University of Reading

The impact of management practices on financial performance: evidence from farm businesses in England

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Declaration of original authorship

I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged

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Abstract

The aim of this research was to assess the impact of management practices on the financial performance of farm businesses in England. In addition, it sought to provide insight into the financial performance of the sector. Four farm types (Cereal farms, Dairy farms, Less-favoured Areas Grazing Livestock farms and Lowland Grazing Livestock farms) were selected for this research.

First, using the ratios from the DuPont Expansion model (Return on Sales, Asset Turnover, Compound Leverage Factor, Return on Assets and Return on Equity), the results show that Cereal farms consistently perform better than Dairy farms, LFA Grazing Livestock farms and Lowland Grazing Livestock farms, both for the period 2008 to 2013 and in 2011/12, with the exception of Asset Turnover, where Dairy farms achieved the highest performance due to stock management practices, and the duration of the production cycle. Farming does not seem to have issues with liquidity, and the level of indebtedness is low overall. However, low profitability is an issue, which is not necessarily due to cost control, but to falling revenue.

Second, management practices, defined as planning, organising, leading and controlling, taking into account the environment to achieve organisational goals, was found to have positive effects on individual farm financial performance, both for all farm types as well as per farm type. In particular, formal planning and benchmarking have positive, statistically significant effects. Highly performing farms (in financial terms) apply management practices more on the farm compared with the lowest 25 percentile of farm businesses. In addition, regression models were estimated to assess the effects of these practices in relation to financial performance. The results showed that increasing in size will also lead to better financial performance for all farm types.

Acknowledgements

I have thoroughly enjoyed studying at the University of Reading.

I remember writing my research proposal, and attending an interview in October 2012, hoping that I would be accepted into the PhD programme and start my journey in academia again. In the years I've studied at Reading, I've had the opportunity to broaden my understanding in a lot of fields – theoretical, practical and philosophical – and it has been a great experience. It would however not have been possible without the support of several people.

First of all, I would like to thank my supervisors Richard Tranter and Dr. Alison Bailey for guiding and advising me along the PhD journey. Besides providing insight into the topic, they supported me to attend conferences, present my work and publish papers. They made sure that I got as much out of the PhD as possible. For this, I am very grateful.

Special thanks are also due to Dr. Ariane Kehlbacher for the discussion on my data analysis and results prior to presenting at the EAAE conference in Rome in June 2015; and to Prof. Elizabeth Robinson and Dr. Chittur Srinivasan for challenging me during the confirmation of registration process. That experience helped me focus my research and work out the priorities in the vast field of financial performance and management.

I am also very grateful to the Edith Mary Gayton Bequest and the Agricultural and Food Investigation team for the financial support they have provided, without which I would not have been able to undertake this research. In addition, thanks to Dr. Nenia Micha and Dr. Yiorgos Gadanakis for helping me get insight into the FBS dataset and discussing my research findings with me.

Finally, I would like to thank my parents, sisters and brother for believing in my skills, for continuingly supporting me and for cheering me on in times of need. I'm also very happy to have been surrounded by great friends along the way, who brought in advice and fun when needed. Without you, my life would have been less colourful for sure.

I am very happy to have produced this dissertation, as evidence of my learning and development. I hope readers find this topic as engaging as I do.

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1. Introduction

This chapter sets out the background, objectives and structure of this research. In the first section, an overview is given of the agricultural industry in England as well as the policy and main policy makers that govern the industry. In addition, a brief summary is given of issues that farmers deal with, in order to frame the research. Following the scene setting, the aim and objectives of this research are set out in the second section, with the research question being: "What is the impact of management practices on the financial performance of farm businesses in England?". The third section demonstrates how this research contributes to new knowledge, before closing the chapter with a fourth section on the structure of the research and thesis.

1.1. Agriculture in England

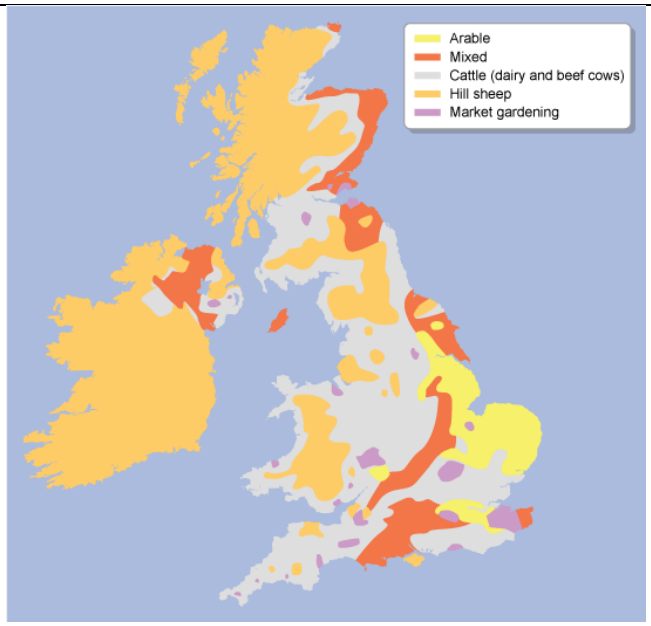
1.1.1. Background

Over the past two hundred years, the agricultural industry, in England as elsewhere, has undergone massive transformation, including the increasing use of technology to produce, store and transport agricultural produce, the speed at which the sector evolves, the sheer scale of operations, and the availability of goods to tailor to a plethora of tastes and customers. Reasons for this transformation were population growth, the industrial revolution, globalisation and the integration of markets, not only on a continental but on a global level. In addition, the two world wars have brought with them the need to safeguard food security in times of crisis, and the integration of the European Union led to the establishment of the Common Agricultural Policy (CAP), the current policy that guides farming within the EU and the UK (EC, 2015).

The Department for Environment, Food and Rural Affairs (Defra) found that in 2012, 70% or 17.2 million hectares of the UK's land was used for agriculture – be it arable, under permanent crops or permanent pastures. In England, agriculture takes up 8,959,000 hectares of the territory. Figure 1-1 shows the distribution of farms in the UK as well as some key facts about agriculture in the UK.

The condition of the soil, precipitation and altitude decide what farm type is most viable in a certain area. The precursor to Defra, the Ministry of Agriculture, Fisheries and Food (MAFF), set out a framework known as the Agricultural Land Classification that classified land based on

its possibilities for agriculture (MAFF, 1988). There are five categories in which farm land is graded, ranging from excellent quality agricultural land (grade 1) to very poor quality agricultural land (grade 5) that is mainly used as *permanent pasture or rough grazing except for occasional pioneer forage crops* (MAFF, 1988).



Some key facts (Defra, 2013a):

- Number of holdings: 222,000 (UK) – 103,800 (England)
- 59.22% of land is owner-occupied
- Average farm size: 77 ha (UK) – 87 ha (England)
- Average age of the farmer: 59 (Eurostat, 2009)
- Contribution of agriculture to GDP: 0.5%
- Number of people employed in agriculture: less than 1%

Figure 1-1: Agricultural map of the UK, and key facts
Source: BBC (2016) and Defra (2013d).

Farm output is used to classify farms into farm types (Haines, 1982 and Defra, 2013b). There are: Arable farms, Dairy farms, Livestock farms (Less Favoured Area grazing and Lowland), Horticultural farms, Pig farms, Poultry farms, and Mixed farms. A farm is be classified in a certain category if two thirds of the total standard output produced on the farm, is derived from a certain activity (FBS, n.d.).[1] For example, if dairy cows account for more than two thirds of the total standard output of a holding, it is classified as a Dairy farm. Some basic facts about the different farm types are:

- Arable farms are mainly located in East England, and cover Cereal farms and General Cropping farms, with wheat being the most commonly grown crop in England. Cereal farms are, on average, 200ha and general cropping farms 245ha (Ashbridge et al., 2014). On average, production costs of wheat are lower when compared to other EU countries

[1] In 2010, the classification of farms changed from using standard gross margin to standard outputs. With standard gross margins, farmers allocated variable costs from standard outputs, leaving the classification more open for discussion depending on how costs are classified (FBS, n.d.).

(Ashbridge et al., 2014). In 2014/15, average income declined by nine per cent for Cereal farms and by 23 % for General Cropping farms, but for different reasons: Cereal farms witnessed lower prices as production levels increased and hence commodity prices were lower, while General Cropping farms struggled with higher input costs (Defra, 2015).

- Dairy farms have become larger over the past decade, with farms having on average 150 dairy cows (Ashbridge et al., 2014). Production costs in the UK are one of the lowest in the EU; however, in New Zealand and the US dairy products are produced at lower costs (Ashbridge et al., 2014). Milk prices have been decreasing in the last couple of years, putting pressure on farmer's profitability and their ability to remain in the market. Defra (2015) noted that even though milk prices were higher at the start of 2014 compared to 2013, an increase in production and a drop in price later in 2014/15, resulted in a five % decrease in average income.
- Grazing livestock farms take up almost two thirds of British agricultural land (Defra, 2013d). Hill and upland farms are on average 135ha, with 80 to 90ha made up of permanent grassland. For lowland grazing livestock farms, size is on average 101ha, and 70ha are on average permanent grassland or rough grazing (Defra, 2013d). Lowland grazing livestock tend to be smaller than hill and upland farms, as they can stock livestock more intensively. The sector has been struggling to deal with Bovine Tuberculosis. Farms where cattle are diagnosed with bovine TB, are banned from selling cattle until they get negative test results. In 2014/15, livestock farms performed well financially, with an average increase in income of one % for Less-Favoured Area farmers, and a 23% increase for Lowland farmers. These improvements were, however, not due to increased outputs across all livestock (lowland beef outputs decreased), but resulted from agri-environment and diversified activities for Lowland Grazing Livestock farms, and lower costs for Less Favoured Area farms (Defra, 2015).
- Horticultural farms produce vegetables, fruit, salads and ornamentals. This farm type is particularly prone to reduced outputs due to heavy rainfall, low temperatures and little sunshine. Crane et al. (2014) reported that prices had varied widely in the past five years, and that income reduced in 2012. Defra (2015) noted a reduction in average income in 2014/15 caused by lower outputs from retailing activities.
- Pig farms are mainly located in Yorkshire, the Humber and Eastern regions, which accounted for 63% of pigs in England in 2010/11 (Lewis & Grayshon, 2012). However, Lewis & Grayshon (2012) also noted that the number of pigs has decreased for the last number of years, with home fed supply accounting for 53% of total supply in 2011 (Lewis

& Grayshon, 2012). In 2014/15, the average income for pig farmers fell as finished pigs and cull sows achieved lower values (Defra, 2015).

- Poultry farming is a highly vertically integrated system, with farmers breeding, hatching growing and processing poultry meat (chicken, turkey, ducks and geese) and eggs. There are over 2,500 poultry farms in England (BPC, n.d.). Similar to pig farms, the average income for poultry famers declined as outputs were lower than before (Defra, 2015).
- On Mixed farms, a combination of arable and pastoral activities is carried out, with neither of them taking 2/3 of total standard output. Average income decreased with 27% in 2014/15, due to lower outputs (Defra, 2015).

In England, farmers operate under the framework of the CAP, the EU policy that regulates agricultural activity, with Defra responsible for adopting the policy within England, and several other organisations working for or in close collaboration with Defra and the agricultural sector in England to support, advise and monitor agricultural activities. In the sections below an overview of the CAP is given showing the legal/political framework in which most farmers operate, followed by a description of the remit of Defra.

1.1.2. The policy: the Common Agricultural Policy

The CAP was agreed under the Treaty of Rome (1957) and came into effect in 1962, to safeguard agricultural production within the European Union (EU) (EC, 2015). Member States agreed to provide subsidies to farmers when the price of their agricultural produce fell below a certain threshold, in order to guarantee food production and provide a stable income to farmers. Figure 1-2 gives a brief overview of the developments in the CAP.

The UK adopted the CAP in 1973 when it joined the EU (Ashbridge et al., 2014). However, from early on, it became evident that the set-up of the policy in this manner would incentivise farmers to increase their production. To deal with the issues of overproduction, in the seventies, the EU started to put tariffs on agricultural imports to the EU, and provided support to farmers for exporting their outputs beyond the EU. Both these policies motivated farmers to produce more; and led to the creation of large agricultural outputs – and surpluses – resulting in a situation that became unsustainable, among others in financial terms, with support to the sector taking up over 70% of the EU budget (EC, 2015).

Policy reform was required, with restrictions placed on production in the 1980s and, as from 1992 with the MacSharry reforms, a move towards uncoupling subsidies from production (Cunha & Swinbank, 2011). These changes aimed at focusing attention on more sustainable production, taking into account the pressures on the environment (EC, 2012).

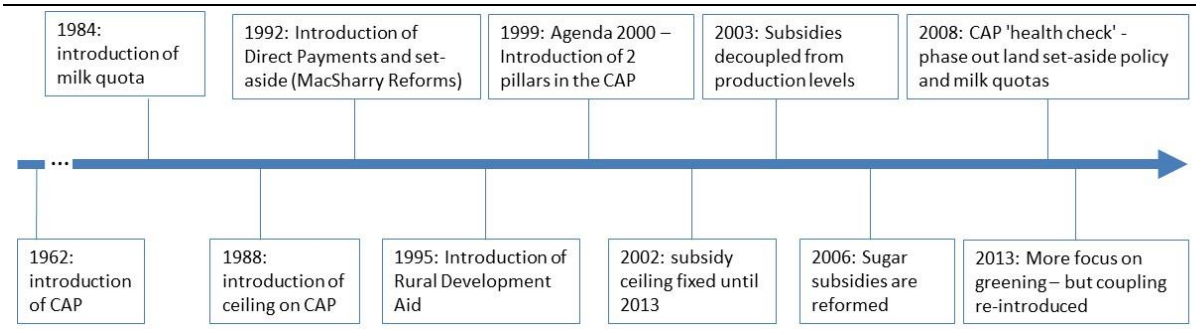


Figure 1-2: Overview of the developments in the Common Agricultural Policy
Source: EC (2015).

The latest CAP reform process started in April 2010, with the European Commission launching the public debate on the CAP and how it would contribute to the Europe2020 strategy. Following this consultation, in October 2011, the Commission put forward a set of legal proposals on the CAP. Negotiations between Member States followed and by June 2013, the Commission, the European Parliament and the Council agreed on the CAP reform. In December 2013, the new CAP–system was formally adopted and its Basic Regulations and Transition Rules were published in the Official Journal (EC, 2013b, 2015).

In broad terms, the CAP programme has three objectives:

1. to support viable food production;
2. to boost sustainable management of natural resources and climate action; and
3. to create a balanced territorial development.

It is built up of two Pillars, one for Direct Payments (Pillar one) and one for Rural Development (Pillar two). The total CAP budget for the period 2014-2020, in 2011 prices, is set at € 363.787 billion (EC, 2013c), divided into:

- € 277.851 billion for Direct Payments (Pillar 1). This Pillar is built up of several parts:
    - The Basic Payment Scheme, which will be gradually adapted to achieve a minimum national average per hectare across all Member States by 2020 (external convergence), as well as move away from historic payments in Member States towards a fairer distribution based on current, agricultural usage (internal

convergence). Member States have the possibility to cap or degress the payments per hectare as well.

  - The Green Direct Payment, as the EC want to reward and support farmers that promote and maintain biodiversity and the landscape. This is 30% of the Pillar 1 envelope. Farmers must abide by three mandatory practices: maintenance of permanent grassland, ecological focus areas and crop diversification.
  - The Young Farmers Scheme (for farmers below 40), to assist young entrants into the agricultural profession with setting up their business.
  - The Redistributive Payment and Small Farmer Scheme (voluntary), which aim to support small farmers (where the first hectares get higher support than additional ones)
  - Coupled support (voluntary), to protect certain markets and agricultural products.
  - Natural constraints support (voluntary)

- € 84.936 billion for Rural Development (Pillar 2), which focuses heavily on the development of skills (including for young farmers), environmental protection, social inclusion and development. These will be distributed through Rural Development Programmes that the Member States set up and manage.

Twelve % of the budget can be transferred between Pillar 1 and Pillar 2.[2]

Compared to the 2003-2013 CAP, policy instruments were adapted or developed, including the removal of production constraints or quotas (Pillar 1), the development of a legal framework to include collective bargaining, and the introduction of delivery contracts so that farmers are incentivised to collaborate (Pillar 2), training and innovation programmes (Pillar 2), the Farm Advisory System (Pillar 2), start-up funds for young farmers (Pillar 2) and a new risk management toolkit with insurance schemes, mutual funds and income hedging at its core (Pillar 2). Table 1-1 sets out how the CAP is implemented in England, compared to the 2007-2013 programme.

[2] A review of this option is foreseen for 2016 (EC, 2013c)

Table 1-1: Overview of the changes to the CAP 2003-2015 compared to 2013-2020

Implementation in England	2007-2013[3]	2014-2020
Total budget	€ 17.927 billion	€ 19.6 billion
Budget Pillar 1	€ 15.076 billion	€ 16.4 billion
EU rules linked with Pillar 1		Compulsory EU Rules: 3% for the creation of a national reserve; 2% for the young farmers payment and direct basic payments to an individual farm of €150,000 or above excluding the greening payment, will be reduced by at least 5%. Optional clauses: 30% for first hectares top-up; No payment for small farmers and 5% for Least Favoured Areas
Pillar 1: Direct Payment to Farmers – Eligibility criteria	Single Farm Payment (without coupled support) • Area of at least 1 ha • Moved stepwise from 90% historic basis and 10% area basis in 2003 to 100% area payment in 2012 ("dynamic hybrid") Different amount awarded based on type of land: • Moorland; • Upland land that is not moorland; and • Other land A farmer has to be active Cross-compliance necessary: keeping the land in Good Agricultural and Environmental Condition (GAEC), biodiversity, animal welfare and water environment.	Basic Payment Scheme (based on area), including a greening payment and young farmers' payment: • Area of at least 5 ha • Entitlements of 2014 will be rolled into 2015 • A farmer has to be active • Cross-compliance necessary: keeping the land in Good Agricultural and Environmental Condition (GAEC), biodiversity, animal welfare and water environment. • To receive the greening payment, a farmer has to fulfil additional rules related to cropping and fallow land. Exempt from greening are organic farmers and small farmers. Farmers below 40 can receive • 25% on top of their payment for 5 years • 25% on top of their payment until they are 40 Small farmers' scheme: are exempt from greening and some cross-compliance requirements
Budget Pillar 2	€ 2.851 billion	€ 1.52 billion
EU rules linked with Pillar 2	In England, about 69% of the total budget was spent on Axis 2 (agri-environmental schemes); 16% on enhancing competitiveness (Axis 1). 11%	• 5% of the RDP has to be spent on the LEADER programme • Min 30% of the budget has to be spent on agri-environment schemes, climate, forestry, Natura 2000 and LFA measures

[3] Total budget, budget Pillar 1 and Pillar 2 are actual payments made by the RPA from 2007 to 2014, based on EU financial years (16 October to 15 October). Figures exclude financial corrections/penalties.

	on improving the vitality of rural areas (Axis 3); and 4% on the leadership programme (Axis 4).	• Less Favoured Areas will be abolished (post 2018) – Areas of Natural Constraint will be established if at least 60% of a farm's area passes 8 biophysical criteria. • Match funding is to be provided by national government, depending on the type of support (LEADER, knowledge transfer, cooperation, the set-up of producer groups, young farmers' installation grants).
Pillar 2: Rural Development Scheme in England (RDPE) - components	Programme developed around 4 axis: • Axis I: Improving the competitiveness of agriculture and forestry, e.g. through the provision of advisory services to farmers and forest holders; support for setting up of farm management, relief and farm advisory services, and forestry advisory services; modernisation of agricultural holdings; improvement of the economic value of forests; promotion of cooperation for the development of new products, processes and technologies and investment in infrastructure related to the development and adaptation of agriculture and forestry. • Axis II: Improving the environment and countryside, through e.g. support for farming in Less Favoured Areas; for agri-environment schemes; for non-productive investments in agri-environment measures; for the establishment of permanent woodland and short-rotation coppice; for the management of existing woods and forests; promotion of cooperation for new products and processes; and support for non-productive investments in forestry measures. • Axis III: Improving the quality of life in rural areas and diversification of the rural economy, such as support for farm business restructuring through the development of diversified activities; for the creation and development of micro-enterprises; encouragement for tourism activities; provision for more and better basic services for the economy and the rural population; village renewal and development; conservation and enhancement of the rural heritage; provision of training in support of measures in Axis III; provision of support for skills acquisition and animation with a view to preparing and implementing a local development strategy. • Axis IV: LEADER programme, focussing on setting up local groups, boosting knowledge and skills and cooperation	6 priority areas: agri-environment schemes; Climate; Forestry; Natura 2000; LFA measures; and LEADER; including: • Managing the environment, with a New Environment Land Management Scheme (NELMS) which replaces the Environmental Stewardship Scheme, called Countryside Stewardship • Increasing farming and forestry productivity, to increase innovation, the uptake of technology and improve the skills base of people working in the agricultural industry, as well as land-based sectors. • Growing the rural economy, with among others support for broadband connections, renewable energy, rural tourism and aid for small/micro businesses

Source: Downing (2013); EFRA Committee (2011); ENRD (2010); and RPA (2013 and 2015c)

The latest CAP reform is considered to potentially decrease the financial support to farms in England[4]. Veit & Swales, (2014, p.12) noted that:

> "*the introduction of Ecological Focus Area requirements represents the biggest potential cost to farmers, at between £21-£37/ha depending on their crop rotation. Crop diversification rules for combinable cropping farms will have, on average, a low financial cost to farms, but some farms will be significantly impacted. There are other costs associated with complying with crop diversification requirements, such as increased time spent managing the farm business, which are difficult to quantify*."

Moreover, Patton et al. (2013) calculated the effects of different scenarios given the CAP discussions in 2011, and concluded that if direct payments are redistributed between Member States, if there is a uniform flat rate payment per hectare and if greening becomes more important, which is what has occurred, production in cereal and general cropping farms will drop, which could lead to lower revenue and decreased profits. They also concluded that there would be a small decrease in milk production and number of dairy cows, while prices should increase by 0.5%. The Rural Payments Agency (RPA) has published the entitlement values of the Basic Payment Scheme, and compared to the Single Payment Scheme, there is a reduction in support for non-Severely Disadvantaged Area (SDA) and upland SDA, other than moorland, but an increase in Upland SDA moorland (RPA, 2014, 2015a).

Table 1-2: Entitlement Values under SPS and BPS

Entitlement value	Single Payment Scheme (2014)	Basic Payment Scheme (2015)
Non-SDA (Severely Disadvantaged Areas)	€ 251.39	€ 171.83
Upland SDA, other than moorland	€ 201.32	€ 170.60
Upland SDA moorland	€ 35.26	€ 45.07

Source: RPA (2014 and 2015a).

Besides a reduction in Basic Payment Scheme entitlement values, the Rural Payments Agency has also indicated in its recent guidelines on the Basic Payment Scheme that several farmers that were granted the Environmental Stewardship scheme on or after January 1, 2012, could

[4] The new CAP rules were to take effect in January 2015. The Rural Payments Agency has confirmed the entitlement values for the Basic Payment Scheme for 2015, but it is unclear how many farmers meet the eligibility criteria, and applied for the Scheme. By early February 2016, 77% of the farmers eligible for the Basic Payment Scheme (66,800 farmers - 84,500 farmers had applied by the deadline in June 2015) had been paid their entitlements for 2015 (RPA, 2015b, 2016). The NAO has been critical of Defra's and the RPA's ability to implement the scheme (see further).

receive less support due to the greening measures (RPA, 2015c). As a consequence, the financial position of farm businesses will be affected.

1.1.3. The organisations governing the agricultural industry in England

Several institutions govern the agricultural industry in the UK. In England, the Department for Environment, Food and Rural Affairs (Defra) is the central government body responsible for policy and implementation of the policy within the agricultural industry (NAO, 2015a). Defra's main objectives are to "*protect biodiversity, the countryside and the marine environment, and support the growth of a sustainable green economy, including rural communities, and British farming and food production*." (NAO, 2014, p.5). In addition, Defra has been tasked with animal health and disease control and flood protection. Its programmes can be divided around four domains (NAO, 2014, p.5):

- *To grow the rural economy: champion a thriving, competitive British food and farming sector and drive sustainable growth in the wider rural economy in support of rural communities.*
- *To improve the environment: manage our rural, urban and marine environments, reducing pollution and waste, and ensuring greater resilience to climate change and other environmental risks*
- *To safeguard animal health: minimise risks and increase preparedness for animal disease outbreaks, driving growth and competitiveness through improving standards of animal health and welfare.*
- *To safeguard plant health: strengthen capability to minimise and manage plant disease and pest outbreaks, with greater economic and environmental resilience to disease threats.*

Defra has transferred a large part of its responsibilities and budget to its thirty four agencies, arm's length bodies and Non-Departmental Public Bodies (NAO, 2015a), as shown in Figure 1-3. The largest receiver of funding is the Rural Payments Agency, which is responsible for distributing the subsidies awarded under the CAP to farmers. The Environment Agency is the second largest receiver of funds, and is charged with protecting and safeguarding the environment, among others from floods and pollution. The Animal and Plant Health Agency (previously Animal Heath and Veterinary Laboratories Agency), the third largest receiver of

funding, sets out policies and undertakes studies related to the prevention and control of diseases.

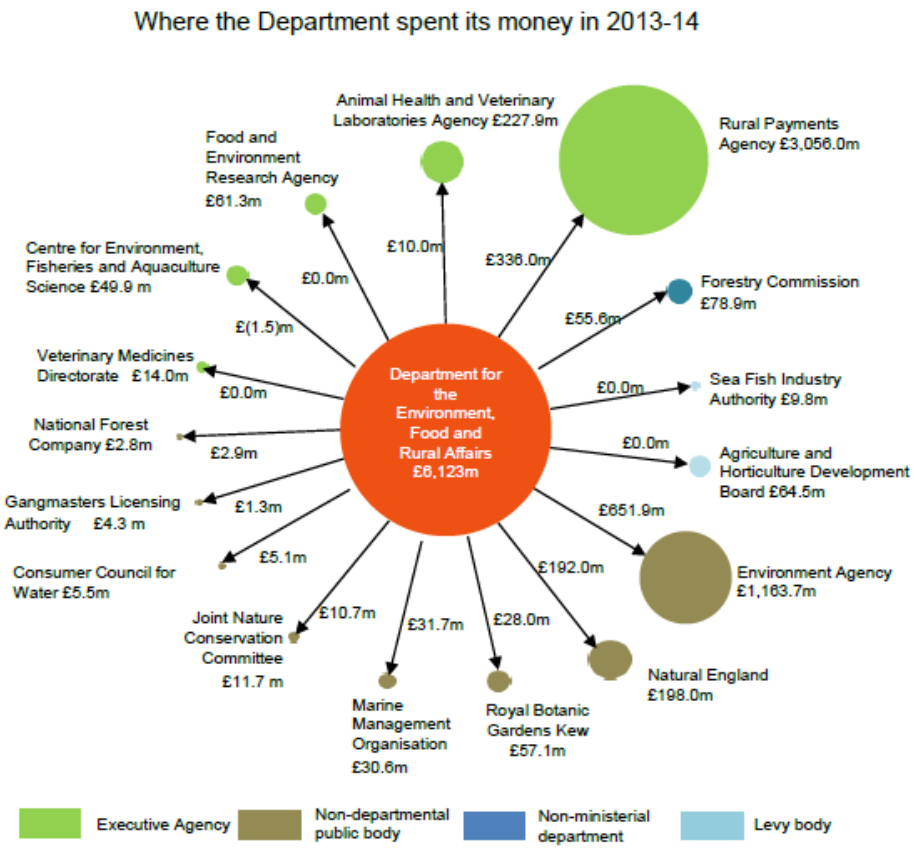


Figure 1-3: Budget destined for Environment, Food and Rural Affairs (2014)

Source: NAO (2014, p.9) – based on Annual Report and Accounts of DEFRA and its subsidiary bodies 2013/14.

NOTES:

1. Figures are shown in millions rounded to one decimal place. Amounts on arrows represent departmental funding to the arms-length bodies.

2. The Department's total expenditure includes that of its arms-length bodies (this includes European Union Common Agricultural Policy expenditure). In 2013-14 the Department received £2.3 billion in government funding

3. Net funded agencies (Food and Environment Research Agency, Centre for Environment, Fisheries and Aquaculture Science, Veterinary Medicines Directorate and Animal Health and Veterinary Laboratories Agency) that operate on a commercial basis recognise funding from the Department as income rather than financing and therefore the Departmental funding is shown as zero or just a small proportion of their overall funding. As a charity, Kew also treats funding from Defra as income. In addition, as levy bodies, Sea Fish Industry Authority and Agriculture and Horticulture Development Board are financed through levies and therefore do not receive funding from the Department.

4. Rural Payments Agency expenditure includes funding from the European Union to paying agencies in Scotland, Wales and Northern Ireland.

5. This Figure includes bodies within the departmental boundary with expenditure greater than £1 million.

The National Audit Office (NAO) has been critical of the Defra's achievements. Issues have been flagged up with Defra's capability in administering the CAP, specifically:

- The IT systems that manage the payments to farmers. While there were severe delays in the payments to farmers under the 2003-2013 programme, in 2015, NAO found that there was a lack of collaboration between Defra, the Rural Payments Agency and Government Digital Services, resulting in inefficiencies in the delivery of the CAP. NAO noted that *"…The Department and the Cabinet Office did not ensure a clear and consistent vision for the Programme with a manageable level of innovation. Nor did they effectively manage competing priorities. The result is that the Department expects higher levels of disallowance penalties, increased Programme costs, poorer customer experience and difficulties paying farmers accurately at the earliest opportunity. The Programme has therefore not provided value for money at this early stage.*."(NAO, 2015b, p.8)
- Defra's accounts were qualified in 2015, as there were large penalties imposed for not complying with the CAP rules. Even though Defra made progress in implementing the rules, there were still significant errors, resulting in disallowance of £642 million since 2005. For 2015-2020, the NAO (2015c) stated to expect further disallowance as the programme is more complex.

Defra has also been criticised in 2015 by a number of organisations such as the NFU for not being ready to implement the CAP programme on time, with farmers expecting to be paid at the soonest towards the end of 2015.

1.1.4. Challenges farmers face

Besides the changing political and financial framework that governs the agricultural industry, and the problems Defra and its arm's lengths bodies have in applying the rules of the CAP, the situation for farmers in England has not been uplifting, with difficulties arising for farmers in several areas. They can be grouped into several categories:

- Production issues: amongst others adverse weather conditions are impacting on the production cycle, and consumers are increasingly demanding the tailoring of agricultural produce to their preferences. Farmers no longer produce one type of good, but need to adjust their produce to market flavour and preference, and market them more extensively. Boehlje et al. (2011) found similar trends in the U.S.A., and stated that as a consequence, the supply chain has become more integrated.
- Pressures on inputs and use of inputs; due to increasing prices but also on the use of resources and public opinion. Farmers are encouraged to produce more outputs without

using more resources, and reduce the impact they have on the environment, also known as sustainable intensification.

- Pressure on revenue, due to amongst others the unfavourable exchange rate Pound-Euro (Defra, 2013a); and for some farm types decreasing prices and the variability in pricing. In recent years, there has been protest, especially in the Dairy sector, with milk prices dropping and dairy farmers struggling to remain in business (NFU, 2016). Total farming income has dropped within the agricultural industry: in 2012 total farming income was 14% lower than in 2011 after an adjustment was made for inflation (Defra, 2013a).
- Social issues, making the sector unattractive for new entrants:
    - There are limited employment opportunities available within the farming industry. In June 2013, less than one % of the British work force was active in the agricultural industry (Jones, 2013). The average age of the farmer is high, 59 according to the Eurostat data (Defra, 2013d; Eurostat, 2009).
    - Salaries are low. In 2012, *the total income from farming per agricultural work unit was £25,175* (Defra, 2013b, p. 1). In the UK, the average before tax income for a full-time employee was £26,200 (OfNS, 2011).
    - Entry costs are high. Land values have increased 202% in the last ten years (Barclays, 2012) and the capital expenditure required can be high. Tenancy is a way for new entrants to get a foot in the door, but opportunities are not widespread, and can still require substantial capital. On average, renting agricultural land has become more expensive, with rents increasing 28% in 2014 and 25% since 2011 (Savills, 2014).
    - The contribution of the agricultural sector to the national GDP was at 0.5% in 2010, making it the least important sector in financial terms in the national economy (AgriStats, 2011).
- Other issues, such as food scares and socio-emotional issues such as the culling of the badgers, foot and mouth disease, and the surpluses that were thrown away in the seventies and eighties, affect the image of the sector. Consumers and environmentalists question current production methods and the impact farming has on the environment.

[5] It is important to understand how the total income from farming per agricultural work unit is calculated i.e. what does total income from farming entail and what is considered an agricultural work unit. This will be done as part of this thesis.

The sector is struggling, and there have been campaigns to improve the image of the agricultural industry, and attract more people to it. Indeed, given the problems mentioned above, it can be questioned as to why people still undertake agricultural activities in England, and whether it is possible to make a living from agriculture. As some farms are financially performing better than others, it is interesting to investigate what characteristics or practices certain farmers apply on their farm, which help them understand – and achieve - financial health.

1.2. The aim and objectives of the research

1.2.1. Aim and objectives

The aim of this research is to assess the impact of management practices on the financial performance of farm businesses in England. The following objectives have been set out:

1. identify a typology of management practices in relation to financial performance;
2. define "healthy" financial performance;
3. identify appropriate methods for assessing financial performance;
4. determine the most appropriate method to assess financial health in the agricultural industry;
5. evaluate the current situation of the agricultural industry in terms of financial performance, and
6. identify measures, through policy and practice to improve/maintain a sustainable financial performance of the agricultural industry.

1.2.2. The research question

The research question for this thesis is:

> "What is the impact of management practices on the financial performance of farm businesses in England?"

From this over-arching research question, four sub-questions are derived:

1. what are management practices, in the context of farm businesses in England?

2. what is the most appropriate method to assess financial performance that is applicable to farm businesses in England?
3. what is the current situation for farm businesses in England in terms of financial performance?
4. what combination of management practices potentially has the greatest influence on the financial performance of farm businesses in England?

This research will lead to recommendations for farmers and policy makers on what practices contribute the most to financial performance, and what farmers and policy makers should focus on and pay attention to in their management practices.

1.3. Relevance of the study

This research is relevant for several reasons.

First of all, it provides insight into the financial situation of farm businesses in England. Even though actors such as Rural Business Research, Nix and Defra report and budget annually on the financial situation in the agricultural industry, there is a gap in the financial analysis of farms, such as the application of financial ratios on farm businesses. This research focuses on this aspect, and uses methods that are applied within the financial industry on farm businesses.

Second, this research investigates the impact of management practices on financial performance for farm businesses in England. There has been little or no such research in England – a lot of studies focus on improving efficiency and productivity, but these do not assess managerial ability and do not focus on financial performance. The research undertaken here puts profit at the heart of the question to reach a thriving sector, not output. And whereas the Farm Business Survey, from which data is used for this research, contains financial data and information on managerial practices and skills, the publications that are available to date do not analyse the data fully as proposed further in this dissertation.

In addition, as part of the CAP support focuses on Rural Development and improving leadership and training skills, this research brings insight for policy makers into how they can support farmers better. It provides evidence as to what themes or skillsets that farmers should acquire or what training courses and materials Defra should provide, in order to support the financial

sustainability of the sector. It serves as evidence within the farming community, to show what practices should be applied and how farmers can set out ways to address financial performance issues.

1.4. Organisation of the study

For this research, an alternative version of the Institutional Development and Organisational Strengthening (IDOS) framework was used (MDF Training and Consulting BV, 2004). This framework is often used to map out problems, assess what should be investigated and how studies should be planned. It allows for research and problem analysis to be structured.

In this situation, the revised framework consisted of: formulating a basic question; undertaking qualitative and/or quantitative research; and developing recommendations that help understand and solve the problem. The following steps were followed to define the research question, the methodology and the outline of the thesis (Figure 1-4).

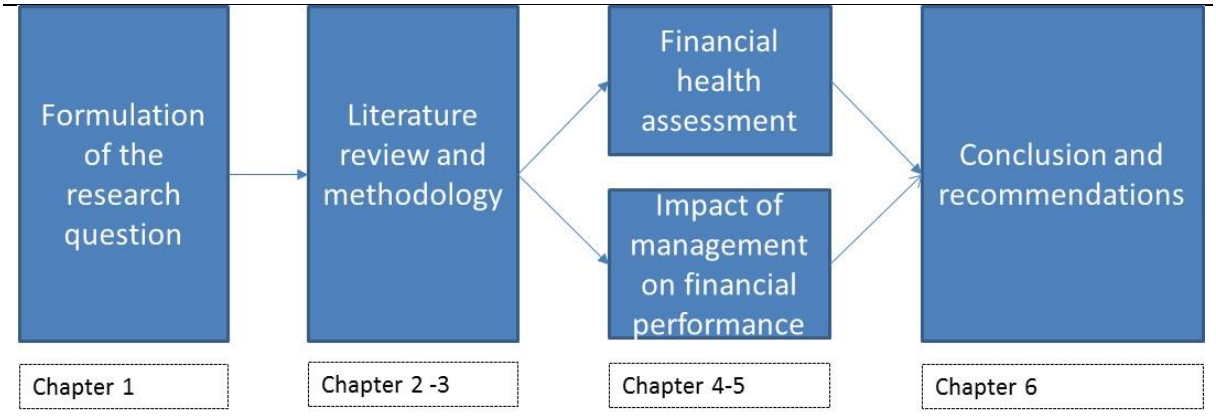


Figure 1-4: Structure of the research and thesis

Source: adapted from MDF Training and Consulting BV (2004).

This first chapter contains the background to this research, the aim and objectives of the research, the research question and the four sub-questions, and the overall relevance of the research.

The second chapter presents the literature review on management and financial performance, and answers sub-question one "What are management practices, in the context of farm businesses in England?" and two "What is the most appropriate method to assess financial performance that is applicable to farm businesses in England?". It also investigates the link

between management practices on financial performance using an adjusted systematic review approach, leading to the establishment of a conceptual framework for the research.

In the third chapter, the dataset is described, as well as the methods used to analyse the data. Different techniques are used to analyse the financial situation of farm businesses in England. For the impact of management on financial performance, an overview is given on what techniques are used in other research, before setting out the assumptions of multiple linear regression. At the end of chapter three, the steps followed for the research are given, in order for this research to be replicable.

Chapter four describes the results of the analysis of the financial situation of farm businesses in England. It sets out the trends from 2008 to 2013, but also looks specifically at the situation in 2011/12, the year that is used to assess the impact of management practices on financial performance. It answers sub-question three "What is the current situation for farm businesses in England in terms of financial performance?". Furthermore, as described in the literature review, an analysis is made of the different financial ratios, and how they link together.

In chapter five, an overview is given of the application of management practices on farm businesses in England, in order to understand the use of tools and methods within the various farm types that are investigated. Second, the results of the regression analysis are given which provides an answer to the fourth and final sub-question "What combination of management practices has potentially the largest influence on the financial performance of farm businesses in England?".

The sixth chapter presents conclusions from the research. It briefly summarizes the research findings, before setting out some recommendations for policy makers and farmers in England, in order to improve the financial performance of their farms. In addition, the limitations of the research are discussed, and some suggestions for further research are given.

2. Literature review

This literature review is broken down into several sections. In the first section, an analysis of management and management practices is given. It describes different theories and frameworks that are applied, as well as different tools that are used by managers. It answers the first sub-question:

1) What are management practices, in the context of farm businesses in England?

The second section contains the literature review on financial performance methods. It gives insight into the tools used for financial analysis (the balance sheet, the profit and loss account and ratio analysis) and assesses different methods that are used in financial research. It addresses the second sub-question:

2) What is the most appropriate method to assess financial performance that is applicable to English farm businesses?

Third, in order to understand the link between the answer to sub-question one and two, a review of existing research was undertaken on the impact of management practices on financial performance. The results of this review are written up in the third section.

The fourth and final section contains the conclusion. It describes the key points of the literature review and the conceptual framework for this research.

2.1. What is management?

2.1.1. Historic evolution

Many books have been written on management and management practices and some journals such as the Journal of Finance, the Academy of Management Review and the Harvard Business Review have published extensively on the topic of strategy strategic planning, leadership and management skills.

Since the early 1900's, management theories have been developed and over time, they have evolved significantly, as new insight brought about additional factors to consider or changed cultural beliefs and perception. Figure 2-1 gives an overview of the schools in the management field.

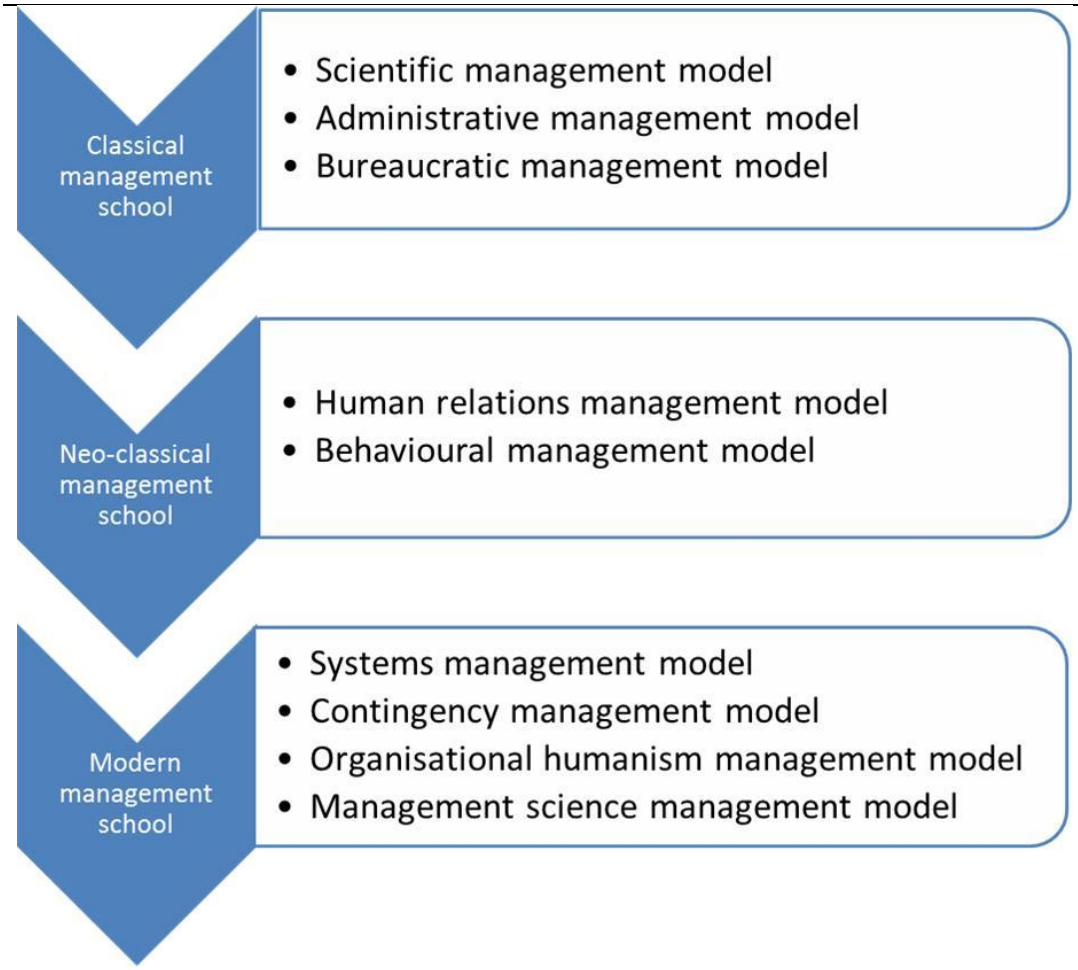


Figure 2-1: Different management theories

Source: adapted from Chandra (2013).

The early models which fall under the classical management school focused on applying science to management, and set out the basics of management theory as it is known today (Chandra, 2013). For example, the bureaucratic management model, developed by Max Weber (1905), is built on the idea that structures and systems are the only essential factors to managing a business. The focus of this model is on setting up a hierarchical organisational chart, with a clearly defined mission, formal procedures and processes, organising work by task competency and recruiting staff based on technical competency. Relationships were thought to be impersonal, and managerial behaviour or leadership skills were not central to this theory. Second, the scientific management model developed by Taylor (1911) used science to select

the most optimal and only way work could be planned and carried out. In order for goals to be achievable, responsibilities were to be clearly delineated between managers and employees, and Taylor introduced performance related pay, as wages were seen as motivational factors. Third, the administrative management model by Fayol (1916) established six roles of management (forecasting, planning, organising, commanding, coordinating and controlling) and is underpinned by 14 principles (division of work, authority, discipline, unity of command, unity of direction, subordination of interests, remuneration, centralisation, scalar chain, equity, order, stability of tenure of personnel, initiative and esprit de corp). This model still remains at the heart of current management theory such as Boddy (2009), with several exceptions made on e.g. stability of tenure of personnel, centralisation and remuneration.

Criticism of the classical school includes the viewpoint that people are seen as machinery, and driven by wages. In the classical models, little attention is paid to leadership style and culture. The external environment is also not made explicit in any of the classical models.

The neo-classical school overcomes some of the above criticism, and puts people at the centre of its models. Within this school, there are the Human Relations management model and the Behavioural management model. The supporters of this school believed that people are motivated by non-financial incentives (e.g. self-fulfilment, job satisfaction, valuation and social status) and that managers have to motivate and support their staff. They are responsible for developing a structure in which the employee flourishes, and builds good relationships. New ideas were developed by Follet (1925) among others on the importance of participative leadership, by Mayo (1933) and Roethlisberger (1939) on meeting social needs through work as essential to motivate staff performance and by Barnard (1938) who identified meeting individual needs as critical for performance. Two of the most famous behavioural theorists are probably Maslow, who developed the hierarchy of needs theory, and Herzberg with the two-factor theory (motivators and hygiene factors).

However, the neo-classical theories did not take into account some of the complexities that organisations face and the interactions between several factors.

2.1.2. The modern management school

The modern school amalgamated the strengths of the classical and neo-classical schools, and adopted them to fit with current practice. Systems are seen to be open, taking into account competitors, government, customers and other stakeholders. The different models developed in the modern school take into account quantitative techniques (modelling and simulation), mainly used in management science models (e.g. total quality management, operations management, management information systems) and leadership styles and willingness to change (for example in the contingency model, where leadership is critical to adapting to external factors).

Two of the most frequently cited researchers on strategy and management are Mintzberg and Porter.

Mintzberg has developed, among others, the 10 roles that a manager carries out (Mintzberg, 1973). He has published extensively on the role of strategy but also on the steps undertaken in the strategic management process. For example, he has set out 10 schools in strategic management, which can be combined into three groups: the prescriptive group focusing on describing what tools a manager needs to use in order to have a strategy (e.g. conceptualisation of the strategy, formal process, analytical process); a process group, which sets out how strategy comes about (e.g. a collective process or a reactive process); and the configuration school, which defines it as "a process of transformation" (Mintzberg et al., 1998, p.13). In addition, he highlighted issues with current strategic planning in several areas such as the fact that the strategic planning process is bureaucratic, prescriptive and does not leave room for innovation; the managers rely on the wrong kind of data (hard data), while "soft" data should be consulted also; and that managers should not develop the strategy in a silo, detached from the reality of the business (Mintzberg, 1994).

Porter on the other hand has developed a theory around Three Generic Strategies and a Five Forces Model (Porter, 1979, 1980, 1985, 2008). He is of the opinion that a firm will be successful through diversification, cost advantage or focus, while taking into account the larger environment it functions it, and positioning itself within the environment. His Five Forces Model looks at the threat of new entrants, threat of substitutes, bargaining power of suppliers, bargaining power of buyers and rivalry among existing competitors, as a way to assess the external environment in which a company functions. This is in line with what Boddy (2009)

established as described in the next section, and which will be used for the research reported here.

2.1.3. Definition of management used for this research

Boddy (2009) defines management as the attainment of organisational goals through planning, organising, leading and controlling on several areas such as production, marketing, financing and staffing, and taking into account the political, economic, social, natural, legal and technological environment (Figure 2-2). There are several aspects to this definition, such as:

- Setting organisational goals: managers need to decide what their objectives are, and what they want to achieve within established time frames (the next year, three years, five years) or for the duration of their company. Goals in general include a financial target such as shareholder dividends and increase in profit margin/market share, but can span non-financial targets as well, such as improving the environment and delivering innovation.
- Planning, organising, leading and controlling resources, which are the four key roles that managers carry out in order to optimise the utilisation of resources. All roles need to be carried out, in order for the organisational goals to be reached.
    - Planning is the process during which resources are mapped against organisational objectives. It entails utilising knowledge around availability of resources and processes to make decisions on allocation of resources, while keeping in mind the goals that are set out.
    - Organising is carrying out activities linked with structure, responsibilities and mandate, in order for systems to function, and activities to take place according to plan.
    - Leading is applying skills and knowledge to achieve alignment between the plan and implementation of the plan. In general this area looks at leadership styles, communication and culture.
    - Controlling is monitoring implementation against the plan, and adjusting processes where possible, or undertaking remedial action to keep progress on track. It looks among others at procedures, plans and regulation, and how progress is made against them.
- Production, marketing, financing and staffing: the key areas that managers need to consider. What will be produced, how will it be marketed, what sources of finance will be used, and who will take on these tasks, are of key importance in the optimisation question.

- Analysing the environment, which is of critical importance, in order to understand the restraints and opportunities available to managers. This is commonly done through the PESTLE framework, a framework that allows for an analysis of the political, economic, social, technological, legal and environmental factors to be taken into account.

This framework is supported by several researchers such as Bailey (2013b); Hall et al. (2004); Lins (1989) and Miller et al. (1998).

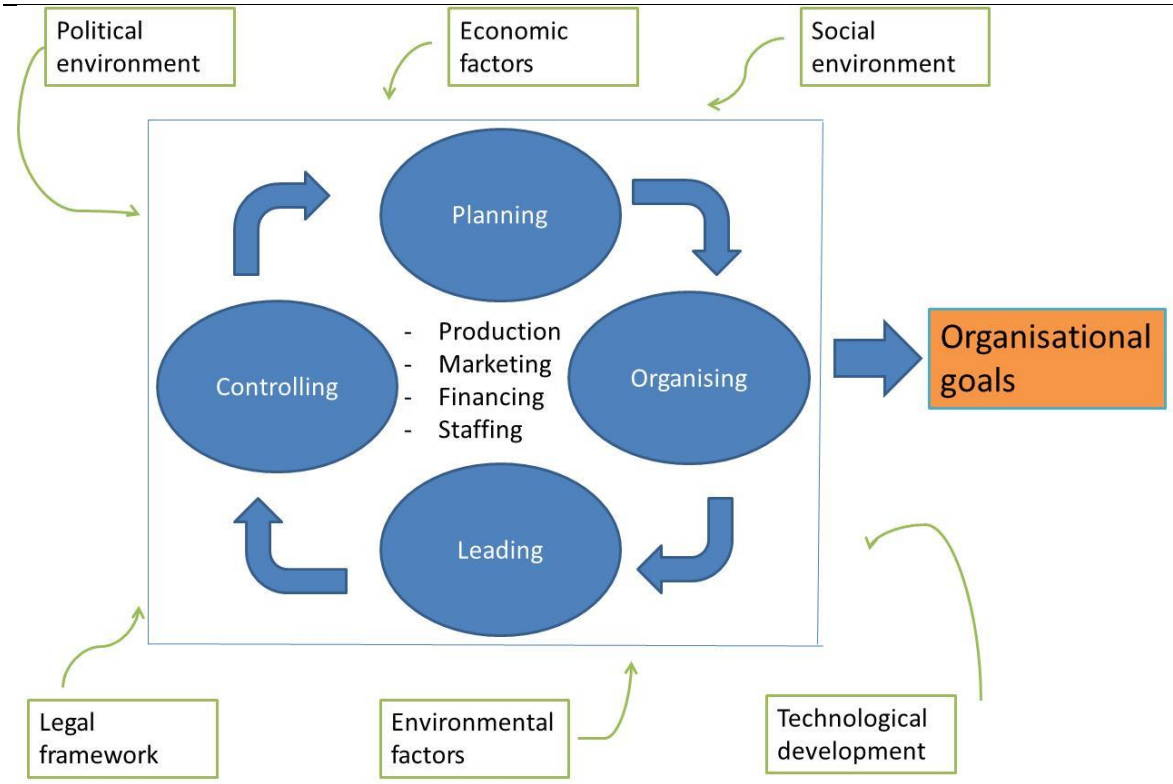


Figure 2-2: The management cycle

Source: adapted from Boddy (2009).

In practice, the manager has a set of structures and systems he/she operates in, as defined by the integrated organisation model (MDF Training and Consulting BV, 2004, p.6-10 (13)) as shown in Figure 2-3:

- Structure, which is *the division of the organisation in groups (units/teams, departments, divisions, etc.), the division of tasks, responsibilities and powers among people and groups and the way the coordination of activities between people is taking place;*
- Systems: *the internal processes that regulate the functioning of an organisation*
- Strategy; defined as *the long term plan of action of an organisation to realise its objectives with the available means (inputs)*

- Management style: *the characteristic pattern of behaviour of management;*
- Staff, which *refers to all activities, rules and regulations related to staff motivation and utilisation and development of staff capacity;*
- Culture: *the shared values and norms of people in an organisation*

Figure 2-3: The Integrated Organisational Model

Source: MDF Training and Consulting BV (2004, p.1 (3)).

Alternatively, the manager faces the following optimisation problem:

Maximise objectives/the organisational goals, under the constraints of

- Resource availability (e.g. finance and staffing profile)
- The PESTLE environment

Several researchers, such as Boehlje (1999); Miller et al. (1998); Nuthall (2010); and Olson (2004), have produced management frameworks specifically for the agricultural industry. From an agricultural perspective, a farm manager has to organise their work and actions to achieve the objectives they set out, whether it be profit maximisation, effective allocation of resources, protection of the environment, others or a combination of the above (Ruth Gasson, 1973). The constraints the farm manager faces are:

- The use of inputs (availability and cost of land, stock, fertiliser, and inclusive of labour with on- and off-farm labour opportunities to be considered for the owner, spouse and staff);
- The PESTLE framework
    - Political – such as the rules and regulations set out by Defra and the EU regarding the CAP, including food hygiene, animal welfare and environmental legislation;
    - Economic – including sales opportunities (including marketing opportunities and stakeholder management) and finance (such as cash flow management and asset management);
    - Social – managing the role and image of a farming business in the local community and nationally, but also tailoring to the needs of customers;
    - Technological – utilising innovations to facilitate, control and improve agronomic and livestock practices;
    - Legal – understanding the set-up of different businesses and areas for expansion, including among others tenancy rights, inheritance rules, and taxation; and,
    - Environmental – managing constraints such as weather and disease control.

2.1.4. Management tools

In order for organisational goals to be achieved, a manager has several tools that they can utilise – if they want – to assist with implementing their roles and responsibilities. The most common tools are shown in Figure 2-4, based on work carried out by Rigby & Bilodeau (2007) and captured in Bain & Company's Management Tools and Trends, using a dataset of 8,500 responses.

Within the management cycle, tools can be used at several points in time. For example, several tools are available to assess the situation an organisation finds itself in, with some examining external environments and stakeholder approach (institutiogramme, environmental scan, coverage matrix and the PESTLE framework) and others entailing an assessment of organisational performance and taking into account the external environment. For example, the SWOT analysis maps internal strengths and weaknesses and external opportunities and risks. Likewise, benchmarking can be applied within the organisation on different business units or cost centres, or by comparing performance to competitors within the sector or in others. Defra (RBR, n.d.), for example, has developed an online farm benchmarking tool to compare results across farms in terms of financial performance and business results. Other benchmarking tools

that exist within the agricultural industry are the Meat Producers benchmark from the Red Meat Industry Forum, Milkbench+ and AHDB Cereals.

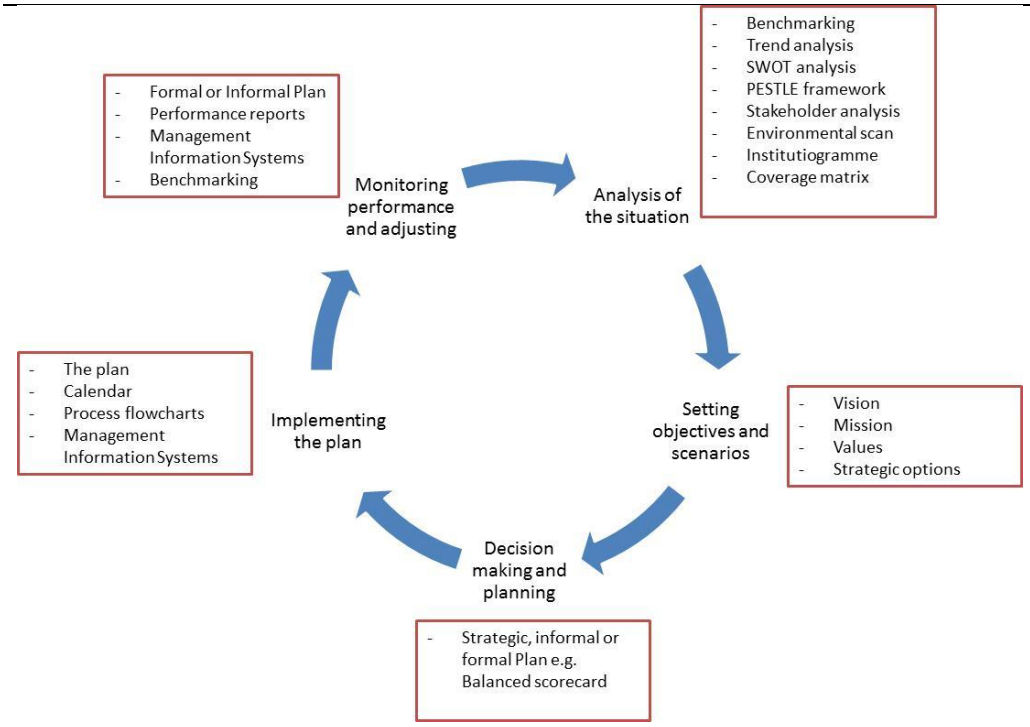


Figure 2-4: Tools in the management cycle

Source: adapted from Friend & Zehle (2009).

Once an assessment is made of the current situation, a manager can set out the strategy for the coming years. While the vision, mission and values remain relatively stable in general and are revisited at less frequent intervals, a strategy refresh is undertaken more frequently. From it, different scenarios can be set up, and one option will be selected to achieve the manager's goals. The results of the decision making process can be summarised in a plan.

There are different ways to plan, and there are different levels of formality associated with plans. However, in the business world, the common practice is for plans to be formalised, as a method for the manager to track progress and evaluate whether the objectives that were set out are reached. The balanced scorecard, for example, is a commonly used tool, developed by Kaplan & Norton (1996) to measure and manage performance. It looks at four domains (financial stewardship, internal business processes, customer/stakeholder satisfaction and organisational capacity) to define objectives and performance metrics, and translate the overall goal in day-to-day management and operational decisions.

Mintzberg (1994) has critiqued the importance that is put on formal planning. In his opinion, the strategic planning process is often bureaucratic, prescriptive and does not leave room for innovation: managers rely on the wrong kind of data (hard data), while "soft" data should be consulted also; and managers developed the strategy in a silo, detached from the reality of the business. Similarly, Fairholm (2009); Miller & Toulouse (1986) and Pettigrew (1992) expressed that a clear strategy in itself is not sufficient. Having effective operations and being a leader to go alongside the strategy is crucial according to them.

Second, the level of detail that is integrated in the plan depends on the manager/business. However, it generally entails a project plan and a timescale for implementing activities, workforce planning, a marketing/sales plan and a financial plan. Plans can span several years but are generally translated into more detailed annual plans and workflows. Defra (2006, 2014a, 2014b) provides detailed information on how to plan, with a special focus on the business plan. According to them, a plan should include short-term and long-term goals, timing, staffing and finance. The structure they promote consists of financial forecasts, marketing and sales strategy, staffing and management, operations.

Implementing and controlling are in turn also using the plan set out during the strategic decision making process, and are based on collecting performance data with management information systems, and utilising benchmarking to monitor performance, and adjust it where necessary.

Looking at the management cycle, the tools of planning and benchmarking are of key importance, as they are used in various stages of the cycle. Similarly, Rigby & Bilodeau (2007), found that planning and benchmarking appear in the top four of most frequently applied tools globally, with planning taking the number one spot as it is applied in 88% of the cases, and benchmarking taking the number four slot, used by 81% of the respondents. The second and third most applied tool is customer relation management and customer segmentation. In Europe and North-America, planning and benchmarking take number one and two respectively. Within the agricultural industry in England, Jack (2012), for example, described the benefits of using benchmarking, be it for performance comparison, for better practice analysis or process benchmarking. The benefits mentioned include financial gains, being an aid in the decision making process and increased sustainability.

The conceptual framework that is therefore constructed for this research is starting from the perspective that planning and using management tools will have a positive impact on financial performance, as set out in Figure 2-5 below. A better utilisation of management tools, better IT skills and better knowledge of these tools will lead to a better evaluation of performance, resulting in increased insight in and understanding of performance, as well as a better assessment of needs and where efficiencies can be made. The consequence of this is that a farmer can better plan and allocate resources, which would result in efficiencies including financial gains.

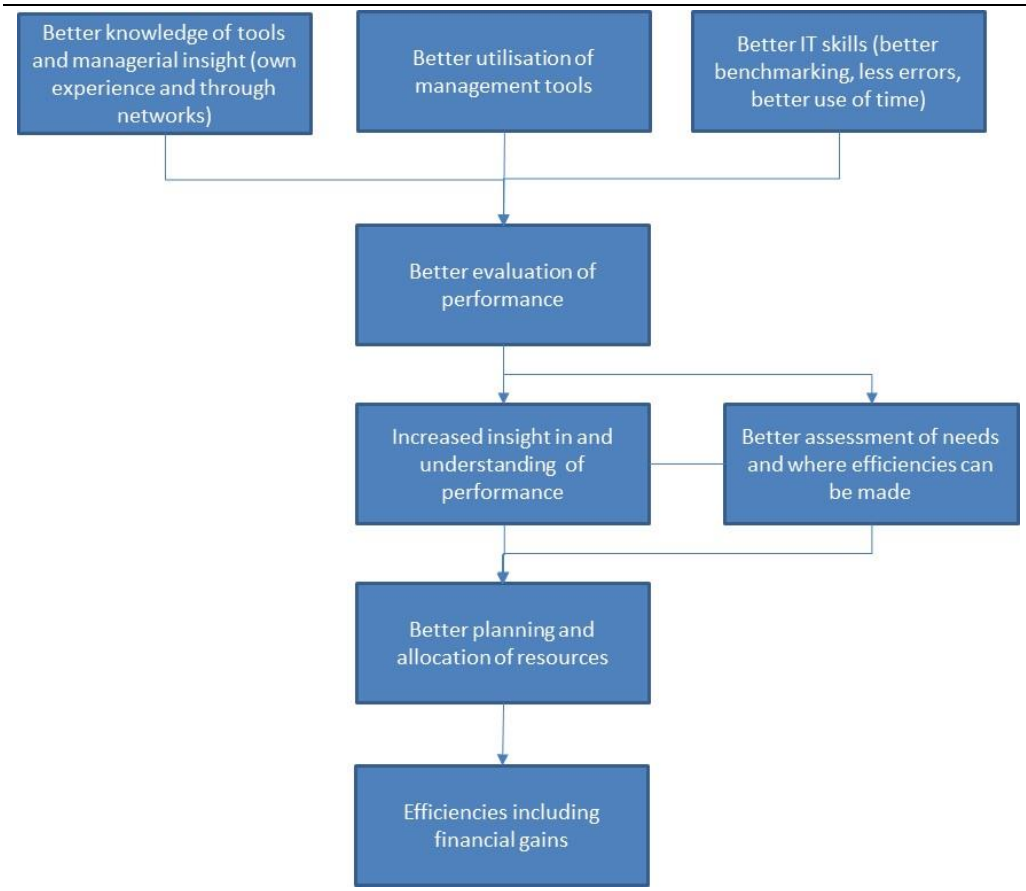


Figure 2-5: The consequences of better usage of management practices

2.2. How to measure financial health?

This section contains an introduction to the tools used for financial performance analysis, followed by an overview of different methods and the selection of the method used in the research reported here.

It starts with an introduction to the tools used for financial performance assessment (the balance sheet and the profit and loss account), and some points of attention when analysing the balance sheet and the profit and loss account. In the second section, an overview of the financial ratios is given, and the difficulties that come with using them. In the third and final part, other research is referenced before concluding on the financial performance indicators for this research.

2.2.1. The balance sheet and the profit and loss account

2.2.1.1. Set up of a balance sheet and profit and loss account

Financial performance assessment is, in general, based on an analysis of the balance sheet and the profit and loss account or trading account:

- The balance sheet provides an overview of the company's assets (in terms of fixed assets, current assets and liabilities) at a certain point of time;
- The profit and loss account or trading account gives an analysis of the company's revenue and costs made during a certain period of time.

Other financial reporting tools are records for cash flow and tax accounts for tax on profits, value added tax (VAT) and wages.

According to general accounting rules, companies provide these statements once a year. The balance sheet and profit and loss account can be represented in various ways. Table 2-1 and Table 2-2 show generally accepted structures of a balance sheet and profit and loss account, specifically for farm businesses. Depending on the type of farm (Livestock, Cropping, etc.), different categories can be added into the balance sheet and profit and loss account.

Table 2-1: Structure of the balance sheet for a farm business

Assets	**Claims**
Fixed Assets	*Long term liabilities*
Land	Mortgage
Buildings	Bank loans
Plant, machinery and vehicles	Hire purchase
Permanent crops	
Breeding livestock	
Quota's	*Current Liabilities*
	Creditors
Current assets	Bank overdraft
Trading livestock	
Crops and cultivations	*Equity (net worth)*
Stores	
Debtors	
Cash in bank	
Cash in hand	
Total Assets	**Total Claims**

Source: Warren (1998), adjusted by Bailey (2013).

Table 2-2: Structure of a profit and loss account or trading account for a farm business

Enterprise output (= sales = turnover)
Milk, cattle, other livestock, crops and other outputs
Tillage valuation change

Variable costs
Food and Seed: purchased and home-grown
Fertiliser, Sprays
Other crop costs
Casual labour
Vet and medicine
Other livestock costs
Store Valuation change

Gross margin = sales – variable costs

Fixed costs
Rent
Regular labour
Machinery costs:
- Fuel costs
- Repairs
- Depreciation of plant, machinery, vehicles and equipment

Overhead costs: electricity, water, gas, internet, insurance, etc.
Financial costs: interest, bank charges, etc.

Other revenue including all kinds of subsidies

Farm Profit or Farm Business Income = gross margin – fixed costs+ other revenue
Unpaid family labour
Notional rent
Interest
Land ownership charges

Net farm income= farm profit – unpaid family labour – notional rent + interest + land ownership charges
Farmer and spouse labour
Management salaries

Management and investment income = Net farm income – farm and spouse labour + management salaries

Source: Warren (1998), adjusted by Bailey (2013).

The subsidies that the farmers receive including the ones under the Single Farm Payment scheme (up to 2015) and the Basic Payment Scheme (as from 2015) are related to trading activities and are therefore a taxable income.

2.2.1.2. Points of attention

There are some difficulties when assessing balance sheets and profit and loss accounts.

First, the balance sheet is a snapshot, taken at a specific moment in time. The situation, if taken on another day, might show a different picture; and the fiscal year does not necessarily collide with the harvesting season of the agricultural sector, or the production cycle of livestock.

Second, the way the profit and loss account is structured is not always identical between firms and can vary from year to year – if accountancy rules and applications are changed. There are discussions as to what is considered a fixed cost and what is considered a variable cost. For example, labour costs can be seen as variable if undertaken by contractors or casual labour, or fixed when undertaken by permanent staff. Terminology might differ and rules can be interpreted differently. This makes benchmarking for comparative purposes a lot more difficult. Although the final result (ultimate profit or loss) will be identical regardless of where revenue and costs are booked, ratios looking at efficiency will generate a different result based on whether costs are fixed, variable or allocated to a certain product, and subsidies, for example, are registered as a negative cost. It is important to keep this in mind when benchmarking, and making sure that the same calculation is used for all participating firms.

Third, there is a difference between accounts for tax purposes and what is done for management purposes. When drafting the accounts for tax purposes, the business owner/accountant has as their purpose to minimise the taxes they have to pay. Profit is minimised by increasing costs or through, for example, a lower valuation of assets. Livestock and crops are, for example, valued at market value and not at cost of production (Defra, 2006). From a management accounts' perspective, the manager wants to see how much profit is generated and how his decisions affected the company's financial position, upon which he can decide what steps to undertake in the coming year. Additional costs such as rent for an owner-occupied farm are added, in order to compare fairly between different types of ownership (owner-occupied or tenanted). Unpaid labour, for example of the farmer and spouse, is also included at a cost so that a full overview of the total labour requirements can be made.

Furthermore, the difference between cash based accounts where expenses and revenue are accounted for in the year they are made and accrual based accountancy where costs and income are allocated to the fiscal year they refer to instead of when the cash expense or income is made, can generate additional difficulties in terms of valuation and depreciation (Gaeremynck & Van Herck, 2004). This difference in representation can have quite large effects on the balance sheet and profit and loss account (Colwell & Koroluk, 1990; Seger & Lins, 1986).

Finally, absolute parameters are of use for managers and investors e.g. how much profit/income was generated, how many fixed assets a company has, etc. It is possible to analyse trends over

a number of years using absolute parameters and is used to monitor internal management. However, for benchmarking reasons, ratios (relative parameters) are more useful as they allow companies of different sizes to be compared and analysed.

2.2.2. The financial ratios

2.2.2.1. Introduction

Financial health refers to the ability of an individual, company or institute to fulfil their obligations towards its debtors, and have sufficient funds to pay taxes, personal drawings and reinvest in the business (Griffis, 1989). For businesses, the balance sheet and profit and loss account needs to be analysed to see whether they can fulfil their obligations, in general via the calculation of financial ratios. Financial ratios can be classified in five different categories, although other classification is possible in terms of short term or long term stability measures (Kay et al., 1994):

- Liquidity ratios: showing a company's ability to fulfil its commitments in the short term;
- Solvency ratios: showing the debt - equity structure and the ability of the firm to fulfil its obligations in the long term;
- Profitability ratios: the ability of the company to make profit and increase the value of the company;
- Financial efficiency: indicating the amount of funding used to pay interest, depreciation and operating expenses, as well as showing how assets are used to generate profit;
- Debt coverage: showing the amount of funds available to cover the debts. The higher this ratio, the easier it is for a business to pay back its debts.

In the U.S.A., a list of 16 indicators called the "sweet 16" is used to assess the financial performance of businesses (Penn State, n.d.). These 16 ratios can be divided into five categories:

- Liquidity ratios: current ratio (total current farm assets/total current farm liabilities) and working capital (total current farm assets - total current farm liabilities)
- Solvency ratios: debt/asset ratio (total farm liabilities/total farm assets), equity/asset ratio (total farm equity/total farm assets) and debt/equity ratio (total farm liabilities/total farm equity)
- Profitability ratios: Return on farm assets ((net farm income from operations + farm interest expense - value of operator and unpaid family labour)/average total farm assets), Return on farm equity (net farm income from operations - value of operator and unpaid family

labour)/average total farm equity), Operating profit margin (net farm income from operations + farm interest expense - value of operator and unpaid family labour)/gross revenue) and Net Farm Income

- Repayment Capacity indicators: Term Debt and Capital Lease Coverage Ratio (net farm income from operations + total non-farm income + depreciation expense + interest on term debt and capital leases - total income tax expense - family living withdrawal)/principal and interest payments on term debt and capital leases), Capital replacement and term debt repayment margin (net farm income from operations + total non-farm income + depreciation expense - total income tax expense - family living withdrawal (including total annual payments on personal liabilities) - payment on prior unpaid operating debt - principal payments on current portion of term debt and capital leases)
- Financial efficiency indicators: asset turnover ratio (gross revenue/average total farm assets), operating expense ratio (operating expense-depreciation/gross revenue), depreciation expense ratio (depreciation expense/gross revenue), interest expense ratio (interest expense/gross revenue) and net farm income from operations ratio (net farm income from operations/gross revenue)

2.2.2.2. Difficulties with financial ratios

Calculating these ratios is normally quite a simple task; however, caution is necessary when interpreting these ratios. There are different definitions of ratios depending on sector and type of information that is available (one of them being accounts for tax purposes and for managerial purposes). The calculated ratios and standards, set for managers and owners of the company, will not necessarily be based on the same definition of the ratios and standards that bankers and investors uphold (Bailey, 2013a).

There are also different standards for ratios in different sectors (Amit & Livnat, 1990). A high indebtedness for some industries can be acceptable if there are sufficient buffers in place to guarantee payback (such as investment firms). Other industries such as retail or the restaurant industry have high turnover rates of stocks due to the fact that their products are seasonable and/or perishable. In other industries, the values of the turnover of stocks could indicate inefficient stock management. Different farm types also have different ratios. Dairy farms, for example, have considerable assets in their equipment and buildings while lowland grazing livestock have very few buildings so their assets tend to be lower. It is hence important to look at the ratios within a certain sector and assess whether they are sufficient or not.

Ratios are also not useful to assess changes in scale, as they are divisions of values found on the balance sheet and profit and loss account or trading account. For benchmarking reasons, firms of similar sizes and industries should be compared against each other (Bailey, 2013a).

Most financial ratios furthermore do not follow the normal distribution (Amit & Livnat, 1990). If a manager wants to compare his performance with that of other firms, he cannot use parametric statistical methods. There are ways to change this, via transformation or truncation or a combination of both. Truncation however is arbitrary and the dataset might be reduced too much, while opting for the inverse transformation or adding the greatest negative score and a small positive real number to all observations might result in outliers. The most commonly used method is the logarithmic transformation. Buijink & Jegers (1986) also suggest cube root and square root transformation. It is important to test the raw dataset for normal and symmetrical distribution prior to deciding whether transformation and/or truncation is necessary.

Ratios are also the point of departure for assessing financial health. Optimal values or ranges exist for a number of ratios such as for Return on Equity, Return on Assets and Return on Sales, where the rule is that the higher the ratio is, the better performance is. However, for certain ratios there is no optimal range. For leverage (debt/assets) for example, a low leverage ratio could mean that the firm has paid off all its debt and is now in a strong financial position. Alternatively, it could be an indication that the firm does not have access to foreign capital. Further research why certain values are generated is necessary to draw a clear picture of the situation, and to establish options for the future.

Finally, there is a lot of discussion as to what ratios are the most useful measures of financial performance. In the next section, a brief overview of other research on financial performance will be made, showing what measure will be used for the research reported here.

2.2.3. What measure to use?

Several articles have been dedicated to investigating financial health in the agricultural industry. Griffis (1989) contributed to the debate on defining business health in the English Agricultural industry. In his opinion, farmers, or decision makers, should have insight into their financial situation in order to set up strategies and plans for the future. The definition of a viable farm

business (Griffis, 1989, p.2) was followed by Defra (2004), with *a viable farm business having the ability to achieve a sufficient cash surplus from trading to cover*:

- *personal drawings and tax,*
- *necessary reinvestment to maintain the business,*
- *repayment of any loans on the agreed timescale,*
- *expansion of the business, if this is necessary for its long term survival.*

Analysing various articles, it shows that different methods are used to assess financial health and performance, as there is disagreement on what method/list of ratios are the most suitable. What follows is an overview of the different methods that can be used and some examples of how they were applied.

The first method is Economic Value Added (EVA). It was used by among others Badicore et al. (1997); Chen & Dodd (1997) and Rogerson (1997). Economic Value Added is used as a performance measure, to assess what value (profit) is created by investing in a certain option, taking into account the opportunity cost of this investment. It is used often to measure corporate performance from the viewpoint of stakeholders and shareholders. For this research however, Economic Value Added would be difficult to calculate, as the opportunity cost of investments is not captured, or registered, farms have no or few shareholders, and options for alternative investment of capital are less widespread than in the corporate world. Badicore et al. (1997) support the use of Return on Economic Value Added as the best financial performance measure. Again, their point of view is maximisation of shareholders' return.

Another method that is used to value the performance of a company is Standard and Poor's credit rating (Standard and Poor, n.d.). This system provides a rating to companies and countries (from AAA, indicating a company (country) that has a strong probability to deliver on its financial commitments, to D, showing a firm (country) that has not been able to pay back its debts, and might default on all its loans). In the agricultural sector, it was used by Brewer et al. (2012) to analyse repayment capacity percentage, owner equity percentage and working capital to measure the financial health of the U.S. Production Agriculture. The farms were classified according to farm types, region and gross sale amounts in order to calculate the probability of default. They find that *debt repayment and equity to assets ratios have increased over time, probability of default has decreased over the time frame and that there is considerable variation in the average probability of default among farms* (Brewer et al., 2012, p. 182). However, this

research is not investigating whether farms are at risk of failing, but is looking at a broader perspective in understanding what the financial performance is for the sector. Similarly, the model of Beaver (1967), Z-score (Altman, 2000) and the Composite Rule Induction System (as applied by Ko et al. (n.d.)) look at predicting the failure of businesses, and not at overall performance.

Other options look at investment decisions (e.g. the calculation of net present value of investments, using discounted cash flow techniques or the calculation of the Internal Rate of Return), but these are again not relevant here as the purpose is not to decide upon an investment, but to assess the performance of the industry.

In a lot of studies, researchers have selected a ratio, or several ratios, to measure financial performance. Brožová (2001), for example, looks at the financial health of 128 organic farms in the Czech Republic using total capital profitability, cost effectiveness, total liquidity, indebtedness ratio, interest coverage and total assets turnover. Frigon (2007) links farm size with financial health and government payments in Canada. He uses the indicator of total net cash income less government payments. Schulte (2012a) proposes to use some liquidity, solvency and a profitability ratio to assess the financial health of the farm. More concretely, the current ratio and working capital were used as measures for liquidity; debt-to asset ratio, operating expense ratio and Asset Turnover ratio for solvency measures and net farm income for profitability. Ansell (n.d.) uses net farm income and management and investment income to discuss profitability in the agricultural sector in the UK in the early nineties. There are also various aids available for farmers online, that help set out how indicators should be interpreted, for example by Ahrendsen & Katchova (2012) who provide insight into the American agricultural industry using the ARMS database, Schulte (2012b), USDA (n.d.) and Plastina (2016) who has calculated several financial ratios and provides benchmarks for Iowa State. Section 2.3.2 provides an overview of what ratios are used in the articles that were retained for the literature review looking at the link between management practices and financial performance.

Capon et al. (1990) undertook a systematic review into financial performance ratios, and mention many ratios being used to measure financial health, with the most frequent being Return on Equity (RoE), Return on Assets (RoA), Return on Sales, Price/Cost Margin and Stakeholder Return.

These ratios are part of the DuPont Expansion model. This model was developed in the 1920s to improve the analysis of balance sheets and profit and loss accounts. It breaks down the rate of return on equity for shareholders into three distinct areas (Bernhardt, 2010):

$$RoE = \frac{Profit}{Equity} = \frac{Profit}{Sales} * \frac{Sales}{Assets} * \frac{Assets}{Equity}$$

With

a) Operational or production efficiency = $\frac{Profit}{Sales}$

b) Asset Turnover = $\frac{Sales}{Assets}$

c) Compound Financial Leverage Factor = $\frac{Assets}{Equity}$

Bernhardt (2010) shows that poor financial performance is due to:

- Operational or production efficiency:
    - Use of indicators of productivity: how much added value was created per unit of capital, labour, land
    - Profitability indicators: how much profit generated per type of input used (labour, capital, land)
- Asset utilization, which shows how assets are used for the amount of sales that is generated
- Leverage, which shows how much of the assets are owned by the enterprise and how much are to be repaid to debtors.

It seems that all of the "sweet 16 ratios" are covered by the DuPont Expansion model (Bernhardt, n.d.). Figure 2-6 shows this, as well as some underlying factors that affect the structure of the balance sheet, and the profit and loss account.

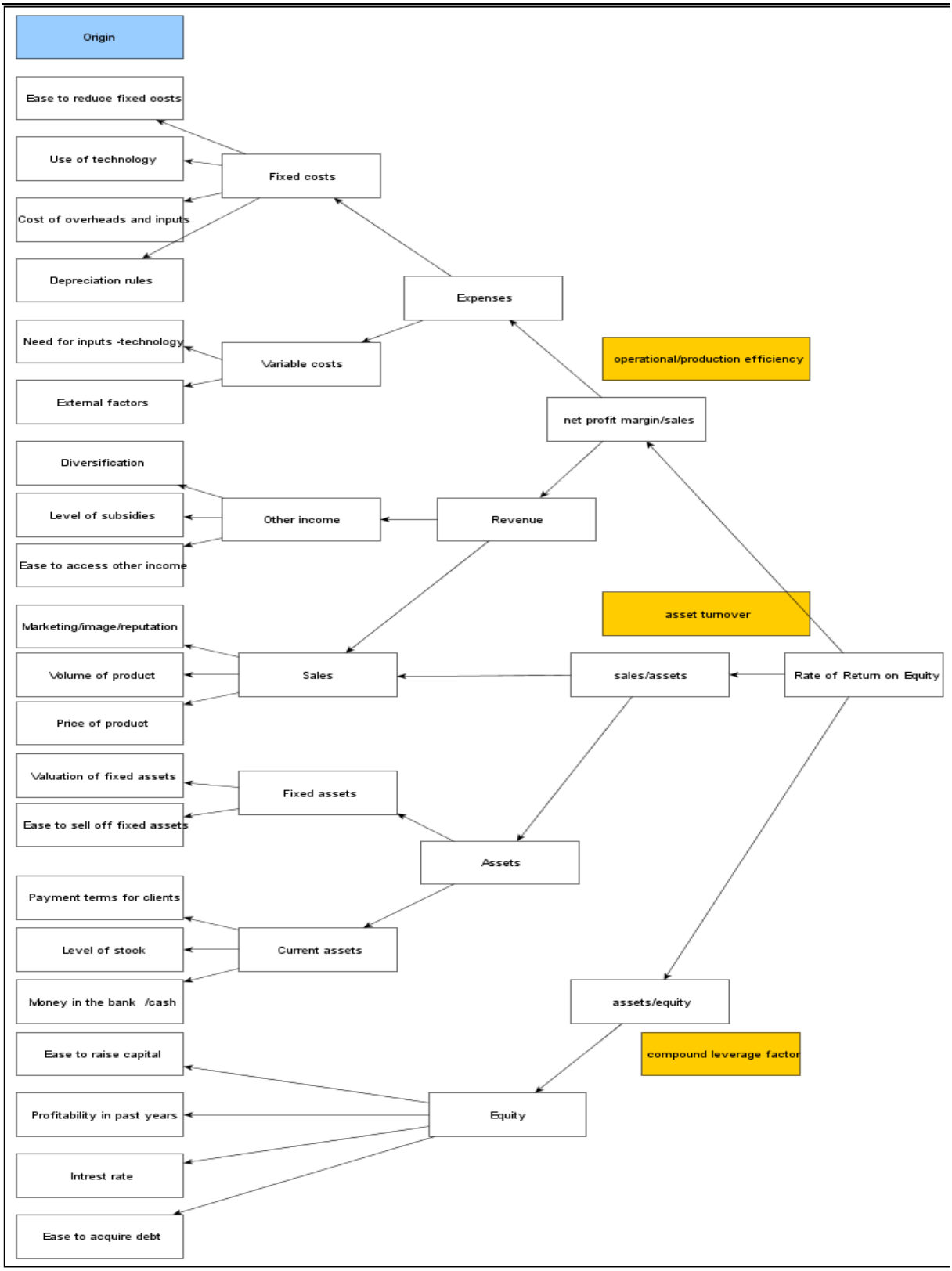


Figure 2-6: The DuPont Expansion model

Notes

1. Origin shows some underlying factors that affect the different parts of the balance sheet and profit and loss account. However, the list is not complete, and there are factors that have an effect on several items in the balance sheet and profit and loss account. For example, depreciation rules affect the fixed cost. Depreciation also affects the balance sheet through the asset valuation.

This model overcomes the criticism that using one indicator is not sufficient to assess the financial health of a firm or industry. Financial decisions are interlinked – for example the decision to invest profit into increasing the asset base, or distribute profit to shareholders, will affect various indicators, which is captured within the DuPont Expansion model. The model has been promoted by several researchers (Boehlje et al. (2001); Boehlje et al. (1999); Eisemann (1997); Firer (1999); Melvin et al. (n.d.); Mumey (1987); Plumley & Hornbaker (1999); Van Voorhis (1981)) and been used to build the evidence supporting this methodology.

For example, Little et al. (2009) use a modified DuPont model to test strategic options and Return on Assets. In their research, the one-year dataset of 129 retail companies is analysed using operating income and net operating assets. The mean between companies that use a differentiation strategy versus the ones that use cost leadership strategy is different, and these differences are statistically significant.

Moss et al. (2009) applied it on cropping farms in the U.S.A. to understand the variations in profitability, government payments and farmland values. They found that government payments affect both profit and the value of farmland.

Zhang & Xiaosong (2012) also use an adjusted DuPont expansion model, this time incorporating cash flow into it. The financial records of only one company (the Chinese National Petroleum Company) are analysed for a period of three years.

Qing et al. (2010) looked into adapting the DuPont model to incorporate Economic Value Added of equity, as there are shortcomings in the traditional model according to them. The first is a mismatch in financial indexes, the fact that net profit does not reflect real profit and that the goal of maximising profit for shareholders is not reflected by Return on Equity. However, for this research management accounts are used and the indicator for profit is farm business income minus unpaid labour or profit before taxes minus unpaid labour, hence their viewpoint is not directly relevant.

Soliman (2004) focuses on adjusting the DuPont model according to the industry that is being investigated. This point of view holds up and the view of the sector will be the basis for the analysis of the ratios. In a second paper, Soliman (2008) investigates the link between stock market returns and forecasts of financial analysts. He finds that the DuPont model (and Asset

Turnover) predicts equity returns quite well, but market participants do not take up that information consistently. His paper proves that the DuPont model is useful for predicting success/failure of companies:

> "DuPont is a useful tool of financial statement analysis… and relates to the operational aspects of the firm." (Soliman, 2008, p. 850)

Furthermore, Melvin et al. (n.d.) developed computer software, specifically for the agricultural industry in the U.S.A., which assists farmers in calculating and analysing their financial performance using the DuPont Expansion model. They found it to be successful in assessing profitability within the industry based on two experiments they carried out.

To close this section, the DuPont expansion model has potential to be a good method to analyse the financial performance of agriculture in England. It has not yet been used to assess the current situation of the agricultural industry, as recent publications (e.g. by Defra and Nix) provide an overview of the sector's most important financial results, but do not apply ratio analysis extensively, with the exception of Defra (2014a) that looks at six ratios for the period 2010/2011 and 2012/13. These are, however, not all the ratios included in the DuPont Expansion model.

Financial performance will therefore be measured with 5 ratios: Return on Sales, Asset Turnover, Compound Leverage Factor, Return on Assets and Return on Equity. In terms of definitions used for each ratio:

- Profit is measured as Farm Business Income minus Unpaid Labour. Farm Business Income is the farm output minus the adjusted input cost. It is the gross margin plus other revenue minus fixed costs. The farm outputs are enterprise outputs and miscellaneous income. Input costs are all costs related to paid labour, machinery, livestock costs, crop costs and general farming costs plus land and property charges (all kind of rents except imputed rent on tenants' improvements and rental value (owner occupiers), tenant type repairs, rates) and write off of bad debts that are under miscellaneous receipts. Occupiers' expenses (buildings and works net depreciation, insurance of farm buildings and landlord-type repairs and upkeep) as well as interest on borrowing are included. Unpaid labour of principal farmer, spouse and others is taken into account, as this is not included in Farm Business Income. This way, the profit shows what is available for reinvestment in the farm, for personal use and to pay off taxes and debts – without making any adjustment for owner-occupied or

tenanted farms as for example land and other assets are fully accounted for in the definition of assets below. This explains also why Net Farm Income was not used, as it includes imputed rent in its calculation.

- Sales are the sum of all enterprise outputs plus miscellaneous income from agriculture related and integrated diversified activities. The enterprise outputs are all crops, by-products, cultivations – revenue excluding subsidies, farm use, farmhouse consumption and benefits in kind -; cattle and cattle products, sheep, pigs, poultry and other livestock – revenue including casualties, farmhouse consumption and benefits in kind, and used on farm. Miscellaneous income is income such as processing and retailing of farm produce; agri-environment agreements; project based schemes and other grants/subsidies for diversification; Single Payment Scheme; rents for farmhouse, cottage and buildings; Recreation; Tourist accommodation and catering; rural crafts; hire work; other miscellaneous receipts and green technology. Subsidies are included in the total revenue or sales, as the majority of these are structural and these are taken into account for the calculation of the Farm Business Income.
- Assets the sum of the current assets and fixed assets at closing value. They include the closing value of crops, trading livestock, breeding livestock, liquid assets, stores, and fixed assets such as total landlord-type capital (agricultural land, woodland, all buildings and the milk quota and any improvements done such as drainage, works and services) plus glasshouses, permanent crops and machinery, miscellaneous business assets, other quotas and entitlements to the Single Payment Scheme. Land is valued at market price (estimate) and Liquid assets are cash in hand and cash in bank, short term deposits and loans, any debtors including EU debtors. Accrued capital gains cannot be taken out of the value of the assets are they are not recorded in the FBS. This is a different approach than the one used by Mishra et al (2009).
- Equity is calculated by deducting the closing value of the total liabilities from the total assets closing value. The total liabilities are the sum of the closing value of the loans (mortgage, building societies, bank term loans, other institutional and other loans) and current liabilities such as hire purchase, leasing creditors, bank overdraft and other.

2.3. Relevant research on financial performance and management

2.3.1. Methodology: an adjusted systematic review

A multitude of studies have been undertaken linking management with financial health in the agricultural industry and in others. According to Van de Ven (1992) teleology, organisations have a purpose i.e. they know where they would like to go and are adaptable to change i.e. they plan and undertake actions to reach their goal. Formal strategic planning fits into this, as it allows organisations to set goals, develop strategies and evaluate alternative options to reach those goals.

There are advocates and opponents to the concept of strategic planning. For example, Hamel (1996) and Mintzberg et al. (1998) believe that strategic planning leads to inaccurate strategies as it is based on incorrect forecasts, and that it drives out innovation as companies do not adapt to change but instead follow the plan. Others (Ansoff, 1991; Grant, 2008) are of the opinion that strategic planning is a useful tool as it not only leads to better performance but also allows a company to map out their actions in more difficult environments. Empirical research has shown that there is an evidence base for the opponents and advocates of strategic planning. In order to analyse these studies, a thorough literature review was undertaken, based on the concept of systematic review.

A systematic review is a methodical assessment of literature published around a certain research question, focusing on the identification of studies, the assessment of whether or not to include them, and the summary of findings, in order to inform the effect and impact of an intervention on an event (Hunter et al., 1982). It is built up of several steps, including setting up the inclusion and exclusion factors for studies, defining what sources to include in the research, and can be built up into several rounds to improve efficiency. For example, in the first review round, only abstracts are read to decide on whether or not to retain the study, followed by an in-depth examination of the publication to confirm rightful inclusion into the database. In general, a team of researchers carry out a systematic review to reduce the selection bias, and come to a consensus score.

Several researchers have carried out a meta-analysis such as Boyd (1991); Miller & Cardinal (1994a, 1994b); Pearce et al. (1987a); Pearce et al. (1987b); and Schwenk & Shrader (1993).

Only Boyd (1991) concludes that the effects of planning are not clear – all others identify a positive link between undertaking management practices and financial performance. The most extensive systematic review in this field however, was carried out by Capon et al. (1990) who reviewed 320 studies published between 1921 and 1987 in order to assess the determinants of financial performance. They found that industry, strategy and organisation had a significant effect on financial performance (the environmental variables); whereas firm size, ownership, marketing expense, industry diversification, inventory, price and approach to sales (consumer versus industrial sales) had no significant effect (Figure 2-7).

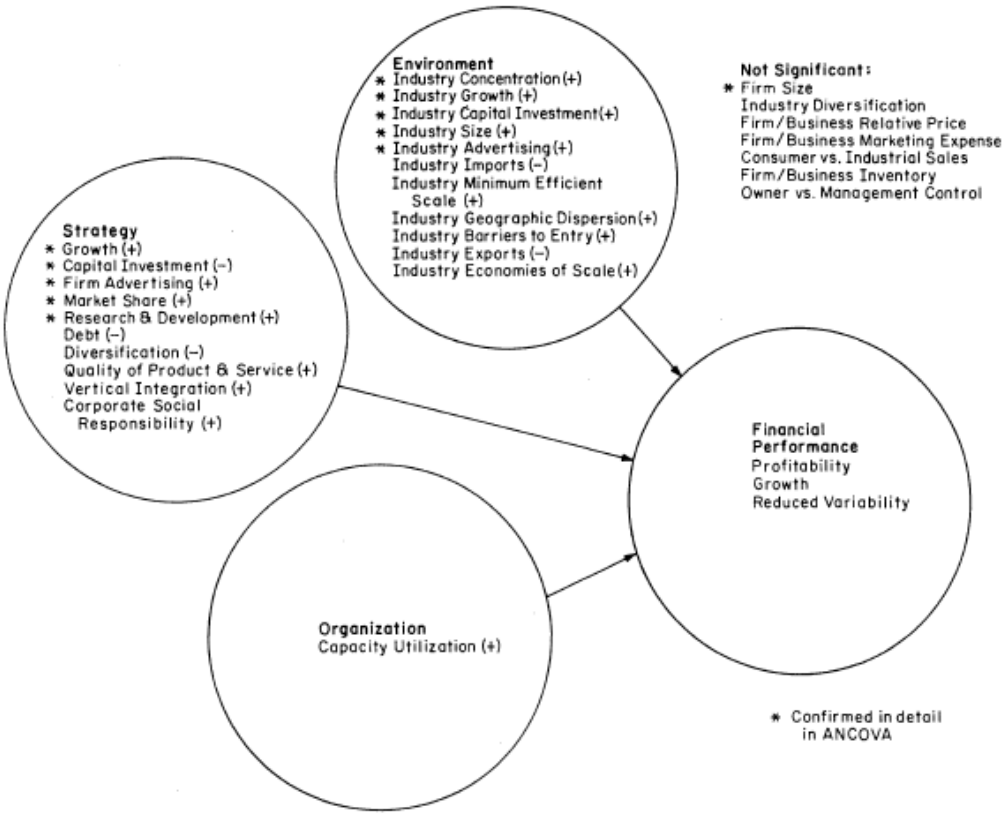


Figure 2-7: Overview of the determinants of financial performance

Source: Capon et al. (1990, p. 1156).

As Capon et al.'s 1990 study was quite extensive, looking at environmental, strategic and organisational factors that affect financial performance, the intention was not to repeat their study, but to set up a framework that focuses specifically on the research questions for this thesis, and not on all determinants of financial performance. A systematic review was not conducted in its truest sense due to resource constraints; however, some aspects of the systematic review methodology were borrowed. Figure 2-8 shows the process followed.

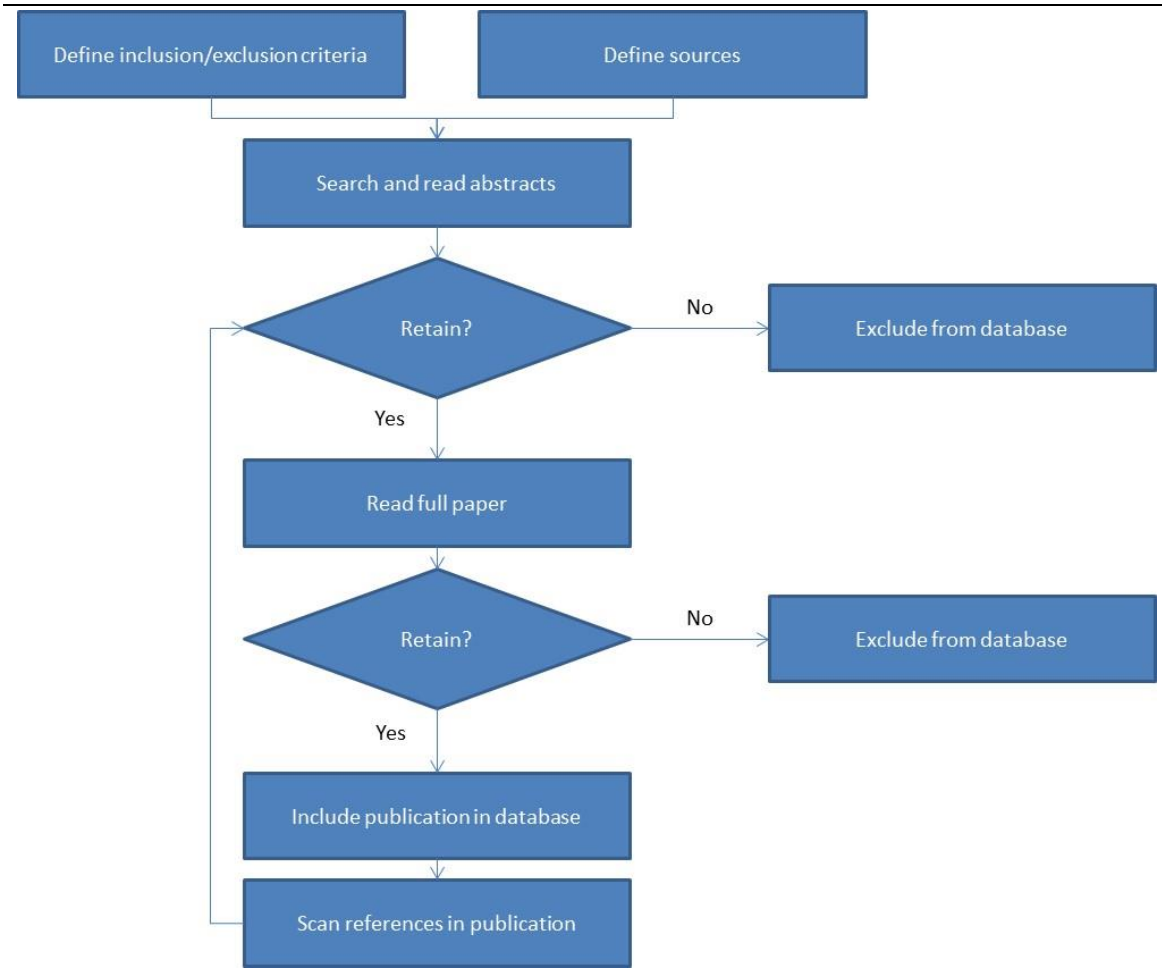


Figure 2-8: The adjusted systematic review process used here

The inclusion and exclusion criteria for studies/ publications for the systematic review were:

- Types of studies: only studies that evaluate the impact of management practices on financial performance have been included. Studies that describe management practices but do not report on impact or outcomes were excluded. They have however been used to inform the definitions used above.
- Types of interventions: studies that consider the impact of management practices
    - Planning, including the level of formality associated with the plan
    - Benchmarking, within the own organisation and outside
    - Knowledge management, including knowledge acquisition (education level), knowledge sharing and responsiveness to knowledge
- Geographical spread: although the focus is on England and Europe, studies that consider management practices and financial performance in America, Australia and New Zealand have been included, as the management practices used there are comparable to the ones

used in England and Europe. Studies from the developing world have been excluded as farm management systems are less comparable to the practices used in the UK.

- Publication date: studies published from 1960 till 2015 are included.
- Sectors: studies that describe the impact of management practices on financial performance in non-agricultural sectors have been included, in order to allow for a comparison of the use of practices to be taken up.

The literature search used databases of scientific journals such as the Journal of Finance, the Journal of Agricultural Economics, the American Journal of Agricultural Economics, large publishers such as Elsevier, Springer, Wiley-Blackwell, Taylor & Francis, and by using Google Scholar, on the terms "management" AND "performance" and "planning" AND "financial performance". Even though the main focus was to look for articles linked with the agricultural industry, articles covering other sectors were included as well.

All studies were assessed, and the ones that matched the inclusion criteria were taken up in an evidence database. This database contained:

- The studies (name of authors, year, journal and title);
- Data source (sector);
- Financial measure used;
- Impact of planning practice: key findings

References that were used in the included studies were scanned and if they were suitable, were taken up in the database. All meta-analyses were taken out of the search in order not to double-count findings. Instead, the references in the meta-analysis were logged and reviewed.

2.3.2. Results of the review

The results of the systematic review can be analysed qualitatively or quantitatively.

Counting, one of the quantitative methods, is based on taking note of the signs of the relationships between explanatory variables and the dependent variable – positive, negative or not statistically significant – and analysing what the research has said to date. The results of each individual study is captured in a database, and then analysed to show whether there is a significant positive or negative effect of the independent variable on the dependent variable

using binomial sign tests. A binomial sign test assesses the probability of one option being chosen over another one. In this case, there are three options: a positive, statistically significant effect; a negative, statistically significant effect; and no statistically significant effect. However, having no statistically significant effect is counted as 0 and are excluded from the binomial sign test, making the equation (Suhov & Kelbert, 2005):

$$\Pr(Y = C) = \binom{N}{C} x\, P^{C} x\, (1 - P)^{N-C};$$

with $\binom{N}{C} = \frac{N!}{C!(N-C)!}$, $\mu_y = NxP$ and $\sigma_y = \sqrt{N\ xP\ x\ (1 - P)}$

The Ancova method, another quantitative method, is based on identifying how the results were affected by the research framework. It takes into account size of the effect as well.

Due to the large variation in research, the counting methodology was preferred as it is simple, robust and flexible to use, even though it does not show the size of the relationship. Given the inclusion criteria mentioned above (e.g. the inclusion of different sectors) and the issues identified with ratio analysis previously, estimating size effects would not be correct. Some qualitative observations are discussed in the section below as well.

In total, 102 studies were retained for this research, coming from the sectors as shown in Table 2-3. It has to be noted that within the agricultural industry, the evidence is mainly from the U.S.A., indicating that there is a gap in this domain in England and Europe.[6] Other sectors were included as well, to complete the assessment.

Table 2-3: Sources for studies selected for the Meta - Analysis

Source	No of studies
Agriculture	10
Banking	10
Care and non-profit	3
Electronics, IT and Technology	4
Manufacturing	25
Retail	3
Tourism	2
Various (i.e. several sectors taken into account, such as the Fortune 500 Companies)	45

[6] Note that the studies from Defra and RBR on management practices were left out of the review, as this research uses the same dataset of farm businesses.

The results of the counting methodology can be found in Table 2-4. The results show that most research reported a positive effect of management practices compared to very few that reported negative effects. The difference is statistically significant, showing that empirical evidence points to a positive link between management practices and financial performance.

Table 2-4: Counts of signs of explanatory variables on financial performance

Independent variable	Number of studies	Number of studies with positive relationships	Number of studies with negative relationship	Number of studies with no statistically significant effect	Significance test of proportion (z-score)
Business planning and benchmarking	102	74	4	24	7.9259***

Notes:
1. *** meaning statistically significant at the 1% level
   +: significantly more positive than negative relationships reported
   -: significantly less positive than negative relationships reported
   no: count of positive versus negative relationships not significant

Looking at the studies that have no statistically significant effect, or where the effect was negative, the majority of the researchers (e.g. Falshaw et al. (2005); Frederickson & Mitchell (1984); Frederickson (1984); Powell (1992); Priem et al. (1995); Rauch et al. (2000) and Rauch & Frese (1998)) concluded that environmental uncertainty and hostility could result in planning not having an effect on performance. In unstable environments, managers need to be more flexible, willing to adapt to change and deviate from the plan.[7]

In addition, Table 2-5 shows how many studies out of the total are applying the ratios that are taken up in the DuPont Expansion model. Even though none of the studies report on all five indicators, there are some that utilise the profitability indicators. Compound Leverage Factor is used only by Dunaway (2013), who combined it with other indicators to assess the financial performance of Kentucky crop farms versus other farms. None of the other studies reported on it. Similarly, Asset Turnover is used only by Argilés & Slof (2003), who found that using financial statements has a positive effect on this indicator.

[7] The dataset did not capture an indicator that measures turbulence (see further). To overcome this issue, the means per ratios for the year 2011/12 were verified against the means per ratio for the period 2008 to 2013. As Annex 2 shows, 2011/12 was a better than average year for most ratios (RoS, RoA and RoE), indicating there is no environmental hostility. It was therefore not included in the conceptual framework.

Table 2-5: Counts of financial performance indicators

Dependent variable	Number of studies (% in brackets – total number of studies considered is 102)
Return on Sales	10 (9.80%)
Return on Assets	30 (29.41%)
Compound Leverage Factor	1 (0.98%)
Return on Equity	21 (20.59%)
Asset Turnover	1 (0.98%)
Perceived Performance (i.e. performance measured subjectively through a survey)	29 (28.43%)
Multiple year ratio (e.g. sales growth)	35 (34.31%)
Other indicators – mainly absolute figures such as revenue and net profit	17 (16.67%)

Some observations need to be made however on the research that was retained for the review. First of all, there is a lack of consistency within the research, as mentioned by among others: Boyd (1991); Bracker & Pearson (1986); and Greenley (1984):

- Very few studies use identical indicators in their analysis – be it management practices or financial performance indicators - and conceptual frameworks differ. This causes difficulties in comparing the findings across various studies.
- Also, methods to analyse the data varied widely: several researchers use correlation analysis (e.g. Hart & Banbury (1994); Hopkins & Hopkins (1997); and Pearce et al. (1987)), others use multiple linear regression (e.g. Andersen (2000); Gul (1991); and Whitehead & Gup (1985)) and again others use t-tests or ANOVA (e.g. Ansoff et al. (1970); Ghobadhian et al. (2008); and Kallman & Shapiro (1978)) to check the relationship between the indicators.

In addition, there is a lack of definitions, again for management practices and financial performance indicators. It is unclear how some financial measures are calculated, and how the management practices are applied in the firm. This can result in heterogeneous data and an incorrect interpretation of results. Also, sample size varies, with for example Burt (1978); Grinyer & Norbum (1975); and Herold (1972) using samples with less than 30 observations, and Argilés & Slof (2003); Ford & Shonkwiler (1994); and Gershefski (1970) using large datasets (over 200 observations).

Finally, it has to be noted that a lot of authors used the same set of articles to build upon, indicating a narrow evidence base.

2.4. Conclusion

The literature review on management practices and financial performance has allowed the development of a conceptual framework for the research reported here.

The empirical evidence from the literature review on the impact of management practices on financial performance shows a positive, statistically significant effect of management on financial performance. In addition, the literature review on financial health indicates that the ratios as identified in the DuPont Expansion model, could be a valuable method to measure the financial performance of the agricultural industry in England.

The conceptual framework, as shown in Figure 2-9, is built on six hypotheses:

- Hypothesis 1: Greater use of business management practices leads to better financial performance;
- Hypothesis 2: Knowledge acquisition has a positive effect on financial performance;
- Hypothesis 3: Experience has a positive effect on financial performance;
- Hypothesis 4: Good IT skills has a positive effect on financial performance;
- Hypothesis 5: Size has a positive effect on financial performance, and
- Hypothesis 6: Depending on the financial performance ratio that is used, ownership will have a different effect.

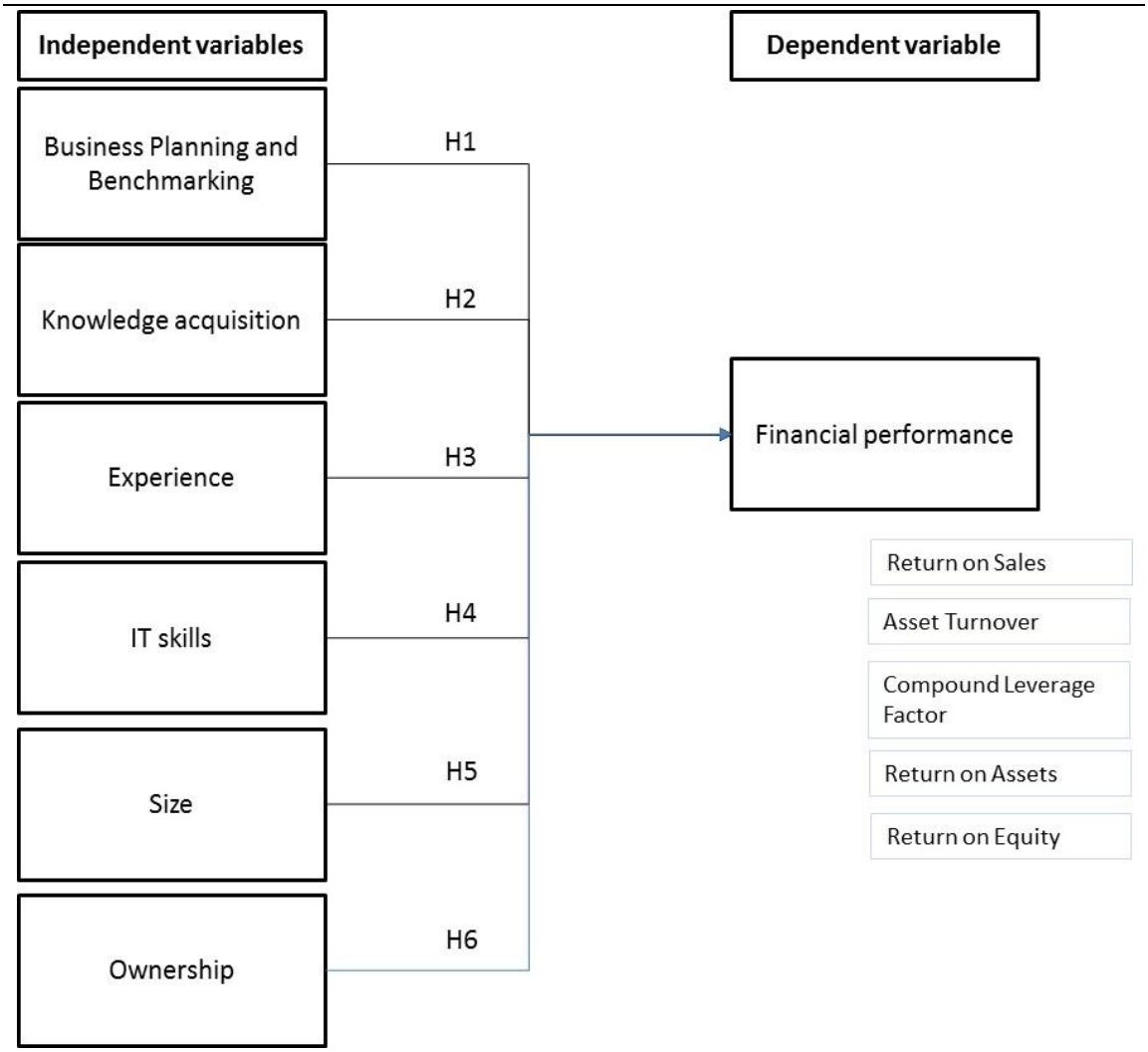
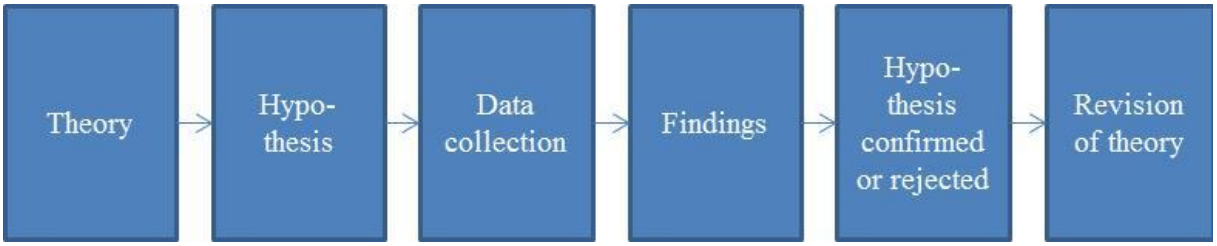


Figure 2-9: The conceptual framework used for this research

3. The research methodology

When research is undertaken, the researcher has to define how they view theory and the construction of knowledge, as it will determine how the research process is structured (Bryman, 2004). For this research, the deductive approach, where theory leads to the undertaking of research, is taken as opposed to the inductive approach where research and its findings leads to the development of theory. In terms of research process, Figure 3-1 shows the main steps taken in the deductive approach to research.

Figure 3-1: The deductive approach



Source: adapted from Bryman (2004, p.9).

Positivism allows the use of research methods from the natural sciences field for social sciences, contrary to interpretivism which believes that the study of people and institutions needs different methods than the ones used for natural sciences (Bryman, 2004). For this research, the researcher has taken the epistemological orientation of positivism, as the topic of financial health is linked more closely with natural and formal sciences than with the social sciences and humanities.

In terms of ontological standpoint, the position taken regarding the belief of what counts as knowledge and how this knowledge is constructed is the idea of objectivism. There is an objective truth that can be observed through research and it is independent of one's own consciousness and experience. This is contrary to the ideas of constructionism and realism where the interpretation of the individual and/or system influences the perception of knowledge (Bryman, 2004).

Given the deductive approach, the epistemological stance of positivism and the ontological standpoint of objectivism, quantitative research methods are usually used to answer the research questions.

3.1. The data source: the Farm Business Survey

The data source used for this research is the Farm Business Survey for England, which feed into the Farm Accountancy Data Network (FADN) of the European Union (EU).

Every year, all countries within the Union have to provide data on their agricultural sector so that the European Commission and the Member States can track the state of the agricultural sector in the FADN (EC, 2013a). In the UK, the Farm Business Survey (FBS) was developed in 1936. It contains information per farm in terms of practice, labour use, land area, production, finances and other.[8] A representative sample of farmers are contacted yearly to ask for their participation in the FBS data collection; participation is voluntary.

Rural Business Research, a consortium of universities and colleges, manages the FBS in England and six teams such as the Agricultural Food and Investigation Team (AFIT) at the University of Reading, are responsible for collecting data on the farms in their area: providing support to these farmers; and giving feedback on the FBS to farmers. Every year, around 2,000 farms participate in the survey in England. The AFIT team at Reading is, for example, in charge of the South East and some parts of the South West and West Midlands. They also produce reports for Defra and for benchmarking purposes (AFIT, 2013).

The FBS covers a number of sections annually, the most relevant for this research being:

- General characteristics of the farm (section A), such as region, number of holdings within the farm, number of livestock and area;
- Miscellaneous receipts (section D1) and entitlements to the Single Payment Scheme (section D2)
- Costs that the farm incurred during the period the FBS refers to (section F1 and F2)
- An overview of assets, liabilities and net worth reconciliation (sections G1, G2, G3)
- Miscellaneous income from agriculture-related and integrated diversified activities (section I)

[8] There's also the Defra annual June survey, which contains more information about land use, Livestock numbers, output. The results of the June survey are captured on https://www.gov.uk/government/statistical-data-sets/structure-of-the-agricultural-industry-in-england-and-the-uk-at-june. The Farm Business Survey focuses on the collection of financial data.

- Enterprise output, variable costs, gross margin (section M1), fixed costs and net margin (section M2)
- Section H4 calculation of Net Farm Income and Farm Business Income.

The data is collected per fiscal year; with every farm having a farm business number.

Additional sections are included on an ad-hoc basis, focusing on a specific topic. In 2011/12, for example, farmers participated in a survey on the use of management practices. Questions were asked about among others what business planning and benchmarking practices farmers used, what their education level was, what IT skills they possessed, how they accessed advice and whether they were a member of a Continuing Professional Development Scheme (CPD).

3.2. The financial performance of farm businesses in England

3.2.1. Introduction

To provide an overview of the current financial performance of farm businesses in England and answer research question three "What is the current situation for farm businesses in England in terms of financial performance?", two datasets were downloaded from the FBS. The first one was a balanced panel from 2008/2009 ending with 2012/2013; the second one was a dataset containing farm data for the year 2011/12. This was done to get insight into the overall financial performance of the sector for five years, but additionally to understand the financial situation for one year i.e. the year that the farms participated in the management practice survey.

The first dataset, therefore, contains farms that participated in the FBS over five consecutive fiscal years. In order to achieve this, the list with farm numbers of year 2008/2009 was compared with the list of 2009/2010 and subsequently with all following years. The data was then adjusted according to the following decisions:

- In terms of area, all farms outside England were excluded as different subsidy rules apply in Wales, Scotland and Northern Ireland.
- In terms of farm type: all non-classified farms were excluded.
- Pig farms, Poultry farms and Horticultural farms were excluded from the dataset as the farms that participate in the FBS classified under those farm types are likely not to be fully representative of their sector. Additionally, General Cropping farms and Mixed farms were taken out as their inclusion would have made the analysis procedure too complicated.

Table 3-1 provides an overview of the final dataset of 431 farms, consisting of 75 Cereal farms, 159 Dairy farms, 108 LFA Grazing Livestock farms and 89 Lowland Grazing Livestock farms. There are 165 farms located in West England, 128 in East England and 138 in North England. While Cereal farms and LFA Grazing Livestock farms are grouped in one region mainly (East England for Cereal farms and West England for LFA Grazing Livestock farms), the Dairy farms and Lowland Grazing Livestock farms are more evenly spread out throughout England.

Table 3-1: Overview dataset, 2008 to 2013

Overview data per farm type and region	West England	East England	North England	Total
Cereals	13	53	9	**75**
Dairy	55	30	74	**159**
LFA Grazing Livestock	77	9	22	**108**
Lowland Grazing Livestock	20	36	33	**89**
Total	**165**	**128**	**138**	**431**

Source: calculated from Farm Business Survey 2008-2013.

The second dataset contains data for the year 2011/12, also downloaded from the FBS. Using the same criteria applied to the dataset 2008/2013, this dataset contained 862 farms, split over four farm types (Table 3-2). There are 233 Cereal farms, 228 Dairy farms, 170 LFA Grazing Livestock farms, and 231 Lowland Grazing Livestock farms. As with the dataset 2008/2013, most Cereal farms can be found in East England, and most LFA Grazing Livestock farms in North England.

Table 3-2: Overview dataset, 2011/12

Overview data per farm type and region	West England	East England	North England	Total
Cereal farms	38	156	39	**233**
Dairy farms	104	55	69	**228**
LFA Grazing Livestock farms	48	18	104	**170**
Lowland Grazing Livestock farms	104	86	41	**231**
Total	**294**	**315**	**253**	**862**

Source: calculated from Farm Business Survey 2011-2012.

Financial data was downloaded for the dataset; and Profit and Equity were calculated. The detailed definitions are described in Annex 1. The sections below contain the methods used to analyse the data, and understand the financial performance of the agricultural industry in England. The results of the analysis can be found in Chapter four – results part one.

3.2.2. Assessing whether the DuPont expansion model is the correct method to use

The ratios used in the DuPont Expansion Model, as well as for fourteen of the "sweet 16" ratios were calculated for the year 2011/12. These are:

- Liquidity ratios:
    - Current ratio: Current farm Assets/Current farm Liabilities
    - Working capital: Current farm Assets – Current farm Liabilities
- Solvency ratios:
    - Total Liabilities/Total Assets
    - Equity/ Total Assets
    - Total Liabilities/Equity
- Profitability ratios:
    - Return on Sales: Profit/ Total Sales
    - Return on Assets: Profit/Total Assets
    - Return on Equity: Profit/Equity
    - Profit: Farm Business Income minus Unpaid Labour
- Financial efficiency indicators:
    - Asset Turnover: Total Sales/Total Assets
    - Operating Expense ratio: (Operating Expenses – Depreciation)/Total Sales
    - Interest Expense ratio: Interests/Total Sales
    - Depreciation Expense ratio: Depreciation/Total Sales
    - Net farm income from operations ratio: net farm income from operations/Total Sales

The two ratios that were not calculated are term debt and capital lease coverage ratio, and capital replacement and term debt replacement margin, both repayment capacity indicators, as the level of detail needed for the correct calculation and interpretation of these ratios was incomplete. Nevertheless, as Chapter four will show, indebtedness within the sector is low, leading to the assumption that these ratios will not influence the assessment of whether the DuPont Expansion model is relevant to analyse the financial performance of the agricultural industry in England.

The detailed definitions of the indicators above and the codes used to extract the data from the FBS, can be found in Annex 1, and are summarised as follows:

- Profit is calculated as Farm Business Income minus unpaid labour, allowing for a comparison across all farms regardless of ownership status or managerial labour;

- Total Sales is the sum of all enterprise outputs plus miscellaneous income from agriculture related and integrated diversified activities;
- Total Assets is the sum of the current assets and fixed assets at closing value; and
- Equity is the result of deducting the closing value of the total liabilities from the total assets closing value.

Once the ratios were calculated, a correlation analysis was carried out to check if there is a linear relationship between variables, as applied by Andersen (2000) and Martínez-Solano & García-Teruel (2006) and as evidenced by Barnes (1987) in his review of financial ratio analysis. The method to be used is as follows (Thompson, 1984):

- Assuming the variables are jointly normally distributed, a Pearson's correlation coefficient of above 0.6 (or below –0.6), shows that both variables move in the same (or opposite) direction.
- If variables are not normally distributed, the Spearman Rank Correlation Coefficient is used.

This method will allow the assessment of whether the ratios proposed in the DuPont Expansion model have links with the sweet 16 list, and see whether the DuPont Expansion model is an appropriate method to assess the financial performance of the agricultural industry in England.

3.2.3. Understanding the financial performance of the industry

As correlation analysis does not establish cause- effect relationships, and we want to acquire insight in the current situation for farm businesses in England in terms of financial performance (research question three), the data was analysed in several ways. In a first step, descriptive statistics were used. A central tendency indicator (the mean) as well as indicators of dispersion (variance and standard deviation) were calculated for all farm types.

Second, in order to understand the trends, graphs were made to show the fluctuation of the ratios, and financial data, this for the period 2008 to 2013, and for the year 2011/12. Graphs were designed for all five ratios in the DuPont Expansion model as well as for average profit, sales, costs, Farm Business Income and unpaid labour; as well as for average assets, equity and debt. Using the dataset 2008 to 2013, a comparison between the farm types over the years was done, based on the mean ratio per farm type. This evened out any short-term fluctuations that

were recorded in farm profitability (e.g. when stocks are not sold in one particular year), asset base or equity.

For the year 2011/12, revenue, costs and profit, as well as assets and liabilities were visually represented per farm type, showing whether there is a large variation within each farm type or not.

3.3. The link between management practices and financial performance

3.3.1. Introduction

For the year 2011/12, a module was added to the FBS in which farmers had to answer questions related to business management practices. Farmers received a list of options per category of management practices, and had to indicate which practices they use. For example, under business planning and benchmarking, there are eight options, and farmers could select none, one or more of the practices.

In the FBS, every option received a unique code to allow for combinations of practices to be recorded. For example, a code "8" under business planning, benchmarking and management meant that the farmer used formal planning, but not any other practices, while a code "24" meant that the farmer used formal planning and cash flow planning but not any other practices.

A list of variables was downloaded from the FBS 2011/12 and used in combination with the financial data and ratios as calculated above. The detail can be found in Annex 1.

In a first step, the management practice variables were unpacked into their binary counterparts, in order to understand how each practice was applied on the farm. Subsequently, the variables that were selected for this research and are part of the conceptual framework were retained. Variables that were not included in the conceptual framework (such as informal planning) were discarded from the dataset. Finally, some interaction variables were calculated, to understand the extent to which certain practices are used in combination on the farm. They are cash flow planning and formal planning; formal planning and benchmarking; and cash flow planning, formal planning and benchmarking.

The results of the methods described below are described in Chapter five for all farm types together. It starts with an overview of how the management practices that are analysed in this research, are applied to the four farm types: Cereal farms; Dairy farms; LFA Grazing Livestock Farms; and Lowland Grazing Livestock farms. In addition, the data is analysed in two ways: first, a comparison between low and high performers is made in terms of how they apply management practices on their farm. Second, the size of the effect or impact of applying management practices is estimated using regression analysis.

In addition, Annex 4 contains the analysis carried out per farm type, i.e. the comparison between low and high performers, and the regression models for the four ratios, and addresses the comment that adding various sectors together leads to incorrect conclusions. The results are different, due to the fact that the sample size is a lot smaller as the dataset is divided per farm type. For example, the regression analysis for the interaction effects are not always statistically significant from zero, and often shows a low R-squared. However, the results support the analysis and discussion in Chapter five, even for each farm type, despite the fact that some effects are less strong.

3.3.2. Assessing the difference between low and high performers

In order to understand whether there are differences in the application of management practices between low performers and high performers, statistical tests can be applied, as done by, for example, Anderson & Sohal (1998); Baker & Leidecker (2001); Little et al. (2009) and Wilson et al. (2013). The difference in the various tests available is as follows (Carter-Hill et al., 2011):

- The t-test is used to test the difference in means between two groups. The dependent variable is assumed to be normally distributed, the observations are independent and there is homogeneity of variance;
- ANOVA is used to test the difference in means from three or more groups. It does, however, not show which groups are different. The dependent variable is assumed to be normally distributed, the observations are independent and there is homogeneity of variance;
- If the dependent variable is not normally distributed, the non-parametric Kruskal-Wallis H test can be used to test the difference in means; and,
- If there is no homogeneity of variance, Welch F-test or the Brown and Forsythe test can be used. Alternatively, the non-parametric Kruskal-Wallis H test can be used.

- If the dependent variable is not normally distributed and there is no homogeneity of variance, the Welch t-test is used even though it violates the normality assumption.

Per farm type, for each ratio, the top 25% and bottom 25% performing farms were selected. These were then put together into one dataset, and tested for the assumptions as set out above. Depending on the outcome of the assumption tests, a different test was applied, to see if there are statistically significant differences in the use of management practices and characteristics between low and high performers.

3.3.3. Assessing the size of effect of management practices on financial performance

In a second step, a regression model was set up in order to assess the magnitude of the impact of these practices on financial performance, following the classical equation structure:

$$Y = \beta_0 + \sum_{i=1}^{K} \beta_{ij} X_{ij} + \varepsilon_i$$

with Y being the independent variable, β_0 the intercept with the Y-axis, X_{ij} the independent variables, β_{ij} the parameters and ε the error terms.

The purpose of a regression analysis is to estimate relationships between variables. It is often applied to predict or forecast outcomes and/or effects of events. The econometric model used to link management practices and financial performance can be specified with the following equation:

$$FPI_i = \beta_0 + \sum_{i=1}^{K} \beta_{ij} X_{ij} + \varepsilon_i$$

Where FPI_i is the financial performance indicator for farm i and $FPI_i \in \{RoS_i, ATO_i, RoA_i, RoE_i\}$; X_{ij} are the explanatory variables such as formal business planning, cash

flow planning, benchmarking, education, accessing advice, size, tenure, age and having a working spouse[9]; β_{ij} are the coefficients to be estimated; and K is the number of coefficients.

There are several econometric models that can be used for this study (Carter-Hill et al., 2011). When the dependent variable is limited (binary, categorical or ordered), discrete choice models need to be used such as:

- The probit and logit model, which is used when the dependent variable takes only two values (0 or 1) – this is the case when the farms would for example be classified in successful/unsuccessful categories, and the regression would be run on this categorisation (e.g. top 50% and bottom 50% of the sample);
- The multivariate probit model, which estimates the joint relationship between several dependent variables and independent variables; and
- Ordered probit/logit model, which is used when the independent variable has more than 2 options - which would be the case if the ratios are classified into categories (for example 20% percentiles or 5 categories).

When the dependent variable is continuous, there are, among others, the following options:

- Simple linear regression, when there is only one independent variable;
- Multiple linear regression, when there are at least 2 independent variables; and
- Tobit (Heckit) model, when the dependent variable is truncated.

The section below describes the model used in this research, namely a multiple linear regression model, as the dependent variable is continuous and not truncated and there are several independent variables. The discrete models were tested, and rejected as too much of the detail was lost with the conversion of financial performance to successful and unsuccessful farms, resulting in models with few significant variables. For RoS, RoA and RoE, a multiple linear regression model was estimated, as the ratios are continuous and there are several independent variables. For ATO, the lower limit of the data is 0, as sales are generally not negative. This data is, however, not truncated or censored, so a multiple linear regression model is also appropriate for use.

[9] See Chapter 5 for more detail on what variables are retained for the research.

3.3.4. The multiple linear regression model

There are six assumptions underpinning the multiple linear regression model (Carter-Hill et al., 2011):

1. There is a linear relationship between the dependent variable and independent variables[10]:

$$y = \beta_0 + \sum_{ij}^{K} \beta_i x_{ij} + e_i$$

2. The expected value of the error term is 0 (exogeneity):

$$E(e) = 0 \leftrightarrow E(y) = \beta_0 + \sum_{ij}^{K} \beta_i x_{ij}$$

3. The variance of the error term is constant (homogeneity of variance or homoscedasticity):

$$var(e) = \sigma^2 I_n = var\ (y)$$

with I_n a n x n identity matrix.

4. The covariance between errors is zero – the errors of one observation are not correlated with the errors of other observations (independence or not correlated):

$$cov(\ e_i, e_j) = cov\ (y_i, y_j) = 0$$

5. The variables x_{tK} are not random, and are not exact linear functions of the other explanatory or independent variables (no linear dependence or collinearity)

6. The values of ε are normally distributed about their mean: $e \sim N(\ 0, \sigma^2)$

[10] If a non-linear relationship exists, transformation of the dependent and/or independent variables is sometimes feasible in order to achieve a linear relationship. These include a log-log model, a log-linear model and a linear-log model, where either the dependent and/or independent variables are transformed.

If the assumptions stated above hold, the estimation of the parameters is based on the ordinary least squares (OLS) principle that minimises the sum of squared residuals, resulting in the best linear unbiased estimators (BLUE) of the parameters β, calculated with the following formula:

if $SSE = \sum_{i=1}^{N} \hat{e}_i^2$ and $SSE^* = \sum_{i=1}^{N} \hat{e}_i^{*2}$ then $SSE < SSE^*$

$$\hat{\beta} = (X'X)^{-1}X'Y$$

with SSE being the sum of squares due to the error, and $\hat{\beta}$ the best linear unbiased according to the Gauss-Markov theorem (Carter-Hill et al., 2011).

When the variance of the errors is not constant (there is heteroskedasticity) or when the errors are correlated, resulting in a violation of the assumptions mentioned above, parameters can be estimated through the Generalised Least Squares (GLS) method (Cameron & Trivedi, 2010):

$$V(e|X) = \sigma^2\Omega$$

With Ω being a symmetric, positive definite n x n matrix. In this case, the Gauss-Markov theorem does not hold anymore, and the estimated β are inefficiently estimated, even though they are unbiased.

The GLS method will overcome this issue, and will result in efficient estimates, with smaller standard errors and larger t-statistics:

$\widehat{\beta_{gls}} = (X^{*\prime}X^*)^{-1}X^{*\prime}Y^* = (X'\Omega^{-1}X)X'\Omega^{-1}Y$

When Ω is equal to I_n, then $\widehat{\beta_{gls}}$ will be equal to $\hat{\beta}$.

Special cases of GLS are weighted least squares (WLS) or feasible generalised least squares (FGLS). When there is heteroskedasticity present in the model, but no correlation between the errors, WLS is used; while FGLS when there is heteroskedasticity and serial correlation (Greene, 2003).

Goodness of fit of the model is tested with R-squared (R^2), which indicates how much of the variation in the sample is explained by the regression model:

$$R^2 = \frac{\sum(\hat{y}_i - \bar{y})^2}{\sum(y_i - \bar{y})^2} = 1 - \frac{SSE}{TSS}$$

with TSS the total sum of squares for y and SSE the sum of squares due to the residuals. When none of the variance in the dataset is explained by the model, the R-squared is 0; while an R-squared of 1 means that the model is a perfect fit (all variance in the sample is explained by the model). The rule, therefore, is the higher the R-squared, the better.

Measuring goodness of fit can also be assessed through Aikake's Information Criterion (AIC) and the Bayesian Information Criterion (BIC), when the R-squared is not available, and as there are issues with the interpretation of Pseudo R-squared calculations (Williams, 2015). They allow for a comparison between different model estimates instead of generating the absolute deviation of observed data in a model.

They are calculated as follows:

$$AIC = DEV_M + 2P$$

and

$$BIC = DEV_M + \ln(N) * P$$

with P being the number of estimated parameters, N the number of observations, and DEV_M is equal to $-2 *$ the log-likelihood of the model (LL_M). For both criteria the rule is the smaller the result, the better the fit.

3.3.5. Seemingly Unrelated Regressions (SUR)

Another model that can be used is the Seemingly Unrelated Regressions (SUR) model (Greene, 2003). With this model, a number of linear regressions is estimated simultaneously, using OLS and GLS in a two-step calculation. However, if the errors are not related between equations, and if the independent variables are the same in all equations, the SUR model will generate the same results as the OLS, which is the case in this research. Therefore, we have used the multiple

linear regression model, in order to represent the effect of management practices on each financial performance indicator separately and in turn.

3.3.6. Considerations to be made with all models

There are certain things one needs to look out for when estimating linear regression models:

1. Non-normality of the dependent variable;
2. Non-linear relationships between the independent variables and the dependent variable;
3. Heteroskedasticity, and the need to maybe transform variables, or a use robust estimation;
4. Collinearity or multicollinearity; and
5. Endogeneity.

The first assumption of the linear regression model is that the dependent variable is normally distributed. If the dependent variable is not normally distributed (i.e. it is skewed, there are substantial outliers and/or there is kurtosis), the relationship and significance tests can be distorted. Research by, among others, Jondeau et al. (2007) has shown that *empirical distributions of asset returns have tails thicker than those from a normal distribution and appear to be negatively skewed* (Jondeau et al., 2007, p. 3).

Dependent variables can be transformed to achieve the normal distribution. Options include cube root, square root or inverse. In the case of financial performance, it has been suggested by Buijink and Jegers (1986) that using cube root is the best method for the transformation of ratios, as returns can be negative and as this helps to reduce right skewedness. It is, however, less strong than the logarithmic transformation. Logarithmic transformation is, however, not applicable to negative numbers and 0, and in the sample, there are several observations that have negative returns, which is not untypical for the agricultural industry to make losses some years.[11]

All ratios were visualised, and tested for normality and symmetry. Outliers in the dataset were inspected in more detail, and a judgement was made as to which ones should be removed to reduce type I and type II errors, and improve the estimates (Osborne & Waters, 2002).

[11] More details on the dataset can be found in Chapter 3 the research methodology, and Chapter 4 Results Part 1.

The second assumption is about the linear relationship between variables. When relationships between variables are non-linear, there are methods available to transform variables to achieve a linear relationship. Table 3-3 gives an overview of the most commonly used methods.

Table 3-3: Methods to transform variables

Method	**Transformation**	**Regression equation**	**Predicted value ($\widehat{y}$)**
Standard linear regression	None	$y = b_0 + b_1x$	$\hat{y} = b_0 + b_1x$
Exponential model	Dependent variable = log(y)	$\log(y) = b_0 + b_1x$	$\hat{y} = 10^{b_0 + b_1x}$
Quadratic model	Dependent variable = sqrt(y)	$\text{sqrt}(y) = b_0 + b_1x$	$\hat{y} = (b_0 + b_1x)^2$
Reciprocal model	Dependent variable = 1/y	$1/y = b_0 + b_1x$	$\hat{y} = 1 / (b_0 + b_1x)$
Logarithmic model	Independent variable = log(x)	$y= b_0 + b_1\log(x$	$\hat{y} = b_0 + b_1\log(x)$
Power model or log-log model	Dependent variable = log(y) Independent variable = log(x)	$\log(y)= b_0 + b_1\log(x$	$\hat{y} = 10^{b_0 + b_1\log(x)}$

Source: StatTrek (2016).

The errors were plotted to see if they showed a non-linear pattern, and if so, various options were tested to see if the variables (dependent and independent) needed to be transformed.

The third assumption related to heteroskedasticity, which occurs when the variance of the errors is not constant across the observations. There are several cases when heteroskedasticity is present (Williams, 2015, p. 1-2):

- *when the value of the independent variables increases* i.e. when the variability of the independent variable is large*;*
- *when the value of the independent variable becomes more extreme in either direction;*
- *when there are errors in measurement;*
- *if there are subpopulation differences or other interaction effects;* and
- *when there are other misspecifications in the model,* for example, when the model should have been transformed into a log-linear model.

Heteroskedasticity will result in biased standard errors but not in biased, or inefficient, coefficients.

The easiest way to verify the presence of heteroskedasticity is by plotting the residuals that are generated from the model estimate against the observed data. When the plot does not show random fluctuations around 0, i.e. there is a pattern in the plot, there is heteroskedasticity. There are, however, also several tests that will point to it. The most frequently used are the Breusch-

Pagan/Cook-Weisberg test and the White test. A statistically significant result on the Breusch-Pagan/Cook-Weisberg test points to the existence of linear forms of heteroskedasticity (Carter-Hill et al., 2011). White's test on the other hand also verifies non-linear forms of heteroskedasticity. Both tests were applied to the model results.

If heteroskedasticity occurs, variables can be transformed in various ways such as the quadratic, logarithmic and root transformation. If transformation of variables is not possible, the model can be estimated with robust standard errors. When robust estimates are used, the assumption of independent errors and normally distributed errors is relaxed. The final option is to use weighted least squares. Williams (2015) is of the opinion however that one should use weighted least squares with caution as it is more difficult to estimate the weights that should be associated with the model.

The data used for this research was tested for heteroskedasticity in the model. If it existed, an analysis would be done on whether the variables could be transformed, whether robust standard errors should be used or whether weighted least squares was the best option.

The fourth assumption in linear regression models, concerns collinearity or multicollinearity. This occurs when the independent variables are highly correlated with each other or when they move together in systematically. This can result in insignificant coefficients, even when the R-squared of the model is high. Exact collinearity will result in a model that is not usable, and near exact will increase the standard errors associated with the coefficients (Carter-Hill et al, 2011).

There are several ways to identify collinearity, such as the existence of large R-squared and large standard errors in the model or the presence of pairwise correlation coefficients that are higher than 0.6. Another option is to calculate the Variance Inflation Factor (VIF). In general, values of 10 and above indicate collinearity, and it should be assessed whether variables can be dropped from the model (Carter-Hill et al., 2011).

The data used for this research was tested for collinearity and multicollinearity, and, if it existed, an analysis would be done to see which ones could be dropped from the equation or how they could be adjusted. Interaction effects between different independent variables were tested in separate model estimates, as done by Andersen (2000).

Finally, in applying the model, care will need to be taken to avoid endogeneity. This occurs in two instances, namely when there is an omitted variable that is correlated with the independent variable(s) and the dependent variable or error term; and when there is reversed causality, meaning that the dependent variable influences the independent variable(s). The estimated coefficients resulting from the regression model will be biased.

One method to resolve this issue is to use an instrumental variables regression (Wooldridge, 2010). It resolves bias from three situations: a) there is an omitted variable; b) there is simultaneous causation; and c) the independent variables are measured with errors in them. Instrumental variables regression is estimated using a two-stage least squares regression analysis. In a first step, the part of the independent variable that is uncorrelated with the error is estimated and the predicted values of that independent variable are calculated, followed by a second regression using the predicted values of the independent variable from the first regression:

$$X_{ij} = \pi_0 + \sum_{ij}^{K} \pi_i z_{ij} + v_i$$

$$Y = \beta_0 + \sum_{ij}^{K} \beta_i \hat{X}_{ij} + u_i$$

In financial performance research, endogeneity has been addressed in the studies undertaken by Martínez-Solano & García-Teruel (2006). They used independent variables that are endogenous to the model. For example, Martínez-Solano & García-Teruel (2006) believe there is endogeneity in their model, with accounts receivable, accounts payable and inventory affecting Return on Assets. Other researchers (for example, Deloof (2003) and Gloy & LaDue (2003)) mention endogeneity but do not address it in their research.

In this research, there has been no indication of endogeneity as an increase in the dependent variable (financial performance) will not necessarily influence the use of business planning and benchmarking, knowledge acquisition, experience and farm size. The model was however tested for endogeneity in the case of tenure, by reducing the regression against the endogenous variable and using the errors generated in the model to run the second stage regression. If the errors were significantly different from 0, there are signs of endogeneity.

3.3.7. Sequence of estimation of the regression models

Given the theory, the models were estimated in Stata 12, with the detailed procedure used for the regression analysis set out below in Figure 3-2. For each financial performance indicator, the model was run using OLS and GLS, and both were compared in terms of goodness of fit. The results of the model with the best fit can be found in Chapter 5 – results.

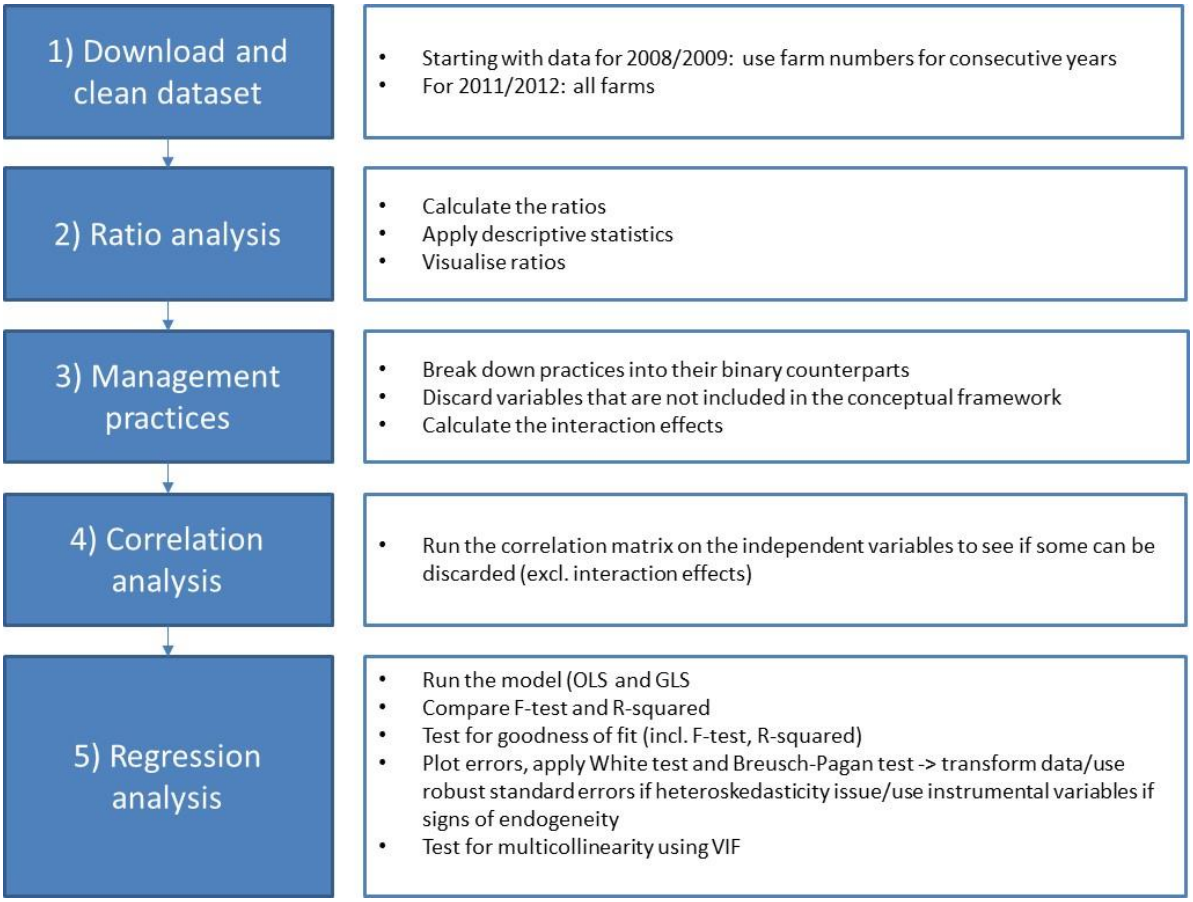


Figure 3-2: The steps in calculating the regression model
Source: adapted from Carter-Hill et al. (2011).

4. Results Part 1: the financial health of agricultural businesses in England

This chapter sets out the financial health of farm businesses in England. It gives insight into the performance of the industry from 2008 to 2013 and what the four study farm types (Cereal farms, Dairy Farms, LFA Grazing Livestock Farms and Lowland Grazing Livestock farms) have achieved in terms of financial sustainability. Additionally, insight will be gained on the 2011/12 dataset specifically, as this is used to assess the impact of management practices on financial performance (see Chapter 5). However, prior to investigating the financial performance of the industry, an analysis will be undertaken of the DuPont Expansion Model to see whether it is an appropriate method to look at financial performance. More specifically, Section 4.1 below will set out how the DuPont Expansion model is linked with the sweet 16 financial ratios. These are used in the agricultural industry in the U.S.A. frequently in order to assess the validity of the model in assessing financial performance.[12]

4.1. Linking the DuPont Expansion model with the sweet 16 ratios

Using the dataset 2011/12, 14 of the sweet 16 financial indicators were calculated. The repayment capacity ratios were left out of the analysis as the data was not available as it is not collected as part of the Farm Business Survey. Within the sweet 16, five ratios are part of the DuPont Expansion model, with Compound Leverage Factor being the inverse of the Equity/Asset ratio.

Table 4-1 sets out the results for the means and standard deviation of each variable, as well as presenting the desirable range for each indicator. Rural Business Research runs a benchmarking system for farms in England through the Farm Business Survey (RBR, n.d.). However, it provides information on the performance of similar farms, but does not stipulate what farmers should achieve as a minimum to be considered as financially healthy. Instead, the information for agricultural enterprises within the U.S.A. and Canada is easily available from the internet and was used here.

[12] As described in Chapter 2, the literature review.

Looking at the results for the agricultural industry in England, and comparing them with the required range, it can be seen that the industry is quite healthy as a whole, as the mean for each indicator falls well within the desirable range except for the profitability indicators.

The farms in the sample have a healthy position in terms of liquidity, indicating that farmers in general have few issues in paying back short term liabilities. The current ratio is, on average, 26.49, far above the preferred range, and working capital is £117,163.5 on average. The reason for this is that the general indebtedness of the sector is low (see further below). This has also been flagged up by Defra (2014a).

In terms of solvency, or ability to pay back loans, again, farmers tend to have a good position, with debt levels set at an average of 11.5% of assets. Again, this falls well below the suggested rate of 0.4 debt-to-asset ratio. The Equity-to-assets ratio is on average 88.5% (the opposite of the debt-over-asset ratio). As shown in the sections below, the level of indebtedness of farms is low. Profitability seems to be an area of concern for farmers. Looking at RoA, RoE and RoS, the industry as a whole scores below the suggested range. Nevertheless, profit is, on average, positive (but has a high standard deviation). Finally, farmers fare well in terms of financial efficiency, meeting all standards set in that category.

Table 4-1: Mean and St.Dev for 14 of the sweet 16 ratios for the farms in England (2011/12)

Financial performance indicator	**Mean**	**St. Dev.**	**Suggested range**
Liquidity ratios			
Current ratio	26.4919	166.3192	1.5 to 2
Working capital	117,163.5	278,784.3	Positive
Solvency			
Debt/Asset ratio	.1150	.1516	Less than 0.4
Equity/Asset ratio	.8850	.1516	Above 0.6
Debt/Equity ratio	.1922	.4037	Less than 0.66
Profitability			
Return on Assets	.0149	.0552	Above 4%
Return on Equity	.0090	.1028	Greater than RoA
Return on Sales	.0423	.2040	20 to 30%
Profit	44,606.03	99,721.65	Positive
Financial efficiency			
Asset Turnover	.2885	.2328	> 25-30%
Operating Expense ratio	.5414	.2772	< 65%
Depreciation Expense ratio	.0253	.0372	< 15%
Interest Expense ratio	.0163	.0345	< 15%
Net income from operations ratio	.1824	.1782	> 15%

Source: calculated from FBS 2011/12 and PennState (n.d.).

Table 4-2 shows the results per farm type. Even though there are differences, there are similar results as well. In terms of liquidity, all farm types exceed the desirable range of two easily on

the current ratio, and working capital is, on average, positive. There are, however, differences between the four farm types, with LFA Grazing Livestock farms having the highest working capital, and cereal farms the lowest. The standard deviation is also high for working capital, indicating there is large variability within each sub-sector.

The solvency ratios show that average debt is low within each farm type, with Dairy farms having the highest foreign capital (16.88% of Total Assets on average), and Cereal farms, LFA Grazing Livestock farms and Lowland Grazing Livestock farms having approximately the same proportion of debt (around 10%). This is far below the suggested range, indicating that farmers will have few difficulties in paying back their long term debts.

Only Cereal farms seem to have few profitability issues. Nevertheless, the standard deviation is large on all four indicators, showing that there are some farms even within the Cereal industry that have difficulties. The other three farm types struggle, with Lowland Grazing Livestock marking a negative RoA and RoE, and LFA Grazing Livestock farms showing a negative RoS. Nevertheless, all farm types still note a positive profit on average.

The results for financial efficiency are more varied, with none of the farm types showing difficulties with Interest Expense ratio or Depreciation Expense ratio, but with Dairy farms struggling on their Operating Expense ratio; Lowland Grazing Livestock farms showing weaknesses on Asset Turnover and both farm types just falling below the 15% range on Net Income from Operations ratio.

Noting that indebtedness is low for all farm types, the Repayment Capacity indicators that were not calculated are deemed to be of little interest and would be within the acceptable range as indebtedness is low in the sector.

Table 4-2: Mean and St.Dev for 14 of the 16 sweet 16 ratios per farm type in England (2011/12)

Financial performance indicator	Cereal farms	Dairy farms	LFA Grazing Livestock farms	Lowland Grazing livestock farms	Suggested range
Liquidity ratios					
Current ratio	37.6685 (148.5554)	5.5128 (16.5523)	51.03118 (324.9483)	17.8662 (48.4970)	1.5 to 2
Working capital	29,9713.1 (462,050.7)	46,450.16 (118,829.1)	58,218.51 (87,935.83)	46,207.88 (98,182.39)	Positive
Solvency					
Debt/Asset ratio	.1042 (.1042)	.1688 (.1633)	.0905 (.1436)	.0909 (.1487)	Less than 0.4
Equity/Asset ratio	.8958 (.1355)	.8312 (.1632)	.9095 (.1436)	.9090 (.1487)	Above 0.6
Debt/Equity ratio	.1649 (.3755)	.2765 (.4021)	.1501 (.3381)	.1672 (.4632)	Less than 0.66
Profitability					
Return on Assets	.0570 (.0726)	.01685 (.0598)	.0099 (.0707)	-.0017 (.0578)	Above 4%
Return on Equity	.0711 (.1075)	.0176 (.0818)	.0087 (.0904)	-.0059 (.0787)	Greater than RoA
Return on Sales	.2432 (.1627)	.0558 (.1522)	-.0184 (.2870)	-.0131 (.2545)	20 to 30%
Profit	115,756.6 (150,156.6)	32,882.86 (68,542.86)	9,831.794 (35,752.28)	10,001.76 (39,324.72)	Positive
Financial efficiency					
Asset Turnover	.2640 (.2700)	.3400 (.2208)	.2543 (.2241)	.1923 (.1889)	> 25-30%
Operating Expense ratio	.4304 (.1981)	.7723 (.2430)	.5108 (.2560)	.4480 (.2586)	< 65%
Depreciation Expense ratio	.0200 (.0341)	.0238 (.0239)	.0295 (.0466)	.0292 (.0423)	< 15%
Interest Expense ratio	.0118 (.0215)	.0189 (.0298)	.0196 (.0549)	.0160 (.0296)	< 15%
Net income from operations ratio	.2632 (.1397)	.1452 (.1230)	.1669 (.2019)	.1490 (.2132)	> 15%

Notes:
1. Standard deviation is given between brackets ( )

Source: calculated from FBS 2011/12.

In order to verify whether the DuPont Expansion model is an appropriate model to assess the financial performance of the agricultural industry in England, a correlation analysis was undertaken to see if there are links between the various ratios. Table 4-3 shows the results of this analysis, carried out on all farm types in one dataset:

- RoS, RoA, RoE, Net farm income from Operations ratio and Profit have a strong, positive correlation. Note that the correlation between RoS and Profit stands at 0.5614, which is

below the rule of 0.6. The correlation between RoA and RoE is 0.9426, indicating that assets are quite similar to equity, which was evidenced above with a low indebtedness rate.

- There is a perfect, negative correlation, between Debt-over-Assets and Equity-over-Assets. This is due to the fact that Total Assets equal the sum of Debt and Equity. These ratios are also strongly linked to the Debt-over-Equity ratio.
- The Interest Expense ratio is correlated with the debt-over-assets and equity-over assets (0.5990 and -0.5990 respectively)
- Asset Turnover, the Current Ratio, the Operating Expense ratio and the Depreciation Expense ratio are not correlated strongly with any other indicator.

Applying the same methodology on each individual farm type (Table 4-4 for Cereal farms, 4-5 for Dairy farms, 4-6 for LFA Grazing Livestock farms and 4-7 for Lowland Grazing Livestock farms), the results show that:

- for Cereal farms, RoS is positively correlated with Net Income from Operations ratio; ATO with RoA and RoE; and the three solvency ratios (Debt/Assets, Equity/Assets and Debt/Equity) also linked;
- for Dairy farms there is a strong link between all profitability indicators (RoS, RoA, RoE and Profit) and Net income from Operations ratio. The solvency ratios are also correlated with each other, as well as with the Interest Expense ratio; and,
- similarly for LFA and Lowland Grazing Livestock farms, there is a strong link between all profitability indicators (RoS, RoA, RoE and Profit) and Net Income from Operations ratio. Again, the solvency ratios are also correlated with each other, as well as with the Interest Expense ratio.

Table 4-3: Correlation matrix for 14 of the sweet 16 indicators for all farms in England

Ratio	RoS	ATO	RoA	RoE	Current Ratio	Working Capital	Debt/ Assets	Equity/ Assets	Debt/ Equity	Profit	Operating Expense ratio	Depreciation Expense ratio	Interest Expense ratio	Net farm income from Operations ratio
RoS	1													
ATO	0.0365	1												
RoA	0.6679 ***	0.3156 ***	1											
RoE	0.6031 ***	0.3299 ***	0.9426 ***	1										
Current Ratio	0.0315	0.0044	0.0213	0.0123	1									
Working Capital	0.3368 ***	-0.0717 **	0.2034 ***	0.1700 ***	0.0464	1								
Debt/ Assets	-0.1317 ***	0.3682 ***	-0.0103	-0.0066	-0.0981 ***	-0.2015 ***	1							
Equity/ Assets	0.1317 ***	-0.3682 ***	0.0103	0.0066	0.0981 ***	0.2015 ***	-1	1						
Debt/ Equity	-0.1368 ***	0.2930 ***	-0.0516	-0.0549	-0.0647	-0.1678 ***	0.8998 ***	-0.8998 ***	1					
Profit	0.5614 ***	0.0076	0.4374 ***	0.4106 ***	-0.0169	0.5911 ***	-0.0683 **	0.0683 **	-0.0966 ***	1				
Operating Expense ratio	-0.2228 ***	0.1604 ***	-0.1492 ***	-0.1134 ***	-0.0629	-0.1082 ***	0.0953 ***	-0.0953 ***	0.0076	-0.1284 ***	1			
Depreciation Expense ratio	-0.3185 ***	-0.2438 ***	-0.1675 ***	-0.1515 ***	-0.0259	-0.0615 ***	0.0219	-0.0219	0.0355	-0.1175 ***	-0.1613 ***	1		
Interest Expense ratio	-0.2468 ***	-0.0725 **	-0.1811 ***	-0.2358 ***	-0.0620	-0.1592 ***	0.5990 ***	-0.5990 ***	0.5216 ***	-0.1393 ***	-0.0112	0.1925 ***	1	
Net farm income from Operations ratio	0.7990 ***	0.1162 ***	0.5558 ***	0.5070 ***	0.0912 ***	0.2396 ***	-0.0685 **	0.0685 **	-0.0831 **	0.4312 ***	-0.2499 ***	-0.307 ***	-0.1437 ***	1

Source: calculated from FBS 2011/12.

Note: *** is statistically significant at the 1% level, ** at the 5% level and * at the 10% level

Table 4-4: Correlation matrix for 14 of the sweet 16 indicators for Cereal farms in England

Ratio	RoS	ATO	RoA	RoE	Current Ratio	Working Capital	Debt/ Assets	Equity/ Assets	Debt/ Equity	Profit	Operating Expense ratio	Depreciation Expense ratio	Interest Expense ratio	Net farm income from Operations ratio
RoS	1													
ATO	-0.1654 **	1												
RoA	0.386 ***	0.6787 ***	1											
RoE	0.2977 ***	0.6875 ***	0.9328 ***	1										
Current Ratio	0.0297	-0.0973	-0.0552	-0.0669	1									
Working Capital	0.3031 ***	-0.1256 *	0.0445	-0.0073	0.0441	1.0000								
Debt/ Assets	-0.1507 **	0.4993 ***	0.2704 ***	0.4606 ***	-0.1628 **	-0.1940 ***	1.0000							
Equity/ Assets	0.1507 **	-0.4993 ***	-0.2704 ***	-0.4606 ***	0.1628 **	0.1940 ***	-1.0000	1.0000						
Debt/ Equity	-0.1212 *	0.3887 ***	0.1724 ***	0.4286 ***	-0.097	-0.1540 **	0.8601 ***	-0.8601 ***	1.0000					
Profit	0.4717 ***	-0.0582	0.2098 ***	0.1714 ***	-0.0821	0.5352 ***	0.0452	-0.0452	-0.0092	1.0000				
Operating Expense ratio	-0.0598	0.0773	0.0494	0.0594	-0.0903	0.0418	-0.0901	0.0901	-0.0267	-0.0547	1			
Depreciation Expense ratio	-0.0688	-0.2327 ***	-0.2041 ***	-0.1587 **	-0.0573	-0.0366	0.0995	-0.0995	0.0664	-0.0359	-0.332 ***	1		
Interest Expense ratio	-0.0481	-0.0598	-0.0663	0.0216	-0.1119 *	-0.2092 ***	0.5162 ***	-0.5162 ***	0.3763 ***	0.0356	-0.197 ***	0.4234 ***	1	
Net farm income from Operations ratio	0.8321 ***	0.0901	0.4359 ***	0.3676 ***	-0.0098	0.2145 ***	0.0308	-0.0308	0.0300	0.3663 ***	-0.0388	-0.113 *	0.0179	1

Source: calculated from FBS 2011/12.
Note: *** is statistically significant at the 1% level, ** at the 5% level and * at the 10% level

Table 4-5: Correlation matrix for 14 of the sweet 16 indicators for Dairy farms in England

Ratio	RoS	ATO	RoA	RoE	Current Ratio	Working Capital	Debt/ Assets	Equity/ Assets	Debt/ Equity	Profit	Operating Expense ratio	Depreciation Expense ratio	Interest Expense ratio	Net farm income from Operations ratio
RoS	1													
ATO	-0.063	1												
RoA	0.8369 ***	0.1039	1.0000											
RoE	0.8062 ***	0.1206 *	0.9571 ***	1.0000										
Current Ratio	0.121 *	-0.0591	0.0276	0.0214	1.0000									
Working Capital	0.2996 ***	-0.0224	0.1848 ***	0.1829 ***	0.3155 ***	1								
Debt/ Assets	-0.2943 ***	0.2473 ***	-0.1431 **	-0.1675 **	-0.2357 ***	-0.4615 ***	1							
Equity/ Assets	0.2943 ***	-0.2473 ***	0.1431 **	0.1675 **	0.2357 ***	0.4615 ***	-1 ***	1						
Debt/ Equity	-0.2762 ***	0.2266 ***	-0.1638 **	-0.2001 ***	-0.1670 **	-0.4032 ***	0.9338 ***	-0.9338 ***	1					
Profit	0.8073 ***	-0.0086	0.6457 ***	0.6385 ***	0.0444	0.3895 ***	-0.2643 ***	0.2643 ***	-0.2725 ***	1				
Operating Expense ratio	-0.191 ***	0.2076 ***	-0.1416 **	-0.1124 *	-0.1102 *	-0.0612	0.012	-0.012	-0.0929	-0.0756	1			
Depreciation Expense ratio	-0.1376 ***	-0.3077 ***	-0.0867	-0.0815	-0.0034	-0.0182	0.0032	-0.0032	-0.0122	-0.1126 ***	-0.1597 **	1		
Interest Expense ratio	-0.3888 ***	-0.1745 ***	-0.2531 ***	-0.2980 ***	-0.1475 **	-0.3787 ***	0.6577 ***	-0.6577 ***	0.6143 ***	-0.3151 ***	-0.0872	0.1295 *	1	
Net farm income from Operations ratio	0.8421 ***	0.0602	0.7032 ***	0.6567	0.1532 **	0.1803 ***	-0.1605 **	0.1605 **	-0.1536 **	0.669 ***	-0.1908 ***	-0.182 ***	-0.2054 ***	1

Source: calculated from FBS 2011/12.

Note: *** is statistically significant at the 1% level, ** at the 5% level and * at the 10% level

Table 4-6: Correlation matrix for 14 of the sweet 16 indicators for LFA Grazing Livestock farms in England

Ratio	RoS	ATO	RoA	RoE	Current Ratio	Working Capital	Debt/ Assets	Equity/ Assets	Debt/ Equity	Profit	Operating Expense ratio	Depreciation Expense ratio	Interest Expense ratio	Net farm income from Operations ratio
RoS	1													
ATO	0.2281***	1												
RoA	0.7215***	0.3367***	1											
RoE	0.6743***	0.3252***	0.9457***	1										
Current Ratio	0.027	0.119	0.0665	0.0545	1									
Working Capital	0.326***	-0.003	0.3446***	0.3007***	0.0055	1								
Debt/ Assets	-0.1717**	0.3126***	-0.1172	-0.1509**	-0.0766	-0.2537***	1							
Equity/ Assets	0.1717**	-0.3126***	0.1172	0.1509**	0.0766	0.2537***	-1	1						
Debt/ Equity	-0.1698**	0.2873***	-0.1111	-0.1699**	-0.0578	-0.1703**	0.9551***	-0.9551***	1					
Profit	0.7555***	0.1881**	0.7260***	0.7265***	0.0013	0.5038**	-0.3218***	0.3218***	-0.3275***	1				
Operating Expense ratio	-0.2651***	-0.0205	-0.2470***	-0.1948**	-0.0138	-0.0865	-0.06	0.06	-0.0977	-0.2009	1			
Depreciation Expense ratio	-0.4901***	-0.2924***	-0.2174***	-0.2179***	-0.0178	-0.0241	0.0685	-0.0685	0.1015	-0.3144***	-0.0923	1		
Interest Expense ratio	-0.3185***	-0.0752	-0.2279***	-0.3871***	-0.0490	-0.0625	0.6913***	-0.6913***	0.7218***	-0.4472***	-0.0361	0.2797***	1	
Net farm income from Operations ratio	0.8411***	0.2392***	0.6829***	0.6271***	0.1508**	0.254***	-0.0652	0.0652	-0.0771	0.6332***	-0.3853***	-0.4061***	-0.1923**	1

Source: calculated from FBS 2011/12.

Note: *** is statistically significant at the 1% level, ** at the 5% level and * at the 10% level

Table 4-7: Correlation matrix for 14 of the sweet 16 indicators for Lowland Grazing Livestock farms in England

Ratio	RoS	ATO	RoA	RoE	Current Ratio	Working Capital	Debt/ Assets	Equity/ Assets	Debt/ Equity	Profit	Operating Expense ratio	Depreciation Expense ratio	Interest Expense ratio	Net farm income from Operations ratio
RoS	1													
ATO	0.0164	1												
RoA	0.6631 ***	-0.0944	1											
RoE	0.596 ***	-0.0949	0.9164 ***	1.0000										
Current Ratio	0.0391	-0.0489	-0.0439	-0.0133	1.0000									
Working Capital	0.307 ***	-0.0706	0.2138 ***	0.2286 ***	0.2522 ***	1.0000								
Debt/ Assets	-0.0854	0.2976 ***	-0.1128 *	-0.3089 ***	-0.1702 ***	-0.3742 ***	1							
Equity/ Assets	0.0854	-0.2976 ***	0.1128 *	0.3089 ***	0.1702 ***	0.3742 ***	-1	1						
Debt/ Equity	-0.1061	0.2242 ***	-0.1441 **	-0.3953 ***	-0.1087 *	-0.3005 ***	0.8908 ***	-0.8908 ***	1					
Profit	0.7138 ***	0.0269	0.5612 ***	0.5238 ***	0.0097	0.4685 ***	-0.1239 *	0.1239 **	-0.1491 **	1				
Operating Expense ratio	-0.2985 ***	0.0068	-0.2318 ***	-0.1632 **	-0.0866	-0.1284 *	0.0588	-0.0588	-0.0443	-0.236 ***	1			
Depreciation Expense ratio	-0.3243 ***	-0.1899 ***	-0.0565	-0.0533	-0.0581	-0.0814	-0.025	0.025	0.0144	-0.1615 **	-0.1862 ***	1		
Interest Expense ratio	-0.1444 **	-0.0396	-0.1286 *	-0.2403 ***	-0.1497 **	-0.3278 ***	0.6666 ***	-0.6666 ***	0.4969 **	-0.1735 ***	0.0513	-0.0266	1	
Net farm income from Operations ratio	0.7361 ***	0.1353 **	0.3999 ***	0.3858 ***	0.1020	0.1958 ***	-0.0384	0.0384	-0.088	0.5101 ***	-0.1964 ***	-0.3553 ***	-0.0912	1

Source: calculated from FBS 2011/12.

Note: *** is statistically significant at the 1% level, ** at the 5% level and * at the 10% level

The analysis above shows – for all farms as well as per individual farm type in England– that the DuPont Expansion model seems to be a good model to assess financial performance for the agricultural industry in England. The reasons for this can be summarised as follows:

- the five ratios in the DuPont Expansion model are correlated with several of the indicators in the sweet 16 model;
- the Depreciation Expense ratio is low on average for all farms together, and for every individual farm type, and could be left out of the analysis;
- none of the farms struggle with liquidity on average, so even though the ratios are not correlated with any of the five ratios under the DuPont Expansion model, the sector is not having difficulties in this field; and,
- as indebtedness is low, the repayment capacity ratios, even though they were not calculated as part of this research, will be well within the suggested range, and there is no indication that the sector as a whole is having difficulties in this field.

Therefore, the five ratios from the DuPont Expansion model will be used in the two sections that follow (4.2 and 4.3) to look at the trends (from 2008 to 2013) as well as individual farms (2011/12).

4.2. Financial indicators and trends (2008 to 2013)

4.2.1. Descriptive statistics

As stated in Chapter three, four farm types are used for this research, resulting in a dataset of 431 farms for the period 2008-2013. The dataset contains: 75 Cereal farms; 159 Dairy farms; 108 LFA Grazing Livestock farms; and 89 Lowland Grazing Livestock farms. They are geographically represented in North England (165), East England (128) and West England (138). In terms of size (measured in fulltime equivalent (FTE) workforce on the farm), there are only two very small farms (part-time), 153 small farms (less than 2 FTE), 110 medium farms (2-3 FTE) and 166 large farms (more than 3 FTE). In terms of tenure, 117 farms are owner-occupied, 84 are tenanted and 230 are mixed farm types, where the farmer owns part of its land, and rents part of it. On 253 farms, the spouse is not working versus 178 farms where spouses do work. There are 416 farms that are run by men versus 15 female farmers.

Overall, the mean is positive for Return on Sales, Return on Assets and Return on Equity, which is a positive sign; as it shows that on average, farmers are making a profit. On average, farmers own 77.99% of their assets, showing a low level of indebtedness in the sector. However, the standard deviation for Compound Leverage Factor is quite high at 0.7449, indicating there are some farms that have substantially more debt than others. The Asset Turnover is, on average, 0.2885, with quite a high standard deviation (0.2328) (Table 4-8).

Table 4-8: Mean, St. Dev. and Significance on for all farm types in England (2008-2013)

Financial performance indicator	Mean	St. Dev.
Return on Sales	.0423	.2040
Asset Turnover	.2885	.2328
Compound Leverage Factor	1.2822	.7449
Return on Assets	.0149	.0552
Return on Equity	.0090	.1028

Source: calculated from Farm Business Survey 2008-2013.

Looking at each farm type, there are large variations (Table 4-9). Cereal farms outperform all other farm types in Return on Sales, Return on Assets and Return on Equity. The livestock farms seem to have issues with their profitability, as their returns are on average negative. Dairy farms have the highest average Asset Turnover, which would be expected for this farm type (high turnover of stock).

Table 4-9: Mean and standard deviation per farm type in England (2008-2013)

Financial performance indicator	Cereal farms	Dairy farms	LFA grazing livestock farms	Lowland grazing livestock farms
Return on Sales	.2104 (.1192)	.0400 (.1335)	-.0099 (.2369)	-.0319 (.2413)
Asset Turnover	.2451 (.2216)	.3759 (.2389)	.2608 (.2121)	.2026 (.2064)
Compound Leverage Factor	1.2951 (.2347)	1.3677 (.5156)	1.2188 (.7418)	1.1955 (.5071)
Return on Assets	.0454 (.0382)	.0154 (.0516)	.0080 (.0631)	-.0033 (.0536)
Return on Equity	.0450 (.1011)	.0124 (.0794)	0.0077 (.1309)	-.0121 (.0953)
Notes: 1. Standard deviation is given in brackets ( )				

Source: calculated from Farm Business Survey 2008-2013.

4.2.2. Trends from 2008 to 2013

Figure 4-1 shows the fluctuation in the five ratios of the DuPont Expansion Model, which are Return on Sales, Asset Turnover, Compound Leverage Factor, Return on Assets and Return on

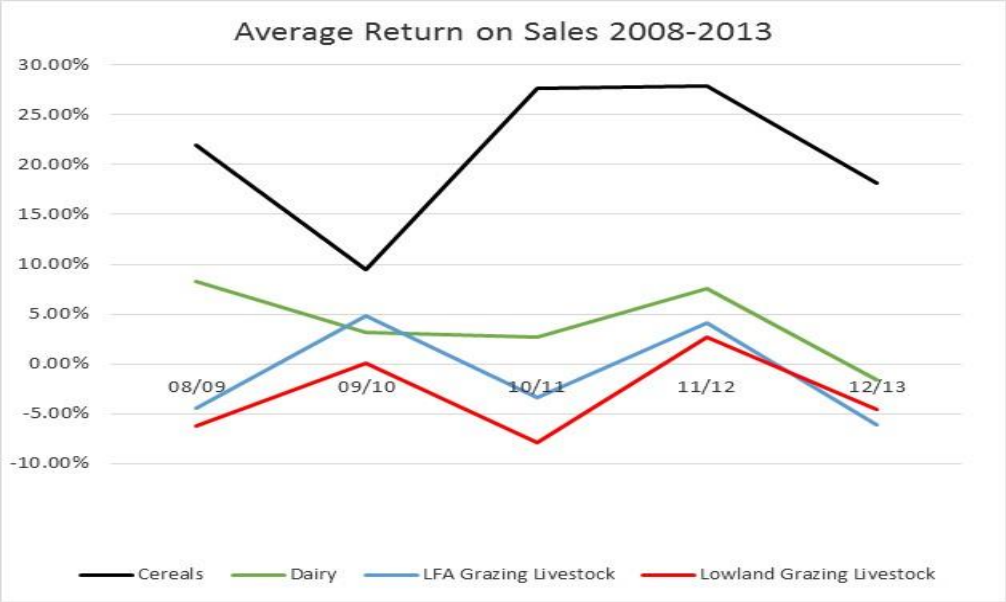
Equity, for each of the farm types. Overall, Cereal farms are, on average, the best performing on profitability (RoS, RoA and ATO). Dairy farms, on the other hand, have the highest ATO. Finally, CLF is quite similar across all four study farm types.

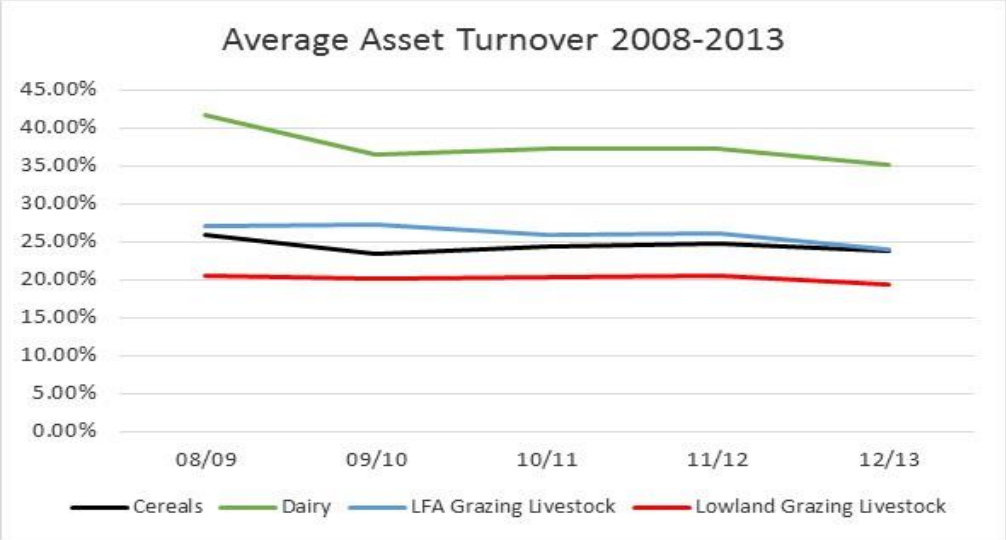
There seem to be few fluctuations in average ATO and CLF compared to the large variation in the profitability indicators. Asset Turnover, on average, is decreasing per farm type, showing that sales are either dropping or the asset base is increasing. The Compound Leverage Factor for all farm types decreased up to the year 2011/12, and has shown a small increase in 2012/2013. This is a positive sign, showing that farmers invest equity in their business (see further). On average, indebtedness is low.

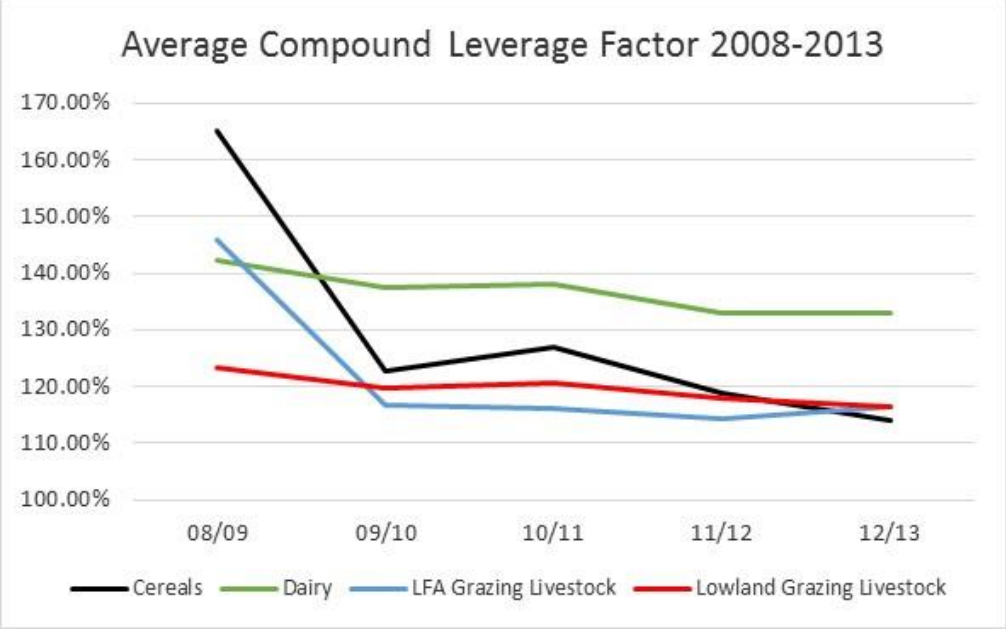
While it has to be noted that, while all farm types fluctuate in similar directions on ATO and CLF, the various farm types move in different directions on the profitability indicators:

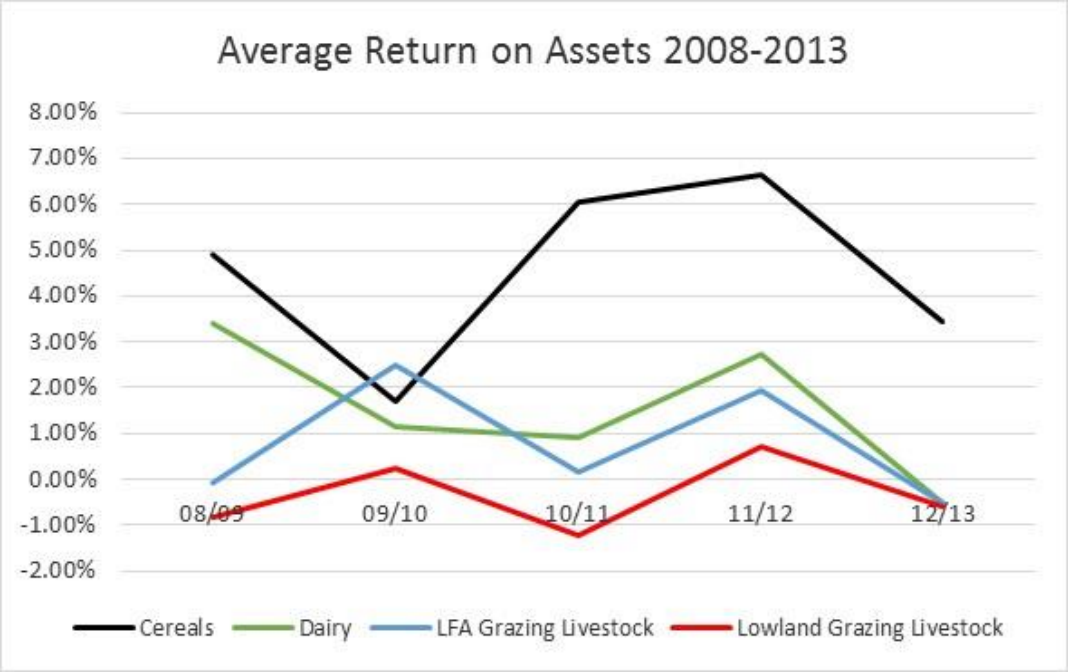
- for RoS, both Cereal farms and Dairy farms experience a decrease in 2009/2010 – the reduction in RoS being quite substantial for Cereal farms – while the Livestock farms experience an increase in RoS in that year. In 2010/2011, while Cereal farms recovered from the shock, the livestock farms experienced a lower RoS, and Dairy farms only slightly increased. For the year 2012/2013, all farm types noted a lower RoS;
- as with RoS, Cereal farms experience the highest RoA and RoE. Similar to the trends seen for RoS, Livestock farms show a sharp increase in return in 2009/2010, followed by a large fall in the next year; and,
- the graph for RoE shows that only Cereal farms have managed to increase their return year on year, with the exception of 2012/2013. For that year, farms across all four farm types recorded a lower return.

Given that all three profitability indicators show similar results over the years, it seems that profit is responsible for the fluctuation shown.


Average Return on Sales 2008-2013
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
-5.00%
-10.00%
08/09
09/10
10/11
11/12
12/13
Cereals
Dairy
LFA Grazing Livestock
Lowland Grazing Livestock


Average Asset Turnover 2008-2013
45.00%
40.00%
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
08/09
09/10
10/11
11/12
12/13
Cereals
Dairy
LFA Grazing Livestock
Lowland Grazing Livestock


Average Compound Leverage Factor 2008-2013
170.00%
160.00%
150.00%
140.00%
130.00%
120.00%
110.00%
100.00%
08/09
09/10
10/11
11/12
12/13
Cereals
Dairy
LFA Grazing Livestock
Lowland Grazing Livestock



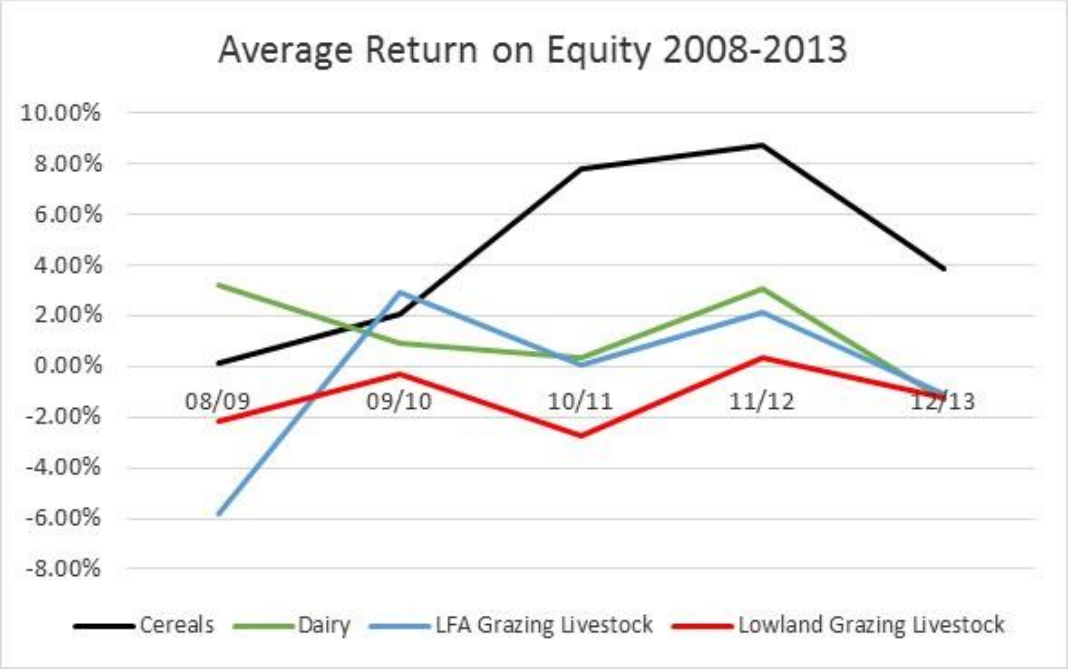


Figure 4-1: The five ratios for the four farm types in England (2008-2013)

Source: calculated from the FBS 2008 to 2013 dataset.

Figure 4-2 shows average profit, average sales, costs, Farm Business Income and Unpaid Labour. Comparing this with the graphs under Figure 4-1, profit undergoes similar trends as the ratios, and is therefore the causing factor.

On average, Cereal farms are achieving the highest profits (£136,032.92 per year on average). The other three farm types achieve much lower profits, with Dairy farms at £30,574.99,

Lowland Grazing Livestock at £8,291.29 and LFA Grazing Livestock farms at £7,940.66 profit per year on average – even though positive, but nevertheless close to the zero profit line. Working backwards from profit to sales and costs via Farm Business Income, increasing costs are the main reason for Cereal and Dairy farms to record lower profitability, as unpaid labour stays largely the same over the five year period, and is relatively low (between £20,000 and £43,000, averaging one to two fulltime equivalents). In the year 2009/2010, Cereal farms experienced a sharp increase in costs, and falling value of sales, resulting in the sharp dip in profitability. The other three farm types appear to be more stable, however, on average costs increase for all farm types.

Tables 4-10 to 4-12 summarize events and key results per farm type from the period 2008 to 2013. Within the cereal sector (Table 4-10), FBI per hectare fluctuated substantially, and in 2009/10 agriculture's contribution to FBI per hectare was negative at -£72/ha. This was due to lower output prices as well as a drop in yield due to bad weather conditions. The price of fertiliser also increased also in 2009/10, putting further pressure on profitability. Nevertheless, the sector recovered in 2010/11, with higher prices for outputs, higher yield and a sharp decrease in fertiliser costs. Looking at the cereal sector, it is evident that prices and the cost of fertiliser are the main factors that have an effect on the profit margin.

Dairy farms witnessed a reduction in number of cows and producers year on year (Table 4-11). Between 2008 and 2013, 1,388 dairy farmers left the sector, and 149,000 cows were lost. This despite relatively high FBI/ha – with the lowest FBI/ha recorded in 2012/13 at £361/ha. Yield per cow has increased since 2008, with the exception of 2012/13, where yield dropped with 3.6% compared to the 2011/12 level due to poor grass growing. Milk price was, on average, at its lowest in 2009/10 at 23.80 pence per litre, which affected FBI/ha (£447/ha).

The Grazing Livestock farms (Table 4-12 and 4-13) have relied more than other farm types on subsidies. Even though about 65% of the revenue for both Lowland Grazing Livestock farms and LFA Grazing Livestock farms originates from cash crops, forage and livestock outputs, they are heavily dependent on the Single Farm Payment (responsible for approximately 20% of revenue on average) and specific agri-environmental schemes (responsible for approximately 5% of revenue on average for Lowland Grazing Livestock farms and 10% for LFA Grazing Livestock farms). On average, the number of livestock on both farm types is relatively stable year on year, leading to price and cost control being key factors for profitability. For Lowland

Grazing Livestock farms, input costs, especially fertiliser costs have increased substantially compared to prior years. Even though price of output (cattle and sheep) mostly increased since 2008, it has been difficult for farmers to remain profitable. For LFA Grazing Livestock farmers, similarly, it is difficult to achieve profits from the agricultural activities. From 2008 to 2013, agricultural business income is almost consistently negative, with the exception of 2011/12, where the agricultural business income amounts, on average, to £583. Total average output increased from 2008 to 2012, and decreased in 2012/13. Farm Investment Income from agriculture was negative over the five year period, but improved in 2008/09, 2009/10 and 2010/11. Still, farmers did not manage to achieve the breakeven line. Variable and fixed costs increased consistently over the five year period.

Table 4-10: key results for the Cereal sector – 2008 to 2013

Cereal sector	2008/09	2009/10	2010/11	2011/12	2012/13
Weather conditions	Dry February conditions, dry June, wet harvest	Wet autumn weather, favourable spring conditions, wet harvest and dry root lifting season	Wet September drilling period in Western and Northern areas, but more usual conditions in the East and South East.	Drought	Grain fill in June and July didn't get enough light radiation; and heavy rainfall in June.
Costs	Increased variable costs compared to 2007/08	Fixed costs similar to 2008/09, with a sharp increase in fertiliser costs	Input costs such as seed and crop protection costs remained at 2009/10 level, but fertiliser costs decreased by 25%.	Energy and commodity driven costs increases substantially. Rents increased.	Variable costs increased substantially -with seed fertiliser and crop protection costs increasing by 29 and 30 per cent respectively. Fixed costs increased with 6%
Output/production	Yields are up	Winter cereals experienced lower yields (although the winter oat yield was unchanged). All spring crops gave increased yields, as did winter oilseed rape.	Aside from the spring cereal, crop yields increased	Very low yields but high prices	Output is slightly lower than in 2011/12 (1%)
Prices	Crop prices increased compared to 2007/2008	Cereal prices were lower than in 2008/09	Improved crop prices	Higher prices	Lower prices
FBI/ha	£327	£217	£453	£499	£343
Agriculture's contribution to FBI/ha	£77	- £72	£165	£213	£72

Sources: Lang (2010, 2011, 2012, 2013 and 2014)

Table 4-11: key results for the Dairy farm sector – 2008 to 2013

Dairy sector	2008/09	2009/10	2010/11	2011/12	2012/13
Milk producers leaving the industry	419	416	286	67	200
Number of cows lost	57,000	42,000	13,000	33,000	4,000

Costs	input costs (feed, fertiliser and energy) increased significantly	input costs increased moderately	increases in input costs	increases (feeds, fertilisers, energy and veterinary costs)	fertiliser costs decreased - other costs increased
Average yield	6,943 litres/cow (+16 litres/cow)	7,094 litres/cow (+151 litres/cow)	7,406 litres/cow (+4.4%)	7,617 litres/cow (+3.3%)	7,327 litres/ cow (-3.6%)
Output/production	Production level is at 12,858 million litres (lowest level since 1972)	Decrease to 12,825 million litres (-0.25%)	Increase with 507 million (+4%)	Increase with 124 million litres (+0.9%)	Decrease with 520 million litres (-3.9%) - due to poor grass growing
Average pence per litre (ppl)	25.75 ppl	23.80 ppl	25.14 ppl	28.06 ppl	28.35 ppl
FBI/ha	£591	£447	£477	£608	£361

Sources: Robertson et al. (2010), McHoul et al. (2011, 2012, 2013 and 2014)

Table 4-12: key results for the Lowland Grazing Livestock sector – 2008 to 2013

Lowland grazing livestock sector	2008/09	2009/10	2010/11	2011/12	2012/13
Average number of livestock	- beef cows: 25 - other cattle: 72 - ewes: 161	- beef cows: 24 - other cattle: 76 - ewes: 169	- beef cows: 25 - other cattle: 100 - ewes: 164	- beef cows: 23 - other cattle: 84 - ewes: 172	- beef cows: 24 - other cattle: 86 - ewes: 165
Costs	Increased, especially costs of fertiliser. Fixed costs were just over £1,000 higher	Decreased compared to the 2008/09 level, but are still substantially higher than the 2005 level	Energy costs, animal feed and repairs increased. Fertiliser costs increased compared to 2009/10, but is still lower than the 2008/09	Sharp increase in fertiliser costs, energy costs and animal feed cost. Moderate increase in machinery cost.	Increase in energy costs and animal feed cost. Moderate increase in machinery cost. Decrease in fertiliser costs
price	Increased for both cattle and sheep- but not as much as input prices	Increased – but not as much as in 2008/09	Price of finished sheep increased, but of cattle it decreased	Increased (finished cattle price and sheep price at its highest level since 2005)	Finished cattle price increased compared to 2011/12; sheep price decreased compared to 2011/12, but is still higher than in 2010/11
FBI	£18,507	£21,995	£21,410	£32,167	£16,268
Origin of revenue					
- Cash crops, forage and	60%	57%	63%	68%	67%

livestock output					
- SFP	21%	21%	19%	17%	16%
- Specific agri-environmental payments	6%	6%	5%	4%	4%
- Other non-farm/ diversification activities	13%	16%	13%	11%	13%

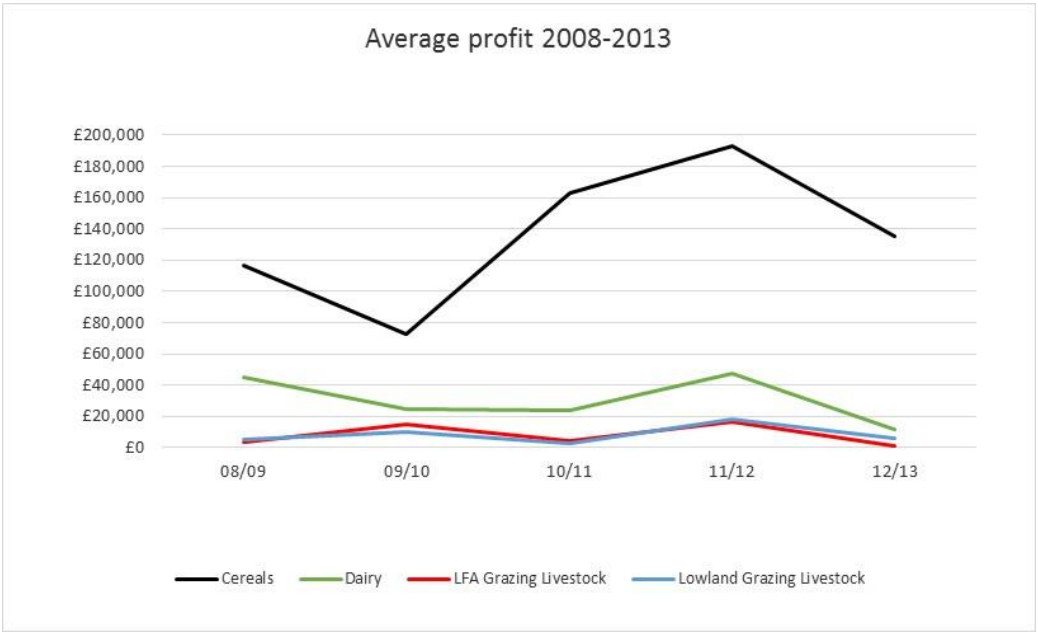
Sources: Fogerty et al. (2010, 2011, 2012, 2013 and 2014)

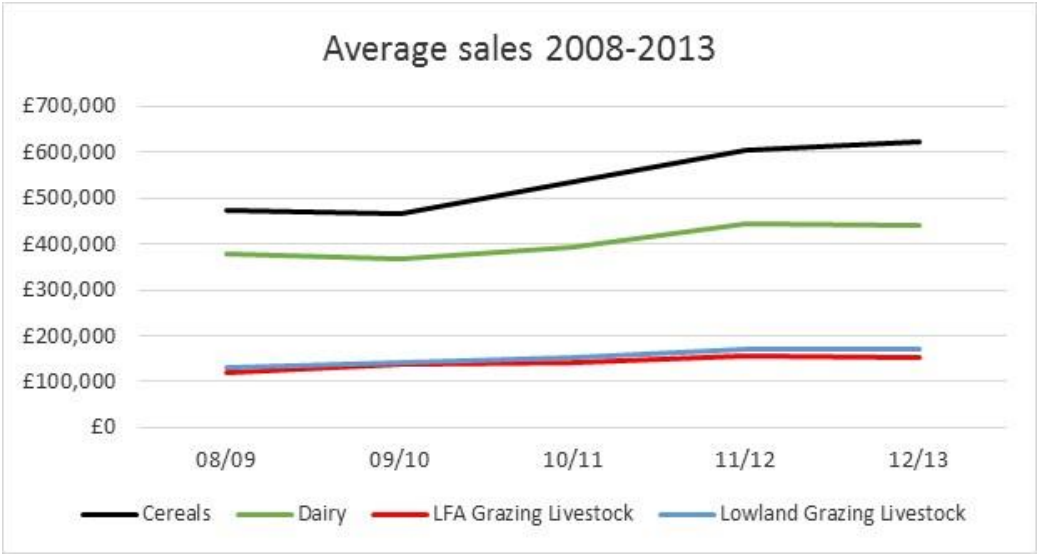
Table 4-13: Key results for the LFA Grazing Livestock sector – 2008 to 2013

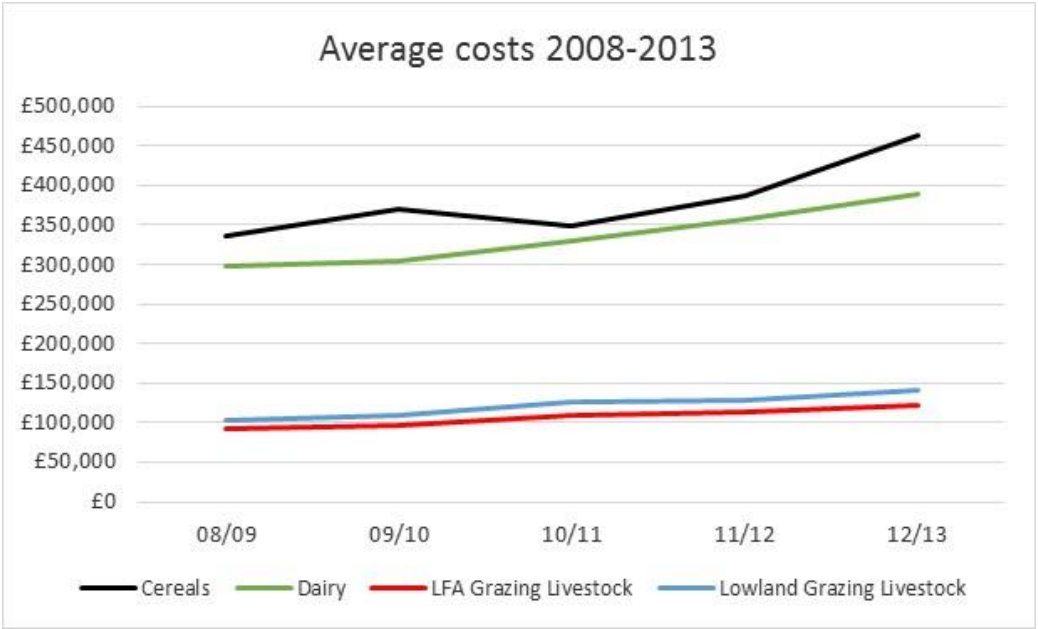
Factor	2008/09	2009/10	2010/11	2011/12	2012/13
Average farm size	137 ha	143 ha	150 ha	139 ha	155 ha
Average number of livestock (Grazing Livestock Units)	89	89	104	93	95
Costs	Variable costs: +17% Fixed costs: +7%	Variable costs: +7% Fixed costs: +3%	Variable costs: +13% Fixed costs: +8%	Variable costs: -7% Fixed costs: -4%	Variable costs: +10% Fixed costs: +6%
Total average input	Increased with 20% compared to 2007/08	Increased with 10% compared to 2008/09 to £102,322	Increase with 3% compared to 2009/10 to £105,488	Increase with 3% compared to 2010/11 to £108,965	Decrease with 3% compared to 2011/12 to £105,729
Farm Investment Income	-£25,475 (increase of 27%)	-£24,332 (increase of 4%)	-£30,002 (decrease of 16%)	-£20,962 (increase of 30%)	-£31,501 (decrease of 50%)
FBI	£17,137	£22,206	£21,279	£29,213	£29,973
Origin of revenue					
- Crop and livestock farming activities	59%	60%	66%	69%	67%
- Single Farm Payment	24%	24%	22%	20%	19%

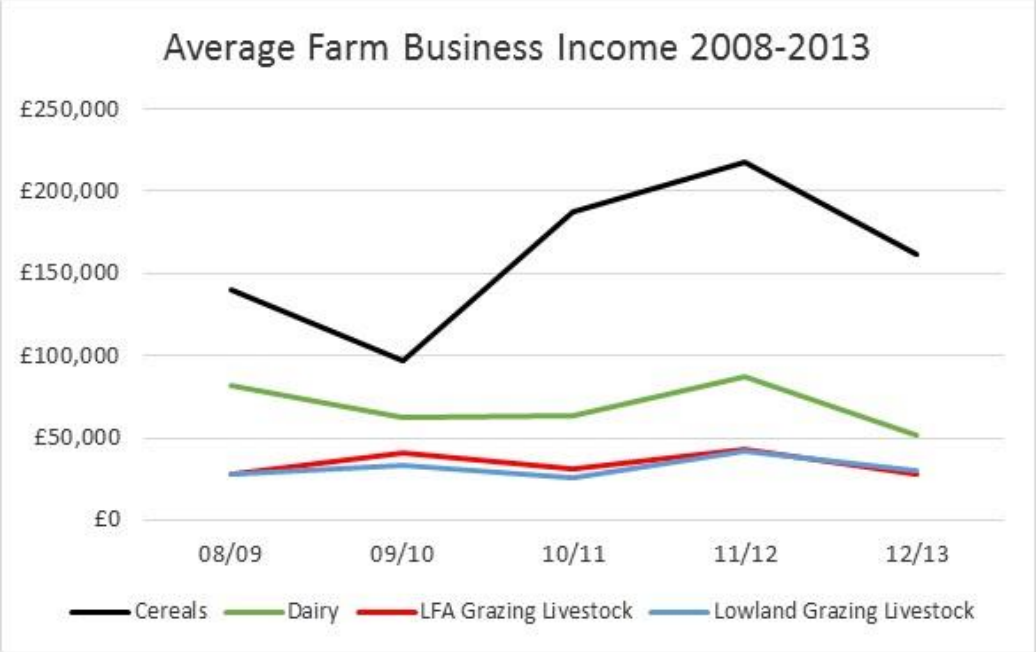
- Specific agri-environmental payments	13%	13%	10%	9%	11%
- Other non-farm/ diversification activities	4%	3%	2%	2%	3%
Agricultural Business Income (from crop and production livestock)	-£8,347	-£5,203	-£8,234	£583	-£8,867

Sources: Harvey et al. (2010, 2011, 2012, 2013 and 2014)


Average profit 2008-2013
£200,000
£180,000
£160,000
£140,000
£120,000
£100,000
£80,000
£60,000
£40,000
£20,000
£0
08/09
09/10
10/11
11/12
12/13
Cereals
Dairy
LFA Grazing Livestock
Lowland Grazing Livestock


Average sales 2008-2013
£700,000
£600,000
£500,000
£400,000
£300,000
£200,000
£100,000
£0
08/09
09/10
10/11
11/12
12/13
Cereals
Dairy
LFA Grazing Livestock
Lowland Grazing Livestock


Average costs 2008-2013
£500,000
£450,000
£400,000
£350,000
£300,000
£250,000
£200,000
£150,000
£100,000
£50,000
£0
08/09
09/10
10/11
11/12
12/13
Cereals
Dairy
LFA Grazing Livestock
Lowland Grazing Livestock



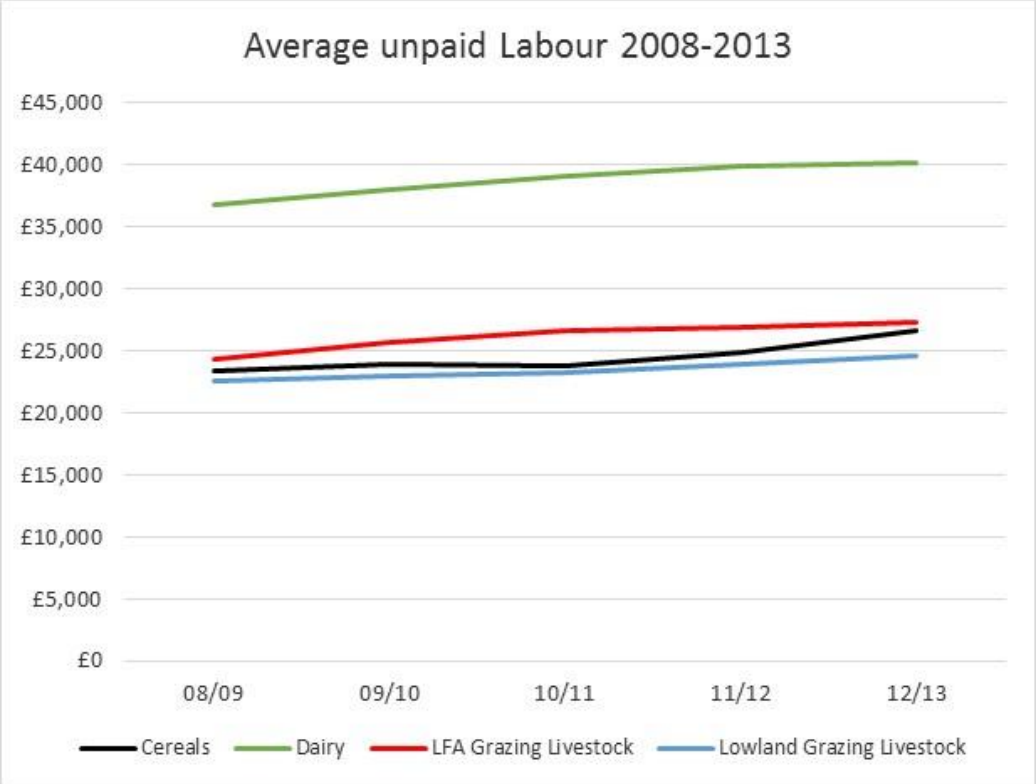


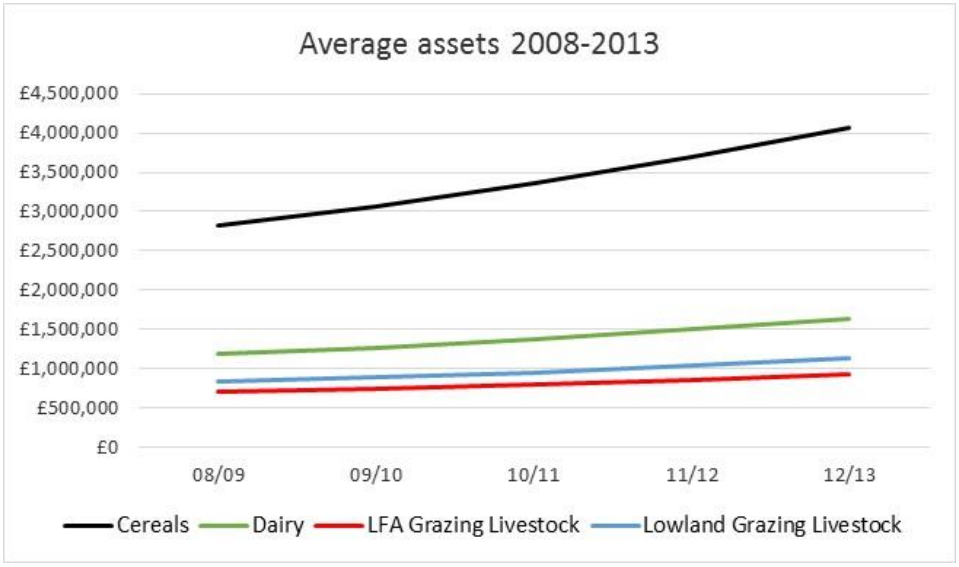
Figure 4-2: Average profit, sales, costs, Farm business income and unpaid labour per farm type, 2008-2013

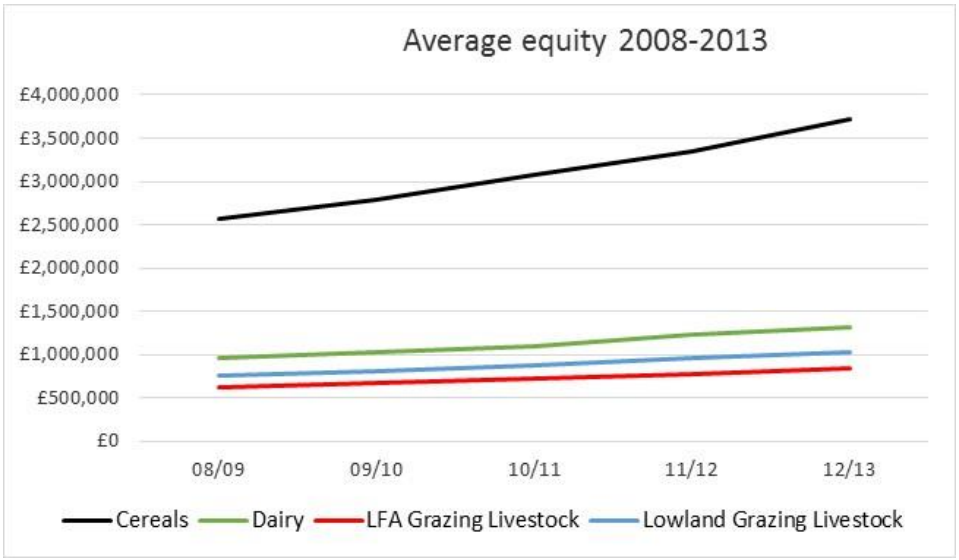
Source: calculated from the FBS 2008 to 2013 dataset.

Note: The axis do not have the same size, resulting in fluctuations that might visually be difficult to interpret.

When looking at the average assets per farm type (Figure 4-3), we find that they increase for all farm types, with the most remarkable increase for Cereal farms. Lowland Grazing Livestock and LFA Grazing Livestock farms have the smallest asset base, which would be in line with the type of farming system for these farm enterprises. Equity follows the same trends as the assets.

For all farm types, there has been an increase in equity, a good sign, indicating that farms reinvest profit into the business. This strengthens the position of the different farm types. As for all graphs, Cereal farms have the highest on average equity and seem the best performing, while Lowland Grazing Livestock and LFA Grazing Livestock farms have a substantially smaller amount of equity on average. The level of debt is low on average for all farm types.





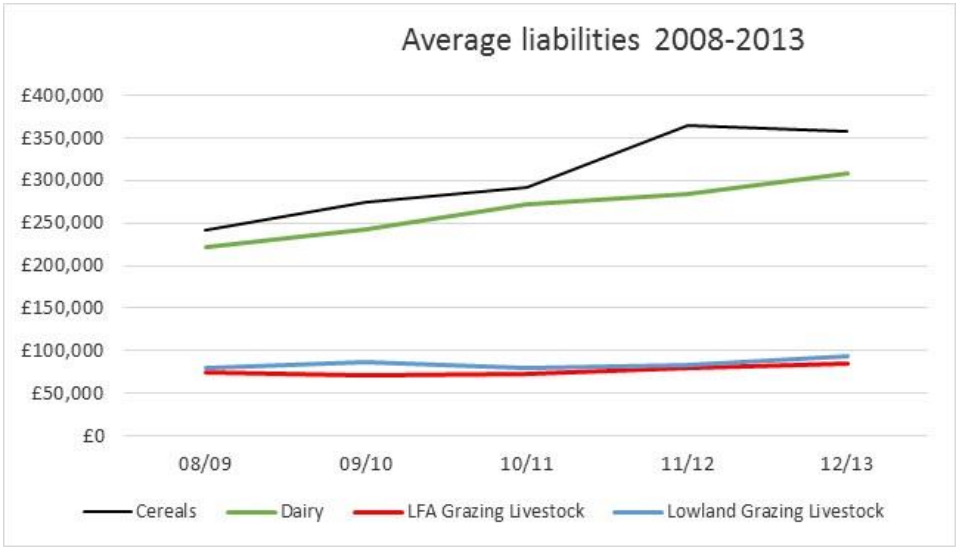


Figure 4-3: Average assets, equity and debt per farm type, 2008-2013
Source: calculated from the FBS 2008 to 2013 dataset.

4.3. The situation in 2011/12

4.3.1. Descriptive statistics

The dataset for 2011/12 contained 862 farms: 233 Cereal farms, 228 Dairy farms, 170 LFA Grazing Livestock farms and 231 Lowland Grazing Livestock farms. Table 4-14 gives the basic statistics for the five ratios from the DuPont Expansion model for all farms. The profitability indicators are on average above zero %, showing that on average, farmers made a profit in 2011/12. The standard deviation for RoS however is quite high at 0.2414. The Compound Leverage Factor is relatively low on average at 1.1922, showing a low level of indebtedness in the sector. Asset Turnover is 0.2630, and has a high standard deviation at 0.2341.

Table 4-14: DuPont ratio statistics general – farms in England (2011/12)

Financial performance indicator	Mean	St. Dev.
Return on Sales	.0733	.2414
Asset Turnover	.2630	.2341
Compound Leverage Factor	1.1922	.4037
Return on Assets	.0213	.0690
Return on Equity	.02402	.0950

Source: calculated from FBS 2011/12.

As seen in the 2008-2013 dataset, there are some differences between the different farm types (Table 4-15). The Livestock Grazing farms have low Return on Sales, Return on Assets and Return on Equity compared to the Dairy farms and Cereal farms. Dairy farms have the highest Asset Turnover, which is in line with practices on the farm. Cereal farms, similar to the period 2008-2013, are the best performing farm type in terms of profitability (Return on Sales, Return on Assets and Return on Equity).

Table 4-15: DuPont ratio statistics per farm type in England (2011/12)

Financial performance indicator	Cereal farms	Dairy farms	LFA grazing livestock farms	Lowland grazing livestock farms
Return on Sales	.2431 (.1627)	.0558 (.1522)	-.0184 (.2870)	-.0131 (.2544)
Asset Turnover	.2640 (.2700)	.3399 (.2208)	.2542 (.2241)	.1923 (.1889)
Compound Leverage Factor	1.1650 (.3755)	1.2765 (.4020)	1.1502 (.3381)	1.1672 (.4632)
Return on Assets	.0570 (.0726)	.0168 (.0598)	.0099 (.0707)	-.0017 (.0578)
Return on Equity	.0711 (.1074)	.0176 (.0818)	.0087 (.0904)	-.0059 (.0787)
Notes: 1. Standard deviation is given in brackets ()				

Source: calculated from FBS 2011/12.

Results from an ANOVA shows that there are statistically different results between the various farm types (Table 4-16), with statistically significant results for each ratio. As said above, the ANOVA does not show which farm types are different from each other, just that there are differences in the groups.

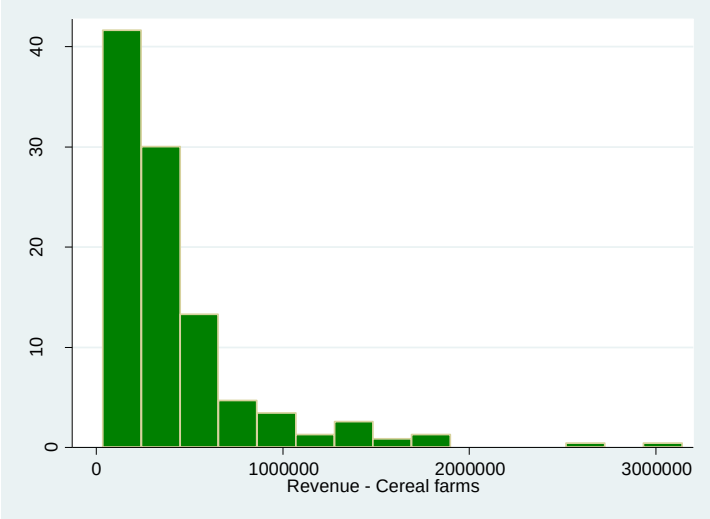
Table 4-16: Results ANOVA on the DuPont ratios

Ratio	Source	SS	Df	MS	F	Prob >F
RoS	Between groups	9.9497	3	3.3166	70.76	0.000
	Within groups	40.2177	858	0.4688		
	Total	50.1674	861	.05266		
ATO	Between groups	2.5198	3	.8399	16.13	0.000
	Within groups	44.6788	858	.0521		
	Total	47.1986	861	.05482		
CLF	Between groups	2.2368	3	.7455	4.63	0.0032
	Within groups	138.0844	858	.1609		
	Total	140.3212	861	.1629		
RoA	Between groups	.4458	3	.1486	34.93	0.000
	Within groups	3.6502	858	.0042		
	Total	4.0960	861	.00475		
RoE	Between groups	.7711	3	.2570	31.49	0.0000
	Within groups	7.0044	858	.00816		
	Total	7.7755	861	.0090		

Source: calculated from FBS 2011/12.

4.3.2. Visual representation

The analysis above shows that there are statistically significant differences in the performance of the various farm types. In addition, even within each farm type, there are large fluctuations. The analysis for 2011/12 shows that the most pronounced differences can be found for profitability in the Cereal sector, followed by Dairy farms (Figure 4-4). Not all farmers manage to achieve a good level of profitability as they cannot control their costs as well as others, or generate a large enough volume and price to achieve success. The balance sheets are also structured differently, pointing at different underlying factors, including tenure, access to foreign capital, and the ability to reinvest previous years' profits into the business. Cereal farms have quite a large asset base compared to Dairy, LFA Grazing Livestock and Lowland Grazing Livestock farms. There is little fluctuation in the liabilities within Cereal farms, regardless of size of the total assets, while with the other farm types more variability is noticeable. On average, indebtedness is low, with Dairy farms having on average the most liabilities (16.88%), followed by Cereal farms (10.42%), Lowland Grazing Livestock (9.10%) and LFA Grazing Livestock farms (9.05%).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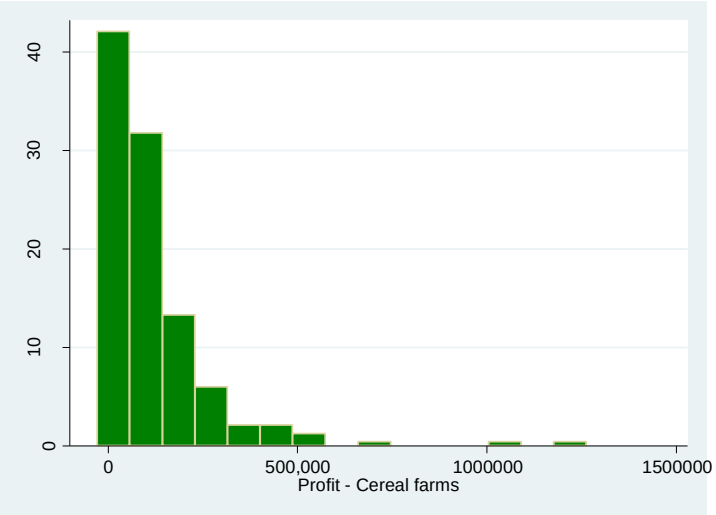
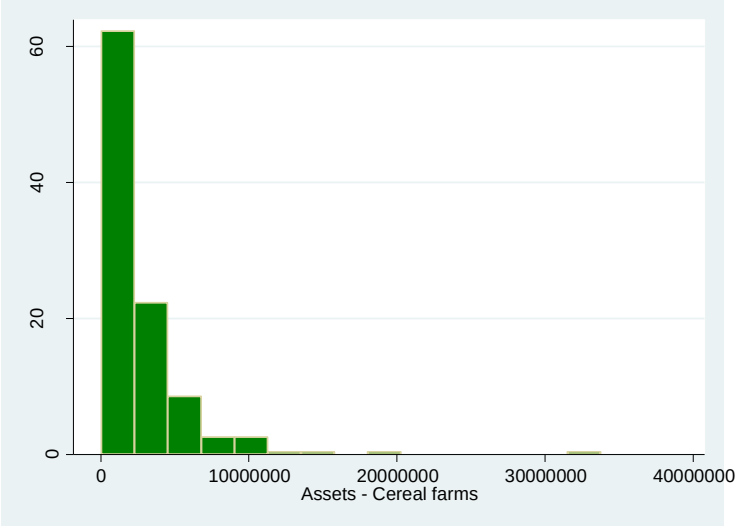
10
20
30
40
0
1000000
2000000
3000000
Revenue - Cereal farms


0
10
20
30
40
0
500,000
1000000
1500000
Profit - Cereal farms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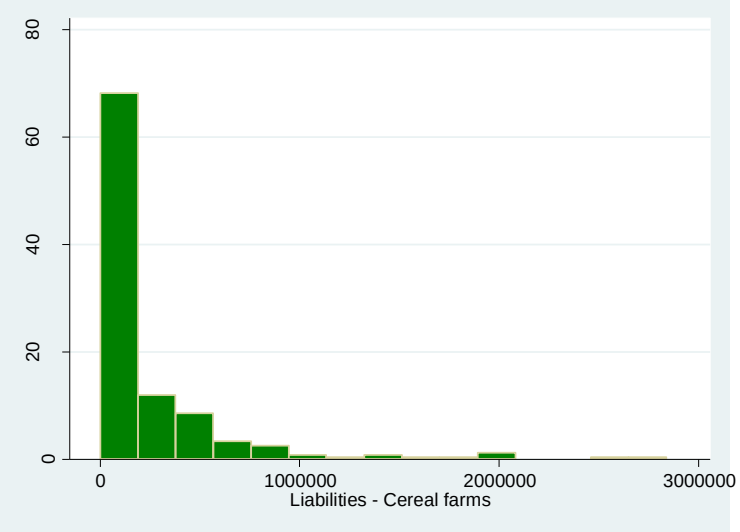
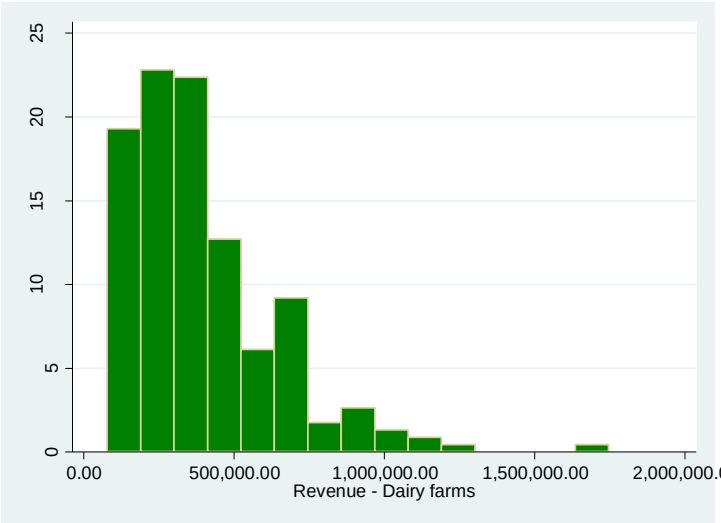
20
40
60
0
10000000
20000000
30000000
40000000
Assets - Cereal farms


0
20
40
60
80
0
1000000
2000000
3000000
Liabilities - Cereal farms


0
5
10
15
20
25
0.00
500,000.00
1,000,000.00
1,500,000.00
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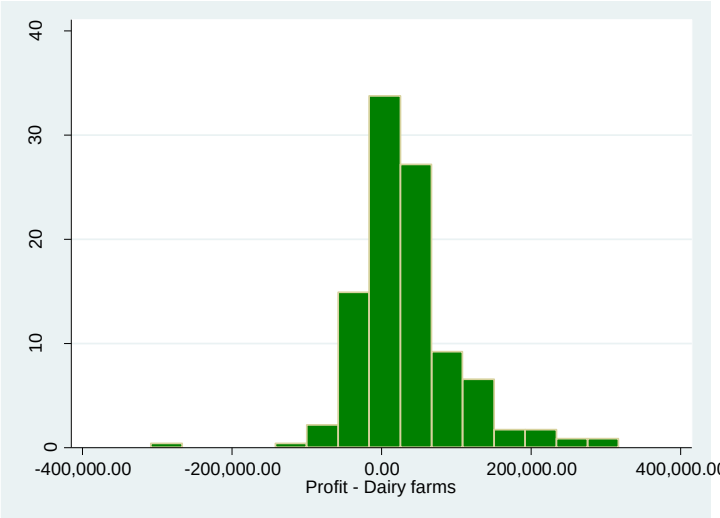
Revenue - Dairy farms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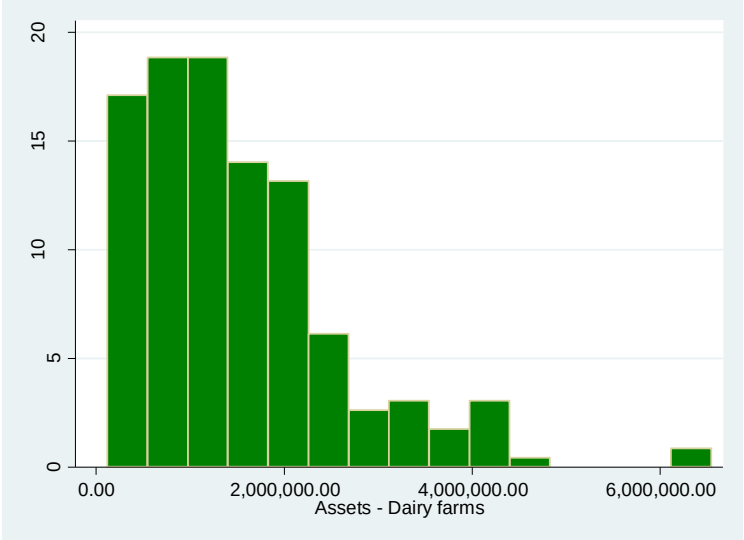
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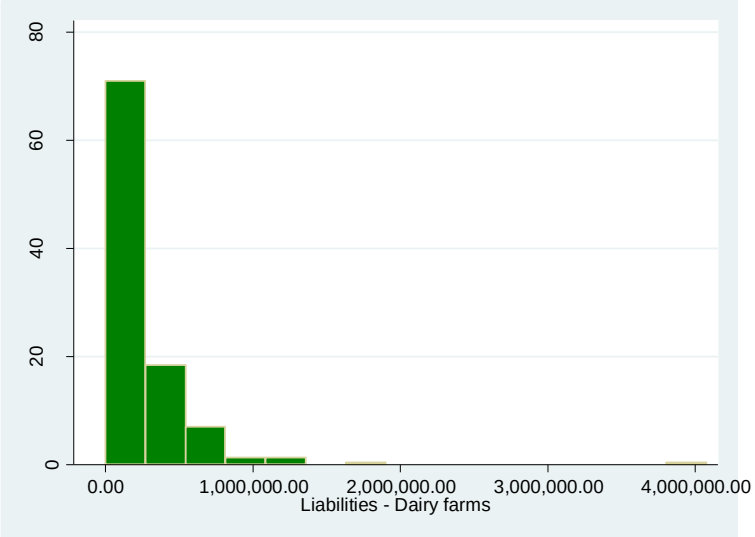
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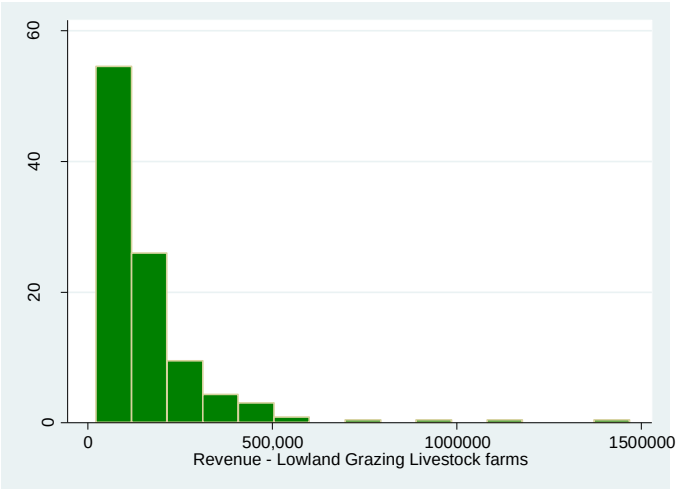
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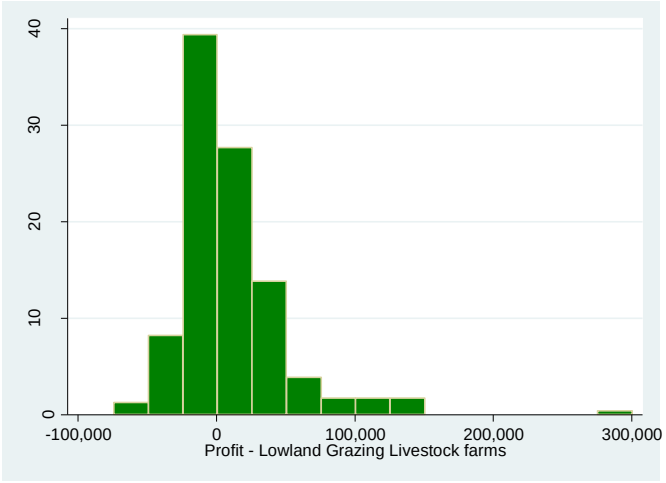
Revenue - Lowland Grazing Livestock farms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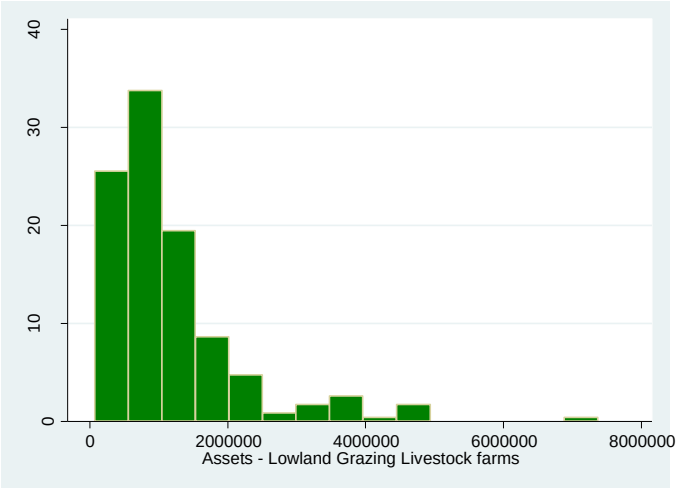
Profit - Lowland Grazing Livestock farms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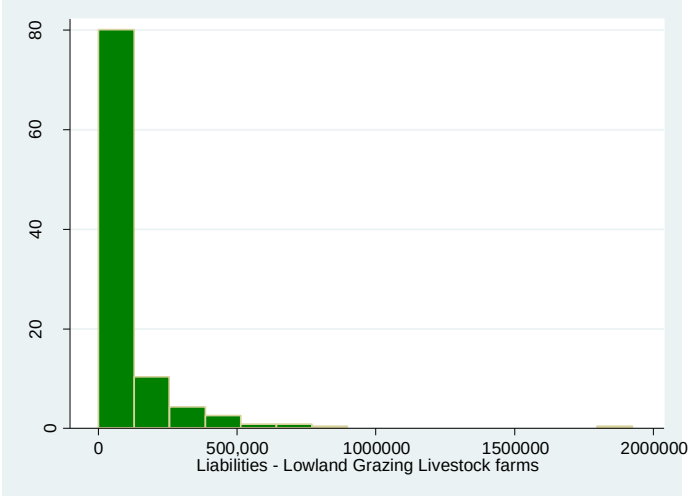
Assets - Lowland Grazing Livestock farms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Liabilities - Lowland Grazing Livestock farms

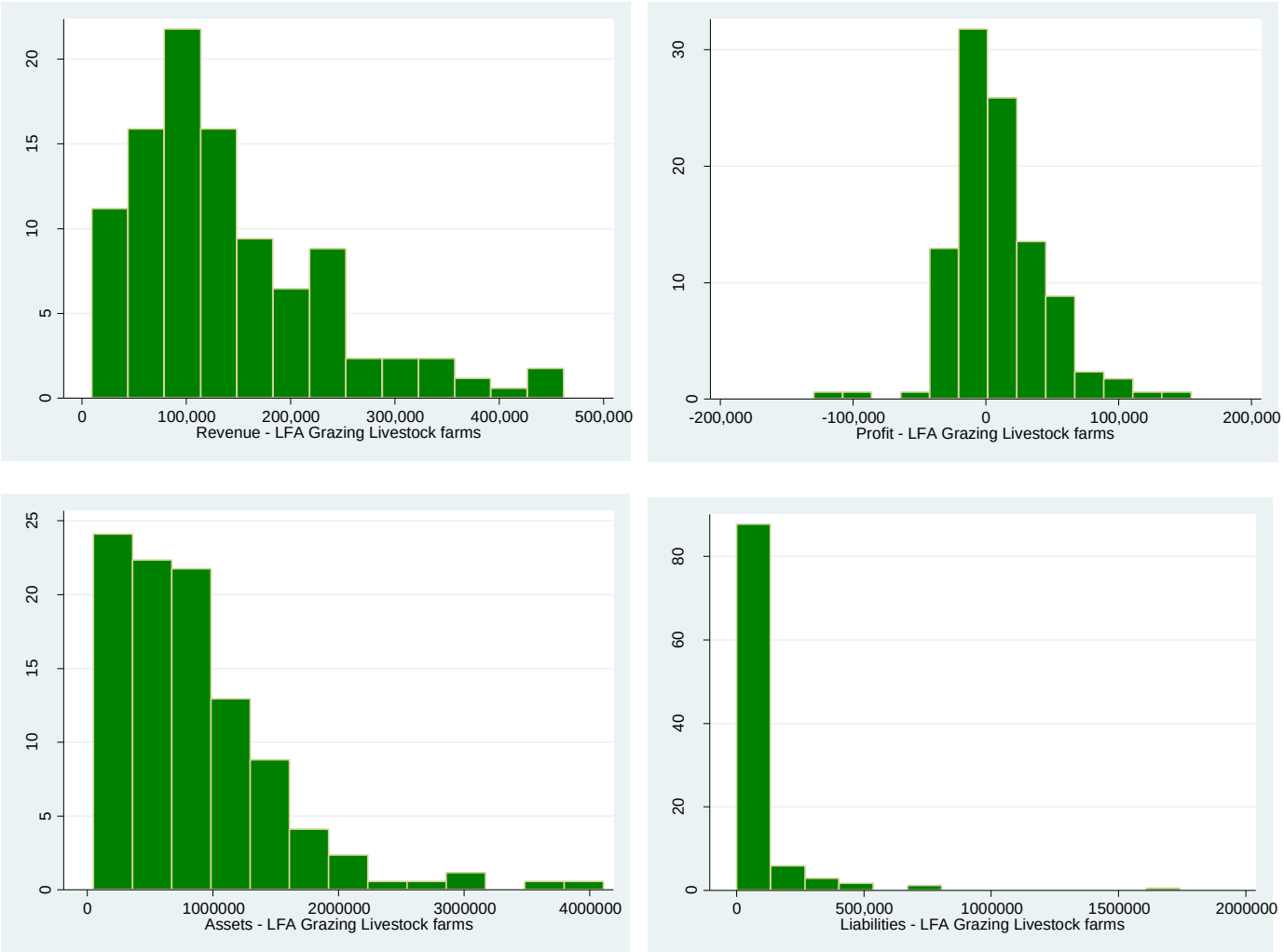

Figure 4-4: Histogram - revenue, profit, assets and liabilities per farm type, 2011/12
Source: calculated from the FBS 2011/12.

4.4. Conclusion

The purpose of this Chapter was to introduce the dataset that is used for this research, and set out definitions for the variables.

The Chapter also aimed at verifying whether the DuPont Expansion model is a good model to understand the financial performance of the agricultural industry in England. The correlation analysis undertaken on 14 of the sweet 16 financial ratios shows that the DuPont Expansion model is, indeed, suitable for analysing the financial situation of the sector.

This Chapter also provided insight into the current performance of the sector. Using the DuPont Expansion model, it shows that overall, the agricultural industry in England is performing relatively well as on 14 of the sweet 16 ratios the industry scores well within or above the suggested range, with the exception of profitability.

However, as the data has shown, there are large fluctuations within the sector per farm type, and within each farm type. A brief analysis of a balanced panel (downloaded from the FBS covering the years 2008 to 2013) gave some insight into the different farm types, with Cereal farms consistently outperforming the other farm types on Return on Sales, and Dairy farms, LFA Grazing Livestock farms and Lowland Grazing Livestock farms struggling around the breakeven line. The trends in Asset Turnover and Compound Leverage Factor are similar for all farm types, indicating that it is Return on Sales that causes the difference in Return on Assets and Return on Equity for the various farm types. For 2011/12, similar results were found, with Cereal farms consistently outperforming all other farm types on the profitability indicators, Dairy farms having greatest Asset Turnover, and indebtedness on all farm types, in general, being low.

5. Results Part 2: the impact of management practices on financial performance

This Chapter contains the results of the analysis of the impact of management practices on financial performance. In the first section, a description is given of how management practices are applied on the four farm types in England (Cereal farms, Dairy farms, LFA Grazing Livestock farms and Lowland Grazing Livestock farms), as captured within the FBS 2011/12 dataset. The management practices are organised around the six domains of the conceptual framework: business planning and benchmarking; knowledge acquisition; experience; IT skills; size; and ownership (grouped into farm characteristics). As there were quite a few options within each domain, the variables were recoded and, at the end of the first section, a brief overview is given of the indicators that were retained for the regression analysis.

The second section compares the application of management practices on low and high performing farms i.e. the bottom and top 25% of each farm type on four of the five ratios of the DuPont Expansion model. As discussed previously, the effect of management practices on Compound Leverage Factor is not assessed as the interpretation of the ratio is not as straightforward as for the other ratios.[13] Using t-tests, an analysis is made on whether the difference in use of management practices and characteristics is statistically significant.

The third section starts with some descriptive statistics on the independent variables, before moving to the results of the regression analysis. As there were issues with multicollinearity, two models were estimated for each of the four ratios: one for direct effects, and one for interaction effects. The results of all models are given in the second part of Section two, before moving to a discussion on the impact of management practices on financial performance.

At the end of this Chapter, a brief conclusion is given.

[13] See Section 2.2.2.2. Difficulties with financial ratios. A high CLF is linked with financial risk, and a low CLF might be caused by a lack of access to foreign capital – unlike the other 4 ratios where the rule is: the higher, the better.

5.1. Application of management practices

As stated in Chapter three, the data in the FBS is collected through the RBR consortium of Universities and colleges, which assist farmers with collecting the data and preparing management accounts. For the year 2011/12, a module was added (Module O), which investigated the use of management within the different farm types. They related to business management practices; animal health and welfare; climate change mitigation and adaption. For this research, the practices that are considered to originate from Module O mainly, can be organised into six domains – the domains as set out in the conceptual framework: business planning and benchmarking; knowledge acquisition; experience; IT skills; size; and ownership. Each of these is given a section in the description below, except for size and ownership which can be found under the single heading of 'farm characteristics'.

Defra (2013) produced two reports that provide insight into the use management practices on farms. One was on the use of business management practices, and one on computer usage. Their reports compared the situation in 2012 with the situation in 2008, and even though some insight is gathered into the usage per farm type, it mainly covers all farmers that participated in the module without going into detail into the differences per farm type – which is what is detailed below.

It has to be noted that little written guidance was provided on how to interpret some of the practices, and the definitions that were provided were brief. For example, there is no detail on what a formal plan should entail as a minimum, or what benchmarking activities look like. Additionally, some terms such as the use of "regular" might be interpreted differently by different people. The lack of definitions might have caused bias in the results, but no suitable solution was found for this problem. Instead, it was assumed that the study teams used the definitions set out by Defra in their guidance, and common sense as to what some of these terms meant.

5.1.1. Business Planning and Benchmarking

The business planning, benchmarking and management section of the FBS survey investigated what planning tools and methods farmers used on their farm. Table 5-1 shows how many farmers apply business practices on their farms by farm type. On average, 83.06% of farmers

apply management practices. Business Planning and Benchmarking are however not embedded across the farm types equally. Whilst only 7.30% of the Cereal farms and 8.33% of the Dairy farms in the dataset do not use any kind of planning and benchmarking methods, over 25% of the Lowland Grazing Livestock farms and nearly 31% of the LFA Grazing Livestock Farms do not use any methods. Several factors could be responsible for this difference, such as the fact that there have been more CPD schemes for Cereal farms (see below) or that assets and investments on Cereal and Dairy farms are substantially higher (see above), requiring more extensive planning from managers.

Table 5-1: Farms that use business planning and benchmarking in the FBS in England

Using business planning and benchmarking	**Number of farms**	**No**	**Yes**
Cereal farms	233	17 (7.30%)	216 (92.70%)
Dairy farms	228	19 (8.33%)	209 (91.67%)
LFA Grazing Livestock farms	170	52 (30.59%)	118 (69.41%)
Lowland Grazing Livestock farms	231	58 (25.11%)	173 (74.89%)
Total	862	146 (16.94%)	716 (83.06%)

Source: calculated from the FBS 2011/12.

Farmers that apply business planning and benchmarking on their farms, could indicate what tools they applied, ranging from participating in a discussion group, to informal planning, formal planning and benchmarking. Table 5-2 captures the responses the farmers gave for each individual tool, organised by farm type, with the definitions of the practices being used (FBS 2011/12, p. 35):

- Discussion groups: *regularly attends discussion groups on business management issues;*
- Informal plan, *e.g. at least once a year the team met to discuss future directions;*
- Formal plan: *making a written, formal plan that is reviewed at least once a year;*
- Cash flow planning: *regularly producing budgets, gross margins or cash flow planning, or reviewing the profit and loss account in-depth;*
- Farm level benchmarking: *whole farm level benchmarking;* and,
- Higher level benchmarking: *enterprise level/ balance sheet/ international benchmarking.*

Table 5-2: Use of Business Planning, Benchmarking and Management practices in the FBS in England

Business Planning and Benchmarking Practice	Number of farms	Discussion Group	Informal plan	Formal Plan	Cash flow plan	Farm Level Bench-marking	Higher Level Bench-marking
Cereal farms	233	87 (37.34%)	157 (67.38%)	74 (31.76%)	89 (38.20%)	38 (16.31%)	24 (10.30%)
Dairy farms	228	99 (43.42%)	148 (64.91%)	85 (37.28%)	86 (37.72%)	73 (32.02%)	39 (17.11%)
LFA Grazing Livestock farms	170	33 (19.41%)	101 (59.41%)	24 (14.12%)	26 (15.29%)	16 (9.41%)	6 (3.53%)
Lowland Grazing Livestock farms	231	53 (22.94%)	136 (58.87%)	46 (19.91%)	41 (17.75%)	15 (6.49%)	9 (3.90%)
Total	862	272 (31.55%)	542 (62.88%)	229 (26.57%)	242 (28.07%)	142 (16.47%)	78 (9.05%)

Note: percentage is given between brackets, based on the total number of farms in the dataset.
Source: calculated from the FBS 2011/12

Some interesting facts to note are:

- The most commonly used tool is the informal plan, which is defined as meeting at least once a year to discuss future directions. Over half of all farm types use this technique.
- Formal planning, defined as producing a formal, written plan and reviewing it at least once a year (FBS 2011/12), is used by approximately 37% of the Dairy farms and over 31% of the Cereal farms. It is less embedded with the Grazing Livestock farms, at 14.12% of the LFA farms and 19.91% for the Lowland farms. This finding is similar for Cash flow planning, although application rates are slightly higher. Cash flow planning here comprises regular production of cash flow statements, budgets or gross margins, or an in-depth analysis of the profit and loss account (FBS 2011/12).
- Very few Grazing Livestock farms engage with benchmarking, be it at farm level or at a higher level. Farm level benchmarking is defined as undertaking comparison activities at the whole farm level, while higher level benchmarking entails comparing results at enterprise level (broken down into various business segments on the farm), a comparison of the balance sheet structure and values, and/or international benchmarking (FBS 2011/12). Dairy farms seem to be the exception, with 32.02% undertaking benchmarking activities at the farm level, but only 19% of the dataset comparing their results with other farms, either at enterprise level, on balance sheet, or internationally. Still, compared to the other three farm types, this is quite a high number. One of the reasons underlying this could be the existence of benchmarks such as the Milkbench+, a benchmarking system developed by the Agricultural and Horticultural Development Board that is used to assess financial performance in the Dairy sector, or the pricing system in the Dairy sector, which is often

based on cost-plus (for the large supermarkets), making Dairy farmers more prone to benchmark (Milkbench +, n.d.). There are also several consultancy agencies who can support farmers with benchmarking.

Looking at the combination of practices that farmers apply (Table 5-3), there is variation in the number of management practices used on the farm. One third of all farm business types undertake only one practice, 22.39% undertake two practices, and some 25% of the dataset undertakes three or more practices (13.69% undertake three practices; 11.95% undertake four or more practices). Within the farm types, however, there are large differences. Cereal and Dairy farms are mainly responsible for achieving high frequencies on two or more practices, as the application rate is high. In contract, on the Livestock farms, most farmers apply only one practice, and less than one third of the farmers uses two or more practices.

Table 5-3: Use of multiple business planning and benchmarking practices

Business Planning and Benchmarking Practice	**No practices**	**Single Practice only**	**Two practices**	**Three practices**	**Four practices or more**
Cereal farms	17 (7.30%)	82 (35.19%)	60 (25.75%)	41 (17.60%)	33 (14.16%)
Dairy farms	19 (8.33%)	57 (25%)	61 (26.75%)	43 (18.86%)	48 (21.05%)
LFA Grazing Livestock farms	52 (30.59%)	64 (37.65%)	30 (17.65%)	16 (9.41%)	8 (4.71%)
Lowland Grazing Livestock farms	58 (25.11%)	99 (42.86%)	42 (18.18%)	18 (7.79%)	14 (6.06%)
Total	146 (16.94%)	302 (35.03%)	193 (22.39%)	118 (13.69%)	103 (11.95%)

Source: calculated from the FBS 2011/12.

Within the FBS dataset, farmers could set out the reasons why they did not undertake business planning and benchmarking and Table 5-4 summarizes such responses. It shows that, for quite a lot of farmers, they either are not interested in undertaking the practices (50.34% of the farmers that do not undertake practices) or they do not have the time (29.31% of the farmers that do not undertake practices). In addition, the relevance of benchmarking is unclear for about one in five farmers. It also looks like it is not a question of not having the relevant skills for budgeting (13.61% of responses), using software (2.04% of responses) or having access to suitable training courses (2.04%).

Table 5-4: Reasons why farmers do not apply business planning and benchmarking on their farm

Reason for not applying business planning and benchmarking	Number of farms	Relevance of bench-marking unclear	No suitable bench-marking data available	Does not have the skills available for budgeting	Could not find the time	Software available but does not know how to use it	Not interested	No suitable training courses
Cereal farms	17	5 (29.41%)	0 (0.00%)	8 (47.06%)	9 (52.94%)	0 (0.00%)	9 (52.94%)	1 (5.88%)
Dairy farms	19	3 (15.79%)	0 (0.00%)	2 (10.53%)	14 (73.68%)	1 (5.26%)	7 (36.84%)	0 (0.00%)
LFA Grazing Livestock farms	52	7 (13.46%)	3 (5.77%)	6 (11.54%)	16 (30.77%)	1 (1.92%)	26 (50.00%)	1 (1.92%)
Lowland Grazing Livestock farms	58	14 (24.14%)	0 (0.00%)	4 (6.90%)	17 (29.31%)	1 (1.72%)	32 (55.17%)	1 (1.72%)
Total	146	29 (19.73%)	3 (2.04%)	20 (13.61%)	56 (38.10%)	3 (2.04%)	74 (50.34%)	3 (2.04%)

Source: calculated from the FBS 2011/12.

The vast majority of farmers (73.67%) indicated that they wished to learn more about business planning and benchmarking practices (Table 5-5). Out of the responses, it is evident that there are large variations between the farm types:

- While little over one in five Cereal, Dairy or Lowland Grazing Livestock farmers have not indicated that they wish to learn more about management practices; more than two in five LFA Grazing Livestock farmers said that they do not to want to increase their knowledge and understanding of practices. What is striking is that it is the LFA Grazing Livestock farms that apply business planning and benchmarking the least out of all four farm types, possibly showing that these farmers have little interest in applying planning tools to their farms.
- The response that most farmers gave was analysing the profit and loss account (8.35% of respondents) followed by producing budgets, cash flows, and gross margins (7.66% of respondents) and benchmarking (6.26% of respondents).

Table 5-5: Business planning and benchmarking practices that farmers would like to learn more about

Farmers want to learn about	Number of farms	None	Producing a formal or informal plan	Producing budgets, cash flows, gross margins	Analysis of profit and loss account	Bench-marking	Enterprise level, balance sheet or international bench-marking
Cereal farms	233	51 (21.89%)	15 (6.44%)	16 (6.87%)	12 (5.15%)	15 (6.44%)	5 (2.15%)
Dairy farms	228	55 (24.12%)	13 (5.70%)	16 (7.02%)	21 (9.21%)	9 (3.95%)	7 (3.07%)
LFA Grazing Livestock farms	170	70 (41.18%)	10 (5.88%)	22 (12.94%)	23 (13.53%)	17 (10.00%)	6 (3.53%)
Lowland Grazing Livestock farms	231	51 (22.08%)	13 (5.63%)	12 (5.19%)	16 (6.93%)	13 (5.63%)	10 (4.33%)
Total	862	227 (26.33%)	51 (5.92%)	66 (7.66%)	72 (8.35%)	54 (6.26%)	28 (3.25%)

Source: calculated from the FBS 2011/12.

For this research, several variables were selected to function as direct effect variables, variables that are used on their own in the regression equation. They are: formal planning; cash flow planning; and benchmarking. The benchmarking category combines the responses of farm level benchmarking and higher level benchmarking, defined as *benchmarking that the farmers undertake, either at farm level, or looking internationally, at the balance sheet, or at enterprise level* (FBS 2011/12). These practices are also supported by Defra (see Chapter 2). Three combinations were made to show the interaction effects in the conceptual framework. They are: cash flow planning and formal planning; formal planning and benchmarking; and cash flow planning, formal planning and benchmarking. Table 5-6 captures how the practices used for this research are applied on the four farm types. As before, Cereal and Dairy farms have the highest application on the farm, followed by Lowland Grazing Livestock and LFA Grazing Livestock farms. As benchmarking is more applied within the Dairy Industry, the interaction variables formal planning and benchmarking; and cash flow planning, formal planning and benchmarking are the highest in the Dairy industry.

Table 5-6: Overview Business Planning and Benchmarking variables

Business Planning and Benchmarking Practice	**Formal Planning**	**Cash Flow Planning**	**Bench-marking**	**Cash flow planning and formal planning**	**Formal planning and bench-marking**	**Cash flow planning, formal planning and bench-marking**
Cereal farms	74 (31.76%)	89 (38.20%)	47 (20.17%)	48 (20.60%)	20 (8.58%)	17 (7.30%)
Dairy farms	85 (37.28%)	86 (37.72%)	87 (38.16%)	58 (25.44%)	45 (19.74%)	36 (15.79%)
LFA Grazing Livestock farms	24 (14.12%)	26 (15.29%)	20 (11.76%)	10 (5.88%)	3 (1.76%)	0 (0%)
Lowland Grazing Livestock farms	46 (19.91%)	41 (17.75%)	22 (9.52%)	22 (9.52%)	11 (4.76%)	9 (3.90%)
Total	**229 (26.57%)**	**242 (28.07%)**	**176 (20.42%)**	**138 (16.01%)**	**79 (9.16%)**	**62 (7.19%)**

Source: calculated from the FBS 2011/12.

5.1.2. Knowledge acquisition

Three indicators were used to describe knowledge acquisition: education; accessing advice; and being a member of a CPD scheme.

In terms of education, farmers could indicate whether the person with managerial decision making power had one of the following four:

- No further/higher education;
- College/national diploma or certificate in agriculture, business management, accountancy, marketing, economics or related subjects;
- A degree in agriculture, business management, marketing, economics or related subjects, and
- A college/national diploma or certificate and a degree in agriculture, business management, accountancy, marketing, economics or related subjects.

Table 5-7 gives the overview of the responses per farm type. Across all farm types, 31.55% of farmers have no further or higher education and 48.96% have a college or national diploma or certificate. Few farmers (11.37%) have a university degree or a university degree and a college or national diploma or certificate (8.12%). Within the farm types, there are differences, with the most frequent response given by LFA Grazing Livestock farmers as having no further or

higher education, while all other farm types indicated having a college or national diploma or certificate most often. The difference between LFA Grazing Livestock farms and Lowland Grazing Livestock farms however is minimal.

Table 5-7: Education level of the farmers in the dataset

Education level of farmers in the dataset	**Number of farms**	**No further or higher education**	**College/national diploma or certificate**	**Having a University Degree**	**College/national diploma or certificate and a Degree**
Cereal farms	233	55 (23.61%)	123 (52.79%)	36 (15.45%)	19 (8.15%)
Dairy farms	228	49 (21.49%)	128 (56.14%)	27 (11.84%)	24 (10.53%)
LFA Grazing Livestock farms	170	74 (43.53%)	72 (42.35%)	11 (6.47%)	13 (7.65%)
Lowland Grazing Livestock farms	231	94 (40.69%)	92 (42.86%)	24 (10.39%)	14 (6.06%)
Total	**862**	**272 (31.55%)**	**422 (48.96%)**	**98 (11.37%)**	**70 (8.12%)**

Source: calculated from the FBS 2011/12.

The second practice that falls under knowledge acquisition, is accessing advice. The FBS captured several ways to access advice. Most of the methods fall under the "free" category, such as talking with other farmers, the media such as internet sites and trade magazines, attending events and demonstrations, discussion groups, farm walks or workshops, and technical advice supplied with no direct charge. The other, paying, category contains accessing advice through technical advice supplied for a charge, RDP funded initiatives with a strong animal health theme or with a strong technical theme other than animal health.

Farmers access advice in various ways as demonstrated in Table 5-8. The most selected response is through talking with other farmers, media, attending events, workshops and free advice (14.59% of Cereal farms, 14.47% of Dairy, 18.24% of LFA Grazing Livestock and 14.29% of Lowland Grazing Livestock farms). Cereal and Dairy farms also access technical advice supplied for a charge in combination with all practices mentioned above (13.73% and 11.40% respectively).

Table 5-8: Use of accessing advice

Accessing advice	Cereal farms	Dairy farms	LFA Grazing Livestock farms	Lowland Grazing Livestock farms
Through taking with other farmers, and media	0.43%	2.63%	9.41%	4.76%
Through media, and free advice	2.58%	3.51%	1.76%	5.19%
Through taking with other farmers, media, and free advice	6.44%	2.63%	12.35%	6.93%
Through taking with other farmers, media, attending events, and free advice	3.86%	3.07%	8.24%	4.33%
Through taking with other farmers, media, attending events, workshops, and free advice	14.59%	14.47%	18.24%	14.29%
Through taking with other farmers, media, attending events, workshops, and paid advice	5.15%	1.32%	0.00%	0.43%
Through taking with other farmers, media, attending events, workshops, free advice, and paid advice	13.73%	11.40%	3.53%	5.63%
Total % of respondents who chose the answers above	**46.78%**	**39.04%**	**53.53%**	**41.56%**

Source: calculated from the FBS 2011/12.

The third and final knowledge acquisition practice – being a member of a Continuing Professional Development Scheme - consisted of a list of options to determine why farmers were not a member of a CPD scheme, and one option for farmers to be a member. The list of reasons for not being a member included:

- not being aware of CPD schemes;
- not having considered the scheme;
- the feeling that the application/membership process is too onerous;
- a lack of time to keep up membership;
- the CPD scheme is not available in the sector;
- that the farmer is not sure which scheme is most appropriate; and
- that the farmer is unsure about how the scheme could benefit the farm business.

Table 5-9 provides an overview of the membership status per farm type. The vast majority of Cereal farmers (70.82%) are members of a CPD scheme while, in all other farm types, not being a member is the majority response (82.46%, 94.71% and 86.15% of Dairy, LFA Grazing Livestock and Lowland Grazing Livestock farmers respectively are not a member of a CPD scheme). This could be due to the fact that, prior to 2012, there were no professional registers for non-cropping farms. In 2012, DairyPro was set up to provide specific advice to Dairy farmers.

Table 5-9: Membership of a CPD Scheme

Member of a CPD Scheme	Number of farms	No	Yes
Cereal farms	233	68 (29.18%)	165 (70.82%)
Dairy farms	228	188 (82.46%)	40 (17.54%)
LFA Grazing Livestock farms	170	161 (94.71%)	9 (5.29%)
Lowland Grazing Livestock farms	231	199 (86.15%)	32 (13.85%)
Total	**862**	**616 (71.46%)**	**246 (28.54%)**

Source: calculated from the FBS 2011/12.

Looking at the reasons why farmers were not members of a CPD Scheme (Table 5-10), the highest response is the one of not being aware of CPD schemes (24.83% of respondents), followed by farmers not having considered it (11.37%). The other reasons (finding the application process too onerous, lack of time, and not having a suitable scheme in the sector or knowing which one is most appropriate or how it could benefit business) were given by quite a low number of respondents (ranging between 1.28% of all respondents to 3.71%). If membership should be taken up, there should be some awareness raising on what schemes are available, and what they can offer in terms of benefits to farmers to engender interest in the schemes.

Table 5-10: Reasons for not being a member of a CPD scheme

Member of a CPD Scheme	Cereal farms	Dairy farms	LFA Grazing Livestock farms	Lowland Grazing Livestock	Total
Not aware of CPD schemes	16 (6.87%)	51 (22.37%)	72 (42.35%)	75 (32.47%)	214 (24.83%)
Have not considered	17 (7.30%)	34 (14.91%)	13 (7.65%)	34 (14.72%)	98 (11.37%)
Application/ membership process too onerous	3 (1.29%)	2 (0.88%)	0 (0.00%)	6 (2.60%)	11 (1.28%)
No time to keep up membership	2 (0.86%)	10 (4.39%)	6 (3.53%)	5 (2.16%)	23 (2.67%)
Interested but not available in relevant sector	0 (0.00%)	16 (7.02%)	3 (1.76%)	13 (5.63%)	32 (3.71%)
Interested but not sure which scheme is most appropriate (e.g. for mixed farms)	1 (0.43%)	9 (3.95%)	3 (1.76%)	13 (5.63%)	26 (3.02%)
Interested but not sure how it could benefit business	5 (2.15%)	3 (1.32%)	9 (5.29%)	5 (2.16%)	22 (2.55%)

Source: calculated from the FBS 2011/12.

In order to reduce the number of variables, the knowledge acquisition variables were all recoded:

- Education was changed into having a university degree or not;
- Accessing advice was changed into accessing paid advice or not, and
- The Continuing Professional Development indicator became a matter of being a member or not. All other indicators were dropped.

Tables 5-11 and 5-12 shows the responses for having a university degree and accessing paid advice respectively. Almost 20% of the farmers have a university degree; with the highest prevalence of university degrees within the Dairy sector (at 24.12%), followed by Cereal farmers (21.89%), Lowland Grazing Livestock farmers (16.45%), and in last position the LFA Grazing Livestock farms at 14.12% of the dataset. Almost 45% of farmers are accessing paid advice. There are large differences between the farm types however, with 57.51% Dairy farmers and 55.70% of Cereal farmers paying for advice, and less than half the Livestock Grazing farmers paying for advice.

Table 5-11: Having a University Degree

Having a University Degree	**Number of farms**	**No**	**Yes**
Cereal farms	233	182 (87.11%)	55 (21.89%)
Dairy farms	228	178 (78.07%)	51 (24.12%)
LFA Grazing Livestock farms	170	146 (85.88%)	24 (14.12%)
Lowland Grazing Livestock farms	231	193 (83.55%)	38 (16.45%)
Total	**862**	**694 (80.51%)**	**168 (19.49%)**

Source: calculated from the FBS 2011/12.

Table 5-12: Accessing paid advice

Accessing paid advice	**Number of farms**	**No**	**Yes**
Cereal farms	233	106 (46.49%)	127 (55.70%)
Dairy farms	228	99 (42.49%)	134 (57.51%)
LFA Grazing Livestock farms	170	129 (75.88%)	41 (24.12%)
Lowland Grazing Livestock farms	231	151 (65.37%)	80 (34.63%)
Total	**862**	**485 (56.26%)**	**382 (44.32%)**

Source: calculated from the FBS 2011/12.

5.1.3. Experience

Two indicators relate to the experience of a farmer. The first indicator is age – the older one gets, the more experienced they should be. In addition, an indicator for off-farm labour was included, to show how spouses contribute to the household, and farm in general.

Table 5-13 provides the average age of the farmer, and confirms findings of Eurostat and Defra that the average farmer is in his/her fifties (Eurostat, 2009 and Defra, 2013). The Dairy farmers in the dataset are, on average, a bit younger than his/her colleagues in the LFA Grazing Livestock, the Lowland Grazing Livestock or the Cereal sector.

Table 5-13: Average age of the farmers in the dataset

Age	**Number of farms**	**Average age**
Cereal farms	233	57
Dairy farms	228	53
LFA Grazing Livestock farms	170	55
Lowland Grazing Livestock farms	231	56
Total	**862**	**55**

Source: calculated from the FBS 2011/12.

Off-farm labour has been shown to have a positive effect on the farm, as evidenced in studies by El-Osta et al. (2004) and Mishra et al. (2007) among others. About 40% of all farmers' spouses are engaged in off-farm employment (Table 5-14), but again, these numbers differ according to farm type. It appears that most Cereal farmers do not have a working spouse (71.67% of the dataset) compared to 58.44% of the Lowland Grazing Livestock farms, 55.70% of the Dairy farms and 52.94% of the LFA Grazing Livestock farms. It is assumed that the spouse helps out on the farm when not engaged in off-farm labour. If their contribution on the farm is not paid for, it has been taken into account in the financial performance ratio.

Table 5-14: Farmers whose spouse engages in off-farm labour

Having a Working Spouse	**Number of farms**	**No**	**Yes**
Cereal farms	233	167 (71.67%)	66 (28.33%)
Dairy farms	228	127 (55.70%)	101 (44.30%)
LFA Grazing Livestock farms	170	90 (52.94%)	80 (47.06%)
Lowland Grazing Livestock farms	231	135 (58.44%)	96 (41.56%)
Total	**862**	**519 (60.21%)**	**343 (39.79%)**

Source: calculated from the FBS 2011/12.

5.1.4. IT skills

The fourth management practice considered concerns the use and knowledge of IT. This category contained the most options:

- There is no pc used on the farm or freely available to the farm business;
- There is a pc used on the farm but not used by the business;
- There is a pc used on the farm, which is used occasionally for some management purposes;
- The business has a computer but cannot get reliable access to the internet/broadband;
- The business has a computer that has good broadband internet access;
- The [farm team] is proficient in Excel/Word/E-mail and web-searching;
- The internet is used to purchase and/or sell material for the farm;
- The internet is regularly used to improve the performance of the farm e.g. benchmarking;
- The main farm business documents (Business Plan, Finance Accounts, etc.) are all managed on the computer;
- The internet/computer is used for submitting forms or banking e.g. CTS/BCMS documents, VAT returns, PAYE forms; and
- The farmer communicates regularly with other farms using the computer.

The responses from farmers were more diversified than the responses regarding business planning, benchmarking and management practices. Table 5-15 represents the then most common responses.

Some of the interesting facts include:

- Over 16% of the LFA Grazing Livestock and 11.26% of the Lowland Grazing Livestock farms do not have a pc or use it for business, compared to 4.30% of the Cereal farms and 3.51% of the Dairy farms.
- Even in the category “has a pc”, there are still quite a lot of farms that do not use it regularly for management purposes, especially in the LFA Grazing Livestock sector (over 15%). Remarkably, while there are very few Dairy farmers who do not have a pc or use it for business purposes (3.51% of the respondents), almost 11% of the Dairy farmers in the dataset use a pc occasionally for some management purposes (in combination with other skills).

- Over 16% of the LFA Grazing Livestock farms do not have a pc or use it for business. Still, 11.26% of the Lowland Grazing Livestock farms also do not utilise a pc for business, compared to 4.30% of the Cereal farms and 3.51% of the Dairy farms.
- Even in the category has a pc, there are still quite a farms that do not use it regularly for management purposes, especially in the LFA Grazing Livestock sector (over 15%). Remarkably, while there are very few Dairy farmers who do not have a pc or use it for business purposes (3.51% of the respondents), almost 11% of the Dairy farmers in the dataset use a pc occasionally for some management purposes (in combination with other skills).
- Cereal farmers and Dairy farmers have better knowledge of IT skills, and apply it more for business purposes than the Grazing Livestock farms. Looking at the percentages of Cereal and Dairy Farms that combine a good internet connection, good MS Office skills, keeping the documents on a pc, we find significantly more frequent application on those farms than on the LFA and Lowland Grazing Livestock farms.

Table 5-15: Knowledge and use of IT

Knowledge and use of IT	Cereal farms	Dairy farms	LFA Grazing Livestock farms	Lowland Grazing Livestock farms
- Has no pc on the farm	2.15%	2.63%	10.00%	4.33%
- Does not use the pc for business	2.15%	0.88%	6.47%	6.93%
- PC occasionally used for some management purposes, and - internet banking	1.72%	2.63%	6.47%	2.60%
- PC occasionally used for some management purposes, - good internet connection, and - internet banking	1.29%	5.26%	5.29%	4.33%
- PC occasionally used for some management purposes, - good internet connection, - has good MS office skills, and - internet banking	4.72%	3.07%	3.53%	3.46%
- Good internet connection, - has good MS Office skills, and - internet banking	3.00%	3.51%	1.76%	3.90%
- Good internet connection, - has good MS office skills, - documents are kept on the pc, and - internet banking	9.44%	9.65%	4.71%	7.79%
- Good internet connection, - has good MS office skills, - documents are kept on the pc, - buys- sells online, and - internet banking	11.59%	10.09%	5.29%	4.33%
- Good internet connection, - has good MS office skills, - documents are kept on the pc, - buys- sells online, - communicates with other farmers via the pc, and - internet banking	13.30%	4.39%	1.76%	5.19%
- Good internet connection, - has good MS office skills, - documents are kept on the pc, - buys- sells online, - communicates with other farmers via the pc, - uses pc to do benchmarking, and - internet banking	5.58%	8.33%	1.18%	2.60%
Total % of respondents who chose the answers above	**54.94%**	**50.44%**	**46.47%**	**45.45%**

Source: calculated from the FBS 2011/12.

Due to the large number of options, this variable was recoded into having good IT skills or not (Table 5-16). Good IT skills here are defined as:

- Having a good internet connection;
- Having good MS Office skills;
- Documents are kept on a pc; and
- Uses the pc to do internet banking.

Almost 55% of the Cereal farmers fall into the category of having good IT skills, followed by 42.98% of the Dairy farmers, 32.90% of the Lowland Grazing Livestock farmers and 19.41% of the LFA Grazing Livestock farmers. This was to be expected given the finding above on the number of Grazing Livestock farms who do not have a pc or use one for their business.

Table 5-16: Having good IT skills

Having Good IT skills	Number of farms	No	Yes
Cereal farms	233	106 (45.49%)	127 (54.51%)
Dairy farms	228	130 (57.02%)	98 (42.98%)
LFA Grazing Livestock farms	170	137 (80.59%)	33 (19.41%)
Lowland Grazing Livestock farms	231	155 (67.10%)	76 (32.90%)
Total	**862**	**528 (61.25%)**	**334 (38.75%)**

Source: calculated from the FBS 2011/12.

5.1.5. Farm's characteristics

In terms of size, there are four options based on the number of fulltime equivalents that work on the farm or standard labour requirements. In the FBS, the labour requirements are standardised per farm type, and each farm is benchmarked against it, falling into one of the following four categories:

- Very small farms employ less than one full-time equivalent;
- Small farms employ one full-time equivalent but less than two full-time equivalents;
- Medium-sized farms employ at least two but maximum three full-time staff;
- Large farms employ over three full time staff members but less than five full-time equivalents; and
- Very large farms employ over five full-time equivalents.

In the dataset (see Table 5-17), there are no very small Cereal farms or Dairy farms and also no small Dairy farms. In contrast, there are no large LFA Grazing Livestock farms and very few large Lowland Grazing Livestock farms (3.46%). Most Dairy farms (70.61% of the respondents) are large farms versus almost 30% of the Dairy farms being medium sized. The majority of the LFA Grazing Livestock and Lowland Grazing Livestock farms are small

(62.94% and 62.34% respectively). Almost 41% of the Cereal farms are medium, 32.62% are large and 26.61% are small.

Table 5-17: Farm size

Farm size	Number of farms	Very small farms	Small farms	Medium sized farms	Large farms
Cereal farms	233	0 (0%)	62 (26.61%)	95 (40.77%)	76 (32.62%)
Dairy farms	228	0 (0%)	0 (0%)	67 (29.39%)	161 (70.61%)
LFA Grazing Livestock farms	170	11 (6.47%)	107 (62.94%)	52 (30.59%)	0 (0%)
Lowland Grazing Livestock farms	231	24 (10.39%)	144 (62.34%)	55 (23.81%)	8 (3.46%)
Total	**862**	**35 (4.06%)**	**313 (36.31%)**	**269 (31.21%)**	**245 (28.42)**

Source: calculated from the FBS 2011/12.

In the regression model, two groups, namely the very small and small farms, were merged.

In terms of tenure (see Table 5-18), the most common type of tenure in all farm types is mixed tenure (part owner-occupied, part tenanted) at 52.78% of the whole dataset, followed by owner-occupied for all farm types at 30.16% for the whole dataset. Within each farm type, there are minor fluctuations around these averages; with Dairy farms having the lowest fully owned farms. This could be due to the size of the Dairy farms (no very small or small farms), and the relative capital intense nature of that sector. LFA Grazing Livestock and Lowland Grazing Livestock farms have, on average, the highest ownership rate, which could again be explained by the lower level of assets needed to run the business, and the prevalence of very small and small farms.

Table 5-18: Tenure of the farms

Farm tenure	Number of farms	Fully rented	Mixed ownership	Fully owned
Cereal farms	233	36 (15.45%)	136 (58.37%)	61 (26.18%)
Dairy farms	228	44 (19.30%)	126 (55.26%)	58 (25.44%)
LFA Grazing Livestock farms	170	40 (23.53%)	74 (43.53%)	56 (32.94%)
Lowland Grazing Livestock farms	231	27 (11.69%)	119 (51.52%)	85 (36.80%)
Total	**862**	147 (17.05%)	455 (52.78%)	260 (30.16%)

Source: calculated from the FBS 2011/12.

5.2. Comparison between low performers and high performers

Before assessing how much impact the use of a certain management practice has on financial performance, a comparison was undertaken between the low and high performers. The bottom 25 and top 25 % performers were distilled from the dataset per farm type (430 farms in total, with 215 in each group), and the application of each practice and characteristic was calculated. T-tests were used to compare the means per indicator, in order to assess whether there are different uses and characteristics within the dataset. The tables showing the detail per ratio can be found in Annex 3. Table 5-19 below shows the summary of the results:

- The higher performers consistently apply more business planning and benchmarking practices on their farm than the low performers. In terms of formal planning, the results show that the differences are statistically significant, three times at the 1% level, and once at the 5% level. The difference in application of regular cash flow planning is also statistically significant for the groups; with low performers using it less than high performers, and benchmarking is applied a lot less on low performing farms than on high performing farms, with the difference being statistically significant at the 1% level for three ratios. In addition, using multiple practices also resulted in a different application across low and high performing farmers.
- In terms of knowledge acquisition, there is a statistically significant difference in paying for advice, with low performers using it less than high performers. There is a difference in having a university degree, with low performers scoring less on this indicator (once statistically significant at the 5% level and twice at the 10% level). However, being a member of a Continuing Professional Development Scheme has no statistically significant effect on any ratio; low and high performers do not apply this tool differently.
- Where experience is concerned, the difference in age is statistically significant, with high performers being younger than the low performers. The difference in having a working spouse is only statistically significant for one of the four ratios (ATO).
- There is also a difference in IT skills, with low performers not rating as highly on this indicator as high performers (three times statistically significant at the 5% level).
- Farm size makes a difference. Low performers are smaller than high performance, and the difference is statistically significant at the 1% level for all four ratios.
- Finally, the effect of ownership is mixed. Low performers rate less on this indicator for the ratio ATO (at the 10% level), but score higher on it for the other ratios than the high performers, indicating that it affects the ratios in a different manner.

Table 5-19: Summary of the tests for statistically significant differences between low and high performers

Results on the four ratios (RoS, ATO, RoA and RoE)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	ATO, RoA, RoE at 1% level RoS at 5% level	ATO, RoA, RoE at 1% level RoS at 10% level	
Using cash flow planning	RoS at 1% level RoA, RoE at 5% level ATO at 10% level	RoS at 1% level RoA, RoE at 5% level	
Any level of benchmarking	RoS, RoA, RoE at 1% level	RoS, RoA, RoE at 1% level	
Using formal planning and cash flow planning	ATO, RoA, RoE at 5% level RoS at 10% level	RoE at 5% level ATO, RoA at 10% level	
Using formal planning and benchmarking	RoS, RoE at 1% level RoA 5% level	RoS, RoA, RoE at 5% level	
Using formal planning, cash flow planning and benchmarking	RoS, RoE at 5% level RoA at 10% level	RoS, RoE at 10% level	
Accessing advice	RoE at 1% level RoS, RoA at 5% level	RoA, RoE at 5% level RoS at 10% level	
Having a university degree	ATO at 5% level RoA, RoE at 10% level	ATO at 5% level	
Being a member of a CPD scheme			
Age		ATO at 1% level RoS, RoA, RoE at 5% level	RoS, ATO at 1% level RoA, RoE at 5% level
Having a working spouse	ATO at 5% level	ATO at 5% level	
Having good IT skills	RoS, RoA, RoE at 5% level	RoE at 5% level RoS, RoA at 10% level	
Farm size	RoS, ATO, Ro, RoE at 1% level	RoS, ATO, RoA, RoE at 1% level	
Ownership	RoS at 10% level	ATO at 1% level RoA, RoE at 5% level	ATO at 1% level RoA, RoE at 5% level

Source: calculated from the FBS 2011/12.

5.3. Results from the regression analysis

5.3.1. The variables

Given the analysis and results showing different application of tools and characteristics between low and high performers, a regression analysis will show the effect of these practices on financial performance. Table 5-20 gives an overview the variables that were used for the conceptual framework, that are considered as independent variables in the regression model.

Table 5-20: Overview of the variables used in the regression analysis

Management practices	Type of variable	Mean
Age (average)	Continuous	55.08
Size	Ordinal variable, ranging from 2 (small), to 3 (medium), and 4 (large)	2.88
Using formal planning	Dummy variable, with 0 meaning not making a formal plan that is reviewed at least once a year, and 1 being undertaking the practice	0.2657
Cash flow planning	Dummy variable, with 0 meaning not undertaking regular cash flow planning, gross margin or budgeting, and 1 being undertaking the practice	0.2807
Benchmarking	Dummy variable, with 0 meaning not undertaking any kind of benchmarking, and 1 being undertaking benchmarking activities	0.2042
Having a university degree	Dummy variable, with 0 meaning having a university degree, and 1 having a university degree	0.1948
Accessing paid advice	Dummy variable, with 0 meaning not paying to access advice, and 1 being accessing paid advice	0.4432
Member of a CPD Scheme	Dummy variable, with 0 meaning not being a member of a CDP Scheme, and 1 being a member	0.2854
Off-farm labour	Dummy variable, with 0 meaning not having a working spouse, and 1 having a working spouse	0.3979
Having good IT skills	Dummy variable, with 0 meaning not having good IT skills, and 1 having good IT skills	0.3875
Formal planning and cash flow planning	Dummy variable, with 0 meaning not undertaking both practices, and 1 being undertaking both practices	0.1601
Formal planning and benchmarking	Dummy variable, with 0 meaning not undertaking both practices, and 1 being undertaking both practices	0.0916
Formal planning, cash flow planning and benchmarking	Dummy variable, with 0 meaning not undertaking the practices, and 1 being undertaking all three practice	0.0742
Owner-occupied	Dummy variable, with 0 meaning not owner-occupied, and 1 meaning owner-occupied	0.3016
Cereal	Dummy variable, with 0 meaning not a Cereal farm, and 1 indicating a Cereal farm	0.2703
Dairy	Dummy variable, with 0 meaning not a Dairy farm, and 1 indicating Dairy farm	0.2645
LFA	Dummy variable, with 0 meaning not an LFA Grazing Livestock farm, and 1 indicating an LFA Grazing Livestock farm	0.1972

Source: calculated from the FBS 2011/12.

As most variables are dummy variables, using Pearson's correlation matrix is not appropriate to assess whether the number of variables can be reduced or are connected. Instead, a Variance Inflation Matrix (VIF) was run on the independent variables, resulting in the identification of multicollinearity for the interaction effects. Therefore, in order to assess the impact of undertaking more than one practice simultaneously, these interaction effects were estimated in a separate model. The Variance Inflation factors for the direct effects and indirect effects models never reached the critical value of 10 (Tables 5-21 and 5-22 respectively).

Table 5-21: Variance Inflation Factors for the direct effects

VIF	RoS	ATO	RoA	RoE
BMP_ Fml	1.32	1.32	1.19	1.29
BMP_CF	1.39	1.32	1.35	1.95
BMP_AnyB	1.08	1.30	1.34	1.23
Uni	1.30	1.11	1.06	1.14
AA	1.22	1.37	1.28	1.84
CPD	1.85	1.71	1.91	2.16
Age	1.21	1.10	1.12	1.56
Work_Sp	1.13	1.07	1.22	1.12
IT	1.39	1.31	1.13	1.65
Size 3	4.38	2.05	1.61	1.82
Size 4	5.88	4.32	3.4	5.50
Own	1.09	1.15	1.29	1.51
Cereals	4.91	2.60	1.82	1.83
Dairy	5.61	4.65	2.53	4.89
LFA	1.45	1.69	1.28	1.19
Mean VIF	2.35	1.87	1.57	2.04

Note: RoS is Return on Sales, ATO is Asset Turnover, RoA is Return on Assets and RoE is Return on Equity

Table 5-22: Variance Inflation Factors for the interaction effects

VIF	RoS	ATO	RoA	RoE
BMP_ Fml_CF	1.32	3.49	3.31	2.87
BMP_Fml_AnyB	1.39	2.37	2.30	1.98
BMP_FML_CF_AnyB	1.08	2.10	1.99	1.92
Cereals	4.91	1.83	1.45	1.46
Dairy	5.61	1.61	1.33	1.29
LFA	1.45	1.44	1.26	1.28
Mean VIF	2.35	2.14	1.94	1.80

Source: calculated from the FBS 2011/12.

5.3.2. Results

The results of the regression analysis can be found in Table 5-23 for the direct effects (estimated with 14 independent variables), and Table 5-24 for the interaction effects (estimated with 6 independent variables). For RoS, RoA and RoE, the variables did not need to be transformed as they approximate the normal distribution. For ATO, logarithmic transformation was necessary, in order to obtain more normally distributed data.

All models were estimated with the Generalised Least Squares Method as it did not violate any of the assumptions or specification tests.

Table 5-23 shows that all direct effect models are significant. The R-squared are 0.3949 for RoS, 0.3141 for log_ATO, 0.1632 for RoA and 0.1979 for RoE. The interaction models were also statistically significant from 0, but had a lower R-squared, namely 0.2461 for RoS, 0.1538 for ATO, 0.1108 for RoA and 0.0956 for RoE. The interaction effect models explain less

variation in the dataset than the direct effect models; however, the interaction effects model for RoS has a higher R-squared than the direct effects model for log_ATO, RoA and RoE.

Looking at the business planning and benchmarking activities (hypothesis one), the direct effects table show different results than the interaction effects table. In terms of direct effects, formal planning, by itself, has a positive, statistically significant effect on log_ATO only. In turn, benchmarking has a positive, statistically significant effect on RoS, but a negative, statistically significant effect on Log_ATO. Cash flow planning is not statistically significant for any of the four ratios. In terms of interaction effects, carrying out formal planning and cash flow planning has a positive, statistically significant effect on Log_ATO, RoA and RoE. Combining formal planning with benchmarking also shows positive, statistically significant effects, this time on RoS, RoA and RoE. These practices are significant at the 5% level, and impact RoS with 8.54%, RoA with 2.27% and RoE with 3.10%. Undertaking all three practices does not have a statistically significant effect on any of the financial ratios.

In terms of knowledge acquisition (hypothesis two), being a member of a Continuing Professional Development Scheme has a positive, statistically significant effect on RoS, but not on any of the other ratios. The effect is quite large (7.42%), and is statistically significant at the 5% level. None of the other knowledge acquisition practices (having a university degree or accessing advice) have a statistically significant effect on the ratios.

Experience, measured in age, has a minor, negative effect on Log_ATO (0.68%) and is statistically significant at the 1% level. Engaging in off-farm labour through having a working spouse does not have a statistically significant effect on any of the ratios (hypothesis three).

IT skills (hypothesis four) have no statistically significant effect on any of the four ratios.

Table 5-23: Results of the regression analysis – direct effects

Direct effects	RoS		Log_ATO		RoA		RoE	
	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value
BMP_Fml	-.0150 (.0168)	0.373	.1466*** (.0555)	0.008	.0011 (.0072)	0.879	.0003 (.0076)	0.971
BMP_CF	.0083 (.0170)	0.623	.0360 (.0491)	0.464	.0159 (.0116)	0.170	.0073 (.0069)	0.293
BMP_AnyB	.0338* (.0174)	0.052	-.1055** (.0534)	0.049	-.0135 (.0091)	0.137	.0069 (.0078)	0.382
Uni	.0096 (.0200)	0.630	.0823 (.0526)	0.118	-.0024 (.0061)	0.698	-.0019 (.0074)	0.795
AA	-.0037 (.0223)	0.869	-.0305 (.0448)	0.496	.0015 (.0052)	0.780	.0049 (.0049)	0.315
CPD	.0742** (.0304)	0.015	.0355 (.0680)	0.602	.0036 (.0064)	0.573	.0071 (.0062)	0.257
Age	-.0002 (.0008)	0.826	-.0068*** (.0020)	0.001	-.0014 (.0017)	0.405	-.0001 (.0003)	0.908
Off_farm	-.0284 (.0223)	0.202	.0511 (.0433)	0.238	-.0091 (.0058)	0.115	-.0060 (.0054)	0.269
IT	-.0075 (.0222)	0.734	-.0153 (.0494)	0.756	.0069 (.0064)	0.280	.0046 (.0055)	0.397
Size 3	.1062*** (.0225)	0.000	.3418*** (.0635)	0.000	.0155*** (.0058)	0.008	.0255*** (.0064)	0.000
Size 4	.1828*** (.0244)	0.000	.3551*** (.0813)	0.000	.0351*** (.0067)	0.000	.0432*** (.0088)	0.000
Own	.0538*** (.0177)	0.002	-.5130*** (.0420)	0.000	-.0033 (.0053)	0.529	-.0082* (.0047)	0.084
Cereals	.1150*** (.0383)	0.003	.0324 (.0855)	0.705	.0209** (.0087)	0.017	.0327*** (.0067)	0.000
Dairy	-.0433* (.0237)	0.068	.3811*** (.0890)	0.000	-.0038 (.0088)	0.666	-.0168* (.0085)	0.049
LFA	.0077 (.0257)	0.765	.1648** (.0760)	0.031	.0038 (.0072)	0.604	.0148* (.0082)	0.072
_cons	-.0503 (.0496)	0.312	-1.5320*** (.1354)	0.000	.0084 (.0132)	0.524	-.0068 (.0175)	0.698

F	23.84***	26.69***	9.67***	8.80***
R-squared	0.3949	0.3141	0.1632	0.1979

Note a) *** is statistically significant at the 1% level, ** is statistically significant at the 5% level, * is statistically significant at the 10% level

Table 5-24: Results of the regression analysis – interaction effects

Interaction effects	**RoS**		**log_ATO**		**RoA**		**RoE**	
	Coefficient (S.E.)	**p-value**	**Coefficient (S.E.)**	**p-value**	**Coefficient (S.E.)**	**p-value**	**Coefficient (S.E.)**	**p-value**
BMP_Fml_CF	.0025 (0.197)	0.900	.3711*** (.0978)	0.000	.0172** (.0084)	0.042	.0194* (.0117)	0.097
BMP_Fml_AnyB	.0854** (.0329)	0.010	-.1471 (.1220)	0.228	.0227** (.0096)	0.020	.0310** (.0121)	0.010
BMP_FmL_CF_AnyB	-.0566 (.0446)	0.204	-.2115 (.1774)	0.233	-.0222 (.0151)	0.141	-.0259 (.0207)	0.212
Cereals	.2547*** (.0199)	0.000	.2898*** (.0749)	0.000	.0562*** (.0060)	0.000	.0738*** (.0086)	0.000
Dairy	.0642*** (.0198)	0.001	.7434*** (.0669)	0.000	.0151*** (.0056)	0.007	.0189*** (.0072)	0.009
LFA Grazing Livestock	.0020 (.0269)	0.940	.2982*** (.0841)	0.000	.0120* (.0066)	0.069	.0151* (.0086)	0.078
_cons	-.0169 (.0165)	0.307	-2.036*** (.0541)	0.000	-.0034 (.0038)	0.377	-.0080 (.0052)	0.123
F	47.13***		26.36***		18.14***		15.23***	
R-squared	0.2461		0.1538		0.1108		0.0956	

Note a) *** is statistically significant at the 1% level, ** is statistically significant at the 5% level, * is statistically significant at the 10% level

Size has a statistically significant, positive effect on all four ratios, and at the 1% significance level (hypothesis five). This shows that resources, if utilised more effectively through an increase in size, will lead to economies of scale and advantages in financial terms. The effect is the largest for log_ATO (which was to be expected as ATO measures how assets are used to generate sales), but is quite substantial for RoS as well, at 10.62% when increasing from a small to a medium-sized farm, and at 18.28% when increasing to a large farm. For RoA and RoE, the effects are between 1.55% and 3.51%, and 2.55% and 4.32% when increasing to a medium and large-sized farm respectively.

Ownership matters for RoS, log_ATO and RoE (hypothesis six). While ownership has a statistically significant, positive effect on RoS due to the fact that owner-occupiers pay no rent and subsequently have lower costs, it has a statistically significant, negative effect on Log_ATO and on RoE. The effect of ownership on log_ATO is quite large (-51.30%), however, but this is because ATO is transformed. For RoE, the effect is small, at -0.82%, and is statistically significant at the 10% level only. Having some debt affects the effect of ownership on financial performance, as ownership is not statistically significant on RoA.

Finally, farm type makes a difference, as was already evidenced, but the differences between farm types were not clear (Table 4-12). The regression analysis shows, however, that – with Lowland Grazing Livestock farms being the group "0":

- Being a Cereal farm has a positive, statistically significant effect on RoS, RoA and RoE. For log_ATO, the effect is not statistically significant.
- Dairy farms have a statistically significant, higher log_ATO than Lowland Grazing Livestock farms, but are worse off for RoS and RoE. The effect of being a Dairy farm is not statistically significant for RoA.
- LFA Grazing Livestock and Lowland Grazing Livestock do not differ significantly on RoS and RoA. Being an LFA Grazing Livestock farm however, positively affects log_ATO and RoE.

5.3.3. Summary

In order to bring the analysis to a higher level, the results were compiled to capture the effects of the various practices on financial performance across all financial ratios (Table 5-25).

Table 5-25: Overview of the effects of the practices on financial performance

Effect on Financial Performance	Direct Effects			Interaction Effects		
	Pos. at 10% level	Not S.S.	Neg. at 10% level	Pos. at 10% level	Not S.S.	Neg. at 10% level
H1: Greater use of business management practices leads to better financial performance (out of 12	2 (16.7%)	9 (75%)	1 (6.3%)	6 (50%)	6 (50%)	0 (0%)
H2: Knowledge acquisition has a positive effect on financial performance (out of 12)	1 (6.3%)	11 (91.7%)	0 (0%)	N.A.	N.A.	N.A.
H3: Experience has a positive effect on financial performance (out of 8)	0 (0%)	7 (87.5%)	1 (12.5%)	N.A.	N.A.	N.A.
H4: Good IT skills has a positive effect on financial performance (out of 4)	0 (0%)	4 (100%)	0 (0%)	N.A.	N.A.	N.A.
H5: Size has a positive, statistically significant effect on financial performance (out of 8)	8 (100%)	0 (100%)	0 (100%)	N.A.	N.A.	N.A.
H6: Ownership has a mixed effect on financial performance (out of 4)	1 (25%)	1 (25%)	2 (50%)	N.A.	N.A.	N.A.
Effect on Financial Performance			Direct Effects		Interaction Effects	
			S.S. at 10% level	Not S.S. at 10% level	S.S. at 10% level	Not S.S. at 10% level
Farm type has an effect on financial performance (out of 12)			8 (66.7%)	4 (33.3%)	11 (91.7%)	1 (6.3%)

Note: a) SS means statistically significant

The results show the importance of undertaking management practices as it affects financial performance positively. While the effects of undertaking individual business planning and benchmarking practices do not make a big difference to financial performance, the results show, overall, that it matters to plan, especially when several tools and techniques are combined. In particular, formal planning and benchmarking, or formal planning and cash flow planning will improve financial performance. In addition, increasing size has a positive, statistically significant effect on all financial performance indicators. This was to be expected, as it is generally believed that larger firms can utilise resources more strategically and effectively. Ownership status has a mixed effect, whilst knowledge acquisition a minor, positive effect. Experience is mainly not statistically significant in the regression models that were carried out.

The research confirms the results from the systematic review in Chapter two, where it was found that undertaking management practices has a positive effect on financial performance.

5.4. Conclusion

This chapter presented an overview on the use of management practices and their impact on financial performance for four farm types in England (Cereal farms, Dairy farms, LFA Grazing Livestock farms and Lowland Grazing Livestock farms). Using the Farm Business Survey data for 2011/12, a dataset of 862 farms was analysed to understand what practices are applied on the farms. The data showed that business planning and benchmarking are not applied equally across the four farm types. Similarly, having good IT skills is not evidenced on all farms. In terms of knowledge acquisition, similar levels of university degrees and accessing advice were found at the four farm types, but there was a large difference in membership of a Continuing Professional Development Scheme. On average, farmers are about 55 years old, and less than fifty per cent have a spouse that works off-farm.

The regression models, both for direct effects and for interaction effects, were estimated for four financial ratios (RoS, log_ATO, RoA and RoE), resulting in eight models in total. The results showed that business planning and benchmarking, especially when two practices are combined, and size have the biggest impact on financial performance. Farm type has a statistically significant effect in the majority of cases. The effect of tenure varies (positive, negative, and statistically insignificant). Knowledge acquisition has a minor effect through membership of a CPD scheme, but is found to be statistically insignificant for the other three ratios. Also, having a university degree and accessing advice is not statistically significant. All other practices (IT skills and engaging in off-farm labour) are not statistically significant either.

6. Conclusion and recommendations

6.1. Summary findings against the main research questions

The research question for this thesis was:

> "What is the impact of management practices on the financial performance of farm businesses in England?"

From this over-arching research question, four sub-questions were derived:

1. What are management practices, in the context of farm businesses in England?
2. What is the most appropriate method to assess financial performance that is applicable to farm businesses in England?
3. What is the current situation for farm businesses in England in terms of financial performance?
4. What combination of management practices has potentially the greatest influence on the financial performance of farm businesses in England?

As for the first sub-question, management was defined as the attainment of organisational goals through planning, organising, leading and controlling on several areas such as production, marketing, financing and staffing, taking into account the political, economic, social, technological, environmental and legal settings an organisation functions in (Boddy, 2009). Within the agricultural industry, the farmer has to maximise his objectives/organisational goals, be it financial returns, conservation of the environment, expressive values or intrinsic values (Gasson, 1973), under resource availability and the constraints (land, capital and labour) in which the farm operates (political, economical, social, technological, environmental and legal).

Looking in more detail at relevant management practices that influence financial performance, the systematic review, described in Chapter 2, showed that management practices have a positive effect on financial performance. Given this finding, a conceptual framework was set up with the following hypotheses:

- Hypothesis 1: Greater use of business management practices leads to better financial performance;
- Hypothesis 2: Knowledge acquisition has a positive effect on financial performance;

- Hypothesis 3: Experience has a positive effect on financial performance;
- Hypothesis 4: Good IT skills has a positive effect on financial performance;
- Hypothesis 5: Size has a positive effect on financial performance; and
- Hypothesis 6: Ownership has a mixed effect on financial performance.

From an agricultural perspective, and taking into account the information that is captured in the Farm Business Survey, the business management practices that were retained for the research were formal planning, benchmarking and undertaking regular cash flow planning. Two of these practices, formal planning and benchmarking, are used frequently to plan, make decisions and monitor progress, and were found to be the most commonly used by managers worldwide (Rigby & Bilodeau, 2007). Knowledge acquisition was defined as: having a university degree; accessing paid advice; and being a member of a continuing professional development scheme. Experience was defined by age and having a working spouse, size by the number of full-time equivalent employees working on the farm, and ownership by fully owning the farm or not.

Four farm types were selected for this research: Cereal farms; Dairy farms; LFA Grazing Livestock farms; and Lowland Grazing Livestock farms. All farms outside of England were excluded, as well as General Cropping farms; Mixed farms; Pig farms; Poultry farms; and Horticultural farms.

Looking at the application of management practices on the farms in the dataset (862 farms based on the Farm Business Survey for 2011/12), formal planning is used on approximately one third of Cereal and Dairy farms. It is less embedded within the Grazing Livestock farms, with approximately 15% of LFA and 20% of the Lowland Grazing Livestock farms using formal planning. Cash flow planning is applied in a similar manner. Even though Jack (2012) says that benchmarking has been used in the agricultural industry for years, it is only Dairy farmers who use benchmarking regularly, with one third of the Dairy farms in the dataset using it. Approximately one in five Cereal farmers use benchmarking. As with other tools, very few Grazing Livestock farms use benchmarking. This could partly be due to the fact that the Grazing Livestock farmers do not use a PC for their business as much as the Cereal and Dairy farmers, resulting in lower access to benchmarking tools.

Knowledge acquisition is also applied differently on the various farm types, with the exception of having a university degree, with approximately 80% of the farmers not having a university

degree. Gasson et al. (1998) already mentioned in their research that education levels within the agricultural industry were low, and having a university degree levels is not widespread on farms. In terms of accessing advice, over half of the Cereal and Dairy farmers pay for this service, compared to approximately one in four LFA Grazing Livestock farmers and one in three Lowland Grazing Livestock farmers. Only Cereal farmers report highly on membership of a CPD Scheme, with approximately seven out of ten farmers participating in CPD. Dairy farmers and Grazing Livestock farmers do not utilise this service often, with only approximately 17% of Dairy farmers, 14% of Lowland Grazing Livestock farmers and 5% of LFA Grazing Livestock farmers reporting membership. This could be due to the fact that prior to 2012, there were no professional registers (CPD schemes) for non-cropping farms.

For experience, two indicators were used: age and engaging in off-farm labour (i.e. having a working spouse). On average, farmers are 55 years old. Almost 40% of farmers have a working spouse, but this distribution varies across the four farm types, with less Cereal farmers having a working spouse (approximately 28% of the dataset), and over 40% of the other three farm types having a working spouse. Shwarz (2004) found in her research that having a working spouse was decreasing in England, and mentioned tax reliefs as a reason for spouses to engage on-farm. However, El-Osta et al. (2004) and Mishra et al. (2007) found it to have a positive effect on the farm, and it was therefore included in the research framework.

Farmers have different levels of IT skills, with over 50% of the Cereal farmers reporting good IT skills compared to 43% of the Dairy farmers, 33% of the Lowland Grazing Livestock farmers and 20% of the LFA Grazing Livestock farmers. Having good IT skills was measured by having good MS office skills, using internet banking, having a good internet connection and keeping documents on a PC. Warren (2004) commented on the low connectivity of farmers and small and medium enterprises in England, stating that a lack of adequate equipment (including a PC and good connectivity) as well as the human factor were part of the causal factors.

In terms of farm size (based on the number of full-time equivalents employed on the farm), there are no very small Cereal and Dairy farms, and no small Dairy farms. Conversely, there are no large LFA Grazing Livestock farms. Cereal farms predominantly employ two to three fulltime staff (41% of the dataset), however, 33% of the Cereal farmers in the dataset employ between three and five staff members and are considered large farms, and about 27% of the Cereal farmers employ one to two staff members, classifying them as a small farm. For Dairy

farms, most farmers are large, employing between three and five fulltime staff (71%) and are considered large farms. The rest of the Dairy farms (29%) are medium-sized, employing two to three fulltime staff on the farm. Most Grazing Livestock farms are small (63% of the dataset). There are also a few very small livestock farms, with 7% of the LFA Grazing Livestock farmers and 10% of the Lowland Grazing Livestock farmers employing less than one full-time equivalent. A quarter of the Lowland Grazing Livestock farms are medium-sized, as are 31% of the LFA Grazing Livestock farms. Only 3% of the Lowland grazing Livestock farmers employ between three and five full-time equivalents, making them large.

In terms of ownership, about 30% of the farmers in the dataset fully own their farm. Approximately 53% of the farmers both own and rent land, and 17% rent all their farms. This variable was included in the dataset as there is a clear distinction in size of the asset base between owner-occupiers and tenant farmers.

For the second sub-question, which was aimed at assessing the most appropriate financial performance measure for the agricultural industry in England, the literature review led to the use of the DuPont Expansion model, a model consisting of five financial ratios: Return on Sales, Return on Equity, Return on Assets, Asset Turnover and Compound Leverage Factor (Bernhardt, 2010). It contains ratios that are assessing solvency, profitability and financial efficiency, which are three of the five categories[14] that are regularly used to assess financial performance. It has been supported and used by various agricultural researchers to understand financial performance (Barnard & Boehlje (2004); Melvin et al. (2004); and Mishra et al. (2009)).

Other methods that are available, such as Economic Value Added, Credit Ratings and models that predict financial distress such as the Beaver model or Z-score, were deemed less appropriate as they looked at the perspective of a shareholder, for example in the case of Economic Value Added (Badicore et al., 1997; Chen & Dodd, 1997; and Rogerson, 1997) or focused on a smaller part of financial performance such as credit rating (Standard and Poor, n.d. and Brewer et al., 2012) and financial distress (Beaver, 1967; Altman, 2000; and Ko et al., n.d.) instead of at the overall financial health of a business and/or industry.

[14] The other two categories are liquidity and repayment capacity (Bernhardt, n.d.).

In order to examine whether the DuPont Expansion model would be a good measure to assess the financial performance of the agricultural industry in England, a correlation analysis was carried out on the financial ratios for the four farm types, calculated from the FBS 2011/12. The results showed that the DuPont Expansion model had links with the (majority of the) sweet 16 ratios (Bernhardt, n.d.), a list of ratios that looks at liquidity, solvency, profitability, financial efficiency and repayment capacity. The DuPont Expansion model did not show a strong correlation with the liquidity indicators (current ratio and working capital). However, the liquidity ratios for the farms in the dataset were, on average, well above the critical value. In addition, for several financial efficiency ratios, the industry fell far below the critical value, and as indebtedness across the sector was on average low, it was deemed that the repayment capacity would not be an issue for farmers either. The DuPont Expansion model was, therefore, regarded as an appropriate model to assess the financial performance of farm businesses in England.

The third sub-question looked at providing further insight into the current financial performance of farm businesses in England. Two datasets were used: the first one a balanced panel covering the years 2008 to 2013, to understand average trends within each farm type, and a second dataset covering the year 2011/12.

For the period 2008 to 2013, an analysis of the financial performance for the four farm types showed that Cereal farms consistently outperform Dairy farms, LFA Grazing Livestock farms and Lowland Grazing Livestock farms on the profitability indicators, achieving, on average, 4.5% Return on Assets and Return on Equity, and 21% on Return on Sales. This is the only farm type that achieves profitability ratios within the range suggested by PennState (n.d.) for farms. In terms of profitability, Livestock farms struggle the most, achieving a negative Return on Sales and Return on Equity. Looking at the origin of this performance, it can be seen that low revenue is responsible for the profitability issues.

On Asset Turnover Ratio, the Dairy farmers outperform the other three farm types, with an ATO of 37% on average for the period 2008 to 2013. Asset Turnover measures how assets are used to generate sales, and is an indicator of stock management. It was expected that Dairy farmers would outperform the other three farm types on this ratio, as their asset base is more in line with the level of their sales. Nevertheless, all four farm types achieve Asset Turnover ratios of above 20%, which is close to the suggested range of 25 to 30% (PennState, n.d.).

On average, indebtedness in the agricultural sector is low, with debts amounting to, on average, 22% of total assets. Within the four farm types, there is some variation, with Grazing Livestock farms having, on average, 18% debt, Cereal farms having 23% debt and Dairy farms 27% debt. All four farm types fall well below the suggested range of 40% debt (PennState, n.d.), showing that the agricultural industry in England has relatively low levels of indebtedness.

Looking at each individual farm type, using the dataset for 2011/12, it showed that the most pronounced differences are found in profitability within the Cereal sector, followed by Dairy farms, but both farm types achieve profits on average. The asset levels are also different across the four farm types, with Cereal farmers having the largest asset base. Indebtedness is low across all farm types. To conclude, it was found that the agricultural industry is, on average, performing relatively well in financial terms. However, there is a large fluctuation across the four farm types.

In order to answer the fourth sub-question, "What combination of management practices has potentially the largest influence on financial performance for farm businesses in England?", the hypotheses as set out above in the conceptual framework were tested on the FBS dataset 2011/12 using t-test and regression analysis.

In order to apply the t-tests, the farms in the 2011/12 dataset were divided into high performers (top 25% of farms depending on the ratio investigated) and low performers (bottom 25% of farms depending on the ratio investigated). The middle group was discarded. T-tests were applied to check if tools and a farmer's/farm's characteristics (age, education level, having a working spouse, having good IT skills, farm size and ownership) were used differently across the groups, and whether these differences were statistically significant. The results showed that high performers use formal planning, cash flow planning and benchmarking more, and the differences are statistically significant. In addition, high performers have higher education levels (university degrees) and pay for advice more. They are, in general, younger than lower performers, have good IT skills and have a working spouse. High performers are also bigger in farm size i.e. they employ more staff. The effect of ownership is mixed, with owner-occupiers outperforming mixed tenure or tenanted farmers on several ratios, but are worse off on others.

For the regression analysis, eight multiple linear regression models were estimated i.e. two per ratio – one for direct effects and one for interaction effects (using more than one business management practice). The results showed that several management practices have a positive effect on financial performance: benchmarking has a positive effect on Return on Sales, and so does being a member of a CPD scheme. Formal planning has a positive effect on Asset Turnover, but benchmarking and age have a negative effect on it. Using more than one business planning and benchmarking practice has mainly positive effects, with the combined use of formal planning and regular cash flow planning having a positive, statistically significant effect on the profitability indicators Return on Assets and Return on Equity, and on the financial efficiency indicator log_ATO. The effect of formal planning and cash flow planning on Return on Sales is positive, but not statistically significant. Similarly, using formal planning and benchmarking has a positive, statistically significant effect on the profitability indicators Return on Sales, Return on Assets and Return on Equity. It has a negative effect on log_ATO, but this effect is not statistically significant. Farm size has a positive, statistically significant effect on all financial performance indicators. Having a university degree, accessing paid advice, having good IT skills and having a working spouse were mainly statistically insignificant. The effect of ownership status was mixed, with owning one's own farm having a positive, statistically significant effect on Return on Sales but a negative one on log_ATO. This was to be expected as the asset base for owner-occupiers is larger, resulting in a lower Asset Turnover. Owning one's own farm also had a negative effect on Return on Assets and Return on Equity, but these were not statistically significant at the 5% level.

The findings described above are consistent with the literature reviewed in Chapter 2, which found that management practices have a positive effect on financial performance. This finding is important, as it shows that it pays to plan, especially when farmers utilise a combination of business planning and benchmarking practices. In terms of benchmarking, the positive effects of it were reported by among others Wilson et al. (2011), Langton (2012) and Gloy et al. (2002). In addition, the findings on knowledge acquisition also confirm findings of other research. For example, while the t-tests showed that high performers have higher education levels than low performers, in the regression analysis, having a university degree was not statistically significant. Wilson et al. (2001) have found something similar, and stated that education is not a significant determinant of efficiency. Furthermore, even though accessing paid advice was not statistically significant in the regression analysis, the high performers did pay for advice more often than low performers. Wilson (2014, p199) concluded that "*successful farm*

businesses will rely upon technical, business and environmental information from a range of sources to achieve … their … objectives", as did Barnes et al. (2011), showing it is worth getting advice and seeking information to improve performance. Finally, the finding on size confirms previous research done by, among others, Kauffman & Tauer (1986); Mishra et al. (1999); Purdy et al. (1997); Langton (2012); and Wilson et al. (2001), indicating that increasing size can lead to further efficiencies, and financial returns.

The research also fits in with technical efficiency studies in agriculture. Several researchers (for example, Wilson et al. (1998), Hadley (2006), and Hallam and Machado (2008)) have investigated technical efficiency of farms – with technical efficiency being *the ability of a decision-making unit to produce maximum output given a set of inputs and technology* (Thiam et al., 2001, p.236) – and subsequently link it with various managerial skills and practices. This method is built up in two steps: in a first step, technical efficiency is calculated, either by using the parametric technique stochastic production frontier analysis (for example Wilson et al. (1998) and O'Neill et al., (2001)) or by using the non-parametric data envelopment analysis (for example, Hansson and Ohlmer (2008) used it on Swedish dairy farms and Davidova and Latruffe (2007) apply it to Czech farms). In a second step, various practices or ratios are linked with the technical efficiency measure, and analysis is undertaken to see whether these have a statistically significant effect on the technical efficiency measure.

Table 6-1 below comprises an overview of the most relevant and recent research undertaken on technical efficiency in agriculture. Studies that did not mention any variables from the conceptual framework that was developed in Chapter two (except for size) were discarded.

Table 6-1: Studies on the impact of management practices on technical efficiency in the agricultural sector

Author	Year	Sector	Dependent variable	Independent variables	Findings
Hallam and Machado	1996	Portuguese dairy farms	Technical efficiency measure	Farm size, specialised farms (0/1), feed per cow, land per cow, stock of machinery and equipment per cow, ratio of family labout to total labour, location, altitude	- Variables that have a positive effect: size (statistically significant), family labour vs hired labour (not statistically significant), location, feed per cow (statistically significant) and land per cow (not statistically significant) - Variables that have a negative effect: diversification - Variables where the effect is not statistically significant: altitude, machinery and equipment per cow
Wilson, Hadley, Ramsden and Kaltsas	1998	UK potato production	Technical efficiency measure	Experience, membership of a cooperative (0/1), cereal rotation (0/1), irrigation, storing potatoes (0/1), chitting potatoes (0/1) and size (0 = smaller than 40ha, 1)	- Variables that have a positive effect: irrigation, storage, size - Variables that have a negative effect: years of experience, chitting seed potatoes (as it requires extra labour and contract costs)
O'Neill and Matthews	2001	Irish agriculture	Technical efficiency measure	age, age squared, debt ratio, off-farm labour (0/1), region, size of farm household, size of the farm, time trend	- Variables that have a positive effect: size of the family, debt/asset ratio - Variables that have a negative effect: off-farm labour, size, location - Age is not statistically significant
Wilson, Hadley and Asby	2001	wheat farms in East England	Technical efficiency measure	area, number of years managerial experience, further education (0/1), objectives (importance of profit and environment), information sources (personal, written, electronic, others), time	- Variables that have a positive, statistically significant effect: area, number of years managerial experience, information sources, objectives - Variables that have a positive effect but are not statistically significant: further education
Hadley	2006	English and Welsh agriculture	Technical efficiency measure	debt ratio, financial stress ratio, subsidies/total gross margin, age, area, herd size, tenancy ratio, specialisation, BSE dummy, regional dummies	- Statistically significant variables are: farm or herd size (positive), farm debt ratios (negative), farmer age (negative), levels of specialisation (positive) and ownership status (positive) - Returns to scale: beef farms and cereal farms have increasing returns to scale; sheep and dairy farms have decreasing returns to scale
Galanopoulos, Aggelopoulos, Kamenidou, Mattas	2006	Greek pig farms	Technical efficiency measure	size (number of sows), mortality rate, choice of insemination (0/1), origin of genotype (0/1), feeding (0/1), weaning (0/1), further education (0/1)	- Decreasing returns to scale: farms are operating on a level that is too big - Variables that have an effect: farm size (positive), mortality (the higher, the lower the efficiency), choice of insemination and genotype, feeding (on-farm is not better than off-farm feed preparation)

					- Variables that are not statistically significant: weaning and further education
Davidova and Latruffe	2007	Czech farms	Technical efficiency measure	debt ratio, current debt to current asset ratio, bank debt to asset ratio, livestock units, capital/labour, land/labour, share of hired labour, share of rented land, corporate vs new farms	- Variables that are not statistically significant: current debt to current asset ratio, bank debt to asset ratio - Variables that negatively impact technical efficiency: debt/asset ratio, new farm - Variables that have a positive effect: size
Barnes	2008	Scottish agriculture	sum of revenues for each agricultural enterprise type including subisidies and grants	Fertiliser, Feed, Seed, Labour, Capital, Land, Time	- Cereal sector: land and capital costs have the largest effect, followed by fertiliser - Dairy and sheep farming: largest effect is generated by the feed cost, followed by capital cost - Beef sector: largest effect from feed costs - Returns to scale: beef farms and dairy farms have increasing returns to scale; sheep and cereal farms have decreasing returns to scale

Linking this research back to the conceptual framework set out for this research (Figure 6-1), we find that similar results have been achieved for several independent variables:

- Wilson et al. (2001) found a positive effect of accessing advice on technical efficiency, although further education was not statistically significant. Galanopoulos et al. (2006) also concluded that even though further education has a positive effect, it is not statistically significant. This is in line with the **knowledge acquisition findings in this research**, where positive effects were found but these were not always statistically significant.
- **Experience**, measured by age and having a working spouse in this research, was also used in other research. Wilson et al. (1998) and Hadley (2006) found a negative effect of age on technical efficiency, and O'Neill et al. (2001) found the effect not statistically significant. This is similar to the findings in this research. Engaging in off-farm labour for the farmer had a negative effect in the study of O'Neill et al. (2001).
- **Size** has a positive effect on technical efficiency, as evidenced in most studies. This research also found a positive, statistically significant effect of size on all financial performance measures.
- **Ownership** status was found to have a positive effect on technical efficiency in the study of Hadley (2006).

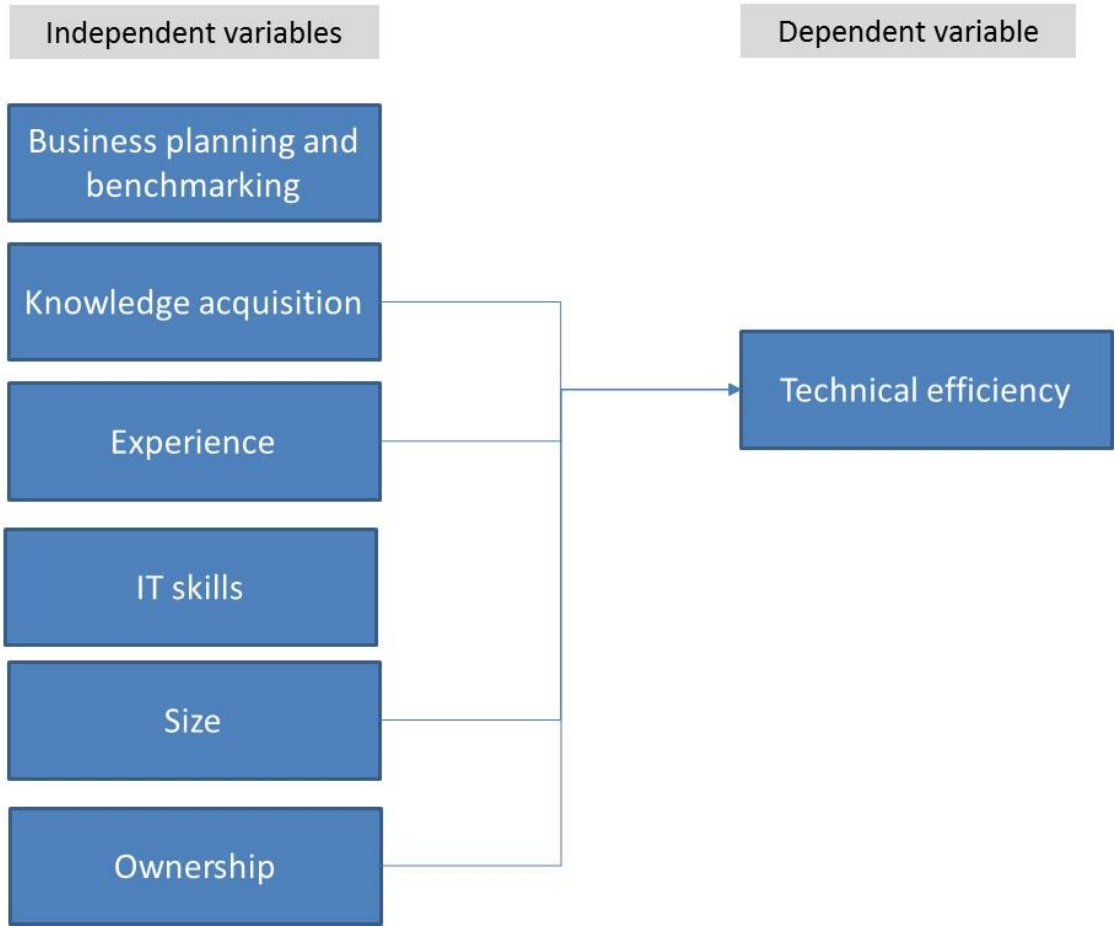

Figure 6-1: The link between the conceptual framework and technical efficiency studies

However, there is a gap in the evidence base for business planning and benchmarking, and IT skills. None of the research in Table 6-1 looks at the effect of formal planning, cash flow planning, benchmarking or IT skills on technical efficiency. This is an area that could be developed further.

In addition, the studies mentioned above focus mainly on technical efficiency measures, and not on overall economic efficiency, which was the focus of this research. Kumbhakar and Lovell (2000) have further developed Farrell's concept of economic efficiency (1957), and added scale efficiency to the equation:

- Technical efficiency is *the ability to produce a maximum output given a set of inputs and technology* (Thiam et al., 2001, p.236);
- Allocative efficiency is *the ability to produce a given level of output using cost-minimising input ratios* (Thiam et al., 2001, p.236);[15]

[15] Several researchers, such as Hadley (2006) and Galanopoulos et al. (2006) mention return to scale, but it is not linked with larger economic efficiency.

- Scale efficiency is the ability to produce output at a level that minimises the average cost of production (Kumbhakar and Lovell, 2000).

Economic efficiency in turn is measured by a profitability variable, such as gross margin per hectare or FBI/ha.

Figure 6-2 sets out how the conceptual framework developed for this research, fits in with the technical efficiency studies mentioned above and the economic efficiency theory. For this research, a direct link was tested between managerial practices and economic efficiency, measured by financial performance ratios. The technical efficiency studies from Table 6-1 linked managerial skill and ability with a technical efficiency measure. However, the effect of managerial practices on allocative efficiency and scale efficiency have not been tested in any of the studies mentioned in Table 6-1. Further research could be undertaken to test these effects. The link between technical, allocative, scale and economic efficiency could also be tested.

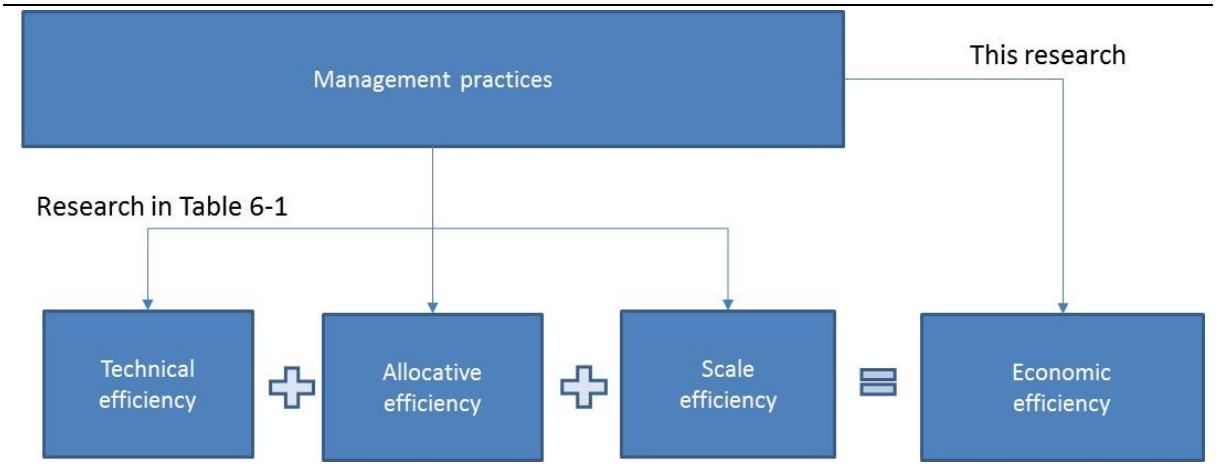

Figure 6-2: The conceptual framework, technical efficiency and economic efficiency

6.2. Implications and recommendations for policy makers

The first recommendation that we, therefore, want to put forward is to increase business planning and benchmarking practices for farmers as these have shown a positive, statistically significant, effect on financial performance. We would like to encourage farmers to investigate whether they can undertake either formal planning and cash flow planning, or formal planning and benchmarking on their farms.

Second, as over 70% of the farmers in the dataset have indicated that they would like to learn more about these practices, we recommend that Defra, and other policy makers, assess whether

they can provide additional courses or fund these through advice services, perhaps as part of Pillar 2 of the CAP, given that it, among others, focusses on improving managerial skills for farmers and that there are additional programmes around knowledge transfer, improving competitiveness and cooperation. Defra could encourage uptake by integrating business management training into the Rural Development Programme. More specifically, these courses should focus on increasing farmers' knowledge and understanding of formal planning, cash flow planning and benchmarking, and ultimately the increased application of these practices within the agricultural industry in England. There are opportunities within the consultancy sector to provide these courses, but Defra could provide access to funding for individuals – or subsidise the cost of the course providers.

The third recommendation, if financial performance is to be maximised, is for farmers to increase their farm size, and try to achieve economies of scale. Farmers could pool their resources, such as labour (and/or machinery), and/or collaborate with other farmers to increase size or investigate whether they could expand their business. Wilson et al. (2014), for example, also reported that farmers had identified that financial benefits can be gained from working together, and this research confirms that finding. Again, Defra could encourage farmers to do this by raising awareness and providing advice and/or funding to collaborate and partner one other in activities such as machinery sharing and contracting actions.

The fourth recommendation focusses on knowledge acquisition. Even though, only being a member of a CPD scheme, had a positive, statistically significant effect on Return on Sales, the comparison between low and high performers has shown that high performers have higher knowledge acquisition skills, either through university degrees or accessing paid advice. Farmers should consider whether it is feasible for them to increase their education levels, and what the pay-off of gaining additional insight would be. Organisations that provide CPD courses include the Institute for Agricultural Management, Basis or DairyPro (FWI, n.d.).

Finally, even though having good IT skills was not statistically significant in any of the regression models, high performers have better IT skills than low performers. If Defra and the Rural Payments Agency plan to increase their online services and go paperless, they need to assure themselves that farmers will still have access to a full range of services. This is particularly important for the Grazing Livestock farms, where IT skills are not embedded well. Further support and roll-out of the Rural Broadband Delivery UK Scheme by the Department

for Culture, Media and Sports should go hand in hand with providing support to farmers in using and enhancing their IT skills (DCMS, 2015).

6.3. Limitations to this research and suggestions for further research

Even though the findings of this research support studies from other researchers as evidenced above, there were some limitations with the definitions and the information available in the dataset. First, it is unclear how farmers understand some management tools and skills, what processes are used to, for example, set-up the formal plan, and how they utilise benchmarking to compare their situation with others. There is, also, no information on the quality of the business planning instruments reported. A suggestion could be to collect information from farmers on how they undertake planning, analyse it and link it to financial performance, and produce best practice guides that can be shared with farmers.

A second limitation in the dataset is around knowledge acquisition. Education level is an insufficient indicator to measure knowledge acquisition– it is important to understand how farmers respond to knowledge and apply it on their farm. Dhaoudi (2014), for example, found that responding to knowledge improved innovation and financial performance. This study did not collect farmers' responsiveness to knowledge or application of knowledge. This might be one of the reasons why most knowledge acquisition indicators have proven not to be statistically significant in the regression models reported above.

Finally, this research targeted four farm types. The data was analysed by farm type, and with all farms in one dataset. Even though the results are (slightly) different, the conclusions that were drawn in Chapter four and five largely hold across all farm types. Thus, this research could, however, be extended to other farm types to draw conclusions more broadly, and to give Defra and other policy makers recommendations for all farm types in England.

Despite these limitations, this work has made an important and valid contribution. It has shown that the DuPont Expansion model is a method that can be used to assess the financial performance of the agricultural industry in England. It has also contributed to the understanding of the financial performance of the agricultural sector, showing that the industry is financially healthy in many respects such as liquidity, solvency and financial efficiency, with the exception of profitability which is an issue for some farm types. In addition, it was found that low

profitability is due to fluctuations in revenue, indicating that the management of commodity market prices is particularly important, given the current climate of increased market volatility and the global market the industry now operates in. Finally, it was also found that management practices do make a difference when assessing their full impact on financial performance.

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Annex 1. Definitions used in this research and FBS codes

Name variable	Detailed code (FBS)	Code (FBS)	Type of variable	Definition
Financial performance				
Profit	Farm.business.income-unpaid.labour		Interval - Continuing	Profit is farm business income adjusted for unpaid labour
Farm Business Income	= farm.business.output - farm.business.costs + farm.business.tenant.capital.sale.profits = NFI + unpaid.labour.exc.farmer.spouse - net.interest.payments + imputed.rent.costs - sectionI.imputed.rent.receipts - insurance.repairs - depreciation.bw + sectionJ.output - sectionJ.costs - director.remuneration	Farm.business.income	Interval - Continuing	Farm Business Income is the farm output minus the adjusted input cost. It is the gross margin plus other revenue minus fixed costs. • The farm outputs are enterprise outputs and miscellaneous income. • Input costs are all costs related to paid labour, machinery, livestock costs, crop costs and general farming costs plus land and property charges (all kind of rents except imputed rent on tenants' improvements and rental value (owner occupiers), tenant type repairs, rates) and write off of bad debts that are under miscellaneous receipts. Occupiers' expenses (buildings and works net depreciation, insurance of farm buildings and landlord-type repairs and upkeep) as well as interest on borrowing are included.
Unpaid labour	unpaid.labour.farmer.spouse + unpaid.labour.exc.farmer.spouse	Unpaid.labour	Interval - Continuing	Unpaid labour of principal farmer, spouse and others is taken into account, as this is not included in Farm Business Income. This way, the profit shows what is available for reinvestment in the farm, for

Name variable	Detailed code (FBS)	Code (FBS)	Type of variable	Definition
				personal use and to pay off taxes and debts – without making any adjustment for owner-occupied or tenanted farms as for example land and other assets are fully accounted for in the definition of assets below.
Total sales	C(299+422+420)[30+32+34+36+38+40]+E(27+70)[12+15+16]+sectionI.output+interest.received	Total.sales	Interval -Continuing	Total sales are the sum of all enterprise outputs plus miscellaneous income from agriculture related and integrated diversified activities. • The enterprise outputs are all crops, by-products, cultivations – revenue excluding subsidies, farm use, farmhouse consumption and benefits in kind -; cattle and cattle products, sheep, pigs, poultry and other livestock – revenue including casualties, farmhouse consumption and benefits in kind, and used on farm. • Miscellaneous income is income such as processing and retailing of farm produce; agri-environment agreements; project based schemes and other grants/subsidies for diversification; Single Payment Scheme; rents for farmhouse, cottage and buildings; Recreation; Tourist accommodation and catering; rural crafts; hire work; other miscellaneous receipts; green technology. • Interest received is revenue related to interests received from section D cell 16 (3).
Total assets	Total assets per farm at closing value	Total.assets.cam	Interval -Continuing	Total Assets is the sum of the current assets and fixed assets at closing value. They include the closing value of crops, trading livestock, breeding livestock, liquid assets, stores, and fixed assets

Name variable	Detailed code (FBS)	Code (FBS)	Type of variable	Definition
				such as total landlord-type capital (agricultural land, woodland, all buildings and the milk quota and any improvements done such as drainage, works and services) plus glasshouses, permanent crops and machinery, miscellaneous business assets, other quotas and entitlements to the Single Payment Scheme. • Land is valued at market price (estimate); • Liquid assets are cash in hand and cash in bank, short term deposits and loans, any debtors including EU debtors; • Accrued capital gains cannot be taken out of the value of the assets are they are not recorded in the FBS. This is a different approach than the one used by Mishra et al (2009).
Total liabilities	Total liabilities per farm at closing value	liabilities.cv	Interval - Continuing	The total liabilities closing value is the sum of the closing values of the loans (mortgage, building societies, bank term loans, other institutional loans and other loans) and the current liabilities such as hire purchase, leasing, creditors, bank overdraft and other.
Equity	Total assets per farm at closing value minus total liabilities per farm at closing value		Interval - Continuing	Equity: is calculated by deducting the closing value of the total liabilities from the total assets closing value.
Total current liabilities	Total current liabilities per farm at closing value	11G2(52)[2]	Interval - Continuing	Total current liabilities is the sum of hire purchase, leasing, creditors, bank overdraft and other at closing value
Total fixed assets	Total fixed assets at per farm at closing value	11G1(01)[2]+ 11G1(29)[2]+ 11G1(38)[2]+	Interval - Continuing	Total fixed assets is the sum of agricultural land, woodland, milk quota and buildings (livestock, crop and other), machinery, permanent crops and breeding livestock

Name variable	Detailed code (FBS)	Code (FBS)	Type of variable	Definition
		11G1(31)[2]+ 11G1(32)[2]+ 11G1(15)[2]+ 11G1(13)[2]+ 11G1(14)[2]+ 11G1(16)[2]		
Total current assets	Total current assets is the total assets per farm at closing value minus the total fixed assets per farm at closing value		Interval - Continuing	Total current assets: is calculated by deducting the closing value of the total fixed assets from the total assets closing value.
Entitlements to Single Payment Scheme	Sum of all entitlements to the SPS	11S(90)[4] + 11S(91)[4] +11S(92)[4] +11S(94)[4] +11S(95)[4] +11S(96)[4] +11S(98)[4] +11S(99)[4] +11S(100)[4] +11S(101)[4]	Interval - Continuing	Moorland within SDA – normal Moorland within SDA – normal (formally set-aside) Moorland within SDA – special Other land within SDA - normal Other land within SDA – normal (formally set-aside) Other land within SDA - special Outside SDA – normal/standard Outside SDA – normal (formally set-aside) Outside SDA – special Outside SDA – National Reserve
Depreciation		11G(69)	Interval - Continuing	
Interest		11G(71)		

Name variable	Detailed code (FBS)	Code (FBS)	Type of variable	Definition
Net farm income from operations	Gross margin (all enterprises)	11M(26)	Interval - Continuing	Output from crop enterprise, from livestock enterprise and other enterprises minus variable costs
Operating expenses	Total variable costs	11M(25)	Continuing	Concentrated feedingstuffs (horses, cattle, sheep and goats) Concentrated feedingstuffs (pigs) Concentrated feedingstuffs (poultry and other small livestock) Coarse fodder excl. rent for grazing or forage land rented for less than one year Vet. and medicine Other livestock costs Seeds and young plants Fertilizers Crop protection Other crop costs (excl. rent for bare land rented for less than 1 year) Enterprise specific heating fuel Fuel for crop drying and chilling
General characteristics				
Farm type	Type of farm	11farm.type	Categorical – nominal	1 Cereal farms 2 Dairy farms 4 LFA Grazing Livestock farms 5 Lowland Grazing Livestock farms
Region	Location of the farm	11FADN.region	Categorical – nominal	North (411) East England (412) West (413)
Farm size	As defined by FBS on standard labour requirements	11farm.size	Categorical – nominal	• Very small (1) • Small (2) • Medium (3)

Name variable	Detailed code (FBS)	Code (FBS)	Type of variable	Definition
				• Large (4)
Ownership	3 types of ownership: owner occupied, tenanted or mixed	11tenure.type	Categorical – nominal	• Owner occupied (1) • Tenanted (2) • Mixed (3)
Farmer's characteristics				
Farmer's age (average)	Farmer's age in 2010-2011	11age.of.farmer	Interval – Continuing	
Working spouse	Does spouse work?	11working.spouse	Categorical – Dichotomous	0 – no 1 – yes
Education	Level of education of farmer	11O(124)[19] 11O(124)[20] 11O(124)[21] 11O(124)[22] 11O(124)[23]	Categorical – nominal	Cell 19: No further /higher education? Cell 20: A college/national diploma/certificate in agriculture or related subject? Cell 21: A college/national diploma/certificate in business management, accountancy, marketing, economics or a related subject? Cell 22: A degree in agricultural or a related subject? Cell 23: A degree in business management, accountancy, marketing, economics or a related subject? 1 - Nobody on farm with managerial input has the specific qualification 2 - A person on farm with managerial input has the specific qualification

Name variable	Detailed code (FBS)	Code (FBS)	Type of variable	Definition
Gender	Male/female (in 2011/12)	11farmer.gender	Categorical - Dichotomous	1 – Male 2- Female
Business management skills				
Undertakes business planning, benchmarking or management accounting	Which of the following business planning, benchmarking and management accounting practices are you carrying out?	11O(124)[26]	Categorical – nominal	1 No practices 2 Regularly attends discussion groups on business management issues 4 Informal plan (e.g. At least once a year the team met to discuss future directions) 8 Formal plan produced and reviewed at least once a year. 16 Regularly produces budgets/ gross margins/ cash flows or in depth analysis of profit and loss account 32 Whole farm business level benchmarking 64 Enterprise level/balance sheet/international benchmarking
Reasons for not undertaking business planning, benchmarking or management accounting	Why are you not carrying out business planning, benchmarking or management accounting?	11O(124)[27]	Categorical – nominal	1 Not applicable (practices being carried out) 2 Could not see how benchmarking could help the business 4 No suitable benchmarking data available 8 Does not have the skills required for budgeting 16 Could not find the time 32 Software available but does not know how to use it 64 Not interested 128 No suitable training courses (either subject matter or standard/ location) available including discussion groups 256 Courses are too expensive

Name variable	Detailed code (FBS)	Code (FBS)	Type of variable	Definition
				512 Other
Interested in learning more about business planning, benchmarking or management accounting	In which areas of business planning, benchmarking or management accounting would you like to acquire further knowledge and skills	11O(124)[28]	Categorical - nominal	1 None identified 2 Producing formal/informal business plan 4 Producing budgets/ gross margins / cash flow planning 8 Analysing of profit and loss account 16 Benchmarking 32 Enterprise level/ balance sheet/ international benchmarking
Accessing advice		11O(124)[8]	Categorical – nominal	1 None identified 2 Through talking to other farmers 4 Through the farming media e.g. internet sites, trade magazines 8 Through events and demonstrations e.g. meetings organised by banks/accountancy firms/levy bodies 16 Through discussion groups, farm walks or workshops 32 Through technical advice supplied with no direct charge (e.g. from input supplier) 64 Through technical advice supplied for a charge 128 Through RDP-funded initiatives with strong animal health theme 256 Through RDP-funded schemes with strong technical theme (other than animal health)
Continuing professional advice schemes		11O(124)[31]	Categorical – nominal	1 Not aware of CPD schemes 2 Not a member of CPD schemes 4 Have not considered

Name variable	Detailed code (FBS)	Code (FBS)	Type of variable	Definition
				8 Application/membership process too onerous 16 No time to keep up membership 32 Interested but not available in relevant sector 64 Interested but not sure which scheme is most appropriate (e.g. for mixed farms) 128 Interested but not sure how it could benefit business 256 Yes farm is a member of a scheme
IT skills				1 There is no PC used on the farm or freely available to the farm 2 There is a PC used on the farm but not used by the business 4 There is a PC used on the farm which is used occasionally for some management purposes 8 The business has a computer but cannot get reliable access to the internet 16 The busiess has a computer that has good broadband internet access 32 The [farm team] is proficient in Excel/Word/E-mail and web searching 64 The internet is used to purchase and/or sell material for the farm 128 The internet is used regularly to improve the performance of the farm e.g. benchmarking 256 The main farm business documents (Business Plan/Finance Accounts etc) are all managed on the computer

Name variable	Detailed code (FBS)	Code (FBS)	Type of variable	Definition
				512 The internet/comuter is used for submitting forms or banking e.g. CTS/BCMS documents, VAT returns, PAYE forms, SP5 1024 Regularly communicates with other farms using the computer

Annex 2. Testing for environmental hostility

In order to assess whether the year 2011/12 was representative for the period 2008-2013, t-tests were carried out to check for statistically significant differences in means. This was done in two ways. Firstly, the datasets were compared without weighing the different farm types. The results of that analysis can be found in table A2-1.

Table A2-0-1: Comparing means per ratio – unweighted
Source: Calculated from the FBS 2008-2013 dataset and the 2011/12 dataset

Mean per ratio	**2008-2013**	**2011-2012**	**Ha: diff < 0**	**Ha: diff != 0**	**Ha: diff > 0**
RoS	.0423 (.0098)	0.0734 (.0082)	0.0110	0.0221	0.9890
ATO	.2885 (.0112)	0.2630 (.0080)	0.9680	0.0640	0.0320
CLF	1.2822 (.0359)	1.1922 (.0138)	0.9975	0.0049	0.0025
RoA	.0149 (.0027)	0.0214 (.0461)	0.0461	0.0921	0.9539
RoE	.0090 (.0050)	0.0240 (.0032)	0.0047	0.0094	0.9953

Note: Standard deviation in brackets

For 2011/12, the farms in the dataset experienced a higher RoS, RoA and RoE compared with the 2008-2013 period, and the differences were statistically significant. For ATO and CLF, the farmers achieved lower averages, and these were also statistically significant. However, for CLF this means that the overall level of indebtedness decreased, indicating that farmers either increased their equity and/or reduced debts. The environment in the year 2011/12 therefore does not seem to be hostile, as farmers achieve higher averages on four of the five ratios in the DuPont Expansion model.

The second comparison was done based on weighted datasets. Using the distribution of farm types that were in the dataset 2008-2013, the ratios were weighted for 2011/12. Table A2-2 shows the results of the analysis.

As with the unweighted dataset, farmers achieve on average higher RoS, RoA and RoE in 2011/12 compared with the 2008-2013 period, and these differences are statistically significant. ATO and CLF are on average lower. As discussed above, a lower CLF is a positive indication, meaning farmers reduce their debts or increase their own capital. Therefore, the environment is deemed not to be hostile, even on the weighted dataset. The indicator “environmental hostility or turbulence” is hence not included in the conceptual framework.

Table A2-0-2: Comparing means per ratio – weighted

Source: Calculated from the FBS 2008-2013 dataset and the 2011/12 dataset

Mean per ratio	**2008-2013**	**2011-2012**	**Ha: diff < 0**	**Ha: diff != 0**	**Ha: diff > 0**
RoS	.0423 (.0098)	.0810 (.0076)	0.0013	0.0026	0.9987
ATO	.2885 (.0112)	.2532 (.0094)	0.9886	0.0228	0.0114
CLF	1.2822 (.0359)	1.0980 (.0200)	1.0000	0.0000	0.0000
RoA	.0149 (.0027)	.0227 (.0025)	0.0255	0.0511	0.9745
RoE	.0090 (.0050)	.0254 (.0035)	0.0035	0.0071	0.9965

Note: Standard deviation in brackets

Annex 3. Comparison between low and high performers

The dataset contains 430 farms, with 215 in the group of low performers and 130 in the high performing group. There are 116 Cereal farms, 114 Dairy farms, 84 LFA Grazing Livestock farms and 116 Lowland Grazing Livestock farms; split equally over the groups low performers and high performers.

Table A3-0-1: t-test results for RoS for all farms
Source: calculated from FBS 2011/12

RoS	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.2186 (.4142)	.2930 (.4562)	0.0387	0.0773	0.9613
Using cash flow planning	.2419 (.4292)	.3814 (.0332)	0.0009	0.0017	0.9991
Any level of benchmarking	.1442 (.3521)	.2930 (.4562)	0.0001	0.0002	0.9999
Using formal planning and cash flow planning	.1256 (3322)	.1815 (.3862)	0.0544	0.1089	0.9456
Using formal planning and benchmarking	.0651 (.2473)	.1349 (.3424)	0.0079	0.0158	0.9921
Using formal planning, cash flow planning and benchmarking	.0605 (.2389)	.1070 (.3098)	0.0410	0.0820	0.9590
Accessing advice	.3860 (.4880)	.4698 (.5002)	0.0398	0.0797	0.9602
Being a member of a CPD scheme	.2512 (.4347)	.2930 (.4562)	0.1653	0.3306	0.8347
Having good IT skills	.3814 (.4868)	.4605 (.4996)	0.0486	0.0972	0.9514
Having a working spouse	.4279 (.4959)	.3860 (.4880)	0.8109	0.3782	0.1891
Having a university degree	.2046 (.4044)	.2372 (.4263)	0.2085	0.4170	0.7915
Farm size	2.6046 (.7469)	3.0140 (.8287)	0.0000	0.0000	1.0000
Ownership	.2977 (.4583)	.3581 (.4806)	0.0913	0.1826	0.9087
Age	55.70 (11.34)	53.2 (10.24)	0.9916	0.0167	0.0084

Table A3-0-2: t-test results for ATO for all farms
Source: calculated from FBS 2011/12

ATO	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.2186 (.4143)	.3349 (.4730)	0.0035	0.0070	0.9965
Using cash flow planning	.2465 (.4320)	.3163 (.4661)	0.0541	0.1082	0.9459
Any level of benchmarking	.1907 (.3938)	.2186 (.4143)	0.2372	0.4744	0.7628
Using formal planning and cash flow planning	.1488 (.3567)	.2139 (.4110)	0.0401	0.0801	0.9599
Using formal planning and benchmarking	.1023 (.3038)	.0791 (.2705)	0.7989	0.4023	0.2011
Using formal planning, cash flow planning and benchmarking	.0791 (.2705)	.0744 (.2631)	0.5717	0.8566	0.4283
Accessing advice	.4 (.4910)	.4139 (.4937)	0.3845	0.7690	0.6155
Being a member of a CPD scheme	.2558 (.4373)	.2977 (.4583)	0.1666	0.3331	0.8334
Having good IT skills	.3488 (.4777)	.4046 (.4919)	0.1167	0.2334	0.8833
Having a working spouse	.3628 (.4819)	.4558 (.4992)	0.0250	0.0500	0.9750
Having a university degree	.1535 (.3613)	.2279 (.4205)	0.0248	0.0497	0.9752
Farm size	2.6977 (.8241)	2.9860 (.7823)	0.0001	0.0002	0.9999
Ownership	.5256 (.5005)	.0837 (.2776)	1.0000	0.0000	0.0000
Age	57.23 (11.38)	53.56 (10.20)	0.9998	0.0005	0.0002

Table A3-0-3: t-test results for RoA for all farms
Source: calculated from FBS 2011/12

RoA	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.2372 (.4264)	.3581 (.4806)	0.0030	0.0060	0.9970
Using cash flow planning	.2698 (.4449)	.3581 (.4806)	0.0242	0.0485	0.9758
Any level of benchmarking	.1535 (.3613)	.2698 (.4449)	0.0015	0.0031	0.9985
Using formal planning and cash flow planning	.1395 (.3473)	.2046 (.4044)	0.0370	0.0740	0.9630
Using formal planning and benchmarking	.0651 (.2473)	.1209 (.3268)	0.0232	0.0465	0.9768
Using formal planning, cash flow planning and benchmarking	.0605 (.2389)	.0977 (.2976)	0.0768	0.1535	0.9232
Accessing advice	.3767 (.4857)	.4744 (.5005)	0.0203	0.0406	0.9797
Being a member of a CPD scheme	.2651 (.4424)	.3023 (.4603)	0.1966	0.3933	0.8034
Having good IT skills	.3628 (.4819)	.4419 (.4978)	0.0475	0.0950	0.9525
Having a working spouse	.4093 (.4929)	.4232 (.4952)	0.3849	0.7698	0.6151
Having a university degree	.1907 (.3938)	.2465 (.4320)	0.0811	0.1622	0.9189
Farm size	2.6186 (.7385)	3.1070 (.7988)	0.0000	0.0000	1.0000
Ownership	.2837 (.4519)	.1953 (.3974)	0.9841	0.0318	0.0159
Age	55.19 (11.50)	53.09 (9.96)	0.9785	0.0429	0.0215

Table A3-0-4: t-test results for RoE for all farms
Source: calculated from FBS 2011/12

RoE	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.2279 (.4205)	.3721 (.4845)	0.0005	0.0011	0.9995
Using cash flow planning	.2698 (.4449)	.3581 (.4806)	0.0242	0.0485	0.9758
Any level of benchmarking	.1442 (.3521)	.2651 (.4424)	0.0009	0.0018	0.9991
Using formal planning and cash flow planning	.1349 (.3424)	.2186 (.4143)	0.0114	0.0229	0.9886
Using formal planning and benchmarking	.0605 (.2389)	.1256 (.3321)	0.0100	0.0201	0.9900
Using formal planning, cash flow planning and benchmarking	.0558 (.2301)	.1023 (.3038)	0.0371	0.0742	0.9629
Accessing advice	.3674 (.4832)	.4837 (.5009)	0.0073	0.0147	0.9927
Being a member of a CPD scheme	.2605 (.4399)	.3116 (.4642)	0.1207	0.2415	0.8793
Having good IT skills	.3581 (.4806)	.4512 (.4988)	0.0248	0.0496	0.9752
Having a working spouse	.4279 (.4959)	.4326 (.4966)	0.4613	0.9226	0.5387
Having a university degree	.1814 (.3862)	.2465 (.4320)	0.0501	0.1002	0.9499
Farm size	2.6139 (.7329)	3.0930 (.7976)	0.0000	0.0000	1.0000
Ownership	.2884 (.4541)	.1954 (.3974)	0.9879	0.0243	0.0121
Age	55.15 (11.48)	52.95 (9.84)	0.9833	0.0334	0.0167

Annex 4. Results per farm type

Cereal farms

The 2011/12 dataset was organised per farm type, and split into high and low performers for each ratio. The Cereal farms dataset contains 116 farms; with 58 farms in the group of low performers and 58 in the high performing group. For RoA and RoE, the datasets are as good as the same, with 10 different observations in the set.

Table A4-0-1: t-test results for RoS for Cereal farms
Source: calculated from FBS 2011/12

RoS	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.2414 (.0567)	.3276 (.0622)	0.1538	0.3077	0.8462
Using cash flow planning	.2586 (.0580)	.5172 (.0662)	0.0020	0.0040	0.9980
Any level of benchmarking	.1207 (.0431)	.3276 (.0622)	0.0036	0.0073	0.9964
Using formal planning and cash flow planning	.1207 (.0431)	.2241 (.0552)	0.0714	0.1427	0.9286
Using formal planning and benchmarking	.0517 (.0293)	.1379 (.0457)	0.0575	0.1150	0.9425
Using formal planning, cash flow planning and benchmarking	.0345 (.0242)	.1207 (.0431)	0.0420	0.0840	0.9580
Accessing advice	.5 (.0662)	.5689 (.0656)	0.2304	0.4609	0.7696
Being a member of a CPD scheme	.6724 (.0621)	.7414 (.0580)	0.2095	0.4190	0.7905
Having good IT skills	.4827 (.0662)	.5690 (.56890)	0.1784	0.3569	0.8216
Having a working spouse	.2931 (.0603)	.2586 (.0580)	0.6595	0.6810	0.3405
Having a university degree	.2069 (.0537)	.2759 (.0592)	0.1949	0.3898	0.8051
Farm size	2.5690 (.0923)	3.2414 (.0962)	0.0000	0.0000	1.0000
Ownership	.2586 (.0580)	.3448 (.0630)	0.1580	0.3160	0.8420
Age	55.78 (1.63)	55.72 (1.40)	0.5096	0.9808	0.4904

Table A4-0-2: t-test results for ATO for Cereal farms
Source: calculated from FBS 2011/12

ATO	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.2759 (.0592)	.4483 (.0659)	0.0270	0.0540	0.9730
Using cash flow planning	.4138 (.0652)	.3793 (.0643)	0.6464	0.7072	0.353
Any level of benchmarking	.1552 (.0479)	.2414 (.0567)	0.1240	0.2480	0.8760
Using formal planning and cash flow planning	.2241 (.0552)	.2586 (.0580)	0.3338	0.6676	0.6662
Using formal planning and benchmarking	.0862 (.0372)	.0690 (.0336)	0.6344	0.7313	0.3656
Using formal planning, cash flow planning and benchmarking	.0862 (.0372)	.0517 (.0293)	0.7660	0.4680	0.2340
Accessing advice	.4828 (.0662)	.4828 (.0662)	0.5000	1.000	0.5000
Being a member of a CPD scheme	.6724 (.0622)	.6897 (.0613)	0.4219	0.8438	0.5781
Having good IT skills	.4310 (0656)	.5517 (.0659)	0.0984	0.1968	0.9016
Having a working spouse	.3103 (.0613)	.3966 (.0648)	0.1679	0.3358	0.832
Having a university degree	.2241 (.05523)	.2414 (.0567)	0.4140	0.8279	0.5860
Farm size	2.9310 .1068	3.2241 0888	0.0185	0.0371	0.9815
Ownership	.5689 (.0656)	0 (0)	1.0000	0.000	0.000
Age	55.88 (1.62)	57.45 (1.30)	0.2252	0.4503	0.7748

Table A4-0-3: t-test results for RoA for Cereal farms
Source: calculated from FBS 2011/12

RoA	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.2069 (.0537)	.4828 (.0662)	0.0008	0 .0016	0.9992
Using cash flow planning	.2931 (.0603)	.4138 (.0652)	0.0885	0.1769	0.9115
Any level of benchmarking	.1207 (.0431)	.2586 (.0580)	0.0294	0.0589	0.9706
Using formal planning and cash flow planning	.1207 (.0431)	.2759 (0592)	0.0182	0.0363	0.9818
Using formal planning and benchmarking	.0517 (.0293)	.1034 (.0403)	0.1510	0.3019	0.8490
Using formal planning, cash flow planning and benchmarking	.0345 (.0242)	.0690 (.0335)	0.2031	0.4062	0.7969
Accessing advice	.4483 (.0659)	.5517 (.0659)	0.1346	0.2691	0.8654
Being a member of a CPD scheme	.6379 (.0637)	.7241 (.0592)	0.1617	0.3235	0.8383
Having good IT skills	.4138 (.0652)	.6379 (.0637)	0.0077	0.0154	0.9923
Having a working spouse	.3103 (.0613)	.3793 (.0643)	0.2195	0.4390	0.7805
Having a university degree	.1896 (.0519)	.2414 (.0567)	0.2512	0.5024	0.7488
Farm size	2.4310 (.0820)	3.4138 (.0739)	0.0000	0.0000	1.0000
Ownership	.3621 (.0637)	.0345 (0242)	1.0000	0.0000	0.0000
Age	56.10 (1.61)	56.66 (1.27)	0.3942	0.7883	0.6058

Table A4-0-4: t-test results for RoE for Cereal farms
Source: calculated from FBS 2011/12

RoE	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.1897 (.0519)	.5 (.0662)	0.0002	0.0003	0.9998
Using cash flow planning	.2931 (.0603)	.4138 (.0652)	0.0885	0.1769	0.9115
Any level of benchmarking	.0862 (.0372)	.2414 (.0567)	0.0120	0.0239	0.9880
Using formal planning and cash flow planning	.1034 (.0403)	.2931 (.0603)	0.0051	0.0101	0.9949
Using formal planning and benchmarking	.0345 (.0242)	.1034 (.0403)	0.0726	0.1452	0.9274
Using formal planning, cash flow planning and benchmarking	.0172 (.0172)	.0690 (.0336)	0.0866	0.1731	0.9134
Accessing advice	.4310 (.0656)	.5690 (0656)	0.0699	0.1398	0.9301
Being a member of a CPD scheme	.6207 (.0643)	.7069 (.0603)	0.1650	0.3300	0.8350
Having good IT skills	.3966 (.0648)	.6724 (.0622)	0.0013	0.0027	0.9987
Having a working spouse	.3276 (.0622)	.3621 (.0637)	0.3495	0.6991	0.6505
Having a university degree	.1724 (.0500)	.2586 (.0580)	0.1314	0.2628	0.8686
Farm size	2.3966 (.0735)	3.3793 (.0809)	0.0000	0.0000	1.0000
Ownership	.3793 (.0643)	.0517 (.0293)	1.0000	0.0000	0.0000
Age	56 (1.62)	56.5 (1.29)	0.4047	0.8094	0.5953

Table A4-0-5: Results of the regression analysis for Cereal farms – direct effects

Direct effects	RoS		Log_ATO		RoA		RoE	
	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value
BMP_Fml	.0122 (.0026)	0.123	.0861** (.0403)	0.034	0.0122 (0.0098)	0.216	.0561 (.0139)	0.000
BMP_CF	-.0015** (.0310)	0.044	-.0780** (.0385)	0.044	-0.0015 (0.0102)	0.886	-.0267** (.0127)	0.037
BMP_AnyB	.0107** (.0264)	0.035	.0540 (.0495)	0.276	0.0107 (0.0145)	0.460	.0125 (.0182)	0.494
Uni	-.0072 (.0242)	0.229	.0156 (.0469)	0.739	-0.0072 (0.0093)	0.439	.0146 (.0100)	0.145
AA	.0063 (.0204)	0.330	.0124 (.0385)	0.748	0.0063 (0.0083)	0.444	-.0018 (.0091)	0.839
CPD	-.0109 (.0178)	0.667	-.0544 (.0574)	0.344	-0.0109 (0.0090)	0.230	-.0169* (.0102)	0.098
Age	.0001 (.0010)	0.236	.0003 (.0017)	0.871	0.0001 (0.0003)	0.729	-.0004 (.0004)	0.367
Off_farm	.0082 (.0212)	0.635	-.0073 (.0467)	0.877	0.0082 (0.0076)	0.285	.0105 (.0107)	0.330
IT	.0074 (.0200)	0.782	.0336 (.0414)	0.417	0.0074 (0.0079)	0.354	-.0136 (.0103)	0.188
Size 3	.0408*** (.0299)	0.000	.1094** (.0517)	0.036	0.0408*** (0.0093)	0.000	.0488*** (.0124)	0.000
Size 4	.0408*** (.0316)	0.000	-.0016 (.0572)	0.977	0.0408*** (0.0089)	0.000	.0444*** (.0116)	0.000
Own	-.0229*** (.0238)	0.002	-.3614*** (.0365)	0.000	-0.0229*** (0.0078)	0.004	-.0290*** (.0096)	0.003
_cons	.0197*** (.0691)	0.008	-.7069*** (.1153)	0.000	0.0197 (0.0245)	0.423	.06514** (.0255)	0.012
Prob >F	0.0001		0.0000		0.0000		0.0000	
R-squared	0.2103		0.4479		0.2006		0.1916	

Note: *** is statistically significant at the 1% level, ** is statistically significant at the 5% level, * is statistically significant at the 10% level

Table A4-0-6: Results of the regression analysis for Cereal farms – interaction effects

Interaction effects	RoS		log_ATO		RoA		RoE	
	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value
BMP_Fml_CF	.0134 (.0239)	0.576	.1636** (.0805)	0.043	.0385** (.0178)	0.033	.0557** (.0245)	0.024
BMP_Fml_AnyB	.0325 (.0869)	0.708	.1739* (.0929)	0.062	.0344 (.0350)	0.327	.0502 (.0443)	0.258
BMP_FmL_CF_AnyB	.0262 (.0960)	0.785	-.3302** (.1407)	0.020	-.0733* (.0395)	0.065	-.1102** (.0506)	0.030
_cons	.2358*** (.0127)	0.000	-.7638*** (.0253)	0.000	.05148*** (.0052)	0.000	.0633*** (.0079)	0.000
Prob >F	.2898		0.0717		0.1308		0.0652	
R-squared	.0162		0.0301		0.0243		0.031	

Note *** is statistically significant at the 1% level, ** is statistically significant at the 5% level, * is statistically significant at the 10% level

Dairy farms

The 2011/12 dataset was organised per farm type, and split into high and low performers for each ratio. The Dairy farms dataset contains 114 farms; with 57 farms in the group of low performers and 57 in the high performing group. For RoA and RoE, the datasets are as good as the same, with 10 different observations in the set.

Table A4-0-7: t-test results for RoS for Dairy farms
Source: calculated from FBS 2011/12

RoS	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.3333 (.0630)	.4211 (.0660)	0.1692	0.3383	0.8308
Using cash flow planning	.3509 (.0638)	.4737 (.0667)	0.0930	0.1860	0.9070
Any level of benchmarking	.2632 (.0588)	.4912 (.0668)	0.0059	0.0117	0.9941
Using formal planning and cash flow planning	.2105 (.0545)	.2807 (.0600)	0.1943	0.3886	0.8057
Using formal planning and benchmarking	.1404 (.0464)	.2632 (.0588)	0.0521	0.1041	0.9479
Using formal planning, cash flow planning and benchmarking	.1404 (.0464)	.1930 (.0527)	0.2277	0.4553	0.7723
Accessing advice	.4386 (.0663)	.7018 (.0611)	0.0021	0.0043	0.9979
Being a member of a CPD scheme	.1404 (.0464)	.2105 (.0545)	0.1645	0.3290	0.8355
Having good IT skills	.4912 (.0668)	.5088 (.0668)	0.4265	0.8530	0.5735
Having a working spouse	.5088 (.0668)	.3158 (.0621)	0.9817	0.0366	0.0183
Having a university degree	.2281 (.0561)	.2807 (.0600)	0.2615	0.5231	0.7385
Farm size	3.4737 (.0667)	3.8246 (.0508)	0.0000	0.0001	1.0000
Ownership	.1930 (.0527)	.3333 (.0630)	0.0452	0.0903	0.9548
Age	52.26 (1.26)	50.75 (1.20)	0.8058	0.3884	0.1942

Table A4-0-8: t-test results for ATO for Dairy farms
Source: calculated from FBS 2011/12

ATO	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.3333 (.0630)	.4561 (.0666)	0.0915	0.1829	0.9085
Using cash flow planning	.3684 (.0645)	.3860 (.0650)	0.4242	0.8484	0.5758
Any level of benchmarking	.4561 (.0666)	.3158 (.0621)	0.9370	0.1260	0.0630
Using formal planning and cash flow planning	.2456 (.0575)	.3333 (.0630)	0.1530	0.3060	0.8470
Using formal planning and benchmarking	.2105 (.0545)	.1930 (.0527)	0.5913	0.8174	0.4087
Using formal planning, cash flow planning and benchmarking	.1579 (.0487)	.1930 (.0527)	0.3130	0.6260	0.6870
Accessing advice	.5088 (.0668)	.5790 (.0660)	0.2282	0.4564	0.7718
Being a member of a CPD scheme	.2105 (.0545)	.1579 (.0487)	0.7635	0.4730	0.2365
Having good IT skills	.4211 (.0660)	.3860 (.0651)	0.6472	0.7056	0.3528
Having a working spouse	.3684 (.0644)	.5263 (.0667)	0.0458	0.0915	0.9542
Having a university degree	.1930 (.0527)	.2632 (.0588)	0.1882	0.3764	0.8118
Farm size	3.5789 (.0660)	3.6316 (.0645)	0.2847	0.5694	0.7153
Ownership	.4386 (.0663)	0 (0)	1.0000	0.0000	0.0000
Age	53.79 (1.36)	49.29 (1.17)	0.9932	0.0137	0.0068

Table A4-0-9: t-test results for RoA for Dairy farms
Source: calculated from FBS 2011/12

RoA	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.3509 (.0638)	.4737 (.0667)	0.0930	0.1860	0.9070
Using cash flow planning	.3860 (.0651)	.4561 (.0666)	0.2262	0.4524	0.7738
Any level of benchmarking	.2807 (.0600)	.4737 (.0667)	0.0169	0.0337	0.9831
Using formal planning and cash flow planning	.2281 (.0561)	.2982 (.0611)	0.1997	0.3994	0.8003
Using formal planning and benchmarking	.1404 (.0464)	.2632 (.0588)	0.0521	0.1041	0.9479
Using formal planning, cash flow planning and benchmarking	.1404 (.0464)	.2105 (.0545)	0.1645	0.3290	0.8355
Accessing advice	.4561 (.0666)	.7018 (.0611)	0.0038	0.0076	0.9962
Being a member of a CPD scheme	.1404 (.0464)	.1754 (.0508)	0.3056	0.6112	0.6944
Having good IT skills	.5088 (.0669)	.4035 (.0655)	0.8684	0.2632	0.1316
Having a working spouse	.5088 (.0668)	.3860 (.0651)	0.9047	0.1905	0.0953
Having a university degree	.2456 (.0575)	.2807 (.0600)	0.3369	0.6739	0.6631
Farm size	3.5088 (.0668)	3.8596 (.0464)	0.0000	0.0000	1.0000
Ownership	.1754 (.0508)	.1579 (.0487)	0.5982	0.8037	0.4018
Age	51.67 (1.28)	50.03 (1.74)	0.8256	0.3487	0.1744

Table A4-0-10: t-test results for RoE for Dairy farms
Source: calculated from FBS 2011/12

RoE	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.3509 (.0638)	.5088 (.0668)	0.0451	0.0901	0.9549
Using cash flow planning	.3860 (.0651)	.4737 (.0667)	0.1743	0.3486	0.8257
Any level of benchmarking	.2807 (.0600)	.4737 (.0667)	0.0169	0.0337	0.9831
Using formal planning and cash flow planning	.2281 (.0561)	.3333 (.0630)	0.1073	0.2146	0.8927
Using formal planning and benchmarking	.1404 (.0464)	.2807 (.0600)	0.0335	0.0671	0.9665
Using formal planning, cash flow planning and benchmarking	.1404 (.0464)	.2280 (.0561)	0.1154	0.2307	0.8846
Accessing advice	.4561 (.0665)	.7192 (.0600)	0.0020	0.0040	0.9980
Being a member of a CPD scheme	.1404 (.0464)	.2281 (.0561)	0.1154	0.2307	0.8846
Having good IT skills	.5088 (.0668)	.4210 (.0660)	0.8239	0.3522	0.1761
Having a working spouse	.5263 (.0667)	.4210 (.0660)	0.8678	0.2643	0.1322
Having a university degree	.2456 (.0575)	.2807 (.0600)	0.3369	0.6739	0.6631
Farm size	3.5263 (.0667)	3.8246 (.0508)	0.0003	0.0006	0.9997
Ownership	.1754 (.0508)	.1579 (.0487)	0.5982	0.8037	0.4018
Age	51.81 (1.26)	49.58 (1.06)	0.9106	0.1787	0.0894

Table A4-0-11: Results of the regression analysis for Dairy farms – direct effects

Direct effects	RoS		Log_ATO		RoA		RoE	
	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value
BMP_Fml	-.0117 (.02335)	0.616	.0782** (.0307)	0.012	.0101 (.0129)	0.433	.0028 (.0146)	0.846
BMP_CF	-.0096 (.0237)	0.686	.0367 (.0337)	0.278	-.0134 (.0117)	0.254	.0185 (.0119)	0.121
BMP_AnyB	.0602*** (.0204)	0.004	-.0746** (.0299)	0.013	-.0025 (.0089)	0.774	.0168 (.0109)	0.124
Uni	.0057 (.0246)	0.817	.0041 (.0317)	0.898	-.0020 (.0101)	0.842	.0179* (.0104)	0.087
AA	.0296 (.0198)	0.135	.0167 (.0323)	0.610	.0012 (.0095)	0.897	.0052 (.0109)	0.635
CPD	-.0236 (.0220)	0.285	-.0114 (.0398)	0.775	.0356*** (.0123)	0.004	-.0159 (.0159)	0.318
Age	-.0013 (.0009)	0.148	-.0031** (.0014)	0.034	.0010** (.0004)	0.024	-.0007* (.0004)	0.099
Off_farm	-.0419** (.0188)	0.027	.0367 (.0285)	0.200	.0188* (.0098)	0.057	-.0172 (.0115)	0.137
IT	-.0281 (.0201)	0.164	-.0096 (.0287)	0.738	-.0057 (.0096)	0.555	-.0327** (.0129)	0.012
Size 4	.0914*** (.0206)	0.000	.0188 (.0367)	0.610	.0244*** (.0092)	0.009	.0327*** (.0098)	0.001
Own	.0263 (.0211)	0.213	-.1951*** (.0276)	0.000	-.0004 (.0111)	0.974	-.00362 (.0085)	0.670
_cons	.0527 (.0536)	0.327	-.3831*** (.0868)	0.000	-.0595** (.0276)	0.032	.0343 (.0268)	0.201
Prob >F	0.0000		0.0000		0.0000		0.0013	
R-squared	0.1671		0.2641		0.2364		0.1769	

Note ** is statistically significant at the 1% level, ** is statistically significant at the 5% level, * is statistically significant at the 10% level

Table A4-0-12: Results of the regression analysis for Dairy farms – interaction effects

Interaction effects	RoS		log_ATO		RoA		RoE	
	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value
BMP_Fml_CF	-.0040 (.0321)	0.900	.1163* (.0627)	0.065	.0137 (.0115)	0.237	.0168 (.0159)	0.292
BMP_Fml_AnyB	.0911** (.0367)	0.014	-.0729 (.0602)	0.228	.0259** (.0129)	0.046	.0372** (.0163)	0.023
BMP_FmL_CF_AnyB	-.0588 (.0536)	0.274	-.0341 (.0982)	0.729	-.0157 (.0197)	0.427	-.0164 (.0281)	0.560
_cons	.0481*** (.0123)	0.000	-.5578*** (.0196)	0.000	.0107** (.0048)	0.026	.0086 (.0061)	0.163
Prob >F	0.0786		0.1464		0.0579		0.0378	
R-squared	0.0298		0.0237		0.0328		0.0369	

Note *** is statistically significant at the 1% level, ** is statistically significant at the 5% level, * is statistically significant at the 10% level

LFA Grazing Livestock farms

The 2011/12 dataset was organised per farm type, and split into high and low performers for each ratio. The LFA Grazing Livestock farms dataset contains 84 farms; with 42 farms in the group of low performers and 42 in the high performing group. For RoA and RoE, the datasets are as good as the same, with 4 different observations in the set.

Table A4-0-13: t-test results for RoS for LFA Grazing Livestock farms
Source: calculated from FBS 2011/12

RoS	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.0952 (.0458)	.1429 (.0546)	0.2531	0.5063	0.7469
Using cash flow planning	.1429 (.0546)	.2619 (.0687)	0.0893	0.1786	0.9107
Any level of benchmarking	.0952 (.0458)	.1905 (.0613)	0.1085	0.2171	0.8915
Using formal planning and cash flow planning	.0714 (.0402)	.0714 (.0402)	0.5000	1.0000	0.5000
Using formal planning and benchmarking	.0476 (.0332)	0 (0)	0.9220	0.1560	0.0780
Using formal planning, cash flow planning and benchmarking	.0476 (.0333)	0 (0)	0.9220	0.1560	0.0780
Accessing advice	.1666 (.0582)	.2381 (.0665)	0.2107	0.4213	0.7893
Being a member of a CPD scheme	.0476 (.0333)	.0238 (.0238)	0.7190	0.5621	0.2810
Having good IT skills	.1429 (.0546)	.2381 (.0665)	0.1359	0.2718	0.8641
Having a working spouse	.5 (.0781)	.5 (.0781)	0.5000	1.0000	0.5000
Having a university degree	.1905 (.0613)	.1429 (.0546)	0.7182	0.5637	0.2818
Farm size	2.1429 (.0546)	2.4523 (.0777)	0.0008	0.0016	0.9992
Ownership	.4524 (.0777)	.2619 (.0687)	0.9650	0.0699	0.0350
Age	58.98 (1.56)	52.55 (1.38)	0.9986	0.0028	0.0014

Table A4-0-14: t-test results for ATO for LFA Grazing Livestock farms
Source: calculated from FBS 2011/12

ATO	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.0952 (.0458)	.1429 (.0546)	0.2531	0.5063	0.7469
Using cash flow planning	.0714 (.0402)	.2142 (.0641)	0.0313	0.0625	0.9687
Any level of benchmarking	.0476 (.0333)	.1667 (.0582)	0.0397	0.0795	0.9603
Using formal planning and cash flow planning	.0476 (.0333)	.0714 (.0402)	0.3247	0.6494	0.6753
Using formal planning and benchmarking	.0238 (.0238)	0 (0)	0.8399	0.3203	0.1601
Using formal planning, cash flow planning and benchmarking	.0238 (.0238)	0 (0)	0.8399	0.3203	0.1601
Accessing advice	.3095 (.0722)	.1905 (.0614)	0.8938	0.2124	0.1062
Being a member of a CPD scheme	.0238 (.0238)	.1190 (.0506)	0.0461	0.0922	0.9539
Having good IT skills	.1905 (.0613)	.2619 (.0687)	0.2200	0.4401	0.7800
Having a working spouse	.4048 (.0767)	.5476 (.0777)	0.0972	0.1943	0.9028
Having a university degree	.0952 (.0458)	.1429 (.0546)	0.2531	0.5063	0.7469
Farm size	2.0952 (.0458)	2.3810 (.0758)	0.0009	0.0018	0.9991
Ownership	.6905 (.0722)	0 (0)	1.0000	0.0000	0.0000
Age	58.62 (1.44)	54.36 (1.58)	0.9751	0.0498	0.0249

Table A4-0-15: t-test results for RoA for LFA Grazing Livestock farms
Source: calculated from FBS 2011/12

RoA	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.1190 (.0506)	.1905 (.0613)	0.1858	0.3715	0.8142
Using cash flow planning	.1429 (.0546)	.3095 (.0721)	0.0346	0.0693	0.9654
Any level of benchmarking	.0952 (.0458)	.2142 (.0641)	0.0673	0.1347	0.9327
Using formal planning and cash flow planning	.0714 (.0402)	.0714 (.0402)	0.5000	1.0000	0.5000
Using formal planning and benchmarking	.0476 (.0332)	0 (0)	0.9220	0.1560	0.0780
Using formal planning, cash flow planning and benchmarking	.0476 (.0332)	0 (0)	0.9220	0.1560	0.0780
Accessing advice	.1667 (.0582)	.2619 (.0687)	0.1466	0.2931	0.8534
Being a member of a CPD scheme	.0714 (.0402)	.1190 (.0506)	0.2316	0.4633	0.7684
Having good IT skills	.1905 (.0613)	.2381 (.0665)	0.3000	0.6001	0.7000
Having a working spouse	.5238 (.0780)	.4762 (.0780)	0.6665	0.6671	0.3335
Having a university degree	.1429 (.0546)	.1905 (.0613)	0.2818	0.5637	0.7182
Farm size	2.2143 (.0641)	2.4524 (.0777)	0.0102	0.0205	0.9898
Ownership	.2857 (.0706)	.1429 (.0546)	0.9434	0.1133	0.0566
Age	57.98 (1.61)	52.57 (1.42)	0.9931	0.0137	0.0069

Table A4-0-16: t-test results for RoE for LFA Grazing Livestock farms
Source: calculated from FBS 2011/12

RoE	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.1190 (.0506)	.1905 (.0613)	0.1858	0.3715	0.8142
Using cash flow planning	.1429 (.0546)	.3095 (.0722)	0.0346	0.0693	0.9654
Any level of benchmarking	.0952 (.0458)	.2143 (.0641)	0.0673	0.1347	0.9327
Using formal planning and cash flow planning	.0714 (.0402)	.0714 (.0402)	0.5000	1.000	0.5000
Using formal planning and benchmarking	.0476 (.0332)	0 (0)	0.9220	0.1560	0.0780
Using formal planning, cash flow planning and benchmarking	.0476 (.0332)	0 (0)	0.9220	0.1560	0.0780
Accessing advice	.1667 (.0582)	.2380 (.0665)	0.2107	0.4213	0.7893
Being a member of a CPD scheme	.0714 (.0402)	.1190 (.0506)	0.2316	0.2316	0.7684
Having good IT skills	.1904 (.0613)	.2381 (.0665)	0.3000	0.6001	0.7000
Having a working spouse	.5476 (.0777)	.4762 (.0780)	0.7408	0.5184	0.2592
Having a university degree	.1429 (.0546)	.1667 (.0582)	0.3831	0.7663	0.6169
Farm size	2.2143 (.0641)	2.4286 (.0773)	0.0179	0.0358	0.9821
Ownership	.2857 (.0706)	.1190 (.0506)	0.9708	0.0583	0.0292
Age	57.95 (1.61)	52.5 (1.43)	0.9934	0.0132	0.0066

Table A4-0-17: Results of the regression analysis for LFA Grazing Livestock farms – direct effects

Direct effects	RoS		Log_ATO		RoA		RoE	
	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value
BMP_Fml	.0360 (.0450)	0.424	-.0103 (.0572)	0.857	.0185 (.0158)	0.244	.0100 (.0144)	0.490
BMP_CF	.0059 (.0619)	0.924	.1308*** (.0473)	0.006	.0219 (.0156)	0.161	-.0011 (.0143)	0.937
BMP_AnyB	.0353 (.0818)	0.667	.0403 (.0574)	0.484	.0297 (.0239)	0.215	.0148 (.0249)	0.552
Uni	-.1018** (.0485)	0.038	.0370 (.0699)	0.597	.0042 (.0147)	0.778	-.0177** (.0088)	0.046
AA	-.0019 (.0327)	0.954	-.0256 (.0489)	0.601	-.0113 (.0120)	0.347	.0131 (.0113)	0.251
CPD	-.0642 (.0895)	0.475	.1551*** (.0542)	0.005	-.0013 (.0181)	0.941	.0375 (.0463)	0.419
Age	-.0039** (.0019)	0.041	-.0049* (.0027)	0.067	-.0003 (.0004)	0.526	-.0009* (.0005)	0.054
Off_farm	-.0731* (.0381)	0.057	-.0751 (.0456)	0.102	-.0253** (.0127)	0.048	-.0059 (.0135)	0.662
IT	.0649* (.0383)	0.092	.0262 (.0516)	0.612	.0170 (.0122)	0.165	.0058 (.0138)	0.677
Size 3	.0972** (.0371)	0.010	.1108*** (.0412)	0.008	.0286** (.0132)	0.032	.0270** (.0129)	0.038
Own	-.0286 (.0484)	0.556	-.3827*** (.0395)	0.000	-.0075 (.0119)	0.533	-.0200 (.0136)	0.143
_cons	.2114* (.1131)	0.064	-.3840** (.1617)	0.019	.0153 (.0252)	0.545	.0529 (.0348)	0.131
Prob > F	.0002		0.0000		0.0001		0.0000	
R-squared	0.2149		0.4735		0.2030		0.3902	

Note *** is statistically significant at the 1% level, ** is statistically significant at the 5% level, * is statistically significant at the 10% level

Table A4-0-18: Results of the regression analysis for LFA Grazing Livestock farms – interaction effects

Interaction effects	RoS		log_ATO		RoA		RoE	
	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value
BMP_Fml_CF	.0970* (.0555)	0.082	.1878* (.1050)	0.075	.0310 (.0218)	0.157	.0383 (.0254)	0.133
BMP_Fml_AnyB	-1.047*** (.0600)	0.000	-.4821* (.2765)	0.083	-.1627** (.0648)	0.013	-.2003*** (.0486)	0.000
BMP_FmL_CF_AnyB	.0000 (omitted)		.0000 (omitted)		.0000 (omitted)		.0000 (omitted)	
_cons	-.0122 (.0219)	0.579	-.7524*** (.0294)	0.000	.0100* (.0055)	0.072	.0089 (.0072)	0.218
Prob >F	0.0000		0.1023		0.0366		0.0003	
R-squared	0.8001		0.0271		0.0391		0.0943	

Note *** is statistically significant at the 1% level, ** is statistically significant at the 5% level, * is statistically significant at the 10% level

Lowland Grazing Livestock farms

The 2011/12 dataset was organised per farm type, and split into high and low performers for each ratio. The Lowland Grazing Livestock farms dataset contains 116 farms; with 58 farms in the group of low performers and 58 in the high performing group. For RoA and RoE, the datasets are as good as the same, with 6 different observations in the set.

Table A4-0-19: t-test results for RoS for Lowland Grazing Livestock farms
Source: calculated from FBS 2011/12

RoS	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.1724 (.0500)	.2414 (.0567)	0.1818	0.3636	0.8182
Using cash flow planning	.1897 (.0519)	.2414 (.0567)	0.2512	0.5024	0.7488
Any level of benchmarking	.0862 (.0372)	.1379 (.0457)	0.1908	0.3816	0.8092
Using formal planning and cash flow planning	0.8092 (.0372)	.1207 (.0431)	0.2730	0.5461	0.7270
Using formal planning and benchmarking	.0172 (.0172)	.1034 (.0403)	0.0259	0.0518	0.9741
Using formal planning, cash flow planning and benchmarking	.0172 (.0172)	.0862 (.0372)	0.0476	0.0951	0.9524
Accessing advice	.3793 (.0643)	.3103 (.0613)	0.7805	0.4390	0.2195
Being a member of a CPD scheme	.0862 (.0371)	.1207 (.0431)	0.2730	0.5461	0.7270
Having good IT skills	.3448 (.0630)	.4655 (.0661)	0.0943	0.1887	0.9057
Having a working spouse	.4310 (.0656)	.5 (.0662)	0.2304	0.4609	0.7696
Having a university degree	.1897 (.0519)	.2241 (.0552)	0.3250	0.6501	0.6750
Farm size	2.1207 (.0431)	2.3965 (.0814)	0.0017	0.0034	0.9983
Ownership	.3276 (.0622)	.4655 (.0661)	0.0656	0.1312	0.9344
Age	56.64 (1.58)	53.55 (1.49)	0.9207	0.1585	0.0793

Table A4-0-20: t-test results for ATO for Lowland Grazing Livestock farms
Source: calculated from FBS 2011/12

ATO	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.1379 (.0457)	.2414 (.0567)	0.0790	0.1580	0.9210
Using cash flow planning	.0862 (.0372)	.2586 (.0580)	0.0069	0.0137	0.9931
Any level of benchmarking	.0690 (.0336)	.1379 (.0457)	0.1131	0.2262	0.8869
Using formal planning and cash flow planning	.0517 (.0293)	.1552 (.0480)	0.0342	0.0683	0.9658
Using formal planning and benchmarking	.0690 (.0336)	.0345 (.0242)	0.7969	0.4062	0.2031
Using formal planning, cash flow planning and benchmarking	.0345 (.0242)	.0345 (.0242)	0.5000	1.0000	0.5000
Accessing advice	.2759 (.0592)	.3448 (.0630)	0.2133	0.4265	0.7867
Being a member of a CPD scheme	.0517 (.0293)	.1724 (.0500)	0.0198	0.0397	0.9802
Having good IT skills	.3103 (.0613)	.3793 (.0643)	0.2195	0.2195	0.7805
Having a working spouse	.3793 (.0643)	.3793 (.0643)	0.5000	1.0000	0.5000
Having a university degree	.0862 (.0372)	.2414 (.0567)	0.0120	0.0239	0.9880
Farm size	2.0345 (.0242)	2.5517 (.0926)	0.0000	0.0000	1.0000
Ownership	.4483 (.0659)	.3103 (.0613)	0.9360	0.1280	0.0640
Age	60.97 (1.54)	53.28 (1.36)	0.9999	0.0003	0.0001

Table A4-0-21: t-test results for RoA for Lowland Grazing Livestock farms
Source: calculated from FBS 2011/12

RoA	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.2414 (.0567)	.2414 (.0567)	0.5000	1.0000	0.5000
Using cash flow planning	.2241 (.0552)	.2414 (.0567)	0.4140	0.8279	0.5860
Any level of benchmarking	.1034 (.0403)	.1207 (.0431)	0.3854	0.7709	0.6146
Using formal planning and cash flow planning	.1207 (.0431)	.1379 (.0457)	0.3921	0.7843	0.6079
Using formal planning and benchmarking	.0172 (.0172)	.0862 (.0372)	0.0476	0.0951	0.9524
Using formal planning, cash flow planning and benchmarking	.0172 (.0172)	.0862 (.0372)	0.0476	0.0951	0.9524
Accessing advice	.3793 (.0643)	.3276 (.0622)	0.7180	0.5641	0.2820
Being a member of a CPD scheme	.1552 (.0480)	.1379 (.0457)	0.6025	0.7951	0.3975
Having good IT skills	.2931 (.0603)	.4310 (.0656)	0.0622	0.1244	0.9378
Having a working spouse	.3276 (.0622)	.4655 (.0661)	0.0656	0.1312	0.9344
Having a university degree	.1724 (.0500)	.2586 (0580)	0.1314	0.2628	0.8686
Farm size	2.2241 (.0552)	2.5345 (.0894)	0.0019	0.0038	0.9981
Ownership	.3103 (.0613)	.4310 (.0656)	0.0907	0.1814	0.9093
Age	55.74 (1.65)	52.90 (1.43)	0.9025	0.1950	0.0975

Table A4-0-22: t-test results for RoE for Lowland Grazing Livestock farms
Source: calculated from FBS 2011/12

RoE	Low performers Mean (st.dev)	High performers Mean (st.dev)	Ha: diff <0 Pr (T<t)	HA : diff = 0 Pr (|T| > |t|)	Ha : diff > 0 Pr (T>t)
Using formal planning	.2241 (.0552)	.2414 (.0567)	0.4140	0.8279	0.5860
Using cash flow planning	.2241 (.0552)	.2241 (.0552)	0.5000	1.0000	0.5000
Any level of benchmarking	.1034 (.0403)	.1207 (.0431)	0.3854	0.7709	0.6146
Using formal planning and cash flow planning	.1207 (.0431)	.1379 (.0457)	0.3921	0.7843	0.6079
Using formal planning and benchmarking	.0172 (.0172)	.0862 (.0372)	0.0476	0.0951	0.9524
Using formal planning, cash flow planning and benchmarking	.0172 (.0172)	.0862 (.0372)	0.0476	0.0951	0.9524
Accessing advice	.3621 (.0637)	.3448 (.0630)	0.5762	0.8476	0.4238
Being a member of a CPD scheme	.1552 (.0480)	.1379 (.0457)	0.6025	0.7951	0.3975
Having good IT skills	.2931 (.0603)	.4138 (.0652)	0.0885	0.1769	0.9115
Having a working spouse	.3448 (.0630)	.4828 (.0662)	0.0669	0.1338	0.9331
Having a university degree	.1552 (.0478)	.2586 (.0580)	0.0860	0.1720	0.9140
Farm size	2.2241 (.0552)	2.5690 (.0891)	0.0007	0.0013	0.9993
Ownership	.3103 (.0613)	.4310 (.0656)	0.0907	0.1814	0.9093
Age	55.57 (1.65)	53.05 (1.43)	0.8745	0.2509	0.1255

Table A4-0-23: Results of the regression analysis for Lowland Grazing Livestock farms – direct effects

Direct effects	RoS		Log_ATO		RoA		RoE	
	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value
BMP_Fml	.0426 (.0592)	0.472	.0254 (.0689)	0.712	-.0002 (.0163)	0.991	-.0009 (.0129)	0.945
BMP_CF	.0402 (.0722)	0.603	.0821 (.0718)	0.254	.0084 (.0139)	0.547	.0022 (.0189)	0.907
BMP_AnyB	.0314 (.0616)	0.610	-.0010 (.0853)	0.991	.0067 (.0165)	0.683	-.0151 (.0218)	0.489
Uni	-.0272 (.0510)	0.595	.1506** (.0659)	0.023	-.0034 (.0126)	0.786	.0171 (.0131)	0.193
AA	.0343 (.0518)	0.508	-.0564 (.0433)	0.193	.0032 (.0106)	0.759	.0003 (.0092)	0.971
CPD	.0174 (.0499)	0.727	-.0028 (.0576)	0.961	-.0020 (.0098)	0.842	.0028 (.0091)	0.755
Age	.0007 (.0020)	0.712	-.0065*** (.0017)	0.000	.0006 (.0006)	0.313	.0002 (.0003)	0.640
Off_farm	.1005* (.0597)	0.094	-.0417 (.0464)	0.370	.0085 (.0119)	0.476	.0077 (.0116)	0.509
IT	.0578 (.0421)	0.171	.0295 (.0523)	0.573	.0207** (.0090)	0.022	.0115 (.0086)	0.183
Size 3	.0219 (.0688)	0.751	.1659*** (.0472)	0.001	.0083 (.0148)	0.575	.0203* (.0103)	0.051
Size 4	.1869*** (.0598)	0.002	.3406*** (.0752)	0.000	.0456*** (.0106)	0.000	.0449*** (.0102)	0.000
Own	-.0753 (.0689)	0.276	-.0148 (.0476)	0.757	-.0114 (.0132)	0.390	.0113 (.0098)	0.249
_cons	-.1285 (.1246)	0.304	-.5709*** (.1064)	0.000	-.0486 (.0393)	0.218	-.0350 (.0215)	0.105
Prob > F	0.0000		0.0000		0.0003		0.0000	
R-squared	0.1944		0.2845		0.1028		0.0645	

Note *** is statistically significant at the 1% level, ** is statistically significant at the 5% level, * is statistically significant at the 10% level

Table A4-0-24: Results of the regression analysis for Lowland Grazing Livestock farms – interaction effects

Interaction effects	RoS		log_ATO		RoA		RoE	
	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value	Coefficient (S.E.)	p-value
BMP_Fml_CF	-.0510 (.0738)	0.490	.2682** (.1039)	0.010	-.0176 (.0128)	0.170	-.0359 (.0223)	0.109
BMP_Fml_AnyB	.1693 (.1525)	0.268	-.3407*** (.0313)	0.000	.0109 (.0095)	0.252	.0144 (.0103)	0.166
BMP_FmL_CF_AnyB	-.0015 (.2142)	0.994	.0932 (.1505)	0.537	.0512* (.0297)	0.086	.0704* (.0350)	0.045
_cons	-.0170 (.0172)	0.323	-.8852*** (.0249)	0.000	-.0026 (.0040)	0.512	-.0060 (.0055)	0.279
Prob > F	0.4720		0.0000		0.0865		0.0404	
R-squared	0.0111		0.3915		0.0286		0.0359	

Note *** is statistically significant at the 1% level, ** is statistically significant at the 5% level, * is statistically significant at the 10% level

Conclusion

The analysis above shows that management practices do have an effect on the financial performance of each individual farm type.

The comparisons between low and high performers show that:

- For Cereal farms, business planning and benchmarking are applied more by high performers than by low performers. High performers also have better IT skills (statistically significant difference in skills on ATO, RoA and RoE). Accessing paid advice is only different for RoE, but at the 10% level. Finally, ownership does make a difference, with high performers being more mixed or tenants instead of owner-occupiers.
- Dairy farms also benefit from business planning and benchmarking, with high performers also showing statistically significant use of the tools compared to low performers. Accessing paid advice is used less by low performers than high performers (on the ratio RoS, RoA and RoE). For ATO, low performers have less working spouses, and they are on average older than high performers.
- The LFA Livestock farms also indicate a different application of business planning and benchmarking between low and high performers, mainly with the use of regular cash flow planning, where high performers utilise this tool more frequently than low performers. In addition, ownership is different, with less high performers being full owner-occupiers on their farm on all four ratios. High performers are also younger than low performers, with low performers being on average 58 (across all four ratios), and high performers on average 53.
- The difference in application of business planning and benchmarking for Lowland grazing livestock farmers, is in the combined use of tools. High performers apply formal planning and benchmarking; and formal planning, benchmarking and cash flow planning more than low performers (RoS, RoA and RoE). For ATO, formal planning; cash flow planning and combining both methods is applied less. None of the other variables show differences in mean at the 10% level; except for being a member of a CPD scheme, and having a university degree on the ratio ATO. Low performers use both methods for knowledge acquisition less than high performers.
- High performers are larger than low performers, and the difference is statistically significant for almost all performance indicators across the four farm types, except for ATO for Dairy farms, where the difference in size is not statistically significant.

Some interesting facts to note are:

- For ATO, none of high performers in Cereal, Dairy and LFA Grazing Livestock farms are fully owning their farm
- For ATO in the Cereal farms group, the same proportion of low and high performers access paid advice
- None of the high performers from the LFA Grazing Livestock farms apply both benchmarking and formal planning and/or cash flow planning. The same proportion of low and high performers have a working spouse (RoS ratio), and use formal planning and cash flow planning (RoA and RoE).

The regression models somewhat support these findings:

- The analysis for the Cereal farms show that formal planning has a positive, statistically significant effect on log_ATO and benchmarking a positive one on RoS. Cash flow planning seems to be detrimental, as it has a negative, statistically significant effect on log_ATO and RoE. Size is statistically significant for all financial performance indicators, as is ownership. The R-squared of the interaction effects are very low, and the models are not different from zero for RoS and RoA, hence they are deemed to not explain sufficient variation in financial performance.
- For Dairy farms, formal planning has a positive, statistically significant effect on log_ATO; benchmarking a positive, statistically significant effect on RoS, but a negative one on log_ATO; being a member of a CPD scheme a positive, statistically significant effect on RoS. Increasing size has a positive effect on RoS and RoA. For ATO, age and having a working spouse are negatively linked with performance. Similar to Cereal farms, the R-squared for the interaction effects is low, and the model is not statistically significant from zero for log_ATO.
- The LFA Grazing Livestock models show only positive, statistically significant effect for cash flow planning on log_ATO, but not for any other practice. Having a university degree negatively affects RoS and RoE; Age has that effect on RoS, log_ATO and RoE; having a working spouse for RoS and RoA; and ownership on log_ATO. Again, increasing size has a positive, statistically significant effect on all four ratios. The interaction models are statistically significant from zero for RoS, RoA and RoE, but have a low R-squared for RoA and RoE. For RoS, the R-squared is too high compared with other models, pointing to an error in the analysis. The results were therefore not interpreted.

- None of the business planning and benchmarking practices have a direct effect on the four financial performance indicators for the Lowland Grazing Livestock farms. Instead, having a university degree has a positive, statistically significant effect on log_ATO; having a working spouse a positive, statistically significant effect on RoS; having good IT skills a positive, statistically significant effect on RoA and Age having a negative, statistically significant effect on log_ATO. Size matters, with increasing from small to medium being statistically significant and positive for log_ATO and RoE, but increasing from medium to large being positive and statistically significant for all four ratios. The interaction model for RoS is not statistically different from zero, and the one for RoA and RoE have very low R-squared. Log_ATO shows a high R-squared (0.3915), with formal planning and benchmarking have a high, negative effect on log_ATO. As with the RoS-model for the LFA Grazing Livestock farms, the model might contain errors.