An analysis of wealth and viability of the Scottish agricultural sector

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Executive Summary

It is pertinent to discuss the viability of Scottish farming to understand how resilient farmers may be to future shocks due to market prices and changes in policy. As we move to leave the European Union Common Agricultural Policy, there are opportunities to explore newer arrangements and protocols for promoting sustainability within the rural economy.

Viability embodies this concept by using a threshold to determine whether farming incomes operate above or below the level of a minimum hourly wage and thus infer farmer well-being to determine business planning. However, farming offers a range of non-pecuniary benefits when attempting to compare with other sectors of the economy. Moreover, the ownership of land and the accumulation of this land over successive generations provides an accumulation of capital which may influence farmer well-being and approaches to risk taking. In addition, for tenanted farmers the acquisition and management of livestock and investment into machinery assets may also provide source of liquid assets which are not easily compared with other sectors of society.

With this in mind this report presents a number of approaches to study and compare the viability of the industry. We include proxies for the underlying wealth of the industry in determining its viability status. We analyse a sample of Scottish farms over the period 1989/90 to 2015/16 who provide detailed information into the Farm Business Survey.

Firstly we present a discussion of the issues around incomes and wealth and map general trends by owner-occupier and tenanted farmer status. Land and buildings provides a significant tranche to total assets at farm level and this does determine differences across the different ownership categories but nevertheless do fluctuate as farming weathers the bad years and accommodates the better years within the farm management account.

Secondly we apply a threshold, in this case a minimum wage rate per hour, to impute the viability of the farm in the short term (inferred by cash income) and the long term (inferred by net farm incomes. The converse of asking how poor farmers are is to ask how rich farmers are and we provide a further indicator, referred to as ‘wealth-adjusted’ viability, which tries to accommodate these factors. Hence, a series of states can be identified for each farm and for each year, ranging from viable to non-viable. These are mapped across farm types finding remarkably similar trends and issues other arable and livestock sectors.

Thirdly we ask how do transient is non-viability for the farm, through looking at the persistence of a farm being in one state, e.g. long-term non-viable, over a number of years. We find high probabilities for farms remaining in a particular viability state over the period which infers some level of persistence of non-viability status. To explore this further we examine the key drivers such as policy change, farmer factors such as age, education and farmer attitudes towards farming, biophysical disadvantages and other effects. We find a number of these factors significant in determining viability status and more (entrenched) characteristics, such as owner-occupation, land quality and remoteness, are significant it is notable that others such as education and, even farmer attitude, are also significant in determining the state of viability of the farm economic outcomes.

Finally, we examine inequality through simple indicators of the spread of income across the sector as whole and by ownership category, finding that inequality in incomes has increased and that tenanted farmers experience more inequality than owner occupiers, potentially indicating inability to accommodate market shocks compared to owners of land. We also examine by size, finding that inequality has grown the FBStest in larger farms, as they grow and potentially intensify their operations. Smaller farms show more fragility towards market pressures and, in the period 1999-2007 tended to move to more equality in incomes as incomes generally dipped for the farming population.

In terms of informing policy we find the following:
Viability is persistent; Non-Viability is more transitory, within Scottish farming. This reflects the variability inherent in agricultural production and implies that, for a range of farms, policy support incomes does not negate these shocks. Arguably, the presence of an income support subsidies negate the perceived need by farmers to invest in insurance schemes, is simply a matter of farmers not being aware of risk management tools or the tools on offer are not tailored for these farmer needs. This may provide some dialogue for future policy thinking towards farmer incomes.

Patterns of non-viability are similar across different sectors. We found similar effects of bad years on both arable and livestock sectors. At this general level it would seem that there are non-differences across farm types and they all, whether they be upland livestock or lowland beef farms, face periods of non-viability.

Transitions into and out of viability are driven by fixed and variable factors. We use a number of novel indicators to understand what drives viability. Some of these are fixed, such as remoteness and biophysical disadvantage, however some relate to farm management decision making, such as level of off-farm income and profit-orientation attitudes, as oppose to multifunctional attitudes or what we refer to as satisficing, that is maintaining a stable income for themselves and farm families.

Examining wealth is pertinent to agricultural support but difficult to measure. Ultimately, with our accounting system, we will never fully measure farmer wealth, due to the relationship between agricultural activities (fully accounted for) and non-agricultural activities (not accounted for fully). In addition, there are other dimensions of wealth such as the non-pecuniary effects of satisfaction from farming, low travel to work times and further natural capital stored within particular systems.

Inequality in Scottish farming has increased. Our period for analysis covers 1989 to 2015/16. Over that time a series of industry and sectoral level policies have been promoted to support incomes on farms. This is driven by inequalities in tenant farming, potentially due to the effects of market shocks affecting these farms’ sustainability over this period, but also by farm size where some farms have grown in size and led to more inequality in farming income.
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1.0 Introduction

The Common Agricultural Policy (CAP) held fair incomes at its inception as a guiding principle. A rationale for intervention, through subsidy support under the CAP, is the low income profile of farmers. Through a series of interventions which have progressively diversified support mechanisms for income support, since 2003 the support for income has been effectively decoupled from production and focused on redistribution.

Present discussion around the reform of the CAP has focused on risk management solutions to protect farm business incomes from the random perturbations within production, such as crop insurance and disaster management programmes.

If an income support policy were to be integral to a British Agricultural Policy post-exit from the EU, which should be nuanced to Scottish farming conditions, the focus must be on maintaining the resilience of the industry to external shocks. However, resilience is complicated by the concept of farmer wealth which has been understudied in the literature when discussing resilience but would, along with succession, determine long-term robustness to shocks, as would off-farm income and pluri-activity.

The purpose of this report is to examine viability of the Scottish Farm sector, as a means to understand resilience, and advance the debate further by inclusion of wealth metrics to understand how long-term survival of these businesses could be estimated.

What is Farm Viability

Farm viability can be defined as the “farm household that receives enough income from all sources to cover minimum family living expenses, cash farm operating costs and capital replacement costs at the same time as it improves its net worth by making scheduled principal payments on its debts” (Salant et al, 1986). Viability underlines the evolution of a system to defined constraints (Aubin et al., 2011).

Financial viability defines the ability of a business entity to continue to achieve its operating objectives and fulfill its mission over the long term. Implicit within this definition is the capacity of business entities to meet their operating expenses and financial obligations and also, if this matches business objectives, to accommodate growth within the business enterprise.

Very few studies have used longitudinal data to analyse the micro-dynamics of farm incomes. In particular, a number of previous studies (e.g. Hegrenes et al., 2001, Meuwissen et. al., 2008) have provided evidence of considerable volatility in individual farm incomes, thereby emphasising the importance of using multiyear average data to draw meaningful conclusions about the living standards of individual farmers. Phimister et al. (2004) further explore the impact of the movements of farms within the income distribution on the persistence of poverty in Scottish agriculture, building on an older tradition of modelling exchange mobility within agriculture using transition matrices (see e.g. Meuwissen et. al (2008) for a recent example).

Vrolijk 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 zero. They then tested this further by including opportunity costs, reflective of income foregone, set at local interest rates for 10 year government bonds, to classify farmers into different viability types. Accordingly, this multi-period element needs to be considered within any index of viability and we propose two interchangeable indicators to accommodate the effect of farm-level decision-making and response to variability, that is short-term and long-term viability. Barnes et al. (2015) examined the influence of diversification on viability derived from the Scottish Farm Account Survey, finding that diversification does lead to viability of these enterprises. Allanson et al. (2017) complemented this work by proposing a measure of the extent to which incomes are equalized over the longer term that captures the distributional impact of transitory shocks about expected equilibrium incomes rather than about multiyear average incomes. They found that whilst policy shocks occurred (i.e. moving to
decoupling) and economic shocks (i.e. price spikes in 2008/09) these had transitory effects on inequality and, over a short time frame returned to pre-shock levels. This has implications for understanding viability as, whilst these studies use short and medium term indicators, namely cash income and net farm income, as key descriptor variables, more longer term indicators are needed. This is especially so in farming where land ownership provides a basic accumulation of capital over time and the popular phrase ‘cash poor asset rich’ is applied to farming. Whilst Net worth is mentioned in these studies they were not explored further. Net worth can be seen as a proxy for wealth accumulation (Mishra, 2002) as it indicates the accumulation of capital after the removal of debts.

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 being viable to non-viable as well as the subsequent consequences of consistent under-performance within the sector. Frawley and Commins (1996) provide a useful definition in that viability is determined by comparison with minimum agricultural wages but also the capacity to provide an additional return on non-land assets (as a means to infer wealth).

Studies within the farming enterprise (Vrolijk 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 temporal element to accommodate these fluctuations in financial viability.

**Measuring wealth and viability**

Viability should be measured before subsidies are received as the rationale of viability is to inform on the distribution of incomes before support is received. Indeed metrics of viability can be used to inform whether subsidy is directly targeted.

Concerns around farm viability solely based on low farming income have been debated by a number of economists (e.g. Ahearn et al., 1993; Hill, 1982; Salant et al., 1986). Mishra et al. (2002) and Hill (2012) argue that low income farmers, especially those on owner occupied farms, may hold substantial wealth on farm which should be included in determining farm viability.

Hill (1982) has suggested using an annuitisation formula, that is, calculating an annual flow of benefit from each asset to be included in within the total income of the farm. More recently, Hill (2012) claims that a meaningful comparison between farm incomes must accommodate wealth. The selection and valuation of the farm assets to be included as farm wealth however, depends on the context of the study and availability of data. Wealth, as measured by Mishra et al. (2002) allocates changes in net worth from both farming and non-farming sources, such as pension funds and returns from shares available with US sources of farming accounts. However Agra CEAS (2007) point out the current constraints and economic costs for adequate data collection to fully reflect these dimensions of income within European farm accounting systems. A common approach is to simply add a 5% return to non-land assets for determining farm viability (Dillon et al. (2010); Frawley and Commins (1996); Hennessy and O’Brien (2006) and Hennessy et al. (2008). However, we employ the methods of Mishra to derive changes in net worth from both farming and non-farming sources to understand viability further.

As such what follows is structured as i) indicators of viability of these enterprises both short-term and long term, including wealth, ii) how this affects income inequality once a proxy for wealth is including and iii) causal inference on wealth accumulation at the farm level, such as accommodating for biophysical disadvantage.
Methods and Data

The Farm Business Survey (FBS) potentially provides a rich source of information for the analysis of efficiency since farms, once recruited, can stay in the survey for an unlimited length of time (Scottish Government, 2013; Allanson et al., 2017). The FBS is an annual survey of about 500 full-time farms carried out on behalf of the Scottish Government and provides the main source of microeconomic data on farm businesses in Scotland. The farms in the survey are chosen randomly to be representative of their size and type, where the economic size of the business is measured in terms of standard gross margin prior to 2003/04 and standard labour requirement thereafter, and the farm type classification is based on the relative importance of the various crop and livestock enterprises in terms of standard gross margin.

We measure agricultural viability in three ways

Short 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 not including subsidies. This viability is measured based on exceeding an hourly minimum agricultural wage rate (O’Donoghue, 2013; Phimister, 1995). Cash income includes income from farm-diversification and off-farm income (e.g. off-farm employment and other business-holdings). Given the rationale for agricultural support it would seem logical to remove off-farm income as it is difficult to attribute this within a farmer decision making model. Off-farm income is 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 on the farm and then compared to the minimum agricultural wage rate for each year. This is set annually by the Scottish Agricultural Wages Board¹ and reflects the minimum gross wages payable to agricultural workers.

Long-term Viability: Medium 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, adjusted for imputed labour and rent. Accordingly, it provides a longer term return, than cash income alone, by including fixed assets. This was divided by the annual hours worked by the farmer and spouse and then compared to the minimum agricultural wage rate for each country in that year.

Wealth-based viability: We use closing net worth as the key metric for wealth accumulation at the farm level. This is calculated on a farm activity basis. It does not include off-farm investments, aside from a euro account which accommodates payments of agricultural subsidies. However, this includes land capital valuations. Property values constitute a large proportion of Net Worth for owner occupiers and can constitute a high return to a small number of producers. This is shown in figure 1 below, which is known as a quantile plot, which ranks the levels of closing net worth across the farmers in the FBS. It indicates the value of wealth held, imputed by closing net worth, which grows slightly across the population and then, for the final 5% begins to rise sharply. This infers inequality in wealth distribution.

¹ http://www.gov.scot/Topics/farmingrural/Rural/business/18107
Figure 1. Distribution of closing net worth for Scottish farmers in the Farm Account Survey, all years (£2010).

Even so, returns to property are invariably relatively low for most owners but values are resilient and potentially inform decision-making at farm and wider level. Consequently, this indicator varies for land owners and tenants, as a means to accommodate these land based services, which effectively are not part of agricultural production.

Unlike the income based comparators it is not intuitive to compare wealth adjusted viability with a minimum standard agricultural wage, i.e. in terms of a return per hour, against a threshold comparator. There is much debate around what would be the fairest comparison of farm wealth against non-farm wealth (Hill, 2012) as alternative investments, e.g. stocks and shares, reflect different ranges of risk acceptance and this may not be appropriate for the farming population. Generally, we could argue that capital accumulation over the farm is somewhat inherent and potentially accidental given intergenerational transfer of assets within the farm holding, as well as providing asset lock-in effects for determining production potential (Latruffe and Mouël, 2009). There is a strong argument therefore that land (which composes the bulk of net worth growth) is a low risk asset and should be compared as such with external investments to derive a comparator. Accordingly, the main comparator for viability, given the risk profile of Scottish farmers, is to compare against a low risk investment (indexed savings, namely if money were invested in ISA and related safe products) than a higher risk investment (namely the FTSE 100) (See Appendix 1 for further illustration and justification for this approach)
3.0 The Viability of farm enterprises

What follows are indicators from the Farm Business Survey of farm distribution across a range of thresholds of viability, as discussed above. These are the summed totals of farms within the analysis and presented as proportions of the total numbers of farms by farm type.

The proportions represent those farms in each year who are:


Short-term Non-Viable: The proportion of farms who are long-term and wealth viable but fail short-term (cash income) thresholds.

Long-term Non-Viable: The proportion of farms who fail long-term (Net Farm Income), but maintain short term thresholds.

Non-Viable: The proportion of farms who fail long-term (Net Farm Income) and Short term (Cash Income) thresholds.

Wealth Non-Viable: The proportion of farm who fail all (short, long, wealth related) criteria for viability.
Figure 4a. The distribution of Viability for Specialist Cereal Farms, cumulative percentage
Figure 4b. The distribution of Viability for General Cropping Farms, cumulative percentage
Figure 4c. The distribution of Viability for Specialist Dairy Farms, cumulative percentage

- Wealth Non-Viable
- Non-Viable
- Short-term Non-Viable
- Long-Term Non-Viable
- Viable
Figure 4d. The distribution of Viability for LFA Cattle and Sheep Farms, cumulative percentage
Figure 4e. The distribution of Viability for LFA Cattle Farms, cumulative percentage
Figure 4f. The distribution of Viability for LFA Sheep Farms, cumulative percentage

- Wealth Non Viable
- Non-Viable
- Short-term Non-Viable
- Long-Term Non-Viable
- Viable
Figure 4g. The distribution of Viability for Lowland Cattle and Sheep Farms, cumulative percentage
Figure 4h. The distribution of Viability for Mixed Farms, cumulative percentage
Clearly some sectors, such as General Cropping have a higher proportion of viability than others, however there seems little differences that can be drawn from across the farm types. Hence, Table 1 below shows the descriptors for all farms in the FBS comparing 2000 with 2015.

Table 1. Mean descriptors for different viability classes (2000 and 2015), £2010 and percentage within the FBS

<table>
<thead>
<tr>
<th></th>
<th>Viable</th>
<th>Short-Term Non-Viable</th>
<th>Long-Term Non-Viable</th>
<th>Non-Viable</th>
<th>Wealth Non-Viable</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Farms (%)</td>
<td>2000</td>
<td>28%</td>
<td>6%</td>
<td>46%</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>2015</td>
<td>33%</td>
<td>3%</td>
<td>40%</td>
<td>7%</td>
</tr>
<tr>
<td>Share of total value of production</td>
<td>2000</td>
<td>28%</td>
<td>17%</td>
<td>26%</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>2015</td>
<td>26%</td>
<td>26%</td>
<td>20%</td>
<td>14%</td>
</tr>
<tr>
<td>Subsidy to total rev</td>
<td>2000</td>
<td>69%</td>
<td>76%</td>
<td>62%</td>
<td>83%</td>
</tr>
<tr>
<td></td>
<td>2015</td>
<td>53%</td>
<td>48%</td>
<td>39%</td>
<td>45%</td>
</tr>
<tr>
<td>Farm size (Ha)</td>
<td>2000</td>
<td>397</td>
<td>763</td>
<td>277</td>
<td>359</td>
</tr>
<tr>
<td></td>
<td>2015</td>
<td>441</td>
<td>265</td>
<td>282</td>
<td>281</td>
</tr>
<tr>
<td></td>
<td>2015</td>
<td>49,445</td>
<td>-13,294</td>
<td>4,968</td>
<td>-6,000</td>
</tr>
<tr>
<td>Share of off-farm Income to total revenue</td>
<td>2000</td>
<td>29%</td>
<td>27%</td>
<td>24%</td>
<td>41%</td>
</tr>
<tr>
<td></td>
<td>2015</td>
<td>17%</td>
<td>17%</td>
<td>19%</td>
<td>21%</td>
</tr>
<tr>
<td>Family Labour (No.)</td>
<td>2000</td>
<td>1.3</td>
<td>1.9</td>
<td>1.5</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>2015</td>
<td>1.5</td>
<td>1.9</td>
<td>1.5</td>
<td>1.3</td>
</tr>
<tr>
<td>Age</td>
<td>2000</td>
<td>54</td>
<td>53</td>
<td>56</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>2015</td>
<td>55</td>
<td>60</td>
<td>57</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>2015</td>
<td>1,399,805</td>
<td>1,262,335</td>
<td>1,248,932</td>
<td>875,145</td>
</tr>
<tr>
<td></td>
<td>2015</td>
<td>1,152,245</td>
<td>1,241,172</td>
<td>1,077,711</td>
<td>822,194</td>
</tr>
</tbody>
</table>
4.0. The transitions into and out of viability

What does it mean to non-viable?

The transitions into and out of viability

The thresholds for short and long-term investments are related to minimum wage, however unlike other sectors a series of pecuniary benefits emerge from farming, principally through land ownership. Lack of land ownership, but investment, through livestock for example, also provide some support for retirement from farming. Nevertheless, non-land owning farmers are closer to poverty than land owners and there should be some discrimination in what follows when understanding the persistence of non-viability on living standards and, of course, well-being within the farming community. Hence the wealth based non-viability measures attempts to capture some of this dimension.

Table 2 shows the transition probabilities between different classes of viability. Effectively this shows, for those in the FBS, the probability of shifting from one class of viability to another from one year to the next. Hence if a farm is viable in one year (year 1) there is a 76% chance of that farm remaining viable in the next year (year 2); a 12% chance of being short-term non-viable, reflecting the short term nature of this state; a 51% of staying long-term non-viable; a 45% chance of remaining non-viable; and a 49% chance of remaining wealth based non-viable.

Table 2. Markov transition probabilities of viability classes, 1990-2015 for Scottish farming

<table>
<thead>
<tr>
<th>YEAR 1</th>
<th>YEAR 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Viable</td>
</tr>
<tr>
<td>Viable</td>
<td>76%</td>
</tr>
<tr>
<td>Short-Term Non-Viable</td>
<td>54%</td>
</tr>
<tr>
<td>Long-Term Non-Viable</td>
<td>28%</td>
</tr>
<tr>
<td>Non-Viable</td>
<td>8%</td>
</tr>
<tr>
<td>Wealth Non-Viable</td>
<td>7%</td>
</tr>
</tbody>
</table>

Accordingly, for most viability classes there is some persistence with respect to remaining in a particular classes. This reflects a number of dialogues raised before by agricultural economists, principally due to the ‘asset specificity of farming’ and the ‘lock in’ effect of owning non-liquid assets which determines the ‘sticky’ transitions observed here. A caveat to the above tables is that this is presented at an industry level and over the full-time frame. There will be differences across farm types but, perhaps also between owner occupied, tenanted and other states of management. These differences are explored below.

Explaining farms going in and out of viability

As means to explain the drivers behind viability it is worth exploring why individuals enter a particular state and what determines their exit. For us, this means the length of time in which a
farm remains viable and non-viable. Some farms will remain non-viable (0 in the figure below) for sustained periods, whereas others will for non-viable for only short spells of time (Figure 5). Hence, applying this approach to understand viability for Scottish farmers seems appropriate.

Figure 5. Selected farm pathways within Viability and Non-Viability, 2000-2016

Understanding individual spells of viability is explained by a number of variables, thus policy and market drivers will determine the CAP payments, but also personal factors such as succession of the farm, as well as biophysical constraints and remoteness constraints.

In order to explore this further we use an survival analysis framework was used, as the categories reflect ordered groups from viable to wealth adjusted non-viable classes. A range of indicators were used pertinent to developing the Scottish farm sector further.

These are explained below and presented as odds ratios for ease of interpretation. Simply put, if the odds ratio is over 1 it has a positive effect on viability, and if below 1 it has a negative effect on viability.
Table 3. Estimates of Regression across viability classes, odds ratios and significance values

|                                | Odds Ratio | Std. Err. | P>|z| | Sig |
|--------------------------------|------------|-----------|-----|-----|
| Owner Occupier                 |            |           |     |     |
| Tenanted                       | 0.804      | 0.05      | 0.00 | ***|
| Mixed                          | 0.564      | 0.12      | 0.01 | ** |
| Manager                        | 0.883      | 0.05      | 0.03 | *  |
| Farm Diversification Income    | 1.597      | 0.17      | 0.00 | ***|
| Agricultural Diversification   | 1.081      | 0.06      | 0.14 |     |
| Attitude Class 1: Multifunctionalists ± |    |           |     |     |
| Attitude Class 2: Satisficers  | 0.846      | 0.05      | 0.00 | ** |
| Attitude Class 3: Profit Orientated | 1.430 | 0.08      | 0.00 | ***|
| Land Disadvantage φ            | 0.991      | 0.00      | 0.00 | ***|
| Stocking Density               | 1.007      | 0.01      | 0.54 |     |
| Area                           | 1.000      | 0.00      | 0.00 | ***|
| Succession †                   | 1.061      | 0.06      | 0.33 |     |
| Farmer Age                     | 1.005      | 0.00      | 0.01 | ** |
| Agricultural Education         | 0.881      | 0.05      | 0.02 | *  |
| Rate of Subsidy to total revenue | 0.893 | 0.06      | 0.09 | ***|
| SFP                            | 0.596      | 0.05      | 0.00 | ***|
| Remote Small Towns             |            |           |     |     |
| Accessible Rural               | 0.929      | 0.05      | 0.16 |     |
| Remote Rural                   | 0.770      | 0.06      | 0.00 | ***|
| Time trend                     | 1.070      | 0.01      | 0.00 | ***|

φ a weighted index of land classification based on area of LCA within each land class developed by Barnes et al (2016).
† identified by a drop in the age of the farmer within the FBS id.
± In 2013 we included a behavioural model and estimated three types of farmer operating within the FBS. The full methodology is described in Barnes et al., (2017)

Overall, determining more viable status are owner occupiers, relative to other management structures. In addition, farm diversification, which is the total amount of income received from non-farming production activities, such as cottage rentals and contracting. Agricultural
diversification, which relates to the level of specialisation on the farm is not significant for determining viability.

The attitudinal and motivational aspects of farming are captured through a unique module collected on farmer objectives and attitudes towards farming. A latent class clustering approach was used to determine three classes of farmer based on their responses and clearly a profit orientated farmer is more likely to be viable than those identifying with those either getting by, referred to as satisficers and those with a more multifunctional approach, namely those who weight agri-environmental concerns more highly.

Land quality is determined by a coupling of the FBS to land use data. A report on the ANC was produced by Barnes and Thomson (2016) outlining their approach to producing an index of disadvantage. Here we see that the odds ratio is below 1, indicating, as we would expect, that those operating on lower quality land tend be more likely to be in non-viable states.

Farmer age is positive, namely as farmers become older they are more likely to be more viable, which may be a composite of accumulation of assets and knowledge of farming systems. Agricultural education is defined as those taking post school higher qualifications in an agricultural subject. It is therefore compared to school only and non-agricultural education but is lower than one, indicating this tends to lead to non-viability, perhaps reflecting inheritance and asset specificity issues raised earlier. The rate of subsidy to total revenue is significant and lower than one, as is the transition to the single farm payment. A higher ratio of subsidy reflects a high reliance on subsidies, due to low incomes, though for a small percentage of the farming population, a larger subsidy payment in conjunction with lower agricultural activity through rental agreements. As the odds are lower than one it reflects the former, as with the inclusion of subsidies these businesses are still non-viable. The SFP variable reflects the change in payment regime and this is also below 1 and significant, indicating it had a negative effect overall on viability of the industry and subsequently led to destocking as a response to the payment regime.

Whilst we don't know where these farms are, they are classified under the Scottish Government's Rural-Urban classification and, compared to those farms in and around small towns, the more remote these farms are then the more likely they are to be non-viable. This would seem to make sense as additional transport costs, coupled with biophysical disadvantage was an argument for payments under the LFAS scheme as a means to support incomes.

Finally, a time trend is added to the date to capture whether the viability situation has changed over the years from 1989 to 2016. This is above 1 and significant. Consequently, it infers that, on the whole, the viability of the industry has weakened over the last 25 years.
5.0. The spread of inequality

Following that viability of the industry has weakened since the 1990s it is worthwhile examining how the spread of inequality has changed. Measurement of inequality is fairly simple when we have individual income data as the measurement metric (known as the Gini coefficient) can measure where each farm is relative to the total. This is shown below for net farm income between 1989 and 2016. The farms on the left are the low income farmers and it shows that for 2016 there is a fall in incomes for 30% of the population, compared to only 10% in 1989. The right-hand side shows that there is a clustering of farms who report higher net farm incomes from £70,000 upwards for the 10% of the FBS in 2016, compared to 5% in 1989. Hence the distribution of inequality has changed with more farmers in 2016 being less equal than those in 1989.

Figure 6. Quantile plot of net farm income for Scottish FBS farms, selected years

<table>
<thead>
<tr>
<th>1989</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram 1989" /></td>
<td><img src="image2.png" alt="Diagram 2016" /></td>
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</tbody>
</table>

Examining these data it may seem that inequality has increased, however these are selected years. Below is the table of the Gini coefficient for a number of categories of farm types for net farm income over the years of the study. In order to interpret this if there is a coefficient of 0 then all farms share the same income, if the Gini were 1 then only one farm would hold all the income. Consequently it is desirable, from a social distribution perspective at least and arguably under the rationale of CAP support, that there be a fairer distribution of incomes.
Clearly as a whole the Gini coefficient has risen, with respect to farm incomes from 0.46 to 0.53 over the whole period. This means that the industry itself has become more unequal in distribution of incomes. What is noticeable from the scatterplot is the variance over the period of the Gini coefficient within each year. It seems to fluctuate between 0.42 to 0.53 and shows that income shocks will have a short term effect on the distribution but these tend to dissipate over a number of years (Allanson et al., 2017).

Taking the two populations of ownership separately we find some differences due to management structure, with tenanted farmers experiencing more of an upward trend than owner-occupiers, indicating higher inequality within this group than owner-occupiers and potentially reflects the greater fluctuations in income experienced by non-owner occupiers compared to those who own land.
The final figure splits income by size of farm and shows clear differences over the period with the greatest rise in inequality with large farms, followed by medium farms. Notably smaller farms, those less than 50 Ha have a more dispersed trajectory when it comes to inequality. The bad financial years of the later 1990s to the late 2000s tend to have depressed incomes and thus led to greater equality (the Gini coefficient is lower), but then begins to return to earlier levels as we seen more restructuring in the industry.

Figure 9. Gini coefficient by size of farm, 1989-2016
6.0. Conclusion

Income support schemes typify European agriculture and in order to inform a British, or even Scottish, Agricultural Policy it seems pertinent to examine how incomes have been affected from policy for a number of social issues, namely the standards of living of farmers and equality of incomes within farming. All these contribute to farmer well-being and ultimately their approach to farming with respect to investments, seeking new skills and creating innovative practices.

**Viability is persistent, Non-Viability is more transitory, within Scottish farming.**

Using a balanced approach to assessing transitions allowed us to examine how each individual farm performs throughout their time in the FBS and we find that farms do switch between viability states, i.e. with periods of viability and non-viability. This reflects the variability inherent in agricultural production and implies that, for a range of farms, policy support for incomes does not negate these shocks.

Recent discussion at EU CAP level has focused on risk management tools, either through agricultural support or how farmers can voluntarily adopt these measures, such as forward contracts and insurance. Arguably, the presence of an income support subsidy negates the perceived need by farmers to invest in insurance schemes, or is simply a matter of farmers not being aware of risk management tools or that the tools on offer are not tailored for these farmer needs. This may provide some dialogue for future policy thinking towards farmer incomes.

**Patterns of non-viability are similar across different sectors.**

Previous to this research we would have thought that different sectors have different challenges, however we found similar effects of bad years on both arable and livestock sectors. It may be that this requires a more fine grained approach, such as examining different farm sizes or ownership classes per farm type to tease out any differences. Nevertheless at this general level it would seem that there are similarities across farm types and they all, whether they be upland livestock or lowland beef farms, face periods of non-viability.

**Transitions into and out of viability are driven by fixed and variable factors.**

We use a number of novel indicators to understand what drives viability. Some of these are fixed, such as remoteness and biophysical, however some relate to farm management decision making. Taking a whole farm approach we can include farm diversification activities within the assessment of net farm income and the proportion of income from these activities does promote viability within the farming enterprises. Moreover, farmer objectives are critical to understanding viability and if farmers are more profit-orientated then it would be expected that they would be more viable.

This emerges from our study of farmer attitudes and motivates and we find three types of farmer, all of which may be valuable for future discussions within policy reform and what we expect from farmers. We found profit-orientated farmers, multifunctionalists, who balance agric-environment and profit goals equally and satsifiers. This latter group tend to have wider social motives, related to sustaining a farm income for themselves and the families they employ. Hence, a more social orientated policy would focus on this type, whereas support for agri-environment will appeal to multifunctionists. That debate is beyond our remit, nevertheless if supporting incomes is a major tranche to future policy then profit-orientated farmers need to be promoted, arguably not through direct subsidy, but through access to training and support for risk taking to ensure innovation emerges from within the sector.

**Examining wealth is pertinent to agricultural support but difficult to measure.**

Ultimately, with our accounting system, we will never fully measure farmer wealth, due to the relationship between agricultural activities (fully accounted for) and non-agricultural activities (not fully accounted for). This is difficult from a process perspectives, for example a farm shed
is an asset but may be used for a multitude of activities, from storing bales to craft beer brewing. Off-farm incomes and investment activity is an important source of wealth creation for a number of farmers and yet, without fully accounting for these activities, we can never truly know how wealthy some farmers are. Neither can we know how the well-being from off-farm wealth affects decision making at the farm level. Hence, research is needed to understand these trade-offs in farmer decision making to truly understand how wealth affects decision-making.

Inequality in Scottish farming has increased

Our period for analysis covers 1989/90 to 2015/16. Over that time a series of industry and sectoral level policies have been promoted to support incomes on farms. We find that, at least within the FBS sample itself which covers 500 farms, inequality has grown. This is driven by inequalities in tenant farming, potentially due to the effects of market shocks affecting these farms’ sustainability over this period, but also by farm size where some farms have grown in size and led to more inequality in farming income. Hence, whilst this may be seen as a good thing, reflecting commercial sense and expansion to manage potential market shocks, if a future policy focused on social equity within farming it would need to learn from the lessons in redistribution of incomes from previous policy change.
Appendix 1: Choice of Wealth Comparator and trends in wealth

In order to identify an appropriate comparator to wealth we must identify an appropriate match reflecting a similar level of risk taking to determine a similar return to investment. Figure A1 is derived from the farms in the Farm Business Survey and presented at the mean. Clearly owner occupiers have a higher proportion of land attributed to total asset share than non-owner occupiers. What is also noticeable is the higher rate of borrowing within the tenants and other class, compared to owner occupiers, potentially offering an interesting aspect of risk taking which may be above those in the owner-occupied class. Similarly, for owner occupiers net worth is potentially flat since 2011/12 and this can be explained as the CAP was under transition, through proposals for Greening of the CAP, and associated restrictions on grass and grazing land were first announced in 2011, affecting concerns towards accumulation of land (our last available year is 2015/16 and consequently we can say little on how they have responded to 2015 CAP reforms). This is different to tenants and others (namely mixed farming and management) which does show a more dynamic approach to investment in land. Overall, this picture seems to suggest that owner occupiers, are less risk averse, potentially responding to policy (rather than market) signals, due to the higher asset portfolio inherent in land ownership.

Figure A1. Mean real values for total assets, liabilities, land and buildings and net worth for Scottish farms 2007-2016, (£ 2010)

Given this risk portfolio, figure A2 shows the annual percentage change in returns of closing net worth (as a 5-year smoothed average) against a number of other potential investments. Figure A2 shows the change in annual average yield of a number of potential comparators (along this gradient of risk) where money could be invested in non-farm assets, measured against net worth (named wealth in the figure).
Figure A2. Mean growth in asset based investments, 1989-2016

All series are presented as smoothed 5-year moving averages, with wealth indicating closing net worth for all farms in the FBS. What is noticeable is that at times the growth in net-worth exceeds that of the FTSE100\(^2\), as well as the growth in average UK house prices. Net worth tends to mimic change market and Government policies. What is also noticeable is the rise in net worth of farm businesses since the early 2000s. This accumulated until 2009-2010 and then proceeded to fall through successive bad farming years and uncertainty of the future direction of the CAP, specifically greening measures.

This is presented in more detail for the two ownership categories in Figure A3. This is measured against returns to a low risk investment (indexed savings) and a high risk investment (average return to FTSE 100 shares), both presented as smoothed 5-year averages. Note that this does not represent capital accumulation but the potential yield if money were withdrawn from within this time period, namely in terms of a return to that asset.

\(^2\)These indexes do not include losses due to arrangement and management fees of these funds and consequently for the FTSE 100 index provide a more optimistic picture of individual returns shown here.
Figure A3. Mean percentage annual change in net worth, government gilts and shares 1994-2016. Smoothed 5-year average

Clearly the fluctuation represents the variance in land values, investment and the quality of the stock of total assets at farm level. All investments fluctuate over the longer time period but what is clear is that from 2005 the entitlement to subsidy was created, which becomes a tradeable asset itself. This has a noticeable effect on the value of net worth, as the gains increased substantially, outstripping the FTSE100 (the high risk investment in our scenario). However, since 2011 profitability has been hit by weather effects and weakening prices on average, thus, at this aggregate level, this reflects a number of bad years in farming, as well as unfavourable exchange rates.

Accordingly, the main comparator for viability, given the risk profile of Scottish farmers, is to compare against a low risk investment (indexed savings, namely if money were invested in ISA’s and related safe products) than a higher risk investment (namely the FTSE 100).