A report on Resource Use Efficiency for Scottish Agriculture: trends, causes and constraints

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Report deliverables for RD 2.4.1 Economic Resilience

Contents

Introduction

In order to promote a sustainable agricultural industry farms must be resource efficient. The Reforms of the CAP since the early 1990s have increasingly focused on resource efficiency issues in order to preserve the natural environment and secure greater income stability for Scottish farmers. Scottish agriculture has experienced a range of reforms under the Common Agricultural Policy, but also through changing policies at a sectoral level. Changing prices, costs and land use change through succession have had an influence on forming the current technological and management structure of the sector.

Whilst currently vague, proposals for a post-EU farm sector and possible outcomes in terms of support structures make it critically important to examine the efficiencies within this sector and possible sectoral impacts under future scenarios. This report presents technical efficiency change in Scottish agriculture since 1989 up to 2016. It shows how farm resource use is distributed between farms within a set of farming sectors, but also how farms have grown technologically since 1989. This should inform i) debate around future trajectories for Scottish Agriculture under a baseline scenario, and ii) inform how shocks and perturbations through policy and price are (digested) within the industry at an aggregate level.

What is technical efficiency

Ultimately a farm is a decision making unit. The farm manager allocates resources to maximise a return on some output or accepts trade offs in output to meet environmental goals, e.g. more hedgerows, or social goals, e.g. ensuring a fair standard of living for farm and regular labour families. Technical efficiency is an objective measure of how these input resources generate outputs and generally is the ratio of input to output.

Whereas we can assess partial ratios of input to output, e.g. labour inputs (in hours) to quantity of output, produced (in tonnes) it is more useful to take a whole farm approach as a way to account for the majority of input resources which go into making a particular commodity output, e.g. for a dairy farm the quantity of milk produced will be a function of the amount of labour time used, the amount of capital including land and buildings, as well as the variable inputs used in the production process, such as concentrate feed and veterinary products. Moreover, the farm manager is making decisions at a farm level and is allocating resources as a means to maximising output and profits of enterprises on the farm.

A number of external and internal factors may lead to lower than expected efficiency. The weather and disease are prominent factors, but also much of Scotland experiences biophysical disadvantage as the majority are classified as Less Favoured Area. Moreover over the period of study 1989-2016 policy has changed substantially from one focused mostly on output expansion to one promoting multifunctional outputs and income stability.

This refocusing of policy and support had specific effects on how resources are allocated and, moreover, access to inputs such as land but also other input resources, such as imported feed. This final point is of course driven by local and global prices for commodities and inputs. These can be explored as explanatory factors in determining the level of efficiency observed on a particular farm at a particular time and, hopefully, inform intervention in the sector to promote sustainable economic growth.

Methodology

Data

The Farm Business Survey (FBS) 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). 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.

Estimation

We use an approach known as Stochastic Production Frontiers. This is an approach which allows us to estimate the most efficient performers from observable data and also account for the random variances occurring in farms in any one year, for example due to weather or disease issues. The main inputs and outputs of a farm for each year are used to estimate this allocation of resource. The result of the estimation is the efficiency of each farm within each year, and farms are allocated a score between 0 and 1, where 1 is technically efficient. This represents a 'best practice farm' from the sample. Effectively those farms who are allocating their resources, relative to other farms in the sample, at a more efficient level provide a best practice benchmark – known as the efficiency frontier – by which other farms can be measured. Namely a farm with a score of 0.9 is nearer to the best practice farm benchmarks as a farm with a score of 0.6. Over time the technology is expected to move forward, e.g. as more farmers investing in more advanced kit, and this leads to technical progress for the industry. Moreover, this means that if a farm is a technically efficient benchmark in 2010 it may not be the same in 2016, unless the farmers is continuously allocating resources at an efficient level.

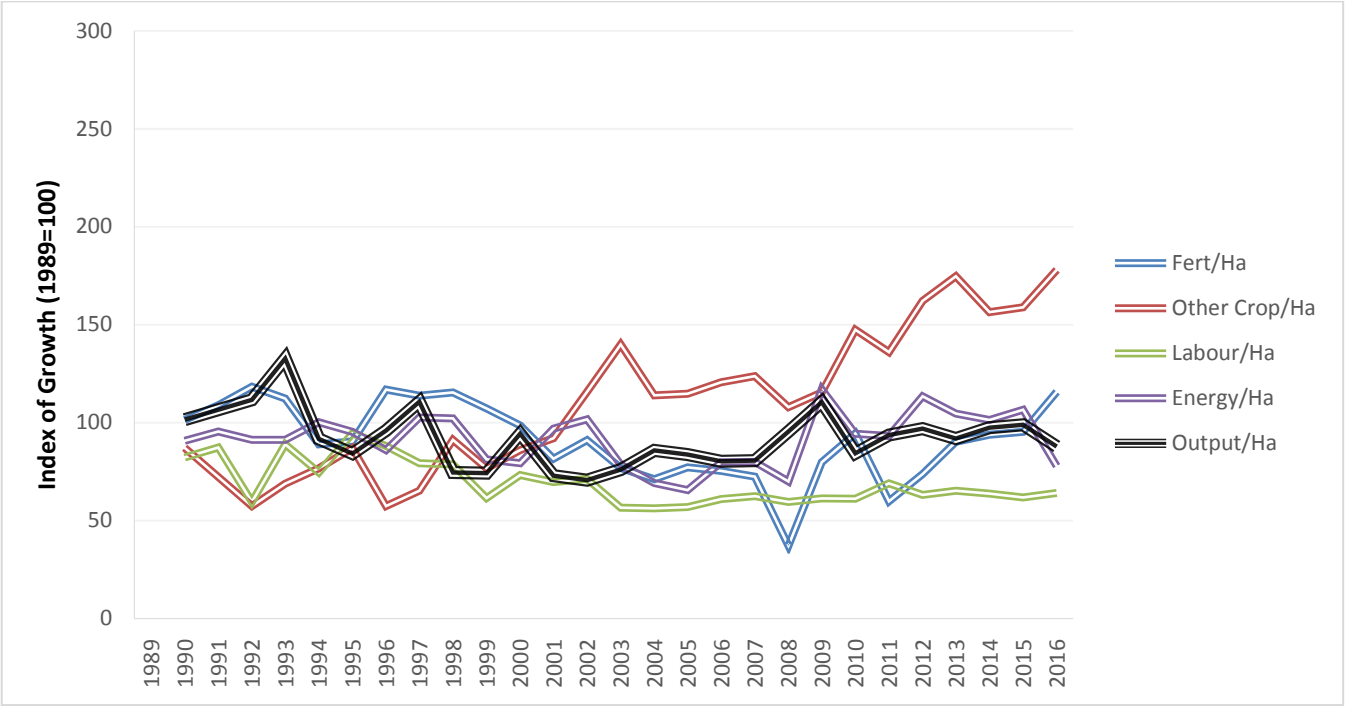
From this approach we can address three main questions, namely:

1) what is the average technical efficiency of a sector
2) have the technical efficiency improved over time (more farms move towards or away from the benchmark frontier)
3) what factors characterise a farm on the frontier compared to one below the frontier

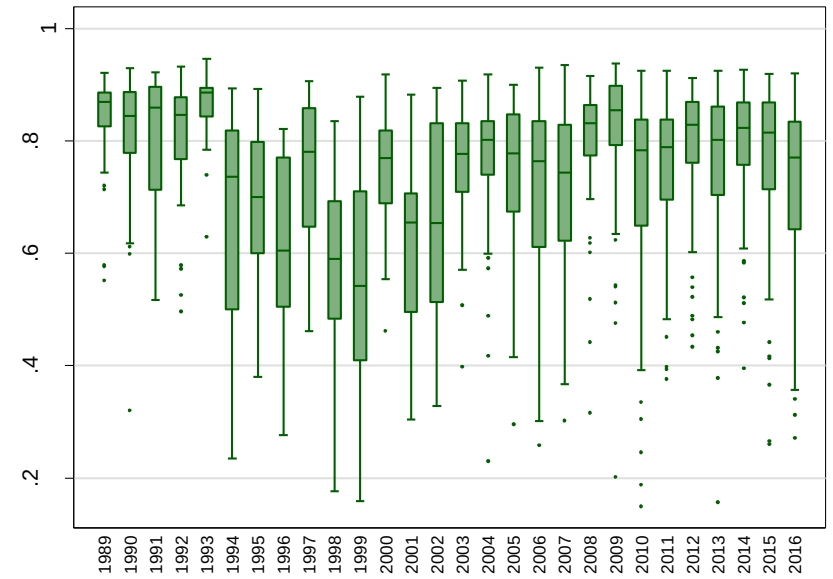
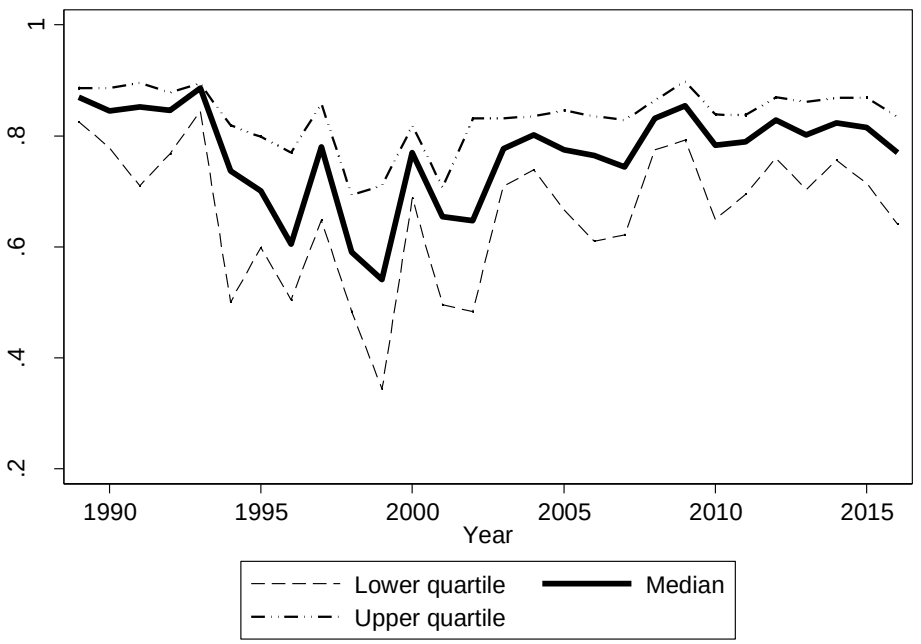
For this approach we must compare 'like with like' and consequently we estimate within the RESAS farm type categories, namely specialist and mixed enterprises in crops and livestock. These are defined as having at least 2/3rds of their income for one enterprise, e.g. cereals production.

What follows are brief summaries and figures for each farm type and some discussing over how these have changed since 1989 and concludes with some key issues for future resource use efficiency in Scotland.

1.0 Specialist Cereal Farms



The figure shows indexes of growth (since 1989) for the cereal farm within the FBS' inputs and output on a per ha basis. They show that output is generally flat with fluctuations in the early 1990s due to policy change, the commodity price spikes of 2008/09 can be clearly seen. Fertilisers and other crop expenses (seeds, crop protection etc.), as well as energy seem to fluctuate with demand and changing prices. Labour is generally downward over the whole-time period.

Distribution of efficiencies within Specialist Cereals Farms	Efficiency gap between efficiency quartiles within Specialist Cereals Farming
	

The figure shows the distribution of farm efficiency across the farms in the FBS (left hand side). The nearest to 1 they are the more technically efficient they will be and the figure shows significant distribution within each year. For example, in 2016 the median efficiency was 0.71, but some farms were estimated at 0.4 or lower. This makes them more than half the resource efficient as the median farms.

The second figure (right hand side) shows the median efficiency with the upper and lower quartiles to demonstrate the efficiency gap, namely for those within the lower quartile it represents the gains that could be made if these farms were to improve efficiencies to the median level. Reduction of these gaps would not only improve the economic position of these individual farms but also improve resource use and sustainability within the sector. Moreover, this represents the lower quartile but the left hand figure indicates a number of outlier farms with significantly lower efficiency scores.

In order to explore this further the table below shows the probability of year on year changes in efficiency of the farms. This takes each farm and compares them over each year of their appearance in the FBS. This shows that if a farm is in the lowest quartile (lower than 0.5 technical efficiency) they have around a 50% chance of remaining in that group and only a 7 % chance of entering the highest quartile. Similarly, those in the upper quartile have around 50% chance of remaining in the upper quartile. This seems to suggest that a range of farms tend to be stuck in the lowest performance categories year on year.

	Year 2				
Year 1	Lower Quartile	Mid-Lower Quartile	Mid-Upper Quartile	Upper Quartile	Mean Efficiency
Lower Quartile	52	25	15	8	0.55
Mid-Lower Quartile	21	36	27	16	0.74
Mid-Upper Quartile	15	25	33	27	0.81
Upper Quartile	7	13	31	49	0.88

The next table shows the average efficiencies for selected periods, covering policy changes, and indicates that with the introduction of Set Aside there was an average drop in efficiency for these farms, which recovered and remained stable throughout the period since the decoupling reforms under the single farm payments.

Av Efficiency	
1989-1996	0.75
1997-2003	0.66
2004-2012	0.76
2013-2016	0.76

Finally the average growth rate (1989-2016) was estimated at 1.63% per annum. This means that the sector has, more or less, adopted newer technologies to push the technology frontier forward for the cereals sector.

2.0 General Cropping

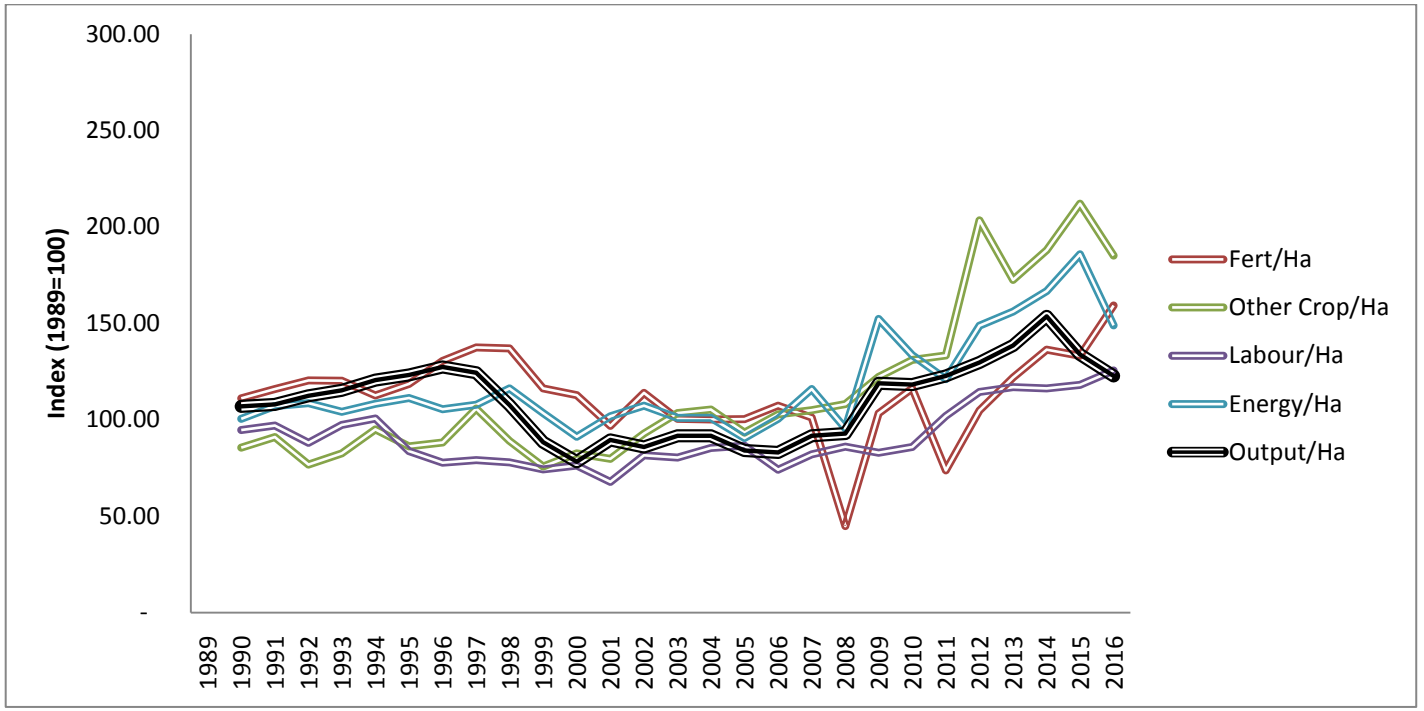
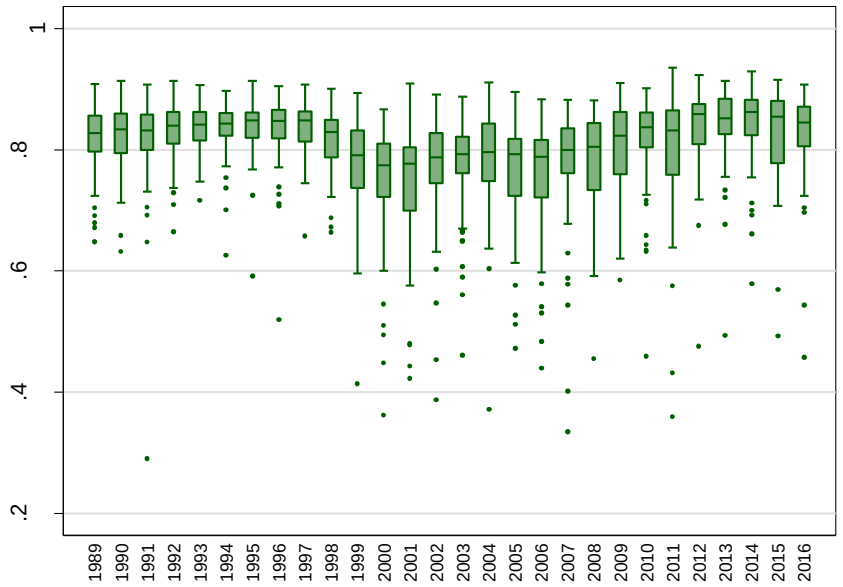
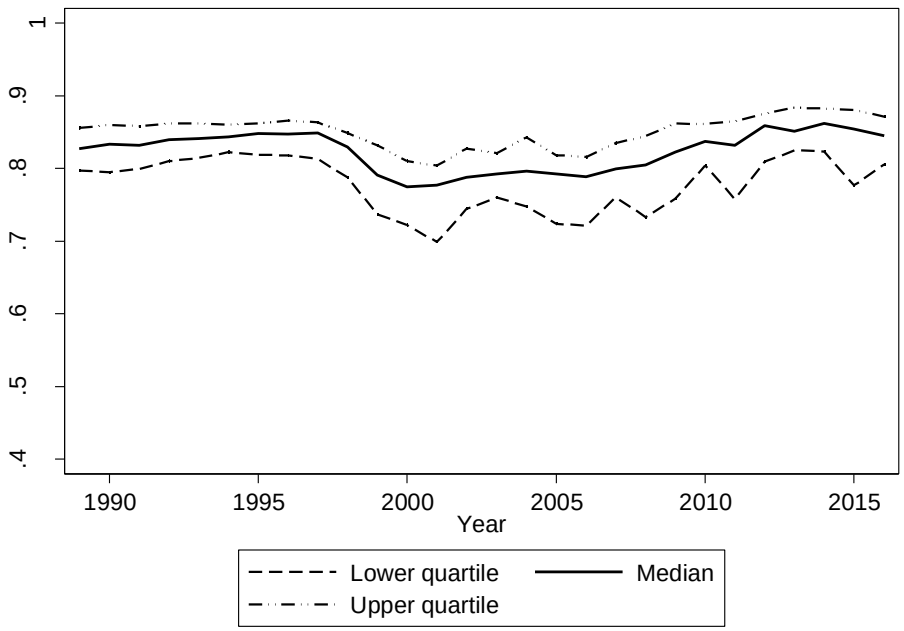


Figure 2 shows the growth rate of inputs to outputs per ha in General Cropping. What is noticeable is that output growth occurs between 1989 and 1996 and from 2008 to 2014 which is tracked by the upwards trends in energy use, agrochemical and other inputs. Similarly, labour (hours worked on the farm), shows an upward trend on these farms.

Distribution of efficiencies within General Cropping Farms	Efficiency gap between efficiency quartiles within General Cropping Farms
	

Unlike Cereals there seem to be less distribution and lower numbers of outliers between efficiency classes. The distribution of scores (left hand side) shows a reduction in median efficiency in the late 1990s to the late 2000s but this is complemented by a widening of dispersion of scores, indicating that whilst there was a general downturn in efficiency some farms maintained their efficiencies. Similarly, in the right-hand side figure, this is demonstrated by the widening of the gap between median and lower quartile performers. From the mid-2000s median efficiency was upward and the lower quartile fluctuates upward also, indicating some element of fragility towards changing economic and weather-related factors.

The table shows the probability of transition and indicates the more entrenched positions of farms, compared to Cereals. If a farm is in the lowest quartile it has a 67% chance of remaining in that quartile in the next year. The converse is true for those on the upper quartile. This indicates that there is a high probability of farms remaining in these quartiles and less chance of shifting efficiency upwards over time.

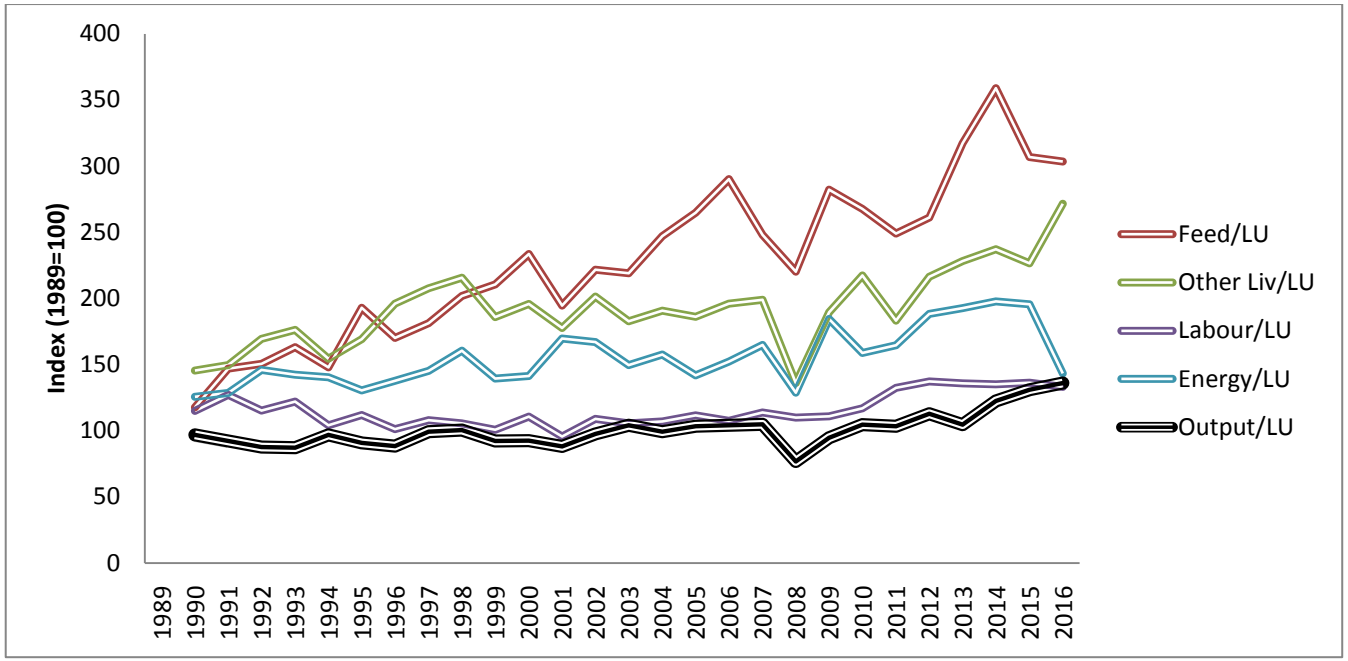
	Year 2				
Year 1	Lower Quartile	Mid-Lower Quartile	Mid-Upper Quartile	Upper Quartile	Mean Efficiency
Lower Quartile	67	23	7	4	0.71
Mid-Lower Quartile	23	42	26	9	0.80
Mid-Upper Quartile	8	25	44	23	0.84
Upper Quartile	5	8	24	64	0.87

Average efficiency growth over specific periods shows that efficiencies were high before 1997 and, since 2013 have reached similar levels of efficiency (at 0.83).

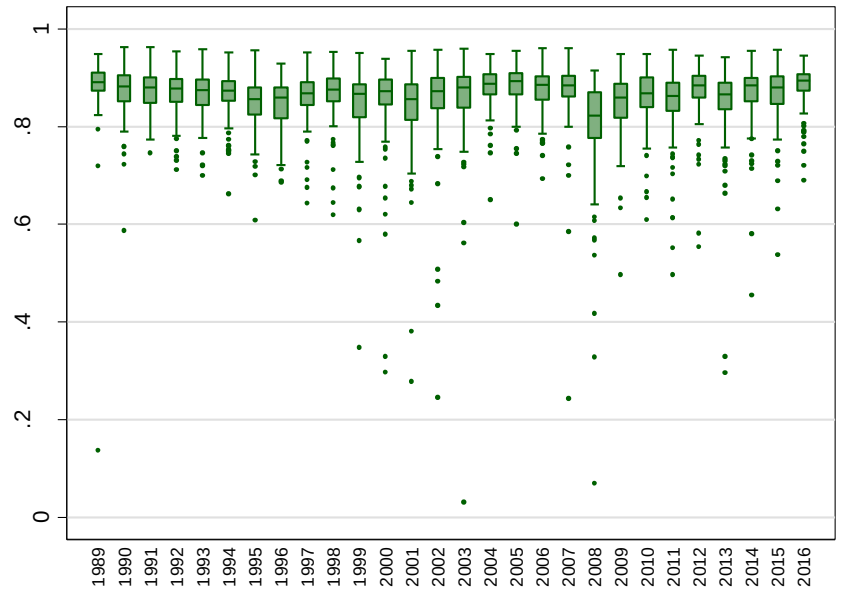
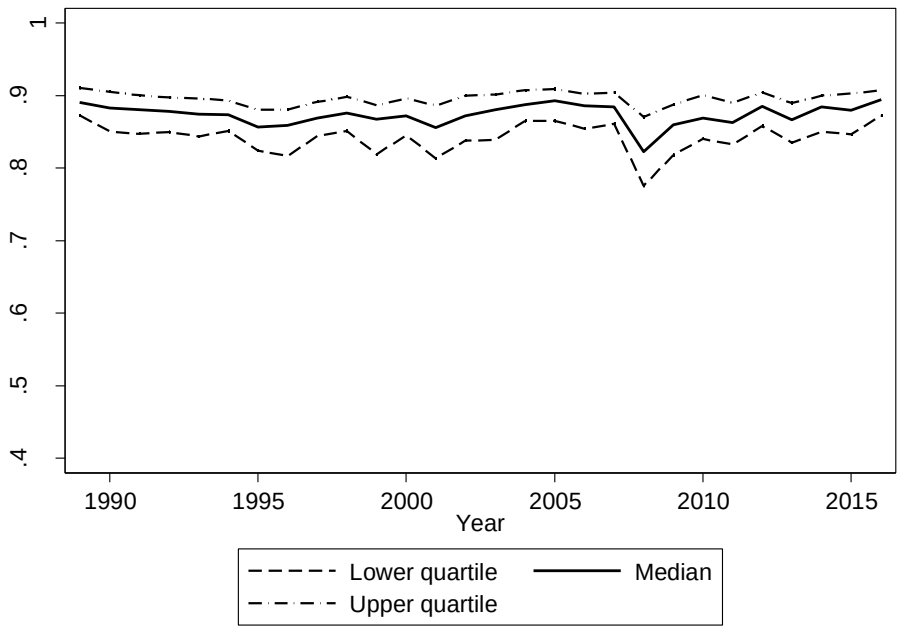
	Av Efficiency
1989-1996	0.83
1997-2003	0.78
2004-2012	0.79
2013-2016	0.83

Finally, average rate of growth (1989-2016) is 2.54% per annum. This is double that found for cereal farms and represents rapid technical progress for the sector.

3. LFA Cattle



The figure shows flat levels of output per livestock unit against a backdrop of growth in inputs, aside from labour, which is also relatively flat. The main fluctuations are within feed costs and other livestock expenditure, which are predominantly veterinary costs.

Distribution of efficiencies within LFA Cattle Farms	Efficiency gap between quartiles within LFA Cattle Farms
	

The left-hand figure shows the distribution of efficiency scores with relatively little dispersion within the top and lower quartiles but the outliers and the lower 25% of the sample are spread widely, especially from 1999 onwards. Nevertheless the gap between the median and lower quartile are relatively small, indicating that there are only a small number of outlier performers and the remainder tend towards the median level of efficiency. Notably there is a pronounced fall in the mid 2000s which may be the result of the implementation of the SFP and the consequent substitution through the coupled Scottish Beef Calf Scheme.

The transition probabilities are shown below and indicate, similar to specialist cereals, show that there is around a 50% chance of farms in the lower quartile remaining in that quartile.

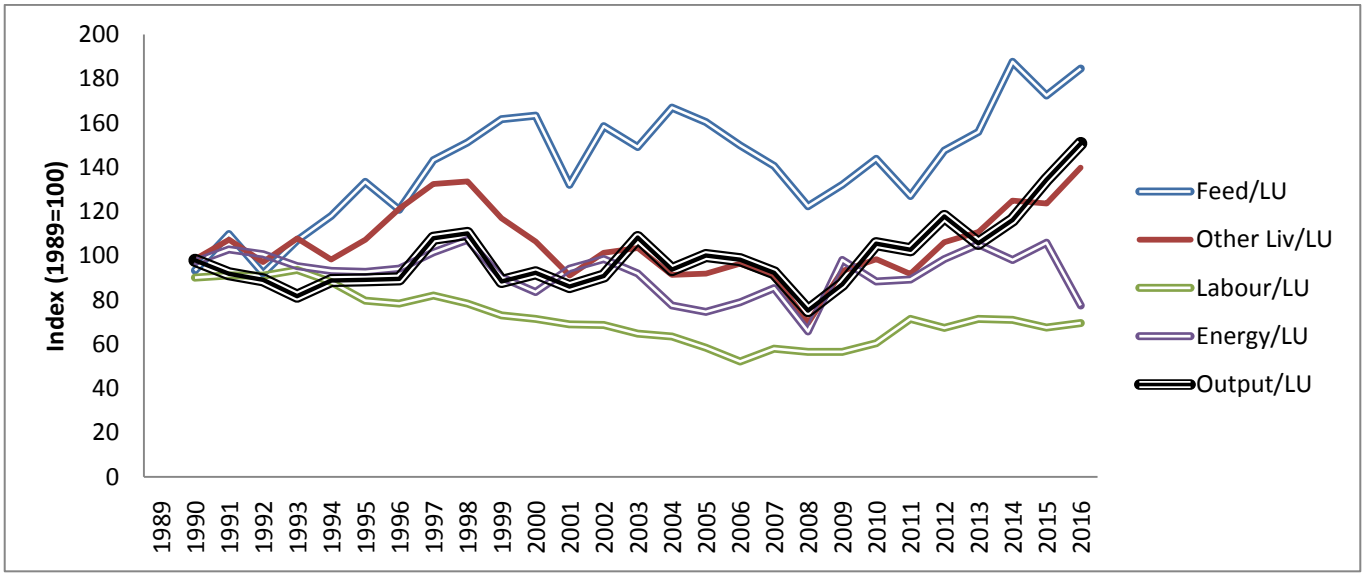
	Year 2				
Year 1	Lower Quartile	Mid-Lower Quartile	Mid-Upper Quartile	Upper Quartile	Mean Efficiency
Lower Quartile	53	24	13	10	0.78
Mid-Lower Quartile	24	35	28	12	0.86
Mid-Upper Quartile	14	26	35	26	0.89
Upper Quartile	9	15	26	50	0.91

Overall average efficiencies over selected periods show little overall change, meaning that the drop, experienced in the late 2000s did not have any long run effects on the efficiency of the industry.

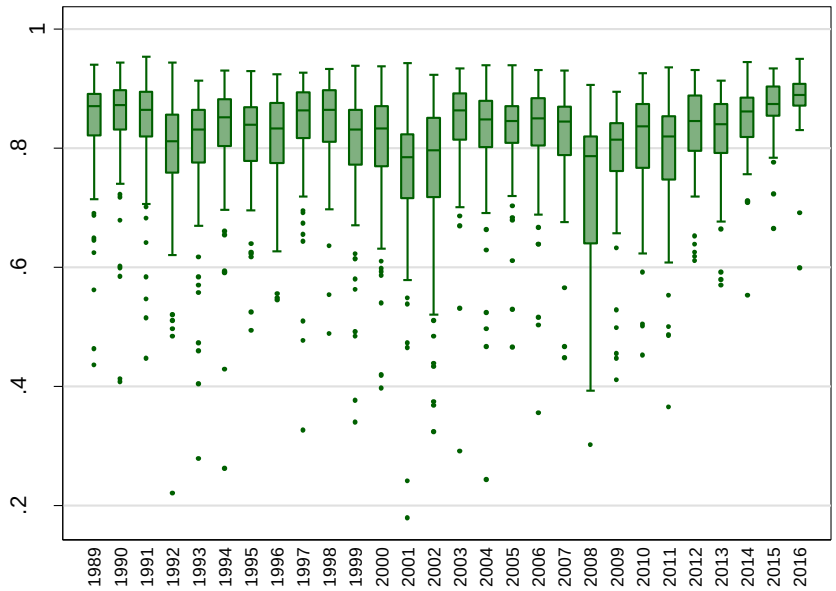
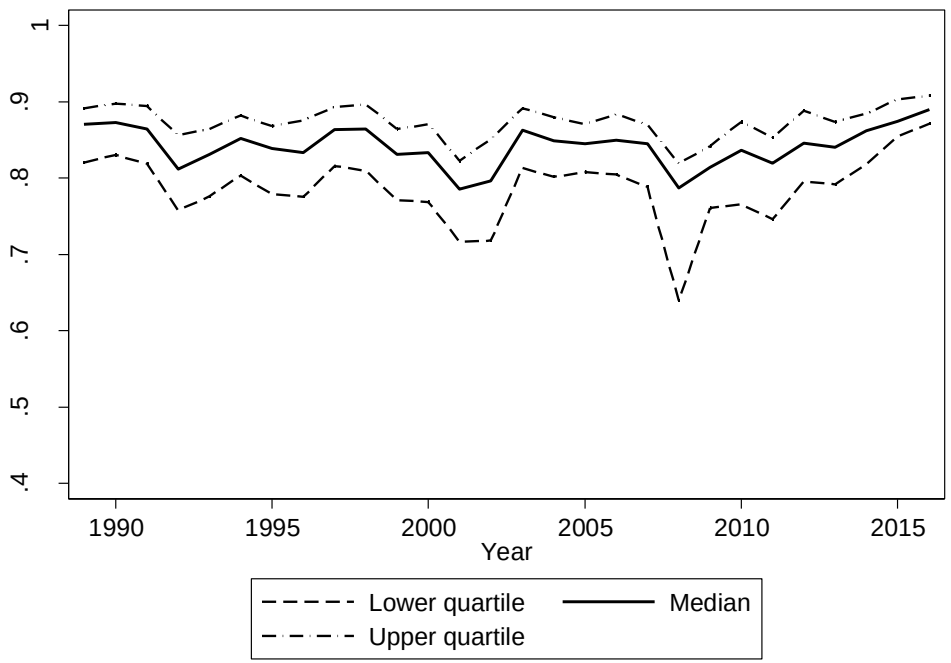
	Av Efficiency
1989-1996	0.86
1997-2003	0.85
2004-2012	0.86
2013-2016	0.86

Moreover, the industry experienced an average annual growth rate of 2.3% per annum which indicates this sector is adopting technologies to push the industry forward.

4. LFA Sheep



With sheep we see an upward curve in output from 2007 onwards which is similar to other livestock expenditures and energy use, with lower growth for labour hours worked. Feed costs again are higher and growing over this period.

Distribution of efficiencies within LFA Sheep Farms	Efficiency gap between mean efficiency and minimum efficiency within LFA Sheep Farms
	

There is a significant fluctuation amongst the Sheep farms, as we would expect given the biophysical constraints of this sector. For several years there are dips in the median efficiency of the industry, around the early and the late 2000s. This is quite explicit in the right hand figure in terms of the drops in the median and lower quartile efficiencies. Notably the gap between the lower quartile and the median is larger than the upper quartile and the median. This suggests that significant gains could be made if these farms improved their resource efficiency.

The transitions are shown below, indicating a strong entrenchment of positions within the sheep sector. Effectively if a farm is the lower quartile in one year then they have nearly a 70% probability of remaining in that sector in the second year.

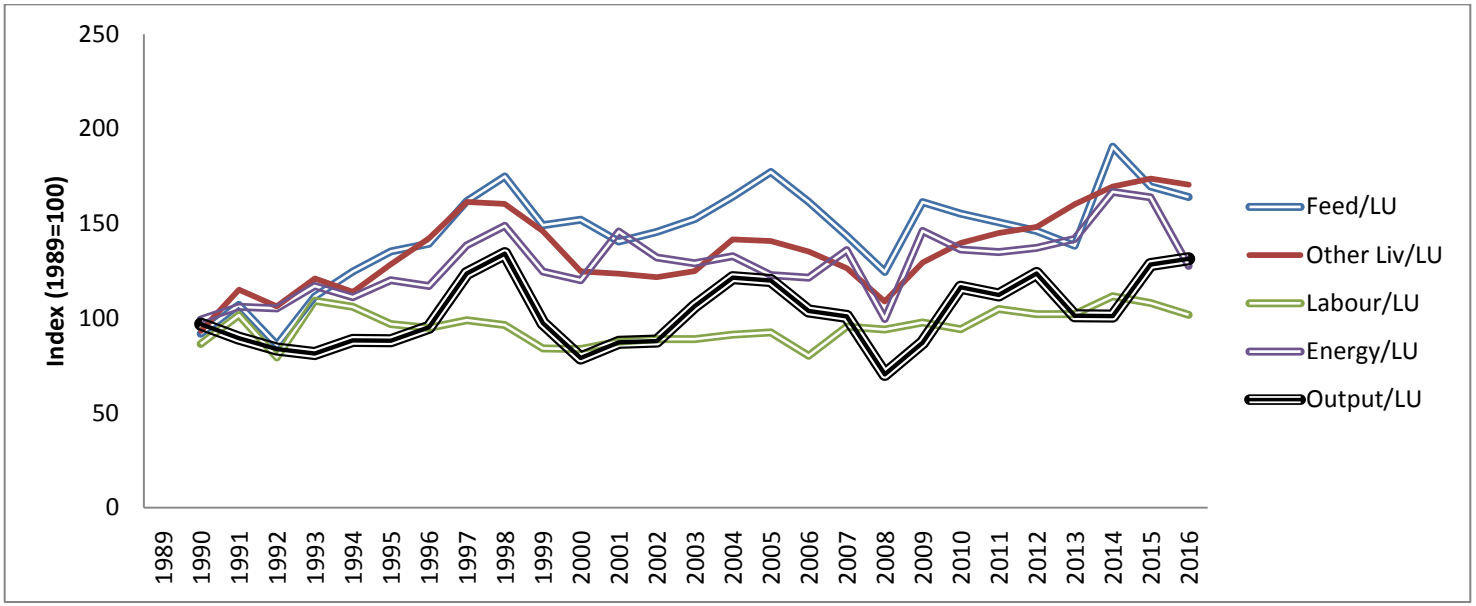
	Year 2				
Year 1	Lower Quartile	Mid-Lower Quartile	Mid-Upper Quartile	Upper Quartile	Mean Efficiency
Lower Quartile	68	22	6	4	0.69
Mid-Lower Quartile	22	42	27	9	0.82
Mid-Upper Quartile	9	27	42	23	0.86
Upper Quartile	4	9	26	62	0.90

Over discrete time periods, the table shows that mean efficiency has grown after a long period of stable efficiency. Essentially, since 2013 efficiency has grown as structural change has occurred within the industry.

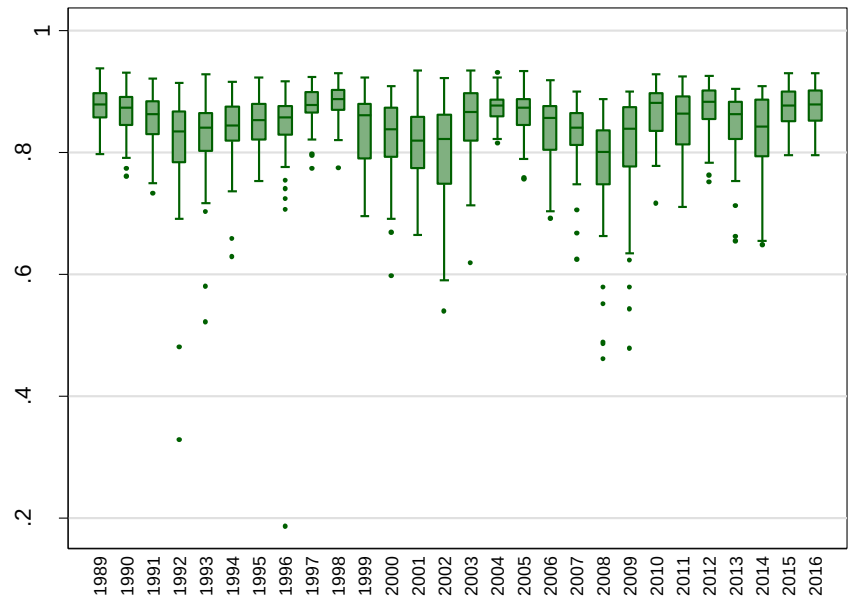
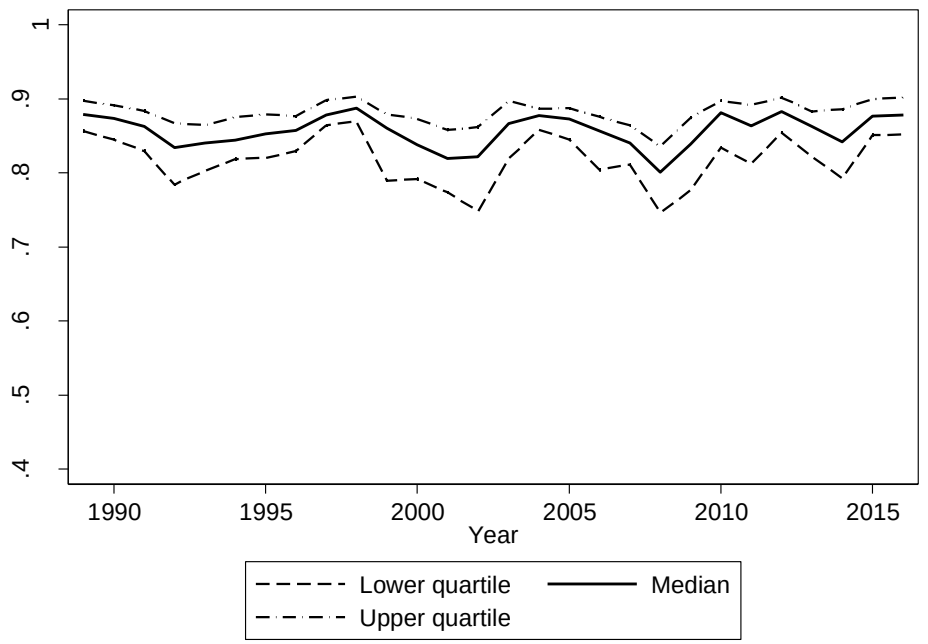
	Av Efficiency
1989-1996	0.82
1997-2003	0.80
2004-2012	0.80
2013-2016	0.86

Overall average technical progress is estimated at 1.93% per annum between 1989 to 2016, indicating that in general this sector has adopted technologies and approaches which improve resource use efficiency.

5. LFA Cattle and Sheep



For this sector, these is a general fluctuation in outputs and inputs and they all seem to track changes in growth in outputs, indicating a relatively flat picture of growth over the 1989 to 2016 period.

Distribution of efficiencies within LFA Cattle and Sheep Farms	Efficiency gap between mean efficiency and minimum efficiency within LFA Cattle and Sheep Farms
	

The efficiency distributions (left-hand figure) show the fluctuating pattern of changes in median efficiency within the LFA Cattle and Sheep sector. In addition, the spread of efficiencies varies within each year. These relate to changes in policy in 2003, around 2009 and in 2015 for the sector. This perhaps indicates that this sector is particularly closer to policy change than other sectors. These fluctuations are indicated in the spread across the quartiles (right-hand figure). Again, it seems the lower quartile has a wider gap to the median than the upper quartile in downturn periods, indicating that these are more fragile businesses and not able to reallocate resources as efficiently as other farms in the sample.

Transitions are shown in the table below, which shows significant entrenchment within efficiency classes. For those farms in the lowest quartile in one year there is a 61% chance of remaining in that quartile in the second year.

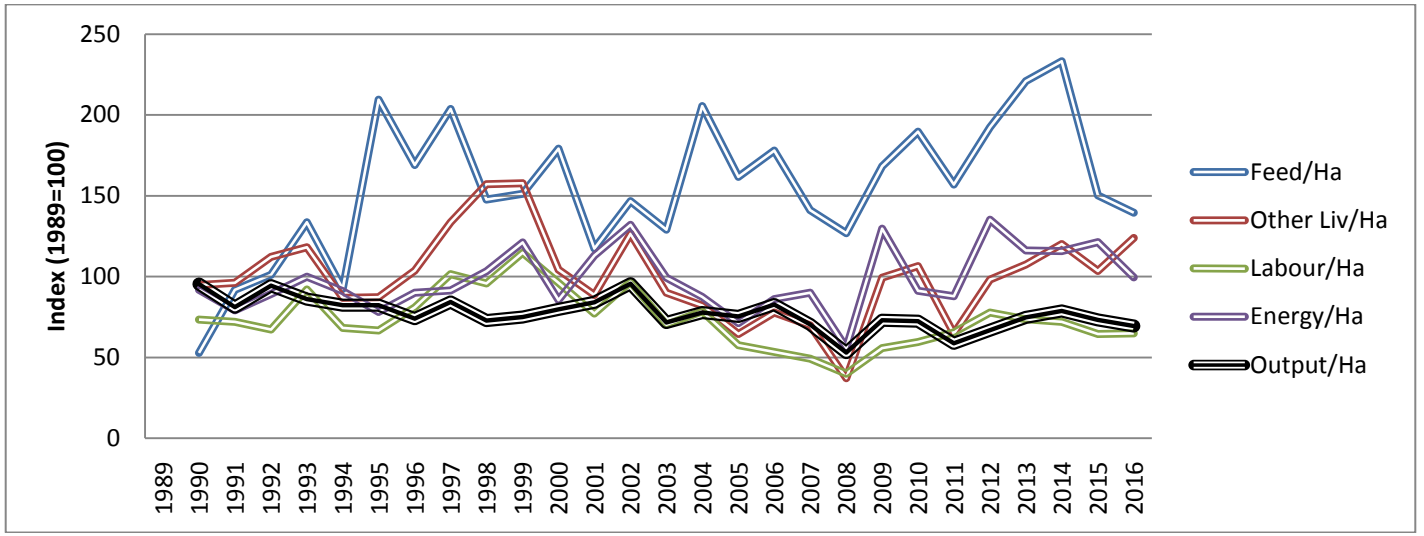
	Lower Quartile	Mid-Lower Quartile	Mid-Upper Quartile	Upper Quartile	Average
Lower Quartile	61	29	7	3	0.77
Mid-Lower Quartile	27	40	26	6	0.84
Mid-Upper Quartile	10	23	40	27	0.87
Upper Quartile	4	7	27	62	0.90

Despite the fluctuations, on average for the sector efficiencies seem to have remained stable, all be it with wider distributions of efficiency within selected years.

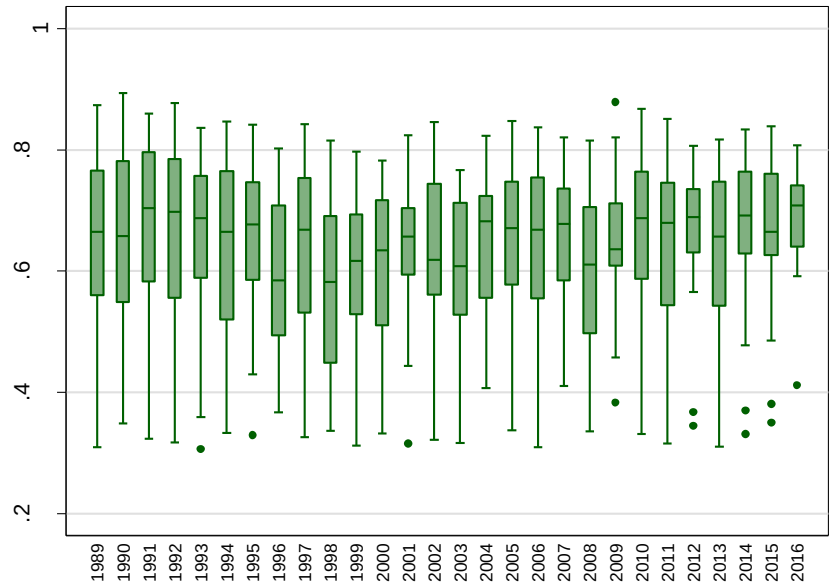
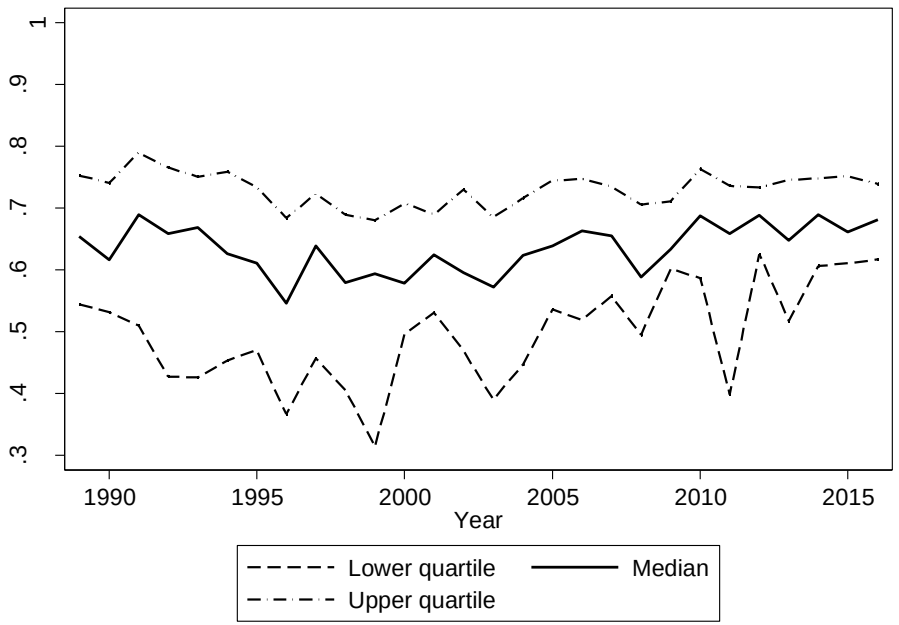
	Av Efficiency
1989-1996	0.85
1997-2003	0.84
2004-2012	0.84
2013-2016	0.85

What is explicit within this sector is that the trend for growth is slightly negative, at -0.2% per annum. This is known as technical regress, namely that the industry does not seem to be progressing with respect to uptake of technologies which will induce resource use efficiency growth within the sector. Naturally this may be the consequence of income constraints, but also biophysical constraints limiting access to management and technical approaches which would improve the sector's position.

5. Dairy Farming



Again, feed costs are higher and fluctuation over the period compared to other inputs. Output has tended to decline slightly, along with labour hours worked. Energy use and other livestock expenditures have growth relatively recently.

Distribution of efficiencies within Dairy Farms	Efficiency gap between mean efficiency and minimum efficiency within Dairy Farms
	

The dairy farms display a wide spread of efficiency throughout the period and this is also demonstrated in the right-hand side figure where the gaps between the upper quartile and the median and the lower quartile and the median are quite large throughout this period. Clearly this indicates differences in performance of these units and potentially offers significant resource use savings if the lower quartile raises their efficiency levels.

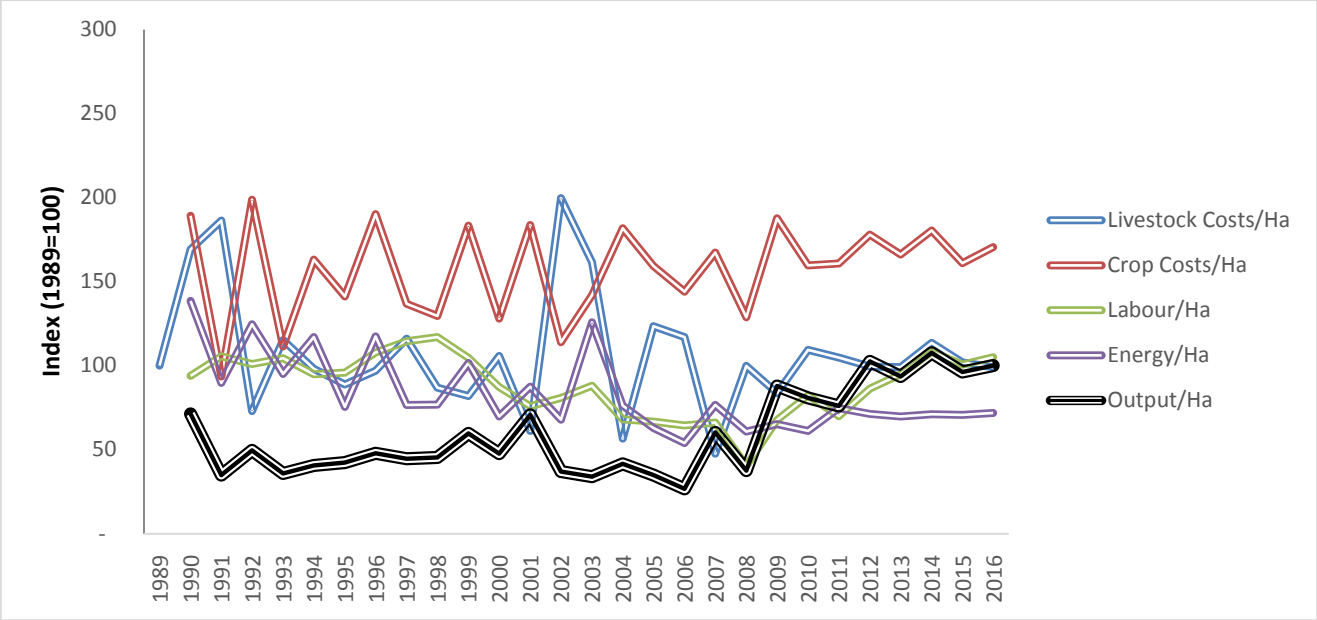
	Lower Quartile	Mid-Lower Quartile	Mid-Upper Quartile	Upper Quartile	Average
Lower Quartile	62	27	9	2	0.31
Mid-Lower Quartile	23	48	21	8	0.58
Mid-Upper Quartile	11	23	51	15	0.69
Upper Quartile	4	6	21	68	0.79

Across discrete periods there is a general trend downwards up to 2003, with an uplift in efficiency seen for these units since 2004 and the reforms to the dairy sector emerge.

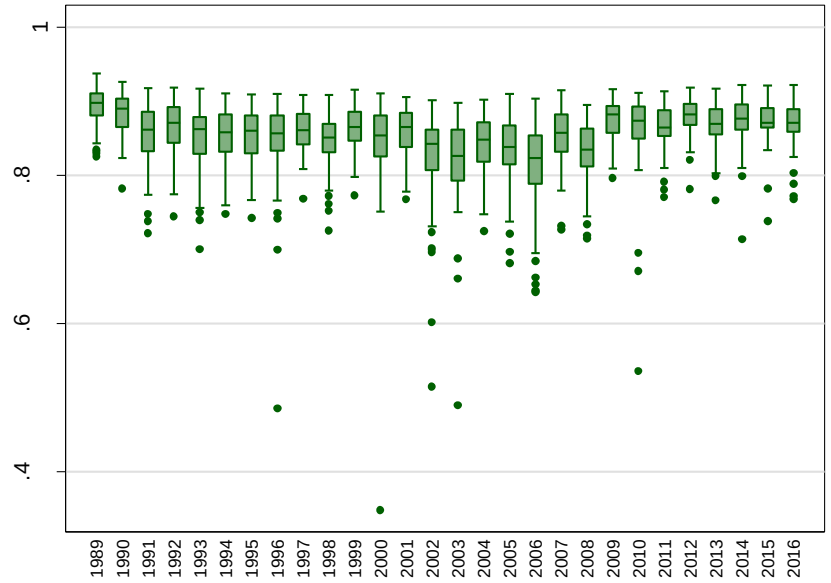
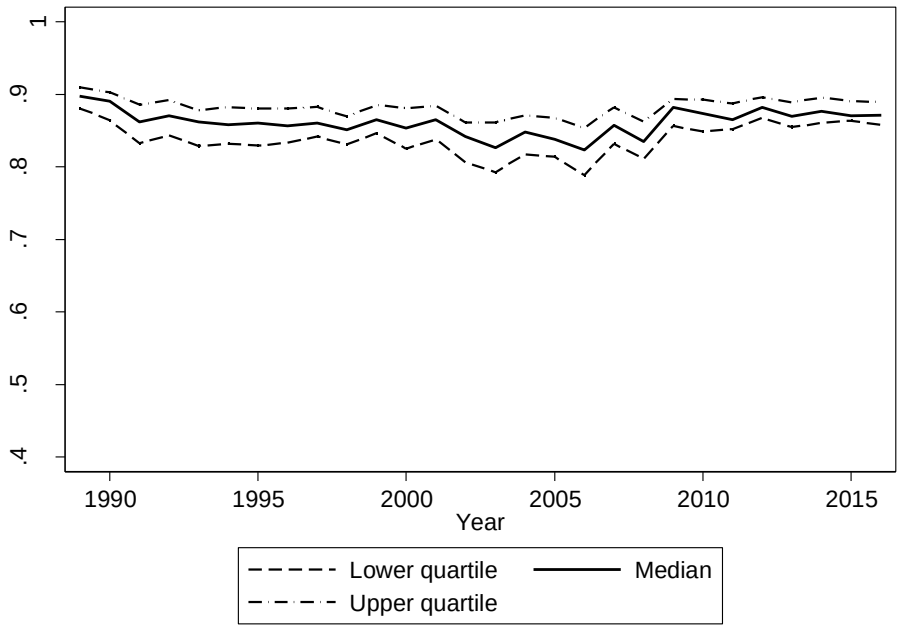
	Av Efficiency
1989-1996	0.58
1997-2003	0.55
2004-2012	0.61
2013-2016	0.62

Overall, given the wide dispersion of performance in this sector this has constrained average annual growth at 0. 55% per annum for the period.

6. Mixed Farming



Mixed farms have both crop and livestock inputs and these are presented by ha. Generally, despite the fluctuations in both these inputs output has risen since 2008.

Distribution of efficiencies within Mixed Farms	Efficiency gap between mean efficiency and minimum efficiency within Mixed Farms
	

There are fluctuations in efficiency up to 2007 and then, potentially with the uplifts in outputs, efficiency is upward and the distribution seems to reduce from the wider dispersion of farms in the 2000s. The right-hand figure shows the gaps between upper and lower quartiles is quite small, with only a larger deviation from the median visible emerging between 2003 and 2007.

The average efficiency across the time periods shows some of these fluctuations, with a fall in average efficiency between 1997 to 2012 and then upwards after this period, indicating perhaps that the MacSharry and Fischler reforms had an effect on refocusing resources to

	Av Efficiency
1989-1996	0.86
1997-2003	0.84
2004-2012	0.85
2013-2016	0.87

The transition probabilities particular intractability within the quartiles, namely those in the lower quartile in one year are highly likely to stay in the same quartile the next year. Similarly, for those in the upper quartile they are extremely likely to remain in that high performance quartile the next year. This indicates that mixed farms may be stuck on a particular trajectory in terms of their resource use and decision making.

		Year 2				
		Lower Quartile	Mid-Lower Quartile	Mid-Upper Quartile	Upper Quartile	Mean Efficiency
Year 1	Lower Quartile	65	23	10	2	0.80
	Mid-Lower Quartile	23	45	26	5	0.85
	Mid-Upper Quartile	7	22	49	22	0.87
	Upper Quartile	1	8	18	72	0.90

Overall average annual growth for the mixed farming sector was 1.8%, indicating a positive trend toward technological progress within the sector.

What explains efficiency changes?

As we estimate efficiency we can also include factors which potentially explain these differences. Essentially these can be personal factors, such as succession, policy factors, such as decoupling of payments, and biophysical factors, such as the level of productive land.

Variable Name	Description
Successor	Dummy variable based on changes in age of the farmer, where 0 equates to a linear age step and 1 indicates a drop in age of the farmer (which indicates some transition in the farm)
Education levels	Categorical variable, where 0 is school only education and 1 is higher than school only.
Age	Continuous variable indicating farmer age
Tenant (compared to Owner)	Categorical variable indicating non-owner occupier status
Gearing	The ratio of debt to total assets to infer risk taking in decision making
Closing Net Worth	The level of net worth at closing to infer resource base for investment
Subsidy	The level of total subsidies received
LFA	Whether farm is in a LFA or non-LFA area
Altitude	Binary variable where 0 is below 1000 metres, 1 is above 1000 metres
Ratio of productive land	A ratio of the amount of land in land classifications below LCA4, to indicate biophysical disadvantage
Stocking Density	The ratio of livestock units to total grass and adjusted rough grazing
Fischler Reform	A dummy indicating the effect of decoupling from 2005 onwards
MacSharry Reform	A dummy indicating the effect of MacSharry and set-aside between 1995 and 2007.

Estimated effects of drivers of technical efficiency change, 1989 to 2016

	Cereals	General Cropping	LFA Cattle	LFA Cattle and Sheep	Dairy	Mixed	LFA Sheep
Successor	-0.15	0.01	0.01	-0.02	0.10	**0.15*** **	-0.06
Education levels	**0.84*** **	0.08	0.05	0.06	**0.53*** **	0.01	**0.31*** **
Age	0.05	**0.06** **	0.02	**0.05***	0.00	**0.04*** **	**0.11*** **
Tenant (compared to Owner)	**-0.78*** **	**-0.21*** **	0.04	**-0.14***	-0.02	0.01	-0.09
Gearing	**-0.06*** **	-0.05	0.01	**-0.10***	**0.19** **	-0.05	0.06
Closing Net Worth	**-0.59*** **	0.05	**0.06***	0.01	0.15	**0.03***	**0.09** **
Subsidy	**0.19***	**-0.05***	0.03	0.01	**-0.20** **	**0.06***	**-0.09** **
LFA	**-0.53***	-0.03	0.00	0.00	**-0.33***	**-0.16** **	0.00
Altitude	0.48	0.07	-0.07	0.11	0.08	-0.05	**-0.24*** **
Ratio of productive land	**0.77***	-0.07	0.03	**0.20*** **	0.13	**0.11*** **	**0.14*** **
Stocking Density	-	-	**-0.02*** **	0.01	**0.04***	0.00	-0.34
Fischler Reform (2003)	-0.13	-0.03	0.06	-0.13	**0.37** **	**-0.31*** **	0.11
MacSharry Reform (1993)	-0.16	**-0.15** **	**0.18*** **	**0.20** **	-0.11	-0.10	0.05

* sig at 0.05%, ** sig at 0.01%, *** sig at 0.001%

In summary, the table shows a range of different factors determining efficiency within each sector.

It seems that **subsidy** has a varying effect within each sector, with it being positive in cereals and mixed farming but has a negative relationship within most other sectors.

Education levels tends to be positive, namely the higher the level of specialist education the more likely they are to be technically efficient.

Age is also positive meaning that older farmers tend to be more efficient, which may be a proxy for experience.

Change over of business (proxied through the **successor** variable) has a positive effect on mixed farming but is not significant for other sectors.

The **level of productive land** is, as would be expected, positive for a number of farms, whereas LFA land is negative.

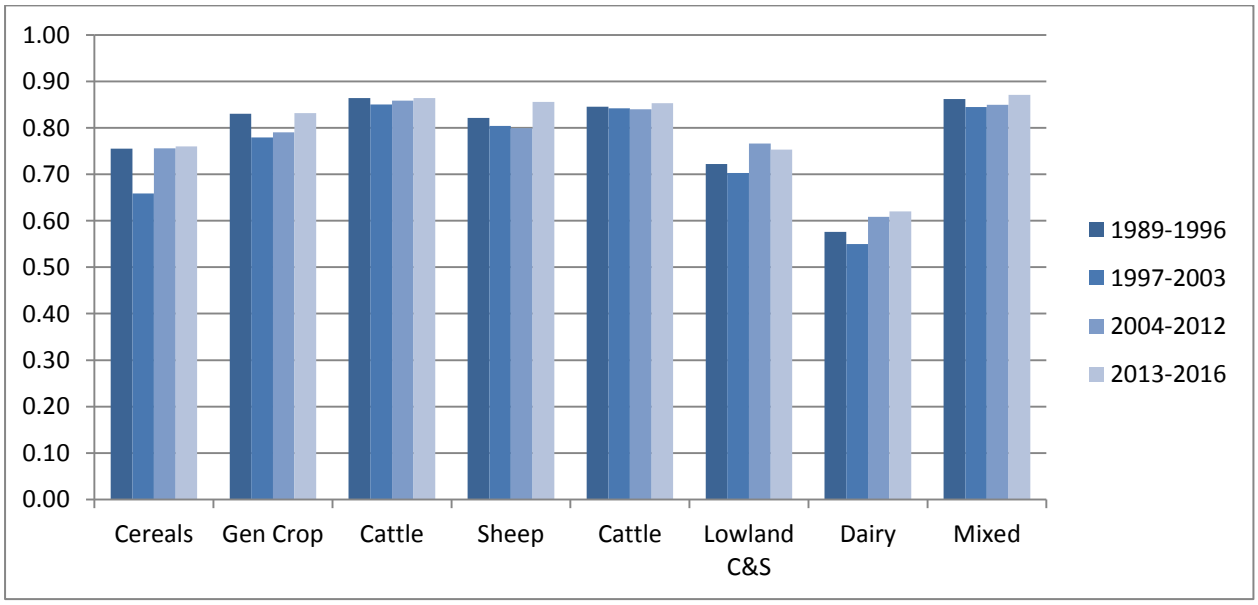
Altitude is only negative for Sheep farms.

Policy reforms have a mixed effect on the sectors, the MacSharry reforms had no significant effect on efficiency in cereals but a negative effect on General Cropping farms. Moreover, it had a positive impact on LFA farms. Similarly, decoupling had no significant effect for most farm types aside from Dairy where it was positive and for mixed farms where it had a negative effect.

Summary

1) The average technical efficiency of the farm has remained stable over the whole period of study

The figure below shows a summary of the average scores for each sector over the discrete periods, divided by policy changes. It is important to emphasise that this is a relative measure within each farm type and we cannot draw conclusions across farm types – as these represent different production systems. Hence, what emerges is the fluctuations between periods for the farm types and that, despite these changes, efficiencies have remained relatively stable which may be a consequence of reorganisation of resources at the farm level to accommodate changing biophysical and policy conditions over these periods.



However, it is notable that the figures in the report find a great level of divergence between top performers and bottom performers. Moreover we found that there are difficulties in a farm changing from a lower to a higher quartile and this reflects quite embedded constraints, through biophysical limitations but also farmer management of inputs. It is worth reemphasising that farmers have a range of motivates one of which is resource efficiency but this may be secondary to other motivates, such as maintaining biodiversity on the land. Nevertheless, there is a clear agenda towards skills and management which could focus on raising efficiency levels on these lower performing farms as high resource use efficiency may lead to protection of natural capital.

2) Have we progressed over the time?

Farming is characterised by a range of decision makers and increasing choices towards technological adoption. Evaluating these techniques in terms of the risks and the rewards helps to categorise some farmers as risk takers and others as risk averse. What emerges from our analysis is that for most farms there has been some technical progress. This shows that Scottish farms within the FBS are continuing to adopt newer technologies and techniques to progress resource use. A word of caution relates to those farms within the FBS are generally seen as more progressive farmers and consequently average efficiencies across Scotland may be lower.

3) what factors characterise a farm on the frontier compared to one below the frontier?
Each sector's technical efficiency is explained by a unique mixture of personal, biophysical and policy factors. Given the wide dispersion of performance outlined above it would also suggest that a range of interventions are needed to fully realise efficiencies for each sector. Moreover, given the regional dimension of agricultural systems it may mean a more place based policy approach.

4) What does it mean for the future of Scottish agriculture?
In order to accommodate future reform and meet the ambitions of a post-EU support climate there is a need to focus on resource use efficiency to maintain resilience against rising costs of inputs and dampening of demand for agricultural products. A discussion is emerging towards protection of natural capital resources within future policy directions however also a number of documents have called for a refocus on productivity. This seems to infer sustainable economic growth is needed and, for our part, would indicate that a suite of indicators would explain the resilience of the sector both economically and environmentally. Nevertheless, indications of resource use efficiency provide some guidance on how inputs are minimised and, consequently, this effect the viability of the farm under increased pressures which may emerge from changes in trade relationships and potential shifts in subsidy.