TEAGASC

The Competitiveness of Irish Agriculture

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List of Abbreviations and Units of Measurement

Acronyms and Agencies

CAP	Common Agricultural Policy
DAFM	Department of Agriculture, Food and the Marine
DAFRD	Department of Agriculture, Food, and Rural Development
DGAgri	Directorate-General for Agriculture and Rural Development
DP	Direct Payment
ECB	European Central Bank
EU	European Union
FADN	Farm Accountancy Data Network
FSS	Farm Structures Survey
IO	Industrial Organisation
MS	Member State
S-C-P	Structure-Conduct-Performance (from IO theory)
UAA	Utilised Agricultural Area

Units of Measurement

AWU	Annual Work Units
kg	kilogram
kg MS	kilograms of milk solids
LU	Livestock Units

Executive Summary

Milk Sector Results

- Data analysis within the EU was confined to specialist dairy farms as defined by FADN (Farm Type 450). The competitive position of Irish dairy farms was compared against key EU competitors, namely: Belgium, Denmark, France, Germany, Italy, the Netherlands and the UK. Outside the EU, the International Farm Comparisons Network (IFCN- dairy) was used to compare costs and returns from representative dairy farms in Ireland with key international competitors in the US, New Zealand and Australia.
- Selected partial productivity measures for Irish dairy herds were generally lower over the period 2004-2015, compared to key EU dairy producing countries examined. These results are consistent with partial productivity indicators for the same EU countries over the past two decades (Fingleton, 1995, Boyle, 200, Thorne, 2004, Donnellan et al., 2011).
- Cash costs as a percentage of market based output were relatively low in Ireland over the period examined. Based on the latest available actual FADN data (2009-2013), Italy and Belgium had the lowest cash costs as a percentage of output at less than 60 percent of output. The cost structures in the next four MS were quite close to each other; Ireland had a figure of 65 per cent, the Netherlands was at 70 per cent, France was at 69 per cent, and Germany was at 70 per cent. The highest ratio was experienced in Denmark where cash costs accounted for 95 percent of output (Figure E1).
- The competitive position of all the examined MS changed when imputed charges for owned resources were taken into consideration. In Ireland's case this meant a fall to the worst ranking at 111 per cent of output. However, Denmark, France and Germany also experienced total economic costs which were in excess of output value.
- Ireland's ranking as highest total economic costs as a percent of output value followed directly from having the highest level of opportunity costs observed in the data at 46 per cent of output. Within each country, the most significant amongst the imputed costs was the charge for family labour, followed by imputed charges for owned land.
- A 'competitiveness index' was calculated and showed that Ireland was at a competitive disadvantage relative to the average for all the countries studied when total economic costs were taken into consideration. Over the period 2009 to 2013, Irish dairy farms had on average 11 per cent higher total economic costs relative to other competing countries in the EU.
- Irish dairy farms had relatively low costs for seeds and plants, crop protection, purchased feedstuffs, depreciation and machinery. However, these relatively low costs were counteracted, in particular, by high costs for fertiliser and imputed charges for owned land.
- Outside of the EU, when IFCN data was examined, , it appears that the competitive position for Irish dairy farms was very positive when cash costs were considered in isolation from imputed charges for owned resources. The larger representative Irish dairy farm had the lowest cash cost to output ratio amongst the key international milk producing regions examined, namely, the US, NZ and Australia. This result is consistent with previous research by Thorne and Fingleton (2006) and Donnellan et al., (2011).
- When economic costs were considered, the competitive ranking for the Irish dairy sector, for the average size farm in particular, slipped

relative to the other countries examined. This finding could also be considered as a warning signal for the future competitive performance for the average sized Irish dairy farm in a global environment. .However, based on the distributional analysis for farms of different sizes, the ability of the larger Irish dairy farms to compete in the longer term in a global context was affirmed. Furthermore, as Irish dairy farming transforms to larger scale production in a no quota environment, the Irish milk sectors competitive position will be strengthened further.

- Finally, as an example of how the competitive process works a case study of Irish dairy farms was examined to compare the impact of innovation on economic performance. Our findings show that innovation increases economic performance on all farms.

Figure E1:Costs as a % of market based output for selected European 'Specialist dairying' farms (2009 – 2013)

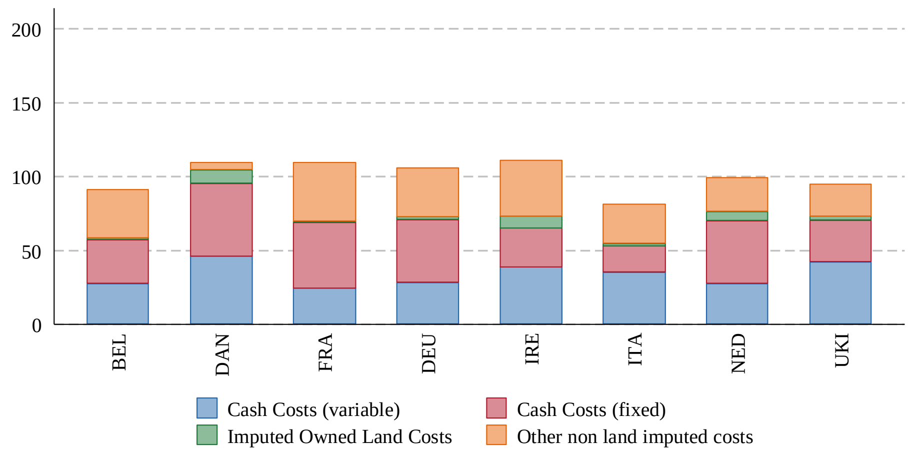
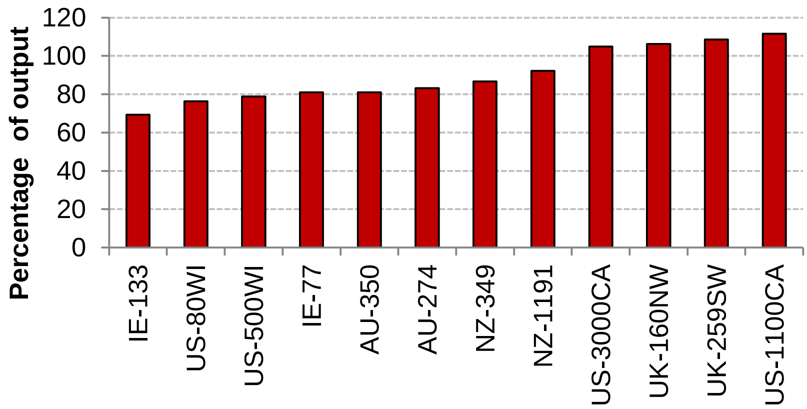


Figure E2: Cash Costs as a percent of output value for selected Irish and non-EU dairy countries (2015)



Beef Sector Results

- Data analysis was confined specifically to specialist beef farms as defined by FADN (Farm type 42). The competitive position of Irish farms was compared against France, Germany and the UK. Outside the EU, data from the Agri benchmark beef and sheep network was used to compare costs and returns from representative beef farms in Ireland with key international competitors in Australia, United States of America, Canada, Argentina and Brazil.

- Selected partial productivity measures for Irish beef herds were generally lower for the period 2004-2015, compared to competing beef producers in Europe examined. These results are consistent with the findings from Boyle (2002) and Thorne (2004) where Irish specialist 'mainly beef rearing and fattening farms' were analysed relative to the same group of countries in 1989/99 and again for the years 1996-2000. However, it is reassuring to note that these disparities were declining over the more recent time period examined.

- A number of cost and return based indicators of competitiveness were examined for beef systems: costs as a percentage of output, margin over costs per hectare and margin over costs per LU. Overall, these results for the beef rearing and fattening enterprises show that over the period 2004 to 2015, Irish producers had a competitive advantage when cash costs were examined amongst the other EU countries examined.

- Based on the latest available actual FADN data (2009-2013), the cash cost to total output ratio (including coupled and a portion of decoupled payments) was lowest in Ireland (62 per cent of output) and highest in UK (80 per cent of output). However, when total economic costs were considered Ireland's competitive position worsens. Ireland had the highest economic cost to output ratio (139 per cent), followed by UK (120 percent), Germany (118 percent), with France recording the lowest total economic costs at 111 percent of output.

- A number of the cost based indicators of competitiveness were recalculated using only market-based returns. When only market based output was considered, Ireland did not hold onto the position as the lowest cash cost producer amongst the countries examined. France now appeared as the lowest cash cost to market based output producer. Ireland and Germany had similar ratios and the UK exhibited the highest cash cost to market based output ratio (Figure E3).

- Irish beef producers experienced relatively low costs for direct inputs such as seeds and plants, energy, and costs for purchased feedstuffs. In addition, overhead costs such as depreciation, rent, paid labour and interest were also relatively low on Irish beef farms over the period.

- The competitive position for Irish beef farms outside the EU was not very positive even when cash costs of production were considered. Based on data from the *agri benchmark* network, representative Irish beef finishing and cow calf farms were in the top quarter of representative farms on a cash cost per kg of carcass/liveweight basis, with relatively high cash costs of production. For both finishing and cow-calf farms, whilst Irish farmers had lower cash costs than some US and Canadian cow-calf farms, the returns from these north American farms in general were superior to those on the typical Irish farm.

- When economic costs were considered, the competitive ranking for the Irish beef sector, for the average size farm in particular, slipped further relative to the other countries examined, both within and outside the EU. The imputed charge for owned land and labour had a large influence on the relative competitive advantage of Irish beef farms. Considering total economic costs as a relative guide to the longer term competitive position of competing countries this may be a warning sign for Irish beef producers in the global environment.

Figure E3: Costs as a % of market based output for selected European 'Specialist cattle – rearing and fattening' farms (2009 – 2013)

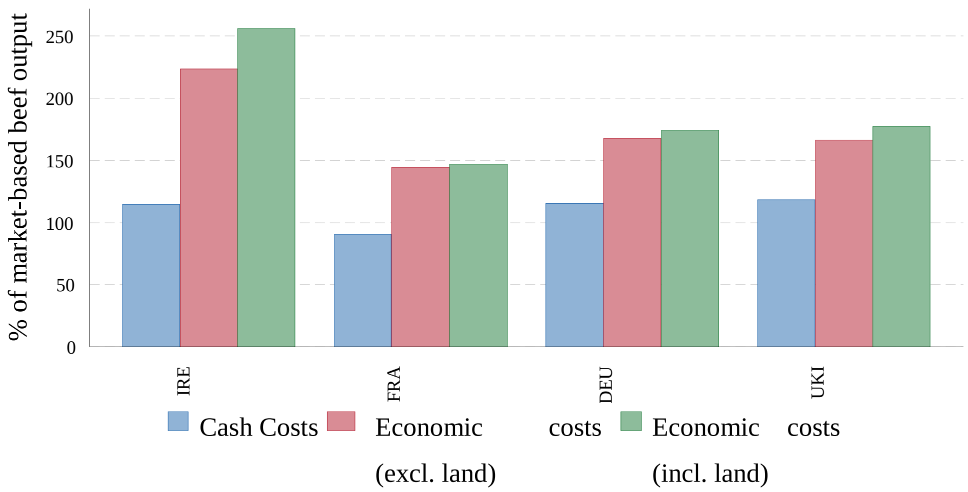
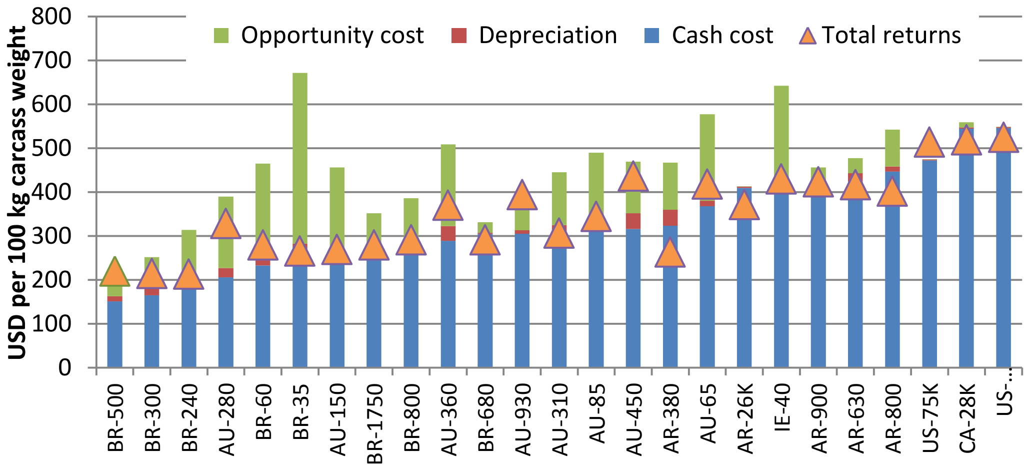


Figure E4: Beef finishing farms - European and North American countries

(USD per 100 kg carcass weight) (Years 2013, 2014 and 2015)



Cereals Sector Results

- The FADN farm classification type examined was specialist cereal, oilseed and protein (COP) producers (Farm type 131). The competitive position of Irish farms was compared against Denmark, Germany, France, Italy and the UK.

- Selected partial productivity indicators on Irish cereal farms were on average more positive than the results shown for the other enterprises examined. For example, yields were well in excess of the average of all countries examined.

- A number of competitive performance indicators were examined for the cereals sector: costs as a per cent of total value of output (and market based output), margin over costs per 100kg of product volume and margin over costs per hectare of cereal production. All measures indicated that Irish cereal producers maintained a competitive advantage relative to the average of all countries in the analysis, when cash costs and economic costs were considered (both including and excluding imputed charges for owned land). For example, Irish cereal producers had the second lowest cash cost: output ratio at 63 per cent of total output, compared to the other countries examined.

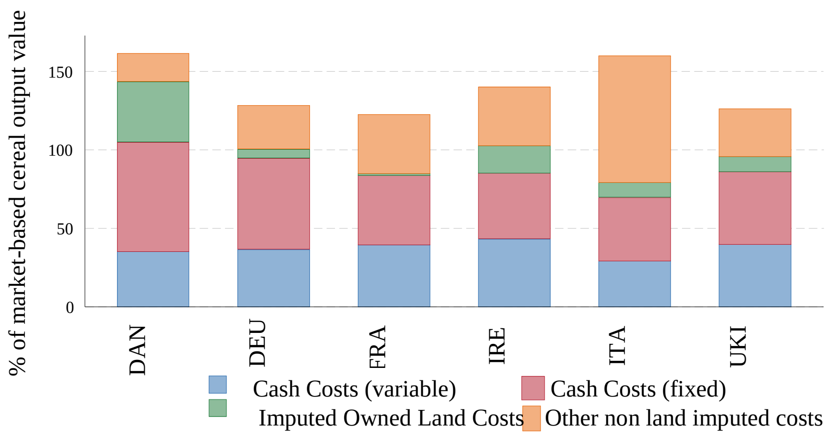
- When economic costs total were measured Irish cereal producers still maintained a competitive advantage compared to the average of all countries with a cost: output ratio that was 5 per cent lower than the average for all countries examined.

- Excluding decoupled direct payments from the analysis, showed that the competitive position of Irish cereal producers was maintained.

- These results are consistent with the findings obtained in Boyle (2002) and Thorne (2004) where Irish cereal producers also emerged as a strong competitor when costs were compared with France, Denmark and the UK.

- Prominent *sources* of competitive advantage were machinery costs, other direct inputs, depreciation and paid wages. In contrast, there were also a number of items that were higher in Ireland than the other countries, with the high expenditure on fertiliser probably the most notable.

Figure E4: Costs as a % of market output selected European cereal producers ('09-'13)



Sheep Sector Results

- The FADN farm classification type used was specialist sheep (Farm Type 441). The EU countries chosen for comparison were the UK and France.

- Selected partial productivity indicators showed that Ireland and the UK had relatively low stocking rates and land productivity compared to France, but Irish sheep farms did have higher technical performance based on these two measures compared to the UK. However, the UK and France both outperformed Ireland in terms of labour productivity. Similar results were obtained by Boyle (2002) and Thorne (2004).

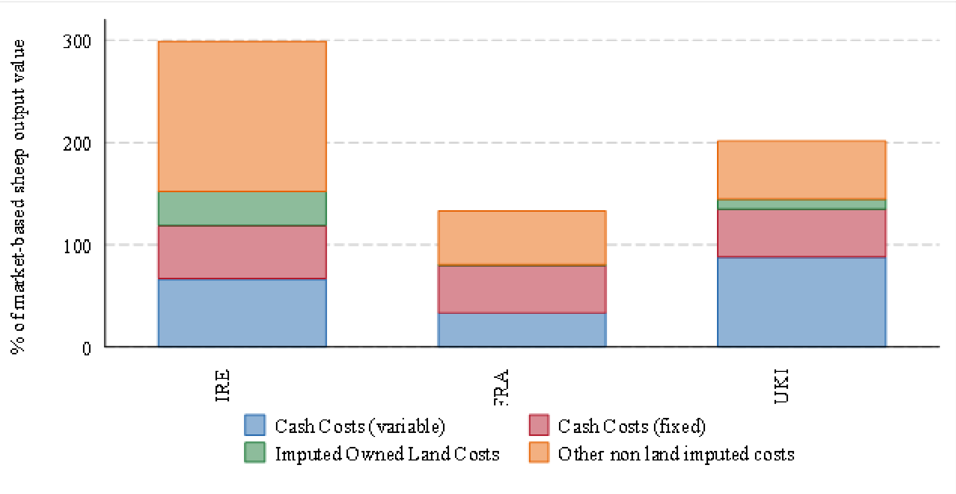
- A number of cost and return based indicators of competitiveness were examined for the sheep sector: costs as a percentage of total output (and market based output), margin over total costs per 100kg of sheep meat and margin over costs per forage hectare. Irish producers had the lowest cash costs as a percentage of total output and the highest margin over cash costs per 100kg of product volume. However, French producers replaced Irish producers with the highest margin over cash costs per forage hectare.

- Ireland's competitive advantage on a cash cost basis deteriorated quite significantly when economic costs were considered, with a cost: total output ratio that was 16 percent higher than the average for all countries examined.

- Over the period Irish sheep producers relied more heavily on subsides to supplement the revenue of the sheep enterprise, compared to the UK and France. Consequently, when costs were expressed as a percentage of market based output, Irish producers were replaced by French producers, who had the lowest cash costs as a per cent of market based output. On an economic cost basis Ireland again appeared as the highest cost producer.

- Costs for seeds and plants, purchased feedstuffs, energy, and depreciation were relatively low on Irish sheep farms over the period. However, imputed charges for owned land and family labour were particularly high in Ireland.

Figure E4:Costs as a % of market output selected European sheep producers ('09-'13)



1. Introduction

How do farms in Ireland compare with farms in other countries, in terms of output price, costs of production and profit margin? With the abolition of the milk quota system and the ambitious plans for the Irish dairy and other agriculture sectors set out in in the Food Wise 2025 report, the competitive position of Irish agriculture and the determinants of this competiveness performance will be critical in framing public policy that seeks to maximise the contribution of the agri-food sector to the Irish economy.

In parallel with developments in multilateral and bilateral trade negotiations, the EU has since the mid-1980s been engaged in a rolling process of Common Agricultural Policy (CAP) reform. In all of the major CAP reforms since the mid-1980s, the European Commission has stressed the need to tailor European agricultural policy to enhance the competitiveness of EU agriculture.

Thus, given the continuing pressures for agricultural policy reform within the EU and the continuing trend towards less trade and price-distorting agricultural income support systems, the relative costs and efficiency of production for the major internationally traded commodities will assume greater importance. The ability of Irish farms to stay in business and grow will depend increasingly on their capacity to sustain profitability from participating in the European and global marketplace, rather than their ability to draw on support policies.

The objective of this research was to measure the competitiveness of Irish agriculture for the major agricultural commodities of relevance to Ireland and to measure Irish agriculture's competitive position relative to a range of the main producing and exporting countries. In this way we can generate information about the competitive strengths and weaknesses of Irish agriculture in a European and global context and gain insights into the capacity of the sector and its sub-components to survive and prosper in an environment of freer trade and diminished protection.

This report will examine the international competitive performance and potential of the main sectors of Irish agriculture against our main trading partners and competitors using microeconomic data from the European Commission's Farm Accountancy Data Network (FADN) and data from international farm comparison networks (*IFCN Dairy and Agri benchmark Beef and Sheep*).

Phase I of this project investigated alternative indicators for measuring the competitive performance of the agricultural and food sectors, which meet the requirements of the theory of competitiveness and for which relevant data could be collected on an annual basis. The main findings from this research are outlined in the literature review (chapter 2) below. The appropriate measures identified were subsequently quantified for the period 2005 to 2015, for some of the main agricultural commodities produced in Ireland: milk, beef, cereals and sheep production. The methodology and results from this analysis are outlined in Chapters 3 and Chapter 4.

2. Literature Review

The literature review[i] focused on the identification of: (i) an appropriate definition of competitiveness; (ii) relevant indicators of competitiveness; (iii) examples of where the indicators were used previously (iv) the features of the identified indicators; (v) advantages and limitations of their use; (vi) availability of data for Ireland; and (vii) ease of international comparison.

Competitiveness is much debated by both economists and policymakers. Nearly every study on the topic of competitiveness adopts a different definition of the term and this was noted by Reich (1992) who had the following to say about the term: ‘Rarely has a term in public discourse gone so directly from obscurity to meaninglessness without an intervening period of coherence’ (p.1). Accordingly, it is imperative for the purposes of this study that the main developments in the theory of competitiveness are outlined in an effort to identify an appropriate definition of competitiveness.

2.1. The Theory of Competitiveness

The theory of competitiveness has been analysed using three approaches (Thorne, 2002b): traditional trade theory, industrial organisation theory and strategic management theory.

2.1.1 Traditional Trade Theory

Traditional economic trade theory provides useful insights into the development of the concept of competitiveness. However, McCalla (1994) identified the focus of traditional trade-based theories of competitiveness as being inherently structured on supply side economics. Relative price differentials have remained the primary indicators of competitiveness definitions based on trade theory. Therefore, it must be concluded that these theories do not account very well for demand side economics. There is an inherent failure amongst these theories to address qualitative differences in products, marketing and service abilities of firms and the strategies by which industries attain competitiveness (van Durren et al., 1991). Following from the failure of trade models to address such issues, additional schools of thought must be investigated to develop a theory which defines the concept of competitiveness from a supply and demand perspective.

2.1.2 Industrial Organisation Theory

The main focus of Industrial Organisation (IO) theory is the identification of variables that influence economic performance and is a derivative of the theory that considers the economic impact of monopoly and monopsony (van Durren et al., 1991). A number of theories have been developed based on the identification of variables which influence economic performance, of which the most notable are: Bain type IO theory, the Schumpterian model, the Chicago School and transaction cost economics (Conner, 1991). However, the main paradigm upon which IO theory is based is the structure, conduct, performance model (S-C-P), also sometimes called Main type IO theory (van Durren et al., 1991).

The S-C-P model is based on the assumption that performance in an industry is said to be dependent upon the conduct of sellers and buyers in such matters as pricing policies and practices, advertising, and so on. Conduct, in the S-C-P model, in turn depends upon the structure of the relevant market, which can be characterised by indicators such as the number of buyers and sellers and the presence or absence of barriers to entry. Subsequent empirical analysis of this concept has paid particular attention to the relationship between industry concentration and profits. According to Conner (1991) the empirical results of research using the S-C-P model has been weak, and that this has cast doubt on the legitimacy of the concept.

McCalla (1994) provided a framework which summarised the attributes of IO based theories of competitiveness in which a number of characteristics of the theory were identified: (i) a limited use of theory, research is inductive in its nature and as a consequence the frameworks developed are complex and conceptual; (ii) the belief that competitiveness is demand driven; (iii) policy is not considered as an important construct variable; (iv) non-price elements are much more important than price variables.

Based on this summary the transition between traditional trade theory and IO is evident. The difference between the two is based on the relative emphasis placed on supply side economics and demand side economics respectively.

2.1.3 Strategic Management

The strategic management school of thought can be viewed as a theory of competitiveness which brings together concepts from both trade theory and IO theory. Kennedy et al. (1997) defined competitiveness as outlined by strategic management theorists as '*the ability to profitably create and deliver value through cost leadership and or product differentiation'* (p.386). This definition implies that competitiveness is directly related to factors that influence both the cost and demand structure of a firm. Traditional trade theory of competitiveness focused on the cost structure of the firm and IO theory focused on the market demand for firm products. In addition to incorporating concepts from other theories of competitiveness the strategic management school has also introduced a number of new concepts which led Martin et al., (1991) to state: '*This literature is pregnant with lessons that businesses are learning about the manner in which they combine their resources, the quality and distribution channels they choose through which to distribute their products and particularly, the use of strategic alliances with their customers or suppliers*' (p.1457).

Porter's 'Competitive Advantage of Nations' (1990) has been identified as the leading text in the strategic management literature that has been proved to have the ability to broaden and integrate contributions to the theory of competitiveness as well as including many of the central concepts of more established theories (van Durren et al., 1991). The basic question which Porter addresses in his work is 'Why does a nation achieve international success in a particular industry?' Porter believes that the answer to this question is inherent in his "Diamond" model. Porter's Diamond sets out to determine the various sources of competitiveness of individual firms which operate within an industry. Along with the four main sources of competitive advantage, i.e. factor conditions, demand conditions, firm strategy, structure and rivalry, and related and supporting industries, Porter believes an additional two factors are important and contribute to the position of competitive advantage. These two additional factors are chance and government. Any given industry may gain a competitive advantage, relative to competitors, based on the exploitation of only one or two of the above factors, but this is unlikely to be sustained for any long period of time. Competitors will soon ascertain the source of advantage and will latch onto the factor providing the initial comparative advantage. Thus, Porter acknowledges the importance of continuing to upgrade individual sources of competitive advantage to remain competitive in the longer term.

Based on the approaches discussed above, the strategic management concept of competitiveness is often argued to be the strongest. This conclusion derives from (i) its explanatory power (van Durren et al., 1991) and (ii) the critical importance assigned to sources of competitiveness rather than indicators of competitiveness. However, Harrison and Kennedy (1997) argue that despite the importance of identifying sources of competitiveness, it is also important that there is a link between the sources and the measures of competitiveness, which they argue the strategic management school, including Porter (1990), has failed to provide. An additional critique of the strategic management concept of competitiveness is that it has not yet advanced to the point where it provides generalised statistically testable hypotheses (van Durren et al., 1991; Grant, 1991).

2.1.4 Defining Competitiveness

Based on these critiques of the main theories of competitiveness, it is appropriate at this stage to adopt a definition of competitiveness that is considered appropriate for this analysis of the competitiveness of Irish dairy, beef, cereal and sheep production.

Earlier work by Pitts and Lagnevik (1998) accepted that ‘a competitive industry is one that possesses the sustained ability to profitably gain and maintain market share in domestic and/or foreign markets’ (Martin et al., 1991). For the purpose of this study profitability is considered as a leading indicator of competitiveness and market share, such as Revealed Comparative Advantage indicators, will be considered in a further study of the topic. Given that the competitiveness theory reviewed above highlights the importance of (i) considering both supply and demand factors and (ii) identifying appropriate measurable indicators, measures of profitability are deemed appropriate, given that both cost and return variables are considered.

2.2. Levels of Competitiveness

Further to defining competitiveness it is necessary to accurately measure the term. Buckley et al. (1988) identified a useful distinction between different measures of competitiveness:

- **Competitive Performance** is the measurement of indicators of the competitiveness of specific firms, sectors or countries. Profitability is considered for this study as a leading indicator of performance.[ii]
- **Competitive Potential** is the measurement of sources of competitive performance. In this context an important question was raised by Boyle (2002): ‘should competitiveness focus entirely on cost comparison or should it also include any product price difference?’ (p. 31)[iii]. As a response to this question, the literature review conducted focused both on costs of production and product price.

– **Competitive Process** is the mechanism whereby competitive potential is translated into competitive performance. The majority of the measures of the competitive processes are qualitative in nature, however more recent work in this area has begun to empirically examine innovation in particular as an example of how the competitive process works in practise. Chapter 6 of this report outlines some recent work on this topic from an Irish perspective.

3. Methods

This section of the report outlines (i) the data sources and (ii) the measures of competitiveness used in the analysis.

3.1. Data Sources

European Commission Farm Accountancy Data Network (FADN)

The Farm Accountancy Data Network (FADN) of the European Commission was the primary source of data used in this analysis. A basic description of the network is available from the documentation on the official FADN website (FADN, 2016). The FADN has gathered accountancy data from farms in the European Union (EU) Member States (MS) since Council Regulation 79/65 established the Network's legal basis in 1965. The data are collected annually by each country's Liaison Agency. Teagasc is the liaison agency for Ireland. The stratified random sample of farms surveyed each year in Ireland represents approximately 80,000 holdings. Across the EU farms within the FADN sampling frame account for approximately 90 per cent of both total agricultural production and total utilised agricultural area (UAA).

FADN data itemises costs on a whole farm basis only, and a method of allocating these costs to the specific enterprises within each farm analysed in this research had to be chosen. For the majority of cost items, whole farm costs were allocated to the specific enterprise activity according to the share of specific enterprise output in total farm output. A number of exceptions to this general rule were adopted for individual cost items at the enterprise level. These are outlined in the individual enterprise sections of this report.

The specific FADN countries used in the analysis for the purpose of comparing the competitiveness indicators for Irish agriculture varies depending on the enterprise. Alternate countries are appropriate comparative units depending on production capacity, export potential and import potential of specific countries. The comparative countries used in the analysis are outlined in chapter 4.

In a previous analysis, Thorne (2004) used the FADN's micro-level data to generate competitiveness measures. Access to the micro-level FADN dataset requires a formal request, and this process introduces a substantial lag time. One of the core objectives of this project (MetriComp) was to produce competiveness measures which can be routinely calculated on an annual basis. To this end, the choice was made to use the publicly available FADN Standard Results files, which the FADN publishes on its public website.

Where possible, this analysis follows the methodology adopted by Thorne (2004). However, switching to the publically available FADN Standard Results as the primary data source has required some changes to the methodology employed. For example, the FADN Standard Results contain only a subset of the variables available within the full FADN dataset. Thorne (2004) used several variables—e.g. categories of cattle, individual crop hectares, etc.—which are not included in the FADN Standard Results. In such instances, calculations employed were simplified to use only available measures, or additional data from the Farm Structures Survey was used as a substitute.

Like the FADN sample, the Farm Structures Survey (FSS) is a harmonised survey carried out by Official Statisitcal Offices in each of the EU MS. The same typology and variable definitions are employed by both the FSS and FADN surveys, but the comparability between the two is hindered by the fact that the FSS sampling frame includes much smaller farms than the FADN. Furthermore, the FSS is not annual; it is collected every two or three years with a full census conducted every 10 years. Lastly, the FSS reports macro measures, e.g. total output for the entire sample, rather than the farm-level mean output which the FADN report. For this reason, and only where necessary, date from the FSS was used to calculate ratios which were then applied to the most appropriate FADN variables available, rather than treating FSS variables as if they were part of the FADN dataset itself.

There were also other secondary data sources used. Interest rate and inflation data were sourced from the European Central Bank (ECB). Various production and price series were also sourced from Eurostat for the purpose of estimating measures in the most recent years; the FADN has a 2 to 3 year publication lag-time. This updating mechanism is an important development on the previous analytic infrastructure (as previously outlined by Boyle, 2002; Thorne, 2004; Donnellan et al., 2011) which now allows for more "current" competiveness measures.

International Farm Comparisons Network (IFCN) – Dairy and Agri benchmark Beef and Sheep

The consistent approach to the examination of competitiveness within the EU is made possible by the existence of the FADN dataset which extends over a long coverage period for MS which are long term members of the EU. However, as this is an EU dataset, it does not provide data for countries beyond the EU. To assess the competitive positon of Ireland relative to non-EU competitors it is necessary to use other available and compatible data. The IFCN dataset is used for international comparisons in the dairy sector and the Agri benchmark network used for beef and sheep is used to draw comparisons internationally relating to the international competitiveness of Irish beef production (Hemme at al., (2016); de Blitz et al., (2016)).

The IFCN and Agri benchmark networks are two separate world-wide partnerships that link agricultural researchers, advisors and farmers to create a better understanding of milk, beef and sheep[iv] production and the costs and returns to agricultural production worldwide. The cost calculations within the IFCN and Agri benchmark networks are based on individual representative farms, so-called typical farms, rather than on the results from stratified random samples of the population as is the case with FADN data. Nonetheless, IFCN and Agri benchmark networks provide data which can be used to examine the relative international competitiveness of 'representative' farms in a global context, given that the data areassembled and analysed using common methodological frameworks. Like the methods outlined previously for FADN data, IFCN and Agri benchmark data also present costs as total 'cash' costs, which consists of expenses from the profit and loss accounts of the farm and total 'economic' costs which include opportunity costs calculated for farm-owned factors of production (family labour, own land, own capital).

Data from all farms in the IFCN and Agri benchmark are collected from specialist dairy, beef and sheep farms actually in operation or from specialist farms modelled directly from regional dairy, beef and sheep farming operations. It is fair to say that the methodology approaches toward improving the validity of comparisons across the world wide countries participating and it is probably more useful for those examining the results of the IFCN and Agri benchmark comparisons to view them as indicative of rather than as an absolute statement on the competitive position of a country with respect to specific sectors. Keeping this in mind, we present comparative results for some important measures of financial and economic performance for the most recent years for which data are available in the Chapter 5.

3.2. Measurement

3.2.1 Competitive Performance and Potential

The expression of the different indicators of competitive potential and performance employed in this analysis varies depending on the enterprise examined. The different methods employed to express the results are presented in the individual commodity sections. However, all the measures of competitiveness used in this chapter are based on profitability as the leading indicator of competitive performance. Boyle (2002) in his analysis of the competitiveness of Irish agriculture said that 'returns and costs matter to competitiveness' (p.153). Using profitability as an indicator of competitive performance means that both costs and returns are taken into consideration.

For each of the enterprises examined, costs were defined in the following way:

i. **Total cash costs**, which include all specific costs directly incurred in the production of a given commodity (e.g. fertiliser, feedstuffs, seeds etc.), external factors (e.g. wages, rent and interest paid), and overhead costs less depreciation (which is considered an opportunity cost in this analysis). Economic textbooks often refer to these costs as accounting costs (Mankiw, 1998, p. 265).

ii. **Total economic costs**, which include all of the cash costs identified above, plus depreciation and imputed opportunity costs for family labour, equity capital and owned land.

The calculation of total economic costs for the competing countries was one of the most problematic exercises in this analysis. If long-term competitiveness is to be examined the assumptions regarding the measurement of opportunity costs for family labour, owned land and other non-land capital must be as realistic as possible. The valuation methods adopted for the research reported in this study are outlined below:

- **Family labour** was assigned an opportunity cost equal to the cost of hired labour in each of the enterprises studied.[v] The hired labour charge was determined from the FADN data.

- **Owned land** was assigned an opportunity cost equal to the cost of rented land in each of enterprises studied. The land rental charge was also determined from the FADN data. This approach follows the methodology adopted by Boyle et al., (1992), Fingleton (1995), Boyle (2002), Thorne (2004), and Donnellan et al. (2011). However, this approach does not distinguish between the marginal and average cost of land rental. Based on Clark's (1973) argument 'that land has an average product and a marginal product which may differ, and that its rent should depend on its marginal product…..[therefore] we have to fall back on estimating economic rent as a residual, from the gross product after all other necessary inputs have been remunerated' (p.14). Consequently, total economic costs were calculated both with and without an imputed value for land. Further discussion on the implication of including and excluding owned land in the valuation of total economic costs can be found in the results and conclusions sections of this study.

- **Non-land assets** also proved to be a problematic resource for valuation purposes. Boyle et al., (1992) and Boyle (2002) recommended using a (i) real interest rate which takes into account taxes, subsidies and inflation adjustments and (ii) a depreciation rate. Fingleton (1995) recommended using a rate derived by subtracting the price deflator for private consumption from the nominal long-term interest rates for each country for each relevant year. Thorne (2004) considered both of these approaches but argued that they were inappropriate in an Irish context for the time period she analysed. She cited an extended period of unusually high inflation during the 1990's and a consequently implausible spread in the level of opportunity costs assigned to non-land assets through time, as the primary reasons for this decision. However, Irish inflation rates have come back in line with most EU MS in recent years, and historically low interest rates make negative real interest rates more plausible than before. Therefore, the decision was made to revert to Fingleton's suggested formulation and to use a real interest rate in the calculation of the opportunity costs of non-land assets.

- The calculation of a real interest rate required two elements—a nominal interest rate and an inflation estimate. The chosen inflation measure was from the Harmonised Index of Consumer Prices (HICP) series sourced from the ECB[vi]. The choice of a nominal rate differed from that published in the FADN's Annual Dairy Report. The FADN's dairy enterprise model uses a weighted average of the Global Insight long-term rate and an interest rate calculated from data contained in the FADN dataset. Where this average rate is lower than the Global Insight long-term rate, the Global Insight rate is used. However, Global Insight's database is proprietary and not reproducible. This led to a search for an alternative interest rate series. Eurostat provides 10-year Government bond rates, but these are not realistic for Ireland, as no farmer would have been able to take advantage of the large rate spike that occurs in this series in 2011. Instead, the decision was taken to use the bank rate for deposits, to non-financial corporations and households, for the longest maturity category (> 5 years) provided by the ECB[vii]. These data are available to the public through the ECB's data warehouse website, and they are more realistic than the Government Bond rate available from Eurostat in the sense that farmers may actually have received such returns on their deposits if they chose to do so.

- In addition to defining the cost variables included in the analysis, it is also important that the returns associated with the individual enterprises are accurately defined. Murphy et al. (2000) outlined the importance of including direct payments in studies which compared inter-country cost and return data. Therefore, the inclusion of direct payments was considered an important issue in this research. The method of allocating direct payments to the different enterprises is outlined in the individual commodity sections.

An important issue in measuring competitiveness is the distinction between the different levels of competitiveness. All too often research on the topic of competitiveness tends to focus on indicators of competitive performance, while indicators of competitive potential are ignored (Harrison and Kennedy, 1997). The indicators presented in this research go some way towards identifying the sources of competitiveness in addition to just presenting results of competitive performance. The individual measures (i) costs as a percentage of output; (ii) margin over costs per product volume; and (iii) margin per hectare; provide an insight into the competitive performance of the countries examined, over the time period 2005 to 2015. However, they do not provide an insight into the sources of competitive potential. The individual cost variables and associated returns which are outlined in the appendices provide insights into the sources of competitive potential for the individual countries. Furthermore, as competitive potential is concerned with the availability, quantity and quality of inputs and how they are formulated to produce superior performance (Pitts and Lagnevik, 1998), the partial productivity indicators presented for each of the commodity sectors are also considered as indicators of competitive potential. However, it is important to reiterate that these indicators of competitive potential and performance should not be examined in isolation from each other. For example, indicators of low physical productivity do not, in and of themselves, imply low competitive potential, as low production costs may more than compensate for low physical productivity.

Finally, following the work of previous authors (Boyle et al., 1992; Fingleton, 1995, Thorne, 2004) a ‘competitiveness index’ was developed, whereby the cost to output ratio for Ireland was expressed as a percentage of the simple average of the cost to output ratios for all the countries examined.[viii]

3.2.2 Competitive Process

As outlined earlier, the competitive process is the mechanism whereby competitive potential is translated into competitive performance. Previous national research which has examined the sources of competitiveness within agriculture include: Carroll et al. (2008); Thorne, (2004); and Kazukauskas et al. (2010). However, the international literature on competitiveness has recently focused on the link between the drivers of competitive performance (i.e. competitive potential) and observed competitive performance. In the context of further explaining the competitive process, the link between innovation and competitive performance has emerged as an important topic in recent work (Alston, 2010; Latruffe, 2010; Wang et al., 2012; OECD, 2013b), but to date this link has not been adequately assessed in an Irish context. Hence, a specific focus on the link between innovation and competitive performance is examined in detail in this research.

The aim of this research was to contribute to the empirical evidence on the impact of innovation and economic performance at a micro-level. By utilizing data from Irish dairy farms obtained from the Teagasc, National Farm Survey (NFS) the relationship between innovation efforts by farmers and economic performance was empirically examined. To this end, a generalised propensity score (GPS) method was used to measure the impact of innovation on farm economic performance measures: productivity of land, profitability and market orientation.

4. The Competitive Performance and Potential of Irish Agriculture within the EU

This chapter outlines the specific methods and results for the individual commodity analyses. The subsections outline results for milk (4.1), beef (4.2), cereals (4.3), and sheep (4.4).

4.1. Indicators of Competitiveness of Specialist Milk Producers in Ireland and Selected EU Member States (2005 – 2015)

4.1.1 Introduction

This section of the report examines specific indicators of cost competitiveness and partial productivity of specialist milk producers in Ireland and selected EU member states, namely: Belgium, Denmark, France, Germany, Italy, the Netherlands and the UK. According to Eurostat over 74% raw cow's milk delivered to dairies in the EU in 2015 was accounted for by the countries specified here (Eurostat)[ix].

Data analysis was confined to specialist dairy farms as defined by FADN (Farm Type 450) with three conditions used to classify the farm type:

1) the value of grazing livestock and associated forage is greater than 2/3 of standard output,
2) dairy cows compose more than 3/4 of all grazing livestock and
3) the value of grazing livestock alone is greater than 1/3 of grazing livestock and associated forage.

This allowed a greater degree of accuracy in the allocation of costs (which the FADN reports on a whole farm basis) to the dairy enterprise than would be the case if all farms with a milk enterprise were selected (Fingleton, 1995).

4.1.2 Measurement and Methods

Measures of competitive performance and competitive potential for the dairy sector are presented in this section of the report. Two separate measures of cost comparisons (competitive performance) were used for specialist dairy farms (farm type 450):

- total costs as a percentage of dairy output, and
- total costs (€) per unit volume of milk solids (kg MS).

Most studies which examine the costs of milk production are made on a raw milk volume basis which does not account for possible variation in milk constituents between different countries (Fingleton, 1995). Results from these studies using such an approach are biased in favour of countries where the levels of milk constituents are relatively low. To overcome this bias Fingleton (1995) measured unit costs per kilogramme of milk solids (i.e. butterfat plus protein). Average fat and protein percentages for each country were used to convert the milk volumes obtained from the FADN data into the equivalent quantities of milk solids. This approach was also adopted in this study.

Table 1 Definitions of output for the Specialist Dairy enterprise using FADN data

MARKET-BASED OUTPUT	TOTAL OUTPUT
SE216 [Cow's milk & milk products] +	Market-based output +
SE616[Subsidies dairying] +	**LU_{SN} ratio * UAA_{SD} ratio** *
LU_T ratio * SE619 [Other livestock subsidies] +	(SE621 [Environmental subsidies] +
DO_{PRDO} ratio *	SE622 [LFA subsidies] +
(SE625 [Subs on intermediate consumption] +	SE630 [Decoupled payments])
SE626 [Subs on external factors])	

where "**Dairy LU**" is SE085 [Dairy cows]
"**LU_T ratio**" is **Dairy LU** / SE080 [Total livestock units]
"**LU_{SN} ratio**" is **Dairy LU** / SE120N [***S***tocking density ***n***umerator]
"DO_{PRDO} ratio" is SE216 [Cows' milk & milk products] / SE131 [Total Output]
and "**UAA_{SD} ratio**" is SE120D [***S***tocking density ***d***enominator] / SE025 [Total UAA]

The partial productivity indicators used to analyse the competitive potential of the dairy sector were defined by Fingleton (1995). The measures relate to animal, land and labour productivities. They were:

- milk yield (kg) per cow,
- milk solids (kg MS) per cow,
- stocking rate (dairy LU/forage ha),
- land productivity - milk solids (kg MS)[x] per forage hectare (ha),
- labour productivity - milk yield per annual work unit (AWU), and
- land productivity - milk yield per forage hectare (ha)[xi].

The remainder of this subsection gives details of (i) cost allocation methods, (ii) methodological changes relative to previous studies, and (iii) the updating procedure as specifically applied to this sector.

Enterprise cost allocation method

As mentioned previously in Chapter 3, in the FADN all costs are specified on a whole farm basis. Consequently, it was necessary to devise a method to apportion costs to the dairy activity. Table 2 outlines the allocation keys used for the purpose of defining costs associated with the dairy enterprise. This allocation method was based on that originally used by Fingleton (1995) and further developed in a similar study carried out by the FADN (Vard, 2001a).

Table 2 shows that a number of cost items were allocated based on the percentage of 'dairy' livestock units (LU) in the total of either grazing livestock or total LU. The allocation of specific costs according to dairy LU percentages was based on methods proposed by Fingleton (1995) and further developed by Vard (2001a). However, Vard (2001a) proposed that owned land should be allocated according to the percentage of milk and milk products in the total value of output and subsides of the whole farm, whereas Fingleton (1995) proposed that owned land should also be allocated according to LU proportions. For this analysis it was decided that Fingleton's approach for owned land was most appropriate based on the work carried out by Fingleton which showed that 'applying the output ratio estimating procedure to all cost items in the FADN data resulted in significantly higher unit costs for milk production for Ireland compared to the unit costs derived directly from the Irish data, where direct costs can be allocated to each farm enterprise' (p.4).

Table 2 Allocation Keys used to define costs associated with the Dairy Enterprise using FADN data

COST ITEMS	ALLOCATION KEYS
Purchased feed for grazing livestock (concentrates & coarse fodder) = (Feed for grazing livestock – Feed for grazing livestock home-grown)	% of 'dairy' livestock units in the total of grazing livestock units
Feed for grazing livestock home-grown	% of 'dairy' livestock units in the total of livestock units %
Specific forage costs	% of 'dairy' livestock units in the total of grazing livestock units X
Seeds	% area of fodder crops , other forage crops and temporary grass in the total UAA - after exclusion of fallow lands, meadows and rough grazing
Fertilisers	% area of fodder crops, other forage crops, temporary grass and meadows in the total UAA - after exclusion of fallow lands and rough grazing.
Crop protection	% area of fodder crops and other forage crops in the total UAA - after exclusion of fallow lands, temporary grass, meadows and rough grazing.
Other specific livestock costs, imputed charges for breeding and non-breeding livestock	% of 'dairy' livestock units in the total of livestock units
Owned land (Total U.A.A. – Rented U.A.A.)	% of 'dairy' livestock units in the total of grazing livestock units
All other costs: - all farming overheads - all external factor costs - Imputed charges for non-livestock capital and labour	% value of milk and milk products output in the total value of farm production output

All of the methodological issues for comparing costs of production identified in section 3 are relevant for the dairy sector, including the valuation of owned resources, calculation of cost items etc.

Updating procedure

The FADN goes to great efforts to harmonise and error-check its data, and it relies on reporting from liaison agencies across the EU, so some lag in the publication of the data is inevitable. In general the most recent two or three years have not been available—even in the less detailed Standard Results. This subsection details the procedure used to overcome this data limitation, by approximating the data for the most recent years, thereby allowing estimation of the competitiveness measures described above for the most recent years.

On the cost side, the FADN provided whole-farm figures for various expenditure items. Eurostat has published several input price indices for some agricultural inputs, as well as a total agricultural input index which was used for cost items which did not align with available indices. These indices were applied to update the individual FADN cost variables.

On the output side, volume of production (in physical terms) and value of production were available in the FADN data. Therefore, a unit price was calculated for historic data. The next step used data from the Directorate General of Agriculture (DGAgri) on aggregate price[xii] and volume data by country on a monthly basis from Eurostat[xiii]. These were used to calculate a total annual volume and a weighted average annual price (monthly price multiplied by monthly volume and divided by total annual volume). Percentage changes in the aggregate price and volume were then applied to the corresponding FADN variables for price (derived in the previous step) and volume. Updating output value involved a simple multiplication of the price and volume measures.

The FADN does not report milk constituents in the Standard Results, so these had to be estimated for the entire period. This task was accomplished using Eurostat data on sector-wide average fat and protein content[xiv], as described above. Combining these Eurostat aggregates with farm level observations of milk volume—the most recent years of which were estimated using the procedure outlined in the previous paragraph—yielded estimates of farm-level milk solids for the entire period.

4.1.3 Results

The results for the dairy enterprise are presented in four sections: (i) partial productivity indicators, (ii) comparative costs of production relative to output, (iii) estimates for recent years, and (iv) analysis of long run trends.

Comparison of partial productivity indicators on EU dairy farms

The partial productivity indicators for the eight EU countries compared in this analysis are outlined in Figure 1a and Figure 1b. The results are averages for the years 2009 to 2013, which have been indexed relative to Ireland. The absolute levels of the indicators are shown in Appendix II.

Figure 1a: Partial productivity measures (yields and stocking) for selected European 'Specialist dairying' farms (2009 – 2013)

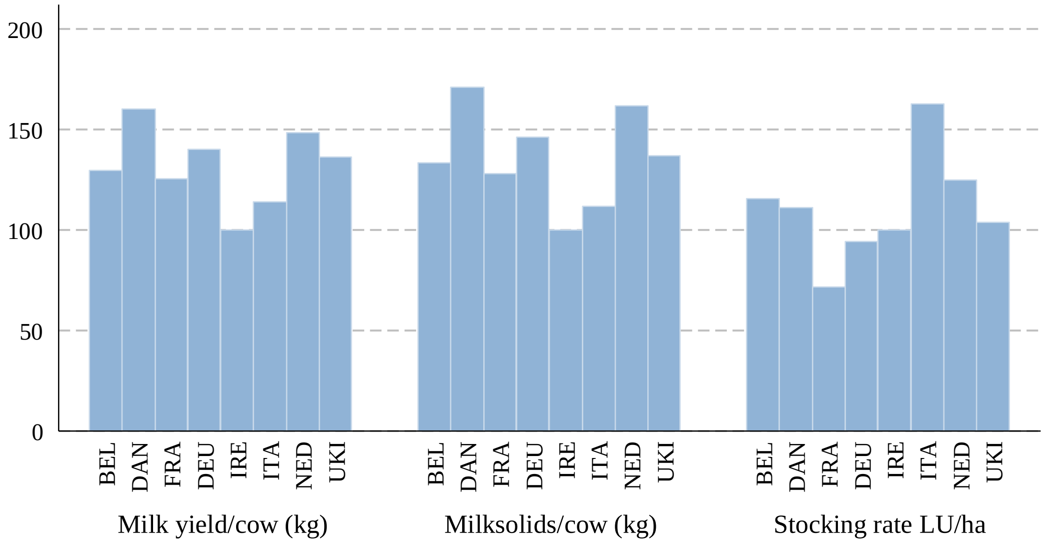
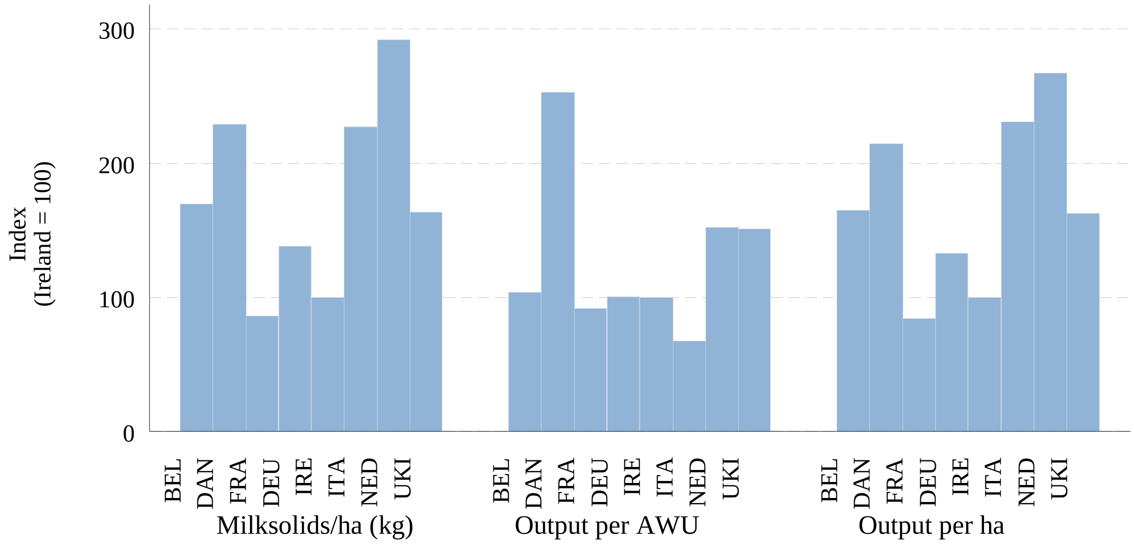


Figure 1a shows that both average milk yields per dairy cow and average milk solids per dairy cow were much lower in Ireland relative to the other countries in the analysis. Average yields in the Netherlands and Denmark were the highest observed.

Stocking densities were highest in Italy and the Netherlands respectively. Ireland was in an intermediate position in this measure; only France and Germany had lower stocking densities, with densities 28 per cent and 5 per cent lower respectively than Ireland. However, the UK, Belgium and Denmark had stocking rates which were only moderately higher than that observed in Ireland.

Ireland employs a relatively extensive production system which attempts to take maximum advantage of a grass-friendly climate. This was reflected in the low yields and moderate stocking density observed in the data.

Figure 1b: Partial productivity measures (land and labour) for selected European 'Specialist dairying' farms (2009 – 2013)



The next three partial productivity measures also showed Ireland near the bottom ranking. Milk solids per hectare were substantially higher in other countries relative to Ireland; the level observed in the Netherlands was about 3 times the Irish value and the figures for Denmark and Italy were both more than double the Irish value. With the exception of France, all other countries analysed had a substantially larger figure than Ireland for milk solids per hectare.

A similar pattern held for output value per hectare. The Netherlands and Denmark again exhibited rates well in excess of the other countries examined. Milk output value per hectare was 114 per cent higher in Denmark and 167 per cent higher in the Netherlands as compared to Ireland. This difference in performance in both measures reflected both the extensive nature of the Irish system, and also the intensity of the Dutch and Danish systems.

However, Ireland narrowed the gap in stocking rate over the period, and this led to some convergence in land productivity measures for specialist Irish dairy farms relative to the average of all countries in the analysis (see Appendix II). Appendix II shows that Ireland had a moderately low stocking rate, especially at the beginning of the time period. This resulted in a lower labour requirement per farm on Irish farms, a larger proportion of which was unpaid family labour. This helped Ireland pull closer to the average of analysed MS in terms of output per AWU, albeit still at a level far behind the Netherlands, Denmark, and the UK.

Comparison of costs and returns in EU dairy farms

The first measure of comparative costs of production used in this analysis was **costs as a percentage of dairy output**. Fingleton (1995) citing Boyle et al., (1992), outlined the relevance of this measure, whereby '*…it reflects the resilience with which a sector of production could cope with a cost/price squeeze. If, for example, there was a substantial fall in milk prices, producers locked into a high cost structure would have much lower chances of survival, other things having been equal'* (p.11). Given that increased milk price volatility is a feature of modern dairy markets (Donnellan et al., 2015), this approach to measuring competitiveness remains appropriate.

Figure 2 below shows five year averages of annual cost to output value ratios for all specialist dairy farms in each of the selected countries. Cash costs and the imputed charges for owned resources were identified, and Appendix III breaks this down further into the respective cost to output value ratios of the individual cost components for all specialist dairy farms in each of the countries.

Figure 2: Costs as a % of market based output for selected European 'Specialist dairying' farms (2009 – 2013)

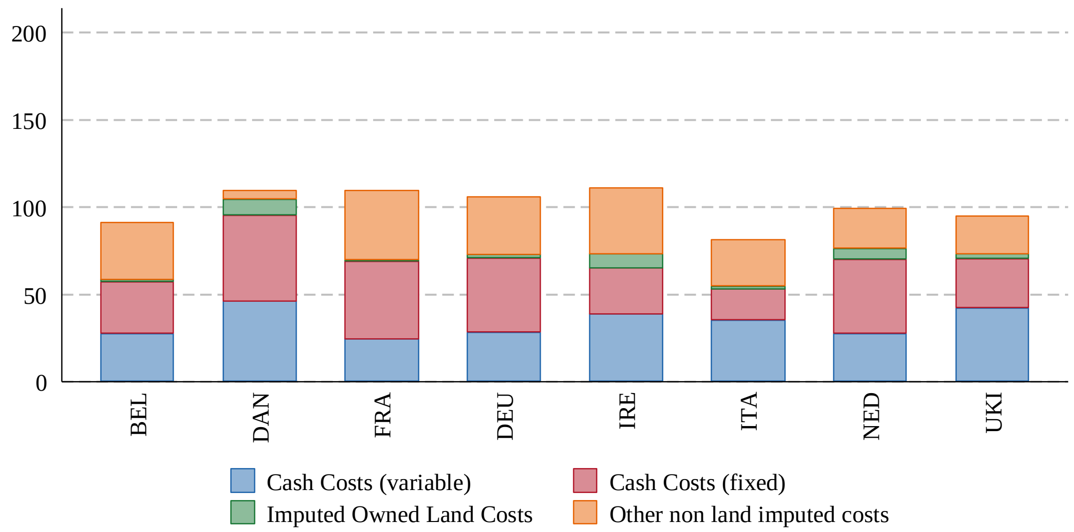


Figure 2 shows that the cash costs as a percentage of output value were relatively low in Ireland over the period 2009 to 2013. Italy and Belgium had the lowest cash costs as a percentage of output value at less than 60 percent of output. The cost structures in the next four MS were quite close to each other; Ireland had a figure of 65 per cent, the Netherlands was at 70 per cent, France was at 69 per cent, and Germany was at 70 per cent. The highest ratio was observed in Denmark where cash costs accounted for 95 percent of output.

Examination of Appendix III revealed several likely sources of competitive potential. The most important of these (in terms of percentage of output value) was expenditure on purchased feeds. With a purchased feed cost to output ratio of 15.45, Ireland belonged to a tier of competitive countries with substantially lower ratios in this cost category. Ireland's ratio for purchased feeds was 10 per cent below the average for all countries in this time period. Belgium, France, and Germany were even further below the average. However, it's worth pointing out that all other MS in the analysis had higher output value on average, so this measure partly reflects output volume and price differences as well as feed intensity. As a matter of fact, the higher milk yields and milk solids per cow for those MS discussed above were indications that they were more feed intensive than Ireland over the period, despite the lower ratios in purchased feed.

Ireland's second largest cost overall was depreciation, but depreciation is even higher in some other MS. Hence, Ireland's ratio was 23 per cent below the average of all countries in this major cost category. It is important to remind the reader that while the FADN considers depreciation as an overhead, this report's methodology classed depreciation as an opportunity cost. Therefore, cash costs for all MS excluded depreciation.

Ireland's cost to output value ratios were below the average level for each overhead cost with the exception of 'upkeep of machinery and buildings'. This item was only three per cent higher than the average of all MS in the analysis. Ireland was between 15 and 25 per cent below the average for most of the remaining overheads. Other direct overheads and interest rates had even lower ratios for Ireland, at 43 and 60 per cent below the average respectively.

These lower overheads were not surprising given Ireland's low input intensity. However, not all of the savings in overheads were necessarily under the farmer's control, e.g. low charges for interest and depreciation could partly be associated with the global financial crisis and ensuing recession.

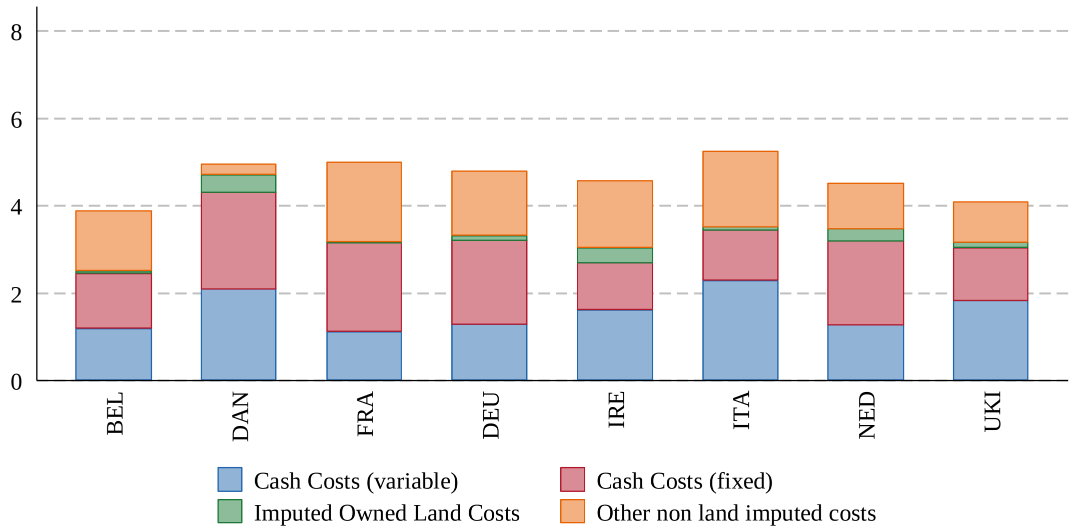
The competitive position of all the examined MS changed when imputed charges for owned resources were taken into consideration. In Ireland's case this meant a fall to the bottom ranking at 111 per cent of output. However, Denmark, France and Germany also showed total economic costs which were in excess of output value.

Ireland's ranking as highest total economic costs as a percent of output value followed directly from having the highest level of opportunity costs (imputed costs) observed in the data at 46 per cent of output. Within each country, the most significant amongst the imputed costs was the charge for family labour, followed by imputed charges for owned land. However, in relative terms, Ireland appears less competitive in the opportunity cost of land; the imputed charge for land in Ireland was 2.04 times the average level of competing nations, whereas the charge for labour was 1.41 times the average level. High owned land charges were due to a moderately high imputed rental charge coupled with high levels of land ownership in Irish agriculture. Ireland's high ratio for the opportunity cost of family labour resulted from a combination of a moderate imputed wage level, a low average product of labour, and a higher proportion of family labour relative to hired labour than found elsewhere.

A 'competitiveness index' was calculated as discussed in section 3.2, and based on the costs presented in Figure 2 and Appendix III. The index presented consistent results regardless of whether or not the imputed charges for owned land were included in the analysis. Ireland was at a competitive disadvantage relative to the average for all the countries studied when total economic costs were taken into consideration. Over the period 2009 to 2013, Irish dairy farms had on average 11 per cent higher total economic costs relative to other competing countries in the EU. When the imputed charge for owned land was excluded from the analysis, this index showed that Ireland had a smaller disadvantage relative to the average for the remaining countries (7 per cent higher economic costs).

The second measure of comparative costs and returns used in this analysis was costs (both cash and economic) per kg milk solids. This measure takes into account the variation in the milk constituents (fat and protein) between different countries. Figure 3 shows the cash and economic costs per kg of milk solids for each of the countries in the analysis averaged over the period 2009 to 2013. Further detail on the cost components of the cash and economic costs are presented in Appendix IV for all specialist dairy farms.

Figure 3: Costs per kg milk solids on selected european 'Specialist dairying' farms (2009 – 2013)



From Figure 3 it is apparent that the inclusion of milk solids has a considerable influence on the competitive position of the countries examined. Based on total cash costs per kg of milk solids produced, Ireland's ranking improved substantially. Only Belgium had lower cash costs per kg milk solids. The UK, France, the Netherlands, Germany followed behind Ireland. Italy dropped from the most competitive position (when ranked by cost as a percent of output value) to the second highest cost structure. Denmark continued to have the highest costs.

Figure 3 also shows that on a total economic cost basis, Belgium had the lowest costs per kg of milk solids and the UK moved up to second position. Ireland dropped back slightly to fourth position. Italy and Denmark continued to show the highest costs on an economic cost basis.

Based on the competitive index of total economic costs, which compares Ireland's position to the average position of the competing countries in the analysis, it appears that Ireland maintained a competitive position over the time period with total economic costs that were 2 per cent lower than the average. Furthermore, this advantage increased when imputed charges for owned land were excluded; Irish costs were then 5 per cent lower than the average of the countries examined.

Estimation of indicators for EU dairy farms in most recent years

The estimation procedure described above was applied to estimate results for the years 2014 and 2015. These results are illustrated in Figure 4 and Figure 5. Both figures show costs which were changing mainly as a result of cash costs movements, rather than changes in imputed charges.

Figure 4 shows the cost to output ratios by country and year. Aside from Denmark, Italy, and the Netherlands, all countries show a pattern of decreasing cost to output ratios in 2014, followed by an increase in 2015. This was attributable to movements in both the cost input price index used and developments in milk prices relative to 2013. Costs decreased in both years, but 2014 saw a very favourable milk price, and the milk price decreased significantly in 2015.

Figure 4: Costs as a % of market based output

for selected European 'Specialist dairying' farms (2013 actual, 2014 – 2015 estimated)

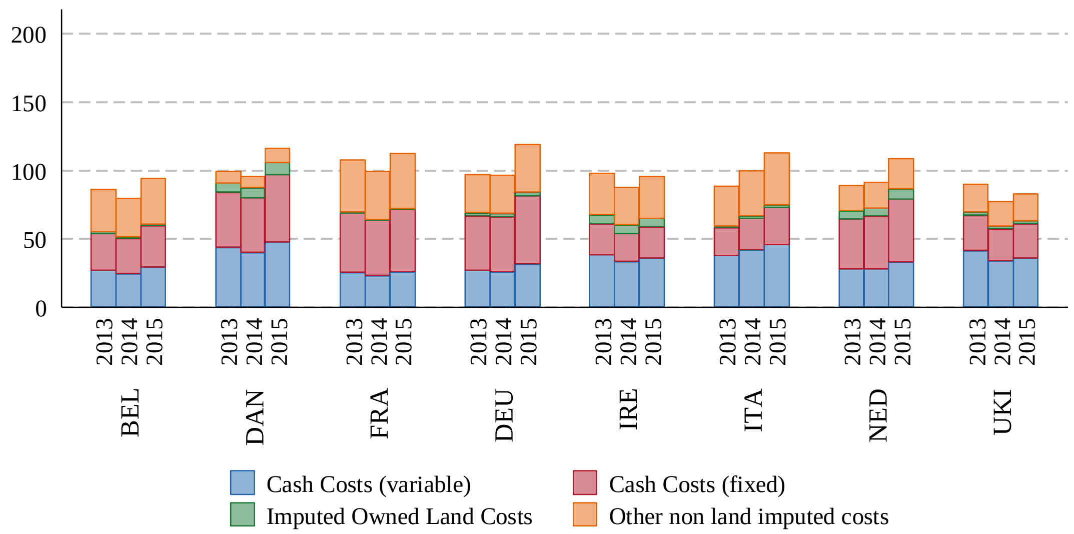
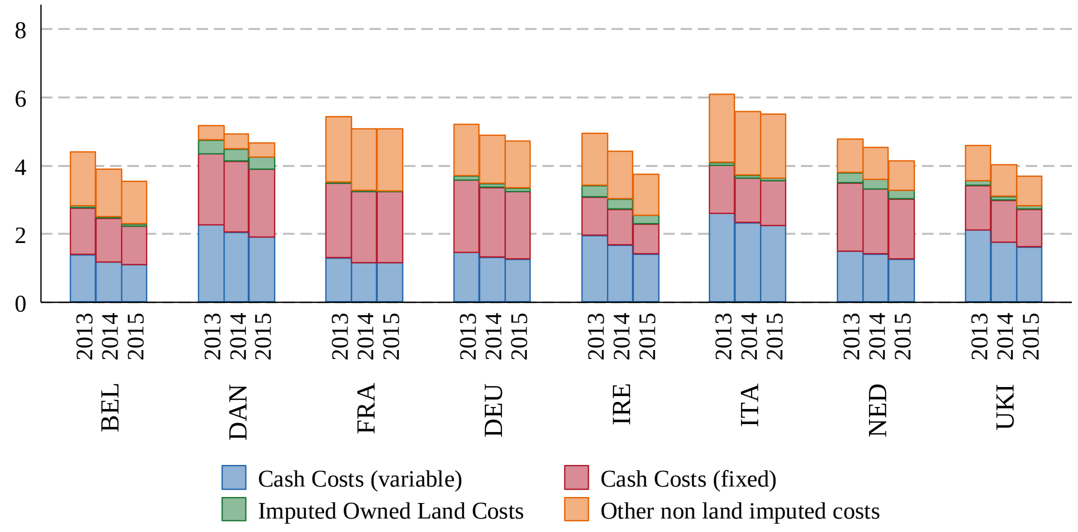


Figure 5: Costs per kg milk solids on selected european ‘Specialist dairying’ farms (2013 actual, 2014 – 2015 estimated)



The cost per kg of milk solids indicator—which removes output value from the calculation—showed the effects of the dairy sector expansion, which began before milk quota was formally abolished. In contrast to the disimprovment in the cost to output ratio seen in 2014 in the majority of countries examined, cost per kg of milk solids declined in 2014 and again in 2015. With a production constraint removed, theory predicts firms should be able to reduce average total costs by spreading total fixed costs over a larger quantity of output. The improvements observed in Figure 5 were consistent with this story. In countries with strong expansions underway (such as Ireland) the indicator improves even faster in 2015 than in 2014.

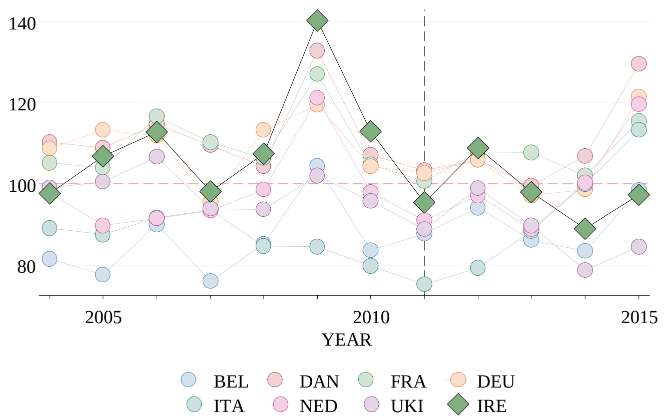
Analysis of indicator trends

This section presents an analysis of trends in the measures of competitive performance described for the specialist dairy enterprise. The discussion is facilitated by Figure 6 and Figure 7 which depict the measures as line graphs. The bar charts above attempt to remove variability in the measures by averaging over multiple years, hence they are not directly comparable to the graphs below. In Figure 6 and Figure 7, individual years are shown at each point along the lines, with the Irish series highlighted with diamond-shaped markers linked by heavier line segments.

Figure 6 shows the cost to output ratios by country and year. The dominant feature in the Irish series was the spike in 2009 which resulted from the collapse of milk prices and contraction in milk production in that year. Similarly, the troughs in the series occurred during 2007, 2011, and 2014, all of which saw favourable milk prices. This illustrates the sensitivity of the indicator to market volatility. The data were noisy, and there were no strong trends observable over the long run. However, the last year of FADN data in 2013 showed a tightening of the measures across all countries, followed by separation in 2014 and 2015 as sectoral expansion began in earnest.

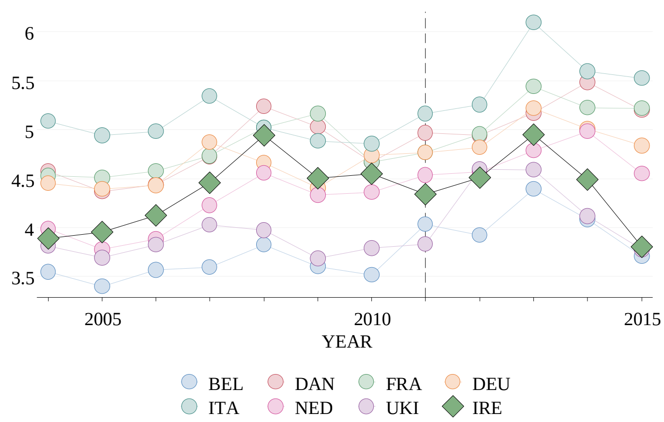
Again, price did not strongly affect the cost per kg of milk solids indicator shown in Figure 7. The peaks in this graph corresponded to input price spikes which didn't feature prominently in Figure 6 because of compensating movements in milk prices. The lack of a spike in 2009 is notable as well; the cost per kg MS remained on trend despite the output price collapse. The salient feature of the Irish series was the reversal of the negative trend exhibited up to 2013 in the estimated years of 2014 and 2015. Importantly, the change in trend was stronger in Ireland than for any other country. This reflected the proportionally large expansion—and consequent lowering of average total costs per kg of milk solids—which occurred in Ireland during these years.

Figure 6: Trends in Total Economic Cost to Market Based Output ratios on selected european 'Specialist dairying' farms



Dashed vertical line marks 2011 change to FADN sampling thresholds.
Dashed horizontal line marks break even point (0 economic profit)

Figure 7: Trends in Total Economic Cost per kg milk solids on selected european 'Specialist dairying' farms



Dashed vertical line marks 2011 change to FADN sampling thresholds.
Dashed horizontal line marks break even point (0 economic profit)

4.1.4 Overall assessment for the dairy sector

Partial productivity measures for Irish dairy herds were generally lower than other important dairy producers in Europe over the period 2009 – 2013. This pattern also emerged in results established for the same EU countries in the period 1990-1993 (Fingleton, 1995), the period 1996-2000 (Thorne, 2004) and for the period 2005-2007 (Donnellan et al., 2011). The results all suggest a relatively low competitive potential for Ireland. However, as stated previously, the partial productivity measures must be interpreted in conjunction with profitability measures to properly account for differing relative costs. Apparent disadvantages in terms of physical productivity may in fact be the consequence of rational reactions to a differing set of input costs, e.g. grass production costs.

Ireland specialises in an extensive low-cost production system; this led to relatively low stocking rates and milk yields per hectare on Irish dairy farms, albeit with an increase in the relative position of Ireland to the average of all countries examined over the time period, in relation to a number of key partial productivity indicators. The strategy pursued by Irish dairy farms naturally resulted in higher cost to output ratios in both home-grown feeds and fertiliser expenditure. Herd health and optimal calving have been emphasised in the recent past, and this may have been reflected in higher livestock specific costs (e.g. AI, veterinary costs).

But the main benefit of a grass-based strategy is the lowering of purchased feed costs, and the analysis showed that this continues to be a major source of competitive potential for Ireland. Additionally, Ireland had an advantage in most overhead costs, notably rent and interest.

This low cost strategy also led to favourable competitive performance in cost per kg MS terms. Similar results for specialist dairy farms were also obtained by Boyle (2002) in his analysis of cost competitiveness for the 1998/99 accounting year. This is an indication that Irish dairy farms have maintained competitive performance since the early 1990's when Fingleton (1995) found that '…Irish dairy farmers held a continuous and relatively strong competitive advantage in the cost of milk production, over the years 1992/93 to 1998/99, when compared with the costs of production in other EU countries.' (p.20) and '…on the basis of using total economic costs as the yardstick of competitiveness, Ireland's position was about the same as the EU average' (p.18).

But Ireland's long-run competitive performance deteriorated when measured by total economic cost to output ratios, owing to the highest imputed charges for owned land and family labour observed in the data.

The Irish dairy sector's response following quota elimination has thus far been to expand milk production, and it is likely that economies of scale will continue to lower average total costs. The indicator estimates for 2014 and 2015 suggest that this is currently improving Irish competitiveness. However, there are some important points of caution to note. Some costs were lower in Ireland because of factors beyond the farmer's control, e.g. low interest and depreciation costs. As dairy expansion proceeds, increased investment and leveraging may increase both of these items, even if nominal interest rates remain at their currently low levels. Furthermore, Irish farms were more heavily weighted towards family labour than other MS. This had the effect of lowering the total wage bill (a cash cost) by substituting an opportunity cost in the form of family labour. As farms expand, the availability of unpaid labour is likely to diminish, so this strategy for (accounting) cost reduction may become less effective.

4.2. *Indicators of Competitiveness of Specialist Beef Producers in Ireland and Selected EU Member States (2005 – 2015)*

4.2.1 *Introduction*

This section of the report examines specific indicators of cost competitiveness and partial productivity for specialist beef producers in Ireland and selected EU member states, namely: Ireland, France, Germany and the UK[xv]. These countries accounted for over 53% of EU beef production in 2015 (Eurostat).[xvi]

There was a difference in the sample selection as compared to previous research studies on the topic. In Thorne (2004) data analysis was confined specifically to two categories of specialist holdings within the FADN dataset: 'Specialist cattle – mainly rearing' (Farm Type 421), and 'Specialist cattle – mainly fattening' (Farm Type 422). However, data constraints arising from changes to the FADN's methodology (and access to publically available data) mean that it will not be possible to split out these two systems going forward. Therefore, the combined farm system Specialist cattle - rearing and fattening (Farm Type 42) was instead selected for analysis.

There was already a wide range of beef production systems within Farm Types 421 and 422. Selecting the more aggregated Farm Type 42 reduced the homogeneity of the sample even further. Some authors have argued that this heterogeneity makes the FADN data unsuitable for comparative analyses (e.g. Murphy et al., 2000). On the other hand, Boyle (2002) put forth a persuasive case that, in the absence of alternative harmonised sources of cost and return data for European beef systems, the FADN dataset was the most appropriate data for the purposes of comparative analysis. However, he also pointed out that 'The drawbacks with this database…..should be noted. The most obvious one is the absence of separate results for rearing and fattening systems' (p.82). The results presented must therefore be treated with a degree of caution.

4.2.2 *Measurement and Methods*

Measures of competitive performance and competitive potential for the beef sector are presented in this section of the report. Three separate measures of cost comparison were used:

- total costs as a percentage of beef output and allocated direct payments,
- total costs (€) per forage hectare (ha), and
- total costs (€) per beef LU.

'Beef output and allocated direct payments' was defined as: 'total output from beef and veal' plus allocated 'subsidies on other cattle'[xvii], 'other livestock subsidies'[xviii], 'environmental subsides'[xix], and 'less favoured areas (LFA) subsidies'[xx].

For the purposes of comparing the relative competitiveness of beef production systems it was not possible to compare costs per unit volume of beef production (e.g. costs per kg of beef carcass or live weight) using the FADN data. Data on LU weight at the point of sale was not available for the different categories of LU sold for the time period under analysis. Consequently, it was not possible to accurately determine the costs per unit volume of production[xxi].

Table 3 Definitions of output for the Specialist Beef enterprise using FADN data

MARKET-BASED OUTPUT	TOTAL OUTPUT
SE220 [Beef and veal] + SE617 [Subsidies other cattle] + **LU_T ratio** * SE619 [Other livestock subsidies] + **BO_{PRDO} ratio** * (SE625 [Subs on intermediate consumption] + SE626 [Subs on external factors])	Market-based output + **LU_{SN} ratio * UAA_{SD} ratio** * (SE621 [Environmental subsidies] + SE622 [LFA subsidies] + SE630 [Decoupled payments])
where "**Beef LU**" is SE090 [Other cattle]	
"**LU_T ratio**" is **Beef LU** / SE080 [Total livestock units]	
"**LU_{SN} ratio**" is **Beef LU** / SE120N [***S***tocking density ***n***umerator]	
"**BO_{PRDO} ratio**" is SE220 [Beef and veal] / SE131 [Total output]	
and "**UAA_{SD} ratio**" is SE120D [***S***tocking density ***d***enominator] / SE025 [Total UAA]	

The partial productivity indicators used to analyse the competitive potential of the beef sector were initially developed by Boyle et al. (1992) and Boyle (2002) and subsequently reported in Thorne (2004). However, the computation of the indicators has been adjusted as a result of data limitations. The partial productivity measures relate to animal, land and labour productivities:

- stocking rate (beef LU/ forage ha),
- land productivity – beef output (€) per forage hectare (ha), and
- labour productivity – beef output (€) per AWU.

The remainder of this subsection gives details of (i) cost allocation methods and (ii) the updating procedure as specifically applied to this sector.

Enterprise cost allocation method

In addition to the measures of cost comparison used for the beef analysis there was also a number of specific cost allocation methods adopted for this enterprise. This allocation method was based on that developed by Vard (2001b).

Table 4 shows that a number of cost items are allocated based on the percentage of 'Specialist beef' LU in the total of either grazing LU or total LU. 'Specialist beef' LU's include: (i) 'other cows'; and (ii) a proportion of 'breeding heifers', 'female cattle 1-2 years', 'other cattle less than one year' and 'calves for fattening'[xxii]. As was the case with the dairy enterprise (section 4.1) the share of the total breeding heifer and young female population reflects the costs associated with cow replacement.

Beef output was defined as all production output from the beef enterprise plus all direct payments allocated to the beef enterprise. A proportion of the total forage hectares on the whole farm was allocated to the Specialist Beef enterprise based on the percentage of the Specialist Beef LU's in the total of grazing LU. The whole-farm AWU's were allocated based on the proportion of beef output and direct payments in the total output and direct payments from the whole farm.

Table 4 Allocation Keys used to define costs associated with the Beef Enterprise using FADN data

COST ITEMS	ALLOCATION KEYS
Purchased feed for grazing livestock (concentrates & coarse fodder) = (Feed for grazing livestock – Feed for grazing livestock home-grown)	% of 'specialist beef' livestock units in the total of grazing livestock units
Feed for grazing livestock home-grown	% of 'specialist beef' livestock units in the total of livestock units
Specific forage costs	% of 'specialist beef' livestock units in the total of grazing livestock units X
Seeds	% area of fodder crops , other forage crops and temporary grass in the total UAA - after exclusion of fallow lands, meadows and rough grazing
Fertilisers	% area of fodder crops, other forage crops, temporary grass and meadows in the total UAA - after exclusion of fallow lands and rough grazing.
Crop protection	% area of fodder crops and other forage crops in the total UAA - after exclusion of fallow lands, temporary grass, meadows and rough grazing.
Other specific livestock costs, imputed charges for breeding and non-breeding livestock	% of 'specialist beef' livestock units in the total of livestock units
Owned land (Total U.A.A. – Rented U.A.A.)	% of 'specialist beef' livestock units in the total of grazing livestock units
All other costs: - all farming overheads - all external factor costs - Imputed charges for non-livestock capital and labour	% of beef production output in the total value of farm production output

Updating procedure

This subsection details the procedure used to estimate, for the most recent years, the beef sector competitiveness measures described above. The procedure for this sector differed slightly from that which was used for the dairy sector described in detail in Section 4.1.

The differences occur in the approach to updating enterprise output value; there were no changes to the procedure on the cost side. The updating procedure for the dairy sector used estimates of the components of output (price and quantity, using appropriate indices) to calculate a new output value. This was made possible by the existence of a physical measure of dairy output in the FADN data. However, physical volumes of outputs are not reported in the Standard Results for sectors other than dairy. Therefore, the output for this sector was updated directly via a price index[xxiii]. The index was sourced directly from Eurostat.

4.2.3 Results

The results for the Specialist beef enterprises are presented in four sections: (i) partial productivity indicators, (ii) comparative costs of production, (iii) estimates for recent years, and (iv) analysis of long run trends.

Comparison of partial productivity indicators on EU beef farms

In Figure 8 the partial productivity indicators identified for the ‘Specialist beef’ system are presented for the four EU countries compared in this analysis. The results presented for each of the countries is the average for the years 2009 to 2013, with each countries indicator indexed relative to Ireland. The absolute levels of each of the indicators, for each of the years and for each of the countries are shown in Appendix V.

Figure 8: Partial productivity measures for selected European 'Specialist cattle – rearing and fattening' farms (2009 – 2013)

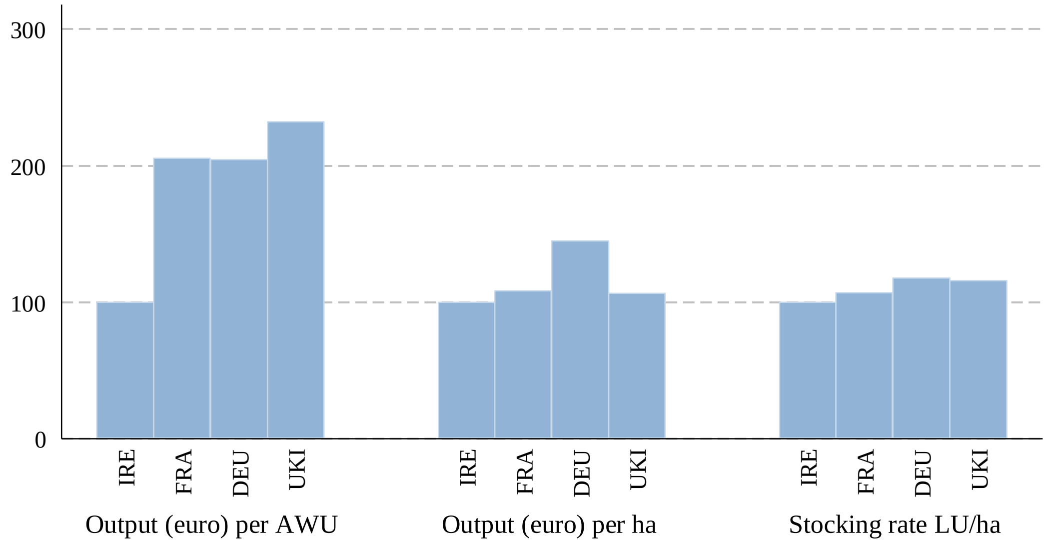


Figure 8 indicates that Ireland's productivity over the period 2009-2013 lagged behind its main competitors[xxiv]. Stocking rates showed relatively minor variation between countries as compared to the variation in output per labour unit (AWU) and output per forage hectare. These two indicators showed considerable variation between the countries, with the highest levels observed per AWU being over double the levels recorded in Ireland. Boyle (2002) and Thorne (2004) also identified wide disparities between partial productivity levels between Ireland and the same set of countries, for specialist beef farms.

Appendix V shows that despite the fact that productivity indicators on Irish 'Specialist beef' farms were on average lower than competing countries, the disparities were decreasing over the period studied. This was especially evident for output per forage hectare, where Ireland went from being 54 per cent below the average to being just 28 per cent below the average of France, Germany and the UK. An increase in stocking rate relative to other MS contributed to this improvement. However, this increase in the intensity of production on Irish 'Specialist beef' also increased labour requirements. Hence, output per AWU improved more modestly; Ireland went from 48 per cent below the average output per AWU in 2009 to 43 per cent in 2013.

The partial productivity measures for beef production yielded similar conclusions to those obtained from the dairy analysis presented earlier in Section 4.1; Irish competitive potential appeared to be at a lower level than competing countries, but the trend was more positive than it was for Ireland's competitors. Again, the grass-based production system in Ireland led to low partial productivity measures, but this was a consequence of the low relative cost of grass production, which also lowers feed costs. Nonetheless, Irish stocking rates increased over the period, and this contributed to the positive trend in the Irish indicators. Differences in direct payments (both coupled and decoupled) also affect the output-based partial productivity measures presented here, so those measures did not solely capture changing physical technology or efficiencies, but also capture changes in direct payment amounts. .

Comparison of costs and returns in EU beef farms

The first measure of comparative costs of production for specialist beef rearing and fattening farms analysed was costs as a percentage of total beef output and allocated direct payments.

Figure 9 shows the cost to output ratios for the five year average, for each of the selected countries for all specialist 'Specialist beef' farms. The individual cost components for each of the countries are presented in Appendix VI.

Figure 9: Costs as a % of total output (incl. of decoupled direct payments allocated to the enterprise) for selected European 'Specialist cattle – rearing and fattening' farms (2009 – 2013)

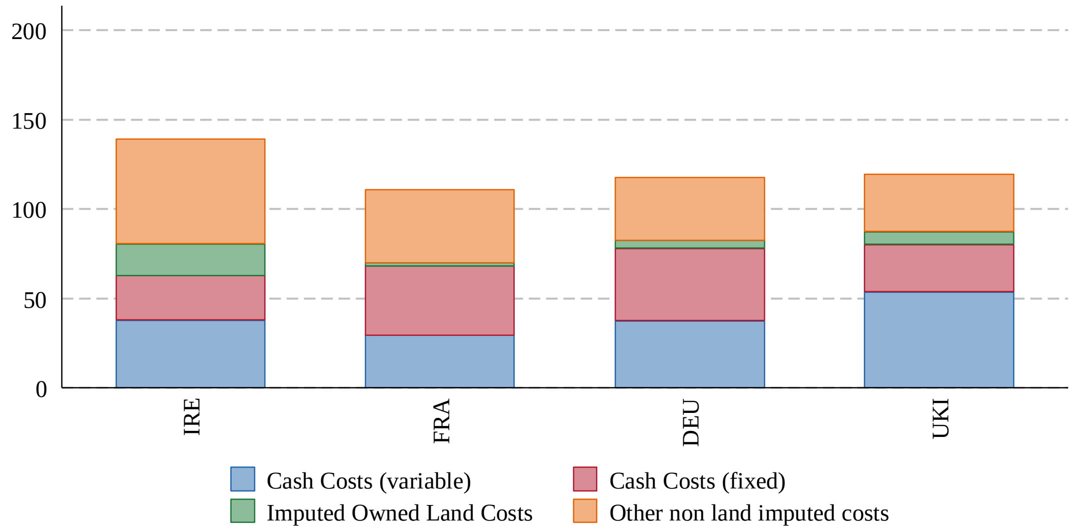


Figure 9 shows the average for the period 2009 to 2013, where some variation in cash costs as a percentage of output was evident between the competing countries. The cash cost to output ratio was lowest in Ireland (62 per cent of output) and highest in UK (80 per cent of output). However, when total economic costs were considered Ireland's competitive position worsens. Ireland had the highest economic cost to output ratio (139 per cent), followed by UK (120 percent), Germany (118 percent), with France recording the lowest total economic costs at 111 percent of output.

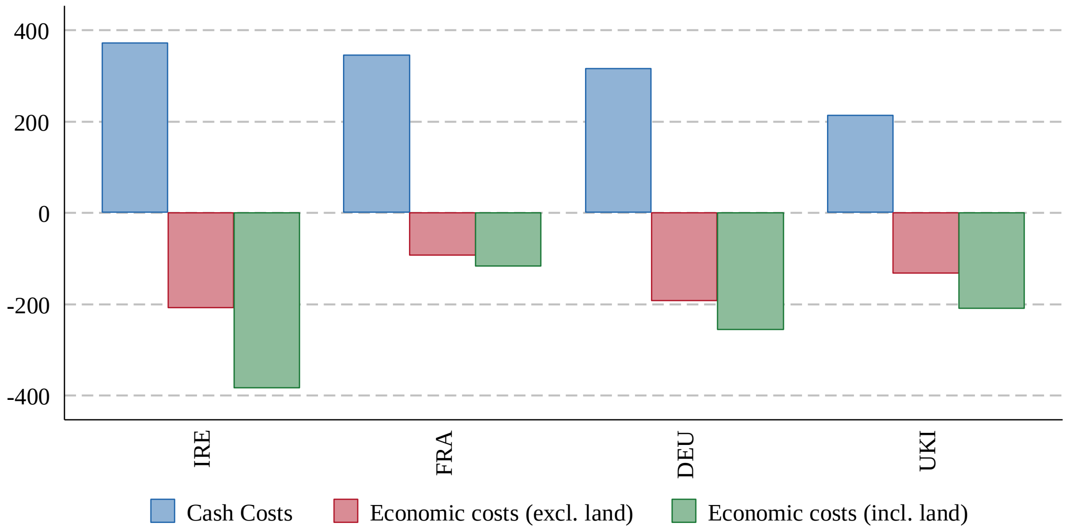
The imputed charges for family labour and owned land for Irish farms significantly altered the competitive position of these farms over the period (Appendix VI). The family labour to output ratio for Irish beef rearing farms was 41 per cent and the owned land cost to output ratio was 18 per cent. These costs were significantly higher than those recorded in competing countries. A large proportion of land is owned on Irish beef farms rather than leased or rented which is more common amongst the competing countries in the analysis. In addition Ireland experienced moderately high land rental charges over the period. The high imputed cost for family labour was due to relatively large amounts of unpaid (family) labour employed on Irish beef farms. These two factors could be considered as impediments to the longer term competitiveness of Irish Specialist Beef farms over the longer term. Even when the imputed charge for owned land was excluded from the analysis the cost to output ratio for Ireland remained the highest observed at 121 per cent.

The longer term outlook for Irish Specialist Beef farms can be summarised by the competitiveness index discussed in section 3.2. The index, which was calculated on the basis of total economic costs, confirmed a lack of long-term competitiveness in the 'Specialist Beef' sector. Irish farms had costs which were 14 per cent higher than competing countries. The index improved somewhat when imputed land charges were excluded, but Irish farms were still found to be uncompetitive overall; Irish costs were 7 per cent higher than competing countries when imputed land charges were excluded.

The second indicator of cost competitiveness for beef production was the margin over total costs per forage hectare for 'Specialist beef' enterprises (Figure 10). Similar approaches have been taken before; Murphy et al. (2000) also examined cost and return data per hectare. Such measures are more appropriate because beef sector costs are strongly influenced by relative stocking rates, so analysis which ignores returns per hectare may result in a misleading indicator of competitiveness. Therefore, margin over cost was chosen instead of, e.g. cost per hectare, as the former is a more reliable indicator of competitiveness.

It can be seen from Figure 10 that Ireland had the largest margin over cash costs, and UK had the smallest. However, imputed charges were particularly large in Ireland. Imputed charges were smaller in the UK and France, but positive margins turned negative for all countries when total economic costs were considered. This situation persisted even after removing the opportunity cost of land from the calculation of margin over cost in each of the countries studied.

Figure 10: Margin over costs (incl. of decoupled direct payments allocated to the enterprise) per forage hectare for selected European 'Specialist cattle – rearing and fattening' farms (2009 – 2013)



The final measure of cost competitiveness of beef production analysed was margin over costs per beef livestock unit (LU). Figure 11 shows that the margin over cash costs was highest for Irish specialist beef farms compared to the other countries in the analysis, and that this position worsened when total economic costs were considered; the margin over cash costs per 'beef LU for Ireland was over €300 per hectare, however this fell to over -€300 with imputed costs included. The competitiveness index for Ireland for margin over economic costs per beef LU was 45 per cent lower than the average for all the other countries studied and again this competitive position persisted even after removing the opportunity cost of owned land from the calculation.

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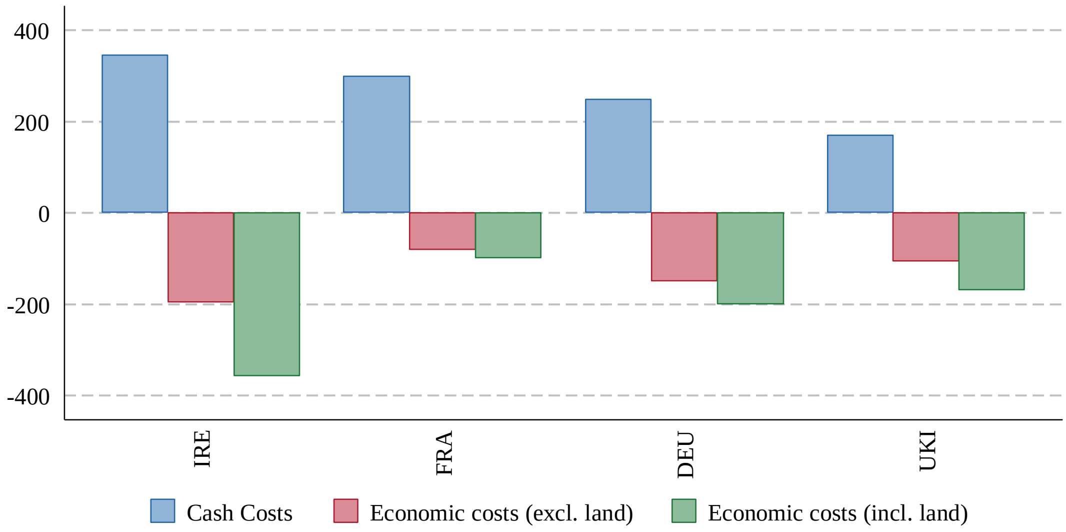
Figure 11: Margin over costs (incl. of decoupled direct payments allocated to the enterprise) per beef livestock unit (LU) for selected European 'Specialist cattle – rearing and fattening' farms (2009 – 2013)



Overall, the results for the 'Specialist beef' enterprises provided a clear indication that over the period 2009 to 2013, Irish producers had a competitive advantage when cash costs were examined. This competitive position disappeared when total economic costs were taken into consideration. The imputed charge for owned land and labour had a large influence on the relative competitive advantage of Irish beef farms. Bearing in mind that total economic costs provided a relative guide to the longer term competitive position of competing countries (Fingleton, 1995), this may be an early warning sign for Irish beef producers. When the imputed land charges were excluded from the calculation, the longer term outlook for these farms improved, but Ireland still had negative margins which were up to twice as large as competing counties, France, Germany and the UK.

Reliance on direct payments is another issue which must be considered in view of the longer term competitiveness of Irish beef production. To investigate this in more detail, a number of the cost based indicators of competitiveness were recalculated using only market-based returns. This approach gives a sense of the ability of Irish cattle farmers to survive in a more liberalised policy environment. Figure 12 below shows the average market-based cost to output ratio, for each of the countries examined, for the years 2009 to 2013. The individual country level results for the years 2009 to 2013 are presented in Appendix IX. Other alternative indicators of beef system cost competitiveness were also re-calculated using market-based margins. These measures did not show substantial deviations from the results presented in Figure 12 and Appendix IX, so are not presented here.

Figure 12: Costs as a % of market based output (excl. of allocated decoupled payments) for selected European 'Specialist cattle – rearing and fattening' farms (2009 – 2013)

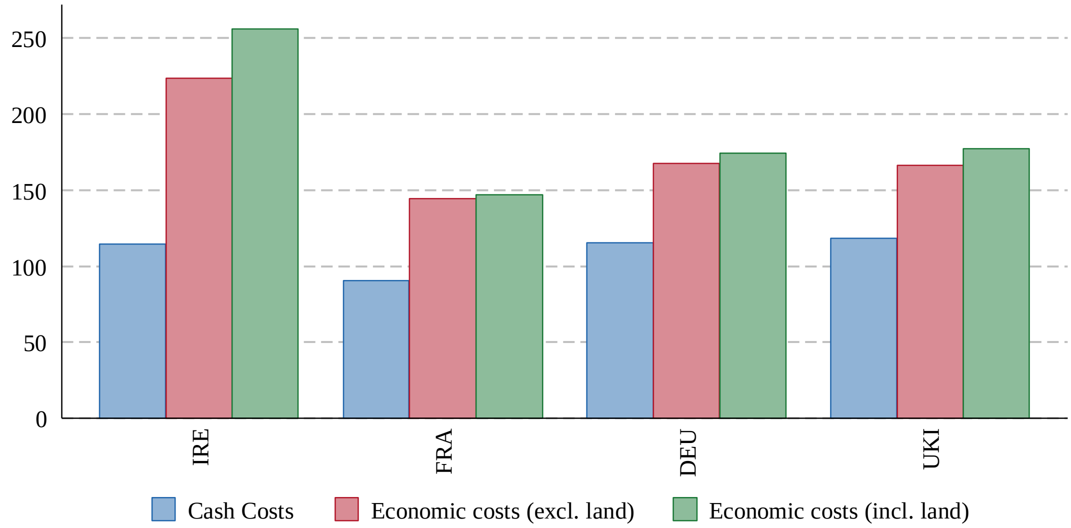


Figure 12 shows that on a market based cash cost margin, the competitive position of Irish beef farms is very different from that presented in previous figures where output value included allocated portions of both coupled and decoupled direct payments. In Figure 12 only market based output is considered, and we see that Ireland does not hold onto the position as the lowest cash cost producer amongst the countries examined. France now has the lowest cash cost to market based output, Ireland and Germany have similar ratios and the UK exhibits the highest cash cost to market based output ratio. However, on a total economic cost basis, Ireland appears to have significantly higher economic costs as a percent of market based output relative to the other countries examined.

Estimation of indicators for EU beef farms in most recent years

The estimation procedure described in section 4.2.2 was applied to obtain results for the years 2014 and 2015. These results are illustrated in Figure 13 and Figure 14. The figures show costs were changing as a result of movements in both cash costs and imputed charges.

Figure 13 shows the cost to output ratios by country and year. Most countries show a pattern of decreasing costs ratios in 2014 and 2015. This was attributable to movements in both the cost input price indices used and the effect of comparatively stable revenue from direct payments.

Figure 13: Costs as a % of total output (incl. of allocated decoupled payments) for selected European 'Specialist cattle – rearing and fattening' farms (2013 actual, 2014-2015 estimated)

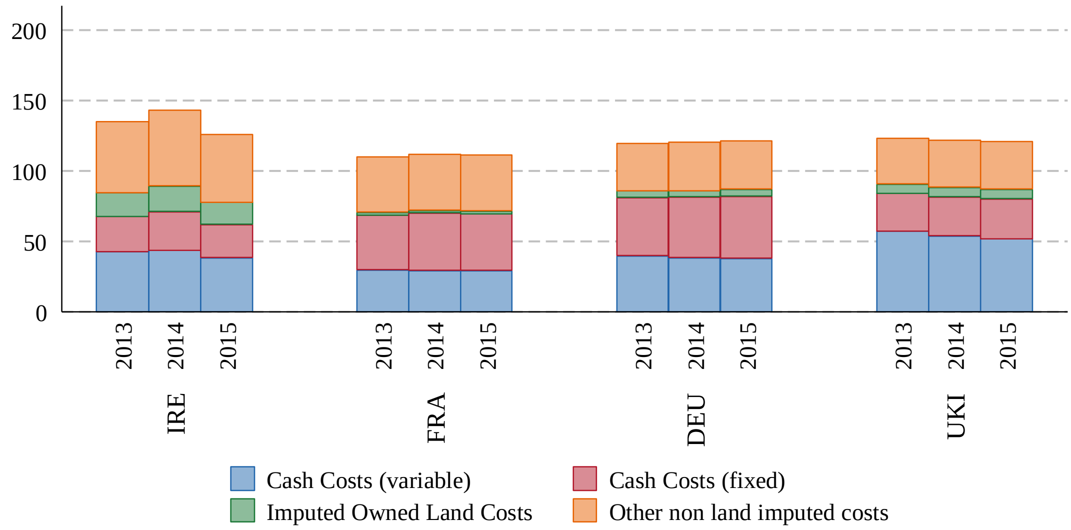


Figure 14: Costs as a % of market based output (excl. of allocated decoupled payments) for selected European 'Specialist cattle – rearing and fattening' farms (2013 actual, 2014-2015 estimated)

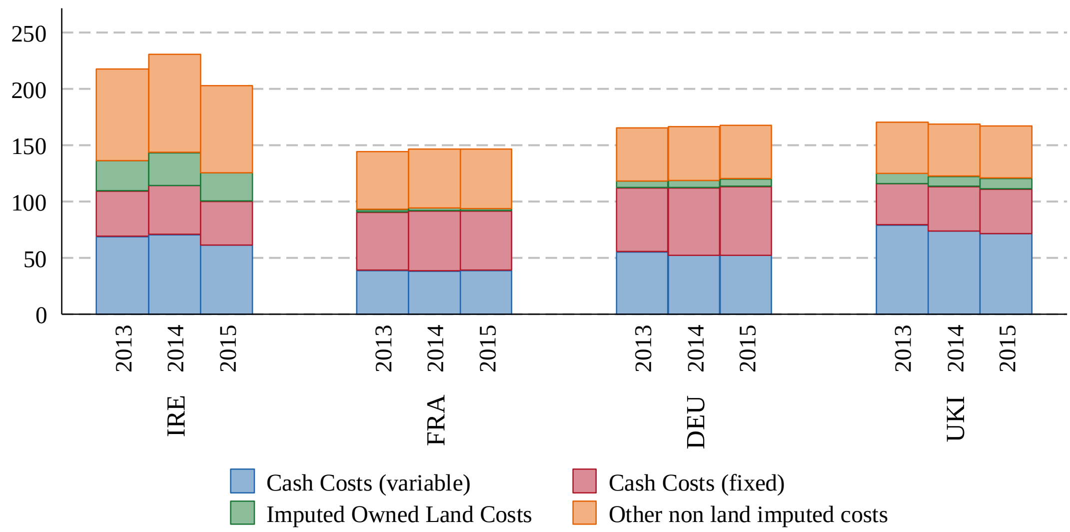


Figure 14 demonstrates the cost position relative to market based income and the ensuing distorting effect of non-market income. Due to a fall in beef prices in France, Germany and the UK, coupled with a decline in costs, there was virtually no movement in the cost to output ratios in three of the four countries analysed. Ireland proves to be an exception to this rule in 2015, as market output actually increased in what was a good year for Irish beef prices, thus improving Ireland's competitive standing.

Analysis of indicator trends

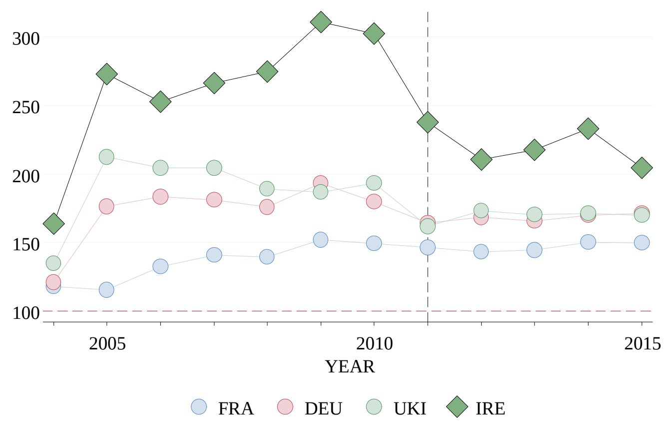
This section presents an analysis of trends in the measures of competitive performance described for the specialist beef enterprise.

Figure 15 shows the market-based cost to output ratio for the beef sector. With subsidies removed from output, the level of this indicator was higher at every point (competitiveness was worse) as compared to Figure 16. The starkest difference in the pattern was the much worse starting position for all MS in 2004. The decoupling of payments began in 2005 in Ireland, and from this year on the series converged for France, Germany, and the UK, with decoupling happening at a different pace in the different MS's. However, the global recession had a more severe impact on Irish beef; Ireland's cost to output ratio didn't begin to approach the level of competitiveness attained by other countries until after 2010.

Figure 16 shows the cost to output ratio by country and year including direct payments. Whilst there is a large amount of volatility between years, nonetheless, Ireland ranked last in every year on a total economic cost basis.

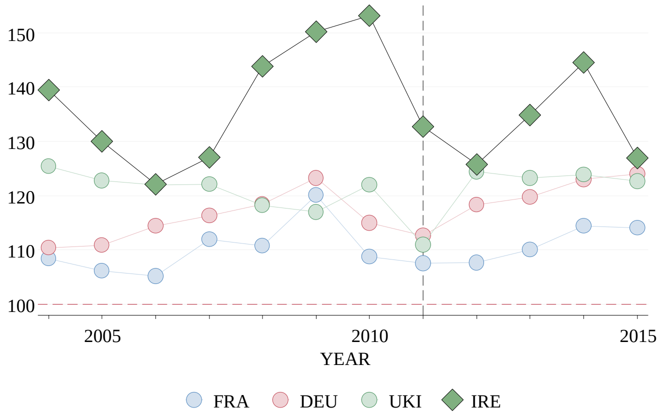
Furthermore, the trends were converging across countries, so competition amongst major beef producing MS was tightening. However, all MS had cost to output ratios which exceeded 100, which marked the break-even point of production. Economic losses such as these suggest pressure on farms to exit the sector, and that market signal was stronger in Ireland than it was elsewhere.

Figure 15: Trends in costs:output ratios (excl. of allocated payments) on selected european 'Specialist cattle – rearing and fattening' farms



Dashed vertical line marks 2011 change to FADN sampling thresholds.
Dashed horizontal line marks break even point (0 economic profit)

Figure 16: Trends in costs:total output ratios (incl. of allocated decoupled payments) on selected european 'Specialist cattle – rearing and fattening' farms



Dashed horizontal line marks break even point (0 economic profit)
Dashed vertical line marks 2011 change to FADN sampling thresholds.

4.2.4 *Overall assessment for the beef sector*

On the basis of partial productivity measures, the competitive potential of the Irish beef sector was relatively weak. While stocking rates were comparable with Ireland's competitors, land and labour productivity were far lower. However, this was partially a consequence of the extensive and grass-based production system employed in Ireland. Detailed cost analysis revealed that purchased feed, overheads, external factors, and depreciation were sources of competitive potential. Many of these advantages were due to Ireland's grass-based system.

The ability to take advantage of grass input, along with the willingness to substitute owned factors for land rental and hired labour costs, and the existence of subsidies have all made small-scale Irish beef production possible over successive short run horizons. A cash cost to total output ratio (inclusive of allocated decoupled payments) below 100 per cent indicated positive financial profits on average over the period 2009 – 2015. However, excluding allocated decoupled direct payments reduced financial profit to below zero.

This result is similar to those obtained by Boyle (2002) and Thorne (2004). Boyle (2002) found that excluding subsidies made Ireland relatively uncompetitive in 1998/99—even on a cash-cost basis. The ratio he calculated was 13 per cent higher than the average of all countries in that year. Thorne (2004) also found that beef systems were generally less competitive than other sectors, and she warned that the sector would come under increased competitive pressure.

In the analysis presented in this chapter for Irish beef farms we have seen that when decoupled payments are excluded from the analysis, France appears to have the lowest cash cost to market based output position, with Ireland and Germany having similar ratios and the UK exhibiting the highest cash cost to market based output ratio. Furthermore, on a total economic cost basis, Ireland continues to appear to have significantly higher economic costs as a percent of market based output relative to the other countries examined.

In summary, the outlook remained bleak in the long run analysis for Irish beef farms. Opportunity costs in the Irish beef sector were much larger than competitors' opportunity costs. In particular, non-land imputed costs (mainly family labour) were a substantially larger percentage of output as compared to competing MS (a cross-country comparison), and as compared to the Irish dairy sector (a cross-sector comparison). This contributed to a total economic cost ratio which was well above the break-even point of production (i.e. 100 per cent). It indicated a substantial pressure for farm exits from the sector in the long run.

4.3. *Indicators of Competitiveness of Specialist Cereal Producers in Ireland and Selected EU Member States (2005 – 2015)*

4.3.1 Introduction

This section of the paper examines the costs and returns associated with the production of cereals in Ireland and some comparable EU member states. The EU countries chosen for comparison were the UK, Denmark, France, Germany and Italy. Together these countries accounted for over 80 per cent of the total cereal production within the EU-15 in 2015 (Eurostat).[xxv]

The FADN farm classification type used in this analysis was Farm Type 131 – Specialist cereal, oilseed and protein (excluding rice) (COP) producers. The FADN classification for COP farms is not as homogeneous as other enterprise systems defined by the Commission, such as specialist dairy (Type 411). Consequently, there is an inherent unavoidable bias introduced as a result of the different cost intensities and output prices commanded by the different products. However, this approach to comparative analysis was defended by Boyle (2002) because ‘a crop by crop analysis is impossible to obtain owing to the paucity of the sample at that level of disaggregation. Moreover, since several different varieties of cereals are produced jointly, such a disaggregated analysis, even if it were feasible, might not be very meaningful’. Nevertheless, efforts were made to redefine farm type 131, whereby the economics of cereal enterprises were analysed in isolation from oilseed and protein producers. Oilseed and protein production is more common in other European countries than in Ireland. In France, for example, oilseed and protein production accounted for 26 per cent of cereal, oilseed and protein output combined, from specialist farms, during the period 2009 to 2013. This figure compares to a value of 7 per cent in Ireland over the same period. Consequently, efforts were made to examine the relative competitiveness of cereal production on these farms as distinct from the competitiveness of the whole farm, which by definition specialises in cereals, oilseed and protein production.

4.3.2 Measurement and methods

Measures of competitive performance and competitive potential for the cereals sector are presented in this section of the report. Three separate measures of cost comparisons were used for comparing the competitiveness of cereal production in the selected member states:

- total costs as a percentage of the:
  - total value of output
  - the market based value of the output, and
- total costs (€) per hectare of cereal production (ha).

Measuring costs of production, in terms of output is consistent with traditional production theory, which aims to minimise costs or maximise net revenue per unit output. Whilst competitiveness in the market place for commodities, such as cereals, is largely determined by costs of production (Boyle, 2002),, this is not entirely the case as quality differences, transport costs to the point of purchase and access to direct payments are also important. Therefore, it was considered important to examine the competitiveness of cereal production in terms of total costs of production as a percentage of the total value of output. The total value of output in this analysis included both production output and direct payments in the form of coupled and decoupled payments.

The indicators of partial productivity used to analyse the competitive potential of the cereal sector were;

- wheat yield – wheat (100 kg) per hectare (ha) of wheat area[xxvi],
- land productivity – output from cereal production plus allocated direct payments (€) per hectare (ha) of land devoted to cereals, and
- labour productivity – output from cereal production plus allocated direct payments (€) per AWU.

The remainder of this subsection gives details of (i) cost allocation methods and (ii) the updating procedure as specifically applied to this sector.

Table 5 Definitions of output for the Specialist Cereals enterprise using FADN data

MARKET-BASED OUTPUT	TOTAL OUTPUT
SE140 [Cereals] +	Market-based output +
CO_{COP} ratio *	**(1 - UAA_{SD} ratio)** *
(SE611 [Compensatory/area payments] +	SE621 [Environmental subsidies] +
SE612 [Set aside premiums]) +	**UAA_{CER}** *
CO_{PRDO} ratio *	(SE622 [LFA subsidies] +
(SE625 [Subs on intermediate consumption] +	SE630 [Decoupled payments])
SE626 [Subs on external factors])	
"**CO_{COP} ratio**" is SE140 [Cereals] / SE140 [Cereals] + SE145 [Protein crops] + SE160 [Oil-seed crops]	
"**CO_{PRDO} ratio**" is SE140 [Cereals (€)] / SE131 [Total output]	
"**UAA_{CER} ratio**" is SE035 [Cereals (ha)] / SE025 [Total UAA]	
and "**UAA_{SD} ratio**" is SE120D [***S***tocking density ***d***enominator] / SE025 [Total UAA]	

Enterprise cost allocation method

As with the previous enterprises examined, it was also necessary to allocate costs to the cereal enterprise to calculate the measures outlined above. Table 3 below outlines the allocation methods used in estimating the costs associated with the cereal enterprise on specialist cereal, oilseed and protein farms.

Table 6 Allocation Keys used to define costs associated with the cereal enterprise on Specialist COP farms, using FADN data

COST ITEMS	ALLOCATION KEYS
Seed costs	% of cereals production output in total cereals, oilseeds, and protein crops production (arable crops)
Fertiliser, crop protection, other crop specific costs, machinery & buildings current costs, and energy costs	% of cereals production output in total crop production
Contract work, other direct inputs, depreciation, external factors	% of cereals production output in total farm production
Imputed charges for owned capital and labour	% of cereals production output plus allocated direct payments in the total output & direct payments of the farm
Imputed charge for owned land	% of cereal acres in total UAA of the whole farm

Table 6 shows that all cost items, apart from owned land, were allocated based on the per cent of cereals production output and allocated direct payments in the total production output and direct payments of the farm.

Updating procedure

This subsection details the procedure used to estimate, for the most recent years, the cereals sector competitiveness measures described above. The procedure for this sector differed slightly from that which was used for the dairy sector. Like the beef and sheep sectors, output was updated directly using a price index[xxvii]. The method was fully described in section 4.2.2.

4.3.3 Results

The results for cereal production are presented in four sections: (i) partial productivity indicators, (ii) comparative costs of production, (iii) estimates for recent years, and (iv) analysis of long run trends.

Comparison of partial productivity indicators on EU cereal farms

Figure 17 below shows the partial productivity indicators for the EU cereal farms identified above. The results presented here for each of the countries is the average for the years 2009 to 2013 and which have been indexed relative to Ireland. The absolute levels of the indicators, for each of the years and for each of the countries are shown in Appendix X[xxviii].

Figure 17: Partial productivity measures for selected European 'Specialist cereals' farms (2009 – 2013)

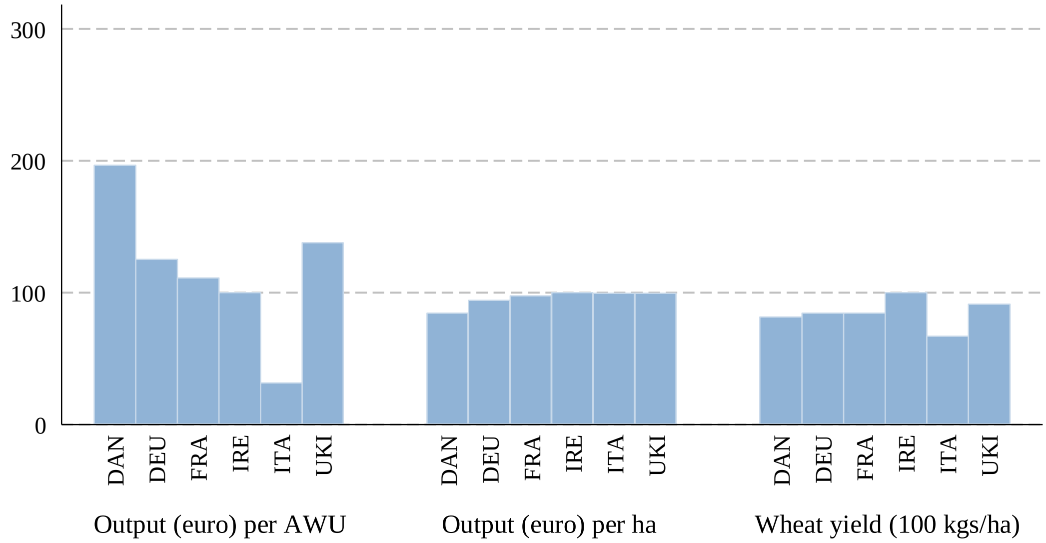


Figure 17 indicates that Ireland's wheat yield[xxix] was the highest over the period, among the countries examined. Yields in the UK were also relatively high compared to the other countries, with yields in Italy substantially lower than all countries. However, it is important to highlight that substantial volumes of durum wheat are produced in Italy

In general, the relative differences in land productivity were not as large as the differences in labour productivity. Output per hectare of cereal production was highest in France, closely followed by the UK, with Ireland in third position, followed by Italy, Germany and Denmark.

Meanwhile, Denmark level of output per AWU was nearly twice as much as that recorded in Ireland over the same period. The UK also had substantially higher output per AWU. Ireland was closer to German and French levels, but these were higher as well. Italy was unique in that it had substantially lower output per unit labour input with levels more 70 per cent lower than in Ireland. A lack of scale economies helped explain this difference; Italian cereal farms were the smallest in the analysis as measured by hectares of utilisable agricultural area (UAA).

Comparison of costs and returns on EU cereal farms

The first measure of comparative costs of production for cereal farms was costs as a percentage of total cereal production output and allocated direct payments. Figure 10 shows the five-year average cost to output results for the cereals enterprise for each of the selected countries. The individual cost components for each of the countries is outlined in Appendix XI.

Figure 18: Costs as a % of total output (incl. allocated decoupled payments) for selected European 'Specialist cereals' farms (2009 – 2013)

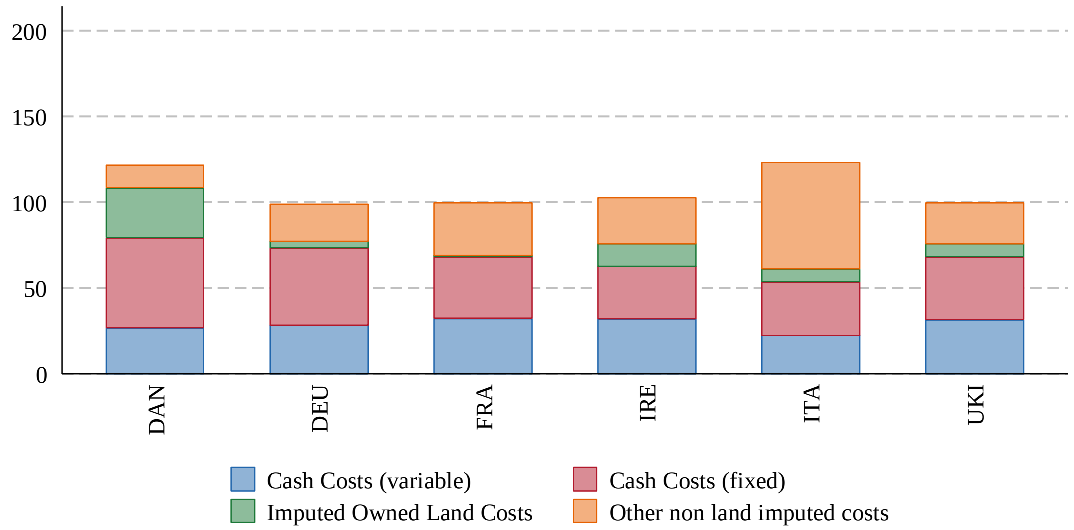


Figure 18 shows that Irish cereal producers had the second lowest cash costs ratio over the period 2009 to 2013. Italy had the lowest cash costs, while costs in France and the UK were quite similar to the Irish position over the period. Higher cash costs were seen in Germany and Denmark, with the ratio in the latter being considerably worse than the Irish level.

The ranking between countries changed considerably when total economic costs were taken into account. Imputed charges were substantially higher in Italy and Denmark than in all other countries. This resulted in Italy slipping from the first position to the last position, with Denmark recording the second highest total economic cost to output ratio amongst the countries examined. On the other hand, imputed charges for owned resources were considerably lower in Germany, the UK France. Overall, Germany, France, the UK and Ireland had very similar total economic costs as a percent of output, all in or around the break-even point (total economic costs equal to 100 percent of output).

When the imputed charge for owned land was excluded from the analysis, the competitive position of Irish cereal producers improved; total economic costs as a percentage of output is the lowest. The imputed charge for owned land over the period accounted for, on average, 13 per cent of the output from cereals on Irish farms, which was substantially higher than in the other countries except Denmark (29 per cent).

The competitiveness index revealed that—even on a total economic cost basis—Irish cereal producers maintained a competitive advantage relative to the average of the countries examined. The Irish cost to output ratio was 5 per cent lower than the average for all countries.

Findings obtained by Boyle (2002) and Thorne (2004) were based on costs as a percentage of market based output for the year 1999; it was considered important to replicate this analysis for the years 2009 to 2013. This market based assessment is particularly important for Irish cereal producers in light of the ongoing reforms of the CAP. To determine whether or not Irish producers could maintain competitive position in a more market-orientated production environment, costs[xxx] as a percentage of market based output are presented in Figure 19 below.

Figure 19: Costs as a % of market output (excl. allocated decoupled payments) for selected European 'Specialist cereals' farms (2009 – 2013)

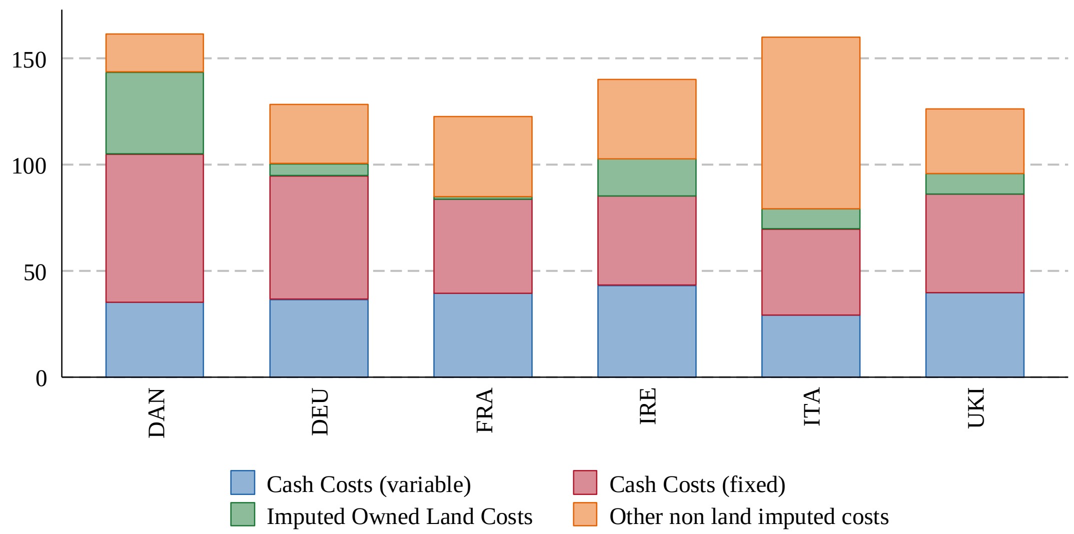


Figure 19 showed that the competitive position of Irish cereal producers was maintained during the period 2009 to 2013, when costs were expressed as a percentage of market based output, as distinct from total output (including direct payments). On a total economic cost basis, Irish cereal producers had 3 per cent lower costs than the average of all countries analysed. Furthermore, when imputed land charges were excluded from the analysis, Irish cereal producers had 6 per cent lower costs relative to the average of all countries.

The next measure of cost competitiveness for cereals used in the analysis was margin over costs per hectare of cereal production. Figure 20 shows the average of these results for the period for all countries examined. Appendix XII outlines the cost, revenue and margin per hectare for each of the countries.

Figure 20: Margin over costs per hectare (incl. of allocated decoupled payments) for selected European 'Specialist cereals' farms (2009 – 2013)

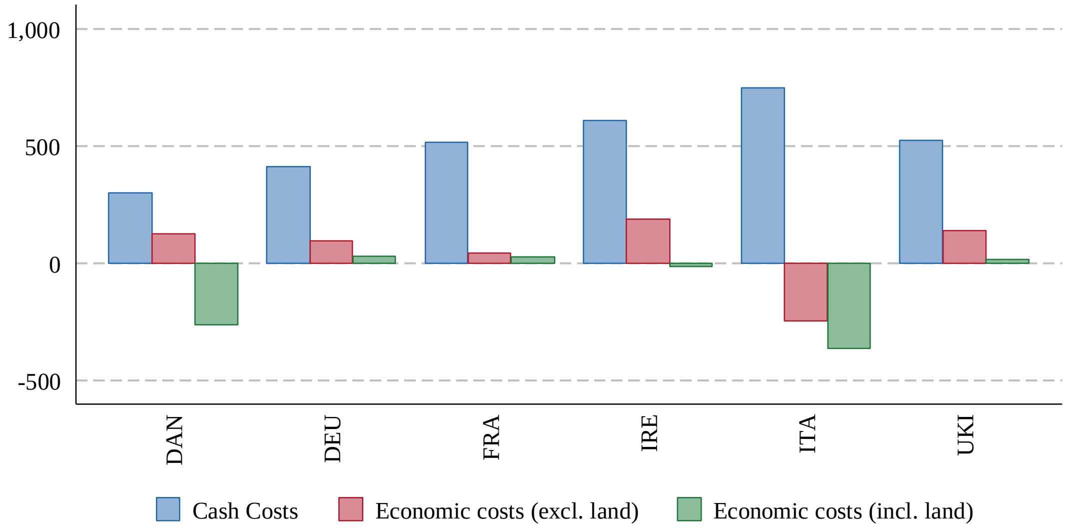


Figure 20 shows results similar to those in Figure 18 and Figure 19. The margin over cash costs per hectare was highest in Italy, followed by Ireland, France, the UK, Germany and Denmark. . Italy dropped to the last position for margin over total economic costs; with Denmark and Ireland also recording a negative net margin. Whilst Ireland was in the third to last ranking, its margin was much closer to the levels observed in Germany, the UK, and France. Furthermore, the results presented here show that imputed charges for owned land have a large influence on relative competitiveness. When these imputed land charges were excluded from the analysis, Irish cereal producers had the largest economic margin per hectare during the period. No obvious trend was associated with Ireland's relative positioning over the period.

The three measures of cost competitiveness indicate that Irish cereal producers maintained a competitive advantage relative to the average of all countries in the analysis, when cash costs and economic costs were considered (excluding imputed charges for owned land). This advantage was less evident when total economic costs were measured relative to cash costs, due to the high imputed charges for owned land in Ireland.

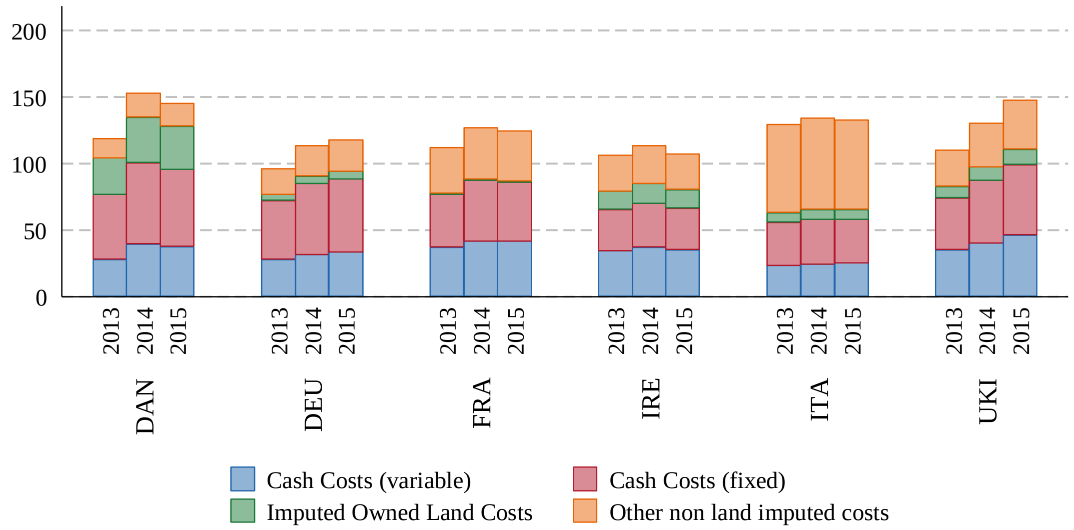
Appendices XII, XIII and XIV show the individual cost items and returns associated with the measures of cost competitiveness. Analysis of these variables showed that the prominent sources of competitive advantage associated with Ireland's relatively low cash cost structure, were low expenditure on energy, 'other direct inputs', and paid wages. Low depreciation and machinery charges in Ireland were probably a reflection of the extensive use of contractors' services in Irish cereal production. Kelly and Shanahan (2001) noted that '*this reduces depreciation and allows the capture of the economies of scale associated with the use of high capacity machinery when this is used for long periods*' (p.5).

In contrast to the above specific cost items, which were lower in Ireland, there were also a few items that were higher in Ireland than the other countries, namely, fertilisers, crop protection and contract work. This could be associated with high usage levels or the relatively high costs of these items in Ireland. The high cost of fertiliser was also evident in the other commodities analysed and was not peculiar to cereals.

Estimation of indicators for EU cereal farms in most recent years

The estimation procedure described above was applied to approximate results for the years 2014 and 2015. These results are illustrated in Figure 21. As in previous sections of this report, the cost to output ratio was plotted by country and year. Figure 21 reveals a steady cost ratio in Ireland; costs decreased gradually, but this was wholly offset by decreasing output value. The same held true for France and Denmark. Meanwhile, Germany, Italy and the UK all saw mildly deteriorating cost to output ratios due to stronger declines in output value (11, 11, and 15 per cent respectively). In contrast, Ireland saw output value decline by only 7 percent.

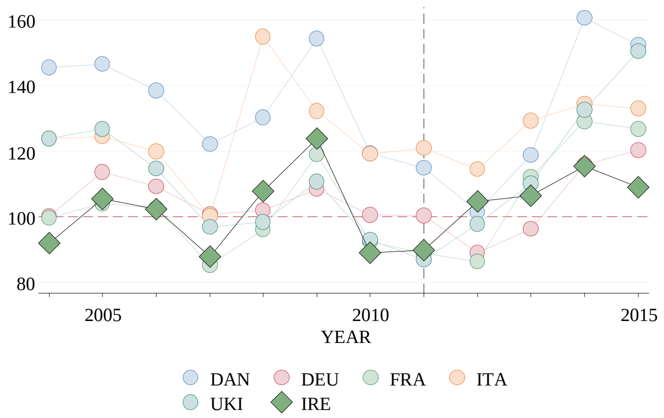
Figure 21: Costs as a % of total output (incl. allocated decoupled payments) for selected European 'Specialist cereals' farms (2013 actual, 2014-2015 estimated)



Analysis of indicator trends

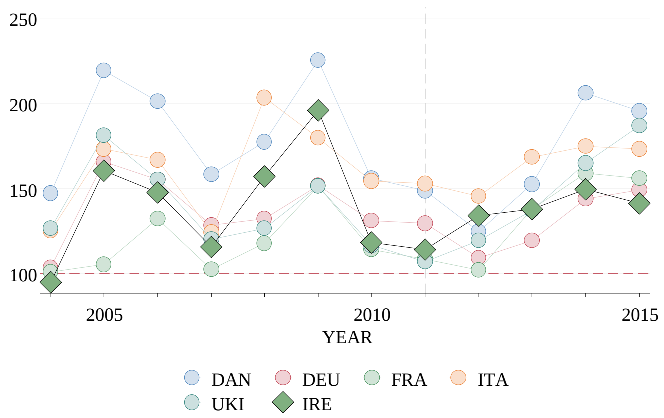
This section presents an analysis of trends in the measures of competitive performance described for the specialist cereals enterprise.

Figure 22: Trends in costs:output ratios (incl. of allocated payments) on selected european 'Specialist cereals' farms



Dashed vertical line marks 2011 change to FADN sampling thresholds.
Dashed horizontal line marks break even point (0 economic profit)

Figure 23: Trends in costs:output ratios (excl. of allocated payments) on selected european 'Specialist cereals' farms



Dashed vertical line marks 2011 change to FADN sampling thresholds.
Dashed horizontal line marks break even point (0 economic profit)

Figure 22 and 23 show Ireland has consistently had some of the lower total economic cost to output ratios observed over the time period 2004 - 2015.

Removing allocated decoupled direct payments from the denominator in Figure 23 had the largest effect in 2004; the cost ratios worsened considerably relative to Figure 22. However, differences between the two measures were much less pronounced from 2005 onwards.

4.3.4 Overall assessment for the cereals sector

On the basis of partial productivity measures, the competitive potential of the Irish cereals sector was moderately strong. Ireland had the highest average wheat yield during the period, and land productivity levels were similar to the average. On the other hand, labour productivity was second to last due to a higher degree of labour intensity and smaller scale of production relative to competing MS.

Sources of competitive potential were traced back to advantages in several of cost categories. Again, depreciation was quite low relative to competing MS, but this was to some extent beyond the farmer's control. Unlike in other sectors, contract work made up a significant proportion of total costs, and this led a lower wage bill for hired labour. Relatively minor interest charges were indicative of low levels of debt. Advantages were also seen in energy, other crop specific costs (e.g. marketing, storage, purchase of standing crops, intra-year land rental), and other direct inputs (e.g. water charges, insurance, accountant's fees). The overall pattern points to a lower level of mechanisation, and a tendency to outsource to contractors. On the other hand, relatively higher fertiliser and crop protection costs were witnessed in Ireland relative to some of the other countries examined.

The short run competitive performance of Irish cereal farms was strong. Cash cost ratios showed that, on average, Irish cereal farms earned financial profits even excluding allocated payments. Unlike the beef and sheep sectors, the competitive standing of Irish cereal farms largely held up in the long run analysis of total economic costs due to more typical opportunity costs to output ratios relative to other MS.

The results remain broadly consistent with findings from previous works. Boyle (2002) and Thorne (2004) both reported partial productivity indicators for Ireland which were higher for cereals than for other commodities analysed. As was found in Thorne and Kelly (2003), and again in Thorne (2004), there was no consistent time trend observed in the relative indices of partial productivity for Irish cereal farms. Boyle (2002) also found Irish cereal producers were strong competitor when costs were compared with France, Denmark and the UK.

Lastly, long run trends in economic cost to output ratios were positive. Prior to 2010, the ratios were somewhat volatile, but have since settled substantially. Trends for all MS have converged in recent years. However, despite a good ranking amongst EU competitors, Irish cereal farms still observed economic losses, so pressure for farm exit also exists in this sector.

4.4. *Indicators of Competitiveness of Specialist Sheep Producers in Ireland and Selected EU Member States (2005 – 2015)*

4.4.1 Introduction

This section of the paper examines the costs and returns associated with sheep production in Ireland and some comparable EU member states. The EU countries chosen for comparison were the UK and France. The UK was selected because, like Ireland, it exports a high proportion of its sheep meat. France was selected due to it being a major sheep producer and importing country within the EU. Together these countries accounted for over 62% of total EU slaughtering in 2015 (Eurostat).[xxxi]

The farm classification type used for analysis was Farm Type 441 – 'specialist sheep'. This farm type, by definition, is characterised by the standard output for the sheep enterprise on the farm accounting for greater than two-thirds of the whole farm standard output. As sheep production consists of a wide variety of different production systems, farm type 441 defined by FADN, could be considered a very generic definition of farming systems, making comparisons between countries difficult. Based on this premise Connolly (1996) in his analysis of the competitiveness of Irish sheep production, confined his research to lowland sheep 'as variation in mountain and hill sheep systems between countries would render such comparisons meaningless' (p.3). However, Boyle (2002), in his analysis of sheep competitiveness, used farm type 44 – 'specialist sheep, goats and other grazing livestock', which is an even more generic farm type than farm type 441. Furthermore, based on the definition of competitiveness adopted for this analysis, which measures how a country can profitably maintain or increase market share, and does not make a differentiation between the resources employed to achieve competitive position, farm type 441 is considered an appropriate unit of analysis for this research. In addition, the variation in the quality of resources employed between lowland and hill and mountain sheep systems is accounted for, to some extent, by the valuation of land in the analysis. It is assumed that the rental value of land, which is used as a base for the valuation of owned resources, reflects the quality of the land resource employed on the farm.

One area where the heterogeneity of the farm type under analysis may impede the comparability of results is the link between indicators of partial productivity and cost competitiveness. When comparing indicators of partial productivity across countries where production systems also vary, there is a danger of not comparing like with like. For example, the stocking rate per hectare on hill and mountain sheep farms will tend to be lower than lowland sheep farms. Therefore, using such indicators of partial productivity as an indication of technical performance or underperformance could be misleading given the fact that costs and returns associated with these production systems are not taken into account. Consequently, the interpretation of the partial productivity indicators outlined for the sheep production systems examined must be treated with caution.

4.4.2 Measurement and methods

Measures of competitive performance and competitive potential for the sheep sector are presented in this section of the report. Three separate measures of cost comparisons were used for comparing the competitiveness of sheep production in the selected member states, these are:

- total costs as a percentage of:
    - total value of sheep output plus allocated decoupled direct payments,
    - the market based value of the output,
- margin over total costs (€) per sheep LU, and
- margin over total costs (€) per forage hectare.

Table 7 Definitions of output for the Specialist Sheep enterprise using FADN data

MARKET-BASED OUTPUT	TOTAL OUTPUT
Sheep ratio * SE230 [Sheep & goats] +	Market-based output +
SE245 [Ewes' & goats' milk] +	**UAA_{SD} ratio** * **LU_T ratio** *
Sheep ratio* SE618 [Subsidies sheep & goats] +	(SE621 [Environ. subsidies] +
LU_T ratio * SE619 [Other livestock subs] +	SE622 [LFA subsidies] +
SO_{PRDO} ratio *	SE630 [Decoupled payments])
(SE625 [Subs on intermediate consumption] +	
SE626 [Subs on external factors])	

where "**Sheep ratio**" is

(**D40AV** [Ewes] +
D41AV [Other sheep])
/
(**D38AV** [Goat (breeding females)] +
D39AV [Other goats] +
D40AV + **D41AV** [see above])

D38AV to **D41AV** are **estimated** from FSS variables via the following FSS codes

D38AV = C_3_2_1_HEADS / C_3_2_1_HOLD
D39AV = C_3_2_99_HEADS / C_3_2_99_HOLD
D40AV = C_3_1_1_HEADS / C_3_1_1_HOLD
D41AV = C_3_1_99_HEADS / C_3_1_99_HOLD

"**LU_T ratio**" is

(SE095 [Sheep & Goats] * **Sheep ratio**) /
SE080 [Total livestock units]

"**SO_{PRDO} ratio**" is

((**Sheep ratio** * SE230 [Sheep & goats]) + SE245 [Ewes' & goats' milk]) / SE131 [Total output]

"**UAA_{SD} ratio**" is

SE120D [***S***tocking density ***d***enominator] / SE025 [Total UAA]

The indicators of partial productivity used to analyse the competitive potential of the sheep sector were:

- stocking rate (sheep LU/ forage ha),
- land productivity – sheep production output plus allocated decoupled subsides (€) per forage hectare (ha), and
- labour productivity – sheep production output plus allocated decoupled subsidies (€) per AWU.

The remainder of this subsection gives details of (i) cost allocation methods and (ii) the updating procedure as specifically applied to this sector.

Enterprise cost allocation method

To calculate the costs per forage hectare for sheep production it was necessary to allocate forage hectares to the sheep enterprise of the farms. This allocation was based on the number of sheep LU in the total of grazing LU on the whole farm. As was the case with the previous enterprises examined, it was also necessary to allocate costs to the sheep enterprise to calculate the measures outlined above. This allocation method is outlined in Table 8 below. It shows that the allocation methods used for the sheep enterprise are essentially the same as the methods adopted for the dairy and beef enterprises.

Table 8 Allocation Keys used to define costs associated with sheep production on 'specialist sheep farms', using FADN data

COST ITEMS	ALLOCATION KEYS
Purchased feed for grazing livestock (concentrates & coarse fodder) = (Feed for grazing livestock – Feed for grazing livestock home-grown)	% of 'sheep' livestock units in the total of grazing livestock units
Feed for grazing livestock home-grown	% of 'sheep' livestock units in the total of livestock units
Specific forage costs	% of 'sheep' livestock units in the total of grazing livestock units x
Seeds	% area of fodder crops , other forage crops and temporary grass in the total UAA - after exclusion of fallow lands, meadows and rough grazing
Fertilisers	% area of fodder crops, other forage crops, temporary grass and meadows in the total UAA - after exclusion of fallow lands and rough grazing.
Crop protection	% area of fodder crops and other forage crops in the total UAA - after exclusion of fallow lands, temporary grass, meadows and rough grazing.
Other specific livestock costs , imputed charges for breeding and non-breeding livestock	% of 'sheep' livestock units in the total of livestock units
Owned land	% of 'sheep livestock units in the total of grazing livestock units
All other costs: - all farming overheads - all external factor costs - Imputed charges for non-livestock capital and labour	% of sheep output & allocated direct payments in the total output & subsidies

Updating procedure

This subsection details the procedure used to estimate, for the most recent years, the sheep sector competitiveness measures described above. The procedure for this sector differed slightly from that which was used for the dairy sector. Furthermore, the same alterations were applicable to the cereals and beef sectors, i.e. the output value was updated directly via a price index[xxxii]. The method was fully described in section 4.2.2.

4.4.3 Results

The results for sheep production are presented in four sections: (i) partial productivity indicators, (ii) comparative costs of production, (iii) estimates for recent years, and (iv) analysis of long run trends.

Comparison of partial productivity indicators on EU sheep farms

Figure 24 shows the partial productivity indicators for EU sheep farms identified above. The results presented here for each of the countries were the averages across the years 2009 to 2013 and which have been indexed relative to Ireland. The absolute levels of the indicators, for each of the years and for each of the countries are shown in Appendix XIV[xxxiii].

Figure 24: Partial productivity measures for selected European 'Specialist sheep' farms (2009 – 2013)

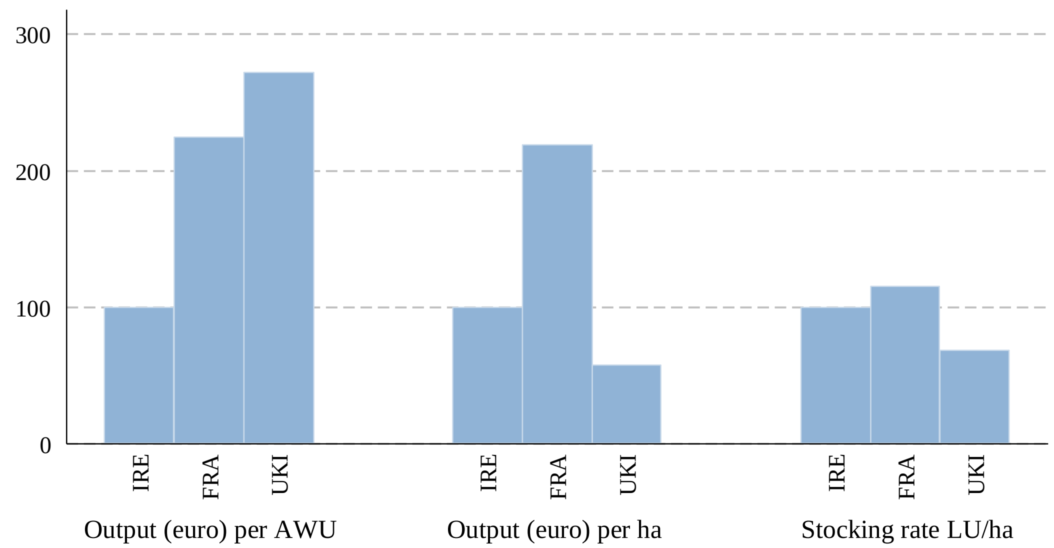


Figure 24 indicates that Ireland and the UK had relatively low stocking rates and land productivity compared to France over the period 2009 to 2013, but Irish sheep farms did have higher technical performance based on these two measures compared to the UK.

The indicators suggested a mixed competitive potential for Ireland, with positives with respect to stocking and land productivity, but also a clear negative with respect to labour productivity. These results are similar to those recorded in Boyle (2002) and Thorne (2004). Furthermore, the data showed a trend of increased competitiveness relative to the UK in terms of both stocking and land productivity. No clear trends emerge from comparing labour productivity or in a comparison with France for any measure over the time period examined.

An important caveat should be emphasised here; strong inferences are not justified when comparing non-homogeneous farm systems on the basis of partial productivity indicators alone. For example, the high stocking rates and land productivity levels in France were linked with the intensive indoor rearing of sheep, for the purposes of milk production, which is common in France. So differences in the measures arise not from innovation or efficiency in the production of meat and wool, but rather from a demand for a complementary product (sheep's milk) in local markets.

Comparison of costs and returns in EU sheep farms

The first measure of comparative costs of production for sheep farms analysed was costs as a percentage of total sheep production output and allocated decoupled direct payments. Figure 25 shows the five year average cost to output ratio results for sheep production in each of the selected countries. The individual cost components for each of the countries are outlined in Appendix XV.

Figure 25: Costs as a % of total output (incl. of allocated decoupled payments) for selected European 'Specialist sheep' farms (2009 – 2013)

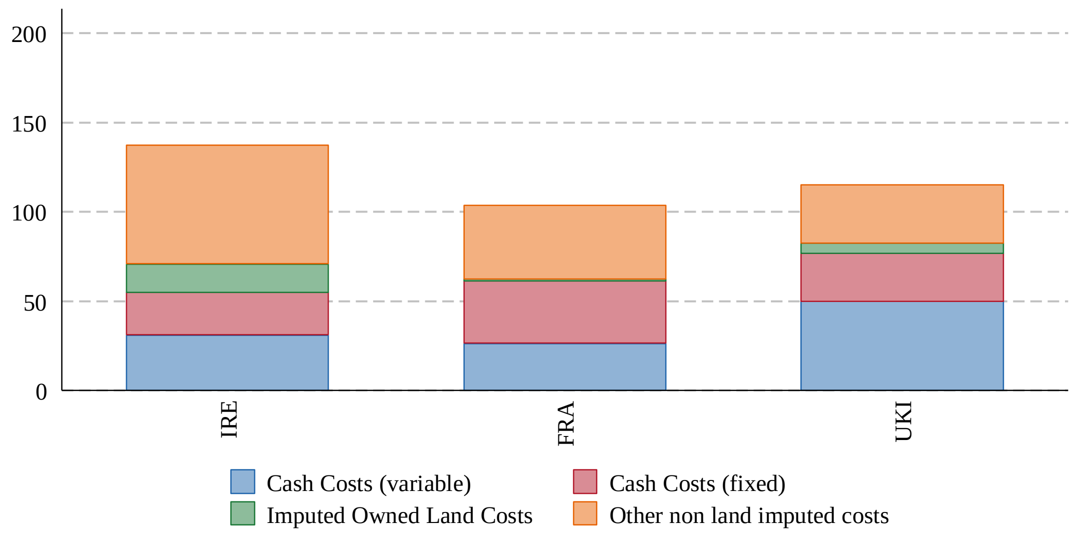


Figure 25 shows that Irish sheep producers had the lowest cash costs as a percent of total output, followed by France, and then the UK, which had the highest cash cost structure over the period 2009 to 2013. Appendix XV showed that Irish producers, in particular, had relatively low expenditure for other direct inputs, purchased feedstuffs, depreciation, land rent and interest. However, when imputed charges for owned resources were taken into account to compare economic costs, the ranking between countries changed considerably. Ireland appeared to have the highest costs as a per cent of output, while France had the lowest costs. However, all three countries had economic costs in excess of total output value of the sheep enterprise, including an allocation from decoupled direct payments. This was true even when imputed charges for owned land were excluded from the analysis.

A 'competitiveness index' was calculated as discussed in section 3.2. The index revealed that the Irish ratio was 16 per cent higher than the average for all countries when total economic costs were considered, it was only 11 per cent higher than the average when imputed land charges were excluded from the analysis. The index showed no significant trend for Ireland during the period 2009 to 2013.

As with other sectors, it was considered important to replicate Boyle's (2002) market-based analysis for the sheep sector. Figure 26 below shows the average costs as a percentage of market based output for 2009 to 2013.

Figure 26: Costs as a % of market output (excl. of allocated decoupled direct payments) for selected European 'Specialist sheep' farms (2009 – 2013)

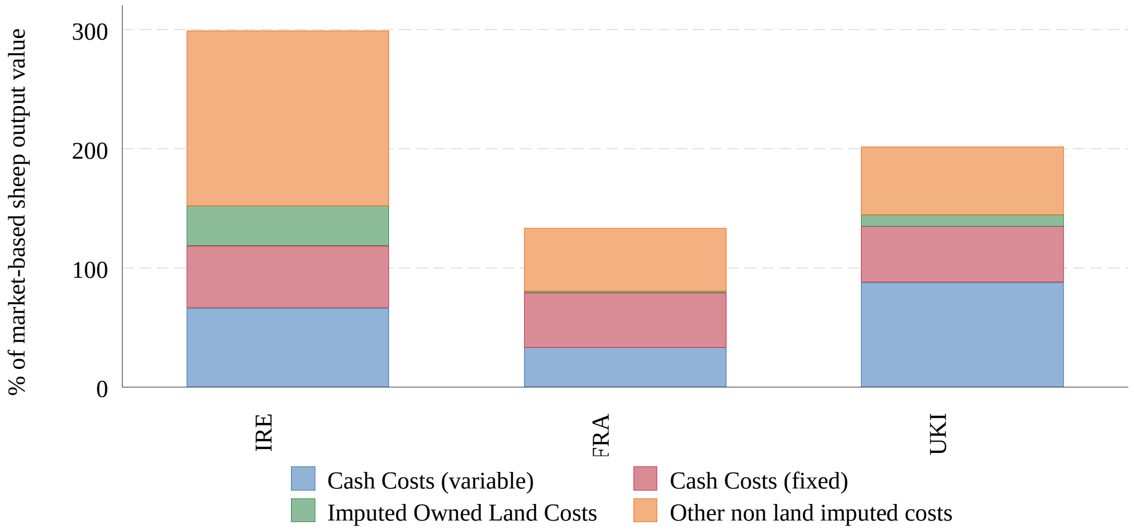
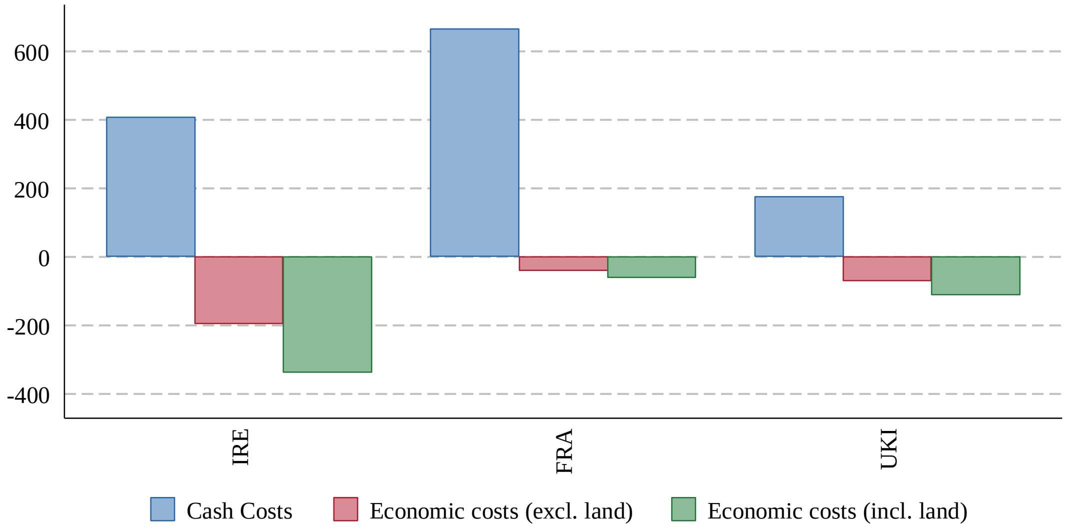


Figure 26 shows that the ranking between the countries changed when costs were expressed as a percentage of market based output instead of relative to total output inclusive of allocated decoupled payments. Irish sheep producers did not remain the lowest cash cost producers. Using this measure France now has the lowest cash costs as a percent of market based output, with Ireland in second place and the UK appearing as the highest cash cost producer (as a percent of market based output). However, the ranking between countries on a total economic cost basis did not change, with Ireland still appearing as the highest cost producer.

The second measure of cost competitiveness employed in the analysis was margin over costs per sheep LU. Figure 27 shows the average of these results over the period for all countries examined. Appendix XVI outlines the cost items and revenue sheep LU for each of the countries.

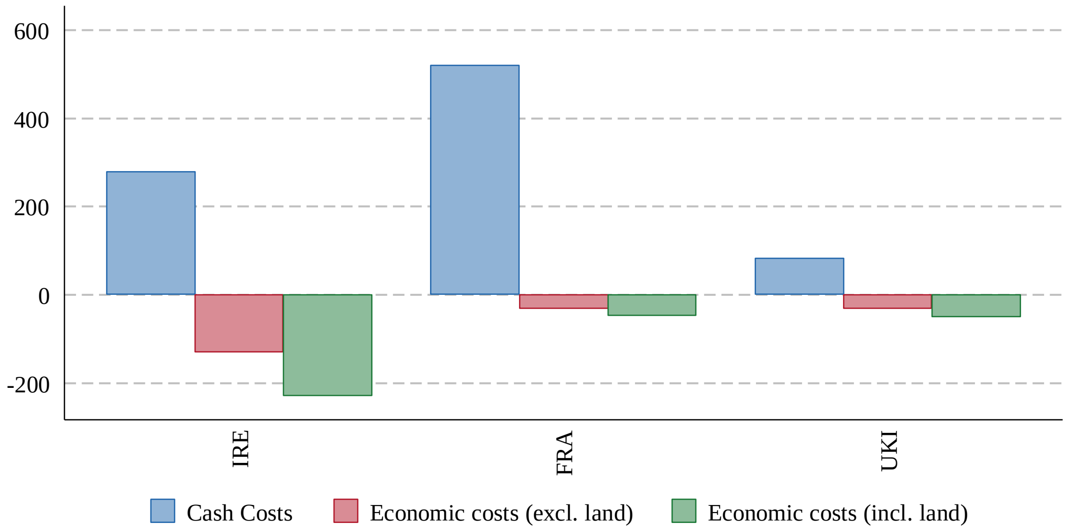
Figure 27: Margin over costs (incl. of allocated decoupled payments) per sheep livestock unit (LU) for selected European 'Specialist sheep' farms (2009 – 2013)



Margin over costs shown in Figure 27 showed a similar ranking between countries to that shown in Figure 25 above. French sheep producers had the highest margin over cash costs per sheep LU, followed by Ireland, and then the UK, which had the lowest margin over cash costs. Again, the analysis showed that Ireland's competitive advantage dissipated when economic costs were taken into consideration.

The third measure of cost competitiveness for sheep production used in the analysis was cash and economic costs per allocated forage hectare.[xxxiv] Figure 28 shows the average of these results for the period for all countries examined. Appendix XVII outlines the cost, revenue and margin per hectare for each of the countries.

Figure 28: Margin over costs (incl. of allocated payments) per hectare for selected European 'Specialist sheep' farms (2009 – 2013)



The per hectare figures were consistent with the results presented for the previous two measures of cost competitiveness. Margin over cash costs per hectare was highest France, followed by Ireland, and again the UK had the lowest margin over cash costs. When total economic costs were considered Ireland again had the lowest margin, followed by the UK and France.

Estimation of indicators for EU sheep farms in most recent years

The estimation procedure described above was applied to approximate results for the years 2014 and 2015. These results are illustrated in Figure 29 and Figure 30. Both figures show costs ratios that were relatively stable in France and a stronger improvement in Ireland and the UK. Figure 29 also revealed that most of the Irish improvement stemmed from changes in other non-land imputed costs

Figure 29: Costs as a % of output (incl. of allocated payments) for selected European 'Specialist sheep' farms (2013 actual, 2014-2015 estimated)

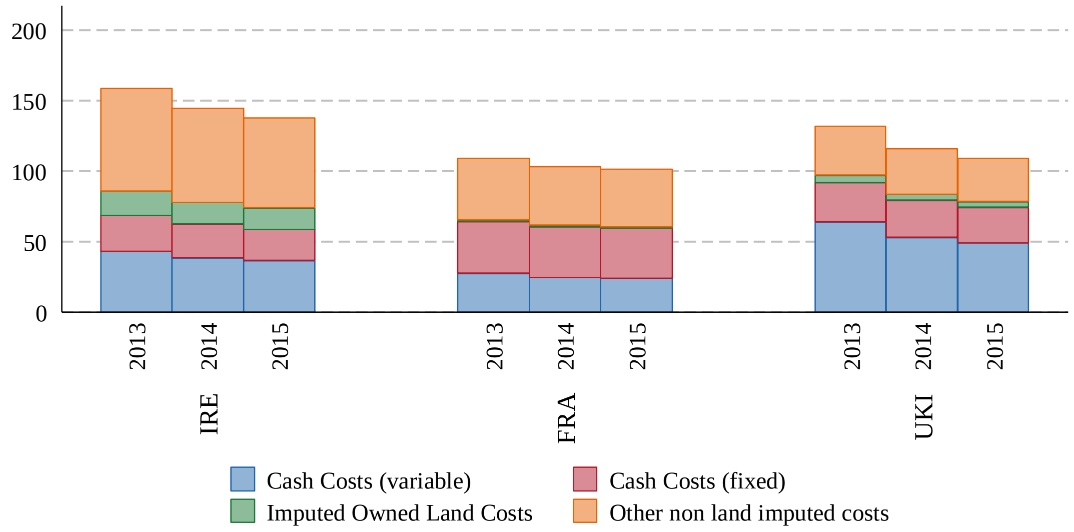


Figure 30: Costs as a % of market output (excl. of allocated payments) for selected European 'Specialist sheep' farms (2013 actual, 2014-2015 estimated)

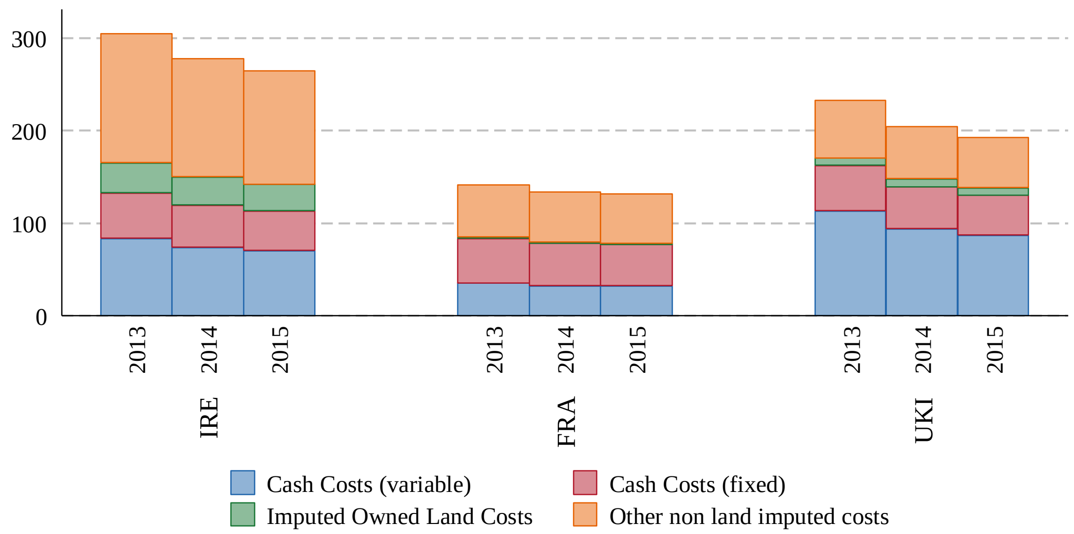


Figure 30 showed the same pattern as Figure 29. The effect of removing subsidies was to change the level of the market-based indicator, as can be seen through the scale on the vertical axis. However, beyond this the figure provides little additional information relative to Figure 29.

Analysis of indicator trends

This section presents an analysis of trends in the measures of competitive performance described for the specialist sheep enterprise. Like the beef sector, the market-based measure provided a very different picture of Irish competitiveness than the short-run measure which includes a portion of decoupled subsidies.

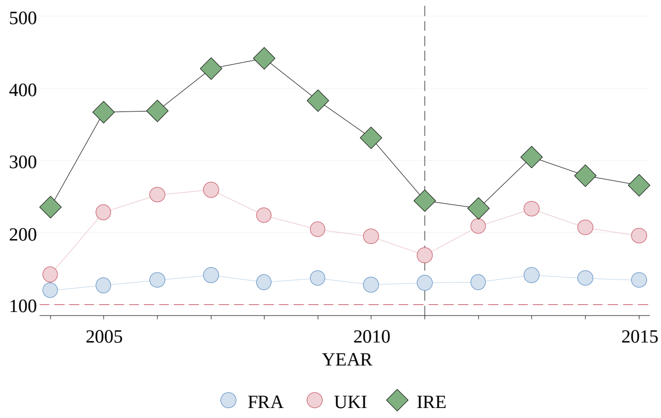
Figure 31 illustrated a sheep sector which was consistently uncompetitive relative to France and the UK. Unlike the other sectors, the cost ratio actually improved in 2009; output value fell but total economic costs fell by more due to a reduction in allocated family labour. Output value dropped by 20 per cent in 2013 and this led to a spike in the cost ratio in that year. The series became more volatile over the period, and there was no obvious long-term trend in the indicator. The indicator was quite stable for France, and it always showed this MS as the most competitive. In the case of the UK, an improvement in the cost ratio between 2006 and 2011 reversed itself between 2011 and 2015.

Figure 31: Trends in costs:output ratios (incl. of allocated payments) on selected european 'Specialist sheep' farms

Dashed horizontal line marks break even point (0 economic profit)
Dashed vertical line marks 2011 change to FADN sampling thresholds.

Figure 32 showed that the removal of decoupled subsidies from the market-based indicator had significant effects on the interpretation of Irish sheep sector competitiveness. As with the other sectors, the initial values of the cost ratios in 2004 were at a much higher level. This was obvious for Ireland, but it was also true to a lesser extent for France and the UK where the change in scale on the vertical axis hides the effects.

Figure 32: Trends in costs:output ratios (excl. of allocated payments) on selected european 'Specialist sheep' farms



Dashed vertical line marks 2011 change to FADN sampling thresholds.
Dashed horizontal line marks break even point (0 economic profit)

4.4.4 Overall assessment for the sheep sector

Ireland's competitive potential, as measured by partial productivity indicators was not as negative as witnessed in some of the other sectors. Ireland outperformed the UK in both stocking rate and land productivity, but the UK has a substantially higher average product of labour. France outperformed Ireland in all three measures by large margins. However, in comparison to Thorne's (2004) results, Ireland has closed the productivity gap with France somewhat. Output per forage hectare in France (as outlined in Thorne, 2004) was previously 250 per cent of the Irish level (now 217 per cent), and France's stocking rate was 125 per cent of the level in Ireland (now 115 per cent). The UK has kept pace with Ireland in terms of changes in these measures.

Additional sources of competitive potential were similar to the other livestock sectors. In particular, costs for seeds and plants, purchased feedstuffs, and depreciation were relatively low on Irish sheep farms over the period. Again, this flows from a relatively extensive and grass-based production system which cannot be easily replicated in other parts of Europe, and so this continues to constitute a competitive advantage.

The Irish sheep producer's competitive performance compared well with the UK and France when only cash costs were taken into account. However, this short run analysis also showed that sheep farms were loss making in accounting terms when allocated decoupled payments were excluded. This indicated a high level of dependence on supplementary payments; over the period Irish sheep producers relied more heavily on subsidies to supplement the revenue of the sheep enterprise, compared to the UK and France. Consequently, as the CAP is further liberalised it is likely that production on Irish sheep farms will be subject to greater competitive pressures.

Furthermore, when economic costs were taken into consideration, the competitive position of Irish sheep farms was the lowest compared to the UK and France. Imputed charges for owned land and family labour were particularly high in Ireland. The imputed charge for labour on Irish sheep farms was double the charge experienced in the UK and France when costs were expressed as a percentage of output.

5. The Competitive Performance of Irish Agriculture outside the EU

The preceding chapter examined the issue of the competitiveness of the Irish farm sector in an EU context. In this chapter we go beyond the EU to look at the competitiveness of the Irish dairy and beef sectors in a wider global context.

The consistent approach to the examination of competitiveness in the EU was made possible by the existence of the FADN dataset which extends over a long coverage period for MS which are long term members of the EU. However, as this is an EU complied dataset, it does not provide, data for countries beyond the EU, hence other compatible data sources were consulted. The IFCN[xxxv] and Agri benchmark networks provide cost of production and return data which is used as the main source of reference for the dairy and beef analysis in this chapter.

5.1. Indicators of Competitiveness of Specialist Milk Producers in Ireland in a Global Context

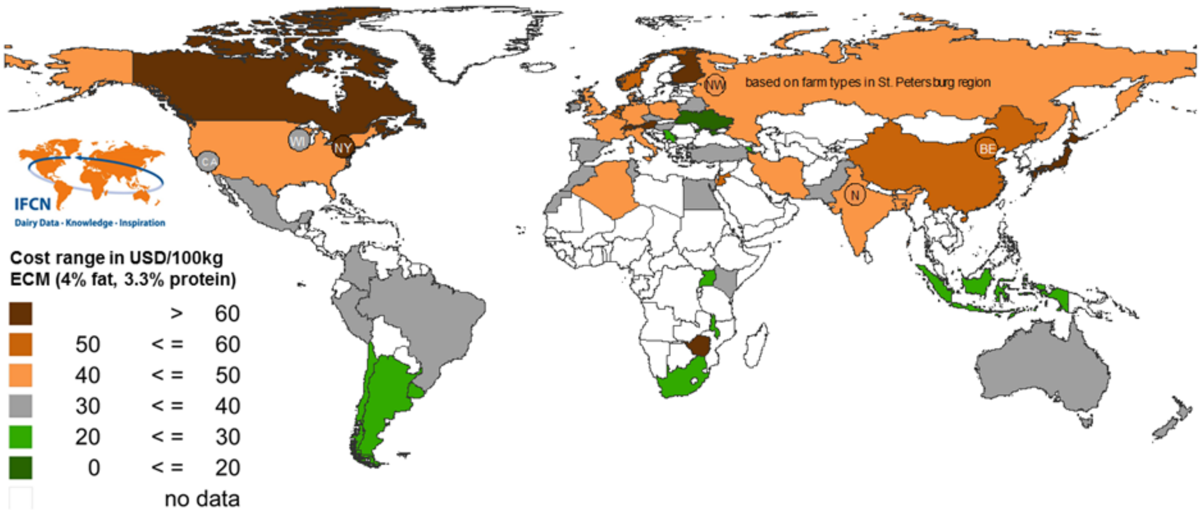
Given that the EU's competitors have increased their share of global dairy trade in recent times and with the elimination of the EU milk quota, the current competitive position of the Irish dairy sector in a global context requires consideration.

This section summarises the key findings of the International Farm Comparisons Network (IFCN) for dairy in 2015 (Hemme at al., 2016). Among the many challenges in producing these comparisons is to provide them in a common currency, namely the USD. Since the value of other currencies against the USD changes through time (and to differing degrees) this has an unavoidable impact on the comparison methodology. For ease of reference a euro per litre comparison is also provided..

Milk production worldwide is carried out on around 121 million dairy farms (Hemme *et al.*, 2016, *op. cit*) which stock 350 million milking cows and buffaloes. This means that the world's average farmer keeps just 3 milk animals and produces 17 litres of milk per day per farm. Of course, such global averages conceal a lot of diversity in dairy farm scale across the world. On the one hand there are countries where there are less than 3 cows per farm and on the other hand in some countries dairy farms are much bigger and keep over 1000 cows per farm.

Furthermore, across the world production systems also differ significantly in terms of farm size, housing, milking and feeding systems. This chapter puts the Irish dairy farming system into a global context by focusing on how the typical Irish dairy farm compares internationally in terms of costs of production and returns with farms in other countries. For the purposes of the exercise the typical average Irish dairy farm has 77 cows.

Figure 33: Cost of milk production 2015 by world region in average sized farms[xxxvi]



ECM correction: As dairy farms around the world produce milk of very different fat/protein contents, the volume of milk produced per farm is standardised using the energy correct milk (ECM) approach to standardise milk volumes to 4% fat and 3.3% protein. This is essential for meaningful milk price comparisons.

Cost indicator: Costs of milk production include all costs from the profit & loss account of the farm. From this cost definition, the non-milk returns from sales of cull cows, heifers, calves, manure, etc. and also returns from coupled direct payments have been deducted. Furthermore, also the opportunity costs for own labour, land and capital are included. Importantly, the scope of this cost definition extends beyond the typical production cost definition that is often cited with reference to Ireland and other EU member states. For creation of the world cost of production map, the average size farm from each country was used to represent that country.(e.g. a 77 cow farm in Ireland)

The annual IFCN comparison of typical farms around the world has been on-going since the year 2000. The costs and returns outlined in Figure 33 relate to what is called 'typical farms' in each region of the world in 2015. The average cost of milk production in 2015 over all countries analysed was 41 USD/100 kg milk (approximately €0.38 per litre). Cost of milk production ranged from 9 USD per 100 kg milk (approximately €0.08 per litre) in extensive farming systems in Uganda to 106 USD (approximately €0.99 per litre) for an average sized farm in Switzerland. The results can be summarised as follows:

- Low cost regions: Based on the average sized farms, three low cost regions have been identified: a) Argentina, Peru, Chile and Uruguay b) Central and Eastern Africa c) some farms in Central and

Eastern Europe as well as Indonesia. Here costs were often less than 30 USD per 100kg (€.28 per litre) of milk.

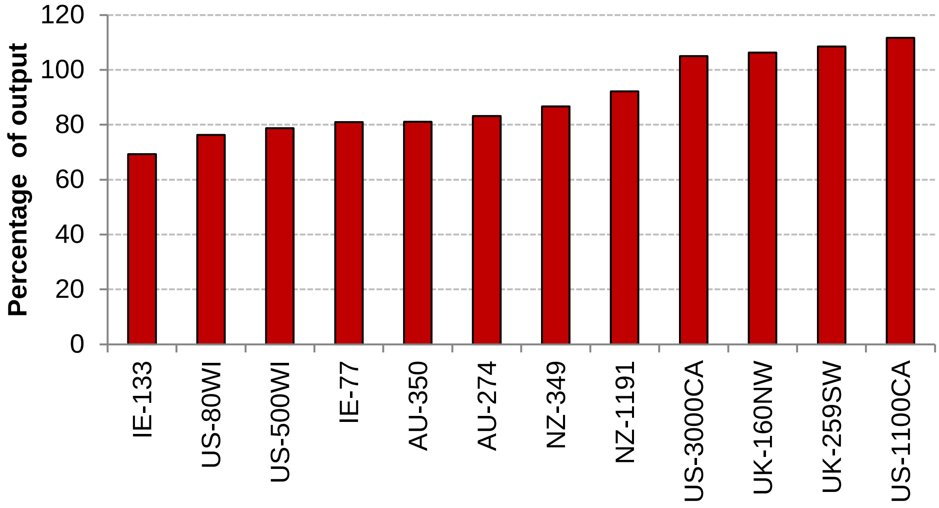
- Western Europe: The leading farms in Western Europe had costs ranging from 40 – 55 USD per 100kg (€ 0.37 to €.51 per litre). The costs of milk production for the average size farm in Ireland in 2015 was around 35$ per 100 kg (€0.33 per litre) of milk.
- The US: The small farms in Wisconsin and New York had a cost of between 45 and 60 USD (€0.42 and €.56 per litre) respectively. While, the large farm in California had the lowest cost of about 35 USD (€0.33 per litre).
- Oceania: The cost level in Oceania was very homogeneous at about 32 USD (€0.28 per litre).
- In summary: On average milk production costs for the year 2015 were lower than in 2014. As the milk price decreased to a larger extent than production costs, farm economics were difficult for many dairy farmers in the world in 2015.

In 2015, milk production costs (in national currency terms) continued to increase on most dairy farms in the world following a rise in price of major input items (feed, labour and land) in many countries. But contrary to the year before, these higher input costs were not counteracted by a higher milk price. Instead the milk price either remained stable or even decreased in many countries leading to lower profitability worldwide.

5.1.1 Cost of milk production as a percent of output

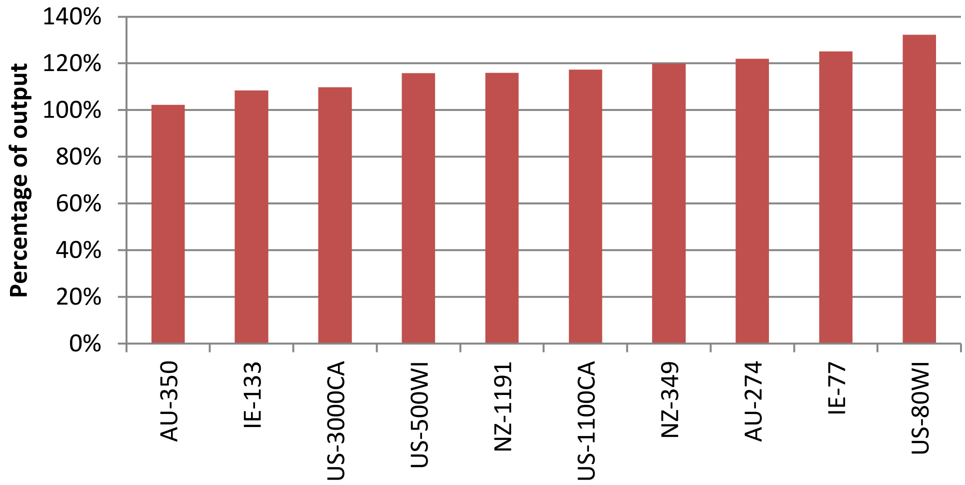
Similar to the Eurozone comparison in the previous chapter, cash costs were also expressed as a percent of returns, as a leading indicator of competitiveness. Figure 34 and Figure 35 outline the cash and economic cost position of a range of comparator countries, with the horizontal axis representing representative farm types of varying sizes in different regions. Figure 34 shows that both the average and the larger size Irish dairy farms fare quite well, the larger type farm being the most competitive out of all the countries examined in 2015. There are a variety of outcomes across the regions examined, with the US worthy of a specific mention, with Wisconsin average and large farms achieving similar ratios as Ireland, but the feedlot system in California is in loss-making position in 2015.

Figure 34: Cash costs as a percent of output value (2015)



The set of comparative results based on IFCN data also includes measures of total cash costs and imputed charges (opportunity costs for own land, labour and other non land capital). The combination of cash costs and opportunity costs for owned factors of production equate to total economic costs of the milk enterprise. Hence the following inter-country comparisons shown in Figure 35 provides further evidence as to the relative competitive position of Irish dairying beyond the EU.

Figure 35: Economic costs as a percent of output value (2015)



Note: AU – Australia, IE – Ireland, NZ – New Zealand, WI – Wisconsin, CA – California,

Figure 35 shows that Ireland's comparative position deteriorated very substantially when total economic costs were compared outside of the EU. The average size typical Irish dairy farm (IE-77) had one of the highest total economic costs as a percent of milk output in 2015, with only the smaller typical farms in Wisconsin experiencing higher total economic costs as a percent of output. However the larger size typical Irish dairy farm

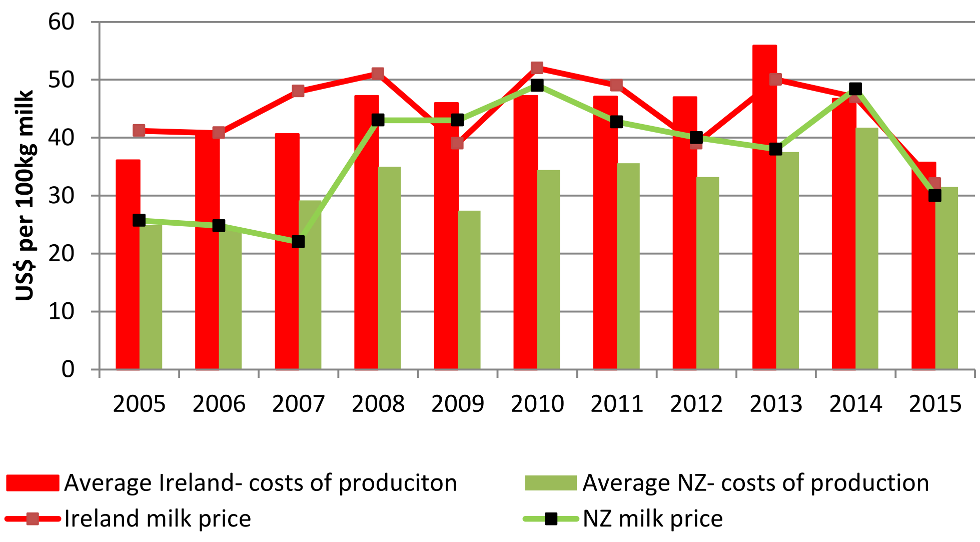
(IE-133) did exhibit substantially lower total economic costs than the average size Irish farm, appearing about to have the second lowest total economic cost ratio amongst the typical farms examined.

5.1.2 Cost of milk production developments 2005 – 2015

As the IFCN has been collecting and observing trends in costs and returns of milk production since 2000, a time series analysis of the data is possible. Charting the data for the period 2005 – 2015 provides a picture of extreme volatility in milk and feed prices in particular. Costs of milk production have increased in all countries through much of the period under examination. This is especially the case for Poland, China, and New Zealand (NZ) where the value of the national currency has significantly strengthened relative to the USD and farm input prices for land, feed, and labour have increased significantly.

It is interesting from an Irish perspective to examine the position in NZ, as it, like Ireland has an extreme dairy export orientation. The results shown in Figure 36 reflect the situation of a typical average sized dairy farm from Ireland and NZ. In the year 2015, this NZ farm type had 349 cows and represented about 45 per cent of the farms and 68 per cent of the total dairy cow population in NZ. We compare this NZ farm type against the average sized Irish dairy farm, with 77 dairy cows in 2015.

Figure 36: Total economic costs of milk production 2005 – 2015 in Ireland and New Zealand for a typical average size dairy farm



In USD terms, milk production costs increased by similar percentages in both Ireland and NZ over the past decade. However, the source of the increase in both regions can be attributed to different reasons. In NZ the rise in costs in USD terms can be explained by rising prices for land and labour in particular over the last ten years. The second driver in NZ was the appreciation of the NZD to the USD for most of the decade. (An appreciating national currency against the USD means increasing costs measured in USD terms.)

However, in Ireland the increasing costs over the period 2005 to 2015 can be attributed to a range of factors, most notably fertiliser, feed, debt servicing and replacement costs. In terms of exchange rates, the Euro has generally been weaker against the USD since the Euro crisis began in 2009. So without the already mentioned inflation in individual costs items, the exchange rate movements on their own should have had a depressing effect on Irish costs in USD terms after 2009.

Both Ireland and NZ exhibited reduction in costs and milk prices in 2015, which can be attributed to currency depreciations against the USD, along with increases in scale in Ireland.

When measuring competitiveness it is vital that costs are not measured in isolation and returns should also be examined. Here the convergence of NZ milk prices over time towards the Irish price is noticeable. It is also apparent (Figure 36) that in 2015 both the average Irish and NZ dairy farmer had total costs of milk production which were higher than average milk returns.

5.1.3 Summary: Competitiveness of Specialist Milk Producers in Ireland in a Global Context

In summary, it appears that the competitive position for Irish dairy farms outside the EU was very positive when cash costs were considered in isolation from imputed charges for owned resources. Based on data from the IFCN, the larger representative Irish dairy farm had the lowest cash cost to output ratio amongst the key international milk producing regions examined, namely, the US, NZ and Australia. This result is consistent with previous research by Thorne and Fingleton (2006) and Donnellan et al., (2011).

However, as the opportunity cost of owned resources are not included in this calculation this indication of future competitiveness can only be considered to be valid in the short to medium term. In the longer term adjustment within the sectors will be a reality. Hence, total economic costs, which include imputed charges for owned resources must be considered to gauge the longer term ability of Irish dairy farmers to compete on a global scale.

When economic costs are considered, the competitive ranking for the Irish dairy sector, for the average size farm in particular, slipped relative to the other countries examined. As was similarly concluded in chapter 4, for competitiveness within the EU, this finding could also be considered as a warning signal for the future competitive performance for the average sized Irish dairy farm in a global environment. .However, based on the analysis in this chapter, the ability of the larger Irish dairy farms to compete in the longer term in a global context was affirmed. Furthermore, as Irish dairy farming transforms to larger scale production in a no quota environment, the Irish milk sector's competitive position will be strengthened and be better able to cope with a cost/price squeeze in the future.

5.2. *Indicators of Competitiveness of Specialist Beef Producers in Ireland and Selected non- EU Countries*

In relation to international competitiveness of the Irish beef sector, whilst the majority of Irish beef exports are to EU markets which makes the use of a harmonised dataset like FADN very important, the prospect of Brexit and possible future free trade agreements, comparisons with producers in non-EU countries is increasingly important.

The agri benchmark network[xxxvii] collects and publishes data on the costs and returns from beef production at the farm level for typical beef farms from around the world. This section summarises the key research findings of the agri benchmark Beef Network for 2015. Teagasc is the Irish partner in this international network and provides data on typical Irish beef and sheep farms based on information collected in the Teagasc National Farm Survey (NFS).

The results presented here place the typical Irish beef farming system into a global context by focusing on how two typical Irish beef farms compare internationally in terms of costs of production and returns with typical beef farms in other countries. For the purposes of the exercise the typical Irish beef finisher has 40 finishers, while the typical Irish cow-calf (single suckling) farm has 30 beef cows. The annual comparison of typical farms from around the world has been on-going since 1997, data are collected using standardized methods so as to deliver reliable and comparable results.

Among the many challenges in producing international cost and profitability comparisons is to provide them in a common currency. In all agri benchmark reports costs and revenues are reported in US dollars (USD). Since the value of other currencies against the USD changes through time (and to differing degrees) this has an unavoidable impact on the comparison results.

Readers should be mindful that averages often conceal a lot of diversity in farm scales across the world. On the one hand there are countries where typically there are only 2 or 3 livestock per farm while on the other hand in some countries typical farms are feed lots which are much bigger operations with up to and over 6,000 finishers per farm. In the figures as presented in this section the number beside each farm indicates the number of livestock, on average that are present on the farm.

5.2.1 *Beef Finishing: cost, returns and profitability outside the EU*

When measuring competitiveness it is vital that costs are not just measured in isolation but that returns are also examined. The agri benchmark data on beef production costs and returns shows that, with few exceptions, beef finishing enterprises around the world have low levels of profitability. The main countries which Ireland and EU beef competes with on the global stage are Australia, United States of America, Canada, Argentina and Brazil. Figure 37 shows the total returns, cash costs, depreciation and opportunity costs from typically sized farms in the afore mentioned countries for 2015. It must be borne in mind that returns from other on-farm enterprises (not included in graphs above/below) and decoupled payments can compensate for losses in beef finishing enterprises, providing a positive income outcome at the whole-farm level.

Figure 37: European and North American countries (USD per 100 kg carcass weight) (Years 2013, 2014 and 2015)

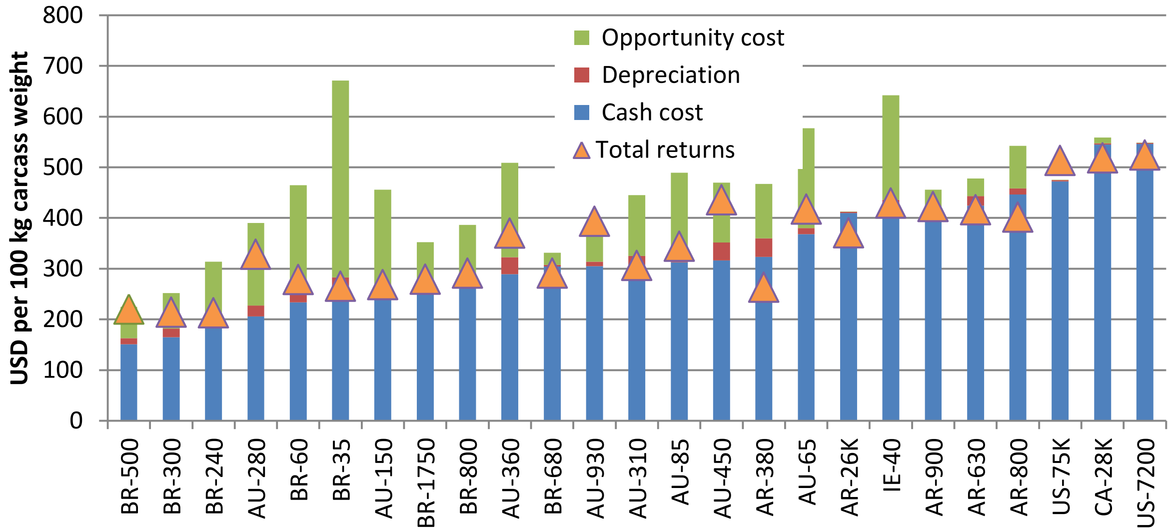


Figure 37 shows that cash costs on a typical Irish finishing farm are higher than costs on typical Brazilian, Argentinian and Australian farms. Opportunity costs, and consequently the total economic costs on the typical Irish finishing farm are much higher than the average for typical farms from Brazil, Argentina and Australia. The typical Irish farm's total returns just about cover the cash costs, but do not cover any of the opportunity costs for own land and labour.

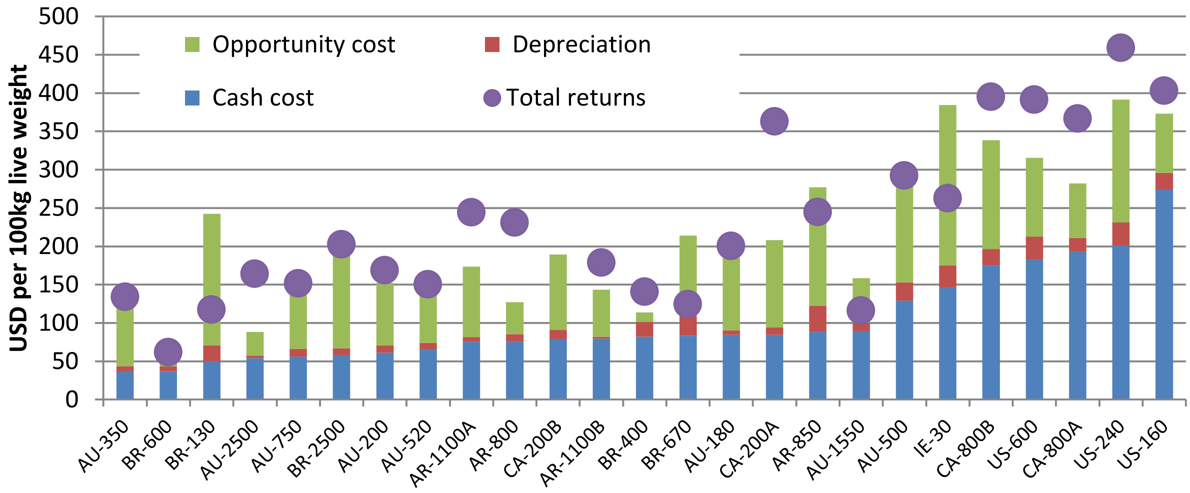
The Irish farm (IE-40) compares favourably to some of the other countries on the basis of total returns. However for IE-40 total returns are not covering opportunity costs in 2015. In terms of Irish beef farming's long term viability and competitiveness this is a worrying outcome. While Irish total cash costs are lower cash costs for some key beef producing regions such as the US and Canada, when the total economic costs of production on Irish beef farms are taken into consideration, economic returns fall well short of total economic cost.

Whilst Irish cash costs are lower than US and Canadian costs, it must also be noted that IE-40 total returns are also lower than the returns on typical US and Canada finishing farms. However, it should be highlighted that the typical US and Canadian farms are of a much greater scale than typical Irish or European farms, CA 28,000 and US 75,000 head respectively. The much greater scale of physical production on typical North American finishing farms allows these farms to survive on very low margins per 100kg carcass weight.

5.2.2 Cow calf farms: cost, returns and profitability outside the EU

In an Irish context, the calf/weaner output from cow-calf farms provides the most important input into the beef finishing enterprise. Returns to cow-calf farms are largely determined further along the supply chain. In this regard it is important to compare the typical Irish cow calf farm (IE-30) with its main international competitors. The countries included in Figure 38 are Canada, US, Argentina, Brazil and Australia.

Figure 38: Cow calf farms – Profitability 2015 (USD per 100 kg live weight)



The Irish farm has relatively high cash costs compared to majority of representative farms examined. Furthermore, the opportunity costs, and consequently the total economic costs are generally higher than in the other country's typical cow-calf farms. The total returns of the Irish cow-calf farm are on a par with the Argentinean typical farm, but are lower than the level achieved by the typical US and Canadian farms. Returns on the typical Irish farm are higher than on all the Brazilian typical farms and on the majority of typical Australian cow-calf farms, but Irish costs are also higher.

These results indicate that the typical Irish cow-calf farm is not competitive internationally. When total economic costs are compared to total revenues from production, the typical Irish cow-calf farm is one of the worst performing farms when assessed on the basis of total economic profit per 100 kg liveweight produced.

The higher costs of production in Ireland are not being offset by sufficiently greater returns per 100kg liveweight. When opportunity costs are accounted for and total economic costs of production are compared, the longer term competitiveness of Irish farms is inferior to that of most North and South American farms.

5.2.3 Summary: Competitiveness of Specialist Beef Producers in Ireland in a Global Context

In summary, it appears that the competitive position for Irish beef farms outside the EU was not very positive even when cash costs of production were considered. Based on data from agri benchmark , representative Irish beef finishing and cow calf farms were in the top quarter of representative farms on a cash cost per kg of carcass/liveweight basis, with relatively high cash costs of production. For both finishing and cow-calf farms, whilst Irish farmers had lower cash costs than some US and Canadian cow-calf farms, the returns from these north American farms in general were superior to those on the typical Irish farm.

When economic costs are considered, the competitive ranking for the Irish beef sector, for the average size farm in particular, slipped further relative to the other countries examined. As was similarly concluded in chapter 4, for competitiveness within the EU, this finding could also be considered as a warning signal for the future competitive performance for the average sized Irish beef farm in the global environment. This highlights again the international competitiveness challenge faced by typically sized Irish cow calf and beef finishing farms.

6. *Competitive Process* - A Case Study of The Role of Innovation in Determining Dairy Farm Economic Performance

Competitiveness and productivity are important aspects of successful dairy farming, especially in view of the recent elimination of EU milk quotas in 2015. Moving from highly protected and regulated markets towards more open markets will exacerbate existing differences in dairy sector performance across countries, but also among individual farms. It is becoming increasingly obvious in the post quota environment that milk production will be more concentrated in countries with production advantages (Donnellan et al, 2016), supplied by farmers who can sustain and improve their productivity and manage a profitable enterprise. However, whilst the abolition of milk quotas facilitates opportunities for expansion on many dairy farms, it also poses challenges in terms of economic performance as a result of increased investment at farm level within a volatile milk price environment. In this context, innovation is generally seen as an important component of achieving improved productivity growth, sustainable use of resources and resilience to market developments (OECD, 2013). Thus, continued innovation will play a central role in the sustainable economic development of the dairy sector. However, to date, there is very little evidence about how innovation affects economic performance at the individual farm level, as the vast majority of existing studies focus on the macro level (Latruffe, 2011; OECD, 2011).

This chapter aims to contribute to this lack of knowledge by assessing the impact of innovation on economic performance. To this end, we use three economic performance indicators: productivity of land, profitability and market orientation (Hennessy *et al* ., 2013). By utilizing data from Irish dairy farms, we assess whether and how innovation efforts by farmers translate into improved economic performance[xxxviii].

6.1. Data and Methods

The main data source used was Irish FADN data for 2012[xxxix] (Hennessy et al., 2013). Irish FADN data are collected through the Teagasc National Farm Survey (NFS). The NFS was established in 1972 and has been published on an annual basis since. Overall, a statistically representative random sample of approximately 900 farms is surveyed representing a farming population of approximately 80,000. The data is collected through a series of face to face interviews by professional farm recorders. Farms are classified into farming systems based on the dominant enterprise which is calculated on a standard gross output basis. The NFS collects data on all prominent farm systems in Ireland, and for the purposes of this analysis we restrict our sample to dairy farms (i.e. specialized dairying and dairying other). While these farms are specialized in dairy production, there is typically a significant alternative enterprise also operating on the farm. The sample used for this analysis comprises 342 dairy farms.

With respect to innovation, this was measured for each farm based on an innovation index developed by Läpple et al. (2015). The innovation index was a composite index that consists of three components of innovation relating to innovation adoption, acquisition of knowledge and continuous innovation (e.g., Spielman and Birner, 2008; Knickel et al., 2009; OECD, 2013). In relation to innovation adoption, the following technologies and farm practices were included: financial analysis tool, information and communications technology usage, soil testing, re-seeding and milk recording. Each of these technologies were assessed by six knowledge transfer and innovation experts and assigned weights in relation to their level of innovativeness and perceived effort of implementation. Acquisition of knowledge, the second indicator, was represented by whether or not the farmer has consulted advisory services for non-scheme related matters, i.e. any advice that is not targeted towards participation in any agricultural policy measures. Whether or not a farmer has renewed some machinery in the past year was used as a proxy for the continuous innovation indicator. The three components of the innovation index were then given expert weights to reflect their relative importance for innovation. As expected, innovation adoption was judged by the experts as the most important component of innovation and assigned a weight of 0.45, followed by acquisition of knowledge with 0.40 and the lowest weight was assigned to the continuous innovation indicator with 0.15. The final agricultural innovation index takes values between zero and one, with larger values indicating greater levels of innovation. Overall the average innovation score in our sample of dairy farms was 0.63, with a standard deviation of 0.28.

In relation to economic performance indicators we assess the impact of innovation on **Productivity of land**, which is measured as gross output per hectare and is seen as a measure of efficiency**. Profitability** which is market based gross margin per hectare and implies that subsidies are taken out of the measure and **Market Orientation** which is the output derived from the market in percentage terms.

With respect to the analysis, we compare and contrast different innovator groups in relation to their farm economic performance and utilise a generalised propensity score (GPS) method to assess the direct impact of different innovation levels on economic performance.

6.2. *Results*

By dividing farms into four innovator groups, we can see that economic performance differs quite remarkably among farms with different levels of innovativeness (see Table 9). For example, a farmer with low levels of innovation (group 1) has an on average € 1,000 lower gross output per hectare (productivity of land) than an innovative farmer in group 4. The market orientation indicator shows that innovative farmers (group 4) are 5 percent less reliant on subsidies than their less innovative counterparts (group 1).

Table 9 Economic Performance by Level of Innovativeness

	All farms	Group 1	Group 2	Group 3	Group 4
Innovation level	0.63 (0.28)	[0; 0.42)	[0.42; 0.7)	[0.7; 0.85)	[0.85; 1)
Economic Performance					
Profitability (€/ha)	1,351.71	1,053.77	1,304.07	1,389.23	1,654.99
	(603.10)	(581.30)	(599.21)	(546.27)	(536.20)
Productivity of land (€/ha)	2,915.89	2,477.49	2,817.36	2,875.03	3,488.00
	(1,040,20)	(971.90)	(1,050.65)	(913.68)	(983.84)
Market orientation (%)	84.31	82.19	83.07	84.96	87.03
	(7.49)	(10.99)	(7.10)	(4.74)	(4.50)
Observations (n)	342	83	89	85	85

Means and standard deviations in parentheses

Further from the above descriptive analysis, the econometric GPS method allowed for an estimation of how much a typical farmer in each innovation group would gain from being more innovative. To this end, we estimated the gains for three typical farmers from innovator groups 1 to 3 and assume they increase their current innovation efforts to a score of 0.9. Typical characteristics for the farmer types can be found in Appendix XVIII For example, Farmer A, a typical farmer from innovation group 1, has a farm size of 52 hectares with a stocking density of 1.72 dairy cows per hectare, is 56 years of age, has completed agricultural education and the farm is located in the south region. We predicted expected innovation and economic performance for each typical farmer with regression analysis. The change in economic performance is then calculated based on a change from the predicted innovation level (i.e. 0.5) to a high level (0.9) based on the output from the GPS method.

Table 10 shows that Farmer A would gain an extra €325 per hectare in profit, which implies €16,825 additional profit per farm, when increasing innovation effort to a high level of 0.9. Farmer B, with an average farm size of 60 hectares, would gain an extra €257 profit per hectare, or €15,352 on a whole farm basis. The largest gains from improving innovativeness on a farm a basis would be made by Farmer C, which however is driven by a considerable larger farm. For example, Farmer C's can achieve € 17,150 higher profit by improving innovativeness from 0.7 to 0.9.

Overall, these results illustrate that increasing innovativeness brings significant economic gains to all farmer types. Moreover, improving relatively high level of innovativeness even further (i.e. from 0.7 to 0.9) still brings significant economic gains. For example, Farmer C would increase productivity on the farm by over €30,000 by being more innovative.

Table 10: Economic Performance Gains for Different Farmer Types, Grouped According to Innovation Effort

	Farmer A (Group 1)	Farmer B (Group 2)	Farmer C (Group 3)
Predicted innovation level	0.53	0.65	0.67
Farm size	51.80	59.66	72.03
Predicted profitability (€/ha)	1,154	1,438	1,374
Δ profitability (€/ha)	325	257	238
Δ profitability (€/farm)	16,823	15,352	17,149
Predicted productivity (€/ha)	2,632	3,050	2,843
Δ productivity (€/ha)	556	450	417
Δ productivity (€/farm)	28,808	26,851	30,100
Predicted market orientation	83.69	82.70	84.74
Δ market orientation	2.80	1.88	1.70

6.3. Conclusions

The case study examined in this chapter relating to the Irish dairy sector provides a policy relevant example that highlights the importance of how innovation on impacts on economic performance. Especially with the 2015 elimination of EU milk production quotas, the need to innovate is an even more pertinent issue. Moreover, in regions with a comparative advantage for milk production, such as Ireland, concentration and intensification of dairy production is well underway. Hence, we compared the economic performance of different innovator groups and also estimated the impact of innovation on economic performance of a representative sample of Irish dairy farms. Our findings show that innovation increases economic performance on all farms. Moreover, our results also reveal that innovative farmers can improve economic gains by innovating further. Overall, the results from this analysis clearly support public policy efforts to increase the level of innovative technologies and farm techniques on Irish dairy farms.

..

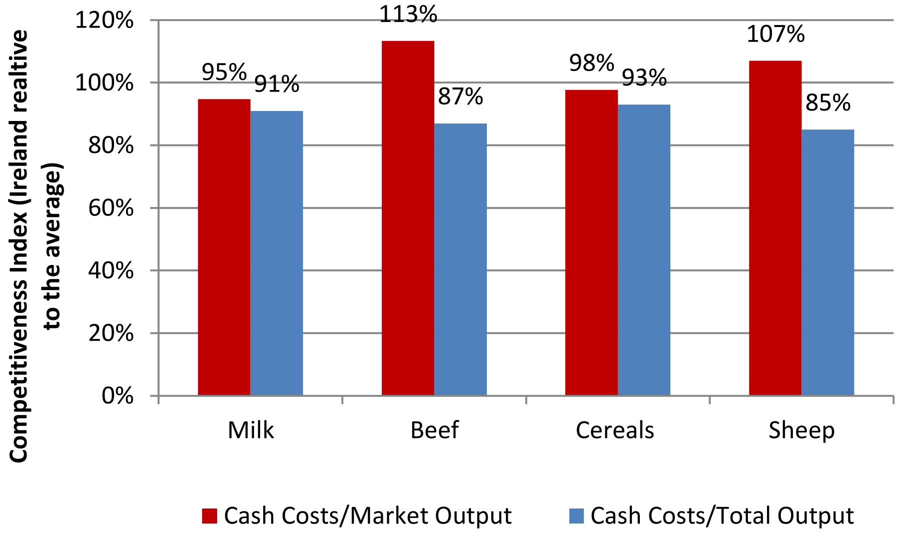
7. Conclusions

7.1. Competitive Performance

For the period 2009 to 2013, Figure 39 shows that the competitive position for Ireland within the EU, for all four enterprises: milk, beef, cereals and sheep, was positive when cash costs were measured as a percent of total output (including an allocation of decoupled payments).[xl]

Figure 39 shows that for dairy and cereal production, Irish producers also had lower cash costs as a percentage of market based output, relative to the average of all countries examined, during the period 2009 to 2013. However, Irish ‘Specialist beef’, and ‘Specialist sheep’ farms had 13 percent and 7 percent higher cost/output ratios compared to the average of all the EU countries studied, when market based output was considered. As the opportunity cost of owned resources are not included in this calculation this indicator of future competitiveness can only be considered to be valid in the short term. In the longer term adjustment within the sectors will be a reality which will be dependent on relative returns to resource use. In this situation relative resource costs are needed to understand and analyse the likely future adjustment process and pressures.

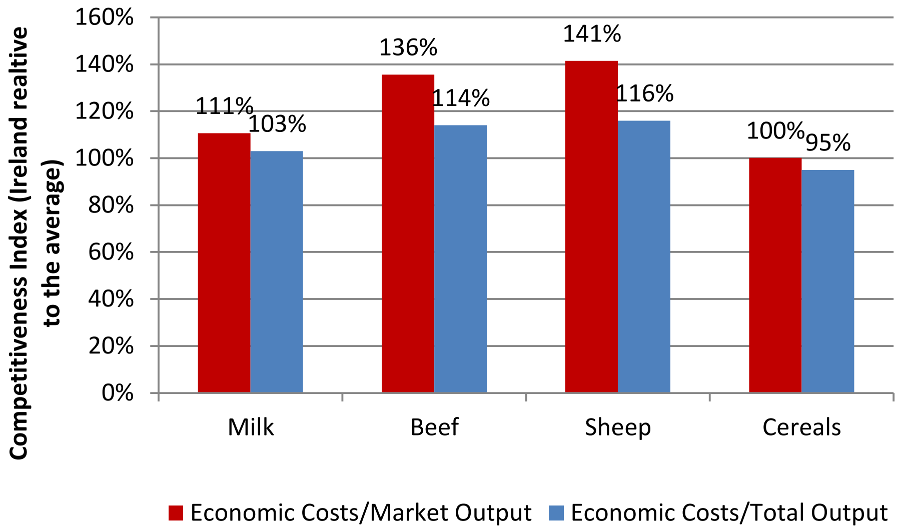
Figure 39: Cash costs as a % of market based & total output for Irish farms, by sector (2009 – 2013), in the EU



Consequently, imputed charges for owned resources were considered in order to examine the longer term outlook for the competitiveness of the four sectors. When imputed costs for owned resources are considered, the competitive ranking for Irish agriculture slipped relative to the other countries, for all of the commodity sectors examined. However, in most cases the exclusion of imputed charges for owned land from the analysis reinforced the competitive position of Irish farms. Figure 40 below summarises the Irish position, relative to the other countries examined, for each of the enterprises, when economic costs were expressed as a percentage of total output.

Figure 40 shows that on a total economic cost basis, Irish cereal producers and dairy producers were the only categories of farms where costs as a percent of total output approached the average of all countries examined within the EU. When the imputed charge for owned land was excluded from the analysis, all categories of farm improved their cost position, relative to the average of the other countries studied.

Figure 40: Economic costs as a % of enterprise output for Irish farms, by sector (2009 – 2013), in the EU



It is however, worth noting that on an economic cost basis (both including and excluding land) Irish beef farms and sheep farms appeared to be uncompetitive relative to the average of the EU countries studied, when costs were expressed as a percentage of market based output. As relative economic costs are considered a 'guide to the longer-term competitive position' (Fingleton, 1995, p.15) of competing countries, these findings should be considered as warning signals for the future competitive performance[xli] of Irish beef and sheep production.

As the unit of measurement changes from cash costs to total economic costs, the deterioration of Ireland's competitive position relative to the other countries within the EU examined has highlighted in Chapter 4. A number of factors are important in explaining this deterioration. Boyle (2002) concluded that part of this explanation relates to 'the relatively low scale of primary agricultural activity in Ireland' (p.177).

In terms of competitive performance outside of the EU, the results from this study show that the competitive position of Irish dairy farms outside the EU was very positive when cash costs were considered in isolation from imputed charges for owned resources. Furthermore, based on data from the IFCN, the larger representative Irish dairy farm had the lowest cash cost to output ratio amongst the key international milk producing regions examined, namely, the US, NZ and Australia. This result is consistent with previous research by Thorne and Fingleton (2006) and Donnellan et al., (2011).

However, as the opportunity cost of owned resources are not included in this calculation this indicator of future competitiveness can only be considered to be valid in the short to medium term. In the longer term adjustment within the sectors will be a reality. Hence, total economic costs, which include imputed charges for owned resources must be considered to gauge the longer term ability of Irish dairy farmers to compete on a global scale.

When economic costs are considered, the competitive ranking for the Irish dairy sector, for the average size farm in particular, slipped relative to the other countries examined. As was similarly concluded for competitiveness within the EU, this finding should also be considered as a warning signal for the future competitive performance for the average sized Irish dairy farm in a global environment. .However, the ability of the larger Irish dairy farms to compete in the longer term in a global context was affirmed. Furthermore, as Irish dairy farming transforms to larger scale production in in the post quota environment, the Irish milk sectors competitive position will be strengthened and it should be better able to cope with a future cost/price squeeze.

Finally, in relation to the competitive performance for Irish beef farms outside the EU the results of this study were not very positive even when only cash costs of production were considered. Based on data from Agri benchmark , representative Irish beef finishing and cow calf farms were in the top quarter of representative farms on a cash cost per kg of carcass/liveweight basis. For both finishing and cow-calf farms, Irish farmers had lower cash costs than some north American and Canadian cow-calf farms, however, the returns from these north American farms in general were superior to those on the typical Irish farm.

When economic costs were considered, the competitive ranking of the Irish beef sector, for the average size farm in particular, slipped further relative to the other countries examined. As was similarly concluded with regard to the competitiveness of Irish beef production within the EU, this finding should be considered as a warning signal for the future competitive performance of average sized Irish beef farm in a global environment. This highlights the international competitiveness challenge faced by typically sized Irish cow calf and beef finishing farms.

7.2. Competitive Potential

To further understand the relative strengths and weaknesses, which underpinned the relative performance of Irish agriculture over the period, indicators of competitive potential were examined, namely, partial productivity measures and the cost and return variables identified in the appendices. Most of the indicators of partial productivity measured for the commodities indicated that the technical performance of Irish agriculture was lagging behind competing EU countries. However, productivity levels on Irish cereal farms were on average more positive than the results for the other commodities. In particular Irish wheat yields were in excess of other competing EU countries.

The cost variables that were identified in the appendices, showed that Ireland had a relative advantage in terms of particular ‘cash cost’ items, but that these particular advantages were outweighed on a total economic cost basis, due to the high imputed cost of owned resources on Irish farms. Certain ‘cash cost’ items consistently appeared as low cost items across the commodities, such as seed and plant costs, interest charges, depreciation, and fixed asset charges, within the EU analysis. However, imputed charges for owned land and labour were also consistently high across the commodities for Ireland. It was the relatively high opportunity cost of labour and land that rendered the majority of Ireland's agriculture uncompetitive during the period 2009 to 2013. The relatively high opportunity costs associated with these owned resources in Ireland will become a major issue in the context of possible further liberalisation of EU agriculture and trade policies.

7.3. Competitive Process

Competitive process is the mechanism whereby competitive potential is translated into competitive performance. The majority of measures of the competitive processes are qualitative in nature, however more recent work in this area has empirically examined innovation in particular as an example of how the competitive process works in practice. As a result of quota abolition in 2015, concentration and intensification of dairy production within the EU is well underway. This also implies increased pressure on existing resources. Bearing these factors in mind a special focus on the impact of innovation on economic performance, specifically focusing on profitability, productivity of land and market orientation, was carried out. From the policy perspective the rationale for examining the interaction between innovation and farm economic performance is clear given that sustainability is playing an ever increasing role in policy objectives. The empirical findings from a sample of Irish dairy farms, using Teagasc, NFS data revealed that innovation improves the economic performance of farms, but not necessarily in a linear fashion.

7.4. Concluding Comments

The results of this study provide a baseline position against which the change in competitiveness of Irish agriculture can be measured. This is an important development in the process of monitoring the position of Irish agriculture relative to other EU and non-countries. Furthermore, the analytical approaches developed in this project allow for the routine annual calculation of competitiveness indicators using the FADN Standard results and the estimation of the indicators for the most recent years using Eurostat price and production indices. Previously when competitiveness indicators were produced for certain sub sectors of Irish agriculture, as a consequence of the nature of the data used to construct the indictors, they tended to be time lagged in nature.

As evolving topics such as trade liberalisation in the context of Brexit negotiations and reform of the CAP will all have major influences on the competitive position of Irish agriculture, the new methods and suite of indicators developed as part of this project will provide a timely and routine metric of the multi-faceted definition of competitiveness which can be monitored in the future.

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Appendix I - Average fat and protein percentages for selected EU member states

	Ireland	Germany	France	Italy	Belgium	Netherlands	Denmark	UK
Mean butterfat content of milk								
2004	3.75	4.22	4.07	3.67	4.14	4.45	4.30	3.99
2005	3.77	4.17	4.06	3.71	4.09	4.40	4.30	4.02
2006	3.75	4.16	4.05	3.69	4.10	4.40	4.30	4.04
2007	3.79	4.16	4.03	3.71	4.07	4.38	4.26	4.05
2008	3.82	4.14	4.03	3.72	4.09	4.37	4.30	4.06
2009	3.83	4.15	4.02	3.74	4.09	4.36	4.31	4.00
2010	3.85	4.16	4.04	3.75	4.10	4.42	4.30	3.96
2011	3.89	4.13	4.00	3.73	4.07	4.40	4.27	4.04
2012	3.94	4.13	3.98	3.78	4.10	4.40	4.28	4.07
2013	3.94	4.12	4.00	3.78	4.10	4.40	4.26	4.03
2014	3.99	4.08	3.94	3.77	4.03	4.34	4.21	3.99
2015	4.03	4.09	3.97	3.80	4.07	4.38	4.23	4.02
Mean protein content of milk								
2004	3.30	3.43	3.40	3.29	3.24	3.49	3.43	3.26
2005	3.30	3.42	3.40	3.30	3.17	3.49	3.42	3.27
2006	3.30	3.40	3.39	3.30	3.35	3.49	3.41	3.27
2007	3.32	3.43	3.40	3.31	3.39	3.50	3.42	3.31
2008	3.34	3.41	3.40	3.34	3.39	3.50	3.41	3.28
2009	3.33	3.42	3.38	3.36	3.35	3.50	3.44	3.27
2010	3.37	3.42	3.42	3.37	3.39	3.53	3.45	3.28
2011	3.37	3.41	3.41	3.36	3.38	3.51	3.46	3.27
2012	3.36	3.41	3.41	3.38	3.40	3.53	3.42	3.26
2013	3.39	3.41	3.38	3.37	3.40	3.53	3.52	3.26
2014	3.43	3.41	3.39	3.37	3.39	3.51	3.53	3.28
2015	3.50	3.41	3.22	3.36	3.40	3.53	3.51	3.32

Source: Eurostat

Appendix II - Partial Productivity Indicators: selected EU Specialist Dairy farms

	2009	2010	2011	2012	2013	Average	Index Relative to Ireland
Milk yield/cow (kg)							
Belgium	6,680	6,888	7,047	7,002	6,984	6,920	130
Denmark	8,385	8,537	8,417	8,572	8,879	8,558	160
France	6,371	6,651	6,936	6,807	6,761	6,705	126
Germany	7,333	7,482	7,586	7,460	7,611	7,494	140
Ireland	5,153	5,450	5,471	5,250	5,385	5,342	100
Italy	5,914	6,116	6,299	6,281	5,835	6,089	114
Netherlands	7,837	7,985	7,984	7,930	7,872	7,922	148
UK	7,036	7,416	7,429	7,203	7,338	7,285	136
Milk solids/cow (kg)							
Belgium	497	516	525	525	524	517	133
Denmark	650	662	651	660	691	663	171
France	472	496	514	503	499	497	128
Germany	555	567	572	562	573	566	146
Ireland	369	394	397	383	395	388	100
Italy	420	435	447	450	417	434	112
Netherlands	616	635	632	629	624	627	162
UK	512	537	543	528	535	531	137
Stocking rate (LU/ha)							
Belgium	2.25	2.28	2.22	2.26	2.3	2.26	116
Denmark	2.21	2.27	2.19	2.17	2.2	2.21	113
France	1.45	1.4	1.38	1.38	1.39	1.4	72
Germany	1.87	1.83	1.82	1.85	1.86	1.85	95
Ireland	1.95	1.91	1.94	1.96	2.01	1.95	100
Italy	3.1	3.21	3.07	3.33	3.28	3.2	164
Netherlands	2.42	2.46	2.41	2.41	2.49	2.44	125
UK	2.01	2.04	2.02	2.04	2.03	2.03	104
Milk production/ha (kg)							
Belgium	5,546	5,699	5,824	5,921	6,012	5,800	165
Denmark	7,404	7,784	7,330	7,429	7,725	7,534	214
France	2,816	2,869	3,047	3,013	3,059	2,961	84
Germany	4,500	4,530	4,719	4,706	4,898	4,671	133
Ireland	3,213	3,436	3,713	3,544	3,715	3,524	100
Italy	7,861	8,105	7,995	8,650	7,962	8,115	231
Netherlands	9,147	9,414	9,350	9,368	9,725	9,401	267
UK	5,343	5,873	5,854	5,773	5,752	5,719	163
Milk solids/ha (kg)							
Belgium	413	427	434	444	451	434	170
Denmark	574	603	567	572	601	583	228
France	208	214	226	223	226	219	86
Germany	341	343	356	355	369	353	138
Ireland	230	248	270	259	272	256	100
Italy	558	577	567	619	569	578	226
Netherlands	719	748	740	743	771	744	291
UK	388	425	428	423	419	417	163
Milk production/labour unit (AWU)							
Belgium	315,234	303,607	303,620	327,942	313,952	312,871	104
Denmark	716,111	773,207	782,357	797,426	748,829	763,586	253
France	254,117	271,092	283,845	294,899	284,631	277,717	92
Germany	289,067	293,847	308,647	323,362	304,150	303,815	101
Ireland	298,680	291,811	304,113	312,674	302,776	302,011	100
Italy	204,771	202,466	201,354	214,884	196,225	203,940	68
Netherlands	451,784	452,841	454,725	474,727	459,959	458,807	152
UK	450,975	474,236	464,143	442,373	449,003	456,146	151

Appendix III - Costs as a % of Output: selected EU Specialist Dairy farms (2009–2013)

	Belgium	Denmark	France	Germany	Ireland	Italy	Netherlands	UK
INTERMEDIATE CONSUMPTION								
Specific Costs								
Seeds and Plants	1.298	1.356	1.592	0.912	0.348	0.671	0.757	0.497
Fertilisers	2.74	1.233	3.411	2.582	6.49	0.863	1.865	3.267
Crop protection	0.821	0.5	0.874	0.626	0.097	0.291	0.407	0.201
Feed for grazing LU, home-grown	2.864	16.98	2.062	4.371	9.38	11.075	0.391	8.038
Feed for grazing LU, purchased	14.694	19.786	13.806	13.964	15.45	19.351	17.634	22.158
Other Livestock specific costs.	5.269	6.367	2.788	5.859	7.298	3.112	6.624	8.16
Overhead costs								
Mach. & Build current costs	5.267	6.515	6.688	7.799	5.703	1.598	6.796	3.897
Energy	4.81	3.423	5.21	8.277	4.374	5.483	4.347	4.581
Contract work	6.761	7.094	9.714	5.396	4.53	0.851	6.206	4.546
Other direct inputs	2.508	3.488	11.44	7.466	3.095	3.38	7.188	4.39
Depreciation	15.773	10.853	20.258	14.971	10.077	8.207	14.657	9.572
Wages	0.331	7.948	1.824	6.021	3.449	4.42	1.773	6.649
Rent	4.717	3.641	6.104	4.82	2.918	2.097	4.572	2.406
Interest	5.125	17.017	3.447	2.674	2.207	0.209	11.364	1.778
IMPUTED OPPORTUNITY COSTS								
Fixed Assets								
Buildings	1.854	1.773	1.411	1.254	3.134	0.659	1.804	0.583
Machinery	0.929	0.935	0.998	1.25	1.357	0.387	0.883	0.703
Breeding livestock.	0.779	0.35	0.685	0.599	1.454	0.342	0.457	0.809
Working Capital								
Non-breeding. livestock	0.305	0.178	0.318	0.293	0.627	0.1	0.159	0.243
Agricultural production stock	0.033	0.275	0.066	0.047	0.168	0.062	0.007	0.084
Other circulating capital	0.123	0.672	1.029	0.79	1.037	1.096	1.254	0.452
Unpaid labour	17.934	7.271	18.777	16.361	22.02	16.266	15.218	10.937
Owned land	1.402	9.08	0.558	2.219	8.071	1.173	6.26	2.91
CASH COSTS	57.205	95.346	68.959	70.765	65.338	53.401	69.924	70.569
OPPORTUNITY COST	34.006	14.369	40.654	35.11	45.74	28.083	29.337	24.514
TOTAL ECONOMIC COST	91.211	109.715	109.613	105.875	111.077	81.484	99.261	95.083

Appendix IV - Costs (€) per kg milk solids: selected EU Specialist Dairy farms (2009–2013)

	Belgium	Denmark	France	Germany	Ireland	Italy	Netherlands	UK
INTERMEDIATE CONSUMPTION								
Specific Costs								
Seeds and Plants	0.055	0.061	0.073	0.041	0.014	0.043	0.035	0.021
Fertilisers	0.117	0.056	0.155	0.118	0.27	0.056	0.085	0.141
Crop protection	0.035	0.023	0.04	0.028	0.004	0.019	0.018	0.009
Feed for grazing LU, home-grown	0.122	0.772	0.094	0.199	0.386	0.712	0.018	0.345
Feed for grazing LU, purchased	0.635	0.902	0.634	0.638	0.647	1.252	0.816	0.963
Other Livestock specific costs.	0.224	0.287	0.127	0.266	0.301	0.2	0.302	0.351
Overhead costs								
Mach. & Build current costs	0.224	0.295	0.305	0.354	0.235	0.103	0.309	0.163
Energy	0.206	0.156	0.24	0.376	0.182	0.355	0.199	0.198
Contract work	0.289	0.321	0.444	0.244	0.188	0.055	0.284	0.196
Other direct inputs	0.108	0.157	0.522	0.338	0.127	0.221	0.327	0.189
Depreciation	0.672	0.489	0.923	0.677	0.416	0.527	0.667	0.414
Wages	0.014	0.358	0.083	0.272	0.142	0.286	0.081	0.286
Rent	0.201	0.164	0.278	0.217	0.12	0.135	0.209	0.103
Interest	0.217	0.753	0.157	0.12	0.089	0.013	0.512	0.077
IMPUTED OPPORTUNITY COSTS								
Fixed Assets								
Buildings	0.075	0.076	0.063	0.054	0.121	0.04	0.077	0.025
Machinery	0.037	0.04	0.045	0.054	0.053	0.024	0.037	0.03
Breeding livestock.	0.031	0.015	0.03	0.026	0.057	0.021	0.02	0.035
Working Capital								
Non-breeding. livestock	0.012	0.008	0.014	0.013	0.024	0.006	0.007	0.01
Agricultural production stock	0.001	0.012	0.003	0.002	0.007	0.004	0	0.004
Other circulating capital	0.005	0.029	0.046	0.034	0.041	0.07	0.054	0.02
Unpaid labour	0.769	0.328	0.854	0.737	0.906	1.047	0.686	0.469
Owned land	0.06	0.407	0.025	0.1	0.331	0.075	0.285	0.125
CASH COSTS	2.448	4.305	3.152	3.212	2.705	3.45	3.194	3.043
OPPORTUNITY COST	1.445	0.649	1.846	1.578	1.866	1.801	1.32	1.054
TOTAL ECONOMIC COST	3.893	4.954	4.998	4.79	4.571	5.251	4.515	4.098

Appendix V - Partial Productivity Indicators: selected EU Specialist Beef farms

	2009	2010	2011	2012	2013	Average	Index Relative to Ireland
Stocking rate (LU/ha)							
Ireland	1.06	1.04	1.03	1.12	1.14	1.08	100
France	1.19	1.17	1.13	1.12	1.15	1.15	106
Germany	1.37	1.23	1.25	1.20	1.31	1.27	118
UK	1.23	1.27	1.25	1.27	1.23	1.25	116
Output/forage ha (€/ha)							
Ireland	863	889	1,037	1,124	1,100	1,003	100
France	1,029	1,034	1,054	1,128	1,159	1,081	108
Germany	1,341	1,352	1,489	1,513	1,524	1,444	144
UK	931	969	1,091	1,187	1,164	1,068	106
Output//labour unit (€/AWU)							
Ireland	36,120	37,524	43,114	49,289	49,956	43,201	100
France	78,436	83,016	89,944	94,479	94,190	88,013	204
Germany	72,230	81,641	94,022	95,589	96,634	88,023	204
UK	91,677	92,205	100,536	103,333	109,403	99,431	230

Appendix VI - Costs as a % of Output: selected EU Specialist Beef farms (2009–2013)

	Ireland	UK	France	Germany
INTERMEDIATE CONSUMPTION				
Specific Costs				
Seeds and Plants	0.378	0.858	1.35	2.18
Fertilisers	7.789	7.34	5.233	5.448
Crop protection	0.088	0.149	0.464	1.413
Feed for grazing LU, home-grown	9.773	18.283	3.215	7.067
Feed for grazing LU, purchased	14.032	17.398	14.298	16.646
Other Livestock specific costs.	5.635	9.308	4.826	4.58
Overhead costs				
Mach. & Build current costs	6.664	5.244	6.812	7.699
Energy	4.618	4.842	4.628	7.675
Contract work	5.045	3.666	5.794	5.711
Other direct inputs	4.202	5.579	10.388	8.517
Depreciation	10.519	11.675	18.126	13.838
Wages	0.956	3.018	1.412	3.349
Rent	2.391	2.677	6.868	5.05
Interest	1.324	1.516	2.755	2.684
IMPUTED OPPORTUNITY COSTS				
Fixed Assets				
Buildings	2.937	0.513	0.995	1.158
Machinery	1.359	0.893	0.94	1.114
Breeding livestock.	1.307	1.123	2.012	0.556
Working Capital				
Non-breeding. livestock	2.231	1.495	1.186	1.525
Agricultural production stock	0.19	0.11	0.063	0.022
Other circulating capital	0.708	0.486	1.037	0.712
Unpaid labour	40.979	17.623	19.122	19.091
Owned land	17.536	7.254	2.026	4.448
CASH COSTS	62.894	79.877	68.041	78.02
OPPORTUNITY COST	76.442	39.655	42.753	39.779
TOTAL ECONOMIC COST	139.335	119.532	110.794	117.799

Appendix VII – Costs (€) per Forage (ha): selected EU Specialist Beef farms (2009–2013)

	Ireland	UK	France	Germany
INTERMEDIATE CONSUMPTION				
Specific Costs				
Seeds and Plants	4	9	15	32
Fertilisers	78	79	57	79
Crop protection	1	2	5	21
Feed for grazing LU, home-grown	97	195	35	102
Feed for grazing LU, purchased	141	188	155	242
Other Livestock specific costs.	56	99	52	66
Overhead costs				
Mach. & Build current costs	67	55	74	111
Energy	47	52	50	111
Contract work	50	39	63	83
Other direct inputs	42	60	112	123
Depreciation	105	125	195	199
Wages	10	32	15	48
Rent	24	29	74	73
Interest	13	16	30	38
IMPUTED OPPORTUNITY COSTS				
Fixed Assets				
Buildings	28	5	11	16
Machinery	13	10	10	16
Breeding livestock.	12	12	22	8
Working Capital				
Non-breeding. livestock	21	16	13	21
Agricultural production stock	2	1	1	0
Other circulating capital	7	5	11	10
Unpaid labour	406	188	206	275
Owned land	174	77	22	65
CASH COSTS	630	855	736	1128
OPPORTUNITY COST	756	424	461	572
TOTAL ECONOMIC COST	1386	1279	1196	1700

Appendix VIII - Costs (€) per LU: selected EU Specialist Beef farms

	Ireland	UK	France	Germany
INTERMEDIATE CONSUMPTION				
Specific Costs				
Seeds and Plants	3	7	13	25
Fertilisers	72	63	49	63
Crop protection	1	1	4	16
Feed for grazing LU, home-grown	90	156	30	80
Feed for grazing LU, purchased	130	150	135	191
Other Livestock specific costs.	52	79	45	52
Overhead costs				
Mach. & Build current costs	62	44	64	88
Energy	43	42	44	87
Contract work	47	31	55	65
Other direct inputs	39	48	98	96
Depreciation	97	100	170	157
Wages	9	26	13	38
Rent	22	23	64	57
Interest	12	13	26	30
IMPUTED OPPORTUNITY COSTS				
Fixed Assets				
Buildings	26	4	9	13
Machinery	12	8	9	12
Breeding livestock.	12	10	18	6
Working Capital				
Non-breeding. livestock	20	13	11	17
Agricultural production stock	2	1	1	0
Other circulating capital	6	4	10	8
Unpaid labour	378	151	179	217
Owned land	162	62	19	51
CASH COSTS	582	684	640	889
OPPORTUNITY COST	702	339	400	450
TOTAL ECONOMIC COST	1284	1023	1040	1340

Appendix IX – Costs as a % of Market-Based Income: selected EU Specialist Beef farms

	2009	2010	2011	2012	2013	Average	Ireland as % of Average
Cash costs							
Ireland	132.66	125.377	103.573	102.545	109.444	115	106
UK	122.982	128.693	109.407	114.611	116.164	118	111
France	85.85	90.033	94.585	91.14	90.351	90	78
Germany	120.731	118.078	113.115	112.674	111.765	115	107
Economic costs (excl. opp. cost of land)							
Ireland	271.238	265.127	206.878	184.318	190.659	224	140
UK	175.757	180.269	151.700	162.949	161.473	166	93
France	149.307	146.205	143.651	140.555	142.090	144	78
Germany	187.166	173.451	158.475	160.758	158.743	168	94
Economic costs (incl. opp. cost of land)							
Ireland	310.762	302.734	237.797	210.528	217.491	256	154
UK	186.971	193.561	161.719	173.296	170.568	177	92
France	152.089	149.069	146.455	143.136	144.514	147	73
Germany	193.235	179.856	164.119	168.657	165.454	174	90

Appendix X - Partial Productivity Indicators: selected EU Cereal farms

	2009	2010	2011	2012	2013	Average	Index Relative to Ireland
Wheat yield (100 kg/ha)							
Denmark	78	65	63	71	71	70	81
Germany	76	70	64	70	80	72	84
France	76	71	66	73	73	72	83
Ireland	86	89	97	73	85	86	100
Italy	57	58	59	57	56	57	67
UK	84	82	81	69	77	79	91
Output/cereal ha (€/ha)							
Denmark	1,034	1,325	1,407	1,661	1,384	1,362	84
Germany	1,156	1,426	1,483	1,830	1,684	1,516	93
France	1,239	1,550	1,639	1,914	1,537	1,576	97
Ireland	1,159	1,733	1,843	1,691	1,686	1,622	100
Italy	1,278	1,557	1,763	1,774	1,667	1,608	99
UK	1,237	1,660	1,723	1,808	1,608	1,607	99
Output//labour unit (€/AWU)							
Denmark	171,600	223,274	265,881	307,678	296,397	252,966	196
Germany	121,358	146,461	159,166	189,633	183,983	160,120	124
France	114,237	137,778	152,824	165,501	138,406	141,749	110
Ireland	88,006	138,100	147,932	136,677	134,033	128,950	100
Italy	36,246	39,496	41,986	41,345	41,168	40,048	31
UK	146,036	171,227	197,236	183,944	175,939	174,876	136

Appendix XI - Costs as a % of Output: selected EU Cereal farms

	Ireland	Italy	UK	Germany	Denmark	France
INTERMEDIATE CONSUMPTION						
Specific Costs						
Seeds and Plants	5.839	7.794	5.314	5.303	5.78	5.996
Fertilisers	15.742	9.68	13.711	12.612	9.695	15.475
Crop protection	9.571	4.395	10.262	9.262	6.461	10.637
Other crop specific costs	0.587	0.627	2.247	1.168	4.756	0.022
Overhead costs						
Mach. & Build current costs	5.932	2.653	5.644	6.778	18.582	6.13
Energy	5.458	10.51	7.24	8.141	6.88	5.33
Contract work	7.607	5.764	5.482	4.604	2.815	4.903
Other direct inputs	3.448	4.642	6.261	6.707	3.841	7.63
Depreciation	8.827	17.611	13.013	10.608	8.63	15.893
Wages	1.896	3.215	5.415	6.931	5.471	2.098
Rent	5.421	4.177	4.614	9.341	3.924	7.661
Interest	1.445	0.121	1.856	2.334	11.081	2.236
IMPUTED OPPORTUNITY COSTS						
Fixed Assets						
Buildings	1.005	1.083	0.458	0.54	1.681	0.265
Machinery	1.805	0.92	1.246	1.035	0.986	1.092
Working Capital						
Agricultural production stock	0.109	0.053	0.452	0.047	0.281	0.407
Other circulating capital	0.798	0.993	1.396	1.147	1.68	1.174
Unpaid labour	15.862	41.715	9.371	10.482	11.288	14.021
Owned land	12.851	7.376	7.657	4.241	29.036	1.022
CASH COSTS	62.946	53.58	68.047	73.181	79.287	68.117
OPPORTUNITY COST	39.811	69.629	31.736	25.765	42.5	31.638
TOTAL ECONOMIC COST	102.757	123.209	99.783	98.946	121.787	99.755

Appendix XII - Costs (€) per 100kg of Product Volume: selected EU Cereals farms

	Ireland	Italy	UK	Germany	Denmark	France
INTERMEDIATE CONSUMPTION						
Specific Costs						
Seeds and Plants	1.089	2.174	1.097	1.121	1.120	1.298
Fertilisers	2.983	2.727	2.802	2.683	1.856	3.311
Crop protection	1.823	1.238	2.111	1.944	1.255	2.299
Other crop specific costs	0.110	0.169	0.463	0.248	0.931	0.005
Overhead costs						
Mach. & Build current costs	1.128	0.746	1.096	1.426	3.653	1.338
Energy	1.048	2.989	1.501	1.72	1.373	1.173
Contract work	1.411	1.618	1.13	0.968	0.546	1.077
Other direct inputs	0.642	1.301	1.293	1.41	0.743	1.666
Depreciation	1.672	4.907	2.7	2.213	1.672	3.459
Wages	0.37	0.882	1.112	1.451	1.073	0.454
Rent	1.036	1.169	0.956	1.95	0.76	1.664
Interest	0.269	0.032	0.381	0.486	2.075	0.484
IMPUTED OPPORTUNITY COSTS						
Fixed Assets						
Buildings	0.173	0.270	0.092	0.104	0.277	0.053
Machinery	0.314	0.231	0.256	0.202	0.165	0.220
Working Capital						
Agricultural production stock	0.018	0.014	0.092	0.009	0.048	0.083
Other circulating capital	0.140	0.272	0.283	0.225	0.280	0.239
Unpaid labour	2.914	11.766	1.936	2.178	2.166	3.029
Owned land	2.416	2.052	1.570	0.888	5.591	0.219
CASH COSTS	11.908	15.045	13.941	15.408	15.385	14.769
OPPORTUNITY COST	7.381	19.480	6.549	5.333	8.123	6.820
TOTAL ECONOMIC COST	19.289	34.525	20.489	20.741	23.508	21.589

Appendix XIII - Costs, Revenue and Margin (€) per ha: selected EU Cereal farms

	Ireland	Italy	UK	Germany	Denmark	France
REVENUE	1623	1607	1607	1516	1362	1576
INTERMEDIATE CONSUMPTION						
Specific Costs						
Seeds and Plants	93	124	85	80	78	93
Fertilisers	253	156	217	191	129	238
Crop protection	154	71	164	140	87	165
Other crop specific costs	9	10	36	18	64	0
Overhead costs						
Mach. & Build current costs	95	43	87	102	251	96
2Energy	89	171	116	123	94	84
Contract work	121	93	88	70	38	77
Other direct inputs	55	74	100	101	51	119
Depreciation	142	280	209	158	115	248
Wages	31	50	86	104	74	33
Rent	88	67	74	140	53	119
Interest	23	2	30	35	144	35
IMPUTED OPPORTUNITY COSTS						
Fixed Assets						
Buildings	15	15	7	8	20	4
Machinery	27	13	20	15	12	16
Working Capital						
Agricultural production stock	2	1	7	1	3	6
Other circulating capital	12	15	22	16	20	17
Unpaid labour	247	673	150	156	150	217
Owned land	205	117	122	64	387	16
CASH COSTS	1012	859	1084	1103	1061	1059
OPPORTUNITY COST	628	1113	507	383	564	489
TOTAL ECONOMIC COST	1639	1973	1591	1485	1625	1548
MARGIN OVER ECONOMIC COSTS (INCL. LAND)	-17	-365	16	30	-263	28
MARGIN OVER ECONOMIC COSTS (EXCL. LAND)	188	-247	138	94	124	44
MARGIN OVER CASH COSTS	611	748	523	413	301	517

Appendix XIV - Partial Productivity Indicators: selected EU Sheep farms

	2009	2010	2011	2012	2013	Average	Index Relative to Ireland
Stocking rate (LU/ha)							
Ireland	0.59	0.65	0.71	0.76	0.71	0.68	100
France	0.81	0.79	0.76	0.80	0.75	0.78	115
UK	0.47	0.45	0.50	0.47	0.43	0.46	68
Output/forage ha (€/ha)							
Ireland	499	613	700	695	596	621	100
France	1,208	1,340	1,360	1,488	1,352	1,350	217
UK	351	343	399	355	318	353	57
Output//labour unit (€/AWU)							
Ireland	29,701	32,553	33,961	39,716	34,262	34,039	100
France	68,631	75,214	78,122	79,890	79,145	76,200	224
UK	87,457	90,721	94,708	93,732	93,094	91,942	270

Appendix XV - Costs as a % of Output: selected EU Sheep farms (2009-2013)

	Ireland	UK	France
INTERMEDIATE CONSUMPTION			
Specific Costs			
Seeds and Plants	0.436	0.394	1.071
Fertilisers	5.645	4.582	3.346
Crop protection	0.069	0.063	0.26
Feed for grazing LU, home-grown	4.162	17.33	3.67
Feed for grazing LU, purchased	14.495	17.033	14.929
Other Livestock specific costs.	6.177	10.523	2.917
Overhead costs			
Mach. & Build current costs	6.94	4.769	7.341
Energy	4.716	4.804	4.384
Contract work	2.657	2.381	5.484
Other direct inputs	5.022	5.849	10.101
Depreciation	9.475	9.72	17.948
Wages	1.829	4.034	1.088
Rent	2.245	3.521	4.63
Interest	0.714	1.592	2.234
IMPUTED OPPORTUNITY COSTS			
Fixed Assets			
Buildings	2.049	0.315	1.003
Machinery	1.441	0.892	1.006
Breeding livestock.	1.369	1.077	0.785
Working Capital			
Non-breeding. livestock	0.858	0.634	0.245
Agricultural production stock	0.105	0.046	0.094
Other circulating capital	0.715	0.579	1.198
Unpaid labour	51.376	20.954	20.983
Owned land	15.652	5.48	1.087
CASH COSTS	55.109	76.876	61.457
OPPORTUNITY COST	82.324	38.104	42.115
TOTAL ECONOMIC COST	137.433	114.98	103.572

Appendix XVI - Costs, Revenue & Margin (€) per LU: selected EU Sheep farms

	Ireland	UK	France
REVENUE	905	759	1724
INTERMEDIATE CONSUMPTION			
Specific Costs			
Seeds and Plants	4	3	18
Fertilisers	51	35	58
Crop protection	1	0	4
Feed for grazing LU, home-grown	38	131	63
Feed for grazing LU, purchased	130	129	258
Other Livestock specific costs.	56	80	50
Overhead costs			
Mach. & Build current costs	63	36	127
Energy	43	36	76
Contract work	24	18	95
Other direct inputs	45	44	174
Depreciation	86	74	308
Wages	17	31	19
Rent	20	27	80
Interest	6	12	38
IMPUTED OPPORTUNITY COSTS			
Fixed Assets			
Buildings	18	2	17
Machinery	13	7	17
Breeding livestock.	12	8	13
Working Capital			
Non-breeding. livestock	8	5	4
Agricultural production stock	1	0	2
Other circulating capital	6	4	20
Unpaid labour	464	159	363
Owned land	142	42	19
CASH COSTS	497	582	1059
OPPORTUNITY COST	744	289	724
TOTAL ECONOMIC COST	1241	871	1783
MARGIN OVER ECONOMIC COSTS (INCL. LAND)	-335	-112	-59
MARGIN OVER ECONOMIC COSTS (EXCL. LAND)	-194	-70	-40
MARGIN OVER CASH COSTS	408	177	665

Appendix XVII - Costs, Revenue & Margin (€) per forage ha: selected EU Sheep farms

	Ireland	UK	France
REVENUE	620	353	1350
INTERMEDIATE CONSUMPTION			
Specific Costs			
Seeds and Plants	3	1	14
Fertilisers	35	16	45
Crop protection	0	0	3
Feed for grazing LU, home-grown	26	61	49
Feed for grazing LU, purchased	90	60	202
Other Livestock specific costs.	38	37	39
Overhead costs			
Mach. & Build current costs	43	17	99
Energy	29	17	59
Contract work	17	8	74
Other direct inputs	31	21	136
Depreciation	59	34	241
Wages	11	14	15
Rent	14	12	62
Interest	4	6	30
IMPUTED OPPORTUNITY COSTS			
Fixed Assets			
Buildings	12	1	13
Machinery	9	3	13
Breeding livestock.	8	4	10
Working Capital			
Non-breeding. livestock	5	2	3
Agricultural production stock	1	0	1
Other circulating capital	4	2	16
Unpaid labour	317	74	284
Owned land	98	19	15
CASH COSTS	342	270	829
OPPORTUNITY COST	507	134	567
TOTAL ECONOMIC COST	850	404	1395
MARGIN OVER ECONOMIC COSTS (INCL. LAND)	-229	-51	-46
MARGIN OVER ECONOMIC COSTS (EXCL. LAND)	-131	-31	-31
MARGIN OVER CASH COSTS	278	83	521

Appendix XVIII: Summary Statistics of Farm Grouping According to Innovation Effort

	All farms	Group 1	Group 2	Group 3	Group 4
Innovation level		[0; 0.42)	[0.42; 0.7)	[0.7; 0.85)	[0.85; 1)
Covariates to estimate GPS					
UAA in hectares	64.69 (33.97)	51.80 (30.45)	59.66 (33.42)	72.03 (35.48)	75.19 (31.51)
Dairy livestock units/hectares	1.85 (0.47)	1.72 (0.50)	1.83 (0.45)	1.84 (0.44)	2.02 (0.46)
Somatic cell count (in 1,000)	222.56 (90.84)	264.71 (110.16)	227.39 (98.27)	210.99 (65.33)	187.89 (64.34)
Feed conversion	5.73 (3.12)	5.23 (2.19)	5.77 (4.44)	5.98 (2.85)	5.94 (2.35)
Age of main farm holder	52.87 (10.51)	56.59 (10.30)	52.27 (10.44)	52.51 (9.82)	50.31 (10.65)
Agricultural education	0.73	0.53	0.73	0.79	0.88
Number of children	1.35 (1.49)	1.14 (1.46)	1.03 (1.36)	1.71 (1.74)	1.51 (1.27)
Farms located in north west (%)	22.22 (1)	20.48	25.84	21.17	20.48
Farms located in south west (%)	21.34 (2)	21.68	23.59	27.06	21.69
Farms located in east (%)	25.73	18.07	29.21	23.52	18.07
Farms located in south (%)	30.70 (4)	39.75	21.35	28.23	39.76

End Notes

[i] Much of the theory relating to competitiveness outlined in this section is based on the review in Thorne (2004) and updated with additions from the literature, both theoretical and applied, where necessary.

[ii] Based on the theory of competitiveness, Brinkman (1987) identified profitability as a superior indicator of longer term competitiveness, relative to market share. However, the opposite case has also been proposed i.e. short term profit can be forfeited in the pursuit of long term market share gains. Based on this analysis it can be concluded that "…one 'best' measure of competitiveness may not exist…(but) market share and profitability provide useful insights into overall competitiveness"(Kennedy et al, 1997, p.24). Therefore, on-going research is currently examining market share based indicators of competitiveness and were also included in this report.

[iii] This issue was addressed in detail in an interim report produced for this project. The literature review identified various indicators of competitive potential and performance. Full details of the evaluation of these indicators can be requested from the authors: Gillespie and Thorne (2015) *Survey of competitiveness measurement literature,* Athenry, working paper series.

[iv] The Agri benchmark Network also comprises other sectors, including cereals, oilseed and protein. Teagasc is currently putting together data for inclusion in the cereals, oilseed and protein network and first results for this sector comparison internationally will be available in late 2017.

[v] The determination of an appropriate opportunity cost for own family labour is always an issue in studies which examine costs of production on family farms. The use of the average agricultural wage to value owned family labour may in some instances over value (due to under employment) or under value (due to managerial or entrepreneurial ability) this resource. However, without any further evidence to suggest in which cases such situations arise the average agricultural wage is used in the absence of this additional information.

[vi] HICP - Overall index, Annual average rate of change, Eurostat, Neither seasonally nor working day adjusted ECB codes vary by country but follow a standard format. For Ireland the code was **ICP.A.IE.N.000000.4.AVR**

[vii] Bank interest rates - loans to corporations with an original maturity of over five years (outstanding amounts). ECB series codes vary by country. For Ireland the code was **MIR.M.IE.B.A20.J.R.A.2240.EUR.O**

[viii] This competitiveness index was constructed following the methodology outlined by Boyle et al., (1992); Boyle (2002); Fingleton (1995); and Thorne (2004). Alternative denominators to a simple average of all countries were investigated but were rejected due to the problems associated with selecting an appropriate measure that would be relevant for all enterprise analysis.

[ix] As measured by Eurostat series apro_mk_cola, in 1,000 tonnes per annum, and compared to the EU 28. Compared to the older EU 15 MS, the figure is above 86 per cent.

[x] By definition this partial productivity measure will be heavily influenced by relative stocking rates.

[xi] By definition this partial productivity measure will be heavily influenced by relative stocking rates.

[xii] Series code his_pri, available for download from DGAgri's Milk Market Observatory website,https://ec.europa.eu/agriculture/sites/agriculture/files/market-observatory/milk/pdf/eu-historical-price-series_en.xls at the time of writing.

[xiii] Eurostat series **apro_mk_colm_mth**, D1110D - Raw cows' milk delivered to dairies, in units of a thousand tonnes

[xiv] Eurostat series **apro_mk_colm_mth**, D1110D - Raw cows' milk delivered to dairies, in units of % of product weight for both fat and protein.

[xv] Italy was also a significant beef producer in the UE during the time period examined. However to keep the set of comparator countries similar to previous studies Italy was not included in the subset of countries.

[xvi] As measured by Eurostat series apro_mt_pann, in 1,000 tonnes per annum, and compared to the EU 28. Compared to the older EU 15 MS, the figure is above 59 per cent.

[xvii] All subsidies received for cattle other than dairy cows.

[xviii] All other farm subsidies on other livestock or livestock products (includes, exceptionally, the amounts for any of the specific livestock subsidies where such amounts could not be entered under specific categories because of a lack of detailed information).

[xix] Includes (i) Direct aids to agricultural production methods designed to protect the environment and maintain the countryside and (ii) Payments to farmers who are subject to restrictions on agricultural use in areas with environmental restrictions (Council Regulation (EC) No1257/99, Art.16).

[xx] Compensatory allowances in less-favoured areas (Council Regulation (EC) No.1257/99, Art.14).

[xxi] Based on specific assumptions regarding average annual prices paid for beef in the different countries, Boyle (1992 and 2002) calculated costs per 100kgs of output for beef rearing and fattening enterprises but noted that "It is certainly not possible to obtain robust costs per 100kgs of output from this data source" (Boyle, 2002, p.82).

[xxii] The proportion of these LU's allocated to the beef rearing enterprise is based on the allocation key: 'other cows' (which excludes dairy cows) as a percentage of 'total cows' on the whole farm.

[xxiii] The price index used to update beef output was from the Eurostat statistical series aact_eaa05. The nominal price index (n-1 = 100) based on production value at producer price for item code 11100 - Cattle was selected.

[xxiv] It is important to remember that these indicators are only partial in indicators of productivity and total factor productivity may show different results.

[xxv] As measured by Eurostat series apro_acs_a, for harvested cereals (excluding rice), in 1,000 tonnes per annum, and compared to the EU 15. Compared to the entire EU 28 MS, the figure is above 55 per cent.

[xxvi] Due to data limitations this was the only indicator of cereal yield available.

[xxvii] The price index used to update cereals output was Eurostat series aact_eaa05, the nominal price index (n-1 = 100) based on production value at producer price for item code 01000 - Cereals (including seeds).

[xxviii] Based on a trend regression analysis there was no apparent significant trend over time in relation to the partial productivity indicators for Irish cereal farms compared to the average of all countries.

[xxix] It was not possible to standardise wheat yield for moisture content.

[xxx] In this analysis costs were allocated to the cereal enterprise based on the allocation key: cereals output divided by total production output. This differs from previous measures of cost competitiveness in that direct payments are not taken into account.

[xxxi] As measured by Eurostat series apro_mt_pann, for sheep meat slaughtering, in 1,000 tonnes per annum, and compared to the EU 15. Compared to the entire EU 28 MS, the figure is above only slightly less at 61%, as the EU 15 accounts for almost all EU sheep meat.

xxxii The price index used to update sheep output was Eurostat series aact_eaa05, the nominal price index (n-1 = 100) based on production value at producer price for item code 11400 - Sheep and goats.

xxxiii Based on a trend regression analysis there was no apparent significant trend over time in relation to the partial productivity indicators for Irish sheep farms compared to the average of all countries.

xxxiv The number of forage hectares allocated to the sheep enterprise was based on the proportion of sheep LU in the total of grazing LU on the whole farm.

xxxv The IFCN - International Farm Comparison Network - is a global network of dairy researchers from 95 countries cooperating with over 100 companies representing the dairy chain. The IFCN is independent from third parties and committed to truth, science and reliability of results. The main research focus of the IFCN and its core competence is in the field of milk production, milk prices and especially dairy farm economics. Further details: www.ifcndairy.org. Teagasc is the supplier of Irish data to the IFCN for dairy farms.

xxxvi A typical farm represents the most common production system in a country or a region. Usually, two typical farm types are used per dairy region – the first represents an average sized farm and the second is representative of a larger farm type for that region. The typical farms are selected and validated by reference to accounting statistics and panels of dairy experts in each participating country.

xxxvii Agri benchmark - is a global network of researchers, representing 149 beef farms internationally in the cow calf and beef finishing systems. This network is independent from third parties and participation in the network provides access to reliable international database, containing farm and agricultural sector data for all participant countries, data that is harmonised so as to facilitate cross country comparisons. The main research focus of the Agri benchmark network and its core competence is in the field of beef production, beef prices and farm economics. Further details: www.agri benchmark .org. Teagasc is the supplier of Irish data to the agri benchmark network for cow-calf, beef finishing and sheep farms.

xxxviii Further detail on the econometric methods employed in this research can be found in the paper Läpple et al., (2017).

xxxix This analysis uses data from a supplementary survey that was only available in 2012".

xl Costs as a % of output was used as a benchmark indicator between the four commodities because it was the only measure of competitiveness that was used in the analysis for all four commodities.

xli Costs as a % of output is considered as an indicator of competitive performance, namely profitability, because both costs and returns are considered.