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The Influence of diversification on short-term and long-term viability in the Scottish and Swedish agricultural sector

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Abstract: The long-term viability of farm businesses has been a stated goal for agricultural policy in most developed and developing economies. Recent investigations have found the level and type of diversification to be a significant factor in determining viability. This paper presents an index of short term and long term viability over the period 2000-2012 across Scotland and Sweden. Transition probabilities are presented using a balanced Markov chain approach. We find stability in both viable and non-viable farms over time, irrespective of policy and market change. A multinomial logistic regression finds the influence agaricultural diversification on determining higher levels of viability at the farm level.

1. Introduction

Diversification of farm businesses outside of what may be viewed as conventional agriculture is strongly promoted in the European Union's rural development policy, and therefore various policy measures related to this has been developed (Council Regulation (EC) No. 1698/2005). Indeed, supporting farmers to use their under-exploited or idle agricultural resources in new ways in order to obtain revenue is seen as a strategy to reduce farm household income risk, encourage diversification of rural economies and, thereby, a means to accomplish goals concerning economic growth in rural areas, create job-openings and encourage in-migration. Farmers seem to have largely responded to the calls of policy makers; for instance in a 2000 – 2007 longitudinal study of a sample drawn from about the 40% largest farms in Sweden 68-75% of the sample reported revenue originating from activities such as renting out of equipment and buildings; and contract work (Hansson et al. 2010). These activities constituted between 12.3-15.2% of total revenue of the reporting firms, and are thus considerable share of total revenue.

A review of the scientific literature related to farm diversification shows that there has been a considerable interest in the phenomenon, especially during the last two decades (e.g. Ilbery 1991; McNally 2001; Chaplin et al. 2004; Gorton et al. 2008; Barbieri & Mahoney 2009; Maye et al. 2009; Vik & McElwee 2011; Hansson et al. 2012; Hansson et al. 2013). In particular, researchers have been interested in its determinants; and farmers' underlying motives for diversifying their farm businesses outside conventional agriculture.

There has also been a significant interest in the different types of incomes (off-farm employment and other business-holdings) of the farm family, i.e. the so called pluriactivity of the farmers and his/her family (e.g. Alsos et al. 2003; Serra et al. 2004; McNamara & Weiss 2005; Lagerkvist et al. 2007).

While the knowledge produced by previous studies is truly essential for the formulation of successful policy, the underlying logic of the policy seems to have been largely taken for granted. This means that the hypothesized positive relationship between farm diversification and the favorable economic situation of the farm business, has, to the best of our knowledge, not received attention in the scientific literature. There has been some interest in how the degree of specialization in the major farm enterprise affects the technical efficiency of farms (e.g. Brümmer et al. 2001; Hadley 2006; Hansson 2007, Barnes et al., 2011), where findings have consistently shown a negative impact of specialization on technical efficiency, lending some support also for a negative relationship between specialization and the economic results

of the farm. Although this lends support in favor of the economic development associated with farm diversification, its existence cannot be taken for granted.

Accordingly, the aim of this paper is to assess the impact of farm diversification on the economic outcome of the farm business. This is considered in terms of the financial viability of the farm (Vrojlick et al., 2010), which relates the farm cash income to the minimal agricultural wage and thereby considers how well the farm business can generate income, something that should be a pre-requisite for rural economic growth. Furthermore, since the definition of farm diversification is based on what is considered conventional farming, and is thus empirically, rather than theoretically driven, we also assess how diversification of conventional agricultural enterprises of the farm business affects the viability of the farm. Diversification in this sense may also contribute to the positive economic development of rural areas, for instance through its obvious positive effects on risk reduction and towards broadening the employment base. However, the strong policy interest in farm diversification outside conventional agriculture motivates us to keep two separate definitions of diversification in this article. Accordingly, this paper is based on empirical evidence from a longitudinal datasets of around 500 farms in Scotland and around 800 farms in Sweden and contributes a valuable analysis of farm diversification and its effect on farm viability.

2. Conceptual Framework

2.1 Farm diversification and diversification of agricultural enterprises

Several authors (e.g. Ilbery 1991; McNally 2001; Turner et al. 2003; Barbieri and Mahoney 2009; Hansson et al. 2012; Hansson et al. 2013) take farm diversification to imply that a farm business uses its agricultural resources to produce income from activities that are not defined as conventional farming, or to process its raw material on-farm, often in order to pursue a marketing strategy based on value-added products.

This definition has several implications. First, and compared to the strategic management literature, where a firm's diversified activities can be addressed within the so called Ansoff product market growth matrix (originally identified by Ansoff, 1957, see e.g. Johnson et al. 2011), Hansson et al. (2013) pointed out that the definition of farm diversification implies that activities that the strategic management literature normally consider vertical integration (on-farm processing of raw material), falls under the definition of farm diversification. Within the Ansoff product market growth matrix, there exist three types of diversified activities: i) developing new products for the firm's existing market; ii) introducing existing products to a new market; and iii) entering new markets with new products.

Within this framework, farm diversification can be seen as activities ii) and iii). Furthermore, and as pointed out by Hansson et al. (2013) farm activities related to vertical integration often involve processing activities that add value to farm products, in practice implying that new products are developed and sold to a, for the farm business, new market. An example can be on-farm processing of milk, as opposed to selling milk to a dairy plant processor, where the milk is often marketed in terms of localised production and thereby is considered to gain added value to farmers and consumers alike.

Second, this definition of farm diversification is fluid in the sense that there is a need to empirically define 'conventional farming' in order to determine whether or not a farm is diversified. As noted by Turner et al. (2003) the definition of conventional farming is likely

to be time-dependent and thus reflecting what is currently considered the mainstream activities of a farm business. There are also likely to be geographical dependencies in what can be considered mainstream farming. While this is likely a necessary condition of the definition of farm diversification – with its interest in activities outside conventional agriculture – it calls for cautious comparisons between studies from different periods in time.

Third, the definition of farm diversification provided above is clearly distinguished from the adjacent concept of pluriactivity, depending on the unit of analysis used in the two concepts. The farm diversification definition builds on the farm business and its use of its resources to generate income, while pluriactivity refers to all the income-generating activities of the farmer and the farm household and thus includes off-farm work and additional businesses run by the farmer and the farm household.

Fourth and finally, the notation of farm diversification as used in the literature and referring to activities outside conventional agriculture, excludes diversification in the sense that the farm business runs several agricultural enterprises, such as grain and milk, and is diversified in that sense. This notation of diversification has only merited limited study, but Hansson et al. (2010) for example, have found that around 70% of the larger Swedish farms are diversified in this sense.

In this study, the point of departure is taken for the farm business and diversification is considered in terms of the revenue-generating activities the farm business produces from its resources. In particular, we distinguish between the following two types of diversification, that is: farm diversification, according to the definition above, and diversification of the agricultural enterprises (agricultural diversification).

This latter activity implies that a farm business is considered if it uses any of its farm resources to produce income from activities outside conventional agriculture, or where farm products are processed on-farm. This notation of farm diversification is thus similar to that of numerous other studies e.g. Ilbery (1991), McNally 2001, Turner et al. (2003), Barbieri and Mahoney (2009), Hansson et al. (2012) and Hansson et al. (2013).

Furthermore, following Hansson et al. (2010) a farm business is considered involved in diversification of the agricultural enterprises if it obtains income from two or more agricultural enterprises, such as grain and milk. For completeness, specialized farm businesses are defined as farms obtaining their agricultural income from only one agricultural enterprise. The definitions of diversification outlined here implies that farm businesses obtaining income from on-farm processing of their own raw-material would be considered diversified even though their production may be specialized in single agricultural enterprise, because it could be argued to provide new products to new markets.

2.2. Farm viability

Viability, based on securing a stable income for farmers, has been a concern for policy makers within the EU since the inception of the Common Agricultural Policy (CAP) in 1957. Whilst national and EU policies have broadened over the recent decades to include community-based and environmental goals, ensuring stability of incomes is still a central aim for support policies within EU agriculture. Whilst viability must include the ability of business entities to meet their operating expenses and financial obligations, there must be some accommodation for future growth. Ultimately, studies on agricultural viability have

attempted to understand the criteria for failure at the farm level and identify factors which determine a switch from viable to non-viable and the consequences of consistent under-performance within the sector. Failure at the farm level can be defined in a number ways and identifying indicators for failure is a non-trivial task (Murdock and Leistritz, 1988). Most studies tend to use a partial measure of change, for example changes in net worth may be indicative of overall asset value change (Lines and Zulauf, 1985; Melichar, 1985; Wadsworth and Bravo-Ureta, 1992; Carley and Flechter, 1988). However, the temporal element of change and farm level biophysical planning requires a multi-indicator approach to assess both a threshold for failure and determinants for avoiding this failure. Frawley and Commins (1996) provide a useful definition in that viability is determined by comparison with the minimum agricultural wages but also the capacity to provide an additional 5% return on non-land assets.

Within the farming enterprise Vroljik et al. (2010) argue that viability is determined by the level of income, but also by the fluctuations in incomes and the level of leverage, that is the ability to obtain capital for investment. Agricultural incomes vary widely and are significantly affected by exogenous biophysical and global financial factors. As such most studies of farm level viability incorporate a time element to accommodate these fluctuations in financial viability. Work by Crodts et al (1984) and the EU (1991) find that income variability tends to be reduced when a three year period is considered, however this could vary given the level of shock and the time lag applied for re-adjustment. Vroljik et al. (2010) used the farm account data network (FADN) to identify viability after reform of the Common Agricultural Policy. Their indicator of viability rested on family farm income being higher than 0, they then tested this further by including opportunity costs, reflective of the income foregone, and set at local interest rates for 10 year government bond rates to classify farmers into different types.

Most studies have not measured the influence of diversified activities on sustaining enterprises at the farm level. An exception is O'Donoghue et al. (2009) who used family farm income and included a return rate, to account for capital investment. They also included off-farm income which they used as a criteria for viability. However, these studies tend to accommodate only year on year changes in viability and clearly a criterion for failure may be both short-term and long-term. Given the temporal nature of viability and the nature of farm level decision making we therefore propose two interchanging indicators to account for short-term, and long-term changes in viability, through cash income and adjusted net farm income indicators.

2.3 Hypotheses

Given these literature we propose to explore two hypotheses which are central to future policy making with respect to diversification and securing stability of incomes in the long-term.

H1) Farm businesses involved in farm diversification activities are more viable than farms involved in specialized activities, and

H2) Farm businesses involved in diversification of the agricultural enterprise (agricultural diversification) are more viable than farms not involved in any type of diversification activity.

3. Data and Methods

3.1. Data

The Scottish and the Swedish Farm Account Survey (FAS), which covers a sample of around 500 and 1000 farms per year respectivelly, offers detailed indicators on inputs, outputs and socio-economic data on the farms themselves. The data are collected yearly under EU FADN quality guidelines and using these data, indicators of viability and diversification can be generated. Whilst it is traditionally biased away from smaller enterprises, which may be exhibiting high levels of diversification, the FAS represents farms which are the main targets for policy intervention and, also are large enough to drive rural economic growth through these diversified and specialised activities. An unbalanced panel was constructed from these data. However those farms which were not in the panel for at least 3 consecutive years were dropped.

3.2. Methods

3.2.1. Identifying viability

The cost structures of farming have provided a basis for harbouring fluctuations in short-term income. The total asset structure of the business provides a basis for understanding the impact on viability and this is our main discriminator between short-term and long-term viability.

Short term viability is based on cash income as an indicator of yearly viability over time. Cash income is the difference between total revenue and total expenditure on a farm. This viability is measured based on exceeding an hourly minimum agricultural wage rate (Phimster, 1995; O'Donohue et al., 2013). Cash income includes income from farm-diversification and non-farm income. However, as discussed above we do not consider off-farm income here, as it defines a wider decision-making unit. Hence non-farm income was deducted from cash income to provide the general indicator of short-term viability. This was divided by the annual hours worked by the farmer and spouse and then compared to the minimum agricultural wage rate for that year.

Long term viability is based on a 3-year moving average of Net Farm Income (NFI). Net Farm Income represents the return to the farmer and spouse for their manual and managerial labour and adjusted for imputed labour and rent. In FADN, this measure does not include income for farm diversification and hence this is added to NFI to give an indication of long term viability. This was divided by the annual hours worked by the farmer and spouse and then compared to the minimum agricultural wage rate for that year.

Accordingly, using the threshold of minimum agricultural wage within each year, three states of viability could be identified for each farm in each time point of the longitudinal data set, namely: short-term and long-term viability (STV LTV) where both indicators are above minimum agricultural wage, short-term viable but long-term non-viable (STV LTNV), where only adjusted cash income is above minimum agricultural wages, and short and long-term non-viable (STNV LTNV), where both indicators are below the threshold.

3.2.2. Identifying Diversification

A range of activities are recorded over time for various diversification activities. Firstly, the degree of specialisation within the agricultural enterprises. This can be identified using the ratio of a single activity revenue (e.g. from cropping or livestock) to total agricultural revenues (Argiles, 1998).

Secondly, farm diversification can be identified in detail. In order to accommodate the definitions outlined above, farm diversification is the sum of income received from contracting work and rental incomes, e.g. farm and cottage rentals and allowances. This is then divided by total income in the farm business to give a ratio running from 0 to 1. Notably, other sources of income collected within the FAS include financial investments and sundry grants received for forestry activities. However, these have not been traditionally defined as farm diversification and have been ignored here. Table 1 shows the mean, averaged over the period 2002-2012, of the different income sources for Scotland and Sweden.

Table 1. Descriptive of main indicators of farm income and diversification, UK £(2005)

	Scotland	Sweden
Farms in sample (No.)	462	792
Cash income (UK £2005)	41,112	66,932
Net farm income (UK £2005)	19,746	28,076
Agricultural diversification	0.78	0.70
Farm diversification	0.22	0.13

3.2.2. Measuring the influence of diversification

The data were considered an unbalanced panel over the the whole period. A multi-nominal logistic regression was used to estimate the probability of entering a particular state of viability compared to a base outcome. Thus the two non-viability states (STNV LTV) and (STNV LTNV) were compared against the base outcome class of short term and long term viability (STV LTV). Predictors of policy support and change were derived as time-dependent dummies, and indicators of farming intensity and tenure were also used to explain changes in viability. Estimation was conducted in Stata 12.1 (Stata Corp, 2011).

4.0. Results

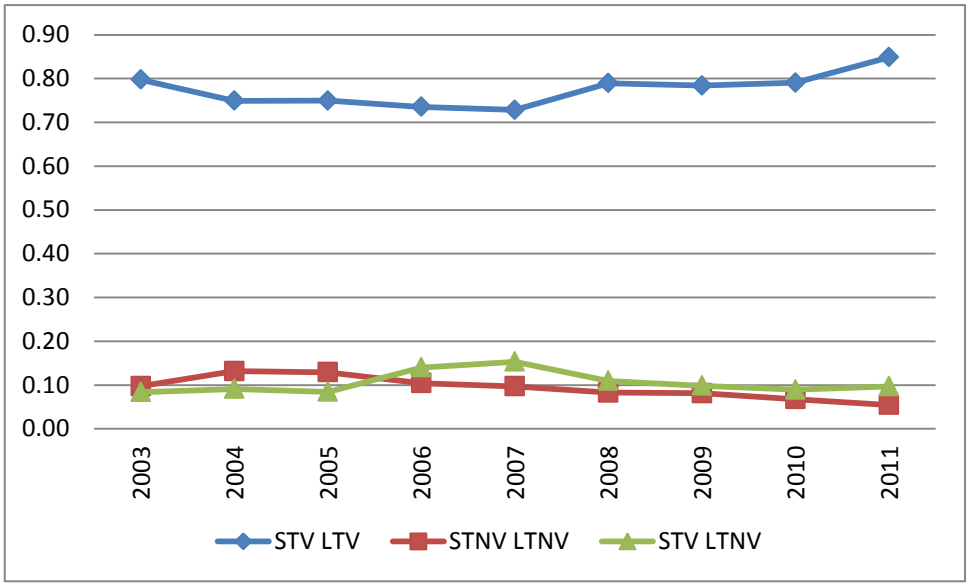
4.1. Viability index

Figure 1 shows the viability index over the period 2003 to 2011 for the three states of short term and long term viable (STV LTV), short term viable and long term non-viable (STV LTNV) and short term and long term non-viable (STNV LTNV). For Scotland this shows a steady increase in the number of viable farms over time relative to the other classes. For Sweden, the proportion of viable farms is lower. In addition, those farms which are both

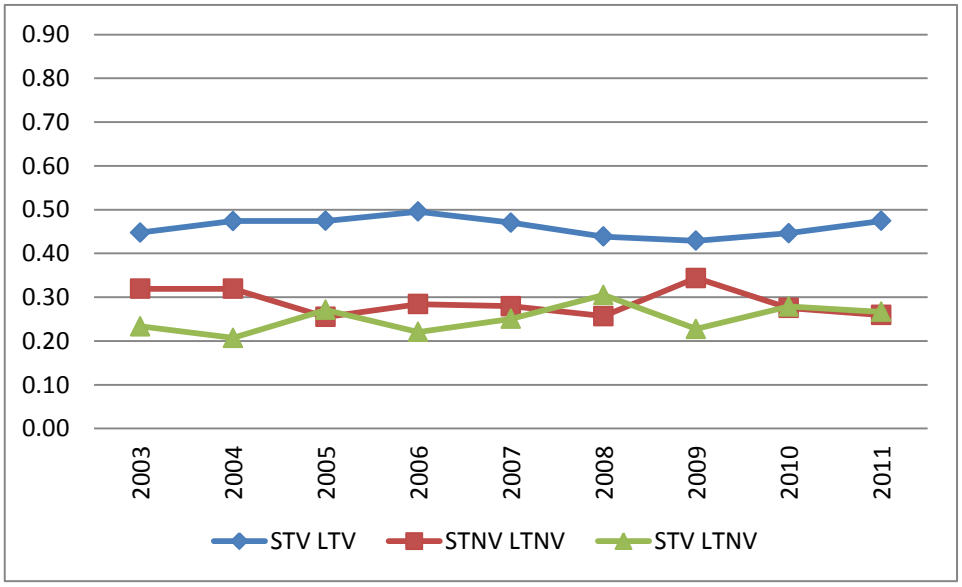
short and long term non-viable (STNV LTNV) have fluctuated between 20 to 10% of the total proportion of the industry for Scotland, though this figure is higher for Sweden.

Figure 1. Distribution of viability states over time, proportion for a) Scotland and b) Sweden(change from 2011 - 2012)

a) Scotland



b Sweden



In order to examine this further a Markov transition matrix was explored. Table 2 shows the balanced transition probabilities for the Scottish and the Swedish farms over time. These

indicate a high likelihood of remaining in the viable group over two periods compared to other states for both groups. Transition probabilities are generally similar between the two countries. Notably, however, the probabilities for transition from non-viable to viable states is much lower in Sweden (0.09) compared to Scotland (0.33). Nevertheless, there is around a probability of 0.5 of remaining in one of the other viability groups or over the same period.

Table 2. Markov Chain transition probabilities for Scottish and Swedish viability index

		Current State		
	Previous State	Viable	Viable / Non-Viable	Non-Viable
Scotland	Viable	0.93	0.04	0.03
	Viable/Non-Viable	0.33	0.47	0.20
	Non-Viable	0.33	0.16	0.52
Sweden	Viable	0.81	0.15	0.04
	Viable/Non-Viable	0.28	0.47	0.25
	Non-Viable	0.09	0.22	0.69

4.2. Multinomial Logistic regression

Table 3 shows the results of a multinomial logistic regression for Scotland and Sweden. It presents results as relative risk ratios, that is if a value is greater than 1 then the variable is more likely to predict membership of the alternative class if it were to increase. In this case the base outcome class was short-term and long-term viability (viable class).

Generally, RRRs are of the same size and magnitude across the two countries within the non-viable class (class 2), but differ with respect to class 1, that is short-term viable and long term non-viable. In the short term, differences in LFA allocation, application of the single farm payment, tenure status and the influence of diversification emerge. The LFA variable is indicative of spatial disadvantage, which is a defining charateristic in both countries but only a significant factor in determine viability in Sweden. Finally, the degree of agricultural diversification is a strong predictor of viability status and is below 1, that is more revenue from a single activity will increase the likelihood of being in the non-viable class. Within Scotland this is significant, which seems to validate the hypothesis that farms involved in agricultural diversification are more viable for this region, but it is not significant in Sweden. The relative risk ratios for farm diversification are below 1 and significant for both countries. This seems to validate the hypothesis that farm diversification will increase the likelihood of remaining viable in the short-term.

Table 3. Multinomial regression of farm viability states, relative risk ratios (compared to viable class) and significance

	Scotland		Sweden	
(1) Short-term viable & long-term non-viable~	exp(β)	p	exp(β)	p
Tenure	0.519	***	1.428	***
Single Farm Payment	0.780	-	1.820	***
Agricultural Diversification	0.391	***	0.939	
Farm Diversification	0.060	***	0.576	***
Less Favoured Area Status	0.930	-	1.204	**
Stocking Density	0.120	*	1.002	*
(2) Short term non-viable & long-term non-viable~	exp(β)	p	exp(β)	p
Tenure	1.208	***	1.263	***
Single Farm Payment	1.380	-	1.319	***
Agricultural Diversification	0.356	***	0.643	***
Farm Diversification	0.553	**	0.216	***
Less Favoured Area	0.775	-	1.555	***
Stocking Density	0.0002	***	0.995	***
~Compared to base outcome: (0) Short term viable/ long term viable				
Log-likelihood	-1138.4		-8643.7	
aic	2304.9		17315.3	
bic	2383.5		17414.3	

(Sig: * = 0.05; **=0.01; ***0.001)

Much more parity in RRRs and significance is found for the non-viability state (class 2). SFP and LFA variables remain insignificant in Scotland, but are both predictors of non-viable status in Sweden. Stocking density and tenure are strongly significant and follow the same signs across the two countries. The likelihood of tenure status is above 1 which means that tenanted farmers are more likely to be within this non-viability class. This could be explained by asset and financial commitment structures, compared to owner-occupied farms. Relative risk ratios are also signficant for both countries for diversification compared to class 1. These both validate the hypothesis that focusing on agricultural and farm diversification will ensure more farm level viability.

5.0 Discussion and Conclusion

This paper has provided both an indication of short and long-term viability and their transitions over the last decade within the Scottish and Swedish agricultural sectors. This highlights both the similarities of the problems faced by farmers across Europe, but also differences in terms of regionalised policy prescriptions. In identifying short-term and long-term states we have included underlying asset structures within the assessment of viability which are affected by these changes in policy and the inherent incentives to remain in farming.

The chief findings however, are that focusing on diversification offers a trajectory towards viability. Mixed levels of production lead to more viability, which implies inter-farm dependancies between crop and animals, and reduces the need to purchase inputs and may create higher incomes for farmers in these farms. In addtion, farm diversification, into non-agricultural activities, also creates a pathway for becoming more viable.

Whilst we could explore two aspects of diversification we are limited in exploring off-farm activity, as the spatial unit of interest is the farm itself. Hence pluriactivity is not included in our definition which could also be a predictor of viable status amongst these farms. We are also limited by the time frame of study, as only in recent years have detailed data been collected on activities which would adequately widen our definition of farm diversification, that is including processing activities. This emphasises the temporal nature of definitions within Government data sources of diversification, reflecting in part the changing nature of the farming system these data aim to reflect. Nevertheless, the likelihoods of farm diversification predicting viability seems to fit within the current literature on viability at the farm level. Further work should seek to compare data sets, definitions of agricultural diversification and results across wider sets of countries in order to compare these findings.

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