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Farm survival and direct payments in the Norwegian farm sector

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1 Introduction

According to OECD (2012), Norwegian farms are most heavily regulated and subsidized making them a natural point of departure for our analysis: Where else if not in Norway should we expect agricultural policies to affect farm structural change? Moreover, keeping farm exit at low numbers has been an important premise for Norwegian agricultural policy. Former minister of agriculture Terje Riis-Johansen once said that "*to me, each farm that exits is a personal defeat*". This view has been weakened by his successor (from the same party) Lars Peder Brekk who said that "*thinking that structural change can be stopped compares to believing in Santa Claus*".

The aim of the paper is to explore what roll policy plays for farmer's exit/survival decision. We aim in particular to explore the importance of the total farm income as well as the on-farm wage rate for farm exit. Both the total income well as the on-farm wage rate is heavily influenced by agricultural support. A common believe which is often brought forward by the farmers lobby is that an increase in agricultural support can decrease farm exit rates. We aim to analyse this claim empirically by using data of all farms for the period 1999 to 2009.

The remaining of the paper is structured as follows. The data are presented in the next section. In Section 3 measures for the on-farm wage rates as well as the total farm income are derived. Following, the relationship between changes in the on-farm wage and farm exit are explored graphically in section 4. The main analysis is presented in section 5 where we aim explaining farmers' exit/survival decision using a binary choice model. To provide a more intuitive interpretation of the regression results a concrete calculation of cost and effects of increasing direct payments is provided. Finally, section 6 concludes.

2 Data [1]

The analysis is based on data from the Norwegian Direct Payment Register PT (Produksjonstilskuddsregister). The register contains agricultural area by crop and number of animals by type of animal for every farm that applies for direct payments. A few exceptions apply. Eligibility for direct payments is subject to certain conditions, one of which is a minimum economic size of the farm (measured by turn-over) in order to prevent "hobby-farms" from receiving subsidies. As a consequence, the total numbers of acreage and/or animals may be somewhat underestimated when compared with other official sources such as slaughter statistics or the decennial total farm census.

This analysis utilizes data for the years 1999 and 2009. Individuals and legal entities managing agricultural area or keeping animals eligible for direct payments may apply for subsidies by filling in data in the register. The register links the amount of acreage and animals with applicants' characteristics: business identification number (foretaksnummer) and property number (kommune-, bruks- og gårdsnummer). In addition, we have the farmers' social security numbers which contains the birth date. Farm intergenerational transfer can thus be measured as a "reduction" in the farmer's age from one year to the next.

For practical reasons, we rely on the property number as the unit of analysis. Property units present in 1999, but not in 2009 are assumed to have left the sector.2 Some aspects follow from this choice. We disregard if farms split their activities in different business units. Small farms may incidentally have left the sector in 2009, but applied for subsidies

[1] This section draws heavily on Mittenzwei (2012).

[2] In very rare occasions, it might be the case that properties have been split up causing the emergence of new property units. This cannot be checked in our dataset.

in 2008 and 2010.

The register contains 126 different crop and animal activities. Although the vast number of direct payments facilitates a comprehensive database, there is a back side of the medal. Changes in the regulations imply changes in the database, and hence breaks, making comparisons before and after the change challenging. Also, the register of a certain activity will cease if the associated payment is ceased.

Table 1 shows the number of farms covered in the PT database for the two measures mentioned above and compared to the number of farms recorded in other statistics.

Table 1: Number of farms for various accounting measures

	1999	2009
Property number (NAA 2011)	66,892	45,460
Business number (NAA 2011)	66,832	45,420
Number of farms (Statistics Norway 2011)	70,740	47,688

Source: NAA (2011) and Statistics Norway (2011)

Table 1 reveals that there are small differences between the measures to identify farms. For all practical purposes regarding the analysis, the number of properties and the number of businesses appears to be the same. Further, the numbers are somewhat lower than the number of farms provided by the Statistical Office (Statistics Norway). The reason is probably certain size limits regarding the eligibility of direct payments.

3 Measurement of total income and on-farm wage rate

In order to analyze the effect on total income, the on-farm wage rate and changes in the on-farm wage rate for farm exit, appropriated measures for each of the three needs to be defined. In order to more clearly separate the influence of direct payment on farm income we divide farm income into two parts, first the market returns and second the return from direct payments. It is important to note that what we termed market returns also depends substantially on policy decision since prices that can be realized on the market are strongly affected by administrative prices. For the market return we consider an average market return for each production activity such all income measures based on the market return can be seen as the potential or average income a farmer can expect given its production program. In the following we will use the terms *income* or *on-farm wage* to describe these potential or average income of a farm. It is important to note that the actual income of one particular farmer can deviate from this potential income which is only an approximation of it. Nevertheless, there are also important situations such as a farm succession or a change of specialization into a new production activity where the potential income is more important for farmer's decisions than the actual income since the latter is largely unknown to a successor or for a new production activity. The direct payments are calculated for the specific production program of a farm based on the actual policy implementation that is in place in the corresponding year.

Total income is than defined as the sum of total market returns and total direct payments. To derive farms on-farm wage the average labour requirement is calculated for each farm based on it actual production program using estimated labour input use coefficients. The potential wage rate of a particular farm is than obtained as the ratio of total income and total labour requirement. Additionally we obtain a measure for the potential change in the on-farm wage rate if the farm would not have altered it size or production program. For the calculation we keep the production program constant to the 1999 level, even so we have observations on the actual production programs during the period. The reasoning behind it is that changes in the production program might already be the results of changes in income opportunities that we aim to explain. Intuitively, changes in on-farm wage can be interpreted to what extend a farm in 1999 is required to change its size or production program in order to maintain its on-farm wage rate to 2009.

In the following a detailed description of the calculation of direct payments and market returns is given.

3.1 Calculation of market returns

To approximate market returns the market return to labour is derived for all production activates distinguished in the payment data base as per unit (head or area) rates for 1999 and 2009. Multiplying the per unit rates for 1999 and 2009 with the observed production activities in 1999 results in the total market return in 1999 and 2009 for each single farm, under the condition that a farm would not have changed it size or specialization. Information about the market return per unit for each production activity is derived from the reference farms (*Referansebruk*) data collection (NILF, 2000b and 2009). The data collection contains information of around 30 reference farms that are selected to represent the diversity of the Norwegian farm sector with respect to size, specialization and location. Data is collected on an annual basis and each reference farm summarizes information from several farms within the Norwegian farm accountancy system (*Driftsgranskinger*), comparable to the EU's Farm Accounting Data Network (FADN), to minimize farm specific variation in for example productivity or the cost structure. The reference farms are the basis for the annual negotiations for the adjustments of the market support and direct payments and thus are central in Norwegian agricultural policy. To derive the market return per unit for each production activity we selected reference farms in 1999 and 2009 that are similar in size, specialization and location. A full cost accounting is applied considering fixed costs, depreciation and capital costs. Labour costs are excluded in order to derive the return to labour. Costs are split between production activities in proportion to the share of total market revenue that can be attributed to the specific production activity. Total market return, obtained as the difference between costs and revenues attributed to a production activity, is then divided by the production quantity to obtain a market return per unit (head or area). For suckler cows, poultry, vegetables in greenhouses and on arable land, which are not sufficiently represented in the reference farms in both years, information about variable and fixed cost as well as on yields and prices are drawn from additional sources (NILF, 1999, 2000a, 2000b, 2009, 2010 and 2011; BFJ, 2001 and 2011; Mittenzwei and Gaasland, 2008). The derived market returns per unit are reported in table 2. The specific calculation of the market returns for each production activity is available on request.

Table 2: Market results per unit for different production activities in 1999 and 2009. Market results consider market incomes, variables costs, fixed costs, capital costs and depreciation but exclude labour costs and direct payments.

			Market Return (NOK/unit)	
Code	**Name**	**Unit**	**1999**	**2009**
119	Other livestock	head	*considered under 120 and 121*	
120	Dairy cows	"	-1484	-2584
121	Suckler cows	"	-10869	-6629
133	Sheep or lamb (kept outside most of the year)	"	-34	-241
134	Female sheep > 1 year (kept inside during winter)	"	*same as 133*	
135	Male sheep > 1 year (kept inside during winter)	"	*considered under 133*	
136	Sheep < 1 year (kept inside during winter)	"	*same as 133*	
140	Female goat over 1 year	"	-790	-1365
144	Male goat over 1 year	"	*considered under 140*	
155	Sows	"	-232	951
157	Slaughter pigs	"	-16	51
160	Laying hens at counting date	1000 head	2672	-4412
186	Poultry sold as living animal	"	2625	1483
210	Fodder on arable land	daa[c)]	-248[a)]	-355[a)]
211	Fodder on non-arable non-fenced land	"	*same as 210*	
212	Fodder on non-arable fenced land	"	*same as 210*	
213	Other fodder	"	*same as 210*	
230	Potatoes	"	1379	-277
237	Oil seeds	"	33	-131
238	Rye	"	*same as 240*	
240	Wheat	"	44	-218
242	Barley	"	35	-180
243	Oats	"	34	-168
245	Peas	"	34[b)]	-174[b)]
250	Vegetables in greenhouses	"	-1204604	-1293257
264	Vegetables on arable land	"	605	1563
272	Apples, pears, plums, cherries	"	1354	2683
280	Berries	"	*same as 272*	

[a)] avg. from fodder production for Milk/Goat/Sheep; [b)] avg. 242/243; [c)]1 daa = 1/10 ha; Source: Own calculation based on the sources in the reference list.

3.2 Calculation of direct payments

There are basically two types of support to agriculture: Direct payments and other subsidies financed by taxpayers and border protection financed by consumers. Table 3 indicates that support to agriculture amounts to roughly two-thirds of the sector's total production value (including direct payments).

Table 3: Decomposition of production value including subsidies for Norwegian agriculture in 1999 and 2009.

	1999	**2009**
Support financed by taxpayers	11 176	12 234
Support financed by consumers	9 211	8 939
Market income at world market prices	8 251	13 583
%-PSE	71	61

Source: OECD (2011)

Direct payments per farm were calculated for each of the two years using actual payment rates and eligibility rules for the most important single programs. Most of these payments are based on current levels for animals and crops. Payment rates are frequently differentiated by region and farm size so as to counter natural handicaps and economies of scale. Table 4 identifies the seven programs for which payments were calculated on an individual basis for each farm. The remaining programs were allocated to the group "Other payments". This group accounted for 10 % and 20 % of total subsidies in 1999 and 2009, respectively.

Table 4: Direct payments in 1999 and 2009

	1999		2009	
	mill kr	%	mill kr	%
Structural income support for milk production	1 394	12.5	972	8.0
Vacation and temporary substitute scheme	1 507	13.5	1 331	11.0
Support for grazing animals (start 2007)	-	0.0	459	3.8
Production subsidy for livestock	2 118	18.9	2 123	17.6
Base and regional price support	1 654	14.8	1 396	11.5
Transport subsidies	238	2.1	212	1.8
Acreage and cultural landscape scheme	3 182	28.5	3 087	25.5
Other payments	1 084	9.7	2 510	20.8
Total	11 176	100	12 0893	100

Source: OECD (2011)

The structural income support for milk production is a program that benefits holders of dairy cows, suckler cows and dairy goats. Payments are made for a certain number of animals on a farm. That number is considerably lower than the average number of animals per farm. In addition, total payments are capped. In effect, most farms receive the same payment amount irrespective of actual farm size.

The vacation and temporary substitute scheme is a program that allows farmers with animal husbandry to employ hired labour in order to be able to go on vacation or take some days off. Program eligibility requires the submission of the costs of hired labour, while payments are made according to fixed rates per animal on the farm. Payment rates do not differ between regions, but with farm size. Rates are higher for the first animals on a farm and lower thereafter. There is an overall payment cap that is binding for farm above average size.

Support for grazing animals was introduced in 2007. Payment eligibility is linked to a requirement that grazing animals must be given the possibility to graze outdoor for at least sixteen weeks in Southern Norway and twelve weeks in Northern Norway. Payment rates are irrespective of region and farm size.

The production subsidy for livestock is a major program for farms with animals. Payments are made for livestock, pigs, and poultry. Overall payments are capped, and the cap is binding for farms above average size. Payment rates differ by region, where rates in Southern Norway are lower than in Northern Norway. Payment rates differ also with regard to farm size. The first animals in a herd receive higher rates than the last animals in a herd. For all animals, payment rates are zero above a certain herd size.

Base and regional price support is made contingent on farm output. Base support is made for cereals, goat milk, sheep and goat meat as well as wool. Regional support is made to cows and goat milk, beef, pork meat, sheep and goat meat, and egg. There is also regional price support to fruits and vegetables. Although the total (national) amount of payments is capped, the cap has not been binding.

Transport subsidies are given to reduce the costs of transport between farms and the first stage food processing industry (i.e., dairies, slaughterhouses, and mills). Products that benefit from transport subsidies are milk, meat, cereals, and foodstuff.

The acreage and cultural landscape scheme is the most important program for crops including fodder and grassland. Payment rates vary between regions and farm size. The first fields receive higher rates than the last fields. The degressivity of the payment rates has been reduced between 1999 and 2009. That is, a larger area on an individual farm is now eligible for that scheme, and payments rates differ less.

The remaining payments were grouped together and distributed per unit of acreage and animal using a key related to environmental cross-compliance. Income tax deduction and agro-environmental support stand out as the two single most important measures in that group. Without further knowledge, it is impossible to allocate these payments to agricultural activities in a meaningful way.

3.3 Calculation of labour requirements

To derive the on farm wage rate the average labour requirement per unit of each production activity is estimated for 1999 and 2009. For this data from the 1999 and 2010 farm census on the total labour input for each farm is used. The census data can be linked to the payment data base. We thus are able to regress total labour input on the different production activities to obtain a measure of the labour requirement per unit of production activity.

Table 5: Estimated labour use coefficients for 1999 and 2009. The dependent variable is total hours of labour input. All coefficients are significant at the 1% level.

Code	**Name**	**Unit**	**1999 Coef.**	**2009 Coef.**
119	Other livestock	head	*considered under 120 and 121*	
120	Dairy cows	"	110.58	74.04
121	Suckler cows	"	11.01	18.45
133	Sheep or lamb (kept outside most of the year)	"	11.06 [a)]	7.00
134	Female sheep > 1 year (kept inside during winter)	"	11.06 [a)]	7.00
135	Male sheep > 1 year (kept inside during winter)	"	11.06 [a)]	7.00
136	Sheep < 1 year (kept inside during winter)	"	*considered under 134*	
140	Female goat over 1 year	"	28.81	23.29
144	Male goat over 1 year	"	*considered under 140*	
155	Sows	"	51.52	29.75
157	Slaughter pigs	"	4.24	2.85
160	Laying hens at counting date	1000 head	319.37	300.13
186	Poultry sold as living animal	"	10.83	9.41
210	Fodder on arable land	daa[c)]	9.79	5.27
211	Fodder on non-arable non-fenced land	"	11.62	9.40
212	Fodder on non-arable fenced land	"	4.23	3.10
213	Other fodder	"	3.48	6.63
230	Potatoes	"	13.02	7.56
237	Oil seeds	"	3.35 [b)]	2.16
238	Rye	"	3.52	3.04
240	Wheat	"	2.97	1.58
242	Barley	"	3.35 [b)]	2.16
243	Oats	"	3.35 [b)]	2.16
245	Peas	"	3.35 [b)]	2.16
250	Vegetables in greenhouses	"	14824.60	10065.67
264	Vegetables on arable land	"	40.25	27.54
272	Apples, pears, plums, cherries	"	53.64	51.18
280	Berries	"	79.09	69.77
	Number of observations		*66150*	*40513*
	R^2		*0.56*	*0.48*

a) considered as the sum of 133, 134, 135; b) considered as the sum of 237,242,243,245; c) 1 daa = 1/10 ha;

Source: Own calculation.

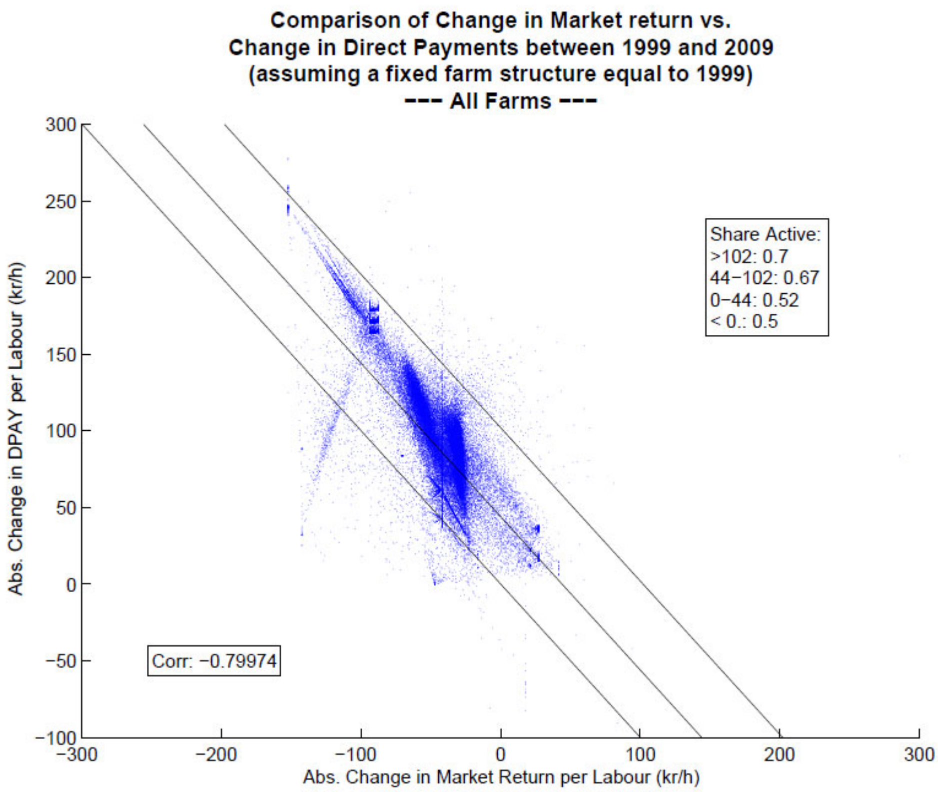
A simple linear least squares regression without a constant is employed. The estimated coefficients are reported in table 5 and are used to calculate total labour requirement for each farm given its specific production program. The market return per hour (nkr/h) as well as the direct payments per hour can be obtained by dividing total market return and total direct payments by the total labour requirement at an individual farm basis. The on-farm wage is then given by the sum of market returns and direct payments per hour.

4 Comparison of changes in market return to labour vs. changes in payments per labour between 1999 and 2003

As a first step of the analysis we analyze the relationship between changes in the on-farm wage and farm exit graphically. Using the derived measures described in section 3 we plot changes in market return to labour against changes in direct payments per labour at farm level (figure 1). Overall we find a relatively high negative correlation (corr: -0.80) between changes in market return and direct payments per labour. This negative correlation is not surprising give the aim of the annually agricultural negotiations to adjust support such that the return to labour is equal for all farm irrespectively of farm specialisation, location or size. A further aim is that changes in the return to labour matches changes in a reference industry wages. A usual dispute during the agricultural negotiations is if relative wage changes or absolute changes should be considered. For the period from 1999 to 2009 the return to labour in agriculture needs to change by 44(102) kr/h when using relative (absolute) changes in order to match the changes in the reference wage. In figure 1 these changes in return to labour are indicated with diagonal lines, plus a line indicating no change in return to labour. Farms that lay right to e.g. the middle line experience in increase in return to labour by more than 44 kr/h, while for those laying to the left return to labour increased by less than that or decreased.

With this setup farm can be grouped in four different classes distinguished by the change in return to labour (<0, 0-44, 44-102, >102 kr/h) and the exit rate can be compared between the classes. Overall, we find that farms are more likely to exit (or less likely to survive) the lower the change in return to labour. Nevertheless around half the farm for which return to labour decreased in absolute terms remain active, while still one third of farms for which return to labour matched or surpassed changes in industrial work quit farming. These findings indicate that the return to labour seems to be correlated with the exit decision but still leaves a substantial part of the exit decisions unexplained.

Figure 1: Comparison of changes in market return to labour versus changes in direct payment per labour between 1999 and 2009.



Source: Own calculations.

5 Binary choice regression on farm exit/survival

5.1 Description of dependent and explanatory variables

In order to further explore the policy influence of farm survival we estimate a binary choice probit model explaining farm survival. We again consider the ten year period from 1999 to 2009 and look at all Norwegian farms that receive any subsidies in 1999. The dependent variable in the analysis represents farm survival (equal to one when a farm is still active in 2009 zero otherwise). We consider a farm as active if at least one production activity is observed for the farm in the payment data base. Because of missing observations due to mergers of municipalities it was necessary to exclude 11 municipalities from the analysis[3].

Beside the total farm income in 1999 (*dpay99* and *mReturn99*), the on-farm wage rate in 1999 (*FarmWage99*) und the change in on-farm wage rate (*C.DPayLabo* and *C.mRetLabo*) discussed in section 3 several other explanatory variables are considered. Among them are the total agricultural area (*area*), the total observed labour input in 1999 (*obsLabo99*) and the estimated labour requirement for 1999 (*reqLabo99*). These three variables together with the total income are all measures for the absolute size of the farm and therefore positively correlated (**Feil! Ugyldig selvreferanse for bokmerke.**).

Table 6: Correlation coefficients between different measures of the absolute farm size

	area	obsLabo99	reqLabo99	dpay99+mRet99
area	1	0.44	0.65	0.62
obsLabo99		1	0.78	0.58
reqLabo99			1	0.69
dpay99+mRet99				1

Source: Own calculation.

[3] Municipality codes 529, 716, 718, 1154, 1214, 1418, 1514, 1569, 1572, 1576, and 1842 needed to be excluded from the analysis.

Table 7: Descriptive statistics and definition of variable codes (n=64488).

	Code	Units	Mean	Median	Max.	Min.	Std. Dev.
Age of Farm holder	age	year	48.8	49.0	97.0	7.0	11.6
Farm Area	area	daa	153.5	121.0	3411.0	0.0	132.4
Agricultural labour input	obsLabo99	hour	2215.5	1900.0	52330.0	0.0	1827.0
Estimated Labour requirement	reqLabo99	hour	1950.4	1454.9	44452.8	9.8	1719.4
Ratio observed over estimated labour requirment	dpay99	1000 Nkr	167.0	128.5	1252.5	0.0	132.1
Total direct payments	mReturn99	1000 Nkr	-33.9	-24.2	1403.8	-2607.0	66.3
Total market Return	laboObs/Req	ratio	1.37	1.13	83.32	0.00	1.33
Ratio leased Area over Total Area	landLease/Tot	ratio	0.27	0.13	1.50	0.00	0.33
Dummy if farm has milk cows	hasMilk	binary	0.33	0.00	1.00	0.00	0.47
Dummy if farm has milk sows	hasSows	binary	0.05	0.00	1.00	0.00	0.22
Dummy if farm has milk sheep	hasSheep	binary	0.33	0.00	1.00	0.00	0.47
Dummy if farm has milk poultry	hasPoultry	binary	0.01	0.00	1.00	0.00	0.08
Return to Labour req. in 1999	FarmWage99	1000 Nkr/hour	0.074	0.074	0.401	-0.176	0.034
Change in direct pay. per labour 99-09 structure equal to 1999	C.DPayLabo	1000 Nkr/hour	0.100	0.094	0.278	-0.170	0.041
Change in market returns per labour 99-09 structure equal to 1999	C.mRetLabo	1000 Nkr/hour	-0.048	-0.042	0.286	-0.152	0.028
Number of Neighbours within 2.5km	numNeigh	#	22	19	130	0	17.00

Additionally, the age of the farmer holder[4] (*age*), the ratio of leased to total agricultural area (*landLease/Tot*), the ration between observed labour input and estimated labour requirements (*laboObs/Req*), dummy variables for indicating if a farm has milk cows (*hasMilk*), sheep (*hasSheep*), sows (*hasSows*) or poultry (*hasPoultry*), as well as the

[4] For observations where age is missing in the data base we imputed the mean age. The age is missing for example for all farms where the owner is not a natural person. In total we have 495 or 0.77% missing observations for age.

number of neighbouring farm within a 2.5 km radius in 1999 (*numNeigh*) are considered as explanatory variables. Descriptive statistics of all explanatory variables, along with their variable codes, are available in table 7.

5.2 Regression results

The final regression results for the binary choice probit model are provided in table 8[5]. Except for the dummy variable indicating if a farm has poultry (*hasPoultry*) all included explanatory variables are highly significant.

With respect to the importance of individual variables, however, this result needs to be set in perspective to the large sample size of more than 60,000 observations. With a sample of this size it is likely that variables become significant even so they actual explanatory power is only minor. A more appropriate measure of the explanatory power of the overall model and individual explanatory variables is the percentage of correct predictions of the model which is a natural measure of fit in a binary choice model. The model with all variables we are able to correctly predict the exit/survival decision in 72.58% of the cases. Compared to the naive model, which correctly predicts survival in 62.72%, this is a total gain of 9.87 percentage points (or a percentage gain of 26.46 on the number of incorrect predictions).

[5] The market return variable (*mReturn99*) and its square as well as the squared term for the estimated labour requirement are excluded from the model specification since they were not found to be significant. The dummy variable for poultry (*hasPoultry*) is also not significant but maintained in model for completeness and as a result in its own right.

Table 8: Probit regression results for all farms active in 1999 (n=64488). The dependent variable is equal to one if the farm is still active in 2009 (number of Obs. with dep. Variable equal to one=40445).

Variable	Coef	p-value
Const	-2.1030	0.0000
Age	0.0498	0.0000
age^2	-0.0006	0.0000
Area	0.0019	0.0000
area^2	-1E-06	0.0000
obsLabo99	0.0002	0.0000
obsLabo99^2	-5E-09	0.0000
reqLabo99	0.0001	0.0000
dpay99	0.0044	0.0000
dpay99^2	-5E-06	0.0000
laboObs/Req	-0.0345	0.0000
landLease/Tot	-0.1217	0.0000
hasMilk	-0.4268	0.0000
hasPoultry	0.1036	0.1785
hasSows	0.2034	0.0000
hasSheep	0.0543	0.0001
FarmWage99	3.8820	0.0000
C.DPayLabo	2.4972	0.0000
C.mRetLabo	2.3590	0.0000
numNeigh2.5km	0.0035	0.0000
% Correct predictions Model		72.58
% Correct predictions Naive		62.72
Total Gain*		9.87
Percent Gain**		26.46

*Change in "% Correct" compared to naive specification
**Percent of incorrect naive prediction corrected by equation

Source: Own estimation.

To assess the explanatory power of individual variables we can explore how the percentage of correct prediction changes with or without the variable under consideration. Overall we found that the variables related to the absolute size of a farm (*area*, *obsLabo99*, *reqLabo99*, and *dpay99+mReturn99*) are most important in explaining farmers' exit/survival decision (table 9) with a positive relationship between farm size and survival. A model with all explanatory variables except these variables related to the absolute size would correctly predict farm exit/survival in 67.83% of the cases which is around 5.1 percentage points more as the naive model and 4.75 percentage points less as the full model. This indicates that the variables related to the absolute size of the farm contribute to around half of the improvement in the percentage of correct predictions. Further, it is interesting to note that all these variables related to the absolute size can explain more or less the same since the percentage of correct prediction with only one of the four variables is only slightly lower as the percentage of correct prediction with all four variables (table 9).

Table 9: Percentage of correct predictions of farm survival between 1999 and 2009 with different model specification of the binary choice probit model with respect to the absolute size of a farm

	Naiv	**All other explanatory variables**					**Full model**
			and Area	**and obs. Labour**	**and est.req Labour**	**and dpay, mReturn**	
% Correct	62.72	67.83	71.89	71.48	72.17	72.23	72.58
Diff to Full M.	-9.87	-4.75	-0.70	-1.10	-0.41	-0.36	0.00

Source: Own estimation.

The importance of the remaining variables is relatively evenly distributed with each variables adding only little to the overall explanatory power of the model. Of particular interest with respect to the aim of the paper is the importance of the on-farm wage rate in 1999 and the change in on-farm wage rate from 1999 to 2009 (Table 10) as derived in section 3. Both variables have a positive influence on farm survival but (individually and together) add only a little to the overall explanatory power of the model and hence seem to be less important for farmers exit/survival decision in comparison to the variables related to the absolute size.

Table 10: Percentage of correct predictions of farm survival between 1999 and 2009 with different model specification of the binary choice probit model with respect on-farm wage and changes in the on-farm wage

	Naiv	All variables except			Full model
		on-farm wage	changes in on-farm wage	on-farm wage and changes in on-farm wage	
% Correct	62.72	72.51	72.32	72.09	72.58
Diff to Full M.	9.87	0.07	0.26	0.49	0.00

Source: Own estimation.

5.3 Cost and effects of changes in direct payments

From the comparison of the explanatory power of different variables we conclude that the absolute size of farm (independent of how it is measures) is the most important factor in explaining farmers' exit/survival decision. From a policy perspective this is an interesting finding since it supports in some way the common believe that an increase in support decreases the number of farm exiting. It is therefore interesting to further explore the roll of total income or more specifically direct payments for farm exit.

For this a concrete example is considered in order to provide a more accessible interpretation of the regression results presented in Table 8. From the regression results marginal effects for total direct payments (*dpay99*) are calculated und used in order to assess the effects of an increase in direct payments on farm survival. This effect can then be put in perspective to the additional costs. As generally know the marginal effect in the probit model depend on the level of all explanatory variables. This implies that the marginal effect will differ between all observations. Therefore, the marginal effect is calculated as the mean effect across all farms. The mean survival probability over the ten year period is equal to 62.7%. An increase of direct payments by 10% for all farms would increase the mean survival probability over the ten year period to 64.4%. This is equivalent to a reduction of the yearly exit rate from 4.56% to 4.30%. In absolute terms this would cumulate over the period to 1,102 farms exiting less resulting in a total number of farms in 2009 of 41,547 instead of the 40,445 farms without the increase. For 1999 level an 10% increase in yearly direct payments would be equivalent to around 1 billion nkr. Similarly, we can calculate that direct payments need to be increased by around 47% (or around 5 billion nkr for 1999 level) in order to reduce the average yearly exit rate over the ten year period from currently 4.56% by around one percentage point to 3.56%. Over the ten year period this would result in absolute terms to around 4,426 farms exiting less resulting in a total number of farms in 2009 of 44,871 instead of the 40,445 farms without the increase.

It should be pointed out that these calculations are rather simply and only provide a rough approximation of the actual cost and effects of a change in direct payments. Nevertheless, they provide an intuitive illustration of the regression results and show that the effects of changes in direct payments on farmers exit decision are relatively minor even for rather drastic changes in support.

6 Conclusion

Our findings show that the absolute size of farms is most important in explaining farm exits. Larger farms have a substantially lower probability to exit than smaller farms. The on-farm wage rate or changes in it are less relevant. Farms seem to need a given size in order to generate a sufficient income for the farmer. In the long run, policy can influence farm size and a farm's income potential. Our results therefore support in some way the common believe that an increase in support decreases the number of farm exiting. However, we see two problems that need to be considered in this respect.

First our findings indicate that the changes is support needs to be rather drastic in order to meaningfully reduce farm exist. We calculate for the period 1999 to 2009 that total support would have need to be approximated 47% (or around 5 billion nkr) higher in order to reduce the yearly exit rate by around 1 percentage point. It is a question if society is willing to pay huge increase in agricultural spending if the effects on farm structural change are rather moderate. In addition we see a more fundamental problem. If support is increase drastically it is likely that the increased income opportunities in agriculture are mirrored by increases in land values. If farmers can earn more in agriculture there might be willing to pay more for agricultural land, if land is scarce this will lead in the long run to an increase in land values. This in turn increases the attractiveness for giving up the farm and renting out or selling the land. Therefore, exits rates might even be less affected by changes in direct payments as our calculations indicate.

There is much we do not yet understand. Farms close down despite of favourable income expectations or relatively large farm sizes. Farmers do not seem to make their decisions out of pure economic considerations. Personal preferences for farming as a lifestyle, family ties, local infrastructure, networks, and employment opportunities may add to the explanation of structural change. But our findings suggest that a continuation of the current policy or even a rather strong increase in support is not likely to fundamentally change the current pattern of structural change in Norwegian agriculture.

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