This is an Accepted Manuscript of an article published in Small Ruminant Research in May 2017, available online: https://doi.org/10.1016/j.smallrumres.2017.02.020

Factors affecting exit intentions in Norwegian sheep farms

Ola Flaten*

Norwegian Institute of Bioeconomy Research (NIBIO), Department of Business Economics and Management, P.O. Box 115, 1431 Ås, Norway

*Corresponding author: Tel.: +47 941 79 046. E-mail address: ola.flaten@nibio.no

Abstract

Western livestock sectors have shifted towards fewer, larger farms, causing concerns about the appearance of the countryside, ecosystem services, and rural depopulation. This study empirically estimates factors likely to affect exit intentions in sheep farms. Data were collected from specialised sheep farms included in the Norwegian Farm Business Survey. Of the 59 responses, 44 operators believed the farm would be producing sheep in 10 years. A logistic regression model was used to determine the most decisive variables associated with an exit intention, where the interdependence of factors affecting profitability and, subsequently, exit intention were taken into account. This study found that farmers reporting the most positive views of the local farming community were less likely to plan an exit. Exit intentions were not significantly influenced by farming goals, location, off-farm income, or profitability. The primacy of non-economic, community-based factors as an engine to sustain farms, suggests that more attention need to be paid to social processes and relations in local communities. Farmer groups and policy-makers should consider how to encourage supportive local communities when designing policies to retain sheep farms.

Keywords: Sheep farming; exit; local community; profitability; logit; Norway

1. Introduction

Over the last decades, Western livestock sectors have witnessed substantial shifts to fewer, bigger farms. The number of sheep farms in Norway has also declined, from 28,887 in 1989 to 14,391 in 2015 (Statistics Norway, 2016). The decline has been concentrated among smaller farms. For example, the number of farms with less than 100 winter-fed sheep decreased by 58% between 1989 and 2015, whereas the number of farms with more than 200 sheep increased from 84 to 527 in the same period. The number of breeding sheep (ewes and rams per July 31) has been quite constant with 0.89 million in 1989 and 0.91 in 2015, while the number of lambs increased from 1.28 million in 1989 to 1.46 million in 2015.

Farm structural changes have been a controversial policy matter in Western societies. Historically, farm exits – and entries – have played an important role in introducing technologies and productivity growth in the agricultural sector of many countries. The shift in production has led to declining farm numbers through farm exit and consolidation. These adjustments are difficult for farm families with implications for the economic and social viability of the local communities (Lobao and Stofferahn, 2008). Fewer sheep farms, and less grazing livestock in particular, will also have consequences for maintenance of rural landscapes, biodiversity and the protection of the environment. Where sheep grazing is removed, there can be shrub encroachment, which can lead to loss of elements of landscape and biodiversity (Dýrmundsson, 2006; El Aich and Waterhouse, 1999; Ross et al., 2016).

Despite the importance of sheep farming as regards provision of ecosystem services and vibrant farming communities, few if any studies have attempted to examine why some operations exit sheep farming whereas others continue. Research from farming in general or other farm enterprises has, however, been conducted to identify a large number of factors that influence exit rates. The majority of contributions show that larger farms (Breustedt and Glauben, 2007; Dong et al., 2016; Landi et al. 2016; Susanto et al., 2010), higher profitability

(Bragg and Dalton, 2004; Dong et al., 2016), and younger farmers (Bergfjord et al., 2011; Bragg and Dalton, 2004; Howley, 2015; Mishra et al., 2014) are associated with a lower likelihood of exit. Some studies have identified part-time farming as a means of stabilising a farm business (Breustedt and Glauben, 2007; Kimhi and Bollman, 1999), whereas others have reported that working off the farm increases the probability of exit (Bragg and Dalton, 2004; Goetz and Debertin, 2001; Weiss, 1997). The influence of location is also mixed. Goetz and Derbertin (2001) and Landi et al. (2016) report that a higher population density positively affects exit behaviour. In contrast, Glauben et al. (2006) argue that population density decreases exit rates.

Mental models are cognitive constructs that people use to interact with the world around them (Jones et al., 2014), and farmers' mental models are influenced by values and knowledge and serve as a guide in learning and decision-making (Eckert and Bell, 2005). Bergfjord et al. (2011) and Howley (2015) have provided support that farmers with financial objectives are more likely to leave farming than those finding non-financial concerns such as environment, farming lifestyle, stewardship and farm labour related benefits more important.

Community-based social processes can also be engines of change. Lyson et al. (2000) found New York dairy farmers' community engagement to be negatively associated with an exit intention. Gezelius (2014) have suggested that the economic viability of modern, capital-intensive farms increases when these farms are located in multi-farm communities characterised by lasting social networks. Further, Morgan-Davies et al. (2012) found interdependencies in Scottish hill farming areas in such a way that as neighbouring farms disappear, remaining farms become less tenable.

The objective of the current study is to identify key factors influencing exit intentions in Norwegian sheep farms. The study combines accountancy and survey data collected from specialised sheep farms.

2. Materials and methods

2.1. Sample and data collection

Data used in this study come from the Norwegian Farm Business Survey (FBS) conducted by the Norwegian Institute of Bioeconomy Research (NIBIO). The FBS contains extensive details about financial condition and farm production from a sample of Norwegian farm holdings. Farms above a minimum economic size (standard gross margin) of 8 ESU (European Size Units, 1 ESU = € 1200), are eligible to become a FBS farm. The annual sample covers about 900 farms, which are selected to represent 70% of the total farm population of about 42 000 farms in Norway, 92% of the total farmland and 96% of the total agricultural gross output. The farms included in the survey are randomly selected along three dimensions: economic size, region, and type of farming (NIBIO, 2016). Around 90% of the farms remain in the sample the following year.

To obtain attitudinal and behavioural data not covered in the FBS data, a questionnaire was sent per mail in mid-March 2009 to all FBS farmers at that time. The questionnaire achieved after two reminders a response rate of 60%.

In Norway, sheep farming are based on the extensive use of free-range forest and mountain pastures in summer. Housing and feeding are required throughout the winter due to snow and frost, often for more than half of the year. Many sheep farms are located either close to mountain areas and other sparsely populated areas or along the coast, but some farms are also more centrally located.

The annual FBS data sets include around 200 farms with sheep. For the purpose of this study, farms with sheep kept in mixed farming systems of various types, for example, mixed dairy and sheep farms, were not included, making it possible to examine the effects of profitability in sheep farming on exit tendencies. This study was therefore restricted to the

annually around 100 specialised sheep farms, where the majority of farm gross output came from sheep. The FBS sample of specialised sheep farms represents 46% of the total sheep population and 33% of the sheep farms in Norway (own calculation). Due to the size requirement of at least 8 ESU, specialised sheep farms with less than 40–50 breeding ewes are not included in the FBS sample. These smaller holdings account for 8% of the sheep and 18% of the sheep farms.

In this paper, data only on sheep farms participating in the FBS in both 2007 and 2008 were used. Average figures of the 2 years were used to better characterise farm differences in physical and financial performance arising from managerial abilities rather than returns from a single year, which are more random because of uncontrollable events (such as the weather). After deleting specialised sheep farms that did not respond to the questionnaire or with missing values on important variables to be used in the analysis, 59 usable observations remained.

2.2. Measures

Variables used in the analysis are presented in Table 1.

[Table 1]

2.2.1. Exit intentions

Exit intentions were measured by a self-reported response to whether the operator believed the farm would be producing sheep in 10 years. The indicator =1 was applied if the farm intended to exit sheep farming, and zero otherwise. Therefore, exit in this article means switching out of sheep production, irrespective of whether the farm exits the farming industry or takes up production of an alternative enterprise.

124

125 *2.2.2. Profitability*

126 The study focus on profitability based on both short-run and long-run rules. The exit or shut-
127 down decision rule is based on the comparison of revenues relative to operating costs. Long-
128 run profitability does also include returns on capital invested in the farm business and the
129 opportunity cost of unpaid labour input, providing an indicator of whether the farm can
130 replace capital assets and stay in business over time.

131 Long-run profitability was measured as the profitability coefficient (PC), defined as
132 (Flaten et al., 2011):

133 $$PC = \frac{\text{Net farm income}}{\text{Interest claims on total value of farm assets} + \text{opportunity cost of unpaid labour}} \times 100.$$

134 Here net farm income represents the return to all unpaid labour and management and to all the
135 capital invested in the farm business. The farm asset value for the year is found by averaging
136 the beginning and ending total asset values from the farm balance sheets. Following the
137 procedures of the FBS, a flat labour charge per worked family hour equal to the wage rate for
138 a skilled farm worker was used to compute costs of unpaid labour. The interest claims for
139 farm asset values were set equal to the interest rate used in the FBS (5.5 per cent per annum).
140 If PC equals 100 (or higher), net farm income is sufficient to provide a return to capital and
141 unpaid labour equal to (or higher than) their opportunity costs.

142 The short-run measure, return over operating costs (ROOC), was defined as gross farm
143 sales (government payments included) net of operating costs, measured per breeding sheep.
144 Operating costs included costs for feed; veterinary and medical services; bedding and litter;
145 marketing; custom services; fuel, lubrication, and electricity; repairs; other costs; and
146 operating interest. Annualised cost of maintaining the capital investment in the farming
147 operation, costs for insurance, and costs of all labour were not included.

148

149 *2.2.3. Off-farm income*

150 The off-farm income variable measures the importance of off-farm income relative to other
151 income sources. Total farm household income is defined as the sum of net income from all
152 farming activities (agriculture, forestry, and on-farm diversification), non-farm business
153 income, wages and salaries, pensions and sick pay, dividends, and interest earnings minus
154 interest payments (NIBIO, 2016:137). The share of work-related off-farm activities (non-farm
155 business income, wages, and salaries) in total farm household income was used as a proxy for
156 the off-farm income variable.

157

158 *2.2.4. Farming goals*

159 The questionnaire included 20 statements on goals in farming, ranging over a wide variety of
160 issues. The items were based on previous studies (Lien et al., 2006; Maybery et al., 2005) and
161 were measured on a 7-point rating scale ranging from "not at all important" to "most
162 important".

163 Principal component analysis (PCA) with varimax rotation was applied to transform the
164 20 items to a smaller number of components. The value of the Kaiser-Meyer-Olkin overall
165 measure of sampling adequacy (MSA) was 0.81 for the final solution, which included 11
166 items. A two-component solution was preferred. These components accounted for 64% of the
167 total variance. Each item had a component loading of 0.74 or higher on only one component.
168 All final communality estimates were above 0.55.

169 The first component, labelled "non-financial", had high loadings on the following seven
170 components: "ensure the best possible animal welfare standard", "contribute to domestic food
171 production", "contribute to rural viability", "maintain the cultural landscape", "use pesticides
172 and fertilisers sparingly", "restrict the loss of nutrients", and "maintain biodiversity"
173 (Cronbach $\alpha = 0.89$). The second component, labelled "financial", included four components:

"high return on investments", "maximise income", "increase net worth", and "reliable and stable income" (Cronbach α = 0.82). The Cronbach α values were above a generally agreed lower limit of 0.70 (Hair et al., 2006).

Summated scales were formed by combining all of the items loading highly on a component into a single composite measure where individual items were averaged. The components, represented by the composite measures, highlighted contrasting farming goals. Finally, the difference between the two summated scales was estimated, to be used in subsequent analysis as a measure of non-financial relative to financial goals.

2.2.5. Local farming community

Self-reported measures of farmers' views on their local farming community were used. These measures are original and were measured on a 7-point rating scale ranging from "totally disagree" to "totally agree". The statements were as follows: "In my local community there is a good farming environment", "meeting other farmers is for me an important source of well-being", and "people in my local community recognise ingenuity and innovation".

A PCA was performed on the three statements. The model achieved an overall MSA of 0.73. One predominant component explained 78.5% of the variance. All component loadings were close to 0.90. The final communality estimates were all above 0.75. Cronbach's α for the three items was 0.86, suggesting that it was appropriate to combine them into a single measure of what was labelled "local farming community". A high score indicates a supportive local farming environment.

2.2.6. Location

Statistics Norway (2008) has constructed an indicator of centrality, placing each Norwegian municipality in one of four centrality categories. The variable measures the municipality's

199 geographical location relative to a centre with higher order functions such as banks or post
200 offices, as well as related to population size. Statistics Norway refers to these categories with
201 values from zero to three, in order of increasing centrality: least central, less central, quite
202 central, and central. To account for possible exit heterogeneity among farms of different
203 centrality, the centrality categories were dichotomised into remote (value 0–1) and central
204 (value 2–3) locations.
205
206 *2.2.7. Other variables*
207 *Flock size* was measured in number of breeding sheep (ewe lambs for breeding included) as
208 of March 1. Flock size was adjusted for other ruminants present based on forage requirements
209 (multiplication factors in parentheses): suckler cows (8), beef bulls (4), and goats (1).
210 *Meat output* per breeding sheep was used as a measure of sheep productivity. In addition
211 to sales of lamb and mutton, inventory changes in sheep stocks and sales and purchases of
212 live sheep were taken into account when calculating production of meat per breeding sheep.
213 Meat output was described on a per kilogram carcass weight basis.
214 *Solvency* refers to a farm household's total capital structure and its ability to meet its
215 liabilities. The equity/asset ratio was used to evaluate solvency. *Agricultural education*
216 indicates if the operator or the spouse has one or more years of agricultural education.
217 *Ownership* denotes the farm operators' years of farm ownership.
218
219 *2.3. Statistical analysis*
220 First, farms that stated an intention to exit and those that did not were compared based on all
221 variables presented in the study. A *t-test* for metric variables and a chi-square or Fisher's
222 exact test for discrete variables was used to assess the significance of differences between the
223 groups.

Next, the most decisive variables associated with an exit intention were determined. There is an interdependence of factors affecting profitability and, subsequently, the exit intention. A two-stage approach was used to control for endogeneity in the exit decision model (Bragg and Dalton, 2004). In the first stage, factors affecting farm profitability measures were estimated. In the second stage, a binary logistic regression model was used to determine how the explanatory variables, including predicted profitability, influence the two options: exit or continue in sheep farming.

In stage 1, ordinary least squares (OLS) regressions were used to calculate the estimated profitability measures as a function of operator and farm characteristics such as ownership, agricultural education, solvency, flock size, and meat output (ownership was chosen instead of the correlated variable operator age).

In stage 2, under a logit specification, the predicted probability of exit for farm i (P_i) (Greene, 2012) is identified as:

$$P_i = \frac{e^{\boldsymbol{\beta} \boldsymbol{X}_i}}{1 + e^{\boldsymbol{\beta} \boldsymbol{X}_i}}.$$

Here $\boldsymbol{X}_i$ contains the values of the explanatory variables of the model (location, off-farm income, predicted profitability, farming goal, and local farming community), including a constant, and $\boldsymbol{\beta}$ represents the model coefficients to be estimated. The small sample size restricted the number of explanatory variables to be included in the logit models. The penalised likelihood approach proposed by Firth (1993) was used to reduce small-sample bias in maximum likelihood estimation of the logit models.

The results are reported as odds ratios and marginal effects. The marginal effects were computed at every observation in the sample and then averaged across all observations, which produces the average partial effects that are preferred in small samples (Greene, 2012).

No collinearity problems were encountered among the explanatory variables using variance inflation factors (all <1. 32 in OLS, all <1.30 in logit) and condition indices (<1.89

249 in OLS, <1.74 in logit). Statistical analyses were carried out with SAS 9.3 (SAS Institute,
250 Cary, NC, USA), except for the use of STATA 12.1 (StataCorp, College Station, TX, USA) to
251 estimate marginal effects.
252
253 **3. Results and discussion**
254 *3.1. Descriptives*
255 Twenty-five percent of the sample farms reported that they intended to exit sheep farming
256 within a time horizon of 10 years. The intended annual exit rate is close to the actual
257 exit rate in Norwegian sheep farming in the last decades.
258 Table 2 presents a summary of the characteristics of the exiting and remaining farms as
259 well as the whole sample of sheep farms. Average performance indicates that flock size across
260 the full sample was 138 breeding sheep, producing 28.2 kg meat per sheep per year with a
261 ROOC per sheep of NOK 1969 and a PC in farming of 43. The low PC implies a return to
262 capital and unpaid labour well below their opportunity costs. Average years of farm
263 ownership was 17.8 years, with 63% holding an agricultural education, 29% with a central
264 location, an average share of off-farm income of total household income of 62%, and an
265 equity/asset ratio of 68%.
266
267 [Table 2]
268
269 Table 2 also present results of a bivariate analysis conducted to test if the distributions
270 of the characteristics between the two groups – exiting and continuing – were statistically
271 significant. The results indicate that the intention to exit sheep farming was significantly
272 associated with only two of the variables: local farming community and farming goals.

Perceptions of the local farming community were in general positive, but exiting farmers scored 1.37 points lower than the continuing farmers ($P = 0.01$). Non-financial farming goals scored on average higher than the business-related goals, supporting the rich literature on the importance of non-monetary benefits from farming (Garforth and Rehman, 2005). Exiting farms did, however, find financial goals relatively more important than the continuing farms ($P = 0.02$), as also reported by Howley (2015).

3.2. Profitability

The first-stage regressions showed as expected that larger flocks, on average, generated a higher PC than smaller flocks ($P < 0.05$; Table 3). On average, more experienced farmers did also perform better, measured as PC ($P < 0.05$). Higher yielding flocks did not achieve higher PC than those with lower meat output per breeding sheep. This result is in contrast with studies of other livestock farming systems, which often find yield differentials to be a key performance driver in farm profitability (Wilson, 2011). A plausible explanation is the use of livestock and area payments rather than higher output prices that moderates the economic importance of high yield per head (Flaten and Rønning, 2011). Agricultural education and solvency also had no significant associations with PC.

[Table 3]

ROOC was positively related to a higher equity/asset ratio ($P < 0.05$; Table 3). The other explanatory variables showed no significant effects on ROOC. The predicted PC and ROOC values from the OLS regressions were integrated into the second-stage logit regression models.

298 *3.3. Model results*

299 Results from the logit model estimates of farmers' intentions to exit sheep farming are
300 presented in Table 4. Specification 1 reports the model that included predicted PC as an
301 explanatory variable, and specification 2 included predicted ROOC. Marginal effects are
302 reported in Table 5.

303

304 [Table 4 and Table 5]

305

306 The overall models were significant ($P < 0.01$) according to the likelihood ratio test
307 (Table 4). To measure predictive power or how well the response variable is predicted based
308 on the explanatory variables of the models, two R^2 measures were calculated: McFadden and
309 Tjur (Allison, 2014). The estimated models showed R^2 measures of 0.26–0.29. Goodness-of-
310 fit (GOF) tests help to decide whether the model is correctly specified. The models were
311 checked for fit using four GOF tests, as recommended by Allison (2014). The low values in
312 all GOF tests, yielding high *P*-values, suggest that both models fit the data well.

313 The estimated models yielded statistically significant parameters for the local farming
314 community variable (Table 4). The other explanatory variables (location, off-farm income,
315 predicted profitability, and farming goal) lacked statistical significance. The two model
316 specifications generally yielded similar estimates in parameters, suggesting that specifying
317 profitability in terms of PC and ROOC provided consistent results. For practical discussion,
318 results given in specification 1 (PC) are emphasised, unless otherwise stated.

319 The higher a farmer's perception was of the local farming community, the lower the
320 probability of an exit intention ($P < 0.01$; Table 4). The odds ratio was close to 0.50; that is,
321 holding all other variables constant, for each one-unit increase in the score on the local
322 farming community variable, the odds of exiting were halved. The estimated marginal effect

was -0.105 ($P < 0.01$; Table 5). This finding means that with a one-unit increase in the score, the probability of exiting decreased by 10.5%. A plausible explanation is that most economic behaviours are embedded in social networks (Granovetter, 1985), and areas where farming and rurality figure prominently are often found to have high levels of civic engagement (Gómez-Limón et al., 2014). Many studies have described how individuals and local communities that are rich in community participation and the social cohesion that it generates are advantaged across economic, social, and health domains (Coleman, 1990; Hogan et al., 2011; Putnam, 1995); it is positive for farmers' well-being to be part of multi-farm communities with lasting social networks (Gezelius, 2014), and these dimensions are consequently important to exit intentions. The findings in this study support the results given by Lyson et al. (2000), where farmers' community engagement decreased exit intentions. Since the local farming community variable was the only statistically significant variable, this factor seems to be of particular importance for the intent to continue with sheep farming. However, a conclusive relationship between the local farming community variable and farm exit rates solely on the basis of findings in this single study cannot be claimed.

The only additional marginal effect that tended to be significant was off-farm income in model 2 (ROOC, $P < 0.10$), suggesting that a 1% increase in total household income from off-farm work increased the probability of exit intentions by 0.36% (Table 5). Many sheep farms are part-time operations that are integrated with off-farm work. High off-farm income nevertheless tended to provide a pulling force on the exit intention, consistent with findings in Bragg and Dalton (2004), Mishra et al. (2014), and Weiss (1997).

The lack of statistical significance of many results should be assessed in light of the small sample used in the analysis. Logit-type models remain relatively robust for Type I errors and marginal effects estimates with small samples; however, caution is necessary in forming conclusions based on non-findings, that is, Type II errors (Bergtold et al., 2011; Hart

348 and Clark, 1999). The risk of making Type II errors (false-negative findings) increases, and
349 several true relationships may not be discovered. For example: a central location of a farm
350 more than doubled the odds of reporting exiting compared to remote farms, and for each one-
351 unit increase in the score on the composite variable for farming goals, the odds of reporting
352 exiting decreased by a factor of 0.74 (Table 4). The magnitudes of these effects are large
353 enough for their explanatory variables to have meaningful (although not statistically
354 significant) influences on the exit rate.

355 Predicted farm profitability had a low impact on the exit intention. The non-significant
356 coefficients suggested that more profitable farms, as measured by PC and ROOC, were more
357 likely to exit. In contrast, studies of dairy farms have found higher profitability to lower the
358 exit rate (Bragg and Dalton, 2004; Dong et al., 2016). At first glance, the finding here is
359 surprising. It is, however, widely reported that farmers farm for reasons other than
360 maximising profit (Garforth and Rehman, 2005; Howley, 2015). Furthermore, studies have
361 found sheep farmers (in Norway) to be more satisfied with their farm work and lifestyle
362 (despite the lower profitability) than farmers in general (Flaten and Rønning, 2011). The high
363 satisfaction with the varied lifestyle and non-financial benefits in sheep farming may explain
364 the low relevance of profitability to the exit decision.

365

366 *3.4. Policy implications*

367 Fewer sheep and sheep farms can have severe effects on the well-being of rural communities,
368 the appearance of the countryside, biodiversity, and heritage values. The question arises of
369 what policies best accomplish keeping sheep farmers in agriculture.

370 A number of government policies can influence farm structure. Some studies have found
371 farm-support programmes to decrease exit rates (Breustedt and Glauben, 2007; Mishra et al.,
372 2014; Raggi et al., 2013), whereas a study by D'Antoni et al. (2012) concluded that

government payments are a factor in pushing labour off the farm. One the one hand, government payments may help marginal farms to remain in business. On the other hand, payments can encourage farmers to expand. As a result, the structural impact of government programmes may be somewhat ambiguous and dependent on their design. This research identified additional factors that influence exit decisions and the need to go beyond the scope of price support and government payments to reduce farm exits.

Findings from this study point to the important effects of farmers' perceptions of their local farming community and social processes on exit intentions. In many societies, (local) farmer collaboration has long been institutionalised in many forms of, for example through, local farmer organisations and associations, meetings and field days, informal farmer networks and groups for co-learning and exchange of ideas. Various collaboration initiatives can be important for farmers' social relations. Further farmer and farmer group engagement and entrepreneurialism in the local community may be required to create new forms of social collaborations, both within and outside the local community, including the use of Internet and social media.

The issue of local social relations and innovations is not only a task for individuals in farming communities; public policy is also important (Bock, 2016). Public financial contributions can help to reduce exit rates if facilitating, for example, social networking and collective learning. Withdrawal of support for collaboration efforts can contribute to farm exits. This study suggests that a somewhat larger proportion of public agricultural funds to initiatives that encourage formation of social relations for farmers could have significant implications for keeping farms in the business.

3.5. Limitations and future research

This study has some limitations. One important point to note is that the reported relationships are associative rather than causal. To control for endogeneity, predicted values of the profitability measures were used. Endogeneity bias could still be affecting the estimates because the presence of other confounding factors cannot be ruled out. Outcomes can also be influenced by factors not specified in the model.

The empirical evidence of determinants of exit intentions is local, derived from a particular time, place, farming enterprise, and research design. There may be a question as to whether the findings are specific to the Norwegian sheep farming context examined at that particular time or whether they are generalisable to other farming environments. To further explore the link between social factors, in particular, and exit rates, additional studies within different kinds of farming environments across time and space should be undertaken so that a more general picture begins to emerge. This study supports the proposal of Gezelius (2014) that more research is needed to address a farm's dependence on the broader community of neighbours, friends, and long-term colleagues.

The omission in the FBS of the smallest sheep farms, operations that may exist independently of the farm economy, precluded an analysis of their exit behaviour and implications for farm structures and land uses.

The sample was necessarily small because of the reliance on archival financial performance measures from specialised sheep farms in the Norwegian FBS. The small sample size restricted analytical options and model specificity. Future research should include more explanatory variables to further examine the extent and limits of local farming community variables on exit behaviour. There is also a need for qualitative approaches such as in-depth interviews with farmers to gain a sharpened understanding of their reflections on exit decisions, and to better understand the deeper reasons and processes behind a decision to leave farming.

This study was based on stated intentions. Stated intentions are valuable information, also serving to examine policy effects. Intentions that are correctly expressed cannot, however, be assumed to be translated automatically into actual exit behaviour. Nor is a retrospective assessment necessarily a good measure of the actual choice because people may state beliefs to justify their choices; that is, the decision affects the beliefs instead of beliefs affecting the decision. Predictive power across a variety of both reported past behaviours as well as future planned behaviour would increase the validity of a hypothesis or theory.

Exit intentions connected to policy changes were not analysed. One needs to be aware that the conclusions derived from this study may not apply if major policy changes are introduced.

4. Conclusions

The results of this study provide evidence of the impact of farmers' perceptions of the local farming community on the probability of exit intentions, where a lower perception increases the probability of exit intentions from sheep farming. The estimated marginal effect suggests that a one-unit increase in the score (on a scale from 1 to 7) on the local farming community variable decreases the probability of exit intentions by 10.5%. Farming goals, location, off-farm income, and profitability did not play a statistically significant role in the current sample. The study suggests that farms and farmers being part of and embedded in community social structures is a key element to enhance the viability of farms. Farm policy may be more cost-effective in retaining sheep farms if the local community factor is considered in its design.

Acknowledgements

Funding for this work was provided by the Research Council of Norway [grant number NFR 208036] and Småfeprogrammet for fjellregionen (County Governor of Hedmark) through the

447 project “Sheep in motion”. The author is grateful to Stig S. Gezelius, Torbjørn Haukås,
448 Valborg Kvakkestad, Gudbrand Lien, Sjur Spildo Prestegard, two anonymous reviewers, and
449 one of the Editors for helpful comments and suggestions.
450

451 **References**

452 Allison, P.D., 2014. Measures of fit for logistic regression. Paper 1485-2014 presented at the
453 SAS Global Forum, Washington, DC.
454 Bergfjord, O.J., Lien, G., Hoveid, Ø., 2011. Factors influencing farmer migration in Norway:
455 a study based on survey results linked to financial data. Acta Agric. Scand. Sect C – Food
456 Econ. 8, 92–104.
457 Bergtold, J., Yeager, E., Featherstone, A. 2011. Sample size and robustness of inferences
458 from logistic regression in the presence of nonlinearity and multicollinearity. The Agricultural
459 & Applied Economics Association’s 2011 AAEA & NAREA Joint Annual Meeting,
460 Pittsburgh, Pennsylvania, 24-26 July 2011.
461 Bock, B.B., 2016. Rural marginalisation and the role of social innovation; a turn towards
462 nexogenous development and rural reconnection. Sociol. Ruralis 56, 552–573.
463 Bragg, L.A., Dalton, T.J., 2004. Factors affecting the decision to exit dairy farming: a two-
464 stage regression analysis. J. Dairy Sci. 87, 3092–3098.
465 Breustedt, G., Glauben, T., 2007. Driving forces behind exiting from farming in Western
466 Europe. J. Agric. Econ. 58, 115–127.
467 Coleman, J.S., 1990. Foundations of Social Theory. Harvard University Press, Cambridge.
468 D’Antoni, J., Mishra, A.K., Barkley, A. 2012. Feast or flee: government payments and labor
469 migration from agriculture. J. Policy Model. 34, 181–92.
470 Dong, F., Hennessy, D.A., Jensen, H.H., Volpe, R.J., 2016. Technical efficiency, herd size,
471 and exit intentions in U.S. dairy farms. Agric. Econ. 47, 533–545.

472 Dýrmundsson, Ó., 2006. Sustainability of sheep and goat production in North European
473 countries–From the Arctic to the Alps. Small Rumin. Res. 62, 151–157.
474 Eckert, E., Bell, A., 2005. Invisible force: farmers' mental models and how they influence
475 learning and actions. J. Ext. 43. https://www.joe.org/joe/2005june/a2.php (accessed 20.01.17).
476 El Aich, A., Waterhouse, A., 1999. Small ruminants in environmental conservation. Small
477 Rumin. Res. 34, 271–287.
478 Firth D., 1993. Bias reduction of maximum likelihood estimates. Biometrika 80, 27–38.
479 Flaten, O., Lien, G., Tveterås, R., 2011. A comparative study of risk exposure in agriculture
480 and aquaculture. Acta Agric. Scand. Sect C – Food Econ. 8, 20–34.
481 Flaten, O., Rønning, L., 2011. Best på sau – faktorer som påvirker økonomisk resultat i
482 saueholdet. NILF-rapport 2011–3. Norsk institutt for landbruksøkonomisk forskning, Oslo.
483 Garforth, C., Rehman, T., 2005. Review of literature on measuring farmers' values, goals and
484 objectives. Project report no. 2 in the 'Research to understand and model the behaviour and
485 motivations of farmers responding to policy changes (England)'. School of Agriculture,
486 Policy and Development, The University of Reading, Reading.
487 Gezelius, S.S., 2014. Exchange and social structure in Norwegian agricultural communities:
488 how farmers acquire labour and capital. Sociol. Ruralis 54, 206–226.
489 Glauben, T., Tietje, H., Weiss, C., 2006. Agriculture on the move: exploring regional
490 differences in farm exit rates in Western Germany. Rev. Reg. Res. 26, 103–118.
491 Goetz, S.J., Debertin, D.L., 2001. Why farmers quit: a county level analysis. Am. J. Agric.
492 Econ. 83, 1010–1023.
493 Gómez-Limón, J.A., Vera-Toscano, E., Garrido-Fernández, F.E., 2014. Farmers' contribution
494 to agricultural social capital: evidence from Southern Spain. Rural Sociol. 79, 380–410.
495 Granovetter, M., 1985. Economic action and social structure: the problem of embeddedness.
496 Am. J. Sociol. 91, 481–510.

497 Greene, W.H., 2012. Econometric Analysis, 7th ed. Pearson, Essex.
498 Hair Jr., J.F., Black, W.C., Babin, B.J., Anderson, R.E., Tatham, R.L., 2006. Multivariate
499 Data Analysis, sixth ed. Pearson Prentice Hall, Upper Saddle River.
500 Hart, R.A., Clark, D.H., 1999. Does size matter? Exploring the small sample properties of
501 maximum likelihood estimation. Paper presented at the annual meeting of the Midwest
502 Political Science Association, Chicago, IL.
503 Hogan, A., Berry, H.L., Ng, S.P., Bode, A., 2011. Decisions made by farmers that relate to
504 climate change. Publication No. 10/208. Rural Industries Research and Development
505 Corporation, Barton.
506 Howley, P., 2015. The happy farmer: the effect of nonpecuniary benefits on behavior. Am. J.
507 Agric. Econ. 97, 1072–1086.
508 Jones, N.A., Ross, H., Lynam, T., Perez, P., Leitch, A., 2011. Mental models: an
509 interdisciplinary synthesis of theory and methods. Ecol. Soc. 16, 46. http://www.
510 ecologyandsociety.org/vol16/iss1/art46/ (accessed 20.01.17).
511 Kimhi, A., Bollman, R., 1999. Family farm dynamics in Canada and Israel: the case of farm
512 exits. Agric. Econ. 21, 69–79.
513 Landi, C., Stefani, G., Rocchi, B., Lombardi, G.V., Giampaolo, S., 2016. Regional
514 differentiation and farm exit: a hierarchical model for Tuscany. J. Agric. Econ. 67, 208–230.
515 Lien, G., Flaten, O., Jervell, A.M., Ebbesvik, M., Koesling, M., Valle, P.S., 2006.
516 Management and risk characteristics of part-time and full-time farmers in Norway. Rev.
517 Agric. Econ. 28, 111–131.
518 Lobao, L., Stofferahn, C.W., 2008. The community effects of industrialized farming: social
519 science research and challenges to corporate farming laws. Agric. Hum. Values 25, 219–240.
520 Lyson, T.A., Guptill, A.E, Gillespie Jr., G.W., 2000. Community engagement and dairy farm
521 performance: a study of farm operators in Upstate New York, in: Schwarzweller, H.K.,

522 Davidson, A.P. (Eds.), Dairy Industry Restructuring, Research in Rural Sociology and
523 Development, Volume 8. JAI, New York, pp. 309–323.
524 MacKinnon, J.G., White, H., 1985. Some heteroskedasticity consistent covariance matrix
525 estimators with improved finite sample properties. J. Econometrics 29, 53–57.
526 Maybery, D., Crase, L., Gullifer, C., 2005. Categorising farming values as economic,
527 conservation and lifestyle. J. Econ. Psychol. 26, 59–72.
528 Mishra, A.K., Fannin, J.M., Joo, H., 2014. Off-farm work, intensity of government payments,
529 and farm exits: evidence from a national survey in the United States. Can. J. Agric. Econ. 62,
530 283–306.
531 Morgan-Davies, C., Waterhouse, T., Wilson, R., 2012. Characterisation of farmers' responses
532 to policy reforms in Scottish hill farming areas. Small Rumin. Res. 102, 96–107.
533 NIBIO (The Norwegian Institute of Bioeconomy Research), 2016. Driftsgranskingar i jord-
534 og skogbruk. Rekneskapsresultat 2015. Norsk institutt for bioøkonomi, Oslo.
535 Putnam, R.D., 1995. Bowling alone: America's declining social capital. J. Democr. 6, 65–78.
536 Raggi, M., Sardonini, L., Viaggi, D., 2013. The effects of the Common Agricultural Policy on
537 exit strategies and land re-allocation. Land Use Policy 31, 114–125.
538 Ross, L.C., Austrheim, G., Asheim, L.-J., et al., 2016. Sheep grazing in the North Atlantic
539 region: a long-term perspective on environmental sustainability. Ambio 45, 551–566.
540 Statistics Norway, 2008. Centrality 2008.
541 http://stabas.ssb.no/ClassificationFrames.asp?ID=919597&Language=en (accessed 25.03.15)
542 Statistics Norway, 2016. Agriculture, forestry, hunting and fishing.
543 https://www.ssb.no/en/jord-skog-jakt-og-fiskeri/ (accessed 01.10.16)
544 Susanto, D., Rosson, C.P., Anderson, D.P., Adcock, F.J., 2010. Immigration policy, foreign
545 agricultural labor, and exit intentions in the United States dairy industry. J. Dairy Sci. 93,
546 1774–1781.

547 Weiss, C.R. 1997. Do they come back again? Empirical results on the symmetry and
548 reversibility of off-farm employment. Eur. Rev. Agric. Econ. 24, 65–84.
549 Wilson, P., 2011. Decomposing variation in dairy profitability: the impact of output, inputs,
550 prices, labour and management. J. Agric. Sci. 149, 507–517.