the same way as in the all farms model. However some parameters (e.g. ORGANIC, LULAND) seems to have the opposite effect, but they are not significant at the farm type level.

Conclusions

This study used data from the Swiss Farm Structure Survey (FSS) a to analyse the forces driving farm exits between 2001 and 2011. These data were used in binary logistic regression models to estimate farm exit probabilities. Results from this analysis reinforce similar findings by other researchers. The logit results show that the probability of farm exit is directly related to farm size, operator age, number of manpower units per hectare, and farming system. The probability of farm exit decreases for younger but increases for older operators. Organic farming, family size and farming full-time are also found to have a significant negative influence on exit. By contrast, work intensity and sex of the farm operator positively influence farm exits.

The present study includes only a limited number of explanatory variables. Other characteristics such as land tenure, succession, economic factors and urban influence may also affect exit probability, and may therefore warrant assessment. As this infor-

mation is not available in the FSS, however, an additional survey would be required to allow a more-detailed analysis to be performed.

Inadequacies within the FSS dataset include a lack of information on farmers' education, economic factors and agricultural policy variables (direct payment). The inclusion of these in the model specifications would add significantly to the knowledge about a farmers decision to exit or not. Despite this shortfall the results in this paper still gives us rich farm specific information for a large number of farmers over a relatively long time horizon and the model allows us to make a judgement on the characteristics of farm households affecting farmers' exit decision process. However, an additional survey would be required to allow a more-detailed analysis to be performed. Analyzing this simultaneous relationship between agricultural policy change and farm exit could be a promising issue for future research into the process and causes of structural change in the farm sector.

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