

APPENDIX TO

THE CHARACTERISTICS OF HIGH PERFORMING FARMS IN THE UK

PRESENTED TO:



By



And Associates

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Dairy farms

Analysis before matching

Table 1 shows comparisons between the top and bottom quartiles of the distribution of performance, based on the ratio of agricultural output to costs, charging unpaid family labour at the minimum wage rate for the year. A wide variety of variables are tested – this is very much a screening procedure. Continuous variables are compared using a t-test, whilst categorical ones use a chi-squared test, with a permutation test to allow for the situation where low expected values invalidate the usual test. Some key variables are included in both continuous and categorical form.

All figures use FBS data from 2011-12 to 2015-16. Variables are averaged across years, using a simple mean, except for categorical variables where the mode is taken. Farms are included where they are always classified as dairy farms and are present in at least 3 of the 5 years. Performance is averaged on the percentile scale (i.e. a percentile is calculated for each year and these are averaged, before recalculating the percentile for the entire period), to minimise the impact of missing years. For similar reasons, the milk price variable is calculated as the deviation from the average price in each year

Figure 0; SLR against performance percentile for dairy farms.

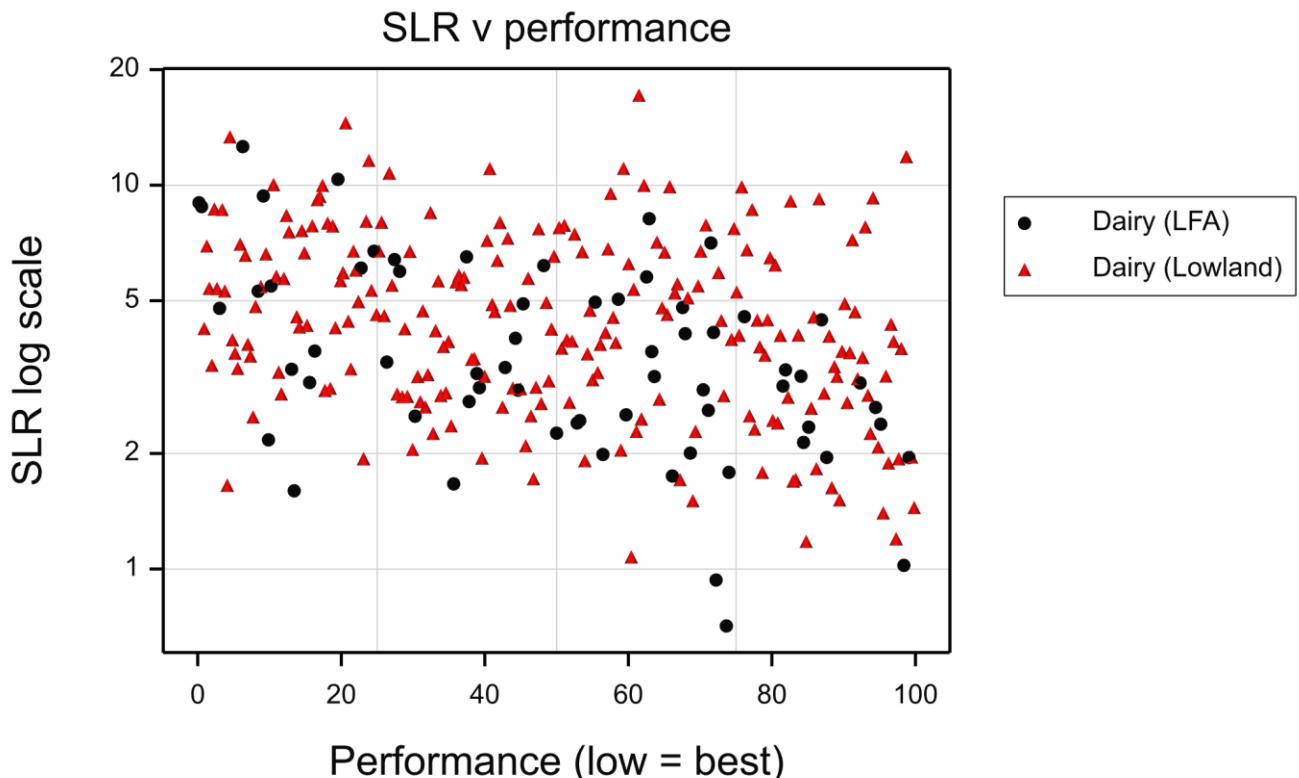


Table 1 shows bar charts for those variables are statistically significant at the conventional 5% level. The tables and figures include Farm Business Income in order to give an idea of the scale of difference between the performance groups. The most obvious feature of the graphs is the strong link with size – farms in the top quartile are on average much larger in terms of SLR or number of cows than those in the bottom quartile. This is also reflected in the higher output and agricultural costs (agcosts) for the top quartile, with the difference larger for output. The other cost variables are expressed as a percentage of total agricultural costs, with the top performers having proportionately higher variable costs, but lower fixed costs. High performers also spend proportionately more on bought feed, but less on general farming costs (things like heating, insurance, etc) and machinery. Unsurprisingly, relative milk prices are higher for the top performers and they were more likely to increase their area farmed (variable %chguaa). Poor performers are more likely to have cereals or beef enterprises.

Table 1: significance test for differences between top and bottom quartiles.

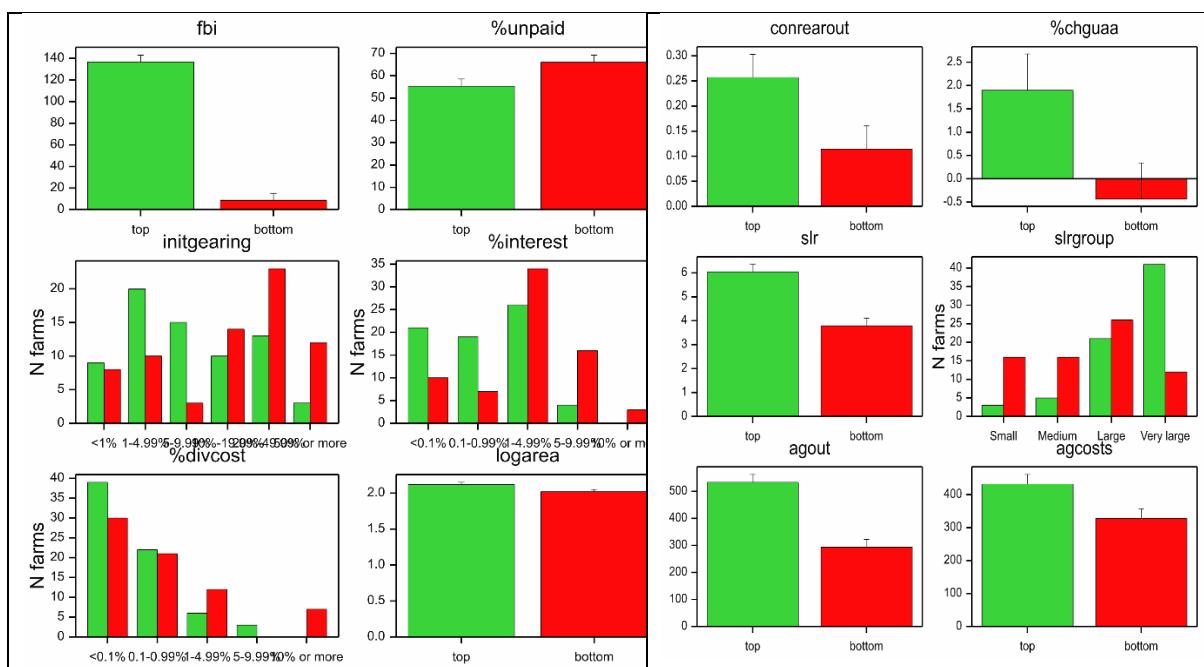
| variable | Mean of quartile | | sed | t | P | sig | Definition |
|-------------|------------------|--------|------|-------|-------|-----|--|
| | Top | bottom | | | | | |
| fbi | 136.8 | 8.5 | 9.0 | 14.24 | 0.000 | *** | Farm Business Income £000 |
| north | 278.5 | 274.0 | 26.0 | 0.18 | 0.861 | NS | Northing (mid point of JCA) |
| east | 364.3 | 395.1 | 15.6 | 1.97 | 0.050 | 10% | Easting (mid point of JCA) |
| altitude | | | | 0.604 | | NS | Altitude (3 bands) |
| gor | | | | 0.110 | | NS | GOR |
| age | 51.9 | 53.7 | 1.6 | 1.08 | 0.282 | NS | Age of farmer |
| education | | | | 0.849 | | NS | education of farmer |
| conrat | 0.3 | 0.3 | 0.0 | 1.23 | 0.222 | NS | Contracting costs as % all |
| %unpaid | 55.3 | 66.1 | 4.5 | 2.37 | 0.019 | * | Unpaid labour as % all labour |
| lfa | | | | 0.939 | | NS | LFA group |
| anylfa | 0.2 | 0.2 | 0.1 | 0.42 | 0.675 | NS | 0/1 for LFA |
| initgearing | | | | 0.004 | | ** | gearing group (opening a/c) |
| %interest | | | | 0.001 | | ** | Interest paid as % farm costs |
| %divcost | | | | 0.006 | | ** | diversification costs as % farm costs |
| logarea | 2.1 | 2.0 | 0.0 | 2.29 | 0.023 | * | Log of total area |
| %nvz | 47.3 | 47.1 | 7.7 | 0.02 | 0.986 | NS | % land in nvz |
| farmass | 0.9 | 0.9 | 0.0 | 0.34 | 0.733 | NS | farm assurance 0/1 |
| conrearin | 0.1 | 0.1 | 0.1 | 0.82 | 0.416 | NS | Contract rearing animals in |
| conrearout | 0.3 | 0.1 | 0.1 | 2.20 | 0.030 | * | Contract rearing animals out |
| %chguaa | 1.9 | -0.4 | 1.1 | 2.13 | 0.035 | * | % change in uaa |
| fbt | 30.2 | 26.6 | 5.1 | 0.71 | 0.478 | NS | FBT land |
| fat | 14.3 | 15.6 | 4.9 | 0.28 | 0.778 | NS | FAT land |
| owned | 55.5 | 57.8 | 6.3 | 0.35 | 0.723 | NS | owned land |
| tenure | | | | 0.975 | | NS | tenure |
| bustype | | | | 0.168 | | NS | business type |
| porg | 0.1 | 0.1 | 0.1 | 0.18 | 0.860 | NS | proportion of land organic |
| aesperha | 24.6 | 30.9 | 7.1 | 0.90 | 0.371 | NS | AES payments per ha |
| aesgroup | | | | 1.000 | | NS | AES grouped |
| slr | 6.0 | 3.8 | 0.4 | 5.14 | 0.000 | *** | SLR |
| slrgroup | | | | 0.000 | | *** | SLR group |
| manager | 0.0 | 0.0 | 0.0 | 1.42 | 0.157 | NS | Paid manager yes/no |
| agout | 533.7 | 293.6 | 40.7 | 5.90 | 0.000 | *** | agricultural output |
| livesubs | 1.1 | 1.3 | 0.5 | 0.35 | 0.729 | NS | livestock subsidies (e.g. TB compensation) |
| unpaidhrs | 4.4 | 4.3 | 0.3 | 0.41 | 0.680 | NS | Unpaid labour hours (000s) |
| agcosts | 431.9 | 328.0 | 41.4 | 2.51 | 0.013 | | agricultural costs |

| variable | Mean of quartile | | sed | t | P | sig | Definition |
|----------------|------------------|--------|------|------|-------|-----|------------------------------|
| | Top | bottom | | | | | |
| agfixedcost | 39.4 | 43.8 | 1.3 | 3.38 | 0.001 | *** | agriculture fixed costs † |
| agvariablecost | 60.6 | 56.2 | 1.3 | 3.38 | 0.001 | *** | agriculture variable costs † |
| bghtfeedcost | 31.8 | 27.4 | 1.6 | 2.75 | 0.007 | ** | Bought feed costs † |
| vetcost | 3.6 | 3.3 | 0.2 | 1.96 | 0.053 | 10% | vet costs † |
| seedcost | 1.0 | 1.2 | 0.1 | 1.80 | 0.073 | 10% | seed costs † |
| fertcost | 4.9 | 4.1 | 0.5 | 1.62 | 0.108 | NS | fertiliser costs † |
| cpcost | 0.7 | 0.9 | 0.2 | 1.34 | 0.183 | NS | crop protection costs † |
| genfarmcost | 8.2 | 11.7 | 0.6 | 5.43 | 0.000 | *** | general farming costs † |
| labourcost | 9.7 | 8.0 | 1.1 | 1.63 | 0.106 | NS | agricultural labour costs † |
| machinerycost | 13.2 | 16.3 | 0.8 | 3.81 | 0.000 | *** | machinery costs † |
| %slrcereals | 1.6 | 3.3 | 0.7 | 2.39 | 0.018 | * | SLR cereals |
| %slrotherarab | 0.1 | 0.2 | 0.2 | 0.88 | 0.379 | NS | SLR other arable |
| %slrdairy | 75.0 | 68.5 | 1.7 | 3.82 | 0.000 | *** | SLR dairy |
| %slrbeef | 16.5 | 19.0 | 1.0 | 2.48 | 0.014 | * | SLR beef |
| %slrsheep | 2.1 | 3.0 | 1.2 | 0.69 | 0.489 | NS | SLR sheep |
| %slrgrass | 4.4 | 5.6 | 0.2 | 5.29 | 0.000 | *** | SLR grass and fodder |
| agdiversity | 0.4 | 0.5 | 0.0 | 3.88 | 0.000 | *** | Agricultural diversity |
| stockingrate | 2.1 | 1.6 | 0.1 | 5.56 | 0.000 | *** | Stocking rate |
| stockgroup | | | | | 0.063 | 10% | Stocking rate group |
| relprice | 0.8 | -0.7 | 0.5 | 3.35 | 0.001 | ** | Relative milk price |
| percowlgrp | | | | | 0.040 | * | Grouped litres per cow |
| dcows | 203.1 | 113.5 | 14.0 | 6.38 | 0.000 | *** | Number dairy cows |
| dcowgroup | | | | | 0.000 | *** | Grouped dairy cow numbers |

Note: NS not significant, 10% P <= 0.1 (almost significant), * P <= 0.05, ** P <= 0.01, *** P <= 0.001

† as a percentage of all agricultural costs, sed=standard error of difference

Figure 1: bar charts for the nominally significant variables. ‘Top’ refers to top quartile, ‘bottom’ to bottom quartile.





Matching process

The matching process is quite problematic for dairy farms within this dataset due to the strong economic size differences. The final process chosen used the following variables: northing (of JCA centroid), easting, SLR, proportion organic, log-transformed area, any LFA land and unpaid labour nominal costs as a percentage of all labour costs. Each farm in the top quartile was matched with one in the bottom half of the distribution that was the closest match in terms of these variables. The correlation between these variables between the matched pairs was generally high (e.g. 88% for area, 91% for unpaid labour), but was lower for SLR (76%) reflecting the difficulty of finding suitable matches.

The algorithm allows multiple matches, i.e. several top-performers may be paired with the same below-average performer. Where more than two top-performers were matched with the same farm, the matching process was repeated for these farms, but with increasing thresholds for detecting a match and with the final match selected at random from those matches less than the threshold. This process was continued until no more than two top-performers were matched with the same farm.

Comparisons post-matching

Table 2 and Figure 2 show the comparisons between the top performers and the matched bottom performers. Significance tests now use a paired t-tests for the continuous variables. Even though economic size was one of the variables used for the matching, economic size remains significant, albeit with a smaller difference than before (mean SLR of bottom quartile is 3.79 compared to 5.03 for the matched sample). Similarly the difference in the number of dairy cows (which was not directly used in matching, although it is the biggest item in SLR), is reduced but again remains significant. Otherwise the significant variables are largely similar to the unmatched comparisons.

Table 2: tests for differences between matched pairs of top and bottom performers.

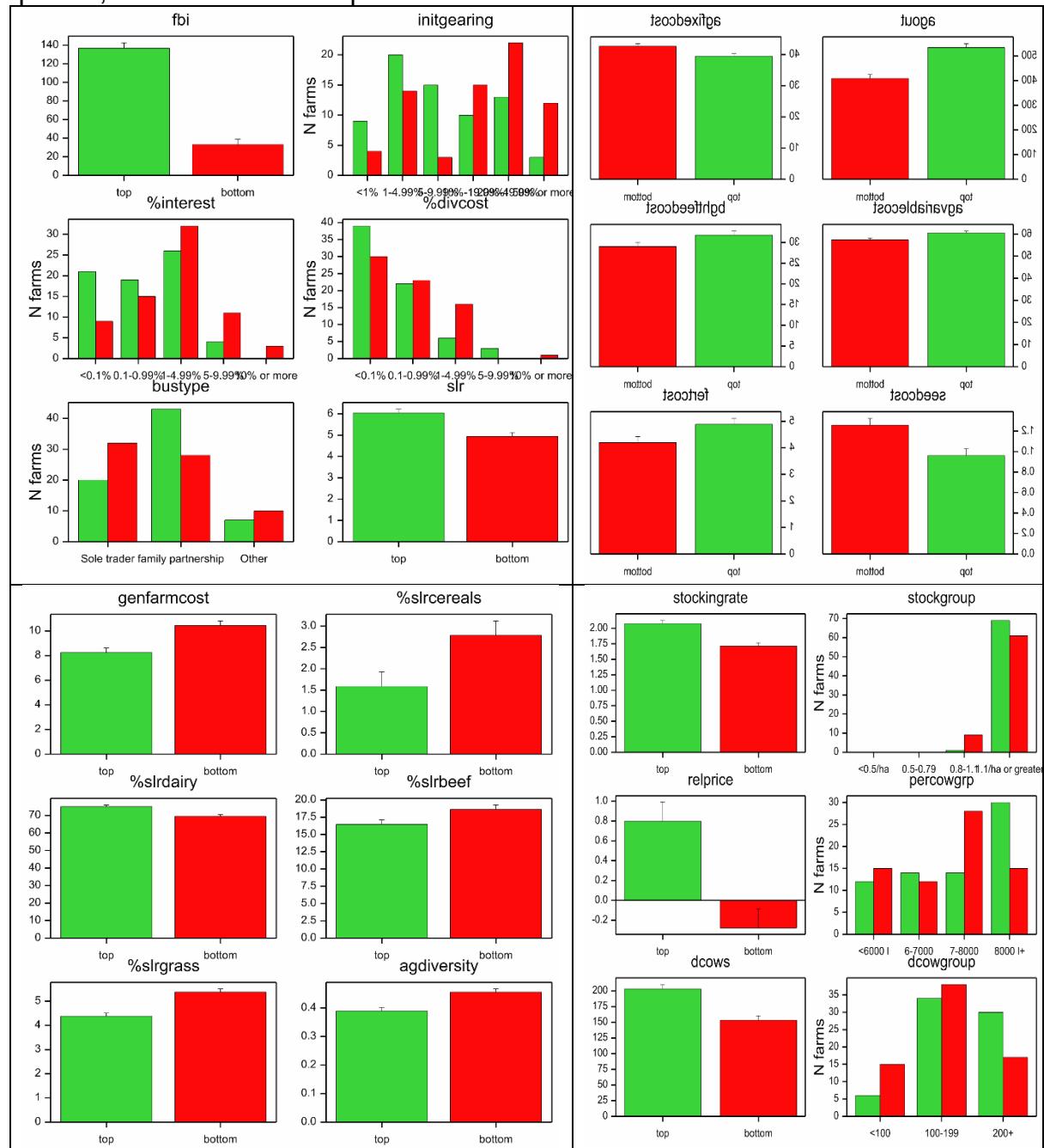
| variable | Means | | | | | | | | Definition |
|----------------|-------|--------|------|-------|-------|-----|------|--|------------|
| | Top | bottom | sed | t | P | sig | diff | | |
| fbi | 136.8 | 33.1 | 8.2 | 12.63 | 0.000 | *** | 1.60 | Farm Business Income £000 | |
| north | 278.5 | 280.5 | 9.0 | 0.22 | 0.825 | NS | 0.01 | Northing (mid point of JCA) | |
| east | 364.3 | 370.4 | 4.9 | 1.23 | 0.221 | NS | 0.07 | Easting (mid point of JCA) | |
| altitude | | | | | 1.000 | NS | | Altitude (3 bands) | |
| gor | | | | | 0.560 | NS | | GOR | |
| age | 51.9 | 53.2 | 1.4 | 0.91 | 0.368 | NS | 0.13 | Age of farmer | |
| education | | | | | 0.902 | NS | | education of farmer | |
| conrat | 0.3 | 0.3 | 0.0 | 0.40 | 0.692 | NS | 0.07 | contracting costs as % all machinery & contracting | |
| %unpaid | 55.3 | 55.0 | 1.1 | 0.33 | 0.741 | NS | 0.01 | Unpaid labour as % all labour | |
| lfa | | | | | 0.672 | NS | | LFA group | |
| anylfa | 0.2 | 0.2 | 0.0 | 1.00 | 0.321 | NS | 0.03 | 0/1 for LFA | |
| initgearing | | | | | 0.004 | ** | | gearing group (opening a/c) | |
| %interest | | | | | 0.019 | * | | Interest paid as % farm costs | |
| %divcost | | | | | 0.019 | * | | diversific costs as % farm costs | |
| logarea | 2.1 | 2.1 | 0.0 | 0.66 | 0.511 | NS | 0.03 | Log of total area | |
| %nvz | 47.3 | 42.6 | 6.3 | 0.74 | 0.459 | NS | 0.10 | % land in nvz | |
| farmass | 0.9 | 0.9 | 0.0 | 0.00 | | - | 0.00 | farm assurance 0/1 | |
| conrearin | 0.1 | 0.1 | 0.0 | 0.70 | 0.483 | NS | 0.09 | Contract rearing animals in | |
| conrearout | 0.3 | 0.2 | 0.1 | 0.62 | 0.535 | NS | 0.11 | Contract rearing animals out | |
| %chguaa | 1.9 | 0.9 | 0.7 | 1.37 | 0.176 | NS | 0.19 | % change in uaa | |
| fbt | 30.2 | 29.6 | 4.8 | 0.13 | 0.899 | NS | 0.02 | FBT land | |
| fat | 14.3 | 17.0 | 5.0 | 0.55 | 0.585 | NS | 0.09 | FAT land | |
| owned | 55.5 | 53.4 | 5.9 | 0.36 | 0.717 | NS | 0.06 | owned land | |
| tenure | | | | | 0.873 | NS | | tenure | |
| bustype | | | | | 0.032 | * | | business type | |
| porg | 0.1 | 0.1 | 0.0 | 0.19 | 0.853 | NS | 0.00 | proportion of land organic | |
| aesperha | 24.6 | 26.2 | 3.3 | 0.47 | 0.638 | NS | 0.04 | AES payments per ha | |
| aesgroup | | | | | 0.202 | NS | | AES grouped | |
| slr | 6.0 | 4.9 | 0.3 | 4.34 | 0.000 | *** | 0.41 | SLR | |
| slrgroup | | | | | 0.106 | NS | | SLR group | |
| manager | 0.0 | 0.0 | 0.0 | 1.42 | 0.161 | NS | 0.27 | Paid manager yes/no | |
| agout | 533.7 | 408.7 | 22.0 | 5.69 | 0.000 | *** | 0.47 | agricultural output | |
| livesubs | 1.1 | 0.8 | 0.4 | 0.85 | 0.398 | NS | 0.11 | subsidies (e.g. TB compensation) | |
| unpaidhrs | 4.4 | 4.2 | 0.2 | 1.18 | 0.244 | NS | 0.13 | Unpaid labour hours (000s) | |
| agcosts | 431.9 | 424.7 | 21.1 | 0.34 | 0.734 | NS | 0.03 | agricultural costs | |
| agfixedcost | 39.4 | 42.6 | 1.1 | 2.80 | 0.007 | ** | 0.40 | agriculture fixed costs † | |
| agvariablecost | 60.6 | 57.4 | 1.1 | 2.80 | 0.007 | ** | 0.40 | agriculture variable costs † | |
| bghtfeedcost | 31.8 | 29.0 | 1.4 | 2.02 | 0.047 | * | 0.29 | Bought feed costs † | |
| vetcost | 3.6 | 3.5 | 0.2 | 0.64 | 0.522 | NS | 0.10 | vet costs † | |
| seedcost | 1.0 | 1.3 | 0.1 | 3.17 | 0.002 | ** | 0.37 | seed costs † | |
| fertcost | 4.9 | 4.2 | 0.3 | 2.20 | 0.031 | * | 0.25 | fertiliser costs † | |
| cpcost | 0.7 | 0.8 | 0.1 | 1.13 | 0.263 | NS | 0.10 | crop protection costs † | |
| genfarmcost | 8.2 | 10.4 | 0.5 | 4.14 | 0.000 | *** | 0.60 | general farming costs † | |
| labourcost | 9.7 | 9.4 | 0.7 | 0.52 | 0.604 | NS | 0.06 | agricultural labour costs † | |
| machinerycost | 13.2 | 14.3 | 0.6 | 1.69 | 0.095 | 10% | 0.22 | machinery costs † | |
| %slrcereals | 1.6 | 2.8 | 0.5 | 2.48 | 0.016 | * | 0.24 | SLR cereals | |
| %slrotherarab | 0.1 | 0.3 | 0.2 | 1.03 | 0.307 | NS | 0.22 | SLR other arable | |
| %slrdairy | 75.0 | 69.5 | 1.4 | 3.97 | 0.000 | *** | 0.52 | SLR dairy | |
| %slrbef | 16.5 | 18.6 | 0.9 | 2.29 | 0.025 | * | 0.35 | SLR beef | |
| %slrsheep | 2.1 | 3.0 | 0.9 | 0.96 | 0.342 | NS | 0.13 | SLR sheep | |
| %slrgrass | 4.4 | 5.4 | 0.2 | 5.38 | 0.000 | *** | 0.68 | SLR grass and fodder | |
| agdiversity | 0.4 | 0.5 | 0.0 | 4.12 | 0.000 | *** | 0.56 | Agricultural diversity | |
| stockingrate | 2.1 | 1.7 | 0.1 | 5.03 | 0.000 | *** | 0.67 | Stocking rate | |
| stockgroup | | | | | 0.014 | * | | Stocking rate group | |
| relprice | 0.8 | -0.3 | 0.3 | 3.97 | 0.000 | *** | 0.38 | Relative milk price | |

| | | | | | | | |
|-----------|-------|-------|-----|------|-------|-----|---------------------------|
| percowgrp | | | | | 0.029 | * | Grouped litres per cow |
| dcows | 203.1 | 153.2 | 9.8 | 5.08 | 0.000 | *** | Number dairy cows |
| dcowgroup | | | | | 0.025 | | Grouped dairy cow numbers |

Note: NS not significant, 10% P <= 0.1 (almost significant), * P <= 0.05, ** P <= 0.01, *** P <= 0.001

† as a percentage of all agricultural costs, sed=standard error of difference, diff=standardised difference

Figure 2: bar charts for the nominally significant variables. ‘Top’ refers to top quartile, ‘bottom’ to bottom quartile.



Cereals farms

Matching process

The variables used for matching were: northing (of JCA centroid), easting, SLR, and log-transformed area. As described in the proposal, each farm in the top quartile was matched with one in the bottom half of the distribution that was the closest match in terms of these variables. The correlation for these variables between the matched pairs was around 0.95, indicating a good match on all variables. Ideally matching would also have used organic status, but the number of organic farms was very small and so adding this variable led to some very poor matches in terms of location and economic size. Ownership was also investigated; this worked better for most of the range but there were some very poor matches for very large businesses.

The algorithm allows multiple matches, i.e. several top-performers may be paired with the same below-average performer. Where more than two top-performers were matched with the same farm, the matching process was repeated for these farms, but with increasing thresholds for detecting a match and with the final match selected at random from those matches less than the threshold. This process was continued until no more than two top-performers were matched with the same farm.

Comparisons between top and bottom performers

A wide variety of variables are tested – this is very much a screening procedure. Continuous variables are compared using a t-test (paired t-test for the matched comparison), whilst categorical ones use a chi-squared test, with a permutation test to allow for the situation where low expected values invalidate the usual test. Some key variables are included in both continuous and categorical form. All figures use FBS data from 2011-12 to 2015-16. Variables are averaged across years, using a simple mean, except for categorical variables where the mode is taken. Farms are included where they are always classified as cereal farms and are present in at least 3 of the 5 years. Performance is averaged on the percentile scale (i.e. a percentile is calculated for each year and these are averaged, before recalculating the percentile for the entire period), to minimise the impact of missing years.

Wheat yields and prices are also examined. A few farms do not grow wheat and so values are imputed based on barley yields/prices which show a high correlation with wheat on those farms growing both.

Table 1 and Figure 1 show comparisons between the top and bottom quantiles of the distribution of performance, based on the ratio of agricultural output to costs, charging unpaid family labour at the minimum wage rate for the year. Table 2 and Figure 2 show comparisons after matching between the top quartile and the matched poorer performers. The tables and figures include Farm Business Income in order to give an idea of the scale of difference between the performance groups.

Whilst there are some differences between the comparisons before and after matching, there are also great similarities so it is sensible to consider them together. Key points are:

- Location; eastings have a highly significant impact, with better performance to the east, but, as intended, this is removed by the matching process.
- Economic size is of borderline significance before matching, with more poor performers amongst the small group (right hand column of Figure 1). The difference is removed by matching.
- Debt; debt is linked to poor performance. This is likely to be because past poor performance has led to the build up of debt.
- Labour is interesting, particularly comparing the matched datasets. The top performers make more use of unpaid labour and contractors, with less paid labour costs.
- Ownership; owner occupied farms are more likely to be in the high performing group. Note that we are not imputing any rents for owner occupiers, so this is not particularly surprising.
- Livestock are more common amongst the poor performers and this is reflected both in the SLR components for beef and grassland, and in costs associated with livestock. Whilst it is possible that this reflects the problems of being a ‘jack of all trades’, it may simply be related to land quality, since livestock will be less common on the best arable land – the matching process is removing gross geographic differences but cannot address more local land quality issues.
- Output and costs. Agricultural output is significantly higher for the top performers. Before matching agricultural costs are not significantly different but, using the matched data, costs are significantly lower for the top performers. Breaking down the costs, the top performers have higher variable costs (including fertilisers and crop protection products) but lower fixed costs.
- Agri-environment schemes; average payment rates are higher for the lower performers. The grouped AES variable makes the position clearer; poor performers are more likely to be in the highest group (generally be HLS recipients), whereas the ‘<£5 per ha’ group is dominated by high performers. This corresponds to previous evidence suggesting that higher value schemes may impact on the agricultural cost centre, but may also reflect a tendency for farms on poor soils to join such schemes.
- Wheat yield is significantly higher for the top performing group, whereas price shows no significant difference.

Table 1: significance test for differences between top and bottom quartiles.

Performance percentiles based on ratio agricultural output to agricultural costs, costing unpaid labour at minimum wage. † as a percentage of total agricultural costs.

| variable | Means | | | | | | Definition |
|----------------|--------|---------|--------|------|-------|-----|--|
| | Top | bottom | sed | t | P | sig | |
| fbi | 157.54 | 32.73 | 28.467 | 4.38 | 0.000 | *** | Farm Business Income £000 |
| north | 282.7 | 271.39 | 21.701 | 0.52 | 0.603 | NS | Northing (mid point of JCA) |
| east | 502.1 | 455.24 | 13.491 | 3.47 | 0.001 | *** | Easting (mid point of JCA) |
| altitude | | | | | 0.501 | NS | Altitude (3 bands from section A) |
| younger | | | | | 0.384 | NS | Transfer to younger farmer |
| education | | | | | 0.201 | NS | education of farmer |
| conrat | 0.3 | 0.26 | 0.052 | 1.65 | 0.101 | NS | contracting costs as % all machinery & contracting |
| %unpaid | 67.9 | 61.07 | 6.007 | 1.14 | 0.254 | NS | Unpaid labour as % all labour |
| initgearing | | | | | 0.000 | *** | gearing group (based on opening a/c) |
| %interest | | | | | 0.000 | *** | Interest payments as % farm costs |
| %divcost | | | | | 0.149 | NS | diversification costs as % farm costs |
| logarea | 2.4 | 2.23 | 0.057 | 2.19 | 0.030 | * | Log of total area |
| %nvz | 70.0 | 56.63 | 7.253 | 1.84 | 0.068 | 10% | % land in nvz |
| farmass | 0.9 | 0.91 | 0.049 | 0.29 | 0.773 | NS | farm assurance 0/1 |
| sharelm | | | | | 0.364 | NS | sharing labour machinery |
| firstyr | 2005.9 | 2005.53 | 0.769 | 0.48 | 0.630 | NS | first year in fbs |
| quotatype | | | | | 1.000 | NS | quota type |
| %chguua | 0.3 | -0.67 | 0.774 | 1.27 | 0.206 | NS | % change in uaa |
| sharefarm | 0.0 | 0.04 | 0.034 | 0.00 | | - | share farming |
| fbt | 8.0 | 13.57 | 3.427 | 1.64 | 0.104 | NS | FBT land |
| fat | 11.5 | 24.55 | 5.374 | 2.43 | 0.016 | * | FAT land |
| owned | 80.5 | 61.88 | 5.872 | 3.18 | 0.002 | ** | owned land |
| tenure | | | | | 0.006 | ** | tenure |
| bustype | | | | | 0.141 | NS | business type |
| porg | 0.0 | 0.05 | 0.032 | 0.79 | 0.432 | NS | proportion of land organic |
| aesperha | 24.4 | 46.04 | 6.117 | 3.53 | 0.001 | *** | AES payments per ha |
| aesgroup | | | | | 0.000 | *** | AES grouped |
| slr | 2.7 | 1.99 | 0.427 | 1.63 | 0.106 | NS | SLR |
| slrgroup | | | | | 0.010 | NS | SLR group |
| manager | 0.1 | 0.07 | 0.040 | 0.21 | 0.832 | NS | Paid manager yes/no |
| agout | 365.4 | 181.79 | 54.155 | 3.39 | 0.001 | *** | agricultural output |
| livesubs | 0.0 | 0.01 | 0.009 | 1.27 | 0.206 | NS | livestock subsidies (e.g. TB compensation) |
| unpaidhrs | 2.3 | 2.31 | 0.290 | 0.09 | 0.930 | NS | Unpaid labour hours (000s) |
| agcosts | 298.5 | 277.83 | 49.338 | 0.42 | 0.676 | NS | agricultural costs |
| agfixedcost | 42.5 | 58.40 | 2.500 | 6.35 | 0.000 | *** | agriculture fixed costs † |
| agvariablecost | 57.5 | 41.60 | 2.500 | 6.35 | 0.000 | *** | agriculture variable costs † |
| bghtfeedcost | 0.3 | 0.88 | 0.221 | 2.79 | 0.006 | ** | Bought feed costs † |
| vetcost | 0.1 | 0.29 | 0.066 | 3.10 | 0.002 | ** | vet costs † |
| seedcost | 6.6 | 4.69 | 0.297 | 6.31 | 0.000 | *** | seed costs † |
| fertcost | 17.6 | 11.98 | 0.752 | 7.47 | 0.000 | *** | fertiliser costs † |
| cpcost | 15.7 | 9.65 | 0.793 | 7.58 | 0.000 | *** | crop protection costs † |
| genfarmcost | 8.6 | 12.23 | 1.049 | 3.46 | 0.001 | *** | general farming costs † |
| labourcost | 3.9 | 6.57 | 1.102 | 2.44 | 0.016 | * | agricultural labour costs † |
| machinerycost | 20.3 | 21.27 | 1.767 | 0.54 | 0.591 | NS | machinery costs † |
| %slrcereals | 83.0 | 72.68 | 2.948 | 3.51 | 0.001 | *** | SLR cereals |
| %slrotherarab | 10.8 | 5.89 | 1.862 | 2.64 | 0.009 | ** | SLR other arable |
| %slrbef | 1.6 | 9.13 | 1.837 | 4.08 | 0.000 | *** | SLR beef |
| %slrsheep | 2.3 | 5.52 | 1.857 | 1.74 | 0.084 | 10% | SLR sheep |
| %slrpigs | 0.2 | 0.13 | 0.254 | 0.42 | 0.673 | NS | SLR pigs |
| %slrglass | 1.7 | 5.14 | 0.537 | 6.33 | 0.000 | *** | SLR grass and fodder |
| wheatprice | 158.9 | 155.38 | 4.592 | 0.76 | 0.446 | NS | Wheat price |

wheatyld 8.6 7.28 0.244 5.61 0.000 *** Wheat yield

Note: NS not significant, 10% P <= 0.1 (almost significant), * P <= 0.05, ** P <= 0.01, *** P <= 0.001

† as a percentage of all agricultural costs, sed=standard error of difference

Figure 1: bar charts for the nominally significant variables. ‘Top’ refers to top quartile, ‘bottom’ to bottom quartile.

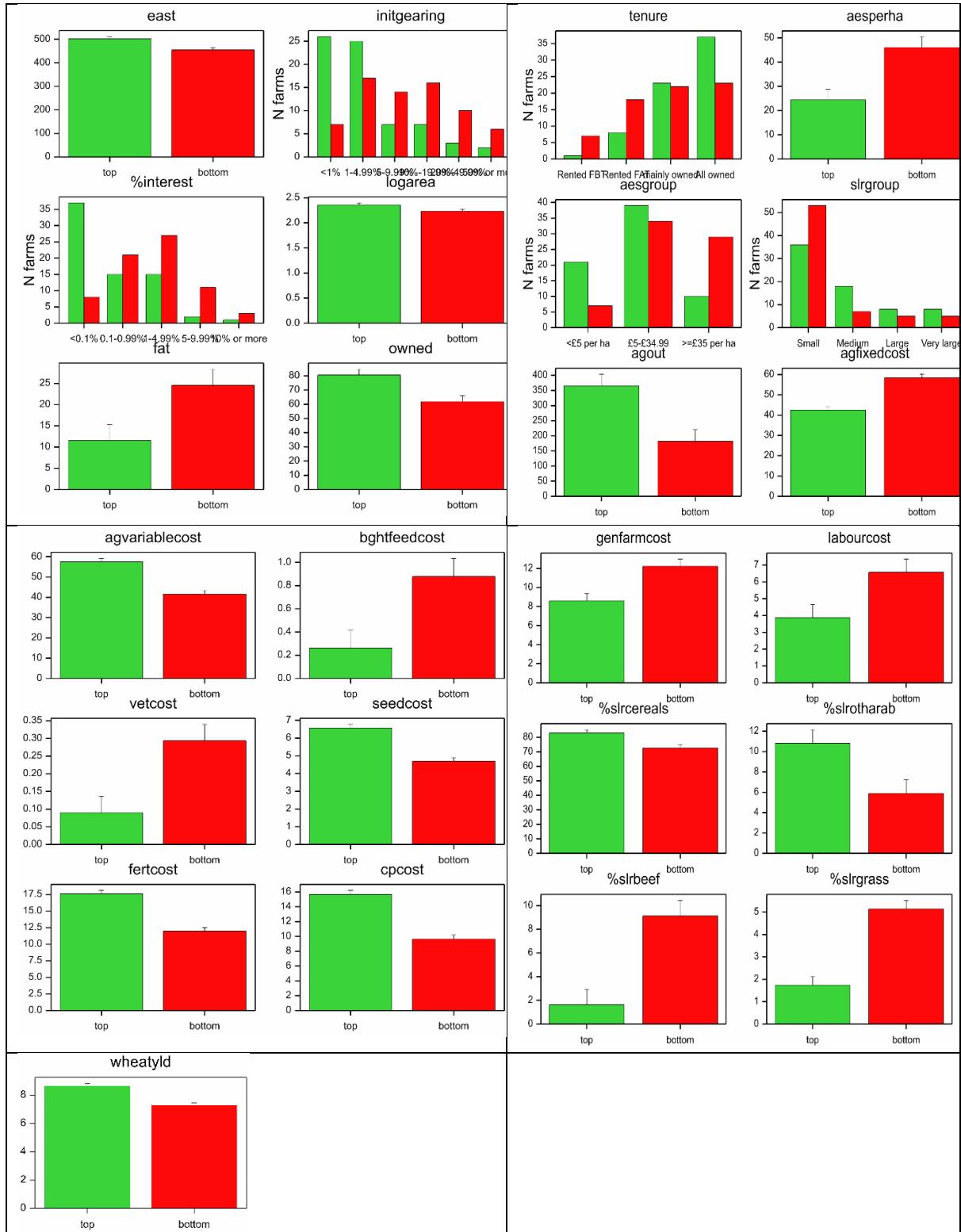


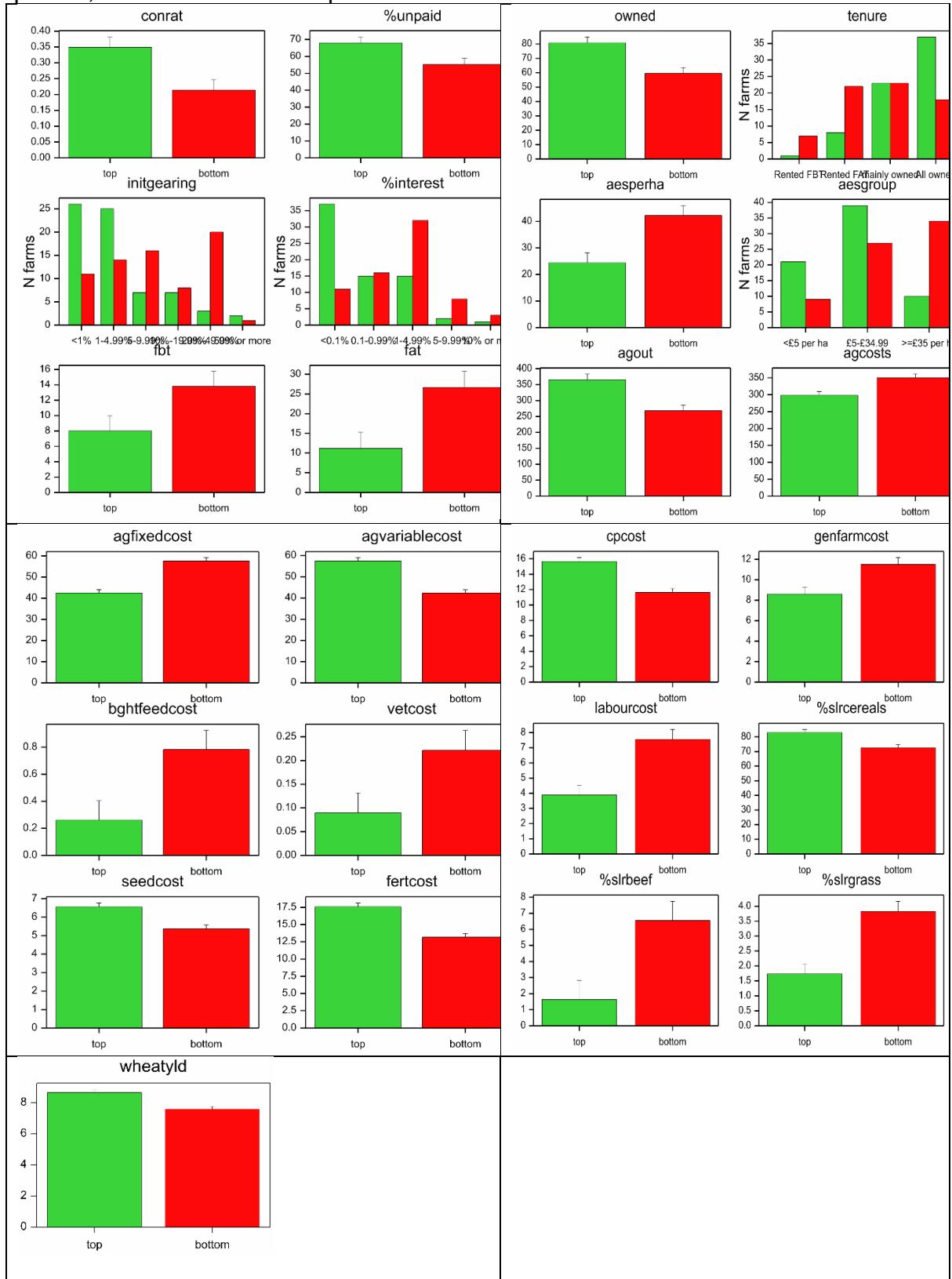
Table 2: significance tests for differences between the matched pairs of top and bottom performers.

| variable | Means | | sed | t | P | sig | Definition |
|----------------|--------|--------|--------|------|-------|-----|--|
| | Top | bottom | | | | | |
| fbi | 157.5 | 58.9 | 27.8 | 3.55 | 0.001 | *** | Farm Business Income £000 |
| north | 282.7 | 281.4 | 3.554 | 0.36 | 0.721 | NS | Northing (mid point of JCA) |
| east | 502.1 | 500.0 | 2.957 | 0.72 | 0.477 | NS | Easting (mid point of JCA) |
| altitude | | | | | 1.000 | NS | Altitude (3 bands from section A) |
| younger | | | | | 1.000 | NS | Transfer to younger farmer |
| education | | | | | 0.094 | 10% | education of farmer |
| conrat | 0.3 | 0.2 | 0.046 | 2.93 | 0.005 | ** | contracting costs as % all machinery & contracting |
| %unpaid | 67.9 | 55.2 | 5.085 | 2.51 | 0.014 | * | Unpaid labour as % all labour |
| initgearing | | | | | 0.000 | *** | gearing group (based on opening a/c) |
| %interest | | | | | 0.000 | *** | Interest payments as % farm costs |
| %divcost | | | | | 0.140 | NS | diversification costs as % farm costs |
| logarea | 2.4 | 2.4 | 0.012 | 0.15 | 0.883 | NS | Log of totarea (which is similar to UAA but minor differences) |
| %nvz | 70.0 | 72.4 | 6.075 | 0.40 | 0.689 | NS | % land in nvz |
| farmass | 0.9 | 1.0 | 0.045 | 1.27 | 0.208 | NS | farm assurance 0/1 |
| sharelm | | | | | 0.279 | NS | sharing labour machinery |
| firstyr | 2005.9 | 2006.5 | 0.717 | 0.82 | 0.417 | NS | first year in fbs |
| quotatype | | | | | 1.000 | NS | quota type |
| %chguaa | 0.3 | -0.7 | 0.662 | 1.53 | 0.132 | NS | % change in uaa |
| sharefarm | 0.0 | 0.1 | 0.038 | 0.38 | 0.708 | NS | share farming |
| fbt | 8.0 | 13.8 | 2.762 | 2.10 | 0.040 | * | FBT land |
| fat | 11.2 | 26.7 | 5.751 | 2.69 | 0.009 | ** | FAT land |
| owned | 80.8 | 59.5 | 5.711 | 3.72 | 0.000 | *** | owned land |
| tenure | | | | | 0.000 | *** | tenure |
| bustype | | | | | 0.225 | NS | business type |
| porg | 0.0 | 0.0 | 0.031 | 0.43 | 0.671 | NS | proportion of land organic |
| aesperha | 24.4 | 42.2 | 5.305 | 3.36 | 0.001 | ** | AES payments per ha |
| aesgroup | | | | | 0.000 | *** | AES grouped |
| slr | 2.7 | 2.6 | 0.087 | 0.62 | 0.537 | NS | SLR |
| slrgroup | | | | | 0.671 | NS | SLR group |
| manager | 0.1 | 0.1 | 0.036 | 0.24 | 0.814 | NS | Paid manager yes/no |
| agout | 365.4 | 268.2 | 25.148 | 3.87 | 0.000 | *** | agricultural output |
| livesubs | 0.0 | 0.0 | 0.004 | 1.74 | 0.086 | 10% | livestock subsidies (e.g. TB compensation) |
| unpaidhrs | 2.3 | 2.4 | 0.263 | 0.33 | 0.742 | NS | Unpaid labour hours (000s) |
| agcosts | 298.5 | 350.5 | 15.144 | 3.44 | 0.001 | ** | agricultural costs |
| agfixedcost | 42.5 | 57.7 | 2.079 | 7.28 | 0.000 | *** | agriculture fixed costs † |
| agvariablecost | 57.5 | 42.3 | 2.079 | 7.28 | 0.000 | *** | agriculture variable costs † |
| bghtfeedcost | 0.3 | 0.8 | 0.200 | 2.60 | 0.011 | * | Bought feed costs † |
| vetcost | 0.1 | 0.2 | 0.059 | 2.22 | 0.030 | * | vet costs † |
| seedcost | 6.6 | 5.4 | 0.284 | 4.18 | 0.000 | *** | seed costs † |
| fertcost | 17.6 | 13.2 | 0.739 | 5.99 | 0.000 | *** | fertiliser costs † |
| cpcost | 15.7 | 11.6 | 0.700 | 5.75 | 0.000 | *** | crop protection costs † |
| genfarmcost | 8.6 | 11.5 | 0.949 | 3.05 | 0.003 | ** | general farming costs † |
| labourcost | 3.9 | 7.6 | 0.926 | 3.97 | 0.000 | *** | agricultural labour costs † |
| machinerycost | 20.3 | 21.2 | 1.586 | 0.58 | 0.563 | NS | machinery costs † |
| %slrcereals | 83.0 | 72.7 | 2.900 | 3.57 | 0.001 | *** | SLR cereals |
| %slrotherarab | 10.8 | 9.5 | 1.915 | 0.71 | 0.481 | NS | SLR other arable |
| %slrbeef | 1.6 | 6.5 | 1.693 | 2.90 | 0.005 | ** | SLR beef |
| %slrsheep | 2.3 | 5.3 | 1.685 | 1.79 | 0.078 | 10% | SLR sheep |
| %slrpigs | 0.2 | 0.0 | 0.234 | 0.99 | 0.327 | NS | SLR pigs |
| %slrgrass | 1.7 | 3.8 | 0.477 | 4.39 | 0.000 | *** | SLR grass and fodder |
| wheatprice | 158.9 | 157.5 | 5.080 | 0.28 | 0.782 | NS | Wheat price |
| wheatyld | 8.6 | 7.6 | 0.231 | 4.59 | 0.000 | *** | Wheat yield |

Note: NS not significant, 10% P <= 0.1 (almost significant), * P <= 0.05, ** P <= 0.01, *** P <= 0.001

† as a percentage of all agricultural costs, sed=standard error of difference

Figure 2: bar charts for the nominally significant variables. ‘Top’ refers to top quartile, ‘bottom’ to matched pairs from the bottom half of the distribution.

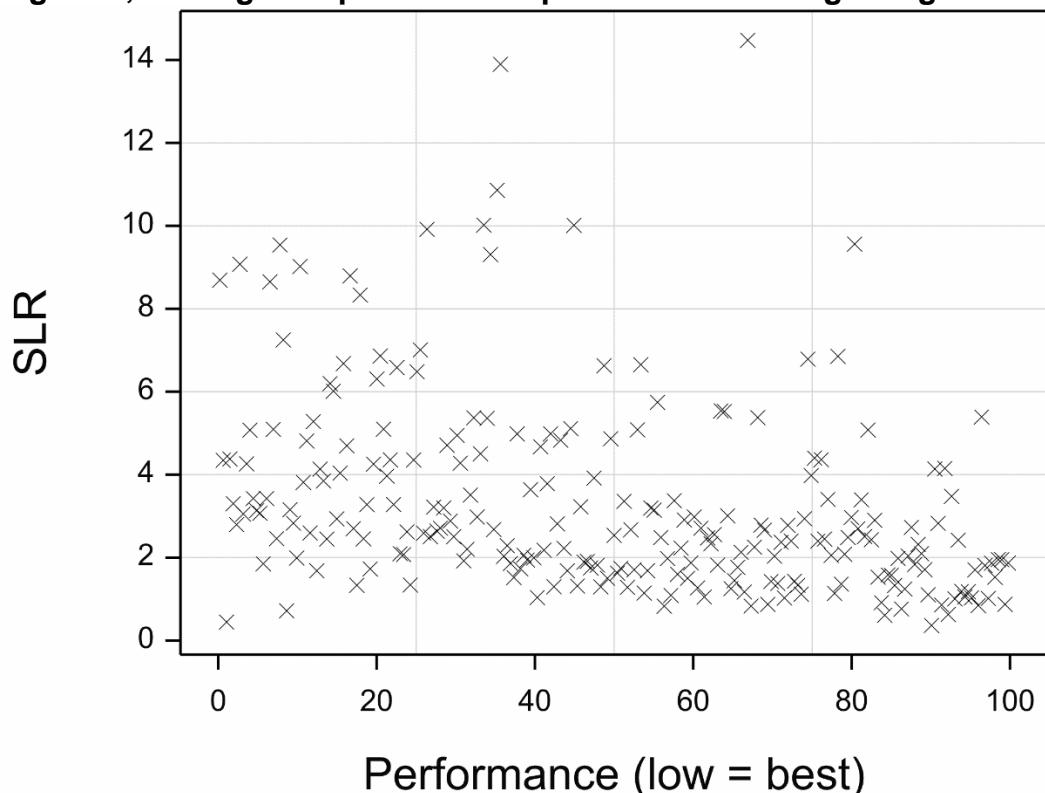


LFA grazing livestock farms

Matching process

The matching process was conducted as described for arable and dairy farms, but using the following variables: northing, easting, altitude over 300m, log-transformed SLR, organic status and log-transformed area. Whilst the matches are generally good there are a small percentage that are unsatisfactory, mainly in terms of SLR. Figure 0 shows why this is the case; the top quartile contains around 15 farms above 6 SLR, whereas there are only 5 in the bottom 50%. Hence it will be a struggle to get matches for these economically large top-performers, even without considering the geographic variables. The decision was therefore taken to exclude 5 pairs of farms where the match is particularly poor from further analysis; whilst this is not ideal in that it will reduce precision slightly and carries some risk of bias, this seems better than compromising the matching process.

Figure 0; SLR against performance percentile for LFA grazing farms.



Comparisons between top and bottom performers

A wide variety of variables are tested – this is very much a screening procedure. Continuous variables are compared using a t-test (paired t-test for the matched comparison), whilst categorical ones use a chi-squared test, with a permutation test to allow for the situation where low expected values invalidate the usual test. Some key variables are included in both continuous and categorical form. All figures use FBS data from 2011-12 to 2015-16. Variables are averaged across years, using a simple mean, except for categorical variables where the mode is taken. Farms are

included where they are always classified as LFA grazing livestock farms and are present in at least 3 of the 5 years. Performance is averaged on the percentile scale (i.e. a percentile is calculated for each year and these are averaged, before recalculating the percentile for the entire period), to minimise the impact of missing years.

Table 1 and Figure 1 show comparisons between the top and bottom quantiles of the distribution of performance, based on the ratio of agricultural output to costs, charging unpaid family labour at the minimum wage rate for the year. Table 2 and Figure 2 show comparisons after matching (and excluding the five poor matches) between the top quartile and the matched poorer performers. The tables and figures include Farm Business Income in order to give an idea of the scale of difference between the performance groups.

The comparisons before and after matching are considered together, but note that the matching has removed many of the differences, suggesting that they were related to either geographic or size differences. Key points are:

- Location; eastings have a highly significant impact, with better performance to the east, but, as intended, this is removed by the matching process.
- Economic size differs hugely before matching, as would be expected from Figure 0. The difference is considerably reduced by matching, but remains statistically significant¹. The graph for the grouped variable reveals why; the top quartile is dominated by large farms, whereas the matched sample contains more medium farms. Again, this makes sense looking at Figure 0 above; farms with SLRs just above 3 in the top quartile will tend to match with those below 3 in the bottom half because of the relative numbers of such farms.
- Debt; proportionately high interest payments are linked to poor performance, and gearing ratio is significant after matching. This is likely to be because past poor performance has led to the build up of debt.
- Ownership; an interesting difference arises between FAT and FBT farmers after matching.
- There are a number of differences relating to top performers growing arable crops and/or managing grassland more intensively – the SLRs for cereals and cost for seeds, fertilisers and crop protection products. With the exception of fertiliser costs, these vanish after matching, suggesting that these are indicative of the better quality land on the top performing farms.
- Output and costs. Before matching agricultural output and costs are both much higher for the top performers. After matching the differences in overall costs vanish, although differences remain in their breakdown; top performers have higher variable costs, but lower fixed costs. The general farming cost category is much lower for the top performers. Outputs remain significantly higher for the top performers after matching.
- Agri-environment schemes; average payment rates are higher for the lower performers but the difference is removed by matching.

¹ It should be remembered that the matching process, combined with analysis using a paired t-test, removes a substantial proportion of the random variation in performance, allowing smaller differences to be detected post-matching. This is reflected in the lower standard error of the difference (sed) in Table 2.

- The proportion of revenue from finished cattle and sheep, as opposed to animals sold as stores for finishing elsewhere, is higher for the top performers. This may indicate that finishing stock is a beneficial strategy, but may also indicate that the matching process is not removing all differences in land quality, with lower performers more likely to be on poor land which is less suitable for fattening animals.

Table 1: significance test for differences between top and bottom quartiles.

| variable | Means | | | | | | | Definition |
|----------------|-------|--------|------|-------|-------|-----|--|------------|
| | Top | bottom | sed | t | P | sig | | |
| fbi | 52.0 | 10.8 | 6.1 | 6.76 | 0.000 | *** | Farm Business income £000 | |
| north | 436.2 | 390.6 | 29.4 | 1.55 | 0.124 | NS | Northing (mid point of JCA) | |
| east | 371.9 | 348.4 | 11.1 | 2.12 | 0.036 | * | Easting (mid point of JCA) | |
| altitude | | | | | 0.079 | 10% | Altitude (3 bands) | |
| gor | | | | | 0.106 | NS | GOR | |
| age | 54.5 | 58.2 | 1.8 | 2.09 | 0.039 | * | Age of farmer | |
| younger | | | | | 0.484 | NS | Transfer to younger farmer | |
| education | | | | | 0.122 | NS | education of farmer | |
| conrat | 0.2 | 0.2 | 0.0 | 0.10 | 0.920 | NS | contracting costs as % all machinery & contracting | |
| %unpaid | 79.9 | 82.4 | 5.0 | 0.52 | 0.604 | NS | Unpaid labour as % all labour | |
| lfa | | | | | 0.831 | NS | LFA group | |
| initgearing | | | | | 0.079 | 10% | gearing group (opening a/c) | |
| %interest | | | | | 0.003 | ** | Interest paid as % farm costs | |
| %divcost | | | | | 0.461 | NS | diversification costs % farm costs | |
| logarea | 2.3 | 2.2 | 0.1 | 1.39 | 0.167 | NS | Log of total area | |
| %nvz | 16.2 | 15.9 | 6.2 | 0.04 | 0.968 | NS | % land in nvz | |
| farmass | 0.9 | 0.7 | 0.1 | 2.11 | 0.037 | * | farm assurance 0/1 | |
| conrearin | 0.1 | 0.1 | 0.0 | 0.34 | 0.731 | NS | Contract rearing animals in | |
| conrearout | 0.3 | 0.3 | 0.1 | 0.39 | 0.697 | NS | Contract rearing animals out | |
| sharelm | | | | | 0.736 | NS | sharing labour machinery | |
| quotatype | | | | | 0.681 | NS | quota type | |
| %chguaa | -0.1 | -0.3 | 0.8 | 0.32 | 0.750 | NS | % change in uaa | |
| fbt | 27.9 | 23.5 | 6.3 | 0.68 | 0.496 | NS | FBT land | |
| fat | 18.4 | 20.4 | 6.2 | 0.33 | 0.744 | NS | FAT land | |
| owned | 53.7 | 56.0 | 7.9 | 0.29 | 0.773 | NS | owned land | |
| tenure | | | | | 0.497 | NS | tenure | |
| bustype | | | | | 0.217 | NS | business type | |
| porg | 0.1 | 0.1 | 0.0 | 0.53 | 0.597 | NS | proportion of land organic | |
| aesperha | 59.6 | 102.3 | 13.6 | 3.14 | 0.002 | ** | AES payments per ha | |
| aesgroup | | | | | 0.003 | ** | AES grouped | |
| slr | 4.3 | 2.3 | 0.4 | 5.45 | 0.000 | *** | SLR | |
| slrgroup | | | | | 0.000 | *** | SLR group | |
| agout | 145.0 | 41.1 | 10.4 | 10.01 | 0.000 | *** | agricultural output | |
| livesubs | 0.2 | 0.7 | 0.3 | 1.63 | 0.106 | NS | subsidies (e.g. TB compensation) | |
| unpaidhrs | 3.4 | 2.6 | 0.3 | 2.53 | 0.013 | * | Unpaid labour hours (000s) | |
| agcosts | 139.3 | 75.3 | 12.4 | 5.17 | 0.000 | *** | agricultural costs | |
| agfixedcost | 46.6 | 56.2 | 2.0 | 4.71 | 0.000 | *** | agriculture fixed costs † | |
| agvariablecost | 53.4 | 43.8 | 2.0 | 4.71 | 0.000 | *** | agriculture variable costs † | |
| bghtfeedcost | 21.4 | 18.3 | 1.9 | 1.65 | 0.101 | NS | Bought feed costs † | |
| vetcost | 5.1 | 4.4 | 0.4 | 1.84 | 0.068 | 10% | vet costs † | |
| seedcost | 0.7 | 0.2 | 0.1 | 3.67 | 0.000 | *** | seed costs † | |
| fertcost | 6.6 | 3.7 | 0.6 | 4.62 | 0.000 | *** | fertiliser costs † | |
| cpcost | 0.5 | 0.2 | 0.1 | 2.97 | 0.004 | ** | crop protection costs † | |
| genfarmcost | 9.4 | 15.1 | 1.1 | 5.01 | 0.000 | *** | general farming costs † | |
| labourcost | 5.5 | 6.5 | 1.8 | 0.55 | 0.583 | NS | agricultural labour costs † | |
| machinerycost | 20.8 | 26.0 | 1.5 | 3.51 | 0.001 | *** | machinery costs † | |
| %slrcereals | 0.9 | 0.1 | 0.3 | 3.06 | 0.003 | ** | SLR cereals | |
| %slrotherarab | 0.0 | 0.0 | 0.0 | 1.41 | 0.160 | NS | SLR other arable | |
| %slrbef | 33.4 | 43.0 | 4.7 | 2.05 | 0.042 | * | SLR beef | |
| %slrsheep | 54.9 | 44.2 | 4.8 | 2.27 | 0.025 | * | SLR sheep | |
| %slrgrass | 8.0 | 11.6 | 1.1 | 3.44 | 0.001 | *** | SLR grass and fodder | |
| pfatcat | 0.3 | 0.1 | 0.1 | 3.80 | 0.000 | *** | prop fat cattle | |
| pfatsheep | 0.7 | 0.4 | 0.1 | 5.54 | 0.000 | *** | prop fat sheep | |
| agdiversity | 0.5 | 0.4 | 0.0 | 1.35 | 0.180 | NS | Agricultural diversity | |
| stockingrate | 0.9 | 0.7 | 0.1 | 2.79 | 0.006 | ** | Stocking rate | |
| stockgroup | | | | | 0.091 | 10% | Stocking rate group | |

Note: NS not significant, 10% P <= 0.1 (almost significant), * P <= 0.05, ** P <= 0.01, *** P <= 0.001
 † as a percentage of all agricultural costs, sed=standard error of difference

Figure 1: bar charts for the nominally significant variables. ‘Top’ refers to top quartile, ‘bottom’ to bottom quartile.

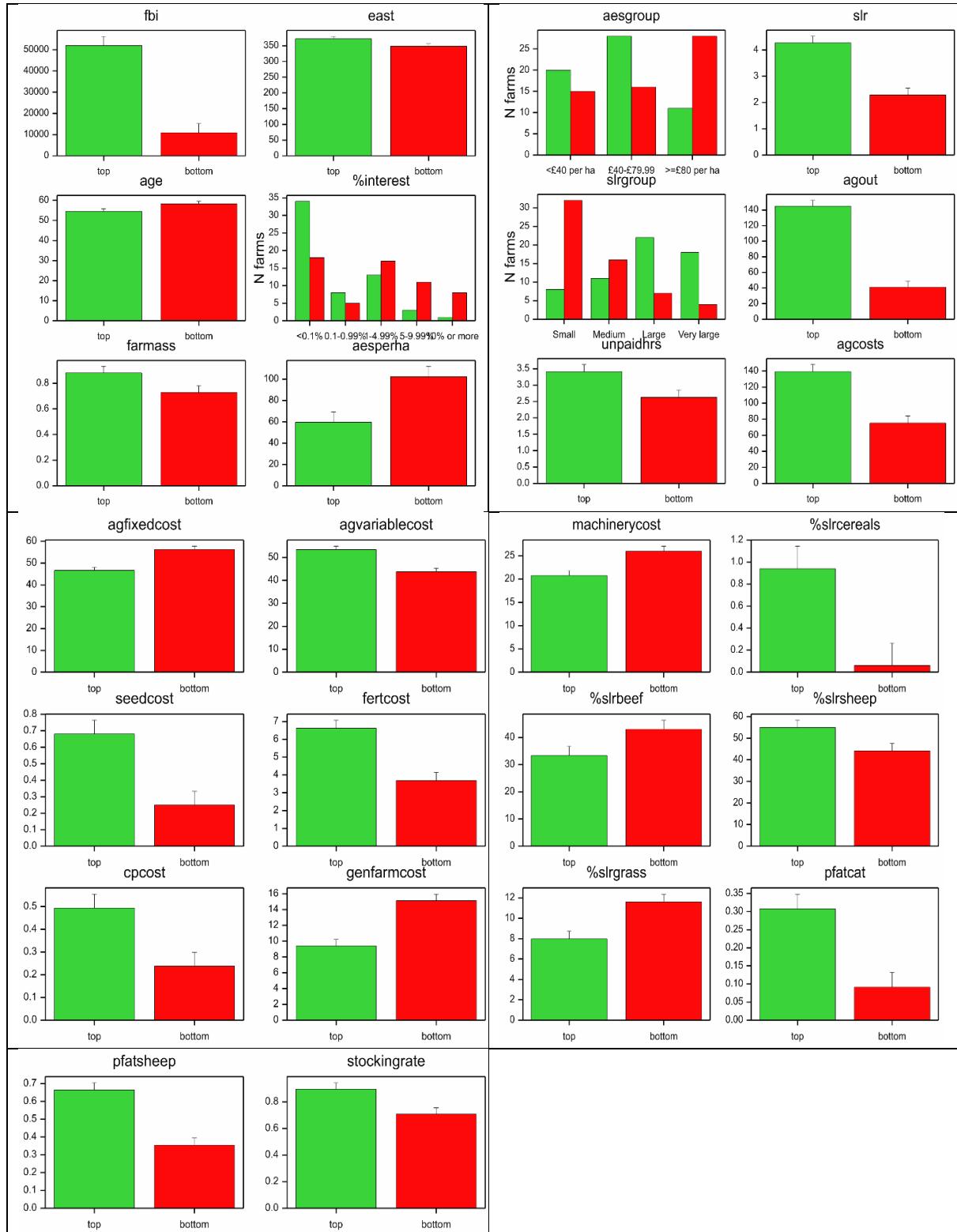


Table 2: tests for differences between matched pairs of top and bottom performers.

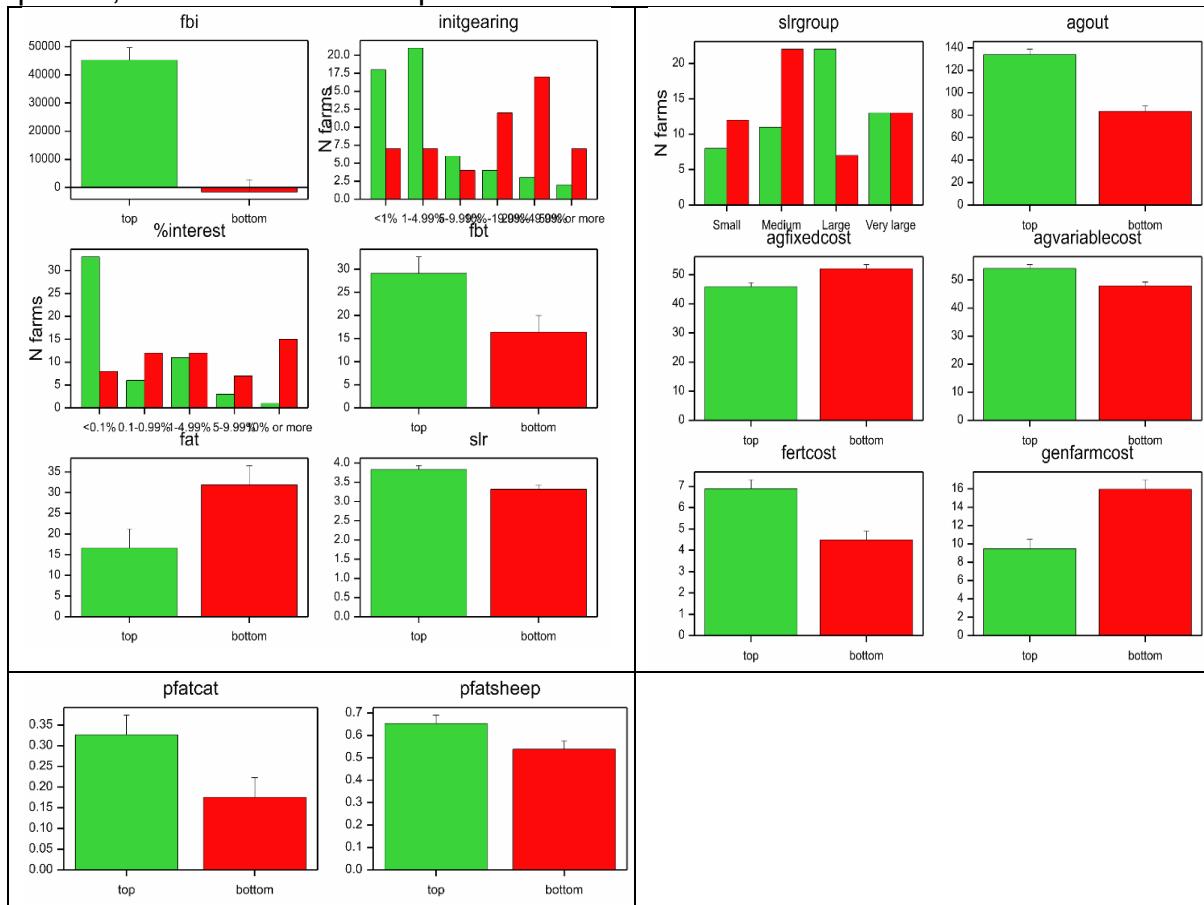
| variable | Means | | | | | | | | Definition |
|----------------|-------|--------|-----|------|-------|-----|------|---------------------------------------|------------|
| | Top | bottom | sed | t | P | sig | diff | | |
| fbi | 45.2 | -1.6 | 6.2 | 7.55 | 0.000 | *** | 1.37 | Farm Business Income £000 | |
| north | 421.4 | 426.7 | 5.9 | 0.91 | 0.368 | NS | 0.03 | Northing (mid point of JCA) | |
| east | 369.1 | 367.8 | 2.3 | 0.56 | 0.578 | NS | 0.02 | Easting (mid point of JCA) | |
| altitude | | | | | 0.664 | NS | | Altitude (3 bands) | |
| gor | | | | | 0.892 | NS | | GOR | |
| age | 54.9 | 54.0 | 1.8 | 0.50 | 0.617 | NS | 0.09 | Age of farmer | |
| younger | | | | | 0.494 | NS | | Transfer to younger farmer | |
| education | | | | | 0.228 | NS | | education of farmer | |
| conrat | 0.2 | 0.2 | 0.0 | 0.36 | 0.719 | NS | 0.06 | contracting costs as % | |
| %unpaid | 83.5 | 84.7 | 4.7 | 0.26 | 0.795 | NS | 0.05 | Unpaid labour as % all labour | |
| lfa | | | | | 0.418 | NS | | LFA group | |
| initgearing | | | | | 0.000 | *** | | gearing group (opening a/c) | |
| %interest | | | | | 0.000 | *** | | Interest paid as % farm costs | |
| %divcost | | | | | 0.672 | NS | | diversification costs as % farm costs | |
| logarea | 2.2 | 2.2 | 0.0 | 1.08 | 0.286 | NS | 0.06 | Log of total area | |
| %nvz | 17.7 | 10.9 | 4.6 | 1.46 | 0.152 | NS | 0.19 | % land in nvz | |
| farmass | 0.9 | 0.8 | 0.1 | 0.90 | 0.371 | NS | 0.14 | farm assurance 0/1 | |
| conrearin | 0.1 | 0.1 | 0.1 | 1.53 | 0.133 | NS | 0.33 | Contract rearing animals in | |
| conrearout | 0.3 | 0.3 | 0.1 | 0.22 | 0.830 | NS | 0.04 | Contract rearing animals out | |
| sharelm | | | | | 0.691 | NS | | sharing labour machinery | |
| quotatype | | | | | 0.304 | NS | | quota type | |
| %chguaa | -0.1 | 1.0 | 0.6 | 1.86 | 0.068 | 10% | 0.24 | % change in uaa | |
| sharefarm | 0.0 | 0.0 | 0.0 | | | - | | share farming | |
| fbt | 29.1 | 16.4 | 5.1 | 2.50 | 0.016 | * | 0.38 | FBT land | |
| fat | 16.6 | 31.9 | 6.5 | 2.34 | 0.023 | * | 0.43 | FAT land | |
| owned | 54.3 | 51.7 | 6.9 | 0.38 | 0.704 | NS | 0.06 | owned land | |
| tenure | | | | | 0.070 | 10% | | tenure | |
| bustype | | | | | 0.467 | NS | | business type | |
| porg | 0.1 | 0.1 | 0.0 | 0.13 | 0.895 | NS | 0.00 | proportion of land organic | |
| aesperha | 58.5 | 70.0 | 8.6 | 1.33 | 0.188 | NS | 0.17 | AES payments per ha | |
| aesgroup | | | | | 0.078 | 10% | | AES grouped | |
| slr | 3.8 | 3.3 | 0.1 | 3.53 | 0.001 | *** | 0.22 | SLR | |
| slrgroup | | | | | 0.006 | ** | | SLR group | |
| manager | 0.0 | 0.1 | 0.0 | 1.35 | 0.182 | NS | 0.39 | Paid manager yes/no | |
| agout | 133.9 | 83.4 | 6.8 | 7.48 | 0.000 | *** | 0.68 | agricultural output | |
| livesubs | 0.2 | 0.3 | 0.2 | 0.29 | 0.776 | NS | 0.04 | subsidies (e.g. TB compensation) | |
| unpaidhrs | 3.5 | 3.3 | 0.3 | 0.76 | 0.451 | NS | 0.16 | Unpaid labour hours (000s) | |
| agcosts | 128.7 | 126.8 | 7.9 | 0.24 | 0.812 | NS | 0.02 | agricultural costs | |
| agfixedcost | 45.9 | 52.1 | 2.0 | 3.09 | 0.003 | ** | 0.56 | agriculture fixed costs † | |
| agvariablecost | 54.1 | 47.9 | 2.0 | 3.09 | 0.003 | ** | 0.56 | agriculture variable costs † | |
| bghtfeedcost | 22.3 | 21.4 | 2.2 | 0.43 | 0.672 | NS | 0.09 | Bought feed costs † | |
| vetcost | 5.1 | 4.5 | 0.4 | 1.45 | 0.153 | NS | 0.25 | vet costs † | |
| seedcost | 0.6 | 0.4 | 0.1 | 1.91 | 0.062 | 10% | 0.31 | seed costs † | |
| fertcost | 6.9 | 4.5 | 0.6 | 4.10 | 0.000 | *** | 0.65 | fertiliser costs † | |
| cpcost | 0.5 | 0.5 | 0.1 | 0.03 | 0.974 | NS | 0.01 | crop protection costs † | |
| genfarmcost | 9.5 | 16.0 | 1.5 | 4.42 | 0.000 | *** | 1.01 | general farming costs † | |
| labourcost | 4.8 | 4.2 | 1.5 | 0.42 | 0.680 | NS | 0.08 | agricultural labour costs † | |
| machinerycost | 20.8 | 22.4 | 1.3 | 1.29 | 0.203 | NS | 0.22 | machinery costs † | |
| %slrcereals | 0.9 | 0.8 | 0.3 | 0.33 | 0.741 | NS | 0.05 | SLR cereals | |
| %slrotherarab | 0.0 | 0.0 | 0.0 | 1.00 | 0.322 | NS | 0.12 | SLR other arable | |
| %slrbef | 32.9 | 37.7 | 4.0 | 1.19 | 0.239 | NS | 0.19 | SLR beef | |
| %slrsheep | 55.3 | 51.9 | 4.3 | 0.79 | 0.433 | NS | 0.13 | SLR sheep | |
| %slrgrass | 8.0 | 8.3 | 0.4 | 0.89 | 0.375 | NS | 0.07 | SLR grass and fodder | |
| pfatcat | 0.3 | 0.2 | 0.1 | 2.26 | 0.028 | * | 0.45 | prop fat cattle | |
| pfatsheep | 0.7 | 0.5 | 0.1 | 2.17 | 0.034 | * | 0.35 | prop fat sheep | |
| agdiversity | 0.5 | 0.5 | 0.0 | 0.74 | 0.461 | NS | 0.12 | Agricultural diversity | |

| | | | | | | | | |
|--------------|-----|-----|-----|------|-------|----|------|---------------------|
| stockingrate | 0.9 | 0.8 | 0.1 | 0.96 | 0.339 | NS | 0.17 | Stocking rate |
| stockgroup | | | | | 0.404 | NS | | Stocking rate group |

Note: NS not significant, 10% P <= 0.1 (almost significant), * P <= 0.05, ** P <= 0.01, *** P <= 0.001

† as a percentage of all agricultural costs, sed=standard error of difference, diff=standardised difference

Figure 2: bar charts for the nominally significant variables. 'Top' refers to top quartile, 'bottom' to matched pairs from the bottom half of the distribution.

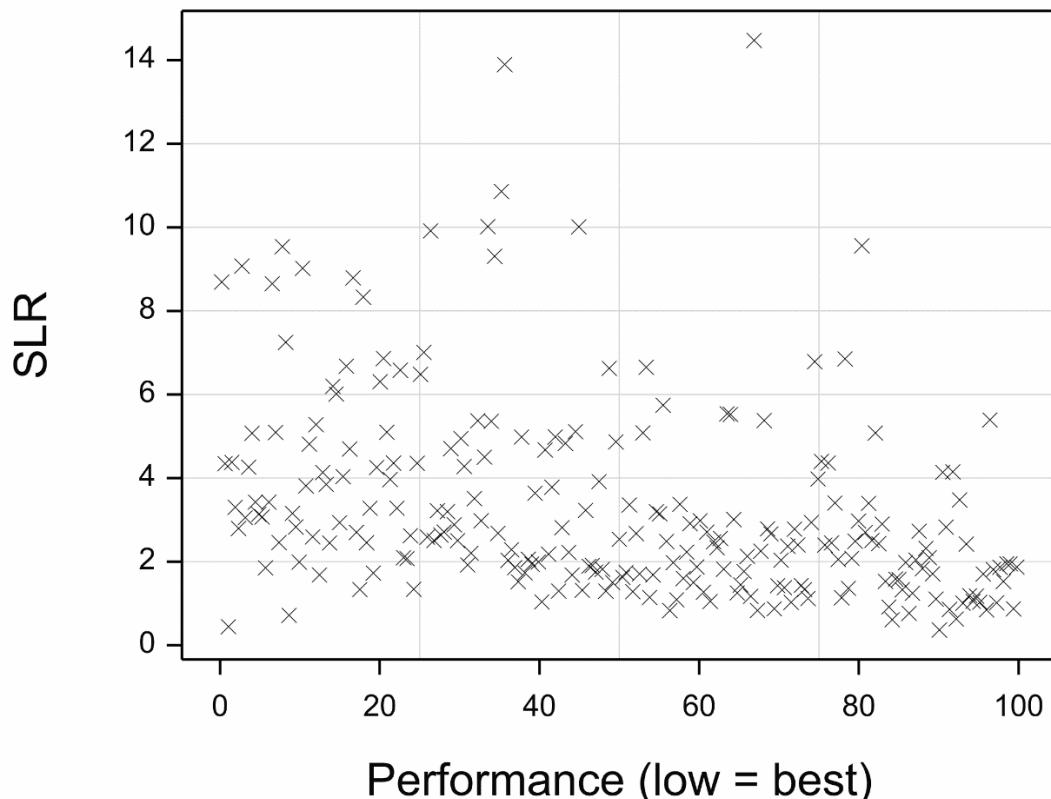


Lowland grazing livestock farms

Matching process

The matching process was conducted as described for arable and dairy farms, but using the following variables: northing, easting, altitude over 300m, log-transformed SLR, organic status and log-transformed area. Figure 0 shows that there are similar issues matching economically large top performers as there are for LFA farms. This time 3 pairs of farms have been excluded from further analysis where the match is particularly poor.

Figure 0; SLR against performance percentile for Lowland grazing farms.



Comparisons between top and bottom performers

A wide variety of variables are tested – this is very much a screening procedure. Continuous variables are compared using a t-test (paired t-test for the matched comparison), whilst categorical ones use a chi-squared test, with a permutation test to allow for the situation where low expected values invalidate the usual test. Some key variables are included in both continuous and categorical form. All figures use FBS data from 2011-12 to 2015-16. Variables are averaged across years, using a simple mean, except for categorical variables where the mode is taken. Farms are included where they are always classified as lowland grazing livestock farms and are present in at least 3 of the 5 years. Performance is averaged on the percentile scale (i.e. a percentile is calculated for each year and these are averaged, before recalculating the percentile for the entire period), to minimise the impact of missing years.

Table 1 and Figure 1 show comparisons between the top and bottom quantiles of the distribution of performance, based on the ratio of agricultural output to costs, charging unpaid family labour at the minimum wage rate for the year. Table 2 and Figure 2 show comparisons after matching (and excluding the five poor matches) between the top quartile and the matched poorer performers. The tables and figures include Farm Business Income in order to give an idea of the scale of difference between the performance groups. Table 2 also includes a column ('sdiff') for the standardised difference between the two groups – i.e. the size of the difference in standard deviation units.

The comparisons before and after matching are considered together, but note that the matching has removed many of the differences, suggesting that they were related to either geographic or size differences. Key points are:

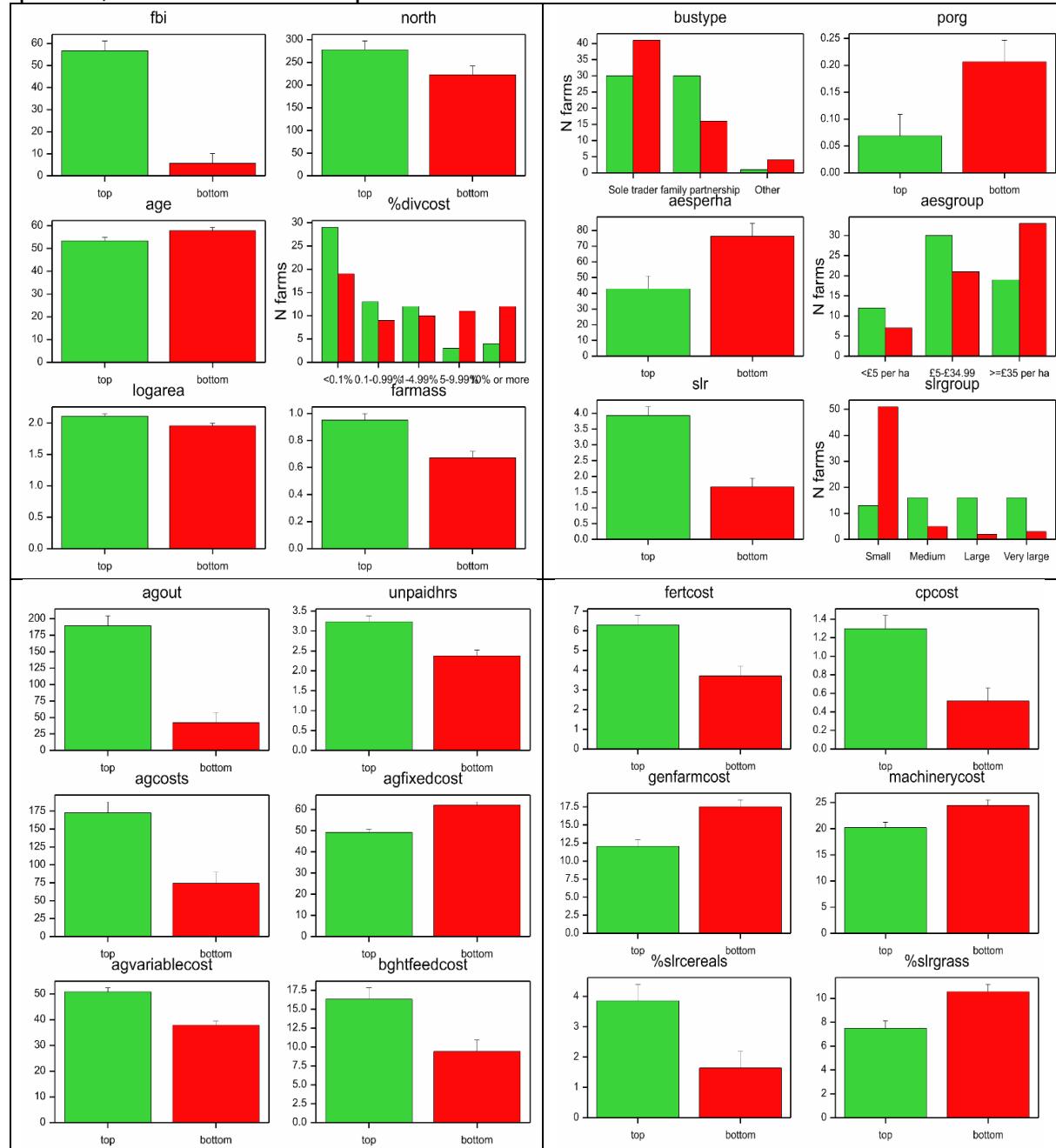
- Location; northings have a borderline significant impact, with better performance to the north, but, as intended, this is removed by the matching process.
- Economic size differs hugely before matching, as would be expected from Figure 0. The difference is considerably reduced by matching, but remains statistically significant.
- Debt and interest payments are not significant for this sector. Before matching there is some sign of a complex relationship, with the bottom performers tending to have either very little debt or very high levels, whereas the top performing group has more with intermediate levels.
- There are a number of differences relating to top performers growing arable crops and/or managing grassland more intensively – the SLRs for cereals and cost for fertilisers and crop protection products. With the exception of crop protection costs, these vanish after matching, suggesting that these are indicative of the better quality land on the top performing farms.
- Output and costs. Before matching agricultural output and costs are both much higher for the top performers. After matching the differences are reduced but remain statistically significant. The breakdown also varies; top performers have higher variable costs (including bought feed), but lower fixed costs.
- Agri-environment schemes; average payment rates are higher for the lower performers, due to more receiving over £35/ha (mainly HLS) but the difference is reduced by matching.
- After matching the top performers have significantly more of their SLR derived from beef cattle. The proportion of revenue from finished cattle is also higher for the top performers. This may indicate that finishing stock is a beneficial strategy, but may also indicate that the matching process is not removing all differences in land quality, with lower performers more likely to be on poor land which is less suitable for fattening animals.

Table 1: significance test for differences between top and bottom quartiles.

| variable | Means | | | | | | Definition |
|----------------|-------|--------|------|------|-------|-----|--|
| | Top | bottom | sed | t | P | sig | |
| fbi | 56.7 | 5.8 | 6.2 | 8.25 | 0.000 | *** | Farm Business Income £000 |
| north | 277.7 | 222.7 | 27.3 | 2.02 | 0.046 | * | Northing (mid point of JCA) |
| east | 394.8 | 406.4 | 20.0 | 0.58 | 0.563 | NS | Easting (mid point of JCA) |
| altitude | | | | | 0.499 | NS | Altitude (3 bands) |
| gor | | | | | 0.604 | NS | GOR |
| age | 53.4 | 57.8 | 2.1 | 2.14 | 0.035 | * | Age of farmer |
| younger | | | | | 1.000 | NS | Transfer to younger farmer |
| education | | | | | 0.091 | 10% | education of farmer |
| conrat | 0.2 | 0.2 | 0.0 | 0.31 | 0.754 | NS | contracting costs as % all machinery & contracting |
| %unpaid | 80.7 | 84.2 | 4.5 | 0.80 | 0.428 | NS | Unpaid labour as % all labour |
| anylfa | 0.0 | 0.0 | 0.0 | | | - | 0/1 for LFA |
| initgearing | | | | | 0.060 | 10% | gearing group (opening a/c) |
| %interest | | | | | 0.229 | NS | Interest paid as % farm costs |
| %divcost | | | | | 0.010 | * | diversification as % farm costs |
| logarea | 2.1 | 2.0 | 0.1 | 2.85 | 0.005 | ** | Log of total area |
| %nvz | 50.3 | 53.2 | 8.7 | 0.34 | 0.735 | NS | % land in nvz |
| farmass | 1.0 | 0.7 | 0.1 | 4.18 | 0.000 | *** | farm assurance 0/1 |
| conrearin | 0.2 | 0.2 | 0.1 | 0.24 | 0.812 | NS | Contract rearing animals in |
| conrearout | 0.0 | 0.0 | 0.0 | 1.76 | 0.081 | 10% | Contract rearing animals out |
| sharelm | | | | | 0.666 | NS | sharing labour machinery |
| quotatype | | | | | 1.000 | NS | quota type |
| %chguaa | 0.9 | 0.9 | 0.9 | 0.09 | 0.930 | NS | % change in uaa |
| sharefarm | 0.0 | 0.0 | 0.0 | 1.00 | 0.319 | NS | share farming |
| fbt | 28.9 | 25.1 | 6.1 | 0.62 | 0.534 | NS | FBT land |
| fat | 12.9 | 11.2 | 5.4 | 0.32 | 0.751 | NS | FAT land |
| owned | 58.2 | 63.6 | 7.1 | 0.77 | 0.444 | NS | owned land |
| tenure | | | | | 0.446 | NS | tenure |
| bustype | | | | | 0.013 | * | business type |
| porg | 0.1 | 0.2 | 0.1 | 2.44 | 0.016 | * | proportion of land organic |
| aesperha | 42.9 | 76.3 | 11.5 | 2.91 | 0.004 | ** | AES payments per ha |
| aesgroup | | | | | 0.033 | * | AES grouped |
| slr | 3.9 | 1.7 | 0.4 | 5.74 | 0.000 | *** | SLR |
| slrgroup | | | | | 0.000 | *** | SLR group |
| agout | 189.3 | 42.2 | 21.7 | 6.78 | 0.000 | *** | agricultural output |
| livesubs | 0.4 | 0.5 | 0.3 | 0.17 | 0.865 | NS | subsidies (e.g. TB compensation) |
| unpaidhrs | 3.2 | 2.4 | 0.2 | 4.03 | 0.000 | *** | Unpaid labour hours (000s) |
| agcosts | 172.6 | 74.3 | 21.8 | 4.50 | 0.000 | *** | agricultural costs |
| agfixedcost | 49.2 | 62.1 | 2.2 | 6.03 | 0.000 | *** | agriculture fixed costs † |
| agvariablecost | 50.8 | 37.9 | 2.2 | 6.03 | 0.000 | *** | agriculture variable costs † |
| bghtfeedcost | 16.3 | 9.4 | 2.1 | 3.27 | 0.001 | ** | Bought feed costs † |
| vetcost | 3.7 | 3.4 | 0.4 | 0.77 | 0.440 | NS | vet costs † |
| seedcost | 1.2 | 1.6 | 0.3 | 1.50 | 0.137 | NS | seed costs † |
| fertcost | 6.3 | 3.7 | 0.7 | 3.79 | 0.000 | *** | fertiliser costs † |
| cpcost | 1.3 | 0.5 | 0.2 | 3.86 | 0.000 | *** | crop protection costs † |
| genfarmcost | 12.1 | 17.5 | 1.3 | 4.09 | 0.000 | *** | general farming costs † |
| labourcost | 5.2 | 5.7 | 1.4 | 0.41 | 0.680 | NS | agricultural labour costs † |
| machinerycost | 20.2 | 24.4 | 1.5 | 2.83 | 0.005 | ** | machinery costs † |
| %slrcereals | 3.9 | 1.6 | 0.8 | 2.88 | 0.005 | ** | SLR cereals |
| %slrotherarab | 0.0 | 0.1 | 0.1 | 1.38 | 0.169 | NS | SLR other arable |
| %slrbef | 52.6 | 51.9 | 5.6 | 0.12 | 0.903 | NS | SLR beef |
| %slrsheep | 35.0 | 30.8 | 5.8 | 0.72 | 0.476 | NS | SLR sheep |
| %slrgrass | 7.5 | 10.6 | 0.9 | 3.51 | 0.001 | *** | SLR grass and fodder |
| pfatcat | 0.6 | 0.3 | 0.1 | 4.10 | 0.000 | *** | prop fat cattle |
| pfatsheep | 0.5 | 0.3 | 0.1 | 3.14 | 0.002 | ** | prop fat sheep |
| agdiversity | 0.4 | 0.4 | 0.0 | 0.83 | 0.407 | NS | Agricultural diversity |
| stockingrate | 1.7 | 0.9 | 0.3 | 2.35 | 0.020 | * | Stocking rate |

| stockgroup | 0.000 *** Stocking rate group |
|--|-------------------------------|
| Note: NS not significant, 10% P <= 0.1 (almost significant), * P <= 0.05, ** P <= 0.01, *** P <= 0.001 | |
| † as a percentage of all agricultural costs, sed=standard error of difference | |

Figure 1: bar charts for the nominally significant variables. 'Top' refers to top quartile, 'bottom' to bottom quartile.



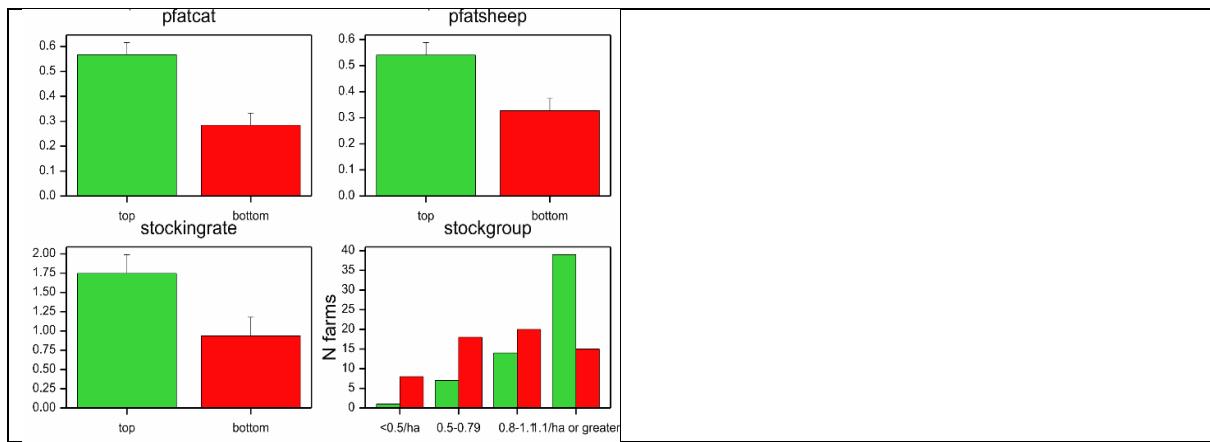


Table 2: tests for differences between matched pairs of top and bottom performers.

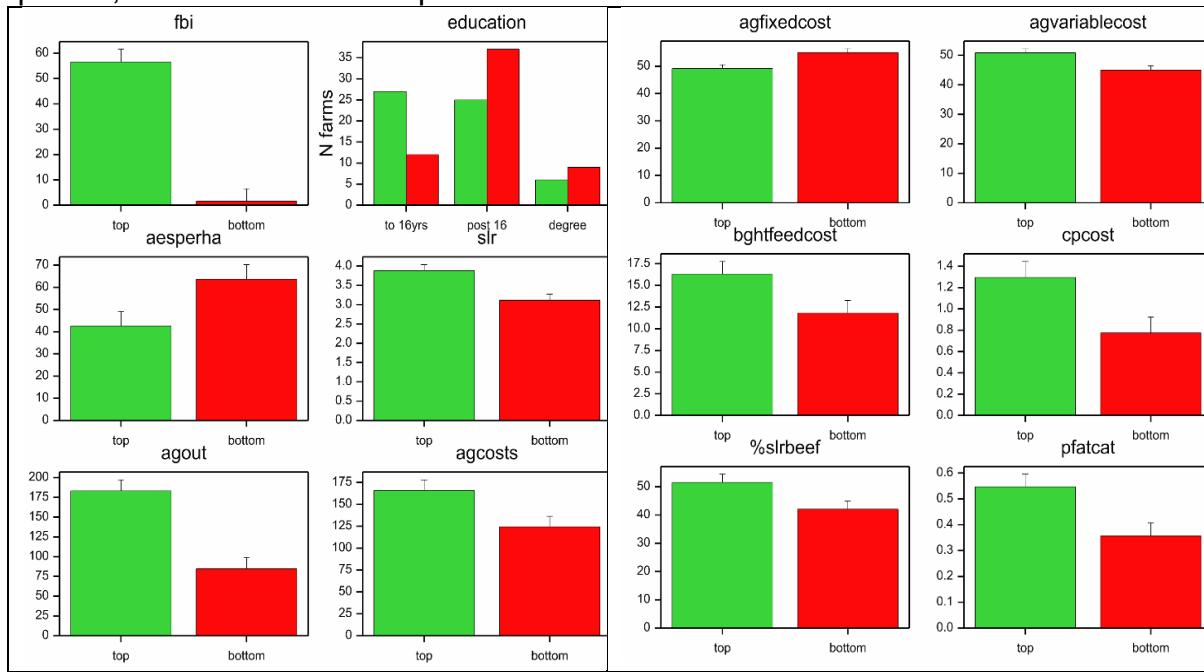
| variable | Means | | | | | | | | Definition |
|----------------|-------|--------|------|------|-------|-----|------|--|------------|
| | Top | bottom | sed | t | P | sig | diff | | |
| fbi | 56.6 | 1.5 | 7.0 | 7.88 | 0.000 | *** | 1.45 | Farm Business Income £000 | |
| north | 275.2 | 271.3 | 7.1 | 0.55 | 0.585 | NS | 0.03 | Northing (mid point of JCA) | |
| east | 391.1 | 388.7 | 3.5 | 0.67 | 0.506 | NS | 0.02 | Easting (mid point of JCA) | |
| altitude | | | | | 1.000 | NS | | Altitude (3 bands) | |
| gor | | | | | 0.764 | NS | | GOR | |
| age | 54.0 | 55.8 | 1.9 | 0.93 | 0.359 | NS | 0.15 | Age of farmer | |
| younger | | | | | 1.000 | NS | | Transfer to younger farmer | |
| education | | | | | 0.015 | * | | education of farmer | |
| conrat | 0.2 | 0.3 | 0.0 | 1.20 | 0.235 | NS | 0.18 | contracting costs as % all machinery & contracting | |
| %unpaid | 81.6 | 76.3 | 3.5 | 1.50 | 0.139 | NS | 0.23 | Unpaid labour as % all labour | |
| lfa | | | | | 1.000 | NS | | LFA group | |
| initgearing | | | | | 0.982 | NS | | gearing group (opening a/c) | |
| %interest | | | | | 0.444 | NS | | Interest paid as % farm costs | |
| %divcost | | | | | 0.186 | NS | | diversification costs as % farm costs | |
| logarea | 2.1 | 2.1 | 0.0 | 0.48 | 0.631 | NS | 0.04 | Log of total area | |
| %nvz | 50.8 | 45.6 | 7.9 | 0.67 | 0.507 | NS | 0.11 | % land in nvz | |
| farmass | 0.9 | 0.9 | 0.1 | 1.52 | 0.133 | NS | 0.23 | farm assurance 0/1 | |
| conrearin | 0.2 | 0.1 | 0.1 | 1.30 | 0.199 | NS | 0.26 | Contract rearing animals in | |
| conrearout | 0.1 | 0.1 | 0.0 | 0.00 | | - | 0.00 | Contract rearing animals out | |
| sharelm | | | | | 0.400 | NS | | sharing labour machinery | |
| quotatype | | | | | 1.000 | NS | | quota type | |
| %chguaa | 0.6 | 1.4 | 1.0 | 0.79 | 0.431 | NS | 0.14 | % change in uaa | |
| sharefarm | 0.0 | 0.0 | 0.0 | 1.00 | 0.322 | NS | 0.27 | share farming | |
| fbt | 27.9 | 28.7 | 5.7 | 0.14 | 0.888 | NS | 0.03 | FBT land | |
| fat | 13.6 | 15.5 | 5.1 | 0.36 | 0.720 | NS | 0.06 | FAT land | |
| owned | 58.4 | 55.8 | 6.5 | 0.40 | 0.687 | NS | 0.07 | owned land | |
| tenure | | | | | 0.346 | NS | | tenure | |
| bustype | | | | | 1.000 | NS | | business type | |
| porg | 0.1 | 0.1 | 0.0 | 0.87 | 0.387 | NS | 0.00 | proportion of land organic | |
| aesperha | 42.6 | 63.7 | 9.3 | 2.28 | 0.027 | * | 0.34 | AES payments per ha | |
| aesgroup | | | | | 0.194 | NS | | AES grouped | |
| slr | 3.9 | 3.1 | 0.2 | 3.49 | 0.001 | *** | 0.36 | SLR | |
| slrgroup | | | | | 0.283 | NS | | SLR group | |
| agout | 183.2 | 84.8 | 19.7 | 4.99 | 0.000 | *** | 0.89 | agricultural output | |
| livesubs | 0.5 | 0.7 | 0.4 | 0.55 | 0.588 | NS | 0.11 | livestock subsidies (e.g. TB compensation) | |
| unpaidhrs | 3.3 | 3.0 | 0.2 | 1.16 | 0.251 | NS | 0.22 | Unpaid labour hours (000s) | |
| agcosts | 166.0 | 124.4 | 16.9 | 2.46 | 0.017 | * | 0.37 | agricultural costs | |
| agfixedcost | 49.2 | 55.0 | 1.9 | 3.00 | 0.004 | ** | 0.47 | agriculture fixed costs † | |
| agvariablecost | 50.8 | 45.0 | 1.9 | 3.00 | 0.004 | ** | 0.47 | agriculture variable costs † | |
| bghtfeedcost | 16.3 | 11.8 | 2.0 | 2.22 | 0.031 | * | 0.43 | Bought feed costs † | |
| vetcost | 3.8 | 4.0 | 0.4 | 0.52 | 0.604 | NS | 0.09 | vet costs † | |
| seedcost | 1.2 | 1.4 | 0.2 | 0.74 | 0.461 | NS | 0.12 | seed costs † | |
| fertcost | 6.4 | 5.4 | 0.7 | 1.46 | 0.151 | NS | 0.24 | fertiliser costs † | |
| cpcost | 1.3 | 0.8 | 0.2 | 2.47 | 0.016 | * | 0.43 | crop protection costs † | |
| genfarmcost | 12.1 | 13.7 | 0.9 | 1.79 | 0.079 | 10% | 0.24 | general farming costs † | |
| labourcost | 5.1 | 7.0 | 1.2 | 1.62 | 0.110 | NS | 0.25 | agricultural labour costs † | |
| machinerycost | 20.2 | 21.0 | 1.1 | 0.67 | 0.505 | NS | 0.09 | machinery costs † | |
| %slrcereals | 3.6 | 2.5 | 0.9 | 1.25 | 0.215 | NS | 0.27 | SLR cereals | |
| %slrotherarab | 0.0 | 0.0 | 0.1 | 0.61 | 0.546 | NS | 0.09 | SLR other arable | |
| %slrbef | 51.5 | 42.1 | 4.1 | 2.29 | 0.026 | * | 0.31 | SLR beef | |
| %slrsheep | 36.2 | 43.7 | 4.4 | 1.73 | 0.089 | 10% | 0.24 | SLR sheep | |
| %slrglass | 7.5 | 8.2 | 0.5 | 1.55 | 0.126 | NS | 0.16 | SLR grass and fodder | |
| pfatcat | 0.5 | 0.4 | 0.1 | 2.73 | 0.008 | ** | 0.47 | prop fat cattle | |
| pfatsheep | 0.6 | 0.6 | 0.0 | 1.63 | 0.109 | NS | 0.20 | prop fat sheep | |

| | | | | | | | | |
|--------------|-----|-----|-----|------|-------|-----|------|------------------------|
| agdiversity | 0.4 | 0.4 | 0.0 | 0.80 | 0.428 | NS | 0.12 | Agricultural diversity |
| stockingrate | 1.8 | 1.1 | 0.3 | 1.93 | 0.058 | 10% | 0.47 | Stocking rate |
| stockgroup | | | | | 0.055 | 10% | | Stocking rate group |

Note: NS not significant, 10% P <= 0.1 (almost significant), * P <= 0.05, ** P <= 0.01, *** P <= 0.001

† as a percentage of all agricultural costs, sed=standard error of difference, diff=standardised difference

Figure 2: bar charts for the nominally significant variables. 'Top' refers to top quartile, 'bottom' to matched pairs from the bottom half of the distribution.



Pig farms

Matching process

The matching process was conducted as described for arable and dairy farms, but using the following variables: northing, easting, and log-transformed SLR, log-transformed area. The small number of farms precludes more complex matching. The range of economic sizes is large (Figure 0) and is strongly related to performance.

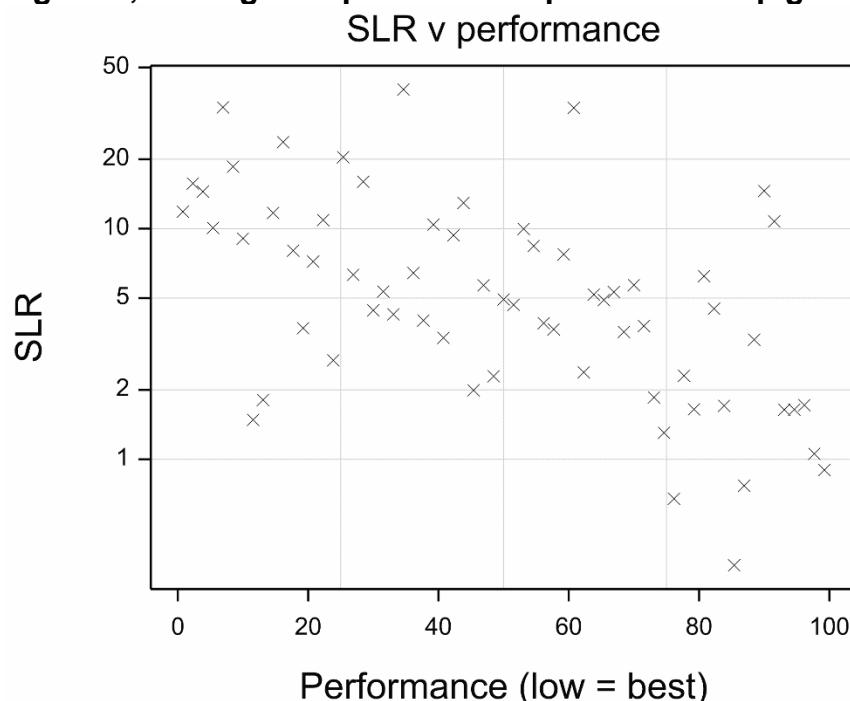
Because of the sparse distribution outside the east of England the weightings for northings and eastings were decreased by setting the divisor to 1200km (just over twice the actual figure). This ensures that matching by economic size generally takes precedence over geographic proximity.

Two variants were tried;

- Using the same definition as in the other sectors; i.e. farms had to be included in at least 3 years out of the 5 and always classified as robust type pigs. This gave only 66 farms in total and hence just 16 in the top quartile.
- A broader definition including any farm classified as pigs in at least one year, provided they always had pigs in each year. Farms only had to be included in two of the five years. This added another 15-20 mixed farms and hence increased the top quartile to 20.

Results were not dissimilar between the two approaches and so the first approach has been used for this analysis.

Figure 0; SLR against performance percentile for pig farms.



Comparisons between top and bottom performers

A wide variety of variables are tested – this is very much a screening procedure. Continuous variables are compared using a t-test (paired t-test for the matched comparison), whilst categorical ones use a chi-squared test, with a permutation test to allow for the situation where low expected values invalidate the usual test. Some key variables are included in both continuous and categorical form. All figures use FBS data from 2011-12 to 2015-16. Variables are averaged across years, using a simple mean, except for categorical variables where the mode is taken. Farms are included where they are always classified as pig farms and are present in at least 3 of the 5 years. Performance is averaged on the percentile scale (i.e. a percentile is calculated for each year and these are averaged, before recalculating the percentile for the entire period), to minimise the impact of missing years.

Table 1 and Figure 1 show comparisons between the top and bottom quantiles of the distribution of performance, based on the ratio of agricultural output to costs, charging unpaid family labour at the minimum wage rate for the year. Table 2 and Figure 2 show comparisons after matching (and excluding the five poor matches) between the top quartile and the matched poorer performers. The tables and figures now include Farm Business Income in order to give an idea of the scale of difference between the performance groups. Table 2 also includes a column ('sdiff') for the standardised difference between the two groups – i.e. the size of the difference in standard deviation units.

Because of the small sample size few variables are statistically significant. Moreover, after matching, most of the significant variables seem to be detecting a difference between highly specialised pig producers in the top quartile and more mixed farms in the matched subset. It is not possible to remove this difference by matching, because the top quartile contains very few non-specialised farms, whereas the bottom half contains few specialised ones.

Table 1: significance test for differences between top and bottom quartiles.

| variable | Means | | | | | | | Definition |
|----------------|--------|--------|-------|-------|-------|-----|--|------------|
| | Top | bottom | sed | t | P | sig | | |
| fbi | 176.8 | 5.8 | 59.5 | 2.87 | 0.007 | ** | Farm Business Income £000 | |
| north | 296.3 | 356.9 | 34.9 | 1.74 | 0.092 | 10% | Northing (mid point of JCA) | |
| east | 515.1 | 501.1 | 35.3 | 0.40 | 0.694 | NS | Easting (mid point of JCA) | |
| altitude | | | | 1.000 | | NS | Altitude (3 bands) | |
| gor | | | | 0.156 | | NS | GOR | |
| age | 53.6 | 55.4 | 3.1 | 0.56 | 0.582 | NS | Age of farmer | |
| younger | | | | 1.000 | | NS | Transfer to younger farmer | |
| education | | | | 0.296 | | NS | education of farmer | |
| conrat | 0.1 | 0.2 | 0.0 | 1.19 | 0.243 | NS | contracting costs as % all machinery & contracting | |
| %unpaid | 39.8 | 75.8 | 10.6 | 3.41 | 0.002 | ** | Unpaid labour as % all labour | |
| lfa | | | | 1.000 | | NS | LFA group | |
| anylfa | 0.0 | 0.1 | 0.1 | 1.00 | 0.325 | NS | 0/1 for LFA | |
| initgearing | | | | 0.898 | | NS | gearing group (opening a/c) | |
| %interest | | | | 0.404 | | NS | Interest paid as % farm costs | |
| %divcost | | | | 0.124 | | NS | diversification costs as % farm costs | |
| logarea | 1.3 | 1.3 | 0.3 | 0.34 | 0.737 | NS | Log of total area | |
| %nvz | 70.3 | 44.3 | 14.8 | 1.75 | 0.089 | 10% | % land in nvz | |
| farmass | 0.9 | 0.7 | 0.1 | 1.84 | 0.076 | 10% | farm assurance 0/1 | |
| conrearin | 0.3 | 0.6 | 0.2 | 2.14 | 0.040 | * | Contract rearing animals in | |
| conrearout | 0.0 | 0.0 | 0.0 | | | - | Contract rearing animals out | |
| quotatype | | | | 1.000 | | NS | quota type | |
| %chguaa | 8.6 | -5.8 | 7.5 | 1.93 | 0.063 | 10% | % change in uaa | |
| fbt | 30.7 | 25.7 | 14.2 | 0.35 | 0.728 | NS | FBT land | |
| fat | 6.0 | 4.9 | 7.1 | 0.16 | 0.873 | NS | FAT land | |
| owned | 63.3 | 69.4 | 14.8 | 0.41 | 0.682 | NS | owned land | |
| tenure | | | | 1.000 | | NS | tenure | |
| bustype | | | | 0.428 | | NS | business type | |
| porg | 0.0 | 0.0 | 0.0 | 1.00 | 0.325 | NS | proportion of land organic | |
| aesperha | 3.9 | 23.9 | 16.1 | 1.24 | 0.222 | NS | AES payments per ha | |
| aesgroup | | | | 0.367 | | NS | AES grouped | |
| slr | 20.1 | 3.2 | 8.9 | 1.90 | 0.066 | 10% | SLR | |
| slrgroup | | | | 0.001 | | ** | SLR group | |
| manager | 0.0 | 0.0 | 0.0 | | | - | Paid manager yes/no | |
| agout | 1630.4 | 117.5 | 878.7 | 1.72 | 0.095 | 10% | agricultural output | |
| livesubs | 0.0 | 0.0 | 0.0 | | | - | livestock subsidies (e.g. TB compensation) | |
| unpaidhrs | 3.1 | 2.7 | 0.4 | 1.02 | 0.317 | NS | Unpaid labour hours (000s) | |
| agcosts | 1492.9 | 127.8 | 842.5 | 1.62 | 0.115 | NS | agricultural costs | |
| agfixedcost | 44.6 | 56.0 | 10.3 | 1.10 | 0.278 | NS | agriculture fixed costs † | |
| agvariablecost | 55.4 | 44.0 | 10.3 | 1.10 | 0.278 | NS | agriculture variable costs † | |
| bghtfeedcost | 43.0 | 27.8 | 10.5 | 1.44 | 0.158 | NS | Bought feed costs † | |
| vetcost | 2.6 | 1.3 | 0.7 | 1.91 | 0.065 | 10% | vet costs † | |
| seedcost | 0.1 | 0.5 | 0.3 | 1.45 | 0.158 | NS | seed costs † | |
| fertcost | 0.1 | 1.1 | 0.5 | 1.93 | 0.062 | 10% | fertiliser costs † | |
| cpcost | 0.3 | 0.4 | 0.3 | 0.48 | 0.637 | NS | crop protection costs † | |
| genfarmcost | 7.5 | 17.1 | 3.2 | 2.95 | 0.006 | ** | general farming costs † | |
| labourcost | 13.2 | 6.0 | 3.4 | 2.14 | 0.040 | * | agricultural labour costs † | |
| machinerycost | 13.7 | 19.8 | 4.2 | 1.45 | 0.156 | NS | machinery costs † | |
| %slrcereals | 1.1 | 1.1 | 1.0 | 0.04 | 0.969 | NS | SLR cereals | |
| %slrotherarab | 0.1 | 0.5 | 0.5 | 0.83 | 0.414 | NS | SLR other arable | |
| %slrbef | 0.0 | 4.7 | 3.0 | 1.55 | 0.132 | NS | SLR beef | |
| %slrsheep | 0.0 | 6.9 | 3.4 | 2.01 | 0.053 | 10% | SLR sheep | |
| %slrgrass | 0.3 | 2.2 | 0.6 | 3.34 | 0.002 | ** | SLR grass and fodder | |
| agdiversity | 0.0 | 0.2 | 0.1 | 3.65 | 0.001 | *** | Agricultural diversity | |
| pfatpigs | 0.7 | 0.8 | 0.1 | 0.70 | 0.492 | NS | Prop fat pig sales | |

Note: NS not significant, 10% P <= 0.1 (almost significant), * P <= 0.05, ** P <= 0.01, *** P <= 0.001

† as a percentage of all agricultural costs, sed=standard error of difference

Figure 1: bar charts for the nominally significant variables. ‘Top’ refers to top quartile, ‘bottom’ to bottom quartile.

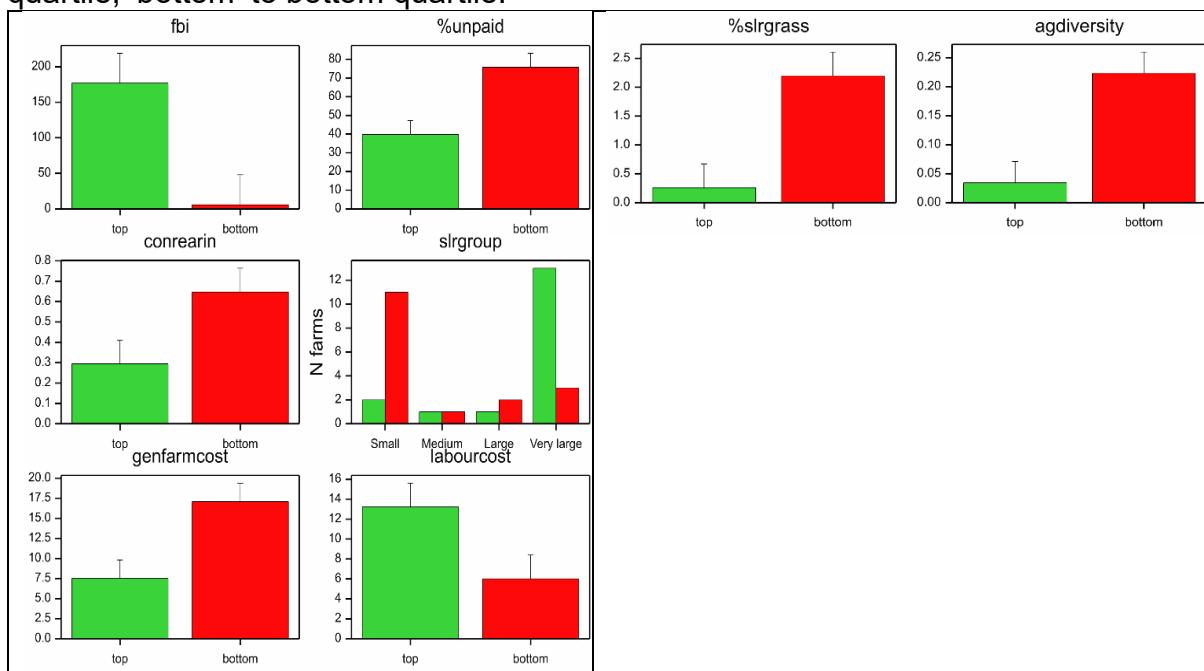
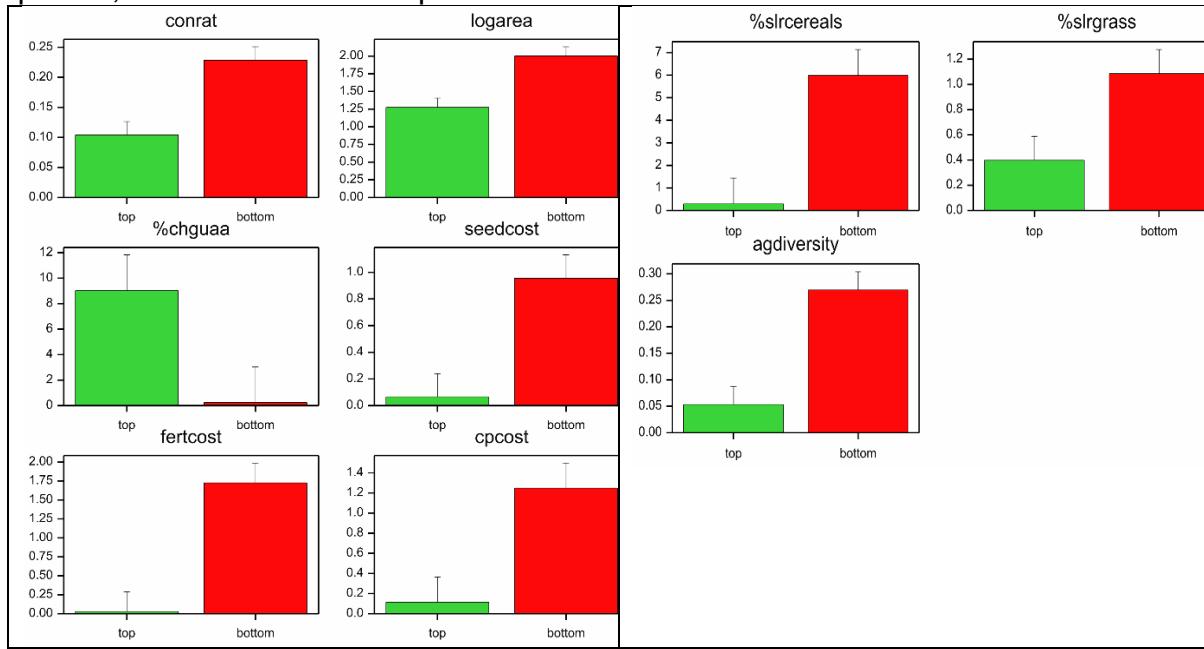


Table 2: tests for differences between matched pairs of top and bottom performers.

| variable | Means | | sed | t | P | sig | diff | Definition |
|----------------|--------|--------|--------|------|-------|-----|------|--|
| | Top | bottom | | | | | | |
| fbi | 143.8 | 40.8 | 79.0 | 1.30 | 0.212 | NS | 0.69 | Farm Business Income £000 |
| north | 283.7 | 303.0 | 25.9 | 0.75 | 0.466 | NS | 0.16 | Northing (mid point of JCA) |
| east | 500.6 | 482.2 | 21.5 | 0.86 | 0.406 | NS | 0.16 | Easting (mid point of JCA) |
| altitude | | | | | 1.000 | NS | | Altitude (3 bands) |
| gor | | | | | 0.568 | NS | | GOR |
| age | 56.5 | 56.1 | 2.0 | 0.17 | 0.869 | NS | 0.04 | Age of farmer |
| younger | | | | | 1.000 | NS | | Transfer to younger farmer |
| education | | | | | 0.447 | NS | | education of farmer |
| conrat | 0.1 | 0.2 | 0.0 | 3.94 | 0.001 | ** | 0.97 | contracting costs as % all machinery & contracting |
| %unpaid | 49.9 | 34.3 | 11.3 | 1.39 | 0.186 | NS | 0.46 | Unpaid labour as % all labour |
| lfa | | | | | 1.000 | NS | | LFA group |
| anylfa | 0.0 | 0.0 | 0.0 | | | - | 0.00 | 0/1 for LFA |
| initgearing | | | | | 0.688 | NS | | gearing group (opening a/c) |
| %interest | | | | | 0.639 | NS | | Interest paid as % farm costs |
| %divcost | | | | | 0.301 | NS | | diversification costs as % farm costs |
| logarea | 1.3 | 2.0 | 0.2 | 3.91 | 0.001 | ** | 1.07 | Log of total area |
| %nvz | 68.4 | 61.7 | 9.7 | 0.70 | 0.494 | NS | 0.15 | % land in nvz |
| farmass | 0.9 | 1.0 | 0.1 | 1.00 | 0.333 | NS | 0.17 | farm assurance 0/1 |
| conrearin | 0.4 | 0.6 | 0.2 | 1.14 | 0.270 | NS | 0.39 | Contract rearing animals in |
| conrearout | 0.0 | 0.0 | 0.0 | | | - | 0.00 | Contract rearing animals out |
| quotatype | | | | | 1.000 | NS | | quota type |
| %chguaa | 9.0 | 0.2 | 4.0 | 2.23 | 0.046 | * | 0.53 | % change in uaa |
| fbt | 27.0 | 32.7 | 14.2 | 0.40 | 0.693 | NS | 0.15 | FBT land |
| fat | 6.4 | 1.8 | 6.0 | 0.76 | 0.458 | NS | 0.26 | FAT land |
| owned | 66.6 | 65.5 | 15.5 | 0.07 | 0.942 | NS | 0.03 | owned land |
| tenure | | | | | 0.409 | NS | | tenure |
| bustype | | | | | 0.152 | NS | | business type |
| porg | 0.0 | 0.0 | 0.0 | 1.00 | 0.333 | NS | 0.51 | proportion of land organic |
| aesperha | 16.7 | 13.5 | 9.6 | 0.33 | 0.743 | NS | 0.08 | AES payments per ha |
| aesgroup | | | | | 1.000 | NS | | AES grouped |
| slr | 18.7 | 12.8 | 9.9 | 0.60 | 0.558 | NS | 0.29 | SLR |
| slrgroup | | | | | 0.486 | NS | | SLR group |
| manager | 0.0 | 0.0 | 0.0 | | | - | 0.00 | Paid manager yes/no |
| agout | 1450.1 | 1145.0 | 1031.3 | 0.30 | 0.771 | NS | 0.15 | agricultural output |
| livesubs | 0.0 | 0.1 | 0.1 | 1.46 | 0.164 | NS | 1.02 | livestock subsidies (e.g. TB compensation) |
| unpaidhrs | 3.2 | 3.2 | 0.5 | 0.10 | 0.918 | NS | 0.04 | Unpaid labour hours (000s) |
| agcosts | 1339.8 | 1158.6 | 998.1 | 0.18 | 0.858 | NS | 0.10 | agricultural costs |
| agfixedcost | 48.7 | 47.9 | 8.2 | 0.10 | 0.922 | NS | 0.03 | agriculture fixed costs † |
| agvariablecost | 51.3 | 52.1 | 8.2 | 0.10 | 0.922 | NS | 0.03 | agriculture variable costs † |
| bghtfeedcost | 39.4 | 30.0 | 8.5 | 1.11 | 0.286 | NS | 0.34 | Bought feed costs † |
| vetcost | 2.1 | 1.8 | 0.6 | 0.55 | 0.591 | NS | 0.18 | vet costs † |
| seedcost | 0.1 | 1.0 | 0.2 | 3.62 | 0.003 | ** | 1.23 | seed costs † |
| fertcost | 0.0 | 1.7 | 0.4 | 4.60 | 0.000 | *** | 1.04 | fertiliser costs † |
| cpcost | 0.1 | 1.2 | 0.4 | 3.21 | 0.006 | ** | 0.88 | crop protection costs † |
| genfarmcost | 9.1 | 9.2 | 2.2 | 0.03 | 0.977 | NS | 0.01 | general farming costs † |
| labourcost | 12.4 | 11.2 | 3.2 | 0.36 | 0.726 | NS | 0.14 | agricultural labour costs † |
| machinerycost | 16.6 | 14.9 | 4.2 | 0.41 | 0.690 | NS | 0.15 | machinery costs † |
| %slrcereals | 0.3 | 6.0 | 1.6 | 3.51 | 0.003 | ** | 1.11 | SLR cereals |
| %slrotherarab | 0.0 | 0.9 | 0.5 | 1.67 | 0.117 | NS | 0.56 | SLR other arable |
| %slrbef | 1.0 | 5.4 | 2.2 | 2.00 | 0.064 | 10% | 0.52 | SLR beef |
| %slrsheep | 0.8 | 2.1 | 1.4 | 0.86 | 0.402 | NS | 0.15 | SLR sheep |
| %slrglass | 0.4 | 1.1 | 0.3 | 2.54 | 0.022 | * | 0.45 | SLR grass and fodder |
| agdiversity | 0.1 | 0.3 | 0.0 | 4.45 | 0.000 | *** | 1.16 | Agricultural diversity |
| pfatpigs | 0.7 | 0.8 | 0.1 | 0.38 | 0.710 | NS | 0.17 | Prop fat pig sales |

Note: NS not significant, 10% $P \leq 0.1$ (almost significant), * $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$
 † as a percentage of all agricultural costs, sed=standard error of difference, diff=standardised difference

Figure 2: bar charts for the nominally significant variables. ‘Top’ refers to top quartile, ‘bottom’ to matched pairs from the bottom half of the distribution.



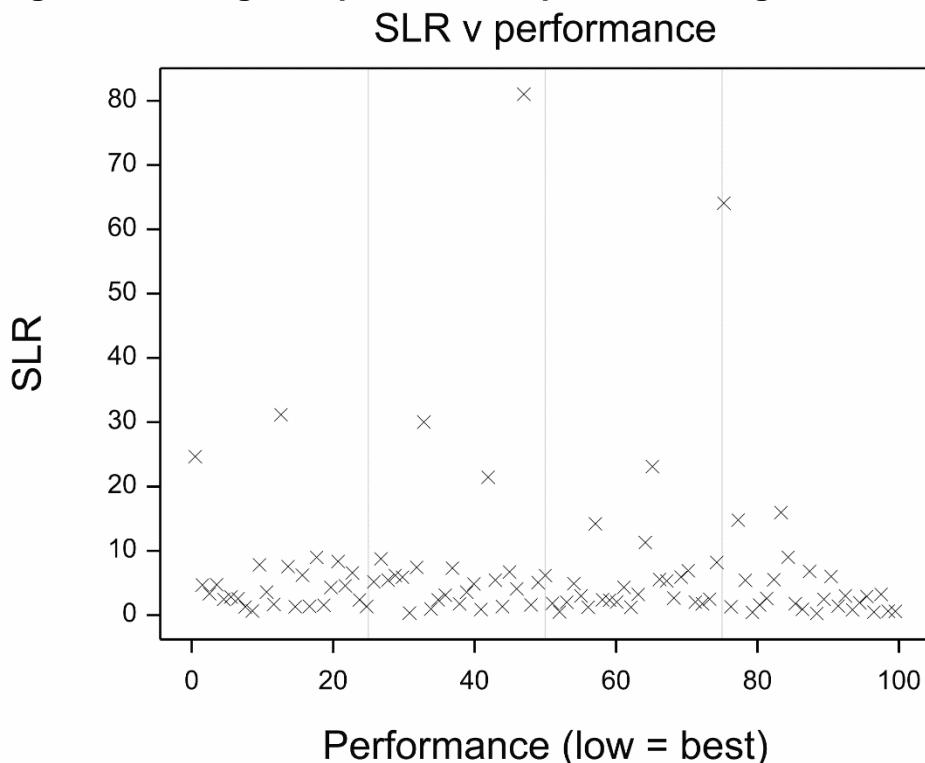
General cropping farms

Matching process

The matching process was conducted as described for arable and dairy farms, but using the following variables: northing, easting, log-transformed SLR, and log-transformed area. Organic status was not used because there were a very small number of such farms, making it impossible to find matches that were acceptable in terms of the other variables. Only 99 farms met the criteria for inclusion and the majority were towards the East coast of England. A further complication is that the economic sizes, whilst showing much less relationship with performance than for the livestock sectors, are extremely skew, with a small number of large SLR values.

For most other sectors, the variables used in the matching process were all giving equal weight, with the algorithm scaling the distances for each variable to the range 0 to 1 by dividing by the observed range of the variable. However, the combination of the sparse geographic distribution and the enormous economic size range meant that this approach gave too much weight to geography and therefore sometimes matched large farms with much smaller ones. The weightings for northings and eastings were therefore decreased by setting the divisor to 1200km (just over twice the actual figure). This gave much more satisfactory matches.

Figure 0; SLR against performance percentile for general cropping farms.



Comparisons between top and bottom performers

A wide variety of variables are tested – this is very much a screening procedure. Continuous variables are compared using a t-test (paired t-test for the matched

comparison), whilst categorical ones use a chi-squared test, with a permutation test to allow for the situation where low expected values invalidate the usual test. Some key variables are included in both continuous and categorical form. All figures use FBS data from 2011-12 to 2015-16. Variables are averaged across years, using a simple mean, except for categorical variables where the mode is taken. Farms are included where they are always classified as general cropping farms and are present in at least 3 of the 5 years. Performance is averaged on the percentile scale (i.e. a percentile is calculated for each year and these are averaged, before recalculating the percentile for the entire period), to minimise the impact of missing years.

Table 1 and Figure 1 show comparisons between the top and bottom quantiles of the distribution of performance, based on the ratio of agricultural output to costs, charging unpaid family labour at the minimum wage rate for the year. Table 2 and Figure 2 show comparisons after matching (and excluding the five poor matches) between the top quartile and the matched poorer performers. The tables and figures now include Farm Business Income in order to give an idea of the scale of difference between the performance groups. Table 2 also includes a column ('sdiff') for the standardised difference between the two groups – i.e. the size of the difference in standard deviation units.

There are far fewer significant values in the tables than in some of the other sectors. This is likely to reflect the difficulty of demonstrating a difference with a small sample, and does not necessarily mean that there are fewer real differences. Key points are:

- Economic size has no significant impact.
- Debt and interest payments are not quite significant before matching. After matching gearing ratio is highly significant, with a similar pattern to many of the other sectors (Figure 2).
- The mix of enterprises varies before matching, with top performers tending to be more specialised into arable, with less grass and sheep. After matching these differences are no longer statistically significant at the 5% level, although the means suggest that the difference may not have entirely disappeared. This may indicate that they are partly due to geographic differences.
- Output and costs. As with the other sectors top performers have higher variable costs, but lower fixed costs.
- Strangely, membership of assurance schemes is lower amongst the top performers, both before and after matching.

Table 1: significance test for differences between top and bottom quartiles.

| variable | Means | | | | | | Definition |
|----------------|--------|--------|-------|-------|-------|-------------------------------|--|
| | Top | bottom | sed | t | P | sig | |
| fbi | 168.9 | 66.9 | 44.0 | 2.32 | 0.025 | * | Farm Business Income £000 |
| north | 331.1 | 318.4 | 27.4 | 0.46 | 0.647 | NS | Northing (mid point of JCA) |
| east | 468.2 | 515.0 | 30.2 | 1.55 | 0.128 | NS | Easting (mid point of JCA) |
| altitude | | | | 1.000 | | NS | Altitude (3 bands) |
| younger | | | | 1.000 | | NS | Transfer to younger farmer |
| education | | | | 1.000 | | NS | education of farmer |
| conrat | 0.2 | 0.2 | 0.1 | 1.07 | 0.290 | NS | contracting costs as % all machinery & contracting |
| %unpaid | 53.7 | 55.7 | 9.3 | 0.22 | 0.830 | NS | Unpaid labour as % all labour |
| initgearing | | | | 0.104 | | NS | gearing group (opening a/c) |
| %interest | | | | 0.068 | 10% | Interest paid as % farm costs | |
| %divcost | | | | 0.162 | | NS | diversification costs as % farm costs |
| logarea | 2.2 | 2.2 | 0.1 | 0.23 | 0.819 | NS | Log of total area |
| %nvz | 64.2 | 50.0 | 12.8 | 1.11 | 0.273 | NS | % land in nvz |
| farmass | 0.7 | 1.0 | 0.1 | 3.36 | 0.002 | ** | farm assurance 0/1 |
| sharelm | | | | 0.601 | | NS | sharing labour machinery |
| firstyr | 2006.8 | 2007.0 | 1.3 | 0.19 | 0.850 | NS | first year in fbs |
| quotatype | | | | 1.000 | | NS | quota type |
| %chguua | 0.4 | -0.5 | 1.2 | 0.81 | 0.423 | NS | % change in uaa |
| sharefarm | 0.0 | 0.1 | 0.1 | 0.59 | 0.561 | NS | share farming |
| fbt | 27.4 | 16.7 | 8.0 | 1.35 | 0.184 | NS | FBT land |
| fat | 14.5 | 16.8 | 8.6 | 0.27 | 0.791 | NS | FAT land |
| owned | 58.1 | 66.5 | 10.5 | 0.80 | 0.428 | NS | owned land |
| tenure | | | | 0.204 | | NS | tenure |
| bustype | | | | 0.422 | | NS | business type |
| porg | 0.1 | 0.0 | 0.1 | 0.51 | 0.612 | NS | proportion of land organic |
| aesperha | 25.6 | 44.8 | 11.7 | 1.64 | 0.108 | NS | AES payments per ha |
| aesgroup | | | | 0.356 | | NS | AES grouped |
| slr | 5.8 | 6.2 | 2.9 | 0.11 | 0.914 | NS | SLR |
| slrgroup | | | | 0.169 | | NS | SLR group |
| manager | 0.0 | 0.0 | 0.0 | 1.28 | 0.206 | NS | Paid manager yes/no |
| agout | 596.2 | 464.0 | 232.4 | 0.57 | 0.572 | NS | agricultural output |
| livesubs | 0.1 | 0.0 | 0.1 | 1.00 | 0.322 | NS | subsidies (e.g. TB compensation) |
| unpaidhrs | 3.2 | 3.0 | 0.4 | 0.36 | 0.723 | NS | Unpaid labour hours (000s) |
| agcosts | 490.3 | 581.8 | 243.2 | 0.38 | 0.709 | NS | agricultural costs |
| agfixedcost | 48.2 | 60.3 | 2.9 | 4.10 | 0.000 | *** | agriculture fixed costs † |
| agvariablecost | 51.8 | 39.7 | 2.9 | 4.10 | 0.000 | *** | agriculture variable costs † |
| bghtfeedcost | 0.7 | 0.8 | 0.4 | 0.19 | 0.851 | NS | Bought feed costs † |
| vetcost | 0.2 | 0.2 | 0.1 | 0.53 | 0.596 | NS | vet costs † |
| seedcost | 9.9 | 6.7 | 1.1 | 2.93 | 0.005 | ** | seed costs † |
| fertcost | 10.5 | 9.7 | 1.3 | 0.64 | 0.528 | NS | fertiliser costs † |
| cpcost | 10.3 | 9.0 | 1.2 | 1.10 | 0.276 | NS | crop protection costs † |
| genfarmcost | 8.9 | 12.1 | 1.3 | 2.45 | 0.018 | * | general farming costs † |
| labourcost | 10.4 | 10.9 | 3.2 | 0.16 | 0.873 | NS | agricultural labour costs † |
| machinerycost | 21.3 | 22.5 | 2.4 | 0.54 | 0.592 | NS | machinery costs † |
| %slrcereals | 25.3 | 31.2 | 5.2 | 1.13 | 0.265 | NS | SLR cereals |
| %slrotherarab | 62.4 | 46.6 | 6.8 | 2.32 | 0.025 | * | SLR other arable |
| %slrbeef | 7.2 | 6.9 | 3.7 | 0.09 | 0.931 | NS | SLR beef |
| %slrsheep | 0.0 | 2.8 | 1.2 | 2.24 | 0.030 | * | SLR sheep |
| %slrpigs | 0.3 | 0.6 | 0.7 | 0.44 | 0.665 | NS | SLR pigs |
| %slrgrass | 0.8 | 4.5 | 1.9 | 1.96 | 0.056 | 10% | SLR grass and fodder |
| wheatprice | 157.7 | 155.2 | 7.2 | 0.35 | 0.728 | NS | Wheat price |
| wheatyld | 8.3 | 7.7 | 0.4 | 1.46 | 0.151 | NS | Wheat yield |
| agdiversity | 0.4 | 0.5 | 0.0 | 2.89 | 0.006 | ** | Agricultural diversity |
| pbara | 2.4 | 1.0 | 0.8 | 1.68 | 0.100 | 10% | Peas & beans as % UAA |
| sbara | 6.2 | 7.5 | 2.3 | 0.55 | 0.583 | NS | Sugar beet as % UAA |
| potarea | 11.1 | 5.4 | 3.6 | 1.59 | 0.118 | NS | Potatoes as % UAA |

Note: NS not significant, 10% $P \leq 0.1$ (almost significant), * $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$
 † as a percentage of all agricultural costs, sed=standard error of difference

Figure 1: bar charts for the nominally significant variables. 'Top' refers to top quartile, 'bottom' to bottom quartile.

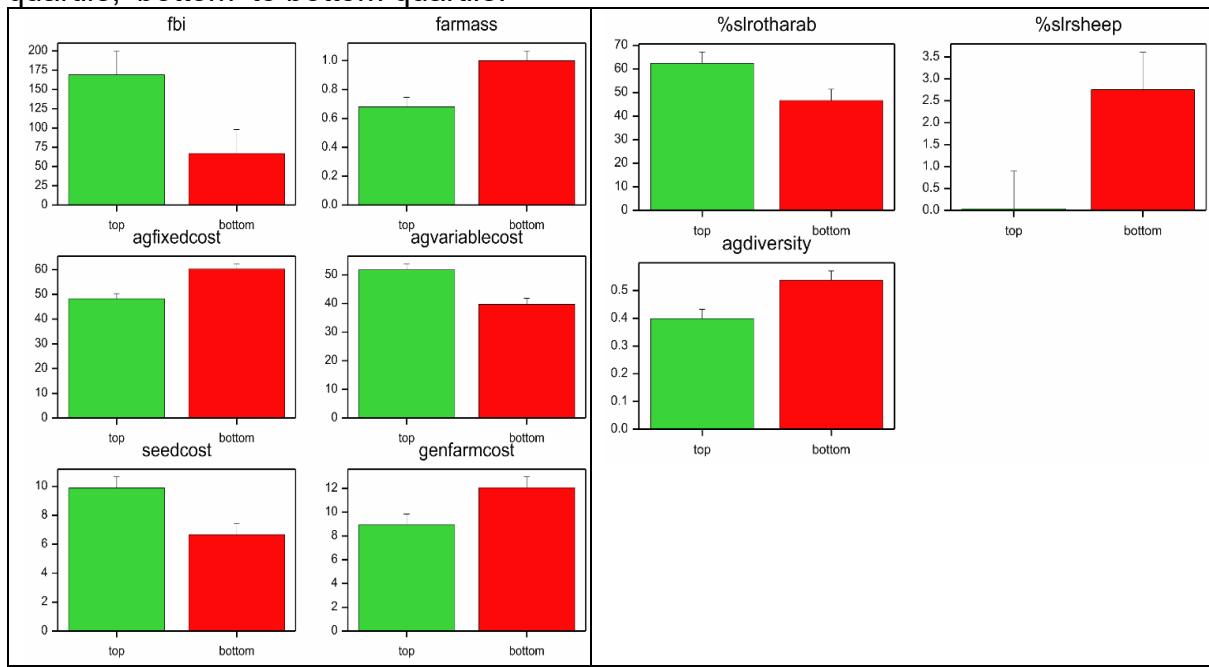
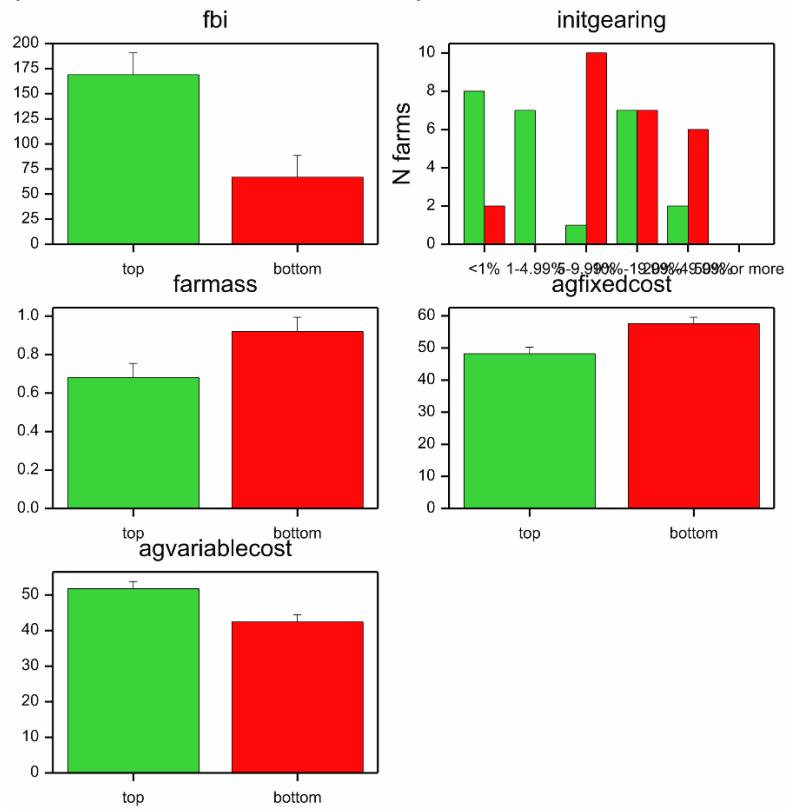


Table 2: tests for differences between matched pairs of top and bottom performers.

| variable | Means | | | | | | | | Definition |
|----------------|-------|--------|------|------|-------|-----|------|--|------------|
| | Top | bottom | sed | t | P | sig | diff | | |
| fbi | 168.9 | 66.8 | 30.6 | 3.33 | 0.003 | ** | 0.58 | Farm Business Income £000 | |
| north | 331.1 | 321.0 | 11.0 | 0.92 | 0.368 | NS | 0.09 | Northing (mid point of JCA) | |
| east | 468.2 | 476.1 | 11.2 | 0.70 | 0.490 | NS | 0.07 | Easting (mid point of JCA) | |
| altitude | | | | | 1.000 | NS | | Altitude (3 bands) | |
| younger | | | | | 1.000 | NS | | Transfer to younger farmer | |
| education | | | | | 0.809 | NS | | education of farmer | |
| conrat | 0.2 | 0.2 | 0.0 | 1.77 | 0.090 | 10% | 0.35 | contracting costs as % all machinery & contracting | |
| %unpaid | 53.7 | 47.9 | 3.8 | 1.50 | 0.147 | NS | 0.18 | Unpaid labour as % all labour | |
| initgearing | | | | | 0.001 | ** | | gearing group (opening a/c) | |
| %interest | | | | | 0.313 | NS | | Interest paid as % farm costs | |
| %divcost | | | | | 0.306 | NS | | diversification costs as % farm costs | |
| logarea | 2.2 | 2.3 | 0.0 | 1.86 | 0.076 | 10% | 0.13 | Log of total area | |
| %nvz | 64.2 | 71.2 | 11.4 | 0.61 | 0.545 | NS | 0.15 | % land in nvz | |
| farmass | 0.7 | 0.9 | 0.1 | 2.30 | 0.031 | * | 0.71 | farm assurance 0/1 | |
| sharelm | | | | | 0.601 | NS | | sharing labour machinery | |
| quotatype | | | | | 1.000 | NS | | quota type | |
| %chguaa | 0.4 | -1.8 | 1.6 | 1.44 | 0.162 | NS | 0.53 | % change in uaa | |
| sharefarm | 0.0 | 0.0 | 0.1 | 0.00 | | - | 0.00 | share farming | |
| fbt | 27.4 | 12.9 | 7.2 | 2.02 | 0.055 | 10% | 0.51 | FBT land | |
| fat | 14.5 | 12.7 | 8.4 | 0.21 | 0.834 | NS | 0.07 | FAT land | |
| owned | 58.1 | 74.3 | 10.6 | 1.53 | 0.139 | NS | 0.45 | owned land | |
| tenure | | | | | 0.076 | 10% | | tenure | |
| bustype | | | | | 0.062 | 10% | | business type | |
| porg | 0.1 | 0.0 | 0.1 | 0.77 | 0.447 | NS | 0.25 | proportion of land organic | |
| aesperha | 25.6 | 30.3 | 8.9 | 0.53 | 0.601 | NS | 0.11 | AES payments per ha | |
| aesgroup | | | | | 1.000 | NS | | AES grouped | |
| slr | 5.8 | 4.6 | 0.8 | 1.64 | 0.115 | NS | 0.11 | SLR | |
| slrgroup | | | | | 0.761 | NS | | SLR group | |
| manager | 0.0 | 0.0 | 0.0 | 1.28 | 0.212 | NS | 0.21 | Paid manager yes/no | |
| agout | 596.2 | 465.4 | 93.3 | 1.40 | 0.174 | NS | 0.15 | agricultural output | |
| livesubs | 0.1 | 0.0 | 0.1 | 1.00 | 0.327 | NS | 0.34 | subsidies (e.g. TB compensation) | |
| unpaidhrs | 3.2 | 3.9 | 0.4 | 1.58 | 0.128 | NS | 0.41 | Unpaid labour hours (000s) | |
| agcosts | 490.3 | 524.1 | 61.1 | 0.55 | 0.585 | NS | 0.04 | agricultural costs | |
| agfixedcost | 48.2 | 57.6 | 2.8 | 3.34 | 0.003 | ** | 0.81 | agriculture fixed costs † | |
| agvariablecost | 51.8 | 42.4 | 2.8 | 3.34 | 0.003 | ** | 0.81 | agriculture variable costs † | |
| bghtfeedcost | 0.7 | 0.6 | 0.3 | 0.62 | 0.539 | NS | 0.11 | Bought feed costs † | |
| vetcost | 0.2 | 0.2 | 0.1 | 0.16 | 0.873 | NS | 0.05 | vet costs † | |
| seedcost | 9.9 | 7.8 | 1.1 | 1.94 | 0.064 | 10% | 0.51 | seed costs † | |
| fertcost | 10.5 | 9.8 | 1.3 | 0.57 | 0.576 | NS | 0.16 | fertiliser costs † | |
| cpcost | 10.3 | 9.0 | 0.8 | 1.61 | 0.121 | NS | 0.26 | crop protection costs † | |
| genfarmcost | 8.9 | 10.8 | 1.2 | 1.54 | 0.136 | NS | 0.40 | general farming costs † | |
| labourcost | 10.4 | 15.0 | 2.7 | 1.72 | 0.099 | 10% | 0.38 | agricultural labour costs † | |
| machinerycost | 21.3 | 21.5 | 1.9 | 0.11 | 0.916 | NS | 0.03 | machinery costs † | |
| %slrcereals | 25.3 | 28.3 | 3.6 | 0.81 | 0.424 | NS | 0.15 | SLR cereals | |
| %slrotherarab | 62.4 | 62.5 | 4.9 | 0.02 | 0.981 | NS | 0.00 | SLR other arable | |
| %slrbef | 7.2 | 5.0 | 2.3 | 0.98 | 0.338 | NS | 0.22 | SLR beef | |
| %slrsheep | 0.0 | 2.4 | 1.3 | 1.77 | 0.090 | 10% | 0.50 | SLR sheep | |
| %slrpigs | 0.3 | 0.0 | 0.3 | 1.00 | 0.327 | NS | 0.09 | SLR pigs | |
| %slrglass | 0.8 | 1.5 | 0.4 | 1.72 | 0.098 | 10% | 0.06 | SLR grass and fodder | |
| wheatprice | 157.7 | 155.4 | 6.0 | 0.40 | 0.693 | NS | 0.06 | Wheat price | |
| wheatyld | 8.3 | 8.2 | 0.4 | 0.34 | 0.735 | NS | 0.09 | Wheat yield | |
| agdiversity | 0.4 | 0.4 | 0.0 | 1.14 | 0.264 | NS | 0.22 | Agricultural diversity | |
| parea | 2.4 | 1.3 | 0.7 | 1.44 | 0.163 | NS | 0.33 | Peas & beans as % UAA | |
| sarea | 6.2 | 7.2 | 1.4 | 0.75 | 0.461 | NS | 0.12 | Sugar beet as % UAA | |
| potarea | 11.1 | 7.9 | 2.6 | 1.26 | 0.219 | NS | 0.25 | Potatoes as % UAA | |

Note: NS not significant, 10% P <= 0.1 (almost significant), * P <= 0.05, ** P <= 0.01, *** P <= 0.001
 † as a percentage of all agricultural costs, sed=standard error of difference, diff=standardised difference

Figure 2: bar charts for the nominally significant variables. ‘Top’ refers to top quartile, ‘bottom’ to matched pairs from the bottom half of the distribution.



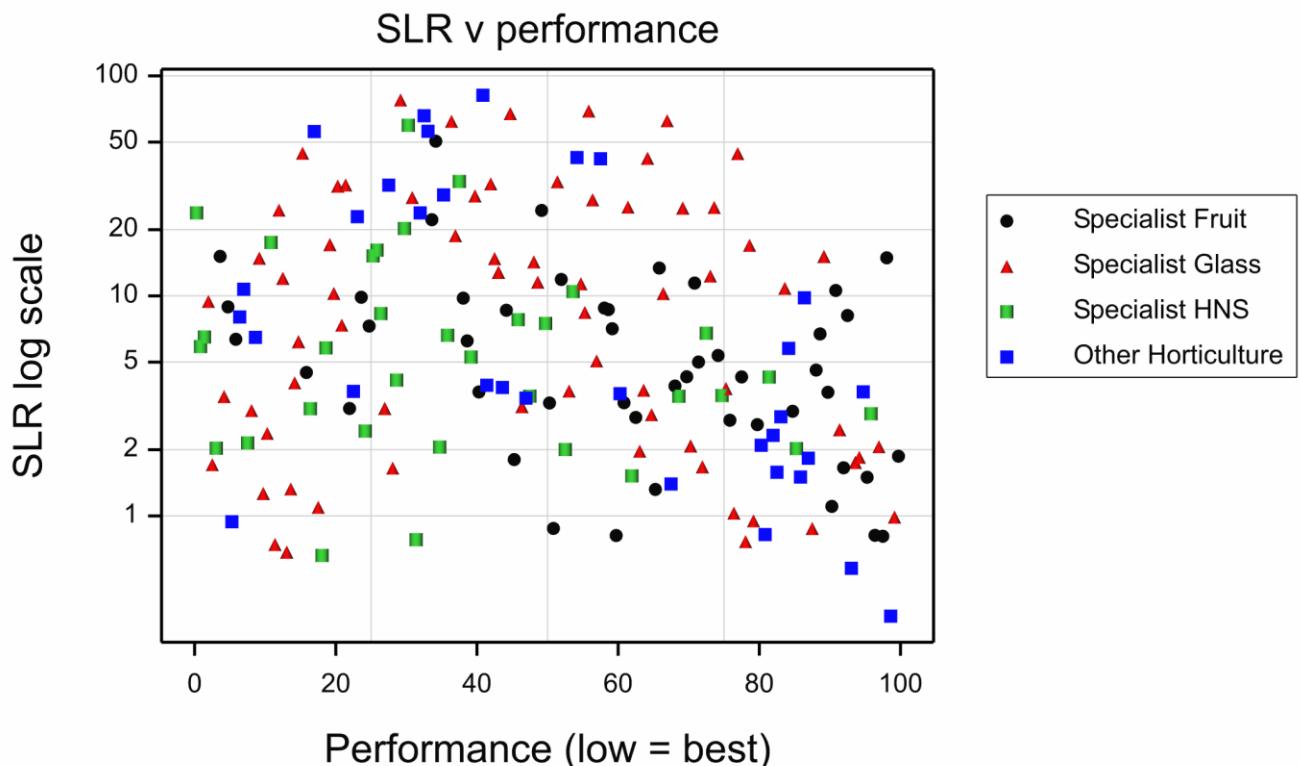
Horticultural farms

Matching process

The matching process was conducted as described for arable and dairy farms, but using the following variables: northing, easting, log-transformed SLR, log-transformed area and quota type. Quota type is important because it divides the sample into specialist fruit, specialist glass, specialist HNS and 'other', thus ensuring that farms are matched with one with a similar production system. Organic status was not used because there were no organic farms in the top quartile. The range of economic sizes is large (Figure 0) but does not differ much between the top and bottom performers and so doesn't cause a major issue.

As with general croppings, the geographic distribution is quite sparse, further complicated by the fact that they are clustered within particular JCAs – thus sometimes there will be a good match within the JCA, whereas in other cases there may be nothing similar within 100km. The weightings for northings and eastings were therefore decreased by setting the divisor to 1200km (just over twice the actual figure). This ensures that matching by quota type and size generally takes precedence over geographic proximity. One problematic match remains, for a farm on the Scilly Isles which gets matched with a farm vastly larger in economic size, and so this pair are excluded from the post matching comparisons.

Figure 0; SLR against performance percentile for horticultural farms by quota type.



Comparisons between top and bottom performers

A wide variety of variables are tested – this is very much a screening procedure. Continuous variables are compared using a t-test (paired t-test for the matched comparison), whilst categorical ones use a chi-squared test, with a permutation test to allow for the situation where low expected values invalidate the usual test. Some key variables are included in both continuous and categorical form. All figures use FBS data from 2011-12 to 2015-16. Variables are averaged across years, using a simple mean, except for categorical variables where the mode is taken. Farms are included where they are always classified as horticultural farms and are present in at least 3 of the 5 years. Performance is averaged on the percentile scale (i.e. a percentile is calculated for each year and these are averaged, before recalculating the percentile for the entire period), to minimise the impact of missing years.

Table 1 and Figure 1 show comparisons between the top and bottom quantiles of the distribution of performance, based on the ratio of agricultural output to costs, charging unpaid family labour at the minimum wage rate for the year. Table 2 and Figure 2 show comparisons after matching (and excluding the five poor matches) between the top quartile and the matched poorer performers. The tables and figures now include Farm Business Income in order to give an idea of the scale of difference between the performance groups. Table 2 also includes a column ('sdiff') for the standardised difference between the two groups – i.e. the size of the difference in standard deviation units.

There are 44 farms in the top quartile; whilst this is not unreasonably small, it is less than for some other types and will increase the difficulty of demonstrating a difference particularly because of the diverse types included. Key points are:

- Economic size shows big differences before matching and, whilst these are considerably reduced by matching they are still statistically significant.
- Similarly, physical area differences are somewhat reduced by matching, but the extra precision resulting from the paired design means that they are significant.
- Diversification is significant both before and after matching, with poor performers more likely to have extensive diversification (measured by the proportion of farm business costs associated with the diversified enterprise). This may be due to the diversified enterprises taking management focus from the core business, or may simply indicate that struggling horticultural businesses are the ones that seek diversification opportunities.
- Tenure is significant after matching, with the difference mainly relating to FAT farms – the numbers involved are quite small so this may just be a chance effect.
- Top performers tend to be more specialised, with the bottom performers showing greater agricultural diversity (based on a Simpson's index of the distribution of partial SLRs across different types of agriculture). Before matching other variables, including the SLR for grassland, associated with this are significant.
- Output and costs. After matching both total output value and total costs are much higher for the top performers. I wonder if this could reflect some subtle differences between the crops grown which is not fully reflected in either the quota type or the SLR coefficients. General farming costs are significantly

higher for the poor performers, as our machinery costs, although these could equally reflect the need for more machinery on the farms less specialised into pure horticulture.

- There is an odd result for sharing labour and machinery, but the difference in numbers is small.

Table 1: significance test for differences between top and bottom quartiles.

| variable | Means | | | | | | | Definition |
|----------------|--------|--------|-------|-------|-------|-----------------------------|--|------------|
| | Top | bottom | sed | t | P | sig | | |
| fbi | 107.1 | 2.5 | 22.9 | 4.57 | 0.000 | *** | Farm Business Income £000 | |
| north | 222.6 | 225.5 | 24.3 | 0.12 | 0.906 | NS | Northing (mid point of JCA) | |
| east | 446.4 | 473.4 | 26.0 | 1.04 | 0.301 | NS | Easting (mid point of JCA) | |
| altitude | | | | 1.000 | | NS | Altitude (3 bands) | |
| younger | | | | 0.665 | | NS | Transfer to younger farmer | |
| education | | | | 0.179 | | NS | education of farmer | |
| conrat | 0.1 | 0.1 | 0.0 | 0.27 | 0.787 | NS | contracting costs as % all machinery & contracting | |
| %unpaid | 38.1 | 64.0 | 6.4 | 4.06 | 0.000 | *** | Unpaid labour as % all labour | |
| initgearing | | | | 0.084 | 10% | gearing group (opening a/c) | | |
| %interest | | | | 0.358 | | NS | Interest paid as % farm costs | |
| %divcost | | | | 0.000 | | *** | diversification costs as % farm costs | |
| logarea | 0.8 | 1.0 | 0.1 | 1.48 | 0.142 | NS | Log of total area | |
| %nvz | 53.1 | 42.3 | 10.0 | 1.08 | 0.282 | NS | % land in nvz | |
| farmass | 0.3 | 0.4 | 0.1 | 1.53 | 0.129 | NS | farm assurance 0/1 | |
| sharelm | | | | 0.181 | | NS | sharing labour machinery | |
| firstyr | 2004.3 | 2003.5 | 1.4 | 0.57 | 0.572 | NS | first year in fbs | |
| quotatype | | | | 0.015 | | * | quota type | |
| %chguaa | -1.1 | -0.6 | 1.7 | 0.30 | 0.767 | NS | % change in uaa | |
| sharefarm | 0.0 | 0.0 | 0.0 | 1.00 | 0.320 | NS | share farming | |
| fbt | 9.7 | 9.8 | 5.2 | 0.02 | 0.984 | NS | FBT land | |
| fat | 2.9 | 4.6 | 3.3 | 0.50 | 0.620 | NS | FAT land | |
| owned | 87.3 | 85.5 | 6.2 | 0.28 | 0.777 | NS | owned land | |
| tenure | | | | 0.626 | | NS | tenure | |
| bustype | | | | 0.592 | | NS | business type | |
| porg | 0.0 | 0.2 | 0.1 | 3.30 | 0.001 | ** | proportion of land organic | |
| aesperha | 3.1 | 54.7 | 27.9 | 1.85 | 0.068 | 10% | AES payments per ha | |
| aesgroup | | | | 0.004 | | ** | AES grouped | |
| slr | 10.3 | 4.8 | 2.1 | 2.65 | 0.010 | ** | SLR | |
| slrgroup | | | | 0.002 | | ** | SLR group | |
| manager | 0.1 | 0.0 | 0.0 | 1.43 | 0.156 | NS | Paid manager yes/no | |
| agout | 675.7 | 90.2 | 166.5 | 3.52 | 0.001 | *** | agricultural output | |
| unpaidhrs | 3.8 | 3.0 | 0.4 | 2.15 | 0.035 | * | Unpaid labour hours (000s) | |
| agcosts | 584.3 | 133.9 | 158.5 | 2.84 | 0.006 | ** | agricultural costs | |
| afixedcost | 50.0 | 62.3 | 3.9 | 3.17 | 0.002 | ** | agriculture fixed costs † | |
| agvariablecost | 50.0 | 37.7 | 3.9 | 3.17 | 0.002 | ** | agriculture variable costs † | |
| bghtfeedcost | 0.3 | 0.7 | 0.4 | 0.88 | 0.381 | NS | Bought feed costs † | |
| vetcost | 0.0 | 0.0 | 0.0 | 1.14 | 0.259 | NS | vet costs † | |
| seedcost | 15.9 | 9.5 | 2.7 | 2.39 | 0.019 | * | seed costs † | |
| fertcost | 4.5 | 2.9 | 0.7 | 2.29 | 0.024 | * | fertiliser costs † | |
| cpcost | 2.9 | 3.0 | 0.7 | 0.25 | 0.801 | NS | crop protection costs † | |
| genfarmcost | 13.5 | 17.5 | 2.2 | 1.86 | 0.066 | 10% | general farming costs † | |
| labourcost | 29.1 | 22.6 | 3.7 | 1.75 | 0.084 | 10% | agricultural labour costs † | |
| machinerycost | 9.0 | 17.5 | 2.1 | 4.06 | 0.000 | *** | machinery costs † | |
| %slrcereals | 0.0 | 0.5 | 0.4 | 1.22 | 0.227 | NS | SLR cereals | |
| %slrotherarab | 6.1 | 10.5 | 5.1 | 0.84 | 0.400 | NS | SLR other arable | |
| %slrbeef | 0.0 | 0.2 | 0.2 | 1.20 | 0.233 | NS | SLR beef | |
| %slrsheep | 0.0 | 0.4 | 0.4 | 1.00 | 0.320 | NS | SLR sheep | |
| %slrpigs | 0.0 | 0.0 | 0.0 | 1.00 | 0.320 | NS | SLR pigs | |
| %slrgrass | 0.1 | 0.7 | 0.3 | 2.38 | 0.019 | * | SLR grass and fodder | |
| agdiversity | 0.0 | 0.1 | 0.0 | 3.02 | 0.003 | ** | Agricultural diversity | |

Note: NS not significant, 10% P <= 0.1 (almost significant), * P <= 0.05, ** P <= 0.01, *** P <= 0.001

† as a percentage of all agricultural costs, sed=standard error of difference

Figure 1: bar charts for the nominally significant variables. ‘Top’ refers to top quartile, ‘bottom’ to bottom quartile.

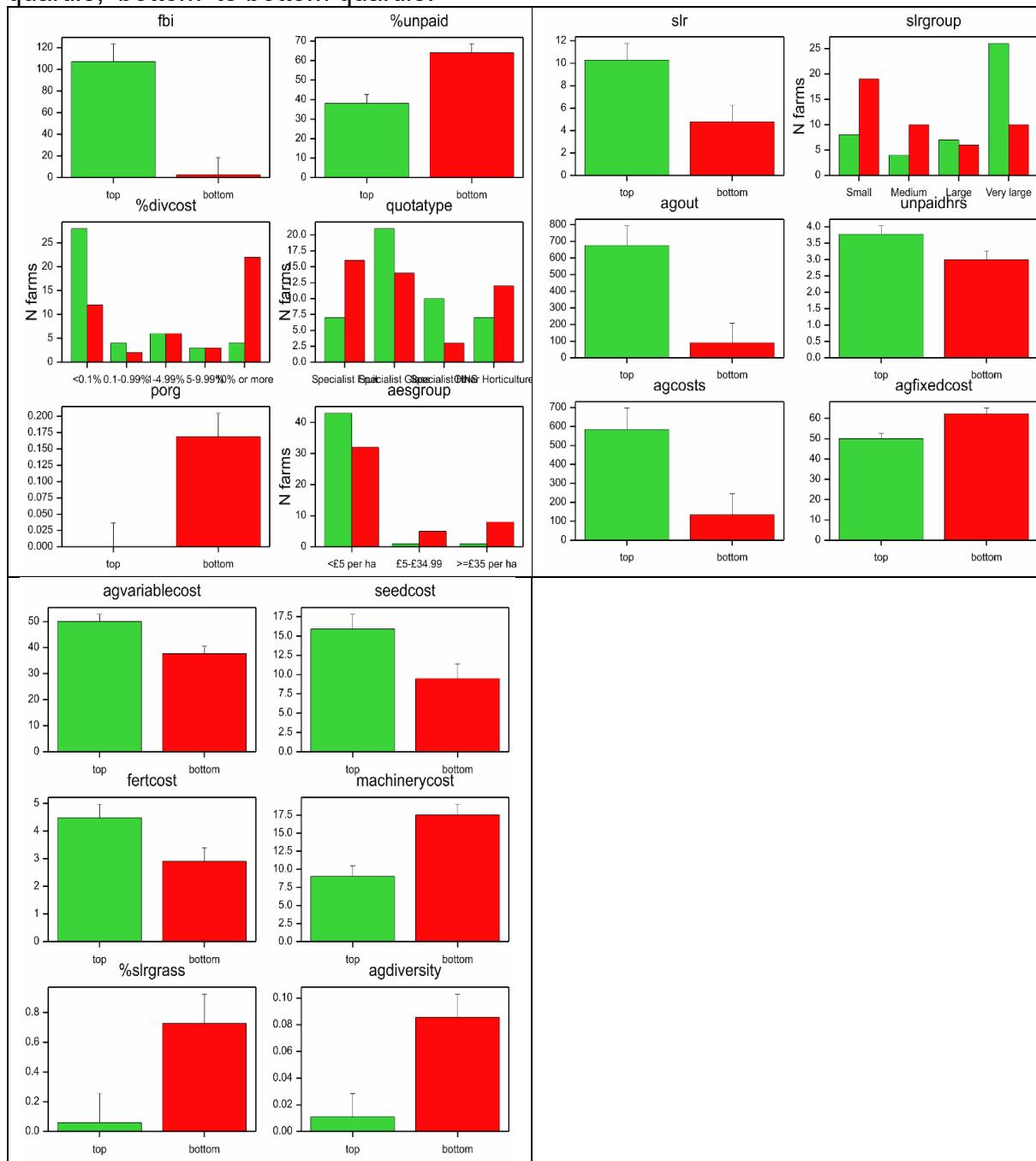


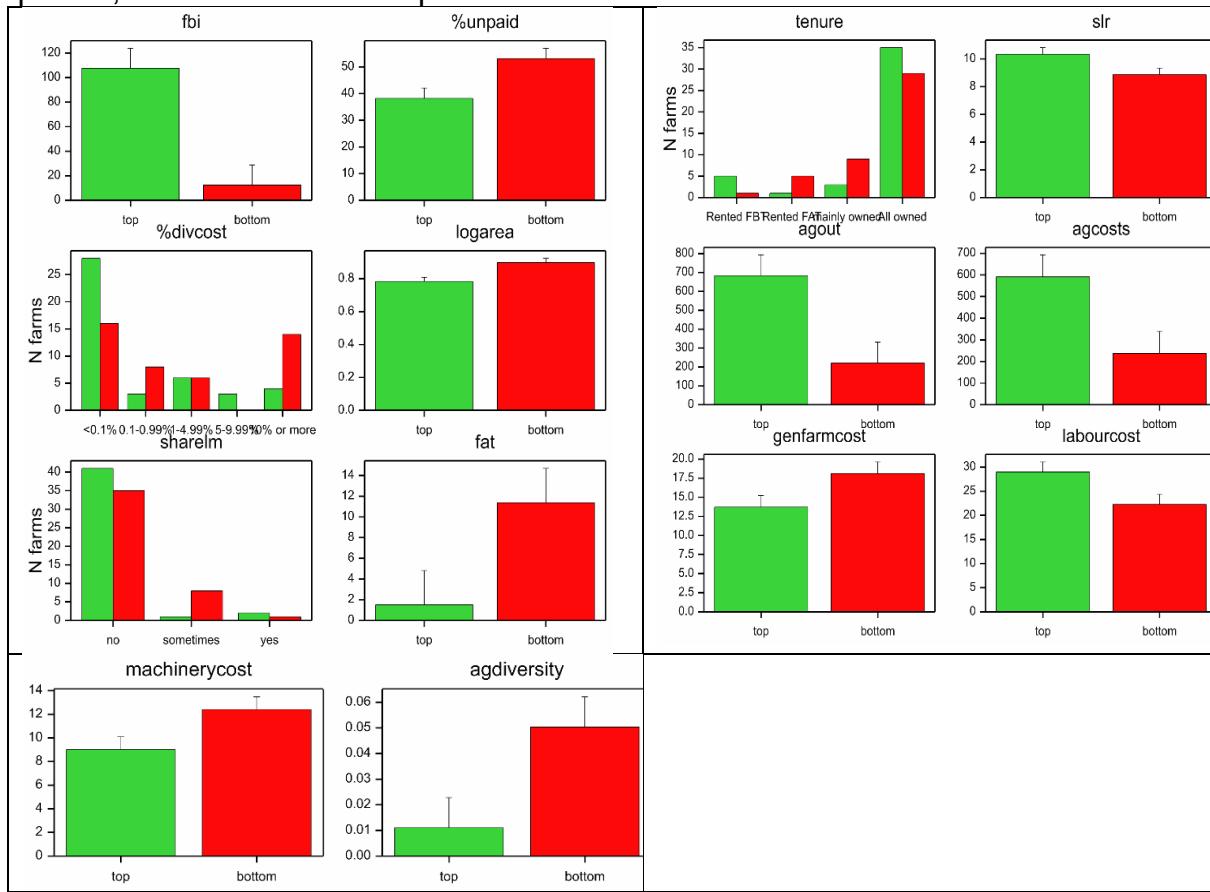
Table 2: tests for differences between matched pairs of top and bottom performers.

| variable | Means | | sed | t | P | sig | diff | Definition |
|----------------|--------|--------|-------|------|-------|-----|------|--|
| | Top | bottom | | | | | | |
| fbi | 107.6 | 12.5 | 23.0 | 4.14 | 0.000 | *** | 0.90 | Farm Business Income £000 |
| north | 227.4 | 215.6 | 12.8 | 0.92 | 0.364 | NS | 0.11 | Northing (mid point of JCA) |
| east | 454.5 | 481.5 | 14.5 | 1.86 | 0.070 | 10% | 0.24 | Easting (mid point of JCA) |
| altitude | | | | | 1.000 | NS | | Altitude (3 bands) |
| younger | | | | | 0.368 | NS | | Transfer to younger farmer |
| education | | | | | 0.257 | NS | | education of farmer |
| conrat | 0.1 | 0.1 | 0.0 | 1.34 | 0.188 | NS | 0.27 | contracting costs as % all machinery & contracting |
| %unpaid | 38.2 | 53.1 | 5.5 | 2.72 | 0.009 | ** | 0.46 | Unpaid labour as % all labour |
| initgearing | | | | | 0.707 | NS | | gearing group (opening a/c) |
| %interest | | | | | 0.509 | NS | | Interest paid as % farm costs |
| %divcost | | | | | 0.002 | ** | | diversification costs as % farm costs |
| logarea | 0.8 | 0.9 | 0.0 | 3.16 | 0.003 | ** | 0.17 | Log of total area |
| %nvz | 54.4 | 45.4 | 10.5 | 0.85 | 0.398 | NS | 0.19 | % land in nvz |
| farmass | 0.3 | 0.4 | 0.1 | 1.40 | 0.168 | NS | 0.23 | farm assurance 0/1 |
| sharelm | | | | | 0.041 | * | | sharing labour machinery |
| firstyr | 2004.2 | 2002.3 | 1.2 | 1.56 | 0.125 | NS | 0.27 | first year in fbs |
| quotatype | | | | | 1.000 | NS | | quota type |
| %chguaa | -1.2 | -0.9 | 1.8 | 0.17 | 0.869 | NS | 0.04 | % change in uaa |
| fbt | 9.2 | 6.4 | 3.8 | 0.73 | 0.470 | NS | 0.12 | FBT land |
| fat | 1.5 | 11.4 | 4.7 | 2.10 | 0.041 | * | 0.42 | FAT land |
| owned | 89.3 | 82.2 | 5.6 | 1.26 | 0.215 | NS | 0.21 | owned land |
| tenure | | | | | 0.019 | * | | tenure |
| bustype | | | | | 0.411 | NS | | business type |
| porg | 0.0 | 0.1 | 0.0 | 1.77 | 0.084 | 10% | 0.27 | proportion of land organic |
| aesperha | 0.4 | 5.9 | 2.8 | 1.95 | 0.058 | 10% | 0.06 | AES payments per ha |
| aesgroup | | | | | 0.487 | NS | | AES grouped |
| slr | 10.3 | 8.9 | 0.7 | 2.20 | 0.033 | * | 0.09 | SLR |
| slrgroup | | | | | 0.857 | NS | | SLR group |
| manager | 0.1 | 0.0 | 0.1 | 0.82 | 0.415 | NS | 0.17 | Paid manager yes/no |
| agout | 683.2 | 220.4 | 156.3 | 2.96 | 0.005 | ** | 0.37 | agricultural output |
| unpaidhrs | 3.8 | 3.4 | 0.3 | 1.02 | 0.312 | NS | 0.18 | Unpaid labour hours (000s) |
| agcosts | 591.5 | 237.8 | 143.9 | 2.46 | 0.018 | * | 0.29 | agricultural costs |
| agfixedcost | 50.4 | 57.1 | 3.7 | 1.83 | 0.074 | 10% | 0.37 | agriculture fixed costs † |
| agvariablecost | 49.6 | 42.9 | 3.7 | 1.83 | 0.074 | 10% | 0.37 | agriculture variable costs † |
| bghtfeedcost | 0.3 | 0.7 | 0.5 | 0.95 | 0.349 | NS | 0.28 | Bought feed costs † |
| vetcost | 0.0 | 0.1 | 0.0 | 1.53 | 0.133 | NS | 0.44 | vet costs † |
| seedcost | 16.2 | 15.7 | 2.6 | 0.15 | 0.879 | NS | 0.03 | seed costs † |
| fertcost | 4.6 | 3.8 | 0.7 | 1.08 | 0.284 | NS | 0.23 | fertiliser costs † |
| cpcost | 2.9 | 2.7 | 0.4 | 0.54 | 0.592 | NS | 0.05 | crop protection costs † |
| genfarmcost | 13.7 | 18.1 | 2.1 | 2.06 | 0.046 | * | 0.49 | general farming costs † |
| labourcost | 29.0 | 22.3 | 3.0 | 2.26 | 0.029 | * | 0.42 | agricultural labour costs † |
| machinerycost | 9.0 | 12.4 | 1.5 | 2.25 | 0.029 | * | 0.34 | machinery costs † |
| %slrcereals | 0.0 | 0.1 | 0.0 | 1.17 | 0.248 | NS | 0.02 | SLR cereals |
| %slrotharab | 6.3 | 5.2 | 3.5 | 0.30 | 0.765 | NS | 0.05 | SLR other arable |
| %slrbef | 0.0 | 0.4 | 0.3 | 1.57 | 0.125 | NS | 0.31 | SLR beef |
| %slrsheep | 0.0 | 0.0 | 0.0 | | | - | 0.00 | SLR sheep |
| %slrpigs | 0.0 | 0.0 | 0.0 | | | - | 0.00 | SLR pigs |
| %slrgrass | 0.1 | 4.7 | 3.2 | 1.46 | 0.151 | NS | 0.62 | SLR grass and fodder |
| agdiversity | 0.0 | 0.1 | 0.0 | 2.36 | 0.023 | * | 0.32 | Agricultural diversity |

Note: NS not significant, 10% P <= 0.1 (almost significant), * P <= 0.05, ** P <= 0.01, *** P <= 0.001

† as a percentage of all agricultural costs, sed=standard error of difference, diff=standardised difference

Figure 2: bar charts for the nominally significant variables. ‘Top’ refers to top quartile, ‘bottom’ to matched pairs from the bottom half of the distribution.



Business management module

Matching process

Because of the restricted sample size for the business management module (1,178 farms meeting the criterion for analysis), the analysis uses all sectors combined but examining differences between robust types within this. Thus the matching process uses the variables northing, easting, log-transformed SLR, and log-transformed area together with robust type. Other variables (e.g. organic status and LFA) would be useful for some sectors, but it seemed best to keep to these five key variables to ensure the matching worked adequately for all farms and that farms could always be matched to one of the same type.

Comparisons between top and bottom performers

Quartiles of performance were defined within each robust type, so that the combined dataset contained the same proportions of each farm type in each quartile. As for the sector analyses, performance was based on FBS data from 2011-12 to 2015-16, with farms being included provided that they occurred in at least three of these five years. Where farms changed robust type between years, the mode value was taken (e.g. if a farm was robust type pigs in three years and mixed the other two, it was treated as pigs).

Table 1 and Figure 1 show comparisons between the top and bottom quantiles of the distribution of performance, for selected variables from the module. Table 2 and Figure 2 show comparisons after matching (and excluding the five poor matches) between the top quartile and the matched poorer performers. In each case I have first tested for overall differences in the proportion of farms reporting the characteristic (e.g. whether there was a difference in the proportion of farms using benchmarking between the top and bottom groups), considering all farm types simultaneously. A graph is shown where the difference was statistically significant (using logistic regression as all variables are 0/1). A test is then made for any interaction between performance group (top v bottom) and robust type. Where this is significant, it suggests that the pattern might be different for different sectors and so a barchart is shown by type.

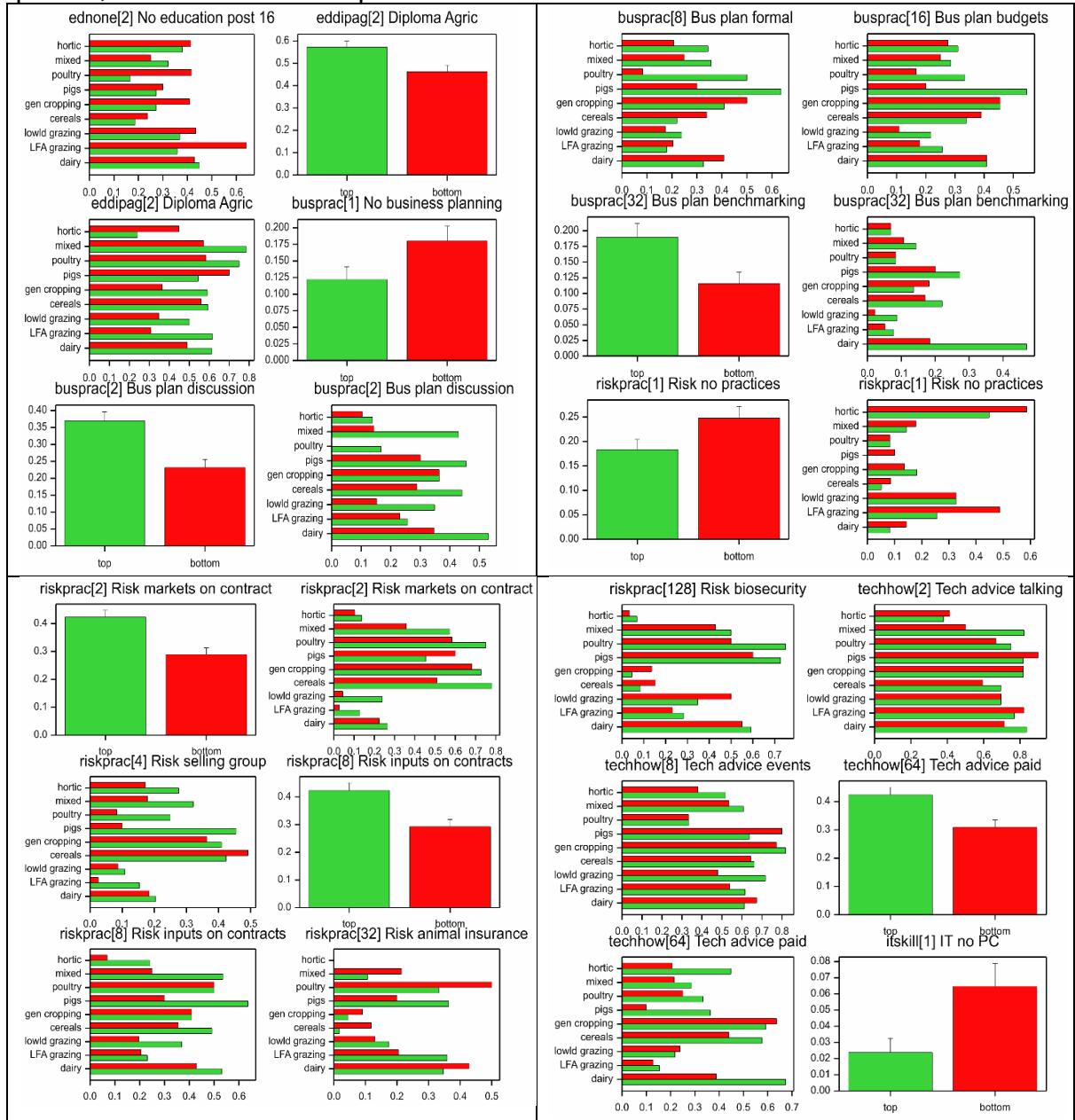
Before matching there are consistent overall differences between top and bottom performers for a fair number of variables, but far fewer are significant after matching. This suggests that some of the differences might be due to the relationship with confounding factors, particularly economic size, which are adjusted for by the matching. However, the interaction terms are frequently significant; this may indicate genuine differences between sectors, although there may be some spurious values due to very low numbers of responses.

Table 1: significance test for differences between top and bottom quartiles in the proportion of farms reporting each action/characteristic. See businessmanagementquestions.xlsx for details of questions.

| variable | Proportion | | | | P | sig | Inter-action | Definition |
|---------------|------------|--------|-----|------|-------|-----|--------------|---------------------------|
| | Top | bottom | sed | t | | | | |
| ednone[2] | 0.3 | 0.4 | 0.0 | 1.88 | 0.062 | 10% | * | No education post 16 |
| eddipag[2] | 0.6 | 0.5 | 0.0 | 2.74 | 0.007 | ** | ** | Diploma Agric |
| eddipbus[2] | 0.1 | 0.1 | 0.0 | 0.17 | 0.865 | NS | NS | Diploma business |
| eddegag[2] | 0.2 | 0.2 | 0.0 | 0.31 | 0.760 | NS | NS | Degree agric |
| eddegbus[2] | 0.0 | 0.0 | 0.0 | 0.21 | 0.836 | NS | NS | Degree business |
| eddegoth[2] | 0.1 | 0.1 | 0.0 | 0.94 | 0.348 | NS | NS | Degree other |
| edpgbus[2] | 0.1 | 0.0 | 0.0 | 0.37 | 0.709 | NS | NS | Postgrad business |
| busprac[1] | 0.1 | 0.2 | 0.0 | 2.00 | 0.047 | * | NS | No business planning |
| busprac[2] | 0.4 | 0.2 | 0.0 | 3.80 | 0.000 | *** | ** | Bus plan discussion |
| busprac[4] | 0.7 | 0.6 | 0.0 | 0.99 | 0.321 | NS | NS | Bus plan informal |
| busprac[8] | 0.3 | 0.3 | 0.0 | 0.42 | 0.677 | NS | * | Bus plan formal |
| busprac[16] | 0.3 | 0.3 | 0.0 | 1.15 | 0.249 | NS | * | Bus plan budgets |
| busprac[32] | 0.2 | 0.1 | 0.0 | 2.61 | 0.010 | * | *** | Bus plan benchmarking |
| busprac[64] | 0.1 | 0.1 | 0.0 | 0.71 | 0.476 | NS | NS | Bus plan benchmarking+ |
| riskprac[1] | 0.2 | 0.2 | 0.0 | 2.06 | 0.041 | * | *** | Risk no practices |
| riskprac[2] | 0.4 | 0.3 | 0.0 | 3.98 | 0.000 | *** | *** | Risk markets on contract |
| riskprac[4] | 0.3 | 0.2 | 0.0 | 1.70 | 0.091 | 10% | *** | Risk selling group |
| riskprac[8] | 0.4 | 0.3 | 0.0 | 3.44 | 0.001 | *** | *** | Risk inputs on contracts |
| riskprac[16] | 0.1 | 0.1 | 0.0 | 0.38 | 0.704 | NS | NS | Risk options |
| riskprac[32] | 0.2 | 0.2 | 0.0 | 0.71 | 0.479 | NS | *** | Risk animal insurance |
| riskprac[64] | 0.1 | 0.1 | 0.0 | 0.44 | 0.660 | NS | 10% | Risk crop insurance |
| riskprac[128] | 0.3 | 0.3 | 0.0 | 0.16 | 0.870 | NS | *** | Risk biosecurity |
| riskprac[256] | 0.1 | 0.0 | 0.0 | 0.40 | 0.689 | NS | NS | Risk exchange rate |
| techhow[2] | 0.7 | 0.7 | 0.0 | 1.69 | 0.093 | 10% | *** | Tech advice talking |
| techhow[4] | 0.9 | 0.8 | 0.0 | 1.58 | 0.116 | NS | NS | Tech advice farming media |
| techhow[8] | 0.6 | 0.6 | 0.0 | 1.49 | 0.137 | NS | * | Tech advice events |
| techhow[16] | 0.6 | 0.5 | 0.0 | 0.95 | 0.341 | NS | NS | Tech advice farm walks |
| techhow[32] | 0.7 | 0.7 | 0.0 | 0.19 | 0.847 | NS | NS | Tech advice free |
| techhow[64] | 0.4 | 0.3 | 0.0 | 3.09 | 0.002 | ** | *** | Tech advice paid |
| techhow[128] | 0.1 | 0.1 | 0.0 | 0.14 | 0.886 | NS | 10% | Tech advice RDP animal |
| techhow[256] | 0.1 | 0.1 | 0.0 | 0.15 | 0.884 | NS | NS | Tech advice RDP other |
| itskill[1] | 0.0 | 0.1 | 0.0 | 2.45 | 0.019 | * | NS | IT no PC |
| itskill[2] | 0.0 | 0.0 | 0.0 | 0.23 | 0.815 | NS | NS | IT not used |
| itskill[4] | 0.3 | 0.3 | 0.0 | 1.36 | 0.175 | NS | * | IT occasional |
| itskill[8] | 0.1 | 0.1 | 0.0 | 1.03 | 0.303 | NS | NS | IT no broadband |
| itskill[16] | 0.8 | 0.7 | 0.0 | 2.96 | 0.004 | ** | * | IT with broadband |
| itskill[32] | 0.8 | 0.7 | 0.0 | 1.45 | 0.148 | NS | ** | IT proficient |
| itskill[64] | 0.5 | 0.5 | 0.0 | 0.95 | 0.343 | NS | NS | IT buying/selling |
| itskill[128] | 0.1 | 0.1 | 0.0 | 0.58 | 0.565 | NS | * | IT performance improve |
| itskill[256] | 0.6 | 0.5 | 0.0 | 0.63 | 0.531 | NS | *** | IT business docs |
| itskill[512] | 0.9 | 0.8 | 0.0 | 3.97 | 0.000 | *** | 10% | IT forms |
| itskill[1024] | 0.3 | 0.3 | 0.0 | 0.06 | 0.949 | NS | 10% | IT communicate |
| cpdprac[256] | 0.4 | 0.3 | 0.0 | 3.15 | 0.002 | ** | *** | CPD scheme member |

Note: NS not significant, 10% P <= 0.1 (almost significant), * P <= 0.05, ** P <= 0.01, *** P <= 0.001

Figure 1: bar charts for the nominally significant variables. ‘Top’ refers to top quartile, ‘bottom’ to bottom quartile.



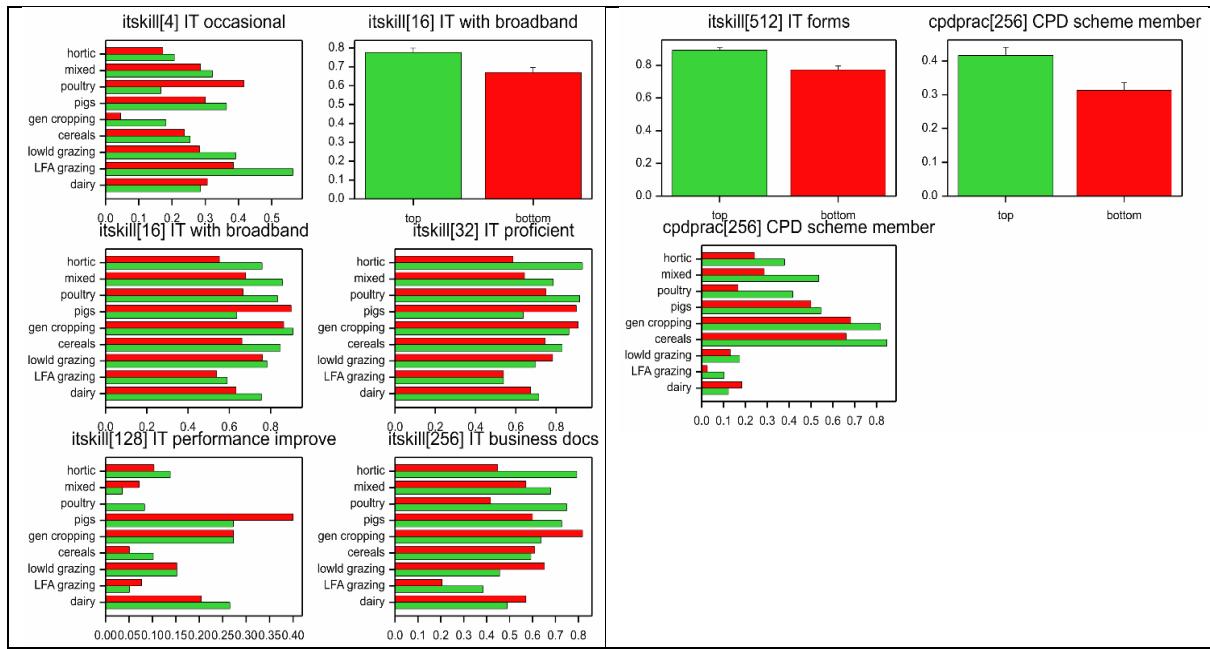


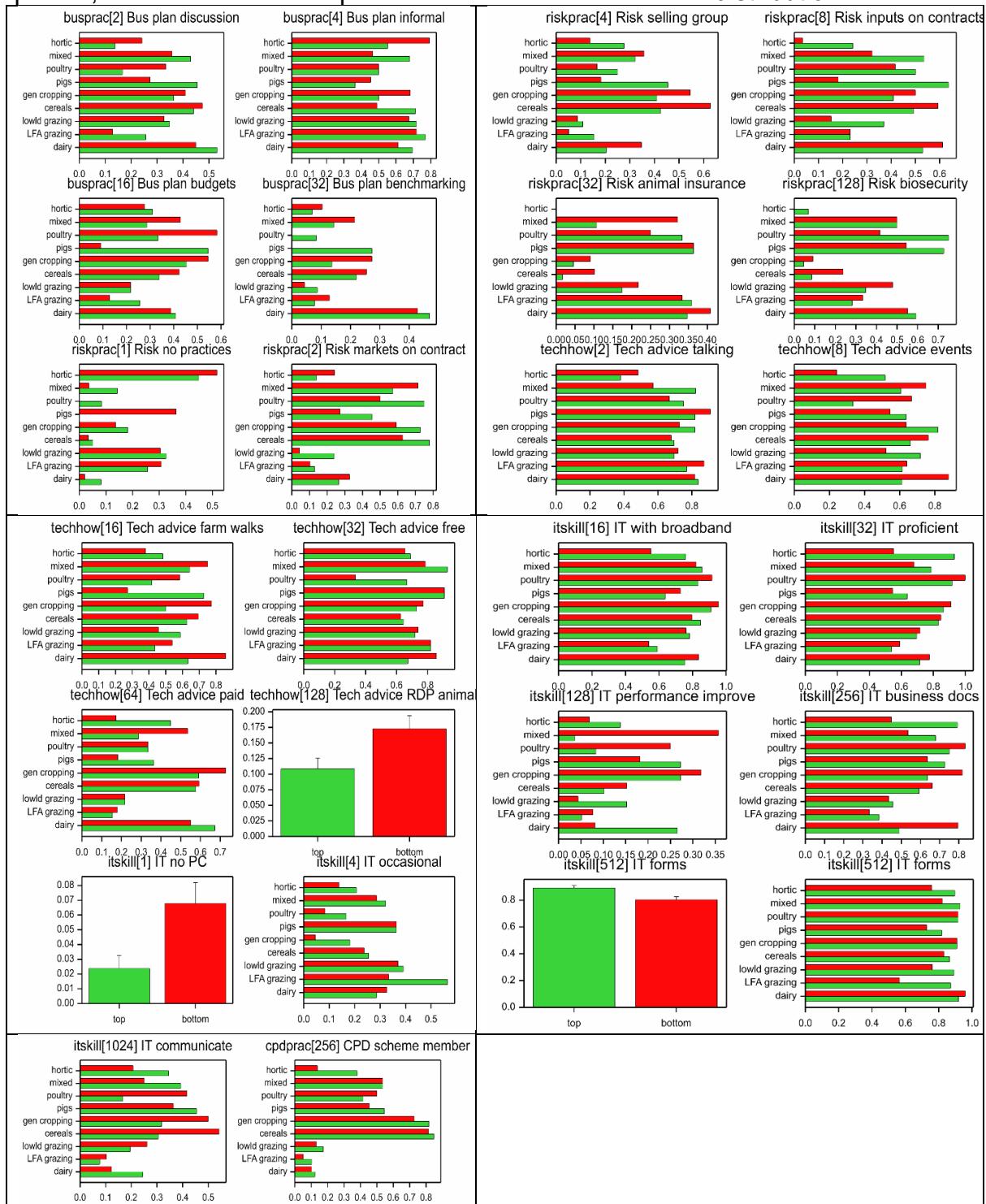
Table 2: tests for differences between matched pairs of top and bottom performers.

| variable | Means | | | | | | | Definition |
|---------------|-------|--------|-----|------|-------|-----|-------------|---------------------------|
| | Top | bottom | sed | t | P | sig | Interaction | |
| ednone[2] | 0.3 | 0.3 | 0.0 | 0.18 | 0.859 | NS | NS | No education post 16 |
| eddipag[2] | 0.6 | 0.6 | 0.0 | 0.34 | 0.734 | NS | 10% | Diploma Agric |
| eddipbus[2] | 0.1 | 0.1 | 0.0 | 0.15 | 0.884 | NS | NS | Diploma business |
| eddeggag[2] | 0.2 | 0.2 | 0.0 | 1.41 | 0.161 | NS | NS | Degree agric |
| eddegbus[2] | 0.0 | 0.0 | 0.0 | 0.20 | 0.843 | NS | NS | Degree business |
| eddegoth[2] | 0.1 | 0.1 | 0.0 | 0.63 | 0.528 | NS | NS | Degree other |
| edpgbus[2] | 0.1 | 0.1 | 0.0 | 0.72 | 0.474 | NS | NS | Postgrad business |
| busprac[1] | 0.1 | 0.1 | 0.0 | 0.00 | 1.000 | NS | NS | No business planning |
| busprac[2] | 0.4 | 0.3 | 0.0 | 0.53 | 0.597 | NS | * | Bus plan discussion |
| busprac[4] | 0.7 | 0.6 | 0.0 | 1.30 | 0.193 | NS | * | Bus plan informal |
| busprac[8] | 0.3 | 0.4 | 0.0 | 1.34 | 0.180 | NS | ** | Bus plan formal |
| busprac[16] | 0.3 | 0.3 | 0.0 | 0.18 | 0.858 | NS | * | Bus plan budgets |
| busprac[32] | 0.2 | 0.2 | 0.0 | 0.22 | 0.825 | NS | *** | Bus plan benchmarking |
| busprac[64] | 0.1 | 0.1 | 0.0 | 0.69 | 0.490 | NS | NS | Bus plan benchmarking+ |
| riskprac[1] | 0.2 | 0.2 | 0.0 | 0.23 | 0.816 | NS | *** | Risk no practices |
| riskprac[2] | 0.4 | 0.4 | 0.0 | 1.65 | 0.099 | 10% | *** | Risk markets on contract |
| riskprac[4] | 0.3 | 0.3 | 0.0 | 0.97 | 0.331 | NS | *** | Risk selling group |
| riskprac[8] | 0.4 | 0.4 | 0.0 | 1.42 | 0.157 | NS | *** | Risk inputs on contracts |
| riskprac[16] | 0.1 | 0.1 | 0.0 | 1.53 | 0.131 | NS | NS | Risk options |
| riskprac[32] | 0.2 | 0.2 | 0.0 | 1.64 | 0.102 | NS | *** | Risk animal insurance |
| riskprac[64] | 0.1 | 0.1 | 0.0 | 0.57 | 0.566 | NS | NS | Risk crop insurance |
| riskprac[128] | 0.3 | 0.3 | 0.0 | 0.77 | 0.442 | NS | *** | Risk biosecurity |
| riskprac[256] | 0.1 | 0.1 | 0.0 | 0.19 | 0.847 | NS | NS | Risk exchange rate |
| techhow[2] | 0.7 | 0.7 | 0.0 | 0.28 | 0.776 | NS | ** | Tech advice talking |
| techhow[4] | 0.9 | 0.8 | 0.0 | 0.58 | 0.562 | NS | NS | Tech advice farming media |
| techhow[8] | 0.6 | 0.7 | 0.0 | 0.53 | 0.596 | NS | *** | Tech advice events |
| techhow[16] | 0.6 | 0.6 | 0.0 | 1.38 | 0.169 | NS | *** | Tech advice farm walks |
| techhow[32] | 0.7 | 0.7 | 0.0 | 0.10 | 0.924 | NS | * | Tech advice free |
| techhow[64] | 0.4 | 0.4 | 0.0 | 0.36 | 0.719 | NS | *** | Tech advice paid |
| techhow[128] | 0.1 | 0.2 | 0.0 | 2.36 | 0.020 | * | 10% | Tech advice RDP animal |
| techhow[256] | 0.1 | 0.1 | 0.0 | 1.41 | 0.161 | NS | NS | Tech advice RDP other |
| itskill[1] | 0.0 | 0.1 | 0.0 | 2.65 | 0.012 | * | 10% | IT no PC |
| itskill[2] | 0.0 | 0.0 | 0.0 | 0.25 | 0.804 | NS | NS | IT not used |
| itskill[4] | 0.3 | 0.3 | 0.0 | 1.49 | 0.137 | NS | * | IT occasional |
| itskill[8] | 0.1 | 0.1 | 0.0 | 0.42 | 0.678 | NS | NS | IT no broadband |
| itskill[16] | 0.8 | 0.8 | 0.0 | 0.60 | 0.547 | NS | ** | IT with broadband |
| itskill[32] | 0.8 | 0.7 | 0.0 | 0.58 | 0.559 | NS | ** | IT proficient |
| itskill[64] | 0.5 | 0.5 | 0.0 | 0.33 | 0.740 | NS | NS | IT buying/selling |
| itskill[128] | 0.1 | 0.1 | 0.0 | 0.12 | 0.905 | NS | ** | IT performance improve |
| itskill[256] | 0.6 | 0.6 | 0.0 | 0.52 | 0.605 | NS | *** | IT business docs |
| itskill[512] | 0.9 | 0.8 | 0.0 | 3.06 | 0.003 | ** | ** | IT forms |
| itskill[1024] | 0.3 | 0.3 | 0.0 | 0.95 | 0.342 | NS | *** | IT communicate |
| cpdprac[256] | 0.4 | 0.4 | 0.0 | 1.71 | 0.089 | 10% | *** | CPD scheme member |

Note: NS not significant, 10% P <= 0.1 (almost significant), * P <= 0.05, ** P <= 0.01, *** P <= 0.001

† as a percentage of all agricultural costs

Figure 2: bar charts for the nominally significant variables. ‘Top’ refers to top quartile, ‘bottom’ to matched pairs from the bottom half of the distribution.



| | |
|---|---------------|
| _all.bck 5/5/18 from FBS databases downloaded 29/3/18 | Datafile |
| Compare_pre.gen, match.gen, compare_post.gen | Program files |