AN ANALYSIS OF MILK QUOTA ABOLITION IMPACT ON SCOTTISH FARMERS' BEHAVIOUR

LUIZA TOMA, ANDREW BARNES, ALAN RENWICK
Land Economy and Environment Research Group, Scottish Agricultural College, UK
Luiza.Toma@sac.ac.uk

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Land Economy and Environment Research Group, Scottish Agricultural College, UK

ABSTRACT[1]

This paper analyses factors influencing Scottish dairy farmers' intentions to change size of business in response to milk quota abolition. The analysis uses structural equation modelling and is based on survey data collected in 2009 through telephone interviews with 533 farmers. Results suggest that farmers who (1) intend to leave their farm to children; (2) have not inherited their farm from previous generation; (3) perceive a lower impact of milk quota abolition on business; (4) have less negative attitudes towards policies/regulations; and (5) perceived a lower influence of policies/markets on business during the past decade are most likely to increase farm size.

KEYWORDS: dairy industry, Scotland, farmer behaviour, milk quota abolition, structural equation model.

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1. INTRODUCTION

During the past decades the Scottish dairy farming industry has undergone a major structural change, i.e., strong decline in numbers and increase in size of farms due to, amongst other reasons, the introduction of the milk quota in the European Union (EU) in year 1984. The current developments in the EU dairy policies, such as the dairy quota abolition forecasted for year 2015 are expected to trigger further changes in the sector.

In the aforementioned context, the purpose of this paper is to analyse Scottish dairy farmers' decision-making and the factors *a priori* identified in the literature as influencing farmers' behaviour as regards changing farm size in the context of policy changes (*i.e.*, abolition of milk quota).

The paper is organised as follows: Section 2 briefly reviews the literature on farmers' behaviour as regards farm growth in the context of policy changes. Section 3 describes the survey data and the methodology (structural equation modelling). Section 4 discusses the results and Section 5 presents some conclusions.

2. FARM GROWTH AND DETERMINANTS OF FARMERS BEHAVIOUR

This section briefly presents the literature on the factors influencing farm growth and farmers' decision making as regards changes in farm size, focusing on the determinants analysed in this paper.

Tweeten (1984), Goddard *et al*. (1993), and Hallam (1993) provide compelling reviews of the literature in this area. Farming, as it is practiced in most industrialised countries, is predominantly a family business (Gasson and Errington, 1993). Therefore issues such as intentions to leave the farm to children are determinants of farmers' behaviour as regards changes in farm size. Gasson and Errington (1993) note that understanding the characteristics of the farm family will be central to explaining success (or failure) of the farm business. The importance of succession to business development was established in the 1980s (Calus *et al*., 2008). Weiss (1999) noted that farm succession has a positive effect on farmer's incentive to undertake long-run investments, ensuring a higher rate of farm growth. This corroborates the findings of Upton and Haworth (1987), namely that family members provide both an incentive and labour resources for expansion.

Goddard et al. (1993) include changes in relative prices and public programs amongst the factors causing change in farming structure. Gladwin and Zulauf (1991) note that small farms exhibit asymmetric price response, namely small farmers exploit their own labour or capital rather than going out of business when prices fall. Zepeda (1995) analyses how prices, interest rates, debt, drought, and the dairy termination program affected farm growth and the entry and exit of Wisconsin dairy farms by size categories during 1972-92. She finds that an increase in the milk-feed price ratio has the expected effect of encouraging expansion of existing farms and increasing the number of large farms relative to small- and medium-sized farms. However, she finds no significant effect of dairy policies (dairy termination program) on farm growth or entry and exit of farms.

Farmers' attitudes to policy changes have been analysed in a number of studies (Gorton *et al*., 2008). Gorton et al. (2008) state that while attitudes' impact on behaviour has been extensively analysed (Bagozzi, 1981), there have been fewer attempts to study the relationship between farmers' attitudes and their behavioural intentions (Bergevoet *et al*., 2004, Burton, 2004; Edwards-Jones, 2006), especially so in the context of policy change. A study by Tranter *et al*. (2004) found that most farmers interviewed in a survey in Germany, Portugal and UK would not alter their farming plans in response to a hypothetical policy change (*i.e*., introduction of a buy-out bond scheme which would put an end to any other type of EU support). Breen *et al*. (2005) found, based on data from a 2003 survey, that Irish farmers were reluctant to change in order to adjust to the Mid-Term CAP Review in Ireland.

METHODOLOGY

As the elimination of the dairy quota can be considered a major structural change for the dairy farms, inferences on their possible response are difficult to make using econometric models based on historical data. Therefore, this paper focuses its analysis on a survey. It should be noted that the analysis of economic agents' intentions as forecasts of future behaviour has been subject to criticism due to differences between intended and actual behaviour (Manski, 1990). Nevertheless, in context of high uncertainty, using behavioural economics methods to analyse intentions is likely one of the best approaches to capture potential response to future events. Moreover, in the case of this analysis, the focus is not on using intentions to predict behaviour, but on assessing how much farmers' perceptions

of the impact milk quota abolition might have on their business influence, amongst other related factors, their intentions to change farm size.

3.1 Data

Central to the empirical analysis in this paper is a cross-section database containing survey data collected in March 2009 through telephone interviews to 600 dairy farmers in Scotland (out of which 533 observations were retained for this analysis). The database includes data on socio-demographic and economic information about farmers and their farm businesses, frequency of access to information sources, attitudes, perceptions and knowledge of dairy policies and markets, attitudes, perceptions and knowledge of environmental/climate change issues, risk perceptions, intentional investment behaviour, attitudes towards animal welfare policies, attitudes towards milk quota abolition, perceptions of milk quota abolition impact on business, and intentions to change farm size in the short/medium/long term.

3.2 Structural equation modelling with observed and latent variables

To test the influence of some factors related to dairy policies and in particular, milk quota abolition, on dairy farmers' intentions to change the size of business after 2015 we employ a structural equation model (SEM) with observed and latent variables. SEM is a statistical technique for testing and estimating causal relationships amongst variables, some of which may be latent (Bollen, 1989) using a combination of statistical data and qualitative causal assumptions. Latent variables are variables that are not directly observed but are inferred from other variables that are observed and directly measurable. SEM is derived from three primary analytical developments, namely path analysis, latent variable modelling, and general covariance estimation methods (Bollen, 1989).

SEM is not intended to discover causes (as the idea of causality may be controversial - see Mueller, 1996), but to test and assess the soundness of the causal relationships researchers formulate. SEM is most commonly used for confirmatory rather than exploratory modelling and thus, it is applied more to theory testing than theory development.

The model consists of two parts, namely the measurement model specifying the relationships between the latent variables and their constituent indicators, and the structural equation model designating the causal relationships between the latent variables.

The model is defined by the following system of three equations in matrix terms (1) (Jöreskog and Sörbom, 2007):

The structural equation model: $\eta = B\eta + \Gamma\xi + \zeta$

The measurement model for y: $y = \Lambda_y \eta + \varepsilon$

The measurement model for x: $x = \Lambda_x \xi + \delta$ (1)

Where: η is an mx1 random vector of endogenous latent variables; ξ is an nx1 random vector of exogenous latent variables; B is an mxm matrix of coefficients of the η variables in the structural model; Γ is an mxn matrix of coefficients of the ξ variables in the structural model; ζ is an mx1 vector of equation errors (random disturbances) in the structural model; y is a px1 vector of endogenous variables; x is a qx1 vector of predictors or exogenous variables; Λ_y is a pxm matrix of coefficients of the regression of y on η; Λ_x is a qxn matrix of coefficients of the regression of x on ξ ; ε is a px1 vector of measurement errors in y; δ is a qx1 vector of measurement errors in x.

SEM takes into consideration both direct and indirect causal relationships between constructs, which means that one causal relation may be reinforced or counteracted by another. As there could be different ways to depict the relationships between the latent variables, running alternative models and comparing them will assist in choosing the model that best represents the data.

We undertake SEM with categorical variables defined on ordinal scales (Likert scale) using the statistical package Lisrel 8.80 (Jöreskog and Sörbom, 2007). SEM estimation is performed by minimising the discrepancy between the covariance matrix of observed variables, and the theoretical covariance matrix predicted by the model structure (Bollen, 1989). The recommended method consistent with the sample size (n=533, a sample size which falls within standard limits for use within SEM) is the normal-theory maximum likelihood (MLE) method (Bollen, 1989).

3.3 Latent variables and indicators

We identified and extracted seven latent variables, expressing the intentional behaviour and the underlying determining factors. The variables are: 'farm business inherited from previous generation', 'intention to leave farm to children', 'size of milk quota owned', 'perceived influence of dairy policies and markets on farm business during the past ten years', 'attitudes towards dairy policies and regulations', 'perceptions of milk quota abolition impact on dairy business', and 'intentions to change farm size after 2015'.

The seven latent variables are measured by 14 indicators (the constituent observed variables). Table 1 presents a series of descriptive statistics for the indicators of the latent variables included in the model.

Table 1

The behavioural variable 'intentions to change farm size after 2015' (behav) is a single indicator latent variable with the indicator (behavlt) being a dichotomous variable taking value 1 for intentions to increase farm size and 0 otherwise.

The variables 'farm business inherited from previous generation' (inherits) and 'size of milk quota owned' (quotas) are observed variables built into the model as single indicator latent variables, with indicators (inherit and quota) being respectively, a dichotomous variable taking value 1 if the farm was inherited from the previous generation and 0 otherwise, and a categorical variable taking values from 1 (less than 600,000 litres), 2 (between 600,000-1,300,000 litres) to 3 (over 1,300,000 litres).

The variable 'intention to leave farm to children' (childs) is a single indicator latent variable, with the indicator (child) being a dichotomous variable taking value 1 if the farmer intends to leave farm to children and 0 otherwise.

The attitudinal variable 'perceived influence of dairy policies and markets on farm business during the past ten years' (businfl) is a latent variable measured by three indicators: 'perceived influence of Government policies in the dairy industry on farm business during the past ten years' (businfl1), 'perceived influence of input prices on farm business during the past ten years' (businfl2) and 'perceived influence of prices for liquid

milk on farm business during the past ten years' (businfl3). The three variables are ordinal using a three-point Likert scale from 'not affected', 'slightly affected' to 'much affected'.

The attitudinal variable 'attitudes towards dairy policies and regulations' (attdp) is a latent variable measured by four indicators: 'I consider Scottish dairy policy to be increasingly restrictive' (attdp1), 'dairy legislation spoils the pleasure in my work' (attdp2), 'the increasing amount of dairy regulations interferes with my plans for the future' (attdp3) and 'changes in dairy regulations and policies are an increasing burden' (attdp4). The four variables are ordinal using a five-point Likert scale from 'strongly disagree' to 'strongly agree'.

The attitudinal variable 'perceptions of milk quota abolition impact on dairy business' (attqab) is a latent variable measured by three indicators: 'removing milk quotas will force me to reduce herd size' (attqab1), 'removing milk quotas will make me focus on the processing side of the dairy business' (attqab2), 'the threat of removing milk quotas stops me from investing in my business' (attqab3). The three variables are ordinal using a five-point Likert scale from 'strongly disagree' to 'strongly agree'.

3.4 Validation of latent variables using factor analysis

As a test of the validity of the latent variables, we undertook factor analysis with varimax rotation. Each set of variables loaded onto a separate factor, and only seven factors were retained, such that these seven factors could be taken to represent the relevant latent variables (Table 2).

Table 2

Once we had established that the latent variables could be identified, we undertook separate factor analyses for the three multiple-indicator latent variables ('businfl', 'attdp' and 'attqab'). The individual factor analyses each extracted a single factor, with all variable loadings above the recommended value of 0.7. The total variance of the indicators explained by each of the latent variables was 55 percent, 64 percent and, respectively, 57 percent for latent variables 'businfl', 'attdp' and 'attqab', thus confirming the choice of observed variables consistent with their empirical significance.

4. RESULTS AND DISCUSSION

Based on the existing literature it was reasonable to assume a certain amount of underlying causality amongst the variables in the model. Hence we tested the model described in Figure 1, which presents the path diagram for the estimated model.

Figure 1

The estimated model includes three exogenous latent variables, three variables with alternating roles (endogenous in some equations and exogenous in some others) and one endogenous variable. The three exogenous variables are: 'farm business inherited from previous generation' (inherits) as predictor of 'intention to leave farm to children' (childs), 'perceptions of milk quota abolition impact on dairy business' (attqap) and 'intentions to change farm size after 2015' (behav); 'perceived influence of dairy policies and markets on farm business during the past ten years' (businfl) as predictor of 'attitudes towards dairy policies and regulations' (attdp); and 'size of milk quota owned' (quotas) as predictor of 'attitudes towards dairy policies and regulations' (attdp) and 'perceptions of milk quota abolition impact on dairy business' (attqap).

'Intention to leave farm to children' (childs) is a variable with alternating roles, namely endogenous as predicted by 'farm business inherited from previous generation' (inherits) and exogenous as a predictor of 'intentions to change farm size after 2015' (behav). 'Attitudes towards dairy policies and regulations' (attdp) is also a variable with alternating roles, namely endogenous as predicted by 'perceived influence of dairy policies and markets on farm business during the past ten years' (businfl) and 'size of milk quota owned' (quotas), and exogenous as a predictor of 'perceptions of milk quota abolition impact on dairy business' (attqap). Same about 'perceptions of milk quota abolition impact on dairy business' (attqap), which is endogenous as predicted by 'farm business inherited from previous generation' (inherits) and 'size of milk quota owned' (quotas), and exogenous as predictor of 'intentions to change farm size after 2015' (behav).

The behavioural latent variable 'intentions to change farm size after 2015' (behav) is endogenous as predicted directly or indirectly by all the other latent variables.

The model has an adequate fit according to the measures of absolute, incremental and parsimonious fit (Hair *et al*., 2006), with a normed chi-square (ratio between the chi-square and number of degrees of freedom) value of 2.97 within the recommended interval of 1 to 3, root mean square error of approximation (RMSEA) value of 0.061 below the threshold maximum value of 0.10, standardised root mean residual (SRMR) value of 0.057 lower than the threshold of 0.08, comparative fit index (CFI) value of 0.93, incremental fit index (IFI) value of 0.93, non-normed fit index (NNFI) value of 0.91, goodness of fit index (GFI) value of 0.95, adjusted goodness of fit index (AGFI) value of 0.92, normed Fit Index (NFI) value of 0.90 and relative fit index (RFI) value of 0.87 are above (or close to) the cutoff values for fit indices, the 'magic 0.90 or 0.95' (Hair *et al*., 2006).

Additional testing of the appropriateness of the models was achieved by comparing the estimated model with three other models that acted as alternative explanations to the proposed model, in a competing models strategy (using a nested model approach, in which the number of constructs and indicators remains constant, but the number of estimated relationships changes). The results across all types of goodness-of-fit measures favoured the estimated model in most cases, so the competing models were discarded.

After the goodness-of-fit tests the validity of the model was assessed in a two-step procedure, the measurement model and the structural model. The measurement model results show that the sets of indicators for the three multiple-indicator constructs do not all have comparable indicators, however, all loadings are statistically significant.

After assessing the overall model and aspects of the measurement model, we examined the standardised structural coefficients for both practical and theoretical implications. The significance tests for the structural model parameters represent the basis for accepting or rejecting the proposed relationships between exogenous and endogenous constructs. All variables with the exception of variable 'quotas' (as predictor of 'attqab') have statistically significant coefficients in all equations. Table 3 presents the standardised total, direct and indirect effects on the behavioural latent variable of all the other latent variables in the model.

Table 3

The model predicts 44% of the variance in intentional behaviour. In terms of individual effects, farmers' intention to leave the farm to children has the strongest impact on their intentions to change farm size. This is consistent with the literature on the importance of succession to business development (Calus *et al*., 2008; Upton and Haworth, 1987). This means that farmers who have children likely to continue in dairy business are more likely to increase farm size.

The next most significant influence on intentional behaviour comes from farmers having had inherited the farm from the previous generation. The impact on intentions to increase farm size is two-fold, as it impacts on it directly and indirectly through intentions to leave farm to children and attitudes towards quota abolition. The indirect effect through the succession variable has the expected sign which again supports the literature (Gasson and Errington, 1993), namely that farmers who own farms which were in the family for more than one generation have more incentives to want to keep the farm in the family. The indirect effect through quota abolition attitudes has a negative sign, meaning that farmers who inherited the business from family perceive a lower impact of quota abolition on business. Reasons for this need further investigation. Same as regards the direct effect which, again has a negative sign, meaning that farmers who inherited the business from the previous generation have lower intentions to increase farm size. This is difficult to interpret and needs further investigation. We intend to expand the analysis to look into effects of current farm size, age and education.

The third significant influence on intentional behaviour are farmers' perceptions of milk quota abolition's impact on own business. Unlike many studies, we found that policy change will influence farmers' intentions as regards farm growth. Namely, the stronger the perception that milk quota abolition will affect the business, the lower the intentions of farmers to increase farm size.

Farmers' perceived influence of dairy policies and markets on farm business during the past ten years has a lower but still significant influence on farmers' intentional behaviour. The impact is indirect through policy attitudes. Namely, the stronger the perceived influence of policies and markets on business, the stronger the 'less positive' attitudes towards dairy policies and regulations and, implicitly the lower the intention to increase farm size.

Farmers' attitudes towards dairy policies and regulations have again a lower but still significant influence on farmers' intentional behaviour. The impact is indirect through attitudes towards quota abolition, namely the stronger the 'less positive' attitudes towards policies the stronger the perceived impact of quota abolition on business and, implicitly the lower the intention to increase farm size.

The impact of owned milk quota on intentions to increase farm size is indirect through attitudes towards dairy policies and perception of quota abolition impact on business. As expected, both relationships are negative, meaning that farmers who own larger quotas have 'less negative' attitudes towards policies and perceive a lower impact of quota abolition on their farm. However, only the impact on policy attitudes was found significant, meaning that perception of quota abolition impacts is not significantly influenced by the size of quota. The impact of owned quota on intentions to increase farm size has an expected positive sign (the larger the quota owned, the stronger the intentions to increase farm size), however the relationship was not found significant.

Overall, results show that farmers who (1) intend to leave their farm to children; (2) have not inherited their farm from previous generation; (3) perceive a lower impact of milk quota abolition on business; (4) have less negative attitudes towards dairy policies/regulations; and (5) perceive a lower influence of policies/ markets on business during the past decade are most likely to increase farm size.

5. CONCLUSIONS

The paper analysed some of the factors influencing Scottish dairy farmers' intentions to change size of business in response to milk quota abolition, using structural equation modelling with observed and latent variables. Results suggest that farmers who (1) intend to leave their farm to children; (2) have not inherited their farm from previous generation; (3) perceive a lower impact of milk quota abolition on their business; (4) have less negative attitudes towards dairy policies and regulations; and (5) perceived a lower influence of policies and markets on business during the past decade are most likely to remain in business and increase farm size. Attitudes towards policies and perceptions of policy impact on business in the past, while still significant, have a low influence on behaviour. Owned quota does not have a significant effect. While the intention to leave the business to children, followed by having had inherited the farm from the previous

generation have the most significant effects on farmers' intentions to increase farm size, the perception of milk quota abolition impact on their business will also significantly influence farmers' behaviour.

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TABLES AND FIGURES

Table 1 Descriptive statistics

	Mean	Std. deviation
Did you inherit your farm from your family? (inherit)	1.21	.410
Do you intend to leave the farm to your children? (child)	1.25	.433
How much quota do you own? (quota)	1.97	.746
During the past ten years had Government policies in the dairy industry had any influence on your dairy farm business? (businfl1)	2.15	.791
During the past ten years had input prices had any influence on your dairy farm business? (businfl2)	2.80	.483
During the past ten years had prices for liquid milk had any influence on your dairy farm business? (businfl3)	2.82	.471
I consider Scottish dairy policy to be increasingly restrictive (attdp1)	3.19	1.120
Dairy legislation spoils the pleasure in my work (attdp2)	3.55	1.215
The increasing amount of dairy regulations interferes with my plans for the future (attdp3)	3.45	1.181
Changes in dairy regulations and policies are an increasing burden (attdp4)	3.96	1.016
Removing milk quotas will force me to reduce herd size (attqab1)	1.80	1.114
Removing milk quotas will make me focus on the processing side of the dairy business (attqab2)	1.84	1.106
The threat of removing milk quotas stops me from investing in my business (attqab3)	2.06	1.230
Do you intend to change the size of the farm after 2015? (behavlt)	1.65	.478

Source: Own research

Table 2 Factor analysis

	Component						
	1	2	3	4	5	6	7
Did you inherit your farm from your family? (inherit)	-.046	-.057	-.012	-.075	.097	**.963**	-.030
Do you intend to leave the farm to your children? (child)	-.038	.020	-.039	.122	**.924**	.103	-.065
How much quota do you own? (quota)	-.048	-.041	.047	-.056	-.065	-.029	**.978**
During the past ten years had Government policies in the dairy industry had any influence on your dairy farm business? (businfl1)	.096	-.033	**.517**	-.508	.249	-.128	.032
During the past ten years had input prices had any influence on your dairy farm business? (businfl2)	.044	.011	**.800**	-.020	.038	.018	-.008
During the past ten years had prices for liquid milk had any influence on your dairy farm business? (businfl3)	.065	.022	**.803**	.057	-.120	-.004	.055

I consider Scottish dairy policy to be increasingly restrictive (attdp1)	**.667**	.203	.013	-.091	.139	-.084	.000
Dairy legislation spoils the pleasure in my work (attdp2)	**.831**	.051	-.010	-.034	-.080	.030	-.013
The increasing amount of dairy regulations interferes with my plans for the future (attdp3)	**.844**	.103	.074	-.002	-.035	.011	-.037
Changes in dairy regulations and policies are an increasing burden (attdp4)	**.818**	-.013	.100	.036	-.047	-.032	-.005
Removing milk quotas will force me to reduce herd size (attqab1)	.052	**.810**	.057	.095	.026	.078	-.076
Removing milk quotas will make me focus on the processing side of the dairy business (attqab2)	.039	**.698**	-.154	-.188	-.078	-.157	-.115
The threat of removing milk quotas stops me from investing in my business (attqab3)	.209	**.717**	.106	.059	.066	-.018	.142
Do you intend to change the size of the farm after 2015? (behavlt)	-.025	-.013	.087	**.832**	.217	-.129	-.048

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 6 iterations.
The loadings of indicators building the factors are in bold fonts.
Source: Own research

Table 3 Standardised total, direct and indirect effects on behavioural latent variable (t-values in parentheses)

Observed/latent variables	Direct effect	Indirect effect	Total effect
	intention to change the size of the farm after 2015 (behav)		
inherits	-0.39 (-5.08)	0.10 (5.13)	-0.29 (-2.72)
quotas	0.0	0.01 (1.23)	0.01 (1.23)
businfl	0.0	-0.01 (-2.05)	-0.01 (-2.05)
childs	0.63 (8.30)	0.0	0.63 (8.30)
attdp	0.0	-0.02 (-2.24)	-0.02 (-2.24)
attqab	-0.16 (-2.46)	0.0	-0.16 (-2.46)

Figure 1 Path diagram for the estimated model (standardised solution)