# Scottish Farm Efficiency: trends and drivers from 1989 to 2020


## Authors

*Andrew Barnes*[*1]



## Summary

Technical efficiency indicates the rate at which physical inputs are converted into physical outputs. We present estimates of the technical efficiency of Scottish farms by standard farm types over the period 1989 to 2020 using the annual Scottish farm business survey (SFBS) data. We find that all farm types show an average increase in annual technical efficiency growth. However, these are quite low, with Less Favoured Area farms (LFA) and specialist cereal farms, having average growth of around 0.2% per annum. In contrast Dairy and General Cropping farms have grown by an average of 1.0% per annum. Notably, growth rates are much lower, and in some cases negative, in the 4-year period directly after the EU referendum in 2016, compared to the 4-year period directly before the referendum, which may in part reflect uncertainty and reluctance to invest before major agricultural policy reform.

- We find a great deal of variance within farm types, which indicates that for each sector there will be challenges and wide level of performance.
- Key drivers of technical efficiency include farm size and increasing specialisation.
- More farmer led characteristics, such as succession planning and age of the main decision maker, were less consistent estimators.
- Both higher levels of subsidy and off-farm income had a depressing effect on technical efficiency, compared to those farms with lower rates of subsidy to turnover, or higher levels of income on farm, compared to off-farm.

Under the potential for new reform of Scottish agricultural policy, which would support sustainable food production and meet the requirements of a net zero carbon target by 2045, the focus of policy interventions should be on promoting improved resource use within our present farming systems.



[1] *Department of Rural Economy, Environment and Society, SRUC, West Mains Road, Edinburgh, UK*



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# 1.0 Introduction

With the UK's withdrawal from the European Union, replacement of the Common Agricultural Policy and progress towards Net Zero there is a renewed focus on how our resources are efficiently used within Scottish farming. The purpose of this briefing is to present results over trends in technical efficiencies of the main Scottish farm types, namely Specialist Dairying, Cereals, General Cropping, LFA Cattle, LFA Sheep and LFA Cattle and Sheep as well as mixed enterprises. As such this provides an update to previous reports on efficiency in Scottish agriculture (Barnes, 2017; Barnes et al., 2020)

# 2.0 Method

The Scottish Farm Business Survey (SFBS) collects data for around 400-500 individual farm businesses across Scotland. The FBS has collected data since the 1930s but has only been digitised from 1989 onwards. Data are collected over each succeeding crop year using detailed farm accounts data for each farm business and collated through an individual assessor. The data go through numerous quality checks before release and are used as the basis for understanding some of the main changes in economic circumstances of Scottish farms.

To estimate technical efficiency we take the major inputs and outputs from the FBS and run an econometric model on each farm type to understand both the historic changes of these farms but also their efficiency relative to other farms of a similar type. As such the estimates indicate the

# 3.0 Results

## 3.1 Technical Efficiency 1989 by 2020

Table 1 shows the average annual growth rates in technical efficiency for set periods, namely

1989-2003: This period reflects the MacSharry reforms and the establishment of set-aside, as well as reductions in payments on previous periods.

2003-2014: This period brings in the Fischler reforms for a single farm payment which decoupled payment from most production (aside from, for example the Scottish Beef Farm Scheme).

2015-2020: There period is the most modern era, and the 2014 reforms which had cross-compliance criteria for more support of environmental goals.

The growth rates show how our farming systems have developed over the last 30 years. This should also show progress in terms of adoption of new practices and technologies, but also disturbances from external events, such as high input costs, disease outbreaks and extreme weather disturbances.

Table 1. Average annual growth rates in technical efficiency by farm type, 1989-2020 (add in number of observations)

| | Sheep | Dairy | LFA C&S | LFA Cattle | Cereals | Gen Crop | Mixed |
|---|---|---|---|---|---|---|---|
| 1989-2003 | 0.01% | 0.93% | -0.03% | -0.21% | -0.13% | 0.05% | -0.15% |
| 2004-2014 | 0.53% | 1.50% | 1.10% | 1.09% | 3.17% | 3.30% | 1.79% |
| 2015-2020 | 0.48% | 0.07% | -0.60% | -0.40% | -1.93% | -1.32% | -1.13% |
| **1989-2020** | **0.17%** | **0.99%** | **0.05%** | **0.21%** | **0.07%** | **1.20%** | **0.40%** |

Growth rates are low in farming systems where there is disadvantage, namely the LFA categories. The Dairy and the General Cropping Sector have seen the greatest growth over the 30 year period.

The highest level of annual growth occurred in 2004-2014, the decoupling era which may reflect the removal of restrictions on commodities grown, but also some restructuring as a consequence of the change in policy. Though only a shorter period, last 6 years shows fairly low rates, and in some cases negative growth rates. It is perhaps driven by higher input costs, but also uncertainty following the EU referendum constraining investment (See Barnes et al., Investment brief).

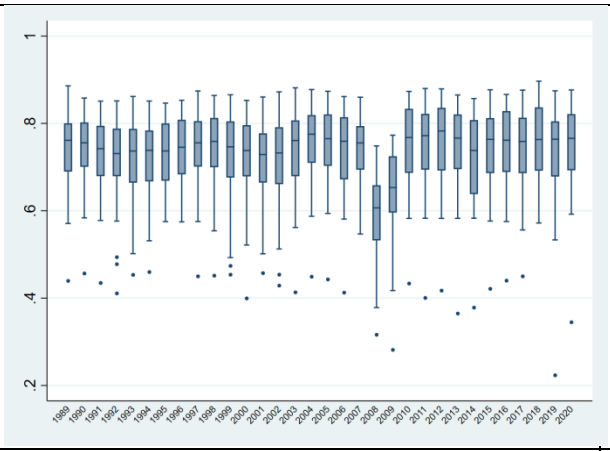
Table 2 shows the average annual growth rates for the 4 years before the referendum and the 4 years after the referendum. For most farms, aside from LFA Sheep the growth rates have either lowered or become negative. Accordingly, whilst it cannot be directly attributed to the referendum outcome there was some stability in policy during this period but there may have been both policy uncertainty and wider macro-economic influences which affected investment reflected in the lower technical efficiencies observed over this period.

Table 2. Annual average growth rates per farm type, pre and post EU referendum

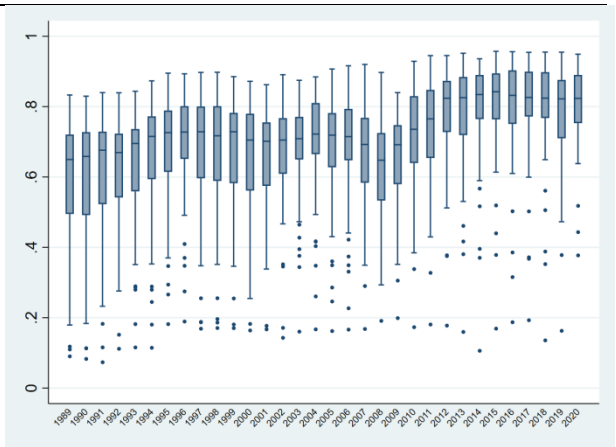
| | **LFA Sheep** | **Dairy** | **LFA C&S** | **LFA Cattle** | **Cereals** | **Gen. Crop** | **Mixed** |
|---|---|---|---|---|---|---|---|
| 2012-2015 | -0.18% | 2.06% | 1.63% | 0.43% | 0.43% | 1.27% | 0.74% |
| 2017-2020 | 0.05% | 0.20% | -1.41% | -0.67% | -1.44% | -0.87% | -1.34% |

## 3.2. Variances in technical efficiency

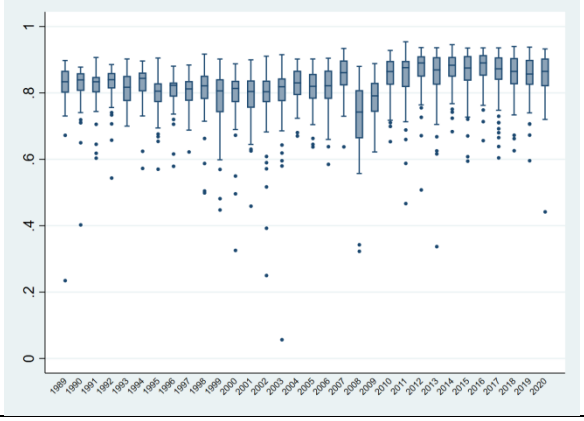
Whilst the above section focuses on the average it is important to emphasise the range of efficiencies within each farm type. These are shown below as box plots for the whole period. The figures shows the scores of each farm, where 1 is the most efficient, the majority of farms are shown in the shaded blue box with the more extreme values as the thin lines, or in the case of lower values as separate dots, indicating they are unusually low in terms of their efficiency.



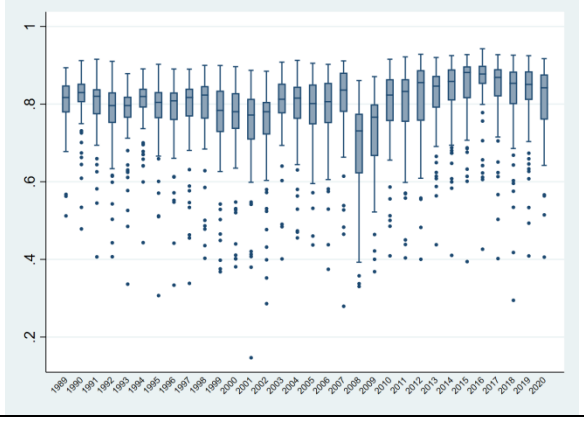
LFA Sheep



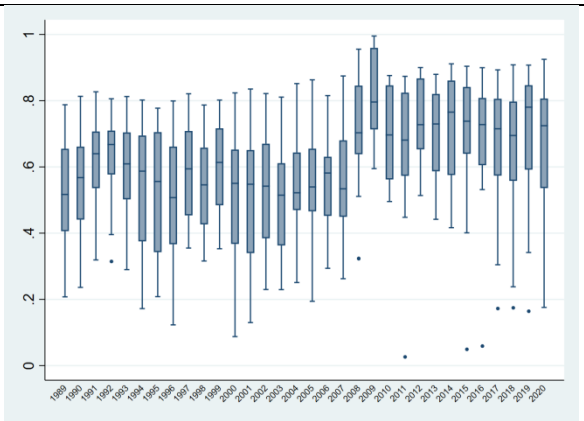
Dairy



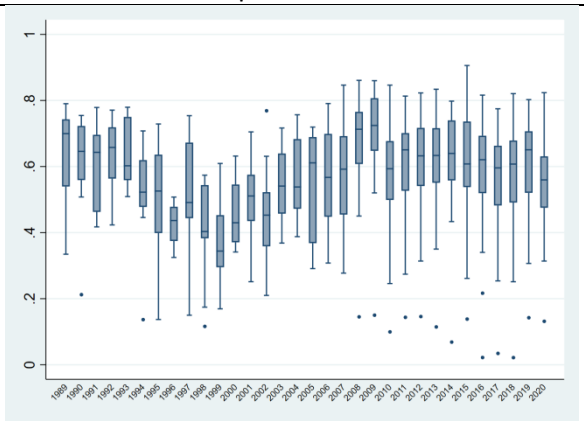
LFA Cattle



LFA Cattle and Sheep



General Cropping



Cereals

It is clear the all farms show a wide spread of efficiencies per year, with general cropping and cereals showing the greatest variances, potentially due to heavy reliance in imported inputs but also weather effects. What is noticeable is that some farms experience a dip in the case of livestock, or a

rise in the case of general cropping around the 2008/2009 financial crash. Whilst we would expect agriculture to be protected from the main effects of this spike, it did lead to increasing input costs and also food price spikes. Notably for most years afterwards the farms return to an equilibrium position indicating that this effect was not persistently depressing efficiencies over the last decade.

## 3.1 Causes of Technical Efficiency growth 1989 by 2020

The table below shows the results of the estimates of key variables from the FBS which may explain differences in technical efficiency. These are shown as marginal effects - which show the effect of a 1% increase in a variable, e.g. a 1% increase in off farm revenue will reduce technical efficiency by 2.08%. The signs of the variable is important as they show both a positive and negative effect.

Table 3. Drivers of technical efficiency growth, showing only variables which significantly effect technical efficiency.

| | LFA Sheep | Dairy | LFA C&S | LFA Cattle | Cereals | Gen Crop | Mixed |
|---|---|---|---|---|---|---|---|
| Succession plan in place | | 0.013 | 0.031 | 0.007 | | | |
| Use PC for record keeping | 0.013 | 0.048 | 0.024 | 0.017 | | | 0.044 |
| Off-farm to total revenue | -0.208 | -0.144 | -0.184 | -0.178 | -0.242 | -0.226 | -0.107 |
| Use of discussion groups | | | -0.013 | 0.009 | | | |
| Age of farmer | 0.001 | | | | -0.001 | | |
| Subsidies to total revenue | -0.033 | -0.148 | -0.165 | -0.140 | -0.345 | -0.334 | -0.241 |
| Livestock Specialisation | | 0.150 | 0.061 | 0.189 | -0.354 | -0.259 | 0.056 |
| Size of Farm | | | 0.029 | 0.024 | 0.044 | 0.060 | 0.111 |
| **Effect of policy periods (compared to 2015-2020)** | | | | | | | |
| 1989-2003 | | 0.138 | 0.008 | | 0.035 | 0.061 | 0.053 |
| 2004-2014 | | 0.091 | | 0.016 | 0.043 | 0.063 | 0.053 |

For the farms there are various variables which were significant. The two most common across the farms are the level of off-farm revenue. This indicates that as off-farm to total revenue increases then we would expect technical efficiency to fall, as labour and other efforts are being directed away from the farm. Similarly, the level of overall subsidy as a significantly negative effect on the farm. As this covers a number of periods the rationale for supporting farmers will have changed but do show a consistent trend. A number of reasons have been cited for this negative relationship, for instance the increasing focus on environmental schemes or the Fischler reforms in 2003 where farm payments were decoupled from production and therefore reduced the incentive to focus on production. However, an argument exists that subsidies tend to dampen risk taking behaviour and, accordingly, affects investment or seeking newer opportunities within farming.

These policy periods are imputed through the final variables which show the effect, compared to recent policy was positive towards technical efficiency compared to the recent reforms, such as cross-compliance and more environmental schemes. In terms of farmer characteristics, farm age, and succession planning have variable effects and, in some cases, not significant. The size of the farm is consistently positive for most farm types, namely as the farm gets bigger we would expect an increase in efficiency. Using a PC for record keeping is a proxy for innovative behaviour and this is positive for most farms, but use of discussion groups had mixed effects dependant on farm type. Finally, specialisation was also positive, that is as farms increase their activity in one enterprise they would be expected to increase their technical efficiency.

## 4.0 Summary

- Technical efficiency indicates the physical resource use on the farm. We measure technical efficiencies using the SFBS for the period 1989 to 2020 and find that all farm types have grown their technical efficiency.
- Growth rates are low for LFA and Cereal farmers, whereas they are higher for Dairy and General Cropping farms
- Growth rates are much lower, and in some cases lower since the EU referendum in 2016.
- The is great deal of variance within farm types and this represents a challenge for farm advisors and policy makers to raise the performance of those farms with low levels of technical efficiency growth.
- Factors which depress efficiency include the having a higher rate of subsidy and a greater level of off-farm activity.
- Increasing farm size and specialisation tend to be consistent estimators of improving technical efficiencies.

## 5.0. References

Barnes, A.P (2017). A report on Resource Use Efficiency for Scottish Agriculture: trends, causes and constraints. Report for RD 2.4.1 Economic Resilience, SRUC, Edinburgh.

Barnes,A.P., McMillan,J., Bevan,K., Bell,J., Logan, R., Morgan Davies, C. and Thomson, S. (2020). Boosting Productivity Growth in Scottish Agriculture. Report for RESAS. Available at: https://www.ruralbrexit.scot/wp-content/uploads/2020/04/Report-on-Scottish-Agricultural-Productivity_SRUC.pdf

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**For further details please contact:**

**Andrew Barnes** SRUC

☎: +44(0)131 535 4042

🖷: andrew.barnes@sruc.ac.uk

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