The impact of grants on farm economic performance

A note based on the Farm Business Survey

February 2014

Defra Agricultural Change and Environment Observatory Research Report No. 34

Observatory contact: Steve Langton (steve.langton@defra.gsi.gov.uk)

Summary

1. ‘Efficiency’ in this report refers to economic efficiency, i.e. the farm’s efficiency at turning economic input into output (in this case mainly the value of livestock). This definition was chosen in order to give a criterion which would identify farms that were viable and competitive, and therefore able to contribute to Defra’s aim of sustainable food production.
2. Details of grants given to a farm in a particular year were taken from Section G of the Farm Business Survey (FBS) covering grants for buildings, machinery and other improvements. Changes in asset values were used to indentify years where investment was made in the farm.
3. Most grants recorded in the FBS were fairly small, both in absolute terms (65% less than or equal to ten thousand pounds) and relative to business turnover (80% no more than 10% of annual turnover). The overall value of grants was approximately one twentieth of the overall level of investment. Farms receiving grants were more likely to undertake major investment than those not receiving grants.
4. There were no statistically significant positive impacts of grants on economic performance. However, this result must be treated with caution, given the small size of the grants and the high level of random variation in the data. In addition, based on RDPE application data, the primary objective of almost of 50% of grants was to improve animal welfare or deliver environmental benefits, rather than to improve competitiveness.
5. Farms applying for grants tended to be significantly better economic performers prior to receiving the grant than those farms not receiving grants.
6. There is a need for more detailed analysis looking separately at different types of grants. Unfortunately the necessary information is not currently collected in the FBS, although it may be possible to obtain it in the future by linking with RDPE application data.

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1. Introduction

Whilst much investment in the infrastructure of English farms comes from internal sources or commercial loans, grant funding may also be used by farmers to assist their businesses to develop. Such grants are available from a variety of organisations, but the largest source is the Rural Development Programme for England (RDPE) which is managed by Defra with the aim of promoting rural growth, improving competitiveness and enhancing the rural environment. The current RDPE is about to end and plans are currently being made for the next RDPE, which will last from 2014 to 2020. It is therefore a timely moment to review the evidence from the Farm Business Survey on the effectiveness of such grants.

The Farm Business Survey (FBS) provides information on the financial, physical and environmental performance of farm businesses in England to inform and evaluate policy decisions[1].

2. Methods: Data and statistical models

2.1. Data

Two types of analyses were applied to assess the impact of grants on farm performance:

1. Analyses building on the previously published reports of farm performance for cereals, grazing livestock and dairy farms. These analyses test the impact of grants by including extra terms in the previously fitted models, thus allowing for the impact of other confounding variables. The criteria for including farms in these models is as described in the relevant reports.
2. Analyses using all farm types. These analyses use all farms appearing the Farm Business Survey of England for at least three years between 2003 and 2011, thus giving a much larger number of grant receipts. 2416 farms are included in the dataset, with 1676 of these occurring in five or more years. Models include terms for economic size and farm type, but do not adjust for other confounding variables.

Whilst the first approach is better in terms of allowing for the impact of key confounding variables, the number of grants received in each sector is relatively small, making it difficult to show any statistically significant results. These results are presented in Appendix 1, but the main section of the report concentrates on the second approach.

2.2. Variables used in the analysis

The principal variables used are shown in Table 2.1. Models are either fitted for the entire farm business (i.e. using ‘fbout’ and ‘fbcosts’ from Table 2.1), or just for the agricultural cost centre (i.e. using ‘agoutput’ and ‘agcosts’).

Analysis of grants uses all grants recorded in Section G of the FBS form; the majority of these are buildings and machinery grants. We believe that most of these grants are from RDPE, but this is not completely clear, since the form does not record the source of the grant. A number of different terms were calculated from the data for inclusion in models, including simple 0/1 indicator variables, cumulative grant amounts and times from the first grant. Lagged versions of these variables were also fitted, in order to detect impacts

[1] See https://www.gov.uk/government/collections/farm-business-survey for more information.

Table 2.1: principal variables used in the analysis

Variable name	FBS database name	Description
fbout	Farm.business.output	Output in £k including that from diversified enterprises as well as traditional farming sources.
fbcosts	Farm.business.costs	All fixed and variable costs relating to traditional farming, agri-environment schemes and diversified enterprises. It does not include a notional cost of unpaid family labour.
agoutput	crop.output.excl.subsidies + livestock.output.excl.subsidies	Output in £k from agricultural enterprises, excluding direct and indirect government support.
agcosts	agriculture.variable.costs + agriculture.fixed.costs	All fixed and variable costs relating to traditional farming. It does not include a notional cost of unpaid family labour. On owner occupied farms it does not include any notional rent.
Unpaid	Unpaid.labour	Notional cost of unpaid labour provided by the farmer, spouse and other family members. The costs are estimated by the researcher based on the hourly rate for skilled labour in the area.

occurring some years after the grant receipt (e.g. where a new enterprise takes time to attract customers).

In order to investigate the relationship between grants and investment, the FBS asset data was used to indicate when investment occurred in a farm business, by identifying when there was an increase in assets that could not be explained by revaluation. In order to exclude small changes in assets, a threshold of 25% of annual costs was applied, thus identifying instances of major investment which were likely to require external finance of some sort.

2.3. 'Unpaid' family labour

Family labour is an important issue when considering farm efficiencies, and the way it is treated can have important implications for the results (Britton and Hill, 1975). The most common approach is to impute a cost equivalent to the amount that the unpaid staff could earn in similar work elsewhere. This approach was adopted in the cereals report, but proved less satisfactory for the grazing livestock and dairy reports since, in practice, many economically smaller farmers are willing to accept a lower rate of pay because of the non-monetary benefits. For these sectors family labour was charged at a rate equivalent to the national minimum wage[2]. Fuller details of this approach are presented in the individual sector reports. The work presented here maintains the approach in the individual reports (i.e. full economic costs for cereals, minimum wage for the other sectors), and uses the minimum wage where all sectors are considered together.

[2] Rates are taken from the 'historical rates' table at http://www.lowpay.gov.uk/

2.4. Statistical models used

Economic efficiency[3] is used in this report to refer to the optimal ratio of output value to input costs. To allow a proper exploration of economic performance statistical models were fitted to the data rather than relying on simple statistics such as the ratio of outputs to inputs. The response variable was the log-transformed total outputs (logfbout for all farm business costs or logagout for agricultural outputs, see Table 2.1):

$logout_{ij} = y_j + b_1*logcosts_{ij} + ef_i + s_i*y_j + e_{ij}$ (Equation 1)

Where:
$logout_{ij}$ is the log-transformed output of farm i in year j (calculated using fbout or agout)
y_j is an effect of the jth year (e.g. allowing for high prices, or poor weather)
$logcosts_{ij}$ is the log-transformed input costs of farm i in year j (calculated using fbcosts or agcosts)
b_1 is the regression slope for logcosts
ef_i is an effect of the ith farm (e.g. allowing for differences in fertility of the land or competence of the farm staff)
s_i represents the trend in efficiency for the ith farm
e_{ij} is a random error term for farm i in year j (e.g. allowing for random events such as disease losses)

The model was fitted using restricted maximum likelihood (REML) in GenStat[4], with the farm effects and the farm trends in efficiency fitted as random terms. Where there was significant non-linearity in the the relationship between the output value and input cost, quadratic terms were added, and an interaction with year was also fitted where necessary, in order to allow the relationship to vary between years. Further details of the models may be found in the individual sector reports.

No adjustments were made to allow for the impact of inflation in either input or output prices. Instead the year terms (y_j in equation 1) and their interactions ensure that the model captures changes in the relationship between input costs and output values.

2.5. Factors correlated with efficiency

When investigating factors associated with efficiency, such as the impact of grants, it is best to include these factors within the main efficiency model:

$logout_{ij} = y_j + b_1*logcosts_{ij} + d_1*z_1 +...+d_p*z_p + ef_i + s_i*y_j + e_{ij}$ (Equation 2)

Where d_1 to d_p are regression slopes for p explanatory variables z_1 to z_p which help to explain the differences in efficiency between farms.

2.6. Binomial model for farms receiving grants

To investigate differences in the proportion of farms receiving grants, a similar model to equation 2 was fitted, but with the response variable being 1 if a farm received a grant in a particular year and 0 otherwise. The model was fitted using the Generalised Linear Mixed Model approach of Breslow and Clayton (1993) with a binomial error structure and logit link.

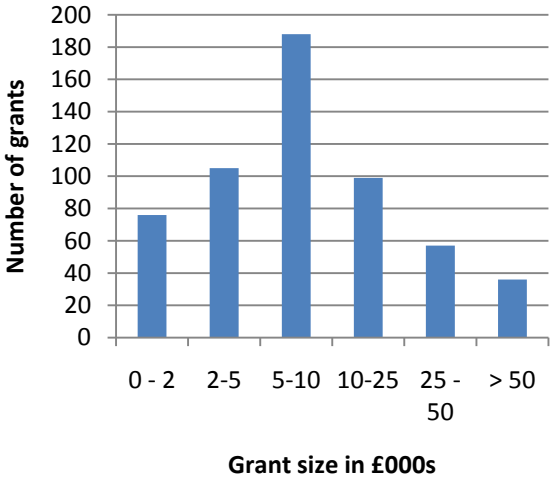
[3] 'Economic efficiency'. This definition is similar to the terminology used by Coelli et al. (see p51) and is the result of both allocative efficiency and technical efficiency. Use of the term is not intended to imply pareto efficiency.

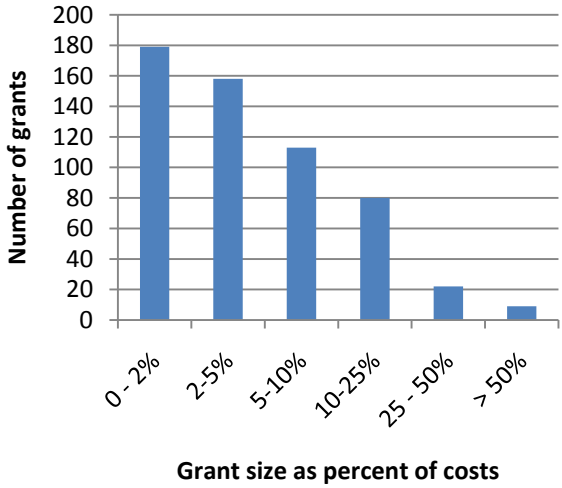
[4] http://www.vsni.co.uk/software/genstat/

3. Results: general statistics

Figure 3.1 shows the size of grants, both in absolute terms and relative to the total costs (including family labour) for the business in the year the grant was received. Most grants are relatively small, with 65% £10,000 or less and 80% equivalent to 10% or less of annual farm business costs. The total value of major investments (see section 2.2 for definition) over all years for the farms used in the analysis was £196 million, compared to a total grant value of £9 million (unweighted figures).

Figure 3.1: value of RDPE grants[5]. The right hand graph shows grant value as a percentage of the farm business costs for the appropriate year. Source: unweighted FBS data for 2003-2011.





Where major investment was recorded, only 12% of farms received a grant in the same year and only 1.6% of the total investment value can be explained by grant receipts. Nevertheless, for a minority of businesses grants appear to be important in funding investment; 3.6% of instances of major investment received grants equivalent to at least 50% of the investment value.

Major investment was significantly correlated ($P<0.001$) with receipt of a grant, with 43% of those farms receiving a grant during the survey period committing to major investment, compared to 23% of farms not in receipt of a grant. However, it is not possible to prove any causal link and it may just be that the entrepreneurial farms that invest in their businesses are equally adept at applying for grants.

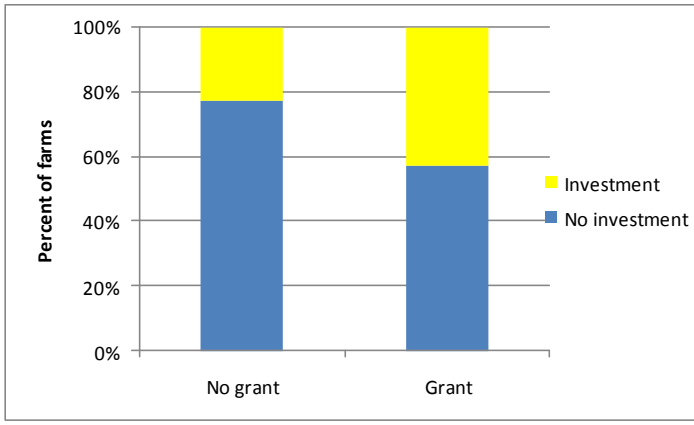


Figure 3.2: relationship between receiving a grant and undertaking major investment. Source: FBS data.

[5] The FBS only records the total value of grants within a small number of categories for each farm in each year. Where a farm receives two similar grants within a year, these cannot be separately identified.

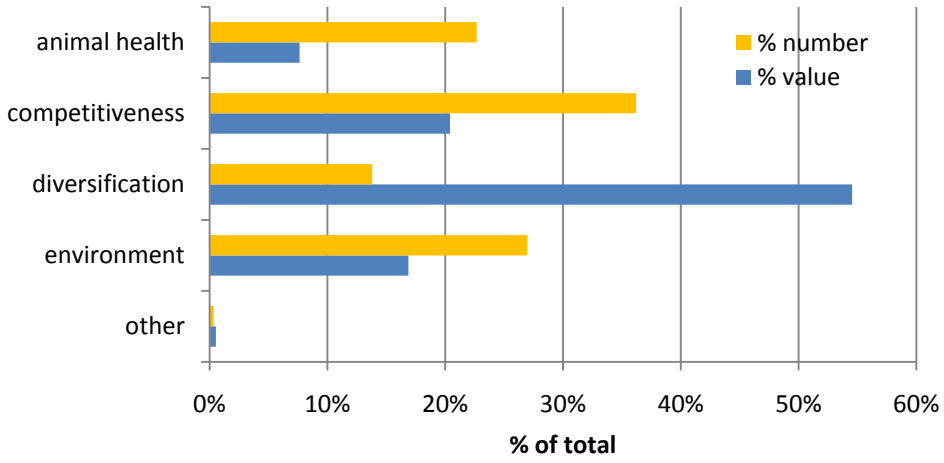


Figure 3.3: Primary objective of RDPE grants to farms, by number and value of grants.
Source: RDPE application data 2008-12.

Unfortunately the FBS data does not distinguish between those grants primarily intended to improve business efficiency and those designed to achieve other objectives, such as animal welfare or protection of the environment. Figure 3.3 therefore presents information on this split based on information from the RDPE delivery team for grants under Axes 1 and 3 during the period 2008-2012 for those categories likely to correspond to the grants analysed in the FBS dataset (i.e. excluding categories such as 'rural microbusinesses' which primarily relate to sectors other than farming, and categories such as training which would not be recorded in Section G of the FBS). The figures need to be treated with caution both because there is evidence of recording differences[6] and because the division between grants to farms and grants to other rural businesses is imperfect. Nevertheless, Figure 3.3 suggests that the primary purpose of around 50% of RDPE grants to farms is to improve the competitiveness of either the core agricultural business or diversified enterprises. The distribution by value is very different, with over 50% of the total value given to diversification schemes. This difference is because diversification grants are larger on average; the median value of diversification grants is £26,000 (and the mean over £100,000), compared to around £6,000 for those primarily for animal health, competitiveness and environmental purposes.

It must also be remembered that even where the main objective of the grant is not to enhance competitiveness, there may well be significant economic benefits to the farm. For example, the animal health and welfare grants are frequently used to provide improved housing or handling systems for cattle or sheep, and it is highly likely that these improvements will have a positive impact on competitiveness, particularly through reductions in labour requirements.

4. Results: impact of grants

4.1. Analyses using all farm types.

Table 4.1 shows estimates for a variety of terms derived from the grant data. The terms labelled 0/1 are indicator variables, taking the value 1 if a grant was received and 0 if there was no grant in the relevant year. Input costs and output values are fitted on the natural log scale, which means that the estimates of the coefficients in the table for the 0/1

[6] For example, grants that give benefits to animal health and welfare, but which also improve competitiveness, may be recorded differently in different years or different regions of the country.

variables can be interpreted as the proportional change in output value when a grant is received. The other two variables reflect the size of the grant, and were tested on both the logarithmic and natural scales.

Table 4.1: effects of grants adding terms individually to the model. The model uses natural logarithms for costs and outputs, and so the estimates are approximately equal to the percentage change in output for unit change in the explanatory variable. Terms are added to a model with terms for costs (linear and quadratic), farm type and the interaction between them.

	Farm Business			**Agricultural cost centre only**		
Variable	**Estimate**	**s.e.**	**P**	**Estimate**	**s.e.**	**P**
Pre-existing differences 0/1	0.03917	0.01408	0.005	-0.00516	0.0190	0.786
Grant amount	-0.000248	0.000193	0.199	-0.000098	0.000280	0.725
Cumulative grant amount	-0.000171	0.000152	0.261	0.000000	0.000220	0.999
Grant given 0/1	-0.008203	0.007860	0.297	-0.02186	0.01126	0.052
Lagged year 1 0/1	-0.00170	0.00809	0.833	-0.00051	0.01172	0.965
Lagged year 2 0/1	-0.01180	0.00900	0.190	-0.02205	0.01303	0.091
Lagged year 3 0/1	0.00410	0.01024	0.688	-0.01351	0.01482	0.362
Lagged year 4 0/1	-0.00246	0.01146	0.830	-0.01020	0.01657	0.538

At the farm business level, none of the variables describing the impact on the business after receiving a grant is close to statistical significance (Table 1). By contrast, for the agricultural cost centre (i.e. excluding SPS, Agri-Environment payments and diversification), there is some indication that receiving a grant has a negative effect on agricultural performance, although this is not quite statistically significant ($F=3.77$ with 1 and 12365 d.f., $P=0.052$). If the lagged variable is fitted, the strongest negative effect (a reduction of 2.2% in agricultural output) is in the second year after the grant, but this is again not significant. It is not clear whether most grants are for agriculture or for diversified activities; it is plausible that grants for the latter might lead to a diversion of management time away from agriculture, leading to this reduced performance. A significant negative association between diversification and agricultural performance was observed in the sector reports for cereals and dairy farms, whilst grazing livestock farms showed a similar trend which was not quite significant.

The variable for pre-grant differences is significant for the business as a whole ($F=7.74$ with 1 and 2583 d.f., $P=0.005$), with farms receiving grants producing on average 3.9% more outputs for a given level of inputs prior to the grant than those not getting grants. The size of the effect does not vary significantly between farm types. This is presumably because those who are good at applying for grants will probably also be good at maximising income from both agriculture and from sources such as agri-environment schemes and diversification.

For the agricultural cost centre pre-grant differences are not significant (Table 1), but there is some sign ($P=0.105$) that this may be because the effect varies with farm type, with the

better performing poultry, horticulture and dairy farms more likely to get a grant, but the less good cereals, pigs and mixed farms more likely to get grants.

5. Results: characteristics of farms receiving grants

Table 5.1 shows the factors that have a significant, or nearly significant, impact on the probability of a farm receiving a grant. Farm business costs followed a non-linear trend and the F-statistic shown is for the quadratic term. This relationship is displayed in Figure 5.1a, grouping the costs into six bands for display purposes. The light blue bars represent any grant and are therefore most relevant to the statistics in Table 5.1. The other bars split grants into those for buildings, machinery and other improvements (e.g. drainage). There is a marked increase in the proportion of grants received by businesses with annual costs of half a million pounds or more, whereas those with costs of less than £75 thousand receive fewer grants. The trend with machinery grants is particularly strong, whereas grants for improvements (dark blue bars) are slightly less common amongst the largest businesses.

Table 5.1: results of the binomial GLMM for probability of receiving a grant.

Term	F	Df1	Df2	P
Year	9.09	8	11266	<0.001
Diversification	2.12	4	1199	0.076
Farm assurance	14.48	1	3266	<0.001
Agri-environment scheme	29.72	3	3679	<0.001
Education	7.98	2	1338	<0.001
Region	10.87	7	231	<0.001
Farm business costs	5.37	1	2922	0.021
Interaction cost and type	2.07	8	3515	0.036

Figure 5.1 also shows the relationship with Year. There are highly significant differences

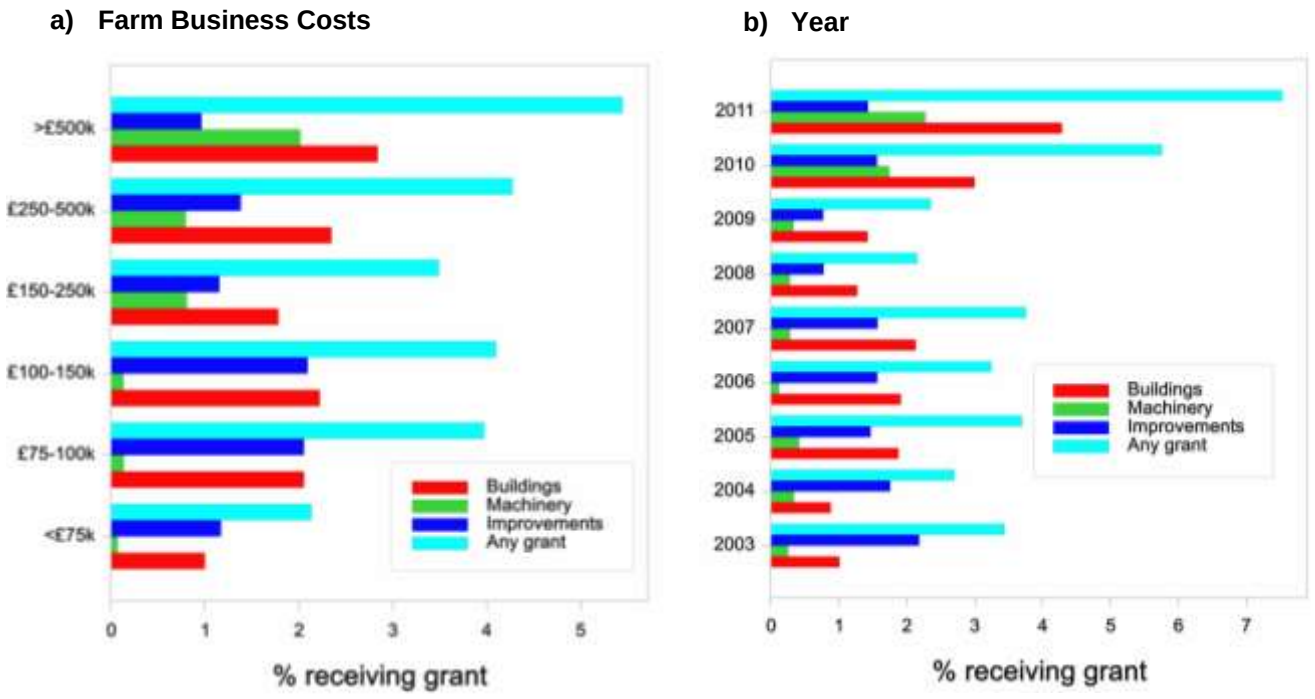


Figure 5.1: percentage of farms receiving grants in any one year, shown by annual business costs and year. Source: unweighted FBS data 2003-2011.

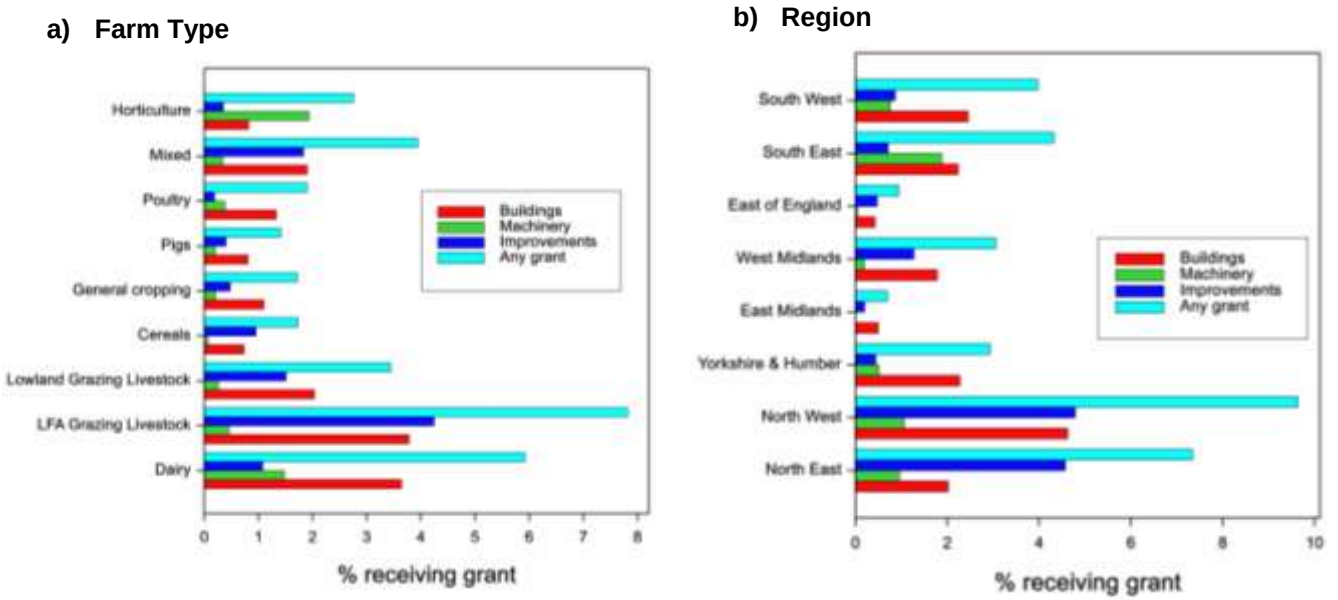


Figure 5.2: percentage of farms receiving grants in any one year, shown by farm type and region. Source: unweighted FBS data 2003-2011.

between years with a higher proportion of farms receiving grants in 2010 and 2011. Machinery grants (green bars) show the most obvious increase after 2009.

Figure 5.2 displays results for region and farm type. These factors are strongly related because of the spatial distribution of different farm types in England. The highest rates of grant receipt are for upland grazing livestock farms, with the other extensive livestock types also having high rates. The pattern varies between the grant types, with machinery grants most common on horticultural and dairy farms. The differences between regions reflect these farm type differences, with high rates in the North of England where there are many upland grazing farms. However, the GLMM results in Table 5.1 indicate that the effect of region is statistically significant even after allowing for the differences in farm types; thus a dairy farm, for example, is more likely to receive a grant if it is in the North East or North

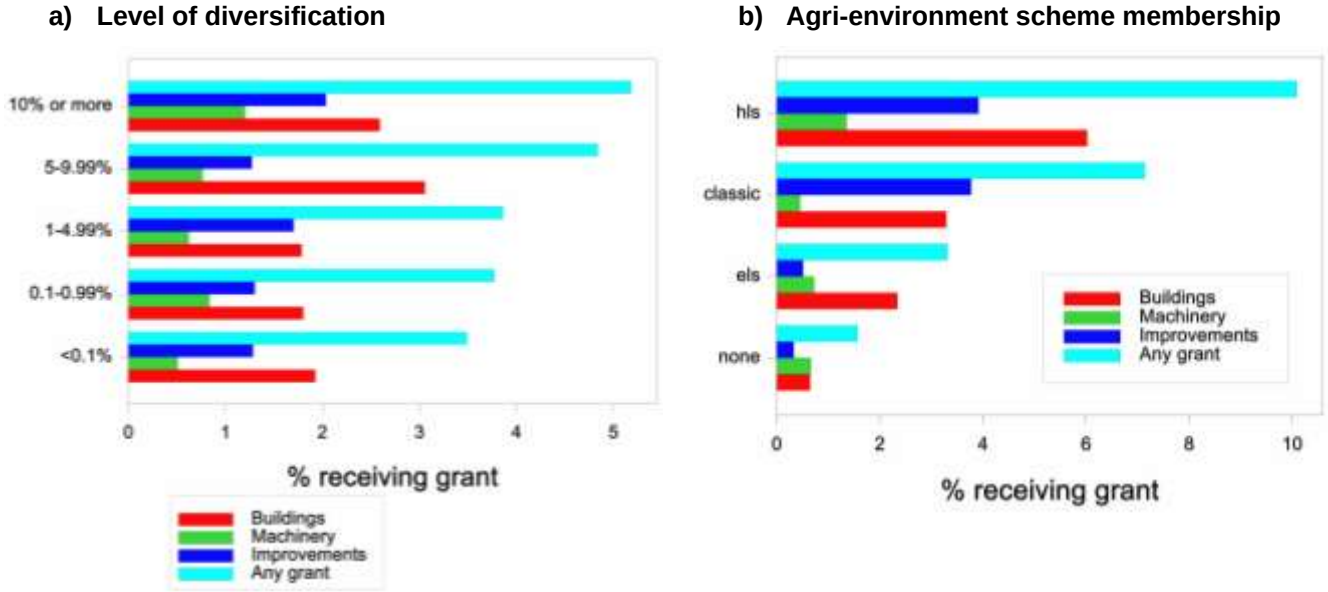


Figure 5.3: percentage of farms receiving grants in any one year, shown by diversification level and agri-environment scheme membership. Source: unweighted FBS data 2003-2011.

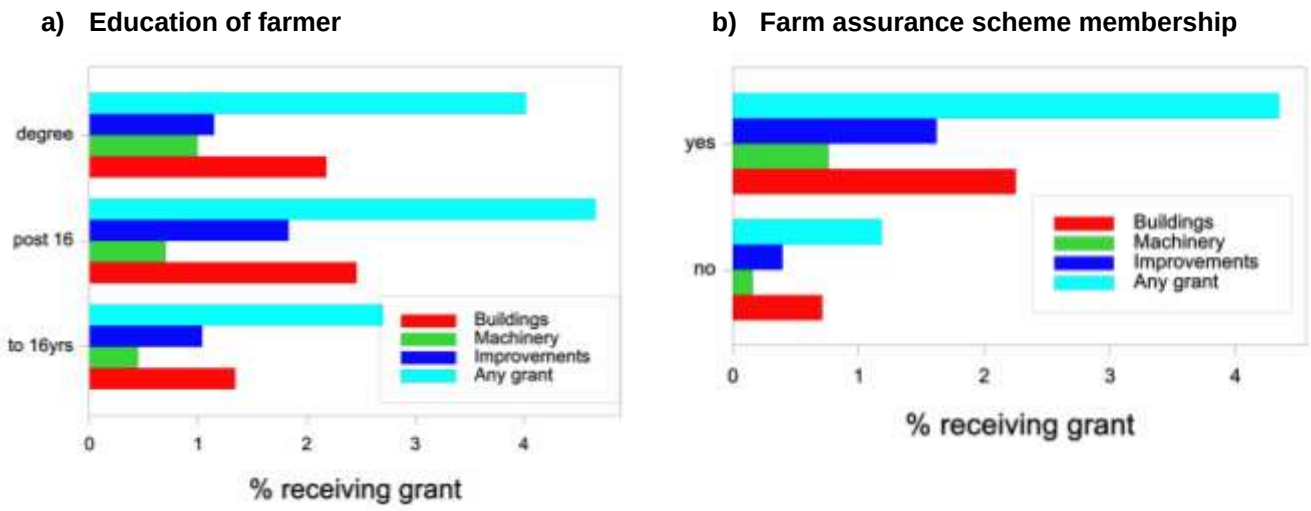


Figure 5.4: percentage of farms receiving grants in any one year, shown by education of farmer and farm assurance scheme membership. Source: unweighted FBS data 2003-2011.

West than if it is in the East Midlands.

The probability of receiving a grant also depends on the non-agricultural activities on the farm. Farms where more than 5% of farm costs are associated with a diversified activity are slightly more likely to receive a grant. However, this relationship is only of borderline statistical significance (Table 5.1) and it is perhaps surprising that it is not stronger since it is likely that at least some of these grants are likely to be associated with non-farming activities. The relationship with agri-environment scheme membership is much stronger, with members of high value schemes (Higher Level Stewardship and the 'Classic' ESA and CSS schemes) more likely to receive grants than farmers in ELS, who are in turn more likely to receive grants than those outside all schemes.

Figure 5.4a shows the relationship with education level of the farmer. Farmers who left school at 16 are significantly less likely to receive grants than those with high levels of education. There is also some signs that younger farmers are more likely to receive grants but this difference is not quite statistically significant (P=0.087). Finally, Figure 5.4b shows that farmers in Farm Assurance schemes are much more likely to receive grants than those outside such schemes.

6. Discussion

Evaluation of the success of past policies is a key step in deciding future policies. Some form of support for farming efficiency productivity looks set to continue in the new Programme, although the government response to the Consultation on the implementation of CAP reform points to a broad range of measures alongside more conventional capital grants (e.g. support for training and skills or more targeted support for take-up of new agri-environment technologies). Hence the lack of any convincing evidence for the economic benefits of such grants in the past must be considered when designing the new schemes.

Nevertheless, some caution is needed in interpreting these results. Firstly, the low value of many of the grants is striking. 60% of the grants were equivalent to less than 5% of the farms annual costs. Hence it would be no surprise if these yielded benefits that were small compared to the high level of annual variation always found in farm accountancy data.

It must also be remembered that the objective of grants, whether from RDPE or other sources, is not always to bring economic benefits to the farm itself. Many smaller grants may be primarily intended to give benefits in terms of animal welfare or environmental protection. Others may yield economic benefits to the wider community, rather than just the farm receiving the grant. Unfortunately, the data routinely collected from FBS participants provides no information on either the anticipated type of benefit, or the actual benefits, other than the direct financial impacts on the farm accounts. There is potential to match the RDPE database with the FBS records to obtain this information (via the Single Business Identifier which is recorded for all RDPE payments), but the methodology to allow this type of data adding whilst preserving FBS confidentiality is still under development. Until that is possible, the evidence here must therefore be viewed alongside other studies (e.g. Powell and Courtney 2013) which have a wider focus.

7. References

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Britton, D. K. and Hill, N. B. (1975). Size and Efficiency in Farming. Farnborough: Saxon House.

Powell, J. and Courtney, P. (2013) An assessment of the Social Return on Investment of Axes 1 and 3 of the Rural Development Programme for England. CCRI, Gloucestershire.

8. List of abbreviations used

CAP Common Agricultural Policy

CSS Countryside Stewardship Scheme

d.f. Degrees of freedom

ELS Entry Level Stewardship

ESA Environmentally Sensitive Areas Scheme

FBS Farm Business Survey

GLMM Generalised Linear Mixed Model

LFA Less favoured area

P Probability value from statistical test

RDPE Rural Development Plan for England

REML Restricted (or residual) maximum likelihood

s.e. Standard error

SPS Single Payment Scheme

Appendix 1: Results from sector models

Sector models: dairy

Table A1.1: effects of grants adding terms individually to the model. The model uses natural logarithms for costs and outputs, and so the estimates are approximately equal to the percentage change in output for unit change in the explanatory variable. Terms are added to a model containing all terms described in the published model.

	Farm Business			Agricultural cost centre only		
Variable	**Estimate**	**s.e.**	**P**	**Estimate**	**s.e.**	**P**
Pre-existing differences 0/1	0.009641	0.007372	0.192	0.01080	0.008848	0.223
Grant amount	0.000025	0.000239	0.917	0.00012	0.00026	0.661
Cumulative grant amount	0.000099	0.000208	0.635	0.00018	0.00023	0.435
Grant given 0/1	-0.00249	0.00464	0.592	0.00098	0.00521	0.852
Lagged year 1 0/1	-0.00358	0.00463	0.440	-0.00052	0.00511	0.920
Lagged year 2 0/1	-0.00208	0.00560	0.711	-0.00484	0.00617	0.432
Lagged year 3 0/1	0.00412	0.00626	0.511	0.00827	0.00689	0.230
Lagged year 4 0/1	0.00099	0.00719	0.890	0.00173	0.00791	0.827

Sector models: grazing livestock

Table 4.3: effects of grants adding terms individually to the model. The model uses natural logarithms for costs and outputs, and so the estimates are approximately equal to the percentage change in output for unit change in the explanatory variable. Terms are added to a model containing all terms described in the published model.

	Farm Business			Agricultural cost centre only		
Variable	**Estimate**	**s.e.**	**P**	**Estimate**	**s.e.**	**P**
Pre-existing differences 0/1	-0.00470	0.01435	0.743	0.00422	0.0222	0.849
Grant amount	-0.000368	0.000315	0.243	-0.00041	0.00058	0.485
Cumulative grant amount	-0.000083	0.000229	0.717	-0.00003	0.00040	0.951
Grant given 0/1	0.00446	0.00725	0.538	0.00585	0.0125	0.640
Lagged year 1 0/1	-0.00193	0.00698	0.783	0.00592	0.0130	0.648
Lagged year 2 0/1	-0.00206	0.00716	0.774	-0.00240	0.0134	0.858
Lagged year 3 0/1	0.00105	0.00748	0.889	-0.01124	0.0139	0.420
Lagged year 4 0/1	0.00949	0.00850	0.264	0.00568	0.0158	0.720

Sector models: cereals farms

Table 4.4: effects of grants adding terms individually to the model. The model uses natural logarithms for costs and outputs, and so the estimates are approximately equal to the percentage change in output for unit change in the explanatory variable. Terms are added to a model containing all terms described in the published model.

	Farm Business			**Agricultural cost centre only**		
Variable	**Estimate**	**s.e.**	**P**	**Estimate**	**s.e.**	**P**
Pre-existing differences 0/1	0.00162	0.0164	0.921	-0.0130	0.0237	0.583
Grant amount	0.00012	0.00028	0.665	0.00008	0.00041	0.848
Cumulative grant amount	0.00032	0.00022	0.144	0.00004	0.00031	0.894
Grant given 0/1	0.013299	0.009590	0.166	0.00548	0.01391	0.693
Lagged year 1 0/1	0.007960	0.010952	0.467	0.02009	0.01587	0.206
Lagged year 2 0/1	-0.012226	0.012545	0.330	-0.01307	0.01819	0.472
Lagged year 3 0/1	0.006365	0.013648	0.641	-0.01753	0.01978	0.376
Lagged year 4 0/1	0.024670	0.015693	0.116	0.03555	0.02274	0.118