Agricultural land valuation in Ireland

A discounted cash flow approach

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Abstract

<u>Agricultural land valuation in Ireland, a discounted cash flow approach.</u>

Valuing real estate is a key requirement for various stakeholders in the property industry. There are many challenges that include the issue of liquidity, individual real estate charachteristics and lot sizes. As this creates difficulties and with limited sales evidence – an analysis of future income streams (including discounted cash flow approach) is one of the accepted methods of valuing a real estate asset. The rationale for this research emerged from an issue facing the professional doctorate candidate in practice. The researcher identified (1) the lack of comparable sales data and (2) the reliance on the comparable method of valuation in the agricultural land market in Ireland. Drawing on his professional experience the researcher observed that in the absence of data or alternative methods of valuation it can lead to non-evidence based opinions of value. The researcher set out to investigate this problem with the aim to provide insights into the valuation of agricultural land in Ireland. The research commences with a historical review of the agricultural land market in Ireland which provides context on the research problem. The reasons for the lack of agriculture land sales are explored. The research proposes and produces a long run dataset of agricultural land sales and rentals from the researchers' firm's (Smith Harrington) records. The literature review goes on to review alternatives methods of valuation. It identifies the discounted cash flow (DCF) method as compatible with the culture and conceptual framework. This leads to the primary research question of the study 'Can the DCF method provide supportive evidence in the estimation of market value of agricultural land in Ireland'. The research develops a model to test this question drawing on investment theory and analyses the results from the model against the sales records from the Smith Harrington dataset. The findings suggest that the DCF model proposed can provide supportive evidence in the valuation of agricultural land in Ireland. A further output from the research is a series of market discount rates. The researcher reasons that improving the availability and accessibility of agricultural land market data through the publication of the Smith Harrington dataset, identifying and testing alternative methods of valuation and discussing these findings, limitations and areas of further research provide a valuable tool for the Irish property industry, insights into the valuation of agricultural land in Ireland and are valuable contributions to knowledge.

Frank Harrington

Chapter 1: Introduction

1.1 Overview

Sampson states that an introduction chapter should provide an overview of the dissertation research by making the reader aware of what will be studied, why the study is needed, the questions that will guide the research, and the social significance of the problem (Sampson, 2017). This general structure has guided this chapter.

1.2 Subject of the study

The subject of this dissertation is whether the discounted cash flow (DCF) method can provide supportive evidence in the estimation of the market value of agricultural land in Ireland. It is a piece of research written by a chartered surveyor and registered valuer, who is currently practising both as a valuer and academic (herein after referred to as "the researcher") examining the valuation of agricultural land in Ireland.

The study's focus is on the agricultural land asset class and on appropriate valuation methodologies to assess the market value of this asset class. Agriculture *"generates 9.8% of Ireland's merchandise exports and provides 8.5% of national employment [in 2016]"* (Teagasc, 2018, p.1). For such a significant asset class it has received limited attention in recent years.

Hargarity and Yu notes that any any asset class with such a significant amount of capital invested requires efficient stewardship (Hargarity and Yu, 1993). The study examines the appropriate cultural context of the Irish agricultural land market and relevant economic and valuation theories. As the title of the dissertation suggests, some of these valuation theories/models (notably the DCF model) were tested on the Irish agricultural land market.

1.3 Need for the study

The rationale for this study emerged after a significant process of reflection. All professional doctoral candidates were encouraged during the Master's in Research element of the programme, to reflect on their professional practice with a view to identifying a practice-based problem as the focus for professional doctoral research. A natural starting point for this submission is to set out how the researcher's reflection on his practice as a valuation surveyor

led him to the practice-based problems that provided the rationale for undertaking this research.

1.3.1 Experiential learning and reflective practice theory

Undertaking this reflection required the identification of appropriate tools for reflection. This led the researcher to examine the concepts of experiential learning and reflective practice theory. Experiential learning, as the name suggests, is about learning from experience. It is a learning style that takes place in life beyond the formal systems of education. Moon refers to this as "everyday learning" (2009 p. 74). However, this is not to say that experiential learning is limited to learning from one's everyday actions. It is about the broader concept of learning from experience.

Learning from experience requires a cognitive process. Reflection is a tool for learning from actions to create everyday learning. Dewey (1933, p. 9) defines reflection as the "active, persistent and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends." While many theories of reflection have evolved from Dewey's work, his definition of the process remains central.

Schön's seminal work, *The reflective practitioner* (1983), focuses primarily on the concept of reflection in practice. Its objective is to convert the knowledge valued in professional practice into a universal knowledge that can be considered alongside academic knowledge. To achieve this, he advocates a process of reflection in actions within day-to-day practice. This is equally valid in professions as broad as architecture and psychotherapy (ibid.) and, subsequently, in science-based professions, planning and management (Schön, 1983).

Reflection in action is well demonstrated by Clarke's 2002 PhD dissertation, *Practicing, developing, and researching – a study of professional development through action learning*. In this thesis, Clarke proposes how to both improve practice and develop as a practitioner and explains how this is achieved through an action-learning process. It is a good example of how action learning can be utilised to achieve both personal development and more contextualised development of a profession or industry.

While Schön's focus is also on reflection in action, he recognises that these processes of reflection can be required by a professional to address both "puzzling phenomena which are new to him, even though they fall within normal boundaries of technical practice" and also "[a] larger situation that impinges on his activity even though it falls outside what are normally considered the boundaries of the profession" (Schön, 1973, p. 170). It is "the larger situation" that is relevant to the current form of enquiry.

The Kolb learning cycle is a model by which experiential learning can be achieved.
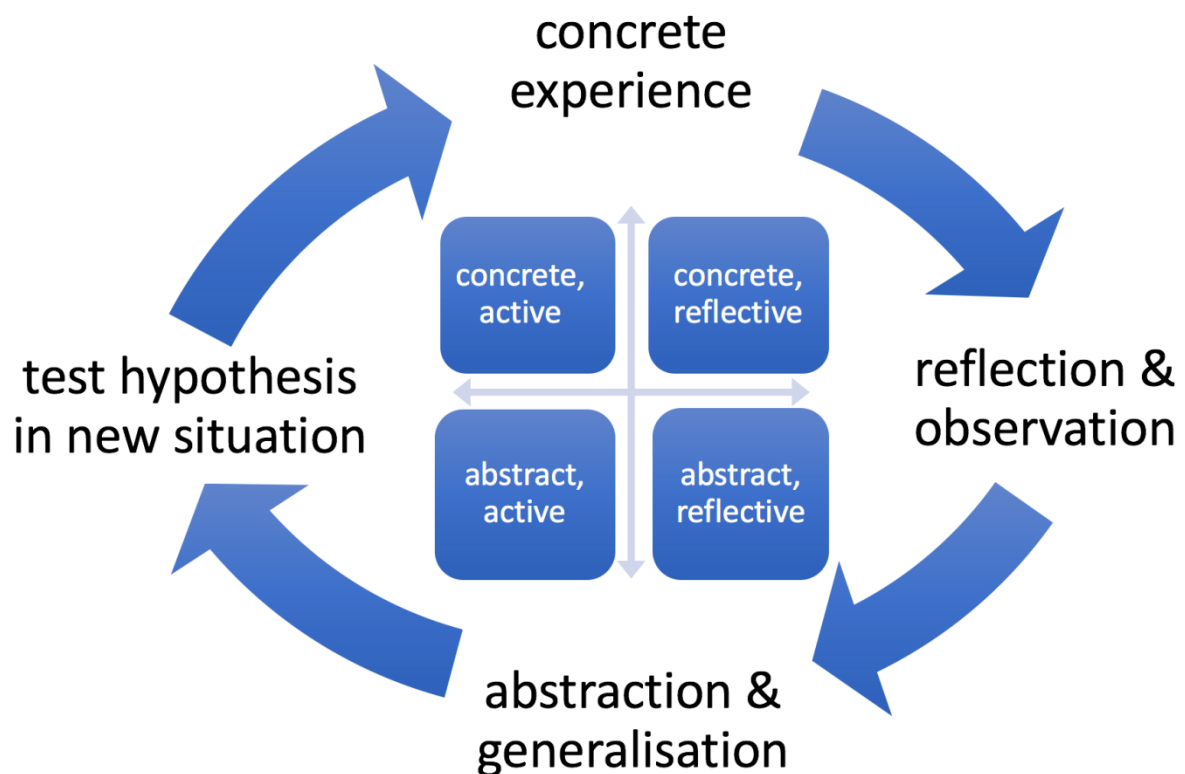
Figure 1.1: The Kolb learning cycle (Kolb, 1984)

Stage 1 of the learning process is concrete experience but in theory the process can start at any stage of the cycle. The concrete experience stage, generally, is about documenting experience in relation to the specific issue of focus. It requires the participant to be actively engaged and attentive in the experience and noticing facts. The observations should be recorded as precisely as possible. These concrete experiences can then be analysed.

If the first stage is about "doing" and gathering information, the second stage is about analysis of the information. It is about stepping back from the task and observing what has been done and reflecting upon it. One might observe what worked well and what did not

work well in one's own experience. This stage should provide the transitional element, in which reflections and observations may be synthesised into a new form of thought.

Stage 3, abstract conceptualisation, is about "thinking" and taking the steps noted and reflected on in stages 1 and 2 and applying them to a bigger picture. This stage requires learners to be critical about their observations. It may be said that the reflection stage utilises the emotional side of the brain. When making observations a person may have "gut feelings" about a subject; stage 3 requires the learner to consider these ideas with more logic than simply labelling them as "feelings" and to consider them in a wider framework. Abstract conceptualisation involves planning and developing theories. It is about making deep and meaningful connections and conclusions in the learning situation. In stage 3 one may be able to consider a learning experience in a broader perspective and make generalisations from it. It should be possible to conceptualise a hypothesis to explain, for example, why a particular phenomenon works or does not work.

Stage 4, active experimentation, involves testing these theories or putting learning into practice. It may involve testing the usefulness of the theory by, for example, testing its reliability in making predictions. Ideally, the outcome of this stage would involve taking learning from this particular experience and applying it to a broader context. Stage 4 is quite like stage 1. Kolb's learning cycle is working around to experience again. This is intentional, as it is a repeatable model that can be utilised until the learning experience is complete. While Kolb designed the model in four stages, the purpose of this section is to explain the development of the current research; the focus, therefore, is on the right-hand side of the model (from concrete experience to abstract conceptualisation). Stages 3 and 4 are further developed in Chapter 3 (methodology) and Chapter 4 (results) of this dissertation, respectively.

The researcher's professional practice area is the valuation of agricultural land in Ireland. Applying the principles of Dewey, Schön et al. to reflect on his knowledge of the subject area, the researcher considered that the "concrete experience" element of the Kolb model could be used as his knowledge of the subject area (the valuation of agricultural land in Ireland). "Concrete reflection" was in the form of the researcher's analysis, which was informed by his professional and academic knowledge. He then attempted to synthesise these reflections into an abstract conceptualisation of the enquiry.

The following section summarises the process and philosophy upon which the researcher drew when identifying the problem, he faced in practice, and states the aim of the research.

1.3.2 Critical reflection

As noted, the researcher is a chartered valuation surveyor who specialises in valuing land. He was brought up meeting with landowners and tenants of agricultural land on a regular basis. His professional experience commenced in 1999 when he began working in the practice on a part-time basis while studying. On completion of his undergraduate studies (a first-class honours degree in Valuation Surveying from Dublin Institute of Technology), he undertook the Assessment of Professional Competence while working in a large national office. He returned to the family firm, where he headed up the professional services department, completed a Master of Planning and Development part time, and subsequently commenced his professional doctorate studies. During his studies, he began lecturing and now balances his valuation lecturing with his professional practice and research. The following sections set out reasons that led him to this form of enquiry.

1.3.1.1 The lack of available data when valuing agricultural land

In practice, when valuing agricultural land, the most commonly adopted valuation approach is the market or comparable approach. This involves comparing land(s) that have been sold to the property for which a valuation is sought. To compare the subject of the valuation with the prices of comparable parcels of land, it is necessary to choose a suitable unit of comparison. For land in Ireland this is generally the price per acre. The price per acre of the comparable property is then analysed to arrive at a price per acre for the subject lands that reflects the differences between it and the comparable property lands. The eighth edition of the *RICS valuation standards* (2012) recommends that differences between the following should be considered:

- the interest providing the price evidence and the interest being valued,

- the respective locations,

- the respective quality of the land or the age and specification of the buildings,

- the permitted use or zoning at each property,

- the circumstances under which the price was determined, and the basis of value required,

- the effective date of the price evidence and the required valuation date (RICS, 2012, p. 66).

This approach, when used correctly, can be an effective method of valuation but has its limitations. One of the limitations (others are assessed in later chapters) in analysing a comparison is that property interests are heterogeneous. This is recognised by the Royal Institution of Chartered Surveyors (RICS):

> Even if the land and buildings to which the interest being valued relates have identical physical characteristics to others being exchanged in the market, the location will be different. Notwithstanding these dissimilarities, the market approach is commonly applied for the valuation of real property interests (RICS, 2012, p. 64).

The limitations of the comparable approach can be overcome if there is enough market evidence available within the local market. When insufficient sales have taken place in a local market within a comparable time frame the valuation practitioner may face significant problems in providing enough evidence base for their valuation.

There is often a lack of comparable evidence in the Irish agricultural land market. Relative to other asset classes the researcher has noted a significantly smaller proportion of agricultural land sales. This claim is substantiated by Bogue (2012), who estimated that only 0.3% of the total land area in Ireland was put on the market for sale in 2011. In the same study he found that two-thirds of farmers stated it was important for the farm to stay in family ownership and that after retirement 78% and 74% would consider short-term renting and long-term leasing, respectively, but only 28% would consider selling the farm. These findings indicate a lack of market transactions and thus a lack of comparable evidence. Even when transactions do occur the data is not always readily available. Practitioners must rely on information supplied by other competing agents. This is not an ideal scenario for the practitioner or the client relying on the advice.

The lack of data is not just a problem for valuers. Reputable bodies such as the Economic and Social Research Institute (ESRI) have noted the lack of data in this area. A study undertaken

by the ESRI on the agricultural land and forestry market reported with "great caution" due to the limited data. The data was used because it comprised "the most reliable statistical estimates possible" and produced "some interesting results" (ESRI, 1999, p. 35). The Central Statistics Office (CSO) made some improvements in collating data sets of prices in recent decades. This was welcome, but the datasets were not localised and during the recession a decision was made to discontinue them.

This limited availability of data on comparable prices of sales and lettings of land in Ireland remains a problem for practitioners and researchers. These problems in practices led the researcher to consider how he might improve the availability of data. Working in a family firm (Smith Harrington) that dates to 1869, he began to consider what data they had recorded and maintained in relation to agricultural land. Initial investigations suggested there would likely be enough data to produce a reliable dataset. This data is recorded in Journals such as those shown in figure 1.2 below. Journals were stored in the basement of the Smith Harrington offices on Bridge Street in Navan, Co. Meath. Access to these journals was not available to the public.

Figure 1.2: Photos of journals where data was recorded
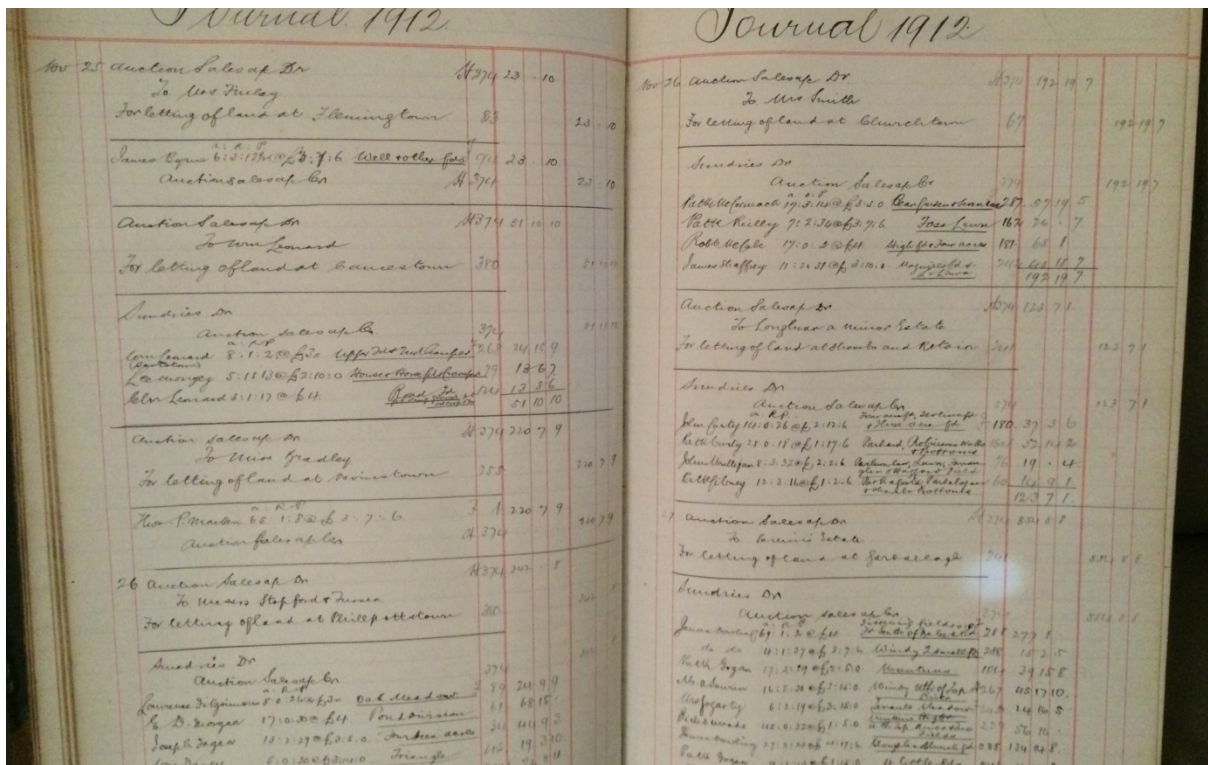
Figure 1.3: An example of the journals in which the data was recorded

It was felt that producing, analysing and publishing a long series data set of agricultural land sale prices and lettings might help address the issues. It would likely be welcomed by valuation practitioners, researchers, and research bodies such as the The Economic and Social Research Institute (ESRI)[1] and Teagasc[2]. While the construction of the Smith Harrington data set includes historic data, it was proposed that it would be updated and maintained on an annual basis and could therefore be utilised as a relatively up-to-date resource for valuation practitioners. In addition, the historic data might be of interest to agricultural economists, economic historians and valuation practitioners seeking validated evidence for historical valuations that are still required from time to time. If nothing else, it was considered that publishing an accurate and validated long-running dataset of this nature, in a field so devoid of reliable data, might be considered a valuable research contribution.

A dataset of this nature may have various other applications. It may prove useful to allow the development of statistical methods for determining the relative importance of the factors affecting the selling and letting prices of agricultural land. The initial research envisaged

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[1] The Economic and Social Research Institute is Ireland's independent source of evidence for policy.

[2] Teagasc is the Irish Agriculture and Food Development Authority, which provides integrated research, advisory and training services to the agriculture and food industry and rural communities.

investigating these issues. One other such application considered was its use in the research to test valuation tools when valuing agricultural land. As the research progressed it was this issue to which the researcher was drawn.

1.3.1.2   The lack of valuation tools when valuing agricultural land

It is interesting to consider the contrast between the approaches to the valuation of agricultural and development land. While both utilise the direct comparable approach as set out above, development land practitioners use additional tools to supplement their valuations.

Agricultural land is not a homogeneous asset; no two parcels are the same. Whether it be the quality of the land, the road frontage, or the location, a comparable valuation will have to be adjusted. The extent of the adjustment is left to the judgment of the practitioner. When enough data is available, this can be partially accounted for within the comparable approach. The researcher's experience is that the amount of adjustment can vary substantially from practitioner to practitioner. To better understand this approach, the researcher briefly set out the process while reflecting, from his experience, on its advantages and limitations.

It is important to understand a typical valuation process to appreciate the advantages and limitations of the comparable approach to valuation. A typical valuation requires an inspection of the subject property that is to be valued, desktop research, and analysis. A common approach to valuation is comparable analysis. This requires gathering information about sales of comparable properties (known as "comparables"), analysing these comparables in relation to the subject property, and determining the market price. However, in many cases the researcher must use a comparable that he has not inspected to undertake the analysis.

While the researcher may be familiar with some comparables, which he may have inspected or sold, many are gathered from other agents. The agents generally describe the property to the researcher, often over the telephone, and provide a brochure. Access is not normally possible, as the property is likely to be occupied.

Regardless of the detail of the information provided, there is a significant chance that the researcher's interpretation of it may not match the reality of the subject property. His valuation report always includes a specific statement of assumptions. However, the lack of

physical experience of inspection can have a considerable impact on his estimate of value, depending on the nature of the property.

One of the advantages of valuing agricultural land is that access is generally available. Experienced practitioners can focus on analysing the market and make judgements as to their opinion that the market would have on the relationship between the comparable and the subject land they are valuing. Notwithstanding these advantages, the possibility of different interpretations by different valuers remains.

For further discussion on the use of comparable evidence in the valuation process, see the RICS's guidance notes on *Comparable evidence in property valuation* (2012) and *Valuation of rural property* (2011).

This contrasts with the approach undertaken to valuing development land. While comparable sales values are often used, on larger sales the predominant method is one based on the end use product of the land. Some practitioners use the residual method, while others use the DCF approach; both approaches rely on similar methods. The residual approach is a snapshot of the land's value on a given day, based on the prevailing prices of the end product, less costs of construction (including the profit of the developer or manufacturer). The DCF approach uses the same principles but normally takes a more detailed approach, accounting for the time value of money of all inputs and outputs, including profits. Both the residual and DCF approaches rely on the principle that what is left after all incomes and expenditures (including the manufacturer's profit) are accounted for in the residual value of the land.

In Ireland, the DCF method is used when valuing wind farms and forestry, but, in the researcher's experience, is not used for valuing agricultural land. However, interestingly, a crude model was applied in the 19th century to establish the appropriate rates (a type of land tax) for agricultural land. This likely evolved from Ricardo's theories of land rent, which is discussed in Chapter 2 (literature review). This led the researcher to an early loose hypothesis that a relatively straightforward model could be constructed that would assist in providing both more certainty in valuations of agricultural land and an additional evidence base.

This process of experiential learning and critical reflection, drawing on the theories of Dewey, Schön, Moon, Clarke and Kolb, assisted the researcher in identifying a focus for the

research. The ideas for the research developed from moving through the process from the researcher's concrete experience to a reflective observation stage. This involved reflecting individually on issues such as:

- The lack of data on the agricultural land market.
- The question of whether land is a good investment relative to other asset classes.
- The lack of valuation tools to assist practitioners.

Following active reflection on these problems, the researcher moved to the bottom right quadrant of the Kolb learning cycle. This involved assimilating and linking these various issues to identify an aim for the research.

1.3.1.3   *Developing the research aim*

While reflecting on the lack of tools available to assist valuation practitioners in the agricultural land market, the researcher also began to reflect on a relative lack of evidence in the sector. There appeared to be few comparables and no reliable published dataset of agricultural land sales and rentals. This issue was identified as a focus of the literature review.

During his practice, he subsequently came across a case where he had sight of two separate valuation reports for the same parcel of land. These valuations were undertaken by two external valuers. One estimated a value of approximately €18,750 per acre while the other valued the same parcel at €8,750 per acre. This was a difference in the region of €10,000 per acre or 114% of the lower value. When he sought to see how these figures were arrived at, the researcher noted that neither party had made any observations on their analysis. This lack of analysis is very different from contemporary standard practice in other asset classes for similar purposes and again increased the researcher's interest as to why this might be the case.

Published studies of valuation inaccuracy suggest that levels of tolerance may range up to a maximum of 20% (Crosby, Lavers, & Murdoch, 1998a). While this could be an outlying example, this example, together with the researcher's awareness of how the market operated, suggested that agricultural land might not be subject to the same rigorous evidence-based

analysis as other asset classes. The question of whether this was due to a lack of valuation tools began to emerge.

The studies of Crosby et al. and most of the other contemporary valuation studies were of other asset classes. This was likely for a variety of reasons, including larger lot size (and therefore arguably greater importance to the stakeholders and the economy generally) and more transparent markets with greater data availability. In Ireland, however, the agricultural land market is a relatively more important component of the national economy and the lack of contemporary studies of valuation approaches in the Irish agricultural land market was noticeable.

While the example provided could have been an isolated incident, it nonetheless highlighted to the researcher that the lack of studies on the subject market and the absence of a published reliable dataset limited the investigations of such an incident. It could be claimed that no relevant comparable evidence was available, and both were valid opinions. This arguably provides a culture where practitioners may produce non-evidence-based valuations and diligent valuers may be at a disadvantage. This did not sit well with the researcher and again sparked further interest in the research area.

As noted, this did not appear to be an isolated incident. The researcher was aware of a general lack of evidence-based analysis around the valuation of agricultural land when utilising comparable analysis as the method of valuation. It has been reported (Adair and McGreal 1987; Mackmin 1985) that residential valuers are reluctant to explain how they analyse and interpret the market as a prerequisite to valuation by direct comparison. This is further discussed in section 2.6.1.

1.4   Statement of the problem

These examples highlighted to the researcher several problems that warranted further investigation. The first was that it appeared that that some practitioners might be undertaking a less than rigorous approach to their valuation analysis of this asset class (agricultural land market in Ireland). It was acknowledged that this might be due to the lack of alternative valuation methods to the comparable approach that could be used to support a valuation. A reliably tested alternative method could provide supportive evidence to be used in the analysis. Finally, the lack of available datasets appeared to be an issue for both practitioner

and researcher. These issues intrigued the researcher and led him to consider how he could assist practitioners and, in some way, improve the valuation approach when undertaking an agricultural land valuation.

Four main issues were identified that together contributed to the definition of a problem worthy of investigation. These were: (1) a lack of transactions in the Irish agricultural land market; (2) a lack of reliable datasets relating to the Irish agricultural land market; (3) limitations to the comparable method of valuation, particularly in this context; and (4) a lack of tested alternative methods to the comparable method of valuation to support the valuation of agricultural land in Ireland. These issues, and the lack of contemporary studies of these issues in an Irish context, provided the rationale for this study.

1.5   Social significance

The social significance of these problems can be summarised in theoretical and practical terms.

It was hypothesised that the combination of these issues had led to a lack of evidence-based valuations in the agricultural land market in Ireland, resulting in a less than optimal valuation process. Accurate valuations are important from a practical perspective for, *inter alia*:

- The farming sector
- The banking sector.
- Investment markets.
- Calculating taxation.
- Dispute resolution (e.g. family settlements).
- Policy.

As the agriculture sector provides a relatively significant contribution to the Irish economy (see appendix 1 for details) the importane of accurate valuations becomes more apparent.

Valuations not being undertaken in a rigorous manner, based on evidence using an accepted valuation approach, can lead to poor farm management/planning, a loss of revenue to the exchequer, and problems in the banking sector.

There is also a theoretical significance, as these issues and a lack of contemporary studies of these valuation tools suggest that valuation theory may be advanced from this study.

1.6   The research aim

The aim was to provide insights into the valuation of agricultural land in Ireland and assist practitioners to make informed decisions. This helped to direct the research focus throughout the process.

1.6.1   The research objectives

The objectives that emerged from this process of reflection were:

- To improve the availability and accessibility of agricultural land market data in Ireland.
- To identify alternative methods of valuing agricultural land that are compatible with established economic theories, practitioners' bases of value, the historical context, and other relevant factors.
- To assess the accuracy of the selected method(s) in providing supportive evidence in the estimation of the market value of agricultural land in Ireland.
- To determine the most appropriate methods for the valuation of agricultural land in Ireland.

1.6.2   Summary

This chapter has set out:

- The elements to be studied.
- The need for the study.
- The question (and overall aim) that would guide the research.

It has also introduced the social significance of the research, its importance to the various stakeholders in the property industry and agricultures importance to the overall economy which is further discussed in appendix 1.

As a professional doctorate student, the researcher drew heavily on reflective practice techniques to identify the research problem, aim and objectives. It was recognised, when forming these elements of the study (which involved constructing a new database and testing the accuracy of a valuation method to value agricultural land), that the research required a solid theoretical and methodological base. The theoretical and methodological base are developed in the following chapters.

Chapter 2: Literature Review

2.1 Introduction

The purpose of a review of literature is to help the reader to understand the variables that will be examined in the dissertation, as well as providing a justification for the research questions examined in the dissertation research (Sampson, 2017). While literature is examined throughout this dissertation, this chapter serves as the core contextual and theoretical foundation necessary to critique the discussion of findings in Chapter 5.

Sampson (2017) cautions against being discipline-bound, noting that other fields can provide alternative theory that is relevant. Developing this point, he notes:

> Often, true innovation, creativity, and advancement of knowledge results from analysing similarities and differences in theory and prior research among disciplines (Sampson, 2017, p. 31).

The RICS *Valuation global standards* (2017) acknowledges that the valuer needs to be aware of any relevant economic developments, industry trends, and the context in which the valuation is being prepared, which may include political outlook, government policies, and market activity. While this refers to individual valuations, it can be extrapolated that it is also relevant when developing valuation theory, particularly in the Irish agricultural land market, as is demonstrated within this chapter. It follows that there is a broad range of relevant literature to be analysed within this review.

Craswell (2005) recommends first mapping the categories, where there is extensive literature. The categories subject to this review have been determined based on the aim and objectives of the study and are sequenced as follows:

- The historical context of the Irish agricultural land market.

- Economic theories of value.

- The valuation practitioner's bases of value, their definitions, underlying assumptions, and conceptual frameworks.

- Irish agricultural land market reports and available datasets.

- Methods of valuation.

After determining what to cover, Craswell (2005) suggests next identifying the tasks of the review, which may include some of the following points:

- Demonstrating through engagement with the literature that you have a thorough critical understanding of the literature.
- Drawing out the key issues essential to your research.
- Justifying the choice of topic/area of research.
- Critiquing: evaluating strengths and weaknesses of the literature relevant to your own research.
- Pointing out gaps in the literature or identifying problems remaining to be solved.
- Drawing together the main themes and arguments of a particular body of literature.
- Developing an argument in the process of reviewing the literature.
- Producing a historical survey (Craswell, 2005).

This chapter draws out the key issues essential to the research, evaluates the strengths and weaknesses of the literature relevant to the research, and draws together the main themes from various relevant bodies of research, with the purpose of helping the reader to understand the variables examined in the dissertation and to justify the research question being examined.

It is relevant at this stage to reiterate the aim of the research, which is to provide insights into the valuation of agricultural land in Ireland and to assist practitioners in making informed decisions. The research problem emerged from practice, rather than from a gap in the literature, as has been set out in Chapter 1. The following sections develop this context, while providing a historical context that is necessary for understanding the overall conceptual framework of the research.

2.2   Historical context

The process of real estate appraisal is intrinsically linked to the cultural and statutory process of the subject market (Graaskamp, 1992). A review of valuation methods undertaken by leading researchers between the University of Reading and the University of Athens

identified that "each country will have a different culture and experience, which will determine the methods adopted for any particular valuation" (French, 2004, p. 536).

Given the long-standing importance placed on the comparable method in agricultural land valuation it was necessary, as part of this research, to explore and trace the relevant cultural and historical links before developing the economic theories that were consistent with Ireland's culture and experience. McGrath (2011) investigated factors influencing the modern agricultural land-letting market in Ireland, interviewing farmers about their decision not to let land to a third party to increase supply. His study highlighted that pride and historical factors continue to have an influence on farmers' choices in the market. As farmers form the majority of buyers and sellers in the agricultural land market, in research examining the methodologies used to value the sale and letting of agricultural land in Ireland it would be negligent not to provide historical context. Agricultural land has played a significant role in Irish society during recorded history. An overview of the issues relevant to the agricultural land market and specifically to this study is provided below.

2.2.1 Selection of study period

The initial study period selected spanned from 1870 to 2014. The rationale for commencing in 1870 was partly based on the availability of data but it was also historically appropriate for a study of the Irish agricultural land market. As is illustrated, the period commences at a critical time for Irish agriculture after the great famine of 1845-49 and at the introduction of the first of several Irish Land Acts (that of Gladstone). The legislative framework often shapes market participants' behaviour. There is a strong argument to be made that the current Irish agricultural market commenced with the introduction of this Act. An indication of Irish Land Holding before 1870 is provided to help explain the significance of the changes introduced in the 1870 Act.

The period selected covers the introduction of legislation aimed at empowering the Irish farmer, two world wars, independence from Britain, joining the European Economic Community (EEC) (eventually the European Union, EU), and periods of economic prosperity and recession. Over the period, many advances in technology and research provided major opportunities to improve land productivity and thereby influence the market. Utilising this broad time frame provides the opportunity to test a variety of theories within future research.

The study also examines the relevant culture and experience that is necessary to determine the appropriate valuation methods for the Irish agricultural land market.

2.2.2 Demographics, settlement patterns and historical context

In 1870 Ireland was part of the United Kingdom (UK), following the Acts of Union of the Westminster Parliament in 1800 and the Act of Union of the Irish Parliament of 1801. By 1870 there was notably less industrial development in Ireland than in the other countries (Scotland and England and Wales) of the Union:

> Dublin largely missed out on the opportunities of the Industrial Revolution and with the exception of the Guinness Brewery and Jacob's biscuit factory, it was largely devoid of major industry (Dublin City Council, 2014, p .4).

British parliamentary control of Ireland began with the 1801 Act of Union, which closed the parliament in Dublin. Consequently, there was a decline in economic and political activity in Dublin, and many of the upper and middle classes emigrated to London. This resulted in a loss of consumer spending and investment within the city.

The "Great" potato famine of 1845-49, and subsequent slightly less catastrophic famines, led to hundreds of thousands of deaths and mass emigration from Ireland. During the period of 1841 to 1871 the population of the Republic of Ireland fell from 6,530,000 to 4,050,000. While such a dramatic fall in population is likely to be evidenced both in rural and urban areas, it could be expected that a famine could be the catalyst for the urbanisation of Ireland. However, while Britain had been experiencing rapid urbanisation during this period, this did not happen in Ireland.

Cork was Ireland's largest city in terms of population, according to the first Census in 1841. However, by 1871 the population had fallen dramatically from 854,000 to 495,000. This decline continued until the 1960s, after which it began to grow relatively slowly to the current population of 518,000. While the population of Dublin showed an overall increase between 1841 and 1871, the period between 1861-71 recorded a decline of 1.22% (Dublin City Council, 2014). Thus, Ireland remained a predominantly agricultural society. The size of farming enterprises and agrarian structures is considered later in this chapter.

2.2.3 Land tenure in Ireland

2.2.3.1 Overview

> … land law has been at the very core of social and economic affairs to an extent certainly unknown in England and rarely equalled in national importance anywhere else (Kolbert & O'Brien, 1975, p. 1).

The above quote highlights the importance of land tenure to the Irish agricultural land market. As highlighted by McGrath (2011), historical issues continue to influence farmers in the market for land. It is also important to examine land tenure, and the political and historical context in which it was introduced, to better understand the Irish agricultural land market. It is useful, when examining land tenure, to commence with the Brehon Laws, which are the first known laws pertaining to Ireland.

2.2.3.2 The Brehon Laws

The arrival of Christianity in Ireland in the 5th century led to the country being considered a centre for learning of the known world. During this period Ireland pioneered a unique code of laws known as the Brehon Laws. This code of laws emerged from the brehons, or professional jurists. One Irish judge remarked that Ireland was "the first adventure of the common law."

Ireland was ruled during this period by a high king. It is now widely accepted that this was an honorary role, rather than one of jurisdiction. The laws were administered by many local states, each ruled by an elected king or prince who swore an oath to govern his territory in important matters, in accordance with its immemorial laws and customs. In contrast to feudal kings, he did not obtain absolute power over his states. The average size of these states, or Tuaths, was 170 square miles. Ireland's 32,000 square miles contained almost 200 Tuaths in the 11th century. Despite the existence of numerous independent states, Ireland retained unity of language, literature, folklore, law, and faith (Kolbert & O'Brien, 1975).

There were two main classes of people in this society: the Saer-Ceili, who were the owners of land and cattle and the Daer-Ceili, who owned neither land nor stock. Both classes of society retained a right to live within the territory and to support themselves with their labour. The Daer-Ceili may even ascend to the Saer classes if they prospered.

Private property, together with tenancies, was well recognised during this period. One of the dominant traits of the Brehon system of land tenure was the tenant's security of tenure. MacNeill, examining this subject in 1921, states:

> a modern landlord may measure his degree of dominion by power to evict; an ancient Irish noble measured his by power to restrain his tenants from leaving him (MacNeill, 1921, p. 111).

Kolbert and O'Brien (1975) suggest that this component of the Brehon Laws was one of the main factors for their retention and tenacity until the 17th century. Perhaps an indication of the strength of this system of land tenure is that one custom was preserved in the west of Ireland into the 20th Century. Donaldson recorded in 1957 that there were "still strips of arable land held by men who were direct successors of men who formerly held land under the Irish custom of rundale" (Donaldson, 1957, p. 230). Rundale was a right of pasturage which was held in common with yearly re-allocations of arable land made between all the participants.

2.2.3.3   Irish and English Land Law, 1169-1613

Kolbert and O'Brien (1975) describe this period as the "condominium" of Irish and English land law. This period represents the commencement of the dual laws and animosity between landlord and tenant, which remains an important part of Irish culture, particularly between participants in the agricultural land market.

The Danes raided Ireland on numerous occasions between the 8th and 12th centuries. The Normans took England in 1066 but did not expand this rule to Ireland until later. The history of transplantation of English law into Ireland can be traced back to when Henry II obtained permission from Pope Adrian IV (Nicholas Breakspear, the only English pope) to restore order to Ireland in 1169. Henry visited Ireland in 1172 and was then recognised as king by some of the Irish chiefs. It is notable that he allowed those chiefs who recognised his position as Lord in Chief to continue their own individual rules, and therefore laws, in their own Tuaths.

He also made grants of Irish land to some Norman barons, who were to hold it, in return for feudal services, as tenants in chief of the King and allowed those living in Wales to make

raids into Ireland, conquering those who objected or rebelled. Kolbert and O'Brien (1975) point out that Henry's men brought over with them their version of the feudal system without its essential keystone – a resident monarch. Despite papal injunctions on which Henry and his Norman barons based their invasion, at no time did an Anglo-Norman monarch accept a real king-and-subject relationship with the Irish people. In the words of their own statutes, the Irish were referred to as "the King's Irish Enemies" and were treated as such.

In the 13ᵗʰ century, several statutes were passed in England, which influenced English real property law and laid its foundations, and which remain to the present day. While these laws in theory applied to all of Ireland, the rule of English law applied primarily in a territory around Dublin known as the Pale.

The practical effect of the feudal system in Ireland was very different from that in England. The situation was described by a Judge as follows:

> In both countries the law is based on the feudal system, which gave the landlord a certain superiority over his tenants. But the feudal relation, with its reciprocal rights and duties, never existed in Ireland. Here the landlord never led his tenants into battle; if they fought on the same field it was on different sides. They had no traditions of common victories or common defeats. The relation that existed between them was hostile (Mountifort Longfield, as cited by Donaldson, 1957, p. 231).

The lack of acceptance by the Irish of the foreign feudal policy and the apparent acceptance of the Brehon Laws by some of the Anglo-Norman barons led to a country subject to two distinct and conflicting legal systems for more than four centuries. This was largely accepted by those governing the Anglicised areas and integration was discouraged (Kolbert & O'Brien, 1975). These divisions caused tensions.

Tensions were heightened due to a combination of absentee landlords and inequitable laws. Kolbert and O'Brien argue:

> the tradition of enmity between landlord and tenant persisted bitterly throughout Irish history until the first Act of the Independent Irish Government abolished tenancy of rural land at a stroke (Kolbert & O'Brien, 1975, p. 12).

This caused unrest and led to the Irish appealing to various English kings to bring the whole country under the protection of a single law. Some of the original Irish leaders appealed to Edward I, offering 8,000 marks for the privilege of being recognised under English law. These appeals might have been successful, had it not been for Anglo-Irish barons who:

> persaded the King of England, that it was unfit to Communicate the Laws of England unto them; that it was the pollicie to holde them as Aliens and Enemies, and to prosecute them with continuall warre (sic) (Davies, 1612, p. 147).

Finally, in 1541, the English Crown (Henry VIII) tried to convert his "Irish enemies" into subjects by allowing Irish princes to sit into the Anglo-Irish Parliament in Dublin. However, following his death in 1547, compulsory Protestantism and land confiscation further heightened animosity between the native Irish and ruling class.

Godkin notes that during the wars of extermination:

> Her [Queen Elizabeth's] deputies and her presidents, too short-sighted to rule with justice, were driven to cruelty in spite of themselves. It was easier to kill than to restrain. Death was the only gaoler which their finances could support, while the Irish in turn lay in wait to retaliate upon their oppressors, and atrocity begat atrocity in hopeless continuity (Godkin, 1870, p. 71).

The wars of extermination led to the defeat of the Gaelic order and the ultimate flight overseas of the last great Gaelic leaders, O'Neill and O'Donnell. This ultimately led to the abolition of the Brehon Laws in 1613.

2.2.3.4   *The reign of English land law 1613-1870*

This period includes the introduction of the Penal Laws, which had a significant impact on land tenure and the Irish agricultural land market in the following centuries. The Cromwellian plantations began in the 17th century and included the plantation of two-thirds of the land of Ulster with English, Scottish and Welsh colonists, many of whom were Presbyterian. The Penal Laws were introduced to deprive Irish Catholics of further rights, including many land-related rights. These included the right to buy land, to take a long lease, and to inherit land, as an heir or legatee. The profit on a Catholic farm, outside the rent, was never to exceed one-third of the rent; and if any Protestant proved that the profit realised exceeded the proportion,

he could obtain legal possession of the farm. On a Catholic's eldest son declaring himself a Protestant, he became the owner of his father's landed property and the father became a life tenant. These provisions were obviously aimed at making it impossible for any Catholics to own land, as they were debarred from holding any office and, until 1794, the vote. Other legislation that affected Irish agriculture included the banning of exports, which effectively destroyed Irish industry and limited Ireland to largely subsistence farming.

Distrust and hatred were further increased following the Treaty of Limerick in 1690. In this Treaty the Irish surrendered the city of Limerick to the Crown and agreed to disband the Irish army, on the condition that Catholics could exercise some rights as free men. However, the men who dominated the Dublin Parliament wished to preserve the "Cromwellian Settlement" and ignored the Treaty (Kolbert and O'Brien, 1975).

2.2.3.5   *The pattern of land use: the Irish land problem*

The total land area of Ireland is 84,421 square kilometres, of which 66% is agricultural. Kolbert and O'Brien (1975) provide a concise overview of the topography:

> On the west side the land is often mountainous and rocky, with narrow valleys and inferior soil, but there are good uplands as well. Moreover, rainfall is high – hence the proverbial greenness of the island. Shaped like a saucer it has extensive areas of rich pasture land, with large sections of peat bog in the central plain. The natural conditions are best suited to grazing, especially as the winters are usually sufficiently mild for cattle to remain in fields all year but the ratio of grazing to arable varies as arable farming traditionally supports more people (Kolbert & O'Brien, 1975, p.24).

The introduction of the vote in 1793 for small landholders, including Roman Catholics, encouraged the ruling landowners to break their holdings into smaller divisions, while retaining only loyal supporters in the larger holdings with votes. This led to the number of small farms growing exponentially. By 1841 five-sixths of all farms were less than 15 acres in extent, while half were less than five acres and one-sixth were less than one acre (Kolbert & O'Brien, 1975).

At the same time there was a great increase in population. Between 1784 and 1841 the population rose from 2,000,000 to 8,000,000. Over 7,000,000 lived in rural areas, with an

average density of 217 persons per square mile (Delany, 1959). Delany noted that this "resulted in a large class of people who required land at any price, since agriculture was their sole mode of existence (Delany, 1959, p. 302)". He argued that this "reckless competition for land developed rents bearing no relation to the actual value of the land concerned (Delany, 1959, p. 302)".

As recognised by Kolbert and O'Brien (1975), there were too many people to obtain a comfortable living from the land. At that time, the potato was the staple food in the Irish diet, as it was possible to produce a large crop from a small plot. The prevalence of the potato, and its susceptibility to blight, left the majority threatened by starvation on an ongoing basis.

2.2.3.5.1 The Great Famine

In the years prior to the famine a new crop, the lumper potato, was introduced, which produced a greater yield. This made it possible to produce a large amount of food from a small plot of land. It was also more susceptible to blight and thus, when blight hit in 1845, it was severe and affected most of the population.

Lyons (1985) characterises the initial response of the British Government to the early, less severe phase of the famine as prompt and relatively successful. However, a poor English crop in the following year led to a limited subsequent response. Others went further. Dempsey (2017) notes that Ireland at this time was known as "the Garden of England" and that over 4,000 food ships left Ireland for England while 400,000 Irish people died of starvation. As the word "famine" is defined as an extreme scarcity of food, he concurs with the former Irish President Mary McAleese's description of the famine as the "Great Starvation."

In any respect, it is hard to disagree that these events would have heightened animosity. Death and emigration caused the population to fall from 8,200,000 in 1841 to 6,500,000 in 1851. Following the famine, the Irish became more active in organised political reform, with Daniel O'Connell's movement for the repeal of the Union. Many advocated the ownership of the land by the Irish, refusal of rent, and resistance to eviction. An armed force known as the Fenians also emerged.

2.2.3.5.2   The Land League and absentee landlordism

> The distinguishing features of Irish Landlordism remain the same in many respects in the days of Victoria as they were in the days of Elizabeth. Uncertainty of tenure was the evil then. It is, in the main, the evil now. The Anglo-Irish landlord was an absentee then. He is, in the main, an absentee today (O'Brien, 1880, p. 12).

As may be expected, O'Brien recognises that, since Queen Elizabeth's time (1837 to 1901), absentee landlordism was present in Ireland. This ties in with the earlier suggestion that post the 1801 Act of Union many wealthy Irishmen left Ireland. The Act of Union was no doubt a factor in accentuating the absentee landlord. It has been estimated that in 1842 Irish absentee landlords spent £6,000,000 outside the country (Woodham-Smith, 1962).

Few Irish landlords spent the income derived from the land on improvements. Unlike his English counterpart, the Irish landlord let "land" not the "farm' and all improvements, including the family home and outbuildings, were made by the tenant. If evicted, the tenant lost everything. During the period between 1850 and 1875 absentee landlords reinvested only 3-5% of rents on farm improvements (O'Grada, 1975).

Bew argues that the Irish land agents of these times were often more self-interested than the landlords themselves. There is likely some truth to this, as suggested by stories of evictions passed down through generations, often by way of *sean nós* (old Irish songs). However, in his recent study of the subject of Irish land agents between 1830 and 1860 Reilly (2014) found that this caricature of the land agent was not always true: the actions of agents such as Charles Boycott may have influenced people's perception. Good agents may have been passable, but the bad ones were ruthless, and this ruthlessness further aggravated tensions.

2.2.3.6   Deasy's Act

Prior to 1860, the relationship of landlord and tenant in Ireland was based on tenure, not on contract (Kolbert & O'Brien, 1975). There was no security of tenure for the tenants and their improvements were not protected. Deasy's Act (1860) simplified and increased the ways in which the landlord could recover possession of the land (Kolbert & O'Brien, 1975). It made the law relating to ejectment for the non-payment of rent and notice to quit more drastic, brought additional rights to Irish landlords but did not add to their responsibilities. However,

the cost of ejectment and legal difficulties did provide a restraining influence in preventing unaccountable evictions. Tensions in the aftermath of the famine continued to increase.

After the repeal of the Corn Laws,[3] the introduction of free trade saw the market for cattle expand and grain decline. This led to further increases in evictions, primarily of small tillage farmers in favour of larger grazing farmers, and was known as the "clearances."

2.2.3.6.1 Congested districts and changing attitudes

The clearances primarily affected the better lands, leading to over congestion on the poorer lands of the west. As the century wore on, the grievances of the people began to be aired in the House of Commons. The attitudes of the British were changing, as the true situation in Ireland was made known for the first time by the Devon Commission, which reported in 1845. This culminated in a violent Fenian outbreak in Manchester, which emphasised what had largely become known. The British Prime Minister of the time, Gladstone, then began introducing measures in Parliament that were designed to alleviate distress in Ireland. The Gladstone Land Act of 1870 aimed to provide compensation for improvements and disturbance, while introducing very limited state land purchase. In these aims the Act failed, as it was too restrictive (Kolbert & O'Brien, 1975). Despite its failure, it represented the turning of a great tide that had drowned many in Irish society in the previous centuries. The emergence of Irish leaders such as Parnell and Davitt, and the founding of the Irish Land League in 1879, ensured that the momentum of change was maintained. The Land League spread throughout the country and provided the mechanism for organised non-payments of rents and protests. This movement increased the popularity of leaders such as Parnell and Davitt and created the momentum for the passing of the subsequent Irish Land Code (see below). This resulted in landlords being supplanted by former tenants as the freehold owner-occupiers of the farms and holdings they cultivated.

The above outlines the historical context of commencing the dataset, which originate at a time when these revolutionary changes to land tenure were beginning to be implemented. One of the original proprietors of the firm from which the dataset was obtained was involved in some of these meetings, as can be seen in the telegram below. Unfortunately, minutes of

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[3] Measures enforced in the UK between 1815 and 1846, which imposed restrictions and tariffs on imported grain and which were most noteworthy for the assertion that they led to an increase in the cost of bread.

this meeting are not available, but it suggests that the firm was involved in the aforementioned revolutionary changes and that the data is reflective of the market at the time.
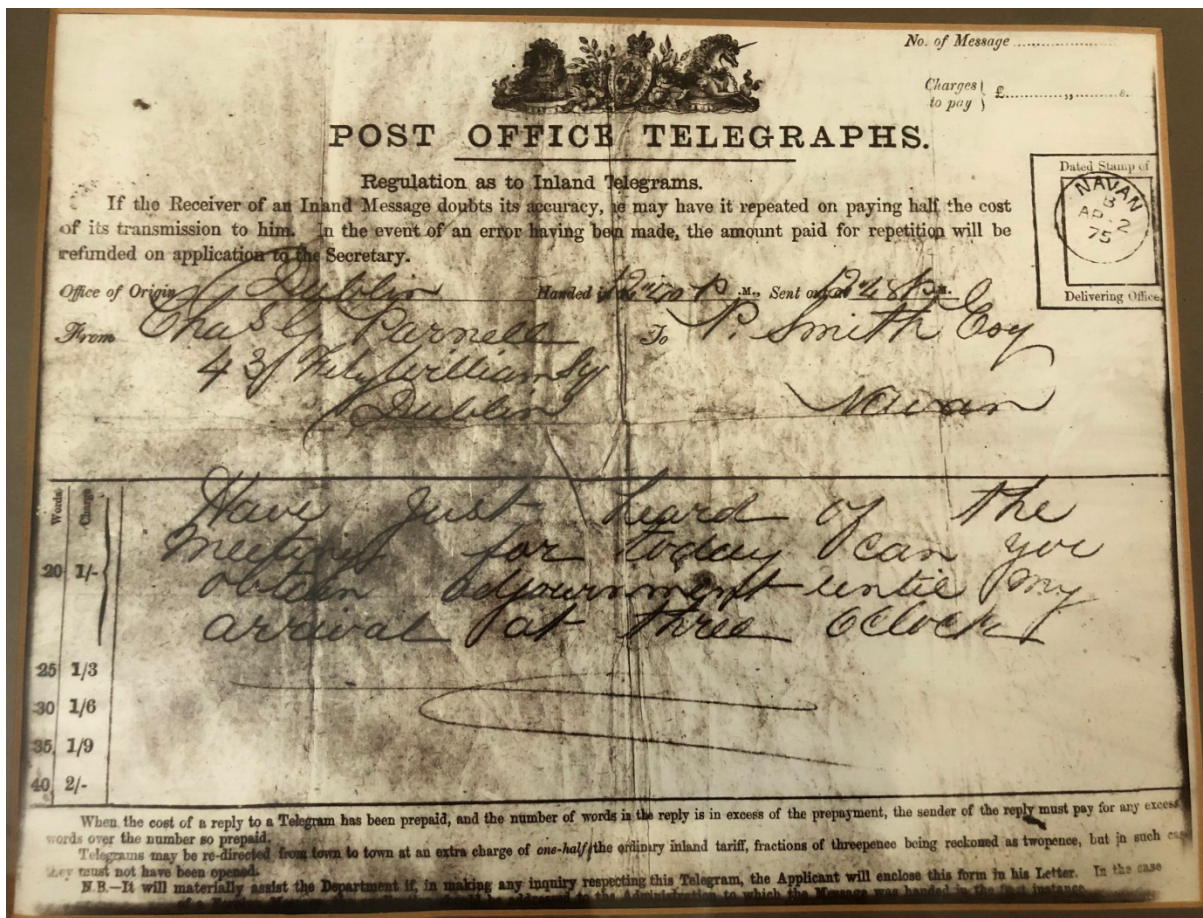
Figure 2.1: Telegram from Charles Stewart Parnell to P. Smith requesting a meeting to be held in Navan at 3.00 pm[4]

The following sections examine the relevant changes that were introduced in land tenure during the period.

2.2.3.6.2   Land reform under British rule 1870-1920

The history of the Irish Land Code falls naturally into two clear periods, namely from 1870 to 1921 under British rule and from 1923 to 1970 under Irish rule. Kolbert and O'Brien identify the Land Acts of these two periods form a consecutive integrity and have to be considered as one complete code.

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[4] Have just heard of the meeting for today. Can you obtain adjournment until my arrival at three o'clock.

Charles Stewart Parnell 43 Fitzwilliam Square to Patrick Smith Esq. Navan Private collection.

Although the first Act of 1870 failed, it paved the way for future changes. The second Gladstone Act of 1881 was more adventurous and legalised the "Three F's", which were the rights of a tenant to:

1. *Fixity of tenure* in their holding so long as they paid their rent and observed their covenants.

2. *A fair rent* on their holding fixed by an independent tribunal.

3. *The free sale* of their interest in their holding.

The granting of the Three F's had great significance for the Irish agricultural land market, as it effectively acknowledged that, prior to the introduction of this Act, a free market as we know it today did not exist in Ireland.

In addition to legalising the Three F's, the 1881 Act introduced many important changes, some of which are relevant to the subject study. For example, it created the Irish Land Commission, with the power to create sub commissions that could sit in all parts of the country to deal with applications for fair rents. Applications could be made, by the landlord or the tenant, to the Land Commission or the ordinary County Courts (Delany, 1959), most of which came before the Land Commission. Fair rents could also be mutually agreed between landlord and tenant. These became legally binding on being filed with the courts. The rents were fixed to run for a term of 15 years, after which they became subject to the possibility of further revision.

While it was not the focus of this study, it was interesting to examine the rental values determined by the Land Commission and compare them to the prevailing market rents and, perhaps more relevantly, to examine whether any significant market outside the this body existed at the time. In the 40 years that these provisions were in operation, the Land Commission data shows that in the 26 counties some 275,000 original rents were reduced by about 21%; some 93,000 rents which had already been fixed for a 15-year term were reduced for a further 15 years by about 18%; and some 3,000 rents were reduced for a third term by about 9%. A more detailed examination of the Land Commission data against the new dataset would provide for an interesting further study, as further expanded in Chapter 6.

In addition to its rent-fixing provisions, the 1881 Act empowered the Land Commission to provide advances to tenants for the purchase of their holding (Kolbert & O'Brien, 1975). The terms of the annuity were 5% for 35 years (subsequently reduced by the 1885 Act to 4% for a 49-year period). As with the 1870 Act, these 1881 purchase provisions were only used to a very small extent. Despite the strides forward of the 1881 Act, it did not solve the Irish land problem. Over time, it was recognised by all parties that a more radical solution was required. The following Land Acts effectively aimed to abolish Irish landlordism. Whether this was an appropriate aim is discussed later.

The 1885 Act (the Ashbourne Act) enabled tenants to obtain the full amount of the loan from the Land Commission. Part of the purchase money advanced to the landlord was retained by the Land Commission to prevent against defaulters. This Act was very popular, with over 16,000 tenants in 26 counties purchasing their holdings. The funds of the 1885 Act were exhausted in six years, leading to the 1891-96 Balfour Acts. The major change was that landlords were paid in full but in government-guaranteed land stock. Under the 1891 Act, 42,000 holdings in the 26 counties were purchased. While more popular, the success was limited, as some landlords preferred cash to stock. The 1885 Act also established the Congested Districts Board, which was the first measure to recognise the issues of uneconomical farms in the congested districts and address them with additional measures.

The price of stock continued to fall, leading to the necessity to introduce the 1903 Wyndham Act. Estates Commissioners were set up, which encouraged the sale of entire estates *en bloc*, with bonus criteria for landlords. The annuities were set below the agreed rents of the 1881 Act, with the term extended to 68.5 years. This made it easier for tenants to make repayments. In the case of non-judicial (market) rents, the Estates Commissioner had to approve the sale before it could take place. Cash for the sales was raised by the issue and sale of government-guaranteed stock. Some 195,000 tenants purchased their holdings under the 1903 Land Act.

The 1909 Act returned to the payment of landowners with stock, which reduced land purchase, although 61,000 tenants still purchased land under the Act. It also, together with a 1907 Act, empowered Estates Commissioners to purchase land compulsorily for the relief of congestion. The Estates Commissioners, together with the Congested District Board,

undertook a substantial investment and the investment included the expansion of uneconomical holdings.[5] In many cases the congested districts (often in the west of the country) were relocated to more fertile areas in the east. By the time of its dissolution in 1923, the Board had redistributed £750,000 for the relief of congestion.

2.2.3.6.3 Land reform under Irish rule

While the 1922 Constitution was silent on agrarian principles, the 1937 Constitution listed the following amongst the Directive Principles of Social Policy:

> The State shall, in particular, direct its policy towards securing … that there may be established on the land in economic security as many families as in the circumstances shall be practicable (Article 45.2 (v)).

Generally, the State followed this principle from its foundation. The 1923 Act abolished dual ownership entirely and introduced compulsory purchase at a "standard price." This was an automatic sum, the interest on which, at 4.75%, was to be equal to the new standard purchase annuity. That annuity was, in turn, to equate to a reduction of 35% of a judicial rent fixed before 16 August 1911 or a reduction of 30% on any thereafter. These were extremely favourable terms. The standard price worked out at about 14 years purchase of the rent formerly paid by the tenants on the average judicial rent (Kolbert & O'Brien, 1975). The dataset constructed as part of this research has demonstrated that yield movements have fluctuated considerably in the interim. The reasons for this have been considered in the context of exit yields, which is relevant to the study. A detailed examination of why the yields in agricultural lands moved out of line with other asset classes has potential for a future paper.

The 1923 Act set the tone for future Acts, relying as it did on compulsory purchase and resettlement. Of relevance to the subject study, the 1950 Act allowed the Land Commission to bid for land offered for sale on the open market, which introduced a powerful new potential purchaser into the market. Other Acts had less impact on the land market, the 1965 Act, for example, providing for investment in farm structures.

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[5] An "uneconomical holding" was one which could not support a man and his family to a sufficient standard of comfort and security.
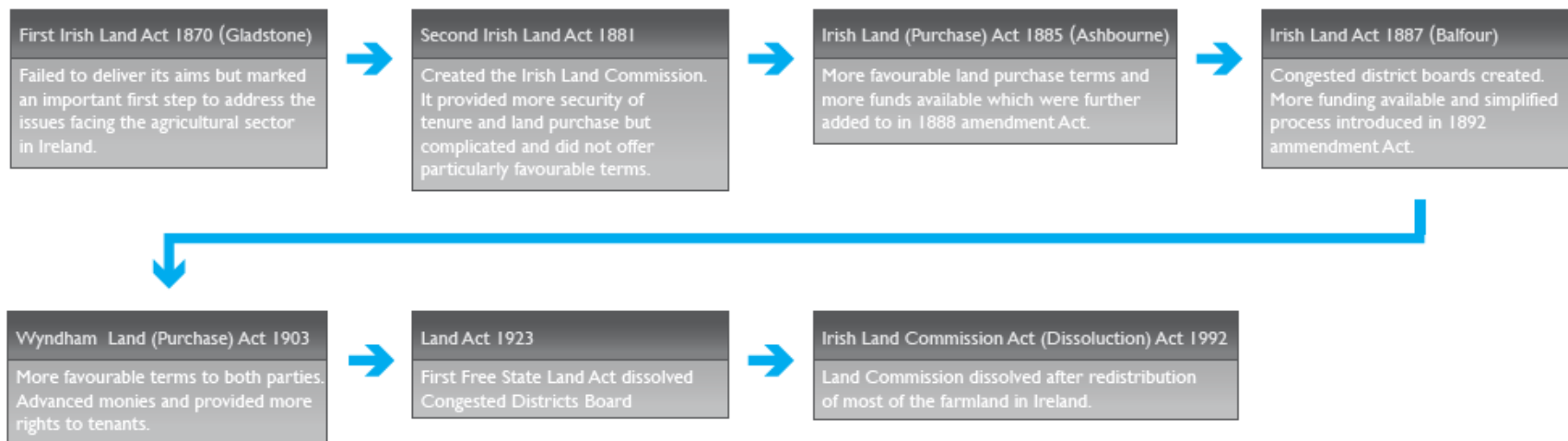
Figure 2.2: Timeline of important Land Acts relevant to research

First Irish Land Act 1870 (Gladstone)

Failed to deliver its aims but marked an important first step to address the issues facing the agricultural sector in Ireland.

Second Irish Land Act 1881

Created the Irish Land Commission. It provided more security of tenure and land purchase but complicated and did not offer particularly favourable terms.

Irish Land (Purchase) Act 1885 (Ashbourne)

More favourable land purchase terms and more funds available which were further added to in 1888 amendment Act.

Irish Land Act 1887 (Balfour)

Congested district boards created. More funding available and simplified process introduced in 1892 ammendment Act.

Wyndham Land (Purchase) Act 1903

More favourable terms to both parties. Advanced monies and provided more rights to tenants.

Land Act 1923

First Free State Land Act dissolved Congested Districts Board

Irish Land Commission Act (Dissoluction) Act 1992

Land Commission dissolved after redistribution of most of the farmland in Ireland.

The result of this Land Code was that from 1870, the system of land tenure in Ireland was reversed from absentee landlordism and native tenants-at-will to a system, throughout the whole country, of owner occupation. The struggle for land reform was closely interwoven with the struggle for home rule and independence from Britain. The attainment of this goal for Irish society and its relationship with the land is significant. There is an argument that, in many ways, Irish farmers still consider ownership of land and independence from Britain to be linked. All these factors have influenced the relationship market participants have with agricultural land. When valuing land the valuer must try and interpret the market behaviour of participants. It is therefore important that this context is carefully considered when selecting the appropriate valuation methodology for agricultural land in Ireland.

2.2.3.7 *Historical context and tenure of ownership of land in Ireland*

The primary message emerging from this context is that the culture and legislative framework runs so deep in the Irish psyche that it is still relevant to how participants behave in the agricultural land market. These cultural and legislative conditions must be considered when selecting the most appropriate valuation tools that reflect how market participants operate.

Ireland had a long-established system of land tenure that was well respected and considered relatively equitable to all market participants. This system was in place from the 5th to the 17th century. This is contrasted with the Penal Laws imposed on the Irish (subsequently tenant) farmers, which were weighted heavily in favour of the landlord. In these circumstances, the market could not operate in a transparent and efficient manner. The Landlord and Tenant Acts that were subsequently introduced set market prices and redressed the more important societal issues. This intervention into the market also prevented normal market trading conditions for many years, following the formation of the Irish Land Commission.

The favourable payment terms (as set out above) that were offered to farmers to purchase land often involved long repayment periods, often spanning generations. This is likely to have influenced how farmers viewed agricultural land as a long-term asset, where the return might well be achieved by future generations.

One of the predominant methods of sale that remains prevalent in the agricultural market in Ireland is the auction method, recognised as the most transparent method of sale. It is likely that this emerged as the predominant method at least partially out of a distrust of the land tenure system of the 19th and early 20th centuries. It filled the need for an open and transparent method of sale.

The public auction method of sale is, as the title suggests, public. It allowed the public, neighbouring farmers and agents to attend the sale of land and record not only the sale price but the number of interested parties (demand) for each piece of agricultural land. Having knowledge of these sale prices provided an evidence base for farmers and agents to assess the value of other farms. As the market emerged out of this period of change, the auction method provided a transparent method for comparable transactions to be reliably gathered, analysed and applied to other lands. It was probably the simplicity and transparency of this approach that quickly ensured the dominance of the comparable method as the preferred method of valuation in Ireland in the 20th century.

The lack of available tools such as spreadsheets and specific computer programs limited the ability to use alternative valuation methods during this period. The availability of agricultural input and output data has improved significantly in the interim. Combined with improved technology, this allows participants in the market, as well as valuers, to use alternatives to the relatively straightforward comparable technique and return to some of the economic theories of value that are explored in section 2.3 below.

2.2.3.8   *Changes in land use patterns and resulting challenges*

The shift in land ownership, from the domination of large land owners and tenant farmers to the domination of owner occupied farms was a welcome relief to most of Irish society in the early and mid-20th century. Although this change was vitally important for the establishment of modern Irish agriculture, not all the outcomes were positive. One negative effect of the shift to owner occupation was a reduction in the ease of land mobility between operators. In 1870, 95% of all agricultural land in Ireland was leased. By 1933 this reached an all-time low of 6% (McGrath, 2011), which is not surprising given that the first Act of the Independent Irish Government was intended to abolish tenancy of rural land (Kolbert & O'Brien. 1975). While this has increased somewhat since then, McGrath reports that by 1997 land leased in

Ireland was the lowest in Europe at 17%. McGrath (2011, p. 4) claims that since 1870, the "ultimate goal" of the Irish farmer has been the purchase of land, with the letting of land a very distant second.

The historical context of land ownership and occupation indicates a possible link between vulnerability and being a tenant. If a farmer owns their land they then know they cannot be thrown off it in the same way as their ancestors. The struggle for fair treatment, and ultimately land ownership, was long and hard. When it was eventually successful, and farmers across the country finally had security of tenure, they were generally slow to relinquish it. The clear goal of the early Land Acts, owner occupation, was achieved. However, this presented its own issues.

The first issue this raised was the impact on the market itself. It could be hypothesised that in the years and decades following the Land Acts, farmers (willing purchasers and willing vendors) placed a much greater weight on ownership than on leasing than was the case in other comparable jurisdictions and asset classes. This may partially explain the yield fluctuations previously referred to. While this theory is not further examined in this thesis, the production of the dataset provides opportunity for further analysis.

Secondly, the unavailability of a fluid sales market limits new entrants and limits the expansion of existing operations. Twomey recognises that because of:

> strong family ties to particular parcels of land [in Ireland], many farmers are farming the same land as their forefathers, and thus leading to an illiquid land market with less than 2% of land being traded annually (Twomey, 2008, p. 2).

Twomey recognises this as one of the main challenges facing the Irish dairy industry, given the relatively small "fragmented" farm operations, which were also a legacy of the Penal Laws and Land Acts.

The issue of land mobility is cited by Meehan in her 2012 report. She notes that the issue was not consigned to Ireland alone, citing a New Zealand professor lamenting the lack of fluidity in that market also:

> *There are three ways to farm ownership*: matrimony, patrimony or parsimony. Matrimony is through marriage, patrimony is through

inheritance and parsimony is by being miserly (Shadbolt, as cited by Meehan, 2012, p. 10).

The Irish Minister for State for Agriculture, Tom Hayes, at the launch of the SCSI/Teagasc land report in 2014, recognised the issue of the lack of land mobility preventing younger generations of farmers from gaining access to productive assets. The lack of fluidity also limits comparable data and therefore results in a less transparent system that restricts informed decision-making. This issue of a lack of comparable data and therefore a less transparent system is central to the thesis of this research.

A counterargument to these issues of mobility is that the prevailing rental system in Ireland is the conacre[6] or 11-month system. While this provides tenants with only conacre rights, it also gives the opportunity for high levels of changes of operator and use on a short-term basis. Some of the land that is rented on a conacre basis does go to the open market, usually on a private treaty basis, but occasionally by public auction. However, these market transactions are not common and usually take place when the existing tenant does not want to rent the land for another conacre period. Most of the land on the 11-month system is offered to the same tenant as for the previous years, at a rent proposed by the agent on the instruction of the landowner. As the agent is often the only party privy to comparable data (data within the agent's firm), the market lacks transparency.

Landowners often cite that the tenant they know keeps the land well or is reliable with payment, which are clearly key concerns. However, it can be argued that even at this level the historical context plays a key role, where landowners do not want to be seen to be evicting tenants, even in instances where their 11-month agreement expires. Ultimately, therefore, the result of this is that previous tenants who were relatively good at paying and keeping the land well, are offered it again. This puts a constraint on land mobility.

Aside from the land mobility issues, this system of tenure provides limited rights to tenants. It could be regarded as a throwback to the pre-1870 system. Tenants are unlikely to invest in

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[6] Conacre (a corruption of *corn-acre*), in Ireland, is a system of letting land, formerly in small patches or strips, and usually for tillage (growth of corn or potatoes). It is considered to be of sufficient length to sow and harvest a crop but without creating a relationship between landlord and tenant. Holding the land under conacre granted no legal rights to the land, with rent being paid in cash, labour or a combination of both (Hickey, 1980). These days short-term agreements accompany the lettings and it operates as a standard short-term, 11-month agreement.

farm improvements with these limited rights and there is not a tradition of landowners investing in farm improvements in Ireland. While the conacre system is not a solution to the "problem" of low land mobility, it still results in higher levels of mobility than long-term leases. Despite its limitations and similarities to the pre-1870 system, the letting of land for 11 months or less continues to dominate the rental market for agricultural land in Ireland.

The lack of market transactions (sales and to a lesser extent rental) results in a shortage of comparable data and the lack of availability of data, in the absence of other appropriate valuation techniques, limits evidence-based valuation. It is this issue that limits the reliability of the comparable method and was a significant motivator for this study. Informed decision-making is important to assist farmers in making capital investments. This lack of evidence hinders decision-making and influences farmers and indirectly other stakeholders such as the banking sector, tax authorities, and parties involved in disputes.

The construction of the dataset provides the basis necessary to test the appropriateness of the DCF approach within this thesis. It will also improve the availability of data to assist in addressing this issue and comprise a significant range of data to test other theories in future studies, such as land mobility and other economic theories of value.

2.3 Economic theory of value

This section examines how a valuation is arrived at, and the emergence of economic theories of value and their development in the context of their application to property uses.

2.3.1 Theories of value

Theories of value have a long history that is not solely concerned with the economic discipline. Broadly speaking, value theory is scientifically empirical, recording what people value and attempting to understand why they value it in the context of psychology, sociology, and economics (Detmer, 1988). While the economic element of value theory is particularly relevant to the valuation of agricultural land, given the historical and political context outlined, it is worth considering its various branches. As previously noted, Sampson (2017) highlights that it is often the crossover between disciplines that provides the most interesting insights.

Early theories were proposed by the Greek philosophers, such as Plato, who primarily focused on the ethics of value theory. Plato argued that "a man should not attempt to raise the price, but simply ask the value" (Plato as cited by Sewall 1901, p.47), implying that value is an absolute quality inherent in the thing. Aristotle also proposed a theory about valuation that emphasised the usefulness of the commodity to be valued. He was one of the first to outline differences between price (an exchange), value, and cost. He identified that an exchange occurs when each gets exactly as much as they give the other; yet this equality does not mean equal costs, but equal wants. If men want the cobbler's product more than the husbandman's, more grain must be given for shoes (Aristotle, as cited by Watkins, 1911, p. 48).

Distinguishing between price, value and cost was a significant development in economic theory. It is important for a valuation practitioner to be able to clearly distinguish between price, value, cost and worth, as discussed later in this chapter. It was not until the early Christian thinkers that theories on value were again advanced. They were like the early philosophers, in that they emphasised what should "justly" be the price. Only the minority, such as St Thomas Aquinas (1225-74), considered elements such as cost in the equation. During the 16th and 17th centuries, early mercantilists redirected the theories on value towards utility theory. Much of the early literature on utility theory, such as the views of John Stuart Mill, consider utility as a measure of pleasure within the theory of utilitarianism. While this has developed in neoclassical economics, Gowdy (1985) argues that in agrarian societies the original interpretation is more appropriate.

The neoclassical model ranks consumers' preferences on the basis that the rational consumer will not spend money on an additional unit of good or service unless its marginal utility (the usefulness gained from the last item purchased) is at least equal to or greater than that of a unit of another good or service. This is explained later in this chapter by way of example.[7] Therefore, the price of a good or service is related to its marginal utility and the consumer will rank his or her preferences accordingly (BusinessDirectory, 2014). According to Gowdy:

> neo-classical utility theory implies that all individuals, regardless of the institutional context in which they find themselves, act according to strict maximisation rules (Gowdy, 1985, p.115).

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[7] See Jevons (1871, p. 38) and Bohm-Bawerk (1891, p. 39).

He notes that these assumptions underlying neoclassical theory make it particularly inappropriate for analysing agrarian communities.

While modern-day Ireland would not be classified as an agrarian society under Gowdy's definition:

> By a peasant economy one means a system of small-scale producers, with a simple technology and equipment often relying primarily for their subsistence on what they themselves produce. The primary means of livelihood of the peasant is cultivation of the soil (Gowdy, 1985, p.104).

there is an argument that 19th- and early 20th-century Ireland would meet elements of this definition.

As the origins of utility theory were developing, William Petty, an economist and philosopher (who came to prominence for surveying land in Ireland), claimed that the market price ("actual price") of any commodity would fluctuate perpetually around its natural value ("natural price"). The determinants of this natural value were deduced as the factors of production – land and labour (Petty, as cited by Fogarty, 1996). Petty focused on the labour only and his theories faced many difficulties with the labour cost theory of value (Fogarty, 2013).

Also, in the late 17th century, Richard Cantillon, another economist with Irish links, came to prominence. Cantillon equated the value of a labourer with that of twice the produce of the land that the labourer consumes, while allowing for variations in the labourer's skills and status. Once this "par" value is calculated, the intrinsic values of any good can be reduced to land only (Cantillon, as cited by Fogarty, 1996). In doing so, Cantillon produced one of the first land theories of value. As highlighted by Fogarty (2013), both Cantillon's land theory and Petty's labour theory were only a true description of value in highly specific cases.

"Pre-classical" economists such as Nicholas Barbon thought:

> the value of all wares arise from their use; things of no use, have no value, as the English phrase is, they are good for nothing" (Barbon, 1690, p.1).

Barbon was from a puritan background and was probably influenced by Christian thinkers. His notion was quite rightly dismissed by John Law, when outlining his solution to the water/diamond paradox of value. Law was the first to consider both the supply and demand

for a product to determine the value of a good to a society, whereby comparatively "useless" diamonds are more highly valued than the more "useful" water (Law, as cited by Blaug, 1991). Fogarty (2013) argues that Law's early solution to value theory gained little following, owing to his failed personal financial operations. It nonetheless represented a breakthrough in value theory.

Smith's (1776) *An inquiry into the nature and causes of the wealth of nations* produced a cost of production value theory. It considered land, labour, and capital value theory. This was a widely accepted theory that was later adapted by Ricardo, who argued that value depended upon the quantity of labour necessary for production, which would be calculated by time (Fogarty, 2013). Ricardo stated that "Possessing utility, commodities derive their exchangeable value from two sources: from their scarcity and from the quantity of labour required to obtain them" (Ricardo, as cited by Fogarty 2013, p. 1). Although he acknowledged that value could be determined by scarcity alone (e.g. rare documents), he argued that these were insignificant cases (Fogarty, 1996).

Ricardo also developed a theory of land rent, which is of particular relevance to the subject study. Ricardo observed that "land has no cost of production (apart from a few exceptional cases) and sells at a price only because people expect to earn a rent from it (or want it for certain other reasons …)" (Ricardo, as cited by Clarke, 1973, p. 2). Clarke notes that it follows that the rent of different land only originate because there are differences between the lands.

He proposed that rent is price determined (as opposed to price determining). In other words, you pay a price for land because of the rent. You do not have to charge a rent because of the price you paid for the land. It is important to note that rent, according to Ricardo's theory, refers to the amount that proceeds received exceed the minimum amount which to evoke the supply of the factors of production required (Clarke, 1973). The minimum amount required to evoke its services will, in the long-run, include maintenance and other fixed improvements. Therefore, the rent receivable by the owner is likely to be less than the Ricardian definition of economic rent. It could be argued from this theory that Ricardo is one of the first advocates of the cash flow approach, based on the economic rent (or income) that can be generated from the land. His theory of land rent remains relevant today and is drawn upon later in this study.

Ricardo's views on value, were not as fully developed as his theories of land rent. Nevertheless, he still believed the quantity of labour used to produce goods was the crucial element in the calculation (Fogarty, 2013).

Mill considered the effects of supply and demand on value theory. Moving away from the Classical Ricardian model, he believed:

> the value which a commodity will bring in any market is no other than the value which, in that market, gives a demand just sufficient to carry off the existing supply (Mill, 1848, as cited by Fogarty, 2013, p. 1).

Although he advanced the thinking on the subject, he also concluded in 1848:

> Happily, there is nothing in the laws of value which remains for the present or any future writer to clear up; the theory of the subject is complete (Mill, 1848, as cited by (Fogarty, 2013), p. 1).

In 1871, Jevons and Mengers independently arrived at theories that value depends entirely on utility. Jevons's theories of marginal analysis held that the utility (value) of each additional unit of a commodity – the marginal utility – becomes less and less useful to the consumer. It is best explained by way of an example. When you are thirsty, you get great utility from a glass of water. Once your thirst is quenched, the second and third glasses are less and less appealing. Feeling satiated, you will eventually refuse water altogether. Bohm-Bawerk's (1891) example of grain provides further insights. Both examples demonstrate that value depends entirely upon utility (Jevons, 1871). Jevons and Mengers argue that, regardless of the costs incurred in producing a good, when it arrives on a market its value will depend solely on the utility the buyer expects to receive (Jevons and Mengers, as cited by Fogarty, 2013). As previously referred to the concept of utility theory forms an important aspect of this research.

With the benefit of this greater understanding of marginal utility, Mengers returned to the paradox of water and diamonds:

> The value of diamonds was greater than the value of water because it is marginal utility, and not total utility, that determines consumer choice and hence, value (Menger, 1871).

In the context of agricultural land, this explains why at an auction a farmer with no or limited land will outbid a rival with equal resources, who has enough land (Jevons, 1871).

These emerging theories of the late 19th and early 20th centuries remain the basis for some of the advanced valuation methods that are examined later. Of particular relevance to the subject study is the conclusion that value comes from future and not past production (Fogarty, 2013). This is particularly relevant when discussing the appropriate valuation model to assess the market value of agricultural land.

Walras and Marshall further advanced the discussion by finding that both the cost of production (supply) and utility (demand) were interdependent and mutually determinant of each other's values (William Stanley Jevons, 2014). Walras's general equilibrium model concluded that in general equilibrium everything depends upon everything else (William Stanley Jevons, 2014). Although others before him had highlighted the interrelatedness of households, firms, prices of final goods, prices of factors of production, and quantities supplied and demanded of all final and intermediate goods, no one had been able to express this as precisely as him, by stating it as a system of simultaneous equations. It was now possible to see that equilibrium for the household and equilibrium in the markets for final goods were consistent with equilibrium for the firm and equilibrium in factor markets (Zera, 2014). This breakthrough again emphasises the need for consideration of all factors that may influence value.

At the same time Marshall, again utilising marginal utility theories, developed an explanation of value in terms of supply and demand. Marshall understood that:

> the study of any economic concept, like value, is hindered by the interrelativeness of the economy and varying time effects (Marshall cited by Fogarty, 2013).

Marshall therefore adapted Walras's theory using a partial equilibrium framework, in which most variables are kept constant, to develop his analysis on the theory of value (William Stanley Jevons, 2014). Marshall divided his study into four periods. Firstly, in the market period, where time is so short that supply is fixed, value of a good is determined by its demand (Fogarty, 1996a). This is the main theory relevant to the agricultural land market, due to the relatively fixed supply of land referred to earlier in this chapter. However, while

total supply is fixed and not infinite, the supply available on the market can change over time. For completeness, Marshall's other scenarios are set out as concisely explained by Fogarty (1996a):

> Secondly, in the short-run period, firms can change their production but cannot vary their plant size, which allows supply as well as demand to have an effect on value. In the long-run periods where plant size can be altered, the large effects of the supply side on value depends on whether the industry of a particular good has constant, increasing or decreasing costs to scale. Finally, in the secular period in which technology and population are allowed to vary, the supply side conditions dominate value (Fogarty, 1996a, p. 1).

While the supply of land on the market can change, for the most part the agricultural land market conditions are primarily categorised as the first scenario. Therefore, it could be argued that value, in an agricultural land context, is driven primarily by its utility and ultimately the demand for this utility. However, it is important to note that in general Marshall believed:

> it was fruitless to argue whether demand or supply determines value as we might as reasonably dispute whether it is the upper or under blade of a pair of scissors that cuts a piece of paper, as whether value is governed by utility or costs of production (Marshal 1890, as cited by Fogarty 2013).

Fogarty's analysis of the history of economic theory similarly concludes that "any attempt to find one single cause of value, as others had unsuccessfully attempted in the past, was likely to fail" (Fogarty, 2013, p. 1).

Applying this logic to an agricultural land context, we can arrive at interesting conclusions. As the supply of land is largely fixed, land price is demand driven. It may therefore be hypothesised that the primary driver of the market is what market participants will obtain from the use of the asset (utility). More specifically, it is the utility obtained by the highest bidder (purchaser), together with the utility attributed to it by the vendor (seller), that primarily influences value. Based on this rationale, the hypothesis adopted for this research is that the best way to assess this utility, as Ireland moves away from an agrarian society, is to use valuation methods that attempt to measure utility. As we will see later in this chapter the DCF method examines the income stream or utility of an asset to the proposed purchaser.

The counter to this is that the historical context in Ireland has a larger influence on the supply of land than in other asset classes. This suggests that while the DCF is likely to have a

significant relationship with value, there are likely to be other considerations, particularly in the earlier period of the dataset. It is the researcher's suggestion that as we advance into the 21st century, market participants attach less weight to the events of the 19th century and more to the returns from agricultural land, when assessing the market value of this land. This would explain the reliance solely on the comparable method of valuation. It would also suggest that it is now timely to test the accuracy of the DCF method to assess the market value of agricultural land in Ireland. However, this historical and economic context needs to be considered in the context of the practitioners' bases of value, as set out in section 2.4.

Considering the various developments of value theory over the centuries, and how even scholars of the subject ignored key concepts (such as Law's understanding of supply and demand, until the late 19th century) shows how different people may have very different understandings of value. It is therefore not surprising that specific tools to value specific asset classes, such as agricultural land, have not already been developed. However, as has been discussed, the theories also provide a logical rationale to test the accuracy of the DCF approach. The following sections focus more specifically on theories of value relevant to the subject study, while section 2.4 further explores the differing conceptual frameworks between price, value and worth relevant in the valuation of agricultural land.

2.3.1.1 The theory of economic rent

The theory of economic rent is an extension of these theories of value and worthy of discussion in greater detail in relation to the valuation of agricultural land. The value of agricultural land is the value that can be attributed to the elements of nature that are not man-made. This definition is almost invariably attributed to Ricardo, who proposed it in 1815, but the physiocrats also referred to the question of the *produit net* between 1755 and 1775 (Fogarty, 1996a). This accrued to the landowners from the "cultivators", who were left with just enough to cover their necessary expenditure (Nix, Hill, Williams, & Bough, 2003). In *An inquiry into the nature and causes of the wealth of nations*, Smith observes that rent is "the produce of those powers of nature, the use of which the landlord lends to the farmer" (Smith, 1776, p. 297)

Of the related theories that emerged from this era, it is Ricardo who has been largely credited with the most complete theory of land rent. The theory introduced the concept of the

"margin" of production. Land is at the margin if it is only just worth cultivating, that is, if the value of the output covers cost, it leaves just enough "profit" to persuade the farmer to continue to farm it. Naturally, better quality land will produce a surplus above the marginal level of output. Farmers will compete with one another to rent this better land so will "bid away" this surplus in their offers of rent to the landlords, as highlighted in the table below.

	A	B	C	D
1		Tonnes per hectare	Cereals price per tonne (net of costs)	Rent per hectare
2	Marginal level	10	€100.00	€0.00
3	Better land	11	€100.00	€100.00
4	Better land	12	€100.00	€200.00

Table 2.1: A notional example of the marginal level of production

The scenario outlined in Table 2.1 assumes that the relationship between yields and costs remains the same. A change in either of these variables would lead to a change in the rent. As we know, land is a heterogeneous asset, with no two parcels being the same. The influence of other variables is discussed at a later stage. An important point to note about Ricardo's theory is the oft-quoted passage "Corn is not high because a rent is paid, but a rent is paid because corn is high." In other words, if the price of corn rises the rent of land increases and not vice-versa.

6		Tonnes per hectare	Marginal price per tonne (net of costs)	Price per tonne (net of costs)	Rent per hectare
7	Marginal level	10	€100.00	€110.00	€100.00
8	Better land	11	€100.00	€110.00	€210.00
9	Better land	12	€100.00	€110.00	€320.00

Table 2.2: The impact of a 10% increase in the price of corn on rent

In modern Ireland, the majority of land is farmed, albeit to different degrees of intensity. Based on Ricardo's theories, this indicates that there is no or very limited marginal land. Some commentators may suggest this disproves Ricardo's theories. It is likely that this lack of "marginal" land is because payments from the EU change land that may otherwise be marginal into land that market participants are prepared to bid for. In addition, some land that may be classified as marginal may be utilised by "hobby" or "lifestyle" farmers. These are farm operators whose primary aim is not necessarily profit maximisation, or even to make a profit. Furthermore, some marginal land likely forms part of the Rural Environment Protection Scheme (REPS), which pays farmers not to cultivate land to enhance the environment.

Not long after Ricardo, an entirely different land rent model was proposed by an amateur economist and farmer, Johann Heinrich Von Thűnen. Rather than focusing on the quality of the land as a determinant of value, as Ricardo had done, he focused on the distance from the nearest market. His basis was the closer to the market the lower the transportation costs and hence the more money a farmer would be prepared to bid for land. This was the first marginal production theory (Sills, 1968). Despite being a self-taught amateur economist, Von Thűnen developed his theories in what is still regarded as a rigorous way, with detailed notes of his workings. However, as with Ricardo's, the theory had its limitations. For theoretical purposes he assumed "an isolated state" that he defined as one single marketplace for goods. Prices were therefore highest closest to the marketplace and dropped as the distance to market increased. This highlights a particular weakness of Von Thűnen's theory. He assumed equal margins, with the only cost differentiation between market participants being the distance from the market. Despite its limitations in developing a comprehensive land use model, his theory provided a solid platform for many modern theories of land use patterns. It also demonstrated the importance of costs of production (including transport costs) in the determination of what farmers were prepared to bid for land. While this is a simple theory in the context of the more complex agricultural land markets of the current era, it nonetheless supports the hypothesis of testing the DCF method as the best method to draw together both approaches.

Jones (1978) attempted to join or synthesise the Ricardo and Von Thűnen models, noting that "a decrease in the transportation rate in the Thünen model is equivalent to a fertility improvement in Ricardo's scheme" (Jones, 1979, p. 642). While Kellerman criticised aspects of Jones's model, it appeared that he accepted this basic premise. This is particularly relevant to the present study of agricultural land values, in that the elements that drive the price or market value of agricultural land come from the productivity of the land and the costs involved in producing the output. This again suggests the DCF method to be a better fit for valuing agricultural land. This will become relevant in the selection of the appropriate model to value agricultural land.

2.3.1.1 Development of economic theories having regard to the Irish historical context

As noted, the valuation of agricultural land was extensively studied throughout Europe before the 20th century by scholars such as Ricardo and Von Thűnen. However, given the Irish political and historical context, many of these principles did not apply to the Irish land market. As previously noted, prior to the establishment of the three F's in 1870, the market was dominated by monopolistic land-holders with limited rights for tenants. In the era of the Land Acts (1870-1930s) market prices were largely set through compulsory purchase (and therefore limited regard to economic rent), and in post-1930 generation, many market participants passed land through generations of family, due to the events of the previous century.

In this context, many of these economic theories, such as Von Thünen's linking the price of agricultural land to solely the profits derived from the land, were of limited relevance. Rather, it is suggested that the utility the land generated was also linked to the sense of pride and historical factors, as highlighted by McGrath (2011) and similar to elements of agrarian societies (Gowdy, 1985). However, in his practice the researcher has identified many young farmers from a new 21st-century generation, who appear to consider the utility of the land more closely linked to the Ricardian and Von Thünen theories of land value. This is not to say that the market has entirely forgotten the historical context, but it is hypotheisesed that as Ireland moves further away from an agrarian society, these economic theories of land value may be more applicable to the Irish agricultural land market in the 21st century than they have been hertofore.

In terms of examining theories and methods of valuing agricultural land, the study is particularly timely. McAuley[8] (2017) found that a shock to farming incomes appears to be impacting on the land market. As the Society of Chartered Surveyors Ireland (SCSI)/Teagasc land market review is based on a survey of practitioners and is only in its fourth year, there is limited evidence to support this hypothesis. However, it provides further support for the hypothesis of this thesis and suggests that the re-evaluation of agricultural land value theories in an Irish context is both timely and warranted.

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[8] It should be noted that the researcher (1) sits on the board of the editorial board of the *Surveyors Journal*, in which this article was published; (2) established the report (*SCSI/Teagasc Land market review and outlook*), of which this article is an extract; and (3) is a former colleague of Edward McAuley, through Smith Harrington.

Furthermore, valuations may be required for the computation of taxation, finance purposes, for making investment decisions, and a growing number of other purposes. The Central Bank of Ireland acknowledges both the importance of valuations and, specifically in terms of finance, the requirement for more frequent valuations (Central Bank of Ireland, 2011). The Central Bank also recognises the need to re-examine the processes used for valuations on a regular basis.

While more frequent valuations would be a welcome improvement, there is an argument that if undertaken on a comparable basis, due to a lack of alternatives, and given the lack of comparable evidence, the smoothing of valuations may occur.

Clayton, Geltner and Hamilton have shown that the comparable analysis has led to the lagging and smoothing of appraisals (Clayton et al., 2001). Michl, Lorenz, Lützkendorf and Sayce (2016) note that while this theoretically should not happen, in practice behavioural studies show that anchoring may occur (Michl et al., 2016). This furthers the argument for a forward-looking valuation methodology, which may provide a cross-check to help protect against these smoothing issues.

In recent years, there seems to have been a disregarding of these fundamental principles by valuation practitioners. This may be due to the more complex markets that now exist. The theroeretical market on which Von Thűnen based his model was simplistic. Indeed, he may not have been able to establish those same theories in today's complex, globalalised markets. Advances in, for example, refrigeration and transport have exponentially increased the market options available to the modern farmer. Some practitioners argue that the market for agricultural land today is not rational and it is not appropriate to apply standard economic rules or principles to this market, as, for example, in the case of farmers being prepared to pay premiums for land adjoining their farms. Prag observes:

> a farmer may bid beyond what is reasonable to another purchaser just in order to secure some land that is close to an existing holding which represents a chance in a lifetime (Prag, 2003, p. 19).

This observation only serves to further reinforce the belief that economic principles hold true in the market for agricultural land. The statement recognises that a neighbouring farmer may bid beyond what is reasonable to another purchaser. In this statement, Prag is recognising

both Von Thűnen's theory and the theory of economies of scale. Von Thűnen's theory applies in this case, as the greater the distance between a farmer's operations the higher the cost and therefore the lower the price they are prepared to bid. If land is beside an existing operation, it is reasonable and rational to hypothesise that a farmer will pay more than an otherwise similar purchaser with a further distance to travel. It also recognises economies of scale, meaning that as the scale of production increases, the average costs reduce.
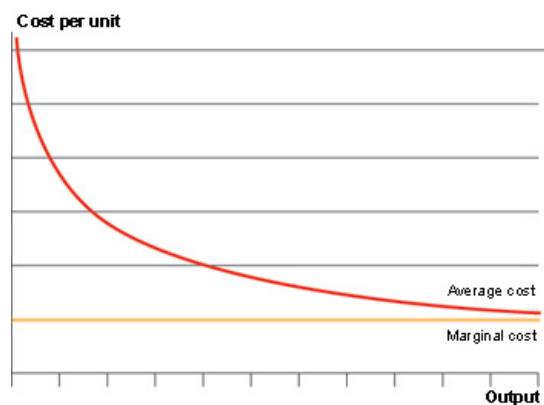
Figure 2.3: Simple diagram showing the reducing average cost on larger scales (Krugman, 2008)

This simple phenomenon of adjoining property being worth more to neighbouring owners is referred to as "marriage value" in real estate. It is often observed with adjoining buildings or adjoining portions of development land. It further supports the idea of testing the DCF, which can account for economies of scale. The limited utility of small parcels of land in modern farming also demonstrates economies of sale in agricultural land. These smaller parcels are particularly prevalent in Irish agriculture for the historical reasons previously outlined. When they go on the market, they are generally only of interest to adjoining farmers (who have economies of scale) or to hobby farmers. This demonstrates why there is often only limited interest in small parcels of agricultural land. Other markets, for example small retail kiosks, may have more universal utility and are likely to be in greater demand due to the increased number of market participants. The practitioner will generally acknowledge this phenomenon in practice. This suggests that fundamental economic principles have as much relevance in modern agricultural land markets as they did in the times of Ricardo and Von Thűnen.

Given the well developed nature of land valuation theory, and acknowledgement of the importance of economic principles to support valuation methodologies throughout Europe, it may appear surprising that valuation practitioners in Ireland have largely disregarded these theories over the last century. However, it is not surprising; nor has it been the incorrect

approach to date. Linking back to Graaskamp (1992), the process of real estate appraisal is intrinsically linked to the cultural and statutory process of the subject market. It is suggested that this supports the claim that valuation practitioners were correct to utilise the comparable method, as it more closely reflected the utility market participants placed on agricultural land during the 20ᵗʰ century. The critical analysis of the cultural and statutory process of the Irish agricultural land market, the researcher/practitioner's experiences, and the economic theories support the hypothesis that these economic theories of land value may be more applicable to the Irish agricultural land market in the 21ˢᵗ century than they have been been hertofore.

This literature review has reviewed and critically analysed the cultural and statutory process of the subject market and linked this analysis with economic theory (and practitioners' bases of value) to support the hypothesis that the DCF model is a valid valuation methodology to estimate the market value of agricultural land in Ireland.

The valuation methodologies are explored in the following sections. First the bases of values are examined and defined for this research.

2.4 The valuation practitioners' bases of value and conceptual frameworks

2.4.1 Market value

The historical and economic contexts need to be considered with reference to practitioners' bases of value. The International Valuation Standards Council (IVSC) recognises four bases of value. These are:

1. Market value.
2. Market rent.
3. Worth (investment value).
4. Fair value. (IVSC, 2017)

The first basis of value to be critically analysed, and which is a key definition that is relevant to this study, is market value. It is perhaps the most commonly used basis of value. This is because it is recognised by the IVSC and adopted by many of the leading professional bodies representing valuers, including the RICS and the European Group of Valuers' Associations (TEGoVA), as the basis of value that should be adopted by valuers. The IVSC and TEGoVA are independent, not-for-profit, private sector organisations that have a remit to serve the

public interest, while the RICS is the largest body representing valuation practitioners in the world. The emergence of global standards proved necessary in the aftermath of financial irregularities, a banking crisis, and the continuing growth of globalisation. The definitions and conceptual frameworks were informed by academic papers on the subject. An internationally accepted concept of market value, recognised by IVSC and TEGoVA, emerged in 1997 defined as follows:

> Market value is the estimated amount for which an asset should exchange on the date of valuation between a willing seller and a willing buyer after proper marketing in an arm's length transaction wherein the parties had each acted knowledgeably, prudently and without compulsion (TEGoVA, 1997, p. 17).

In 1997 the RICS based its definition of market value on IVSC standards. Since this time there has been ongoing refinement of the definition through collaboration among these three organisations. The 2014 global edition of the *RICS Valuation standards*, colloquially referred to as the *Red book*, has moved from basing its definition of market value on the International Valuation Standards (IVS) to agreeing the wording, conceptual framework, and fundamental assumptions underpinning the definition of market value. As it is accepted by both the IVSC and RICS, it is the most internationally accepted definition of market value. It is also accepted by the members of the SCSI, which is the largest professional body representing valuers in Ireland. The 2013 IVSC internationally accepted definition, which is also the most widely adopted definition in Ireland (based on the number of members of SCSI), is set out below:

> The estimated amount for which an asset or liability should exchange on the valuation date between a willing buyer and a willing seller in an arm's length transaction after proper marketing and where the parties had each acted knowledgeably, prudently and without[9] compulsion (RICS 2017, p.10; IVSC 2013, p.5).

The importance of a standard definition cannot be overstated. It is crucial that when practitioners are attempting to estimate the market value they understand the definition and the conceptual framework that it implies. More pertinent to this study, the conceptual

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[9] The 2016 TEGoVA definition differs stating without *being under* compulsion *(TEGoVA, 2016, p.15).* This amendment does not substantially differ from the conceptual framework of the internationally accepted definition.

framework provides the basis for how these theories are tested. This conceptual framework are now explored with significant reference to the RICS *Valuation standards* guidance notes and explanatory commentary from TEGoVA and the IVSC. From this, it should become clear that the market value definition is, in simple terms, trying to replicate an objective market price transaction.

The first term is the "estimated amount", which refers to the fact that the value of an asset is an estimated amount, rather than a predetermined amount or actual sale price (RICS, 2014). The use of the word "should", rather than alternatives such as "will", in "an asset should exchange", again refers to the fact that the value is not predetermined and is an estimate of the price in a market exchange.

"On the valuation date" requires that the value is time specific as of a given date. It is an important point, as markets and market conditions may change based on significant events in a short time span, for example, the events of 10 September 2001 versus 12 September 2001 influenced markets across the globe and valuations of certain assets, including real estate, would be very different on those respective dates, even though they are only two days apart.

A "willing buyer" is one who is motivated, but not compelled to buy (RICS, 2017). The purchaser is therefore "neither over eager nor determined to buy at any price." They will purchase:

> in accordance with the realities of the current market and with current market expectations, rather than in relation to an imaginary or hypothetical market that cannot be demonstrated or anticipated to exist [and] would not pay a higher price than the market requires (RICS, 2017, p.19).

Equally, "a willing seller" is "motivated to sell the asset at market terms for the best price attainable in the open market after proper marketing, whatever that price may be" (RICS, 2017, p.19). The RICS recognise that "factual circumstances of the actual owner are not a part of this consideration because the willing seller is a hypothetical owner" (RICS, 2017, p.19).

"In an arm's length transaction" is one between parties who do not have a particular or special relationship (RICS, 2017, p.19). Both parties must act independently, where no

special relationship exists, for example a transaction between family members, where the vendor may offer a discount to purchaser due to the special relationship.

"After proper marketing" refers to the fact that the "asset would be exposed to the market in the most appropriate manner to effect its disposal at the best price reasonably obtainable in accordance with the market value definition" (RICS, 2017, p.19). A valuer cannot assume an unrealistic marketing period that may cause a lower price to be achieved. The length of exposure time is not a fixed period but will vary according to the type of asset and market conditions.

"Where the parties had each acted knowledgeably, prudently" is a key point for the subject research and it is necessary to quote the RICS explanatory commentary in full for this aspect of the definition. It:

> presumes that both the willing buyer and the willing seller are reasonably informed about the nature and characteristics of the asset, its actual and potential uses and the state of the market at the valuation date. Each is further presumed to use that knowledge prudently to seek the price that is most favourable for their respective positions in the transaction. Prudence is assessed by referring to the state of the market at the valuation date, not with benefit of hindsight at some later date. For example, it is not necessarily imprudent for a seller to sell assets in a market with falling prices at a price that is lower than previous market levels. In such cases, as is true for other exchanges in markets with changing prices, the prudent buyer or seller will act in accordance with the best market information available at the time (RICS, 2017, p.20).

The above commentary is particularly significant to this research. An investigation into whether the DCF can provide supplementary evidence in the estimation of market value of agricultural land in Ireland must have a clear definition and conceptual framework of market value. This element of the definition assumes that both parties to the transaction are:

> reasonably informed about the nature and characteristic of the asset, its actual uses and the state of the market at the valuation date.

It can therefore be assumed that both parties would have knowledge of both the rent and the profits that can be derived from the land at the valuation date and the various methods available to valuers. This point is referenced in the method section.

Finally, "without compulsion" establishes that each party is motivated to undertake the transaction, but neither is forced or unduly coerced to complete it (RICS, 2017, p.20).

2.4.1.1   Relevance to the subject study

Setting this context is important in selecting the appropriate valuation method and critical in setting the assumptions to apply to this model to test it. A valuer, when assessing the market value of the property, tries to assume a normal open market on a specific date, where participants are well informed and utilise appropriate techniques. The understanding that the "market in which the asset is exposed for sale is the one in which the asset being exchanged is normally exchanged" is clearly relevant. Therefore, cultural factors, such as those outlined in the historical context, come into play for the agricultural land market in Ireland. In modern agricultural land markets, international buyers are also a consideration (RICS/RAU, 2014). It is probable that international buyers are more likely to consider the financial factors, rather than historical context, when considering a purchase. This is because they can choose between many markets and are not limited to a small locality. When considering a 400-acre dairy farm in Meath or a 400-acre dairy farm in, for example, New Zealand, it is likely they will only choose Meath if the utility from the Meath farm (returns) is greater than that of the alternative and justifies their doing so.

It has been reported that larger mega farms are becoming prevalent in the UK market (Harvey, 2017). While mega farms were not a significant feature of the agricultural land market in Ireland during the study period, larger scale farming or international purchasers were a consideration in the market. The trend in average farm sizes is upwards (Teagasc, 1994, Teagasc 2014). The concerns of international or larger purchasers are therefore likely to be the return from land, rather than what the neighbouring land sold for. These purchasers are likely to be interested in comparables in the market to check against overpayment, rather than as the basis of value. Market participants who are guided by returns are more likely to prefer to use valuation methodologies that estimate value from the returns from land, rather than comparable methods, at least to determine their bidding.

Of course, it may not always be returns that drive buyers. The RICS/RAU report also recognises the growth of the previously referred to hobby farmers. Furthermore, returning immigrants may be prepared to pay a premium and attach less weight to returns. Marginal

utility is therefore not necessarily the same as marginal returns measured in money, although there is likely a close correlation. This has been considered in the selection of the appropriate valuation model and the analysis.

Another subsection of the Irish market is the international horse breeders around the lands of the Curragh of Kildare. They choose to locate in Kildare for the flat ground, the agglomeration of high-quality trainers, and the tax breaks for breeding horses in Ireland. This culminates in higher prices per acre for this area. Ultimately, all these reasons further justify the returns method of valuation. The flat ground and availability of high-quality trainers (due to the agglomeration of uses) assist in improving financial returns and therefore allow the market participants to bid higher than for other uses (standard agricultural uses). Tax breaks that exist for this sector also relate to the financial return. The model selected should fit the conceptual framework and ideally be adaptable for these different types of uses.

2.4.2 Other practitioners' bases of value

Another key point for the subject study is that:

> the market value of an asset should always reflect its 'highest and best use'. The highest and best use is the use of an asset that maximises its productivity and that is possible, legally permissible and financially feasible   (RICS, 2017. p.20).

For the use of some valuation techniques, it is therefore necessary to consider the highest and best use which may be "the continuation of an asset's existing use or for some alternative use" (RICS, 2017, p.20). The RICS note that "this is determined by the use that a market participant would have in mind for the asset when formulating the price that the participant would be willing to bid" (RICS, 2017, p.20). As in the case of land in the Curragh area, horse trainers often outbid traditional farmers as horse training and breeding is a higher value use in this locality than tillage or grazing. This distinction becomes particularly relevant in the discussion of the difference between the "market value" and "worth" bases of value.

While market value is recognised as the most widely applied basis of valuation and the most important, the RICS *Red book* recognises four bases of value. As noted, these are market value, market rent, worth (investment value) and fair value.

As discussed above, French (2006), among others, identifies market value as a price definition. There is only one price achievable in the market. There may be many opinions of value or worth but only one price. The market rent definition uses largely the same assumptions as the market value definitions to estimate the market rent an asset or liability may lease for on a given date, on appropriate lease terms. The *Red book* definition of market rent is:

> The estimated amount for which a property would be leased on the valuation date between a willing lessor and a willing lessee on appropriate lease terms in an arm's length transaction, after proper marketing and where the parties had each acted knowledgeably, prudently and without compulsion   (RICS, 2012, p. 7).

The RICS recognises that market value and market rent are the most commonly required bases of value. It equally recognises that "members may be legitimately instructed to provide valuation advice based on other criteria." This means that the advice may be founded on other bases such as the "assessment of the investment value, or worth, of the property to that client." With the introduction of the term "worth," the issue becomes more conceptual. The RICS defines worth as: "the value of an asset to the owner or a prospective owner for individual investment or operational objectives" (RICS, 2017, p. 10). The distinction between the concepts of price, value and worth is a key concept relevant to this research.

Adair, McGreal and McParland thoroughly examine the concepts of price, value and worth in their 2000 paper on the subject (Adair et al., 2000). The arguments of those who see no difference between market value and worth are considered before concluding that there are differing fundamental assumptions used when estimating the worth of the asset and its market value. Others, such as French et al. (2003), provide similar comprehensive reviews, reaching the same conclusion. In a practical sense, this means that each use to which land can be put can have a different worth. If someone wished to build, for example, several large houses in a particular location, that land is likely to be worth significantly more than its agricultural use to that person. If the land was zoned, had services and the required permissions, this is likely to be the "highest and best" use for the land and therefore worth more to the individual prepared to develop it than the farmer. Planning restrictions limit these instances. A valuer should always consider whether it is a residential or non-residential holding, to determine the

highest and best use for the land. Again a hobby farmer may be prepared to pay a premium above what the land is worth for agriculture, to obtain a home or rural retreat if the land is suitable for this type of use.

The same use can also have a different worth or utility to different market participants. Take the example of two farmers considering purchasing the same farm. One farmer's property is adjacent to the farm, while the other farmer's entire farming operation is located miles away. The land is likely to be worth more to the neighbouring farmer. If they both act knowledgeably and prudently in the market, they will be bid against each other and the party to whom it is worth more will be prepared to pay the highest price (for the economic reasons previously discussed), thus determining the market value based on agricultural use being the highest and best use for the land.

There are different methodologies that can be used to determine the worth of the land. These are explored later but an obvious option is the DCF approach. This builds on the Ricardian, Von Thűnen and Marshal models of valuing the asset based on the returns that can be extracted from it that are specific to each individual farmer. The DCF approach can also be used to differentiate between the different uses of the land and therefore determine the highest and best use in a quantitative fashion. This relatively modern method of valuing assets does so by determining the net cash flow (income less outputs) over a period that can be derived from the highest and best use for the land. This cash flow is discounted (by allowing for the lower future value of money) back to present values at an appropriate rate. The sum of these DCFs equates to the value for that particular use.

The DCF method is often used to value development land. In these scenarios, an assumption can be made regarding the best type of development (residential, commercial, industrial, mixed, etc.), the size and density of the development, the period of construction, costs involved and the market value of the buildings at the time of sale. All these costs are factored into the equation. A DCF valuation for agricultural land requires similar assumptions about the highest and best use for the crop type or other use. Based on this, the labour, fuel and other costs would have to be assumed, as would the likely returns. This would have to be projected for a reasonable number of years. The appropriate discount rate to reflect the level of risk involved would also have to be considered. This method is closely associated with the

RICS "worth" definition, as it does not necessarily involve a hypothetical exchange. The DCF approach, while appropriate for the calculation of worth, is not exclusive to worth calculations. For the reasons referred to above, any market participant who bids on land based on the returns they can achieve from it is likely to prefer this method. It can be argued that the DCF approach to valuation has a growing importance in the calculation of the market value of agricultural land. The IVSC also recognises that the differences between the "worth" or "investment value" of an asset and its market value provide the motivation for buyers or sellers to enter the marketplace (IVSC, 2017).

The key to determining the difference, if any, between the market value and the "worth" of an asset is to establish its highest and best use. As in the development scenario above, assumptions have been made as to the highest and best use for the development. If the assumed "highest and best use" and subsequent inputs are correct, then in the hypothetical market described above, where market participants act knowledgeably and prudently, the "worth" value is the same as the market value. It follows that it is necessary, for the purposes of answering the research question central to this thesis, to identify the highest and best use of the agricultural land in each given year of the study period. This is a question that is taken up in the method section (section 3.6.4.1).

The concept of worth and intrinsic value is a key but distinct concept that is discussed in greater detail as an area for further research.

There is an additional basis of value recognised by the *Red book*. This is "fair value" and it is generally used for accounting purposes. This is specific to individual valuation cases and as it is not relevant to the subject research, is not discussed further within this literature review.

2.4.3 *From theory to practice*

Some commentators on the agricultural land market argue that the economic theories have little value in practice. Venn argues that the price of rent often differs from the theoretical value, which must account for man-made improvements (Venn cited by Nix et al., 2003). These improvements could include the farmhouse, farm buildings, roads, drainage, and so forth. Nix et al develops this point and argues that there should be a rent paid for marginal land despite its theoretical "economic" rent being zero. The researcher would contend that

Nix et al.'s arguments draw on theory but overlook some factors. Improvements such as those mentioned in theory add to productivity. Drainage is undertaken to improve yields. Roads are built to provide better access, reduce labour and improve productivity. Farm buildings are constructed for various reasons but ultimately to improve productivity. Even a better farmhouse may improve the contentment of the farmer and so make him or her more productive. These buildings, to some extent or another, improve the yields from the land. The original productivity theories therefore hold true. Table 2.3 demonstrates this.

12		Marginal tonnes per hectare	Tonnes per hectare with improvements	Marginal price per tonne (net of costs)	Price per tonne (net of costs)	Rent per hectare
13	Marginal level	10	11	€100.00	€110.00	€210.00
14	Better land	11	12	€100.00	€110.00	€320.00
15	Better land	12	13	€100.00	€110.00	€430.00

Table 2.3: Reflecting the improvements in productivity and 10% increase in price of corn

However, Nix et al. have a point. What is surprising about these theoretical values is that the price difference between the notional rent per hectare for good and bad land can be significant. In practice, Nix et al. argue – and the researcher concurs from his own professional experience – the difference is not as big as theory suggests. This could be partially explained by the number of established landlord and tenant relationships. Where a tenant is in occupation and has maintained the land well and paid his rent on time, there is often a reluctance to increase the rent, even during times of prosperity. Conversely, in bad times there is also often a time lag. Farming is a long-term business and the profitability will not always reflect the actual rent or price being paid, despite the theoretical basis. This is considered in the limitations of data analysis in the Chapter (discussion).

Of greater relevance to the subject study is the examination by Nix et al. (2003)of how farmers prepare an offer to rent land. The budget prepared draws on many of the economic theories previously discussed. Nix utilises the gross margin, which is the enterprise output less the estimated variable costs (such as seed, fertiliser, sprays, and concentrate feed) to establish a rental offer that can be afforded (Nix et al., 2003). While the variable costs can be relatively easy to estimate, the enterprise output requires a greater level of judgement to estimate the yields and the forecast prices. Undertaking such calculations for each farm enterprise brings with it a level of risk and uncertainty. In the Chapter 3 (methodology) the researcher outline the published data (Teagasc) that is available as inputs to facilitate a testing of the DCF method utilising this data (section 3.6.4.1).

As previously discussed, the legislative context is important in choosing the method of valuation. UK valuers are governed by the Agricultural Tenancies Act 1995, when undertaking rent reviews, rather than the *Red book* (Prag, 2003, p. 102). This legislation has focused and arguably advanced the debate in the UK of how to establish the rent of agricultural land. It was particularly necessary in the UK, as there was a tradition of long-term leases with rent reviews. This situation contrasts with Ireland, which is dominated by 11-month short-term leases. In Ireland, therefore, when a dispute arises, and a landlord and a tenant cannot agree a rent (or accept a methodology to arrive at an agreed rent), the option of returning to the market can be exercised to determine the price. This was not available in the UK, due to the prevalence of long-term leases and it was therefore necessary to consider which was the most appropriate methodology to determine the rent. The examination of input and output costs and prices was chosen as the basis for the determination of rent for agricultural land. In the UK and Ireland there is a great wealth of knowledge on landlord and tenant law and, specifically, well-regarded legislation and case law on rent review. An example is Bernstein, Reynolds and Fetherstonhaugh's *Handbook of rent review* (2018), first published in 1981.

The systems in the *Handbook of rent review* (Reynolds et al., 2018) rely on rent review systems largely based on comparable evidence. Yet, when it came to determine the system from agricultural land, the UK focused on the return from land. This was a highly progressive step at the time. In modern Ireland there have been significant cases brought to the High and Supreme Courts, challenging the legitimacy of rent review clauses based on legacy pieces of comparable evidence. All of this suggests that it is both timely and appropriate to test the accuracy of the advanced valuation methods, such as the DCF, to assess the market value of agricultural land in Ireland. However, a lack of data presents challenges to testing valuation methods.

2.5   Irish agricultural land market price data

To test methods of valuation one needs to consider what data is available and currently this is rather limited. The need for the provision of an official Irish agricultural land price series was one of the main recommendations of a report by O'Connor and Conlon (1993). While the

CSO commenced a series in 1996, it was limited and, in any event, discontinued in 2005. The Institute of Professional Auctioneers and Valuers (IPAV) compiled a table of all available datasets in 2007. The table, while in some ways useful, highlights the limitations and inconsistencies.

YEAR	PRICE/AC	YEAR	PRICE/AC	YEAR	PRICE/AC	YEAR	PRICE/AC
1901	9	1928	12.2	1955	62.1	1982	1701.6
1902	7.6	1929	21.9	1956	50	1983	1389.8
1903	11.2	1930	19.4	1957	72.1	1984	1614.9
1904	14.1	1931	16.3	1958	63.2	1985	1754.1
1905	12.9	1932	19.4	1959	70.3	1986	903.8
1906	6.7	1933	26	1960	104.2	1987	858.3
1907	6.2	1934	10.4	1961	70	1988	895.8
1908	11.4	1935	18.8	1962	83.8	1989	1072.7
1909	5.8	1936	13.3	1963	107.8	1990	1178.9
1910	9.5	1937	16.7	1964	74.3	1991	1111.1
1911	16.6	1938	16.5	1965	65.4	1992	1119.4
1912	15	1939	26	1966	127.5	1993	1162.5
1913	12.7	1940	21.8	1967	137.4	1994	1247.3
1914	17.6	1941	25.7	1968	184.8	1995	1301.4
1915	13.2	1942	33.2	1969	223.5	1996	1509
1916	10.8	1943	28.6	1970	256.8	1997	2209
1917	20.3	1944	21.8	1971	366.5	1998	2803
1918	31.2	1945	23.9	1972	348.9	1999	3488
1919	18.7	1946	42.3	1973	544.8	2000	3850
1920	56.3	1947	47.2	1974	594.6	2001	5624
1921	40.6	1948	31.4	1975	641.7	2002	5493
1922	22.2	1949	36.9	1976	856.3	2003	5826
1923	35.6	1950	43.4	1977	1418.7	2004	6579
1924	24	1951	54.1	1978	2068.7	2005	6568
1925	28.6	1952	46	1979	2796.9	2006	23616
1926	22.7	1953	55.5	1980	1682.2	2007	19035
1927	9.7	1954	65.9	1981	2129.4		

Sources

1901 - 1996 Composite derived from various sources. Chiefly Nunan, (1987), Kelly (1983 and subsequent) and CSO (1998).

1997 - 2000 CSO - Agricultural land only. 2000 up to September only.

2001 - 2005 CSO - Agricultural land only. 2005 up to March only.

2006   "The Journal Agricultural Land Price Survey 2006" by Shirley Busteed for The Farmers Journal (Edition 13 Jan 2007) - Survey only of 15 counties.

2007   "The Journal Agricultural Land Price Survey" by Shirley Busteed for The Farmers Journal (Edition 08 Sept 2007) - Survey includes the 26 counties.

NB: Prices from 2001 onwards are in Euros.

Table 2.4: Land prices in Ireland 1901-2007 (IPAV, 2013)

While the table may provide a general overview, there are several serious limitations. There is little explanation on currency, save for a comment that from 2001 onwards the prices are in euros. The variety of sources is a concern, particularly the jumps in values following a change in sources (see 2005 versus 2006 as an example). It also fails to reference that the Nunan dataset (Nunan, 1987) refers to the Limerick and Clare area only, while the CSO data is national. Finally, the Shirley Busteed (Busteed, 2010) data is at best secondary data, as it is sourced by a journalist from what she is advised by agents (often private treaty sales) should be used with an element of caution. This is particularly important because agents are likely to want to report higher prices to newspapers, in the hope of achieving sales from other vendors or getting current sales through (by creating an impression that the market is higher than it is).
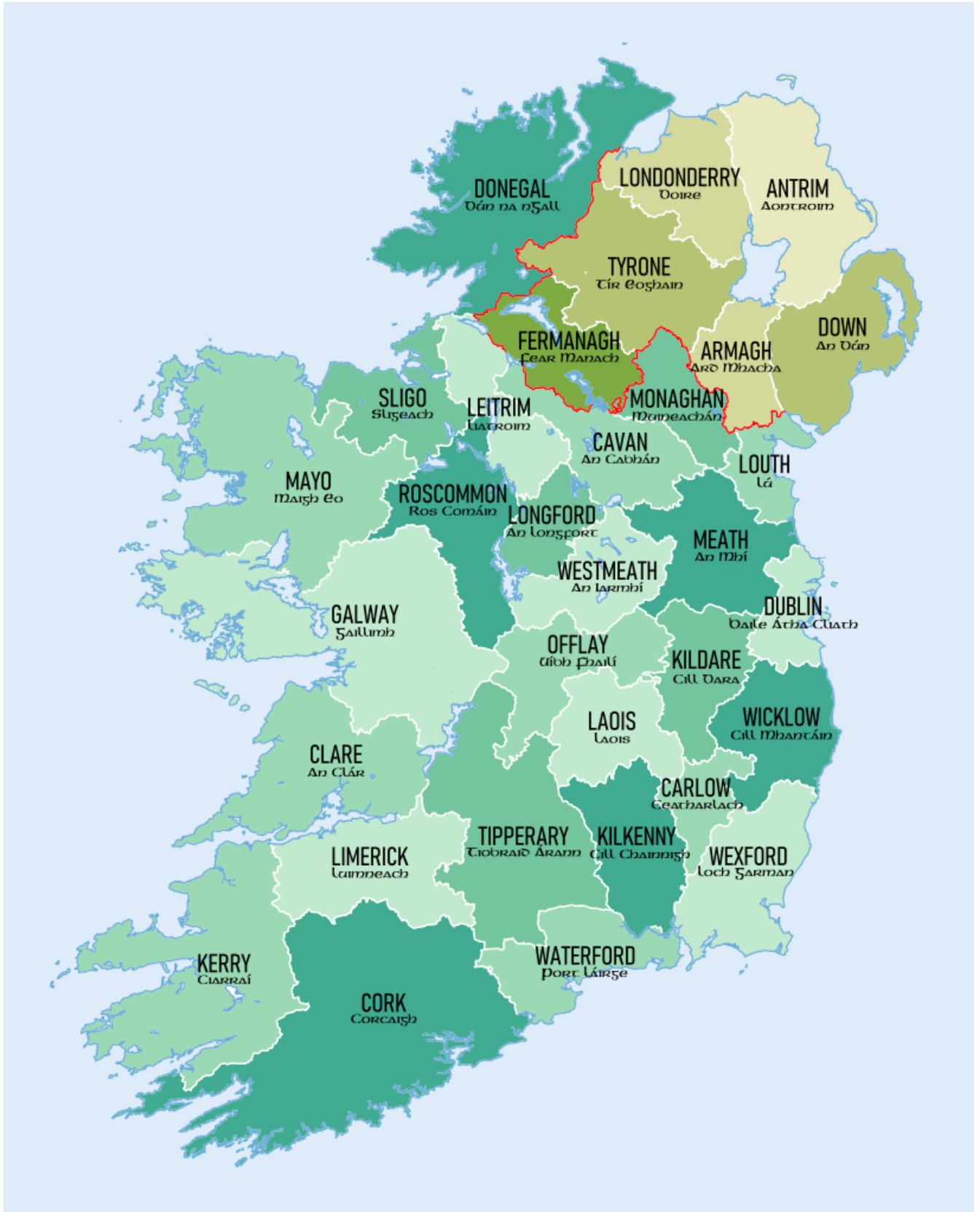
Figure 2.4: Map of the island of Ireland showing county and national boundaries

However, there are other sources: Kelly (1981) identified three: the Irish Land Commission Dataset (which continued until the body was scaled down post 1984), the Teagasc Farm Management Survey (1977) and a survey of auctioneers. As previously referred to, the Irish Land Commission was a rent-fixing body and a significant purchaser and distributor of land throughout the country. The Farm Management Survey asked farmers to provide details on land they had purchased since 1950. The latter was a survey of six firms of auctioneers sampled by Teagasc between the years 1970 and 1980. Kelly (1981) concluded that there was relatively good agreement between the three-price series.

Barrett and Trace (1999) updated earlier data contained in O'Conner and Conlon (1993) and collected from "particular delivered forms" from the Valuation Office records (Roche & McQuinn, 2001). However, forms submitted for Valuation Office records should also be considered with an element of scepticism, as they may undervalue the asset for this purpose.

Of particular relevance to the subject study is the long-run dataset (1901-86) of both land sale prices and rents from a Limerick auctioneering firm (William B. Fitt) by Nunan (1987). According to Roche and McQuinn, the "attraction of the Limerick data lies both in the length of the time series provided as well as the information on the conacre rents" (Roche & McQuinn, 2001). Roche and McQuinn also note that Nunan (1987) "compared both the levels and trends of the Limerick series with both the ILC series and the survey data compiled by Teagasc to gauge the national perspective of the Limerick series" and found that "both series are reasonably close over the long term" (Nunan, cited in Roche & McQuinn, 2001, p. 4) However, Roche and McQuinn cautioned that while:

> the auctioneer and ILC land price are both highly correlated the latter series are only available for a shorter period and may not have been influenced by market forces as much (Roche & McQuinn, 2001, p.4).

In terms of market reports, a June 2011 report from Savills on the 2010 land market appears to be a standalone report, as does the more recent Sherry Fitzgerald Rainey *Farmland market quarter 1 review* (2014). Robert Ganly of Ganly Walters also released a report in 2014. The Sherry Fitzgerald report states that "These values were based on actual sales, or likely achievable sales, in their area in the given quarter" (Sherry Fitzgerald Rainey, 2014, p. 4). The data recorded may thus be valuations, rather than achieved prices, which reduces its validity. The Ganly Walters report states that "the survey is based on research by Ganly

Walters and agricultural land sales reported in the Farmers Journal and the Farming Independent between January and December 2013" (Ganly, R, 2014, p. 2). As previously stated, the reported prices in newspapers are already secondary data.

Savills does not provide a methodology and references charts with "Savills research, Eurostat & various data" (Savills, 2011) however it appears from their other report most of the data is sourced from secondary sources such as newspaper publications (Savills, 2010). In addition, it has not produced a follow-up since 2011. Furthermore, the datasets in the case of Sherry Fitzgerald refer to Quarter 4 2013 and Quarter 1 2013 only; Ganly Walters goes back to 2007; and Savills, utilising data from a combination of sources, goes back to 1974. Probably the best of these recent market surveys is the Farmers Journal Land Market Report (Busteed, 2010). However, it relies on secondary data provided through intermediaries. The RICS note that information provided by the press:

> [is] often not reported in sufficient detail for the valuer's needs, and the reliability of reported details can vary widely" (RICS, 2012, p. 7).

In addition, none of the above surveys gather data on the rental of land, focusing solely on the sale price.

An SCSI/Teagasc *Land market review and outlook* was also published in 2014. As with reports from the RICS and RAU in the UK, this combines practitioners' knowledge with the analysis from external agricultural economists in Teagasc. In addition to the recorded prices from SCSI members, it incorporates a section on input and output costs for the various sectors and references the Present Value Model (also known as DCF), stating:

> In this model, the price of an income-earning asset, such as agricultural land, is equal to the discounted expected stream of future net returns or rents to the asset (SCSI & Teagasc, 2014, p. 1).

It acknowledges the limitations of this model, as highlighted in the earlier sections of this chapter. However, its growing awareness in the context of the valuation of agricultural land is significant.

What can be concluded from this section is that there is a need for a reliable, ideally official, source of data on the sale and rent of agricultural land. During this research, the CSO recommended data collection on agricultural land. The data has been sourced from recorded

transactions and provides the median sale price per acre in different regions (CSO, 2017). This data has been published from 2013 and is welcome. However, this does not address the legacy issue of the historic data and, due to its relatively short length, has proved to be insufficient to reliably test the theories set out in this thesis. Nor does it address the rental index important for testing economic theories. It is proposed that a database of sale and rental data is compiled from information on recorded sales and lettings of agricultural land from Smith Harrington records. The CSO sources and Nunan dataset do, however, provide a basis to test the validity of the Smith Harrington dataset and opportunities for further studies. The Smith Harrington dataset has then been used to test what is considered the most appropriate valuation method, having regard to the literature reviewed within this critical review.

2.6   Critical evaluation of valuation methods

French (2004) describes a valuation as the determination of the price that a property will exchange between a vendor and a buyer on a particular date. The model chosen should therefore reflect the market culture and conditions appropriate to valuing agricultural land. As real estate in general involves complex assets costing in the thousands, every valuation is a simplification of reality (Damodaran, 2010). Fetibegovic and Nilson (2011) develop this, recognising that:

> the time and resources needed to assess every cost in detail for any given property would be unrealistic and the precision would be diluted due to the forecasting of how those costs develop over time. A simplification of the transactions is a necessity (2011, p. 5).

The question of which items to simplify, to what extent, and utilising which method are examined in this section.

Furlong (2011) notes that the common theme throughout the literature is that in the UK and Ireland there are five traditional methods of valuation. According to French (2004), they can be grouped in the following format:

1. Comparable method.
2. Investment/income method.
3. Profit method.
4. Development/residual method.
5. Contractor's/cost method.

Traditional methods of valuation, such as the comparable method, rely upon comparison transactions to assess market value. There is an obvious reason for this. As French (2004) proposes, the ultimate test of validity of a method is its ability to replicate the price on a particular date. The most simplistic method is to use a transaction from the market to replicate the market.

It is therefore not surprising that the comparable method remains the predominant method of valuation in agricultural land in Ireland. However, it has significant limitations. The Irish market has a shortage of transactions and therefore a shortage of comparable evidence, which leads to a lack of evidence-based valuations. This is one geographical limitation.

A more general limitation is the comparable method's reliance on past transactions to reflect current market prices and its inability to identify the "bubbles" in the market. However, this research is primarily concerned with the estimation of market value and this is not a significant drawback in the estimation of market value.

For the reasons outlined in the economic theories section, advanced methods of valuation may lend themselves well to the valuation of agricultural land in the modern market. They may, in certain circumstances, be more reliable measures, as they attempt to mimic the thought processes of the actors in the market, in an attempt to estimate the point of exchange, as in the market value definition. The accuracy and appropriateness of alternative methods is what this study set out to test. Each method or approach is described below, with its respective advantages and disadvantages critically analysed in the context of agricultural land valuation. The historical context and economic theories are considered in relation to these methods and their appropriateness to the valuation of agricultural land in Ireland.

2.6.1   The comparable method

The basis of this method of valuation rests upon comparable evidence, whereby the value of a property is estimated by comparing its location, physical characteristics, amenity, etc. with the characteristics of similar properties that have recently sold (Adair & McGreal, 1987). The process involves the valuer initially selecting several comparable sales and adjusting each to account for differences between the subject and comparable asset. Adjustments may relate to the differences in location, size, selling date or any factor they considers relevant. The final

stage involves the valuer using their knowledge and experience to weight these different characteristics to arrive at a market value of the subject asset at the specific date of valuation from the adjusted sales prices of the comparable evidence.

The comparable approach has its limitations. Castle and Gilbert note that:

> the sales comparison approach is heavily dependent on the availability, accuracy, completeness, and timeliness of sale transaction data (Castle & Gilbert, as cited by Pagourtzi, Vassilis, Hatzichristos, & French, 2003, p. 386).

Lusht notes that the assumptions underpinning the comparable approach do not fit all markets of heterogeneous assets, though the comparable approach often works well enough to justify the use of it. He does note that this is only true if there is enough data on sales in the subject market (Lusht, 2001), which is not currently the case in the Irish agricultural land market. It is therefore less reliable in a market, such as the subject market, with limited transactions. While, in these circumstances a valuer can recognise the lack of evidence and acknowledge the uncertainty in the valuation, it is not an ideal choice of method.

The SCSI also cautions that too much emphasis can be placed on past evidence and may not reflect what current market values are (SCSI, 2014). They note that a comparable used may have had a special purchaser, who was willing to pay over the market value, to acquire the property. A market value valuation should not include a premium that a special purchaser may pay. However, the valuer who acquired the evidence may not have been aware that the sale was influenced by a special purchaser. Utilising the comparable approach in these circumstances, to arrive at a market value, is likely to result in an inaccurate reporting of an appropriate market value.

The problem of obtaining suitable comparables has been recognised as the principal weakness in the direct comparison method of valuation (Adair & McGreal, 1987). Adair & McGreal (1987) put forward the case for a "pooled" database in which the level of information available for the valuer could be greatly enhanced. This supports the case for the publication of the agricultural land dataset.

While it may be possible to find comparables identical in all aspects to the subject property, this would normally be the exception; thus, the valuer must exercise judgment (Adair & McGreal, 1987). Reynolds (1984) argues that the suitability of comparable evidence needs to

be judged in terms of five main elements – time, location, motivation, physical similarities and encumbrances (Adair & McGreal, 1987). The reliability of the evidence depends on several components. A good comparable property, therefore, is normally considered to be one which sold recently in the same locality, was sold in an arm's length transaction, has the same physical attributes such as size, accommodation and condition as the subject property, and has a similar title (Adair & McGreal, 1987). A valuer needs to use their judgement to analyse each of these components and arrive at a market value for the subject property they are valuing.

However, academics have reported (Adair & McGreal, 1987; Mackmin, 1985) that residential valuers are extremely reluctant to explain how they analyse and interpret the market as a prerequisite to valuation by direct comparison. Rather, valuers stress the importance of experience in the marketplace, which over time produces an empathy for movements in the market and allows the experienced valuer to reconcile differences among comparable sales evidence and so produce an accurate opinion of value (Adair & McGreal, 1987). While these reports are somewhat dated and based on observations of the residential market in Northern Ireland, it is the researcher's experience that this is often the case in the Irish agricultural land market, as had been identified in his reflections on practice, set out in Chapter 1.

Adair and McGreal note that most of the firms in their study were single branch offices. Firms dealing in agricultural land in Ireland tend to be of a similar composition. They note that approximately 20,000 houses, or 7% of the owner-occupied stock, are sold in any one year. Valuers in those firms with a large volume of business will have very good information, whereas in other firms the level of information will be sparse (Adair & McGreal, 1987). This is particularly the case in the Irish agricultural land market, where there is a lack of reliable datasets.

Adair and McGreal note that some valuers will be able to ascertain comparable evidence from colleagues and other valuation cases but given the confidential nature of sales information and the competition between firms, such information is not generally available. As has been previously noted, many valuers will face the problem of a lack of good comparable evidence, a situation which undermines the rationale of valuing by the direct comparison method (Adair & McGreal, 1987). Developing this point, Adair and McGreal

pose the question: given the subjective nature of the practice of residential valuation, can an objective analysis of sales data assist the valuer in supporting his opinion of market value? They note that to test this inevitably requires access to an information database and usage of statistical or other methods of analysis (Adair & McGreal, 1987). This argument can equally be applied to agricultural land in Ireland. Their findings highlight the problem that the valuer who lacks good quality data has in arriving at a value within an appropriate range of the market price (Adair & McGreal, 1987).

The reasons why the comparable method, with all its faults, has become the predominant method of valuing agricultural land in Ireland have been considered above. The following section investigates the advantages and disadvantages of alternative valuation methods and considers their appropriateness to the valuation of agricultural land in Ireland.

2.6.2 *Investment (income capitalisation) method*

Baum and Crosby (2008) quote the description by Greer et al. of investment as "the sacrifice of something now for the prospect of later benefits" (Greer, Farrell, & Kolbe, 1996, as cited by Baum and Crosby, 2008, p. 20). They note that investments can generate benefits in two primary ways: (1) generating a flow of income, and (2) generating a return on capital (Baum & Crosby, 2008). More specifically, Baum and Crosby (2008) describe the investment method as a method of estimating the present worth of the rights to future benefits to be derived from the ownership of a specific interest in a specific property, under given market conditions. The future benefits they are referring to are therefore: (1) cash flow; and (2) return on capital (Baum & Crosby, 2008). The investment method of valuation measures the relationship of the flow of income with the price paid to arrive at a yield and ultimately a multiplier to be applied to the rent of the subject property being valued.

If the property is rack-rented, then the "all-risks yield" will be used. Applying this simple income capitalisation method to agricultural land involves multiplying the rent of land by an appropriate multiplier. The multiplier is derived from the yield, which itself is derived from the sale of comparable assets. For example, if a 10-acre farm producing a rent of €5,000 sold for €100,000, this would equate to a yield of 5% (€5,000/€100,000). The yield is then converted to a multiplier, if valuing into perpetuity, by the formula 1/i, where i represents the yield. In this instance, the multiplier would be 20. If a neighbouring 12-acre farm producing

€6,000 per annum went on the market just after this sale and someone decided to utilise the income method, it could be estimated by the valuer as €120,000 (€6,000 divided by 20). If the passing rent differs from the estimated rental value (ERV), then either the term and reversion, hardcore or equivalent yield methods will be employed.

This method also relies heavily on comparable evidence, which is analysed to establish the relevant yield and underlying assumptions such as rent (Blackledge, 2009). French (2003) also notes that where there are regular transactions occurring in the market, it is easier to determine price levels without having to interpret the underlying fundamentals. He states that price is determined by comparison and comparison is the principal unit of currency for the investment method.

Sayce et al. (2006) outline that there are five key inputs in the investment method:

1. The passing rent.
2. The estimated open market rental value, as at the valuation date; this is determined from comparable evidence of recent lettings.
3. The valuation yield(s), as determined from comparable evidence of recent market transactions, from which the years purchase multiplier is derived and applied to the net rents.
4. The purchaser's cost of undertaking the purchase transaction (implied in the net valuation yield).
5. The length of the void or rent-free period and the associated costs before the vacant accommodation becomes income producing. These figures relating to voids are, in many instances, implied into the valuation yield: the valuation yield is adjusted in line with comparable evidence to reflect the impact of current or prospective voids or rent-free periods.

Furlong notes that the investment method has a high level of dependency on comparable data, with three of the five key inputs relying on comparable evidence. He claims that in a market where there is an abundance of transactions, the method can be relatively straightforward and accurate. However, problems start to arise when the market turns, and transactions are limited (Furlong, 2011). With a lack of relevant comparable evidence, Furlong notes that valuers find

it difficult to stand over their calculations and assumptions (Furlong, 2011). The lack of comparables in the agricultural land market has been previously noted and this highlights a limitation of the income capitalisation method.

Another distinction between the markets is the dominance of pension funds in prime retail, office and industrial markets. Eves (2006) makes the case for agricultural land in the UK to be considered alongside these sectors as options for institutional investors. In Ireland, while there are investors active in the agricultural market, these tend to be retired farmers who are renting their land until they can pass it on to the next generation. Their objectives likely differ from those of pension funds and traditional investors.

As noted, in Ireland, McGrath (2011) concluded that the ultimate goal of the Irish farmer is to own land and that rental was a distant second. The relationship between rental and ownership in agricultural land may therefore be different from the assumption of rational action by the purchaser, based on monetary considerations, when offered the choice between rental and purchase. This does not discredit the investment method in its entirety; it may still prove a useful measure. In studies on the method, Castle and Hosch (1982) found that once the yield appropriately reflects the potential for capital growth, it can provide a relatively good estimation of market value; and the yields potential is considered within this research. Compiling and analysing the dataset provides additional insights into yields and the opportunity for more detailed long-term studies of the investment method in the Irish market in the future. However, the traditional investment method itself is not the focus of this research.

2.6.3 *Profits method*

The profits method is generally used in instances where the subject asset has no direct comparisons and is in owner occupation, so does not produce a rent. A hotel is a typical example. The adjusted maintainable net profit is arrived at based on the subject properties' characteristics and the valuer's assumptions and judgement. This is then capitalised at the market rate, generally with reference to the yield recent comparable sales in the industry achieved and reflecting the valuer's judgement on potential growth of the net profits. While the traditional use of the profits method is not examined within this research, elements of the method are considered in developing assumptions for the model.

2.6.4   Residual and the DCF approach

Land that can be developed for a higher use can be valued using:

- A comparable method.

- A residual method.

- A DCF approach.

The comparable method has been examined but it is important to discuss it in this context, to explain the rationale for the appropriateness of other methods. If utilising a comparable approach for this purpose, it is important not simply to compare two similar sized vacant land sales. Elli et al. note that:

> the sales should be reduced to appropriate units of comparison. The value of the land or site should be estimated as if the site were vacant and available for its highest and best use. Each comparable sale should be described" (Pagourtzi et al., 2003, p. 389).

Consideration should be given to the location, the site size, configuration and dimensions, physical and topographical characteristics, zoning and planning, services, the price paid and ultimately the potential return from each parcel of land, and whether this is comparable. The latter is difficult to assess utilising the comparable method alone.

If a detailed comparable analysis is undertaken, it can be an accurate measure of market value. However, as no two sites are the same, the breadth of considerations are often significant, and it is difficult to assess how each would impact on the market by comparison alone. Elli et al. (2003) consider the process of development as a business and therefore look at alternative methods of development. The residual method assesses the end use value of the developed assets and deducts from this "gross development value" the gross costs that will be incurred in putting the end uses into the form that will command that price. The net value should therefore represent the market value of the land.

The issue many practitioners have with the residual method is that it is a relatively static "snapshot" of the value at the time. While it can be adapted to account for a phased sale and

phased construction, other methods such as DCF provide more flexibility to create the scenario that most closely reflects the likely reality. The DCF method addresses some of these issues. The core of DCF analysis is to calculate the net present value of expected future income (Fetibegovic & Nilson, 2011). This is the totalled net operating profit or loss from each period discounted back to the present value of money.

Many of these studies refer to development land as opposed to agricultural land. However, Ricardo and more recent studies, such as Alston (1986) and SCSI/Teagasc (2014), recognise that the present price of land depends on the entire future stream of expected net rental incomes, together with the potential capital gains (Alston, 1986). The DCF method is ideal for this. A valuer has flexibility to include all factors that the market may consider in a market transaction. This may include comparables inflated or deflated by an inflation or deflation rate, and capitalising rents with an appropriate growth rate to reflect all factors. This future asset sale can be inserted into the calculation at the end of the cash flow series to reflect future growth.

To do this for agricultural land is challenging. There is an argument that these types of calculations are only necessary in cases where the income is diverse and therefore are not necessary for agricultural land (Prag, 2003). One of the advantages of DCF is that it provides the flexibility to be as detailed as the valuer requires, but does not need to be unduly complex. As recognised by Damodaran (2002), a simplification of transactions is required when using this method for all real estate assets and this outlook should be considered when constructing a DCF. Even Prag later acknowledges DCF's growing importance in the valuation of rural property (Prag, 2003, p. 93).

There are other challenges to applying these tools to agricultural land. Some of the challenges may be greater in the case of development land, yet the DCF method is still used for it. For example, a developer who owns an adjoining site may achieve much greater densities on the overall development if he acquires the neighbouring site. This should be factored into the valuation. Some sites may also be too small to be developed and only neighbouring occupiers will be in the market to buy them. While these challenges also exist for agricultural land, this suggests that all these issues are surmountable. The DCF method may be a useful tool for modern-day rural practice surveyors. It is certainly the valuation method that is most

accommodating to the value theories of Ricardo, Von Thűnen and arguably Marshall, too.

2.6.5   Cost approach to valuation

The cost approach reverts to the economic theories that assert that value is derived from cost. As has been set out, the majority of developed economic theories suggest this is not the best approach to assessing market value. However, in circumstances where no comparables are available and other methods are not appropriate, it is sometimes necessary to assess the replacement cost of the asset to have an evidence base for the valuation. The thought process of the user is the key. It should not necessarily be the construction cost of the building itself but the reconstruction cost for the equivalent use to the business. These subtle differences are described in detail in textbooks and the RICS *Valuation standard* guidance notes. Rural practice valuers will on occasion need to utilise this method for specialised properties, but the focus of this study is primarily agricultural land. Economic theories suggest that this is not the best approach to assessing market value of agricultural land. Land cannot be recreated in the same way that buildings can. Nor can it be depreciated. This method is therefore not appropriate for the valuation of agricultural land and does not require any further discussion in this context.

2.6.6   Regression modelling

Other valuation models can include regression modelling. Wolverton (1997) studied this with the data from 56 similar residential units located in Tucson, Arizona, on sale over the 1989-91 period. The data was restricted to a relatively small geographic area to control for variation in household income and other exogenous price influences. All the sale properties were located within the same public school district and were equidistant from major employment nodes (Wolverton, 1997, as cited by Pagourtzi et al., 2003).

The characteristic variables of Wolverton's model are:
- "Quality of city view (view) was measured by metrically scaling the width of each lot's angle of city view panorama, adjusted for blockage or potential blockage from nearby homes;
- Lot size (size) was taken from recorded plots;
- A dummy variable (dev);
- Variables that describe 21 sales which occurred in 1988, 11 in 1989, 19 in 1990, and 5 in 1991 (Wolverton, 1997, as cited by Pagourtzi et al., 2003, p.392)."

This model demonstrates that view and size are significant determinants of value. The issue with this model for agricultural land is that it is suited to a particularly liquid market with a very well-developed database. It is a mathematical advancement of the comparable method and has similar limitations to that of the comparable method. It would therefore not be appropriate or practical to develop similar models for the Irish agricultural land market.

There are several other advanced models, which are summarised in a 2003 paper on real estate valuation methodologies. These include stepwise regression; artificial neural networks; hedonic pricing models; spatial analysis methods; fuzzy logic; and autoregressive integrated moving average (ARIMA) (Pagourtzi et al., 2003).

As with the regression model, most of these models require a liquid market with appropriate data to thoroughly examine. They therefore face similar issues to that of the regression model in the current Irish agricultural land market context. To date, no studies have examined them in the context of the Irish land market and while they may warrant further investigation in the future, they are not the focus of the subject study.

2.6.7   Discussion of methods

This section has reviewed the methods currently available to value property and in particular agricultural land in Ireland. The existing literature considers that the comparable method is an accurate and reliable estimating method, particularly in a liquid market. Many researchers (e.g. Elli et al., 2003) have reservations about the method's reliability because of the subjectivity of the choice of key variables. In cases where there is a lack of data, such as the agricultural land market in Ireland, utilising the comparable method as it was designed to be used is challenging and often not appropriate. Alternative methodologies were also presented in this review. The potential advantages and disadvantages of these approaches in the context of the agricultural land market in Ireland were discussed. It was concluded that a study to test the DCF model's appropriateness for the determination of the market value of agricultural land in Ireland was timely. It is worth considering why a study such as this has not been undertaken to date.

Awareness of cash flow techniques has grown among valuers, primarily due to their relevance to development land valuations. Awareness has also grown among market participants. This has been particularly the case in the UK. A study was undertaken to test the present value model of valuing agricultural land in England and Wales (Lloyd, 1992). It did not consider it from a practitioner perspective and in any respect found little correlation. Irish academics may therefore have considered it not to be applicable to Ireland either. However, Ireland is very different, therefore, a study of the method in the UK context is of limited relevance to the Irish context. Furthermore, it has been a long time since the UK study was undertaken. The context has changed. Data availability is better and market participants are more knowledgeable. The emergence of mega farms in the UK (Harvey, Wasley, Davies & Child, 2017) is another factor. It may also be prudent to undertake an updated study in a UK context.

Another reason for the lack of a similar study in Ireland to date is the lack of an appropriate dataset on which to perform the study. The production of the Smith Harrington dataset addresses this issue. A detailed study of the DCF method is therefore theoretically consistent and for the first time possible in an Irish agricultural land market context.

As has been explored in this literature review, the impact of the historical context on the value of agricultural land is important. McGrath (2011) found that pride did influence market participants and therefore this factor does play a role. A study of the present value model in the valuation of agricultural land is unlikely to show significant correlation, at least in the early to mid-20th century, because of these legacy influences. There are increasing reasons as to why now is a relevant time to undertake such a study. In recent years, awareness has been growing among farmers due to the influence of the Common Agricultural Policy (CAP) reforms and tax structures. For example, to claim farming relief on the transfer of land to young farmers, the latter must have first undertaken a qualification known as a "Green Cert." This course educates young farmers on cash flow techniques. The understanding of this technique therefore continues to grow among young and developing farmers. These are the farmers who are often the most active in pursuing land in the market, as older farmers usually have established farms.

This literature review has argued that farmers' perceptions of the value of land relate more closely to its monetary utility than the historical context. It has also highlighted the increased awareness of DCF techniques among farmers. If it can be assumed that farmers are the largest participants in the market on the supply and demand side, then it can be deduced that they are likely to look to cash flow techniques to decide (1) what they are prepared to bid for land on the demand side; and (2) what they are willing to sell the land for on the supply side.

Since the times of Ricardo and Von Thűnen, farmers have considered what they are prepared to bid for land based on the profits (cash flows) they can extract from the subject land. As they are educated on cash flow techniques, these farmers may be expected to refocus on the demand side on Ricardian and Von Thűnen principles.

It was on the supply side that landowners in Ireland have traditionally failed to apply a similar thought process in deciding on the price they would be willing to accept. This may have been caused by a demand for land, over and above the cash flow it could generate. This, it could be argued, would be a natural consequence of the historical context of land ownership in Ireland. The relatively low levels of supply in Ireland may have increased the importance of the supply side in the market, allowing the latter to have a particularly strong influence on market prices. As perceptions of value continue to evolve among farmers, and their awareness of cash flow techniques grows, they are also likely to place stronger emphasis on cash flow techniques on the supply side. They may consider the potential rates of return on a parcel of land that is isolated from their main operations versus a closer parcel. If they do so, via cash flow analysis, these DCF models will also be of greater relevance to the supply side.

In any event, the economic principles suggest that agricultural land in Ireland is largely demand driven. As awareness of DCF methods grows, vendors on the supply side are likely to consider offers received that were made based on these techniques.

All valuation methods, by their nature, are simplifications of reality. As such, all have limitations. This review of methods has highlighted many of these but has also shown elements of these methods that may be adopted in constructing a model for the DCF model of valuing agricultural lands in Ireland, to assess market value. Further discussion on the DCF

model, its inputs in the context of estimating the market value, are assessed in Chapter 3 (methodology).

This study draws on elements of Lloyd's study (Lloyd, 1992) to examine land prices throughout the period. It will test the correlation between the returns (rental and profits) from land in Ireland using the output from the DCF model against the sale prices of agricultural land achieved. From this, conclusions can be drawn on the accuracy and appropriateness of using DCF techniques to estimate the market value agricultural land in Ireland.

The research question that examined within this study can therefore be refined as follows: "Can the DCF method provide supportive evidence in the estimation of the market value of agricultural land in Ireland?"

2.7   Theoretical framework

This chapter concludes by synthesising the themes emerging from the literature review providing a theoretical framework for the development of the methodology and discussion.

2.7.1   The dominance of the comparable method of valuation of agricultural land in Ireland

The predominant approach to the valuation of agricultural land in Ireland is the comparable method. Although there are other approaches, such as the depreciated replacement cost method for the valuation of specialist buildings or income-based methods for forestry, the comparable method remains the predominant approach for agricultural land. Alternative reliably tested alternative methods are not available to valuers. Where data from comparable sales transactions is not available, this can lead to opinions of value that are not based on evidence.

The RICS recognises that the comparable approach is the simplest approach to valuation. The comparable approach works on the principle that the value of one property may be derived by comparing it with prices achieved from transactions in similar properties (RICS, 2013). The simplicity of the approach, and to a lesser extent its transparency, combined with its accuracy when utilised properly in a perfect market, has led to it becoming the predominant method of valuation. However, it is not without its problems, particularly in an Irish context.

2.7.2 *Challenges of the comparable method*

The RICS, in its guidance note on the subject, recommends that when assessing comparable evidence, "the potential purchaser and/or valuer will need to ensure that it is:

1. *"Comprehensive – a sufficient number of transactions is needed to confirm the price. A single transaction is unlikely to be sufficient.*

2. *Identical – or at least very similar – to the item being valued.*

3. *Recent.*

4. *The result of arm's length transactions in the open market.*

5. *Verifiable.*

6. *Consistent with local market practice (RICS, 2013, p. 3)."*

Comprehensive

In 1870, 95% of all agricultural land in Ireland was leased. By 1933 this reached an all-time low of 6% (McGrath, 2011). While this has increased somewhat since then, McGrath reports that by 1997 land leased in Ireland was the lowest in Europe, at 17%. McGrath argues that since 1870 the ultimate goal of the Irish farmer has been the purchase of land, with the letting of land a "very distant second" (2011, p. 4).

Twomey highlights that strong family ties have led to an illiquid land market, "leading to less than 2% of land being traded annually" (Twomey, 2008, p. 2). An illiquid land market results in a limited number of sales transactions that can be analysed. The research would suggest the Irish agricultural land market is not sufficiently comprehensive, in a significant number of cases, to adopt the comparable approach.

Identical

Land is a heterogeneous asset. By their nature, no two parcels of land will be the same. Some general characteristics of property that can be analysed have been identified. Key factors affecting comparability of land, according to the RICS guidance note on the use of comparables, include soil type, aspect, layout, accessibility, drainage and irrigation, and use of machinery (RICS, 2013). Other key factors that should be analysed include the lot size, tenure and the location of the subject comparable, relative to the land that is being valued. For example, land in County Meath sold for €16,000 per acre (€39,537 per hectare) and €6,000

per acre (€14,826 per hectare) within weeks of each other (Smith Harrington, unpublished data, 2014). The factors influencing the difference in prices achieved are a combination of lot size, the location, the quality of the soil, the access to the lands, and their respective road frontages.

From the limited pool of comparable evidence available it is a challenge to identify comparable evidence that is sufficiently like the subject land to allow meaningful analysis. In particular, location is a critically important factor for agricultural land. Smaller plots of agricultural land that are not economically sustainable are generally only of interest to farmers located within a limited distance from the farm the valuer is assessing. This gives rise to highly localised micro markets. A sale of land in a neighbouring localised market may be of limited relevance to a valuer assessing a farm that, at first glance, may appear in very close proximity. Therefore, localised markets by their nature have even fewer transactions, are less comprehensive, and are less likely to be recent transactions. This literature review has outlined that the DCF method can provide a more representative framework than the comparable method to assess market participants' actions in these instances.

These arguments stand up based on each party acting knowledgably, prudently, and without compulsion. If a local party does not act based on the knowledge available, as can be the case, they are not acting under the terms of the market value theoretical framework. It is appropriate to test the model against the theoretical framework and these outliers are irrelevant for testing a model.

Recent

A comparable transaction would ideally occur on the valuation date of the subject plot. This is to ensure that similar external factors are influencing purchasers and sellers in the market. If transactions are significantly distant from the valuation date, they are difficult to adjust for. This adds to uncertainty in comparable analysis. Agriculture is a volatile market, with external factors such as the costs of inputs and outputs often shifting significantly during a short period. The weight attached to comparable sales that did not occur recently must therefore be limited.

There is also a danger in agricultural land valuation that due to the lack of comparable transactions, a relatively recent or identical sale is considered the best comparable and heavily relied on. While it may be possible to analyse factors that reflect changes in the market, or differences in land type, it is dangerous to place great weight on a single comparable, regardless of whether it is recent or similar.

The result of arm's length transactions in the open market

This is not a significant issue with comparable evidence in Ireland, due to the relatively high proportion (of the limited transactions that do occur) taking place by the public auction method of sale. This limits the opportunity for transactions that are not at "arm's length." It is possible to argue that there are some sales at auction which are not fully "open market." There is considerable hearsay evidence in the Irish market that bidders, in some limited cases, try to discourage potential rival bidders before the land goes to auction. It is difficult to find any supporting evidence for this, as any instances, unless proven by the courts, would merely be claims. While fictional, the play *The field* (Keane, 1965) provides a dramatised adaptation of the phenomenon. While it is nearly impossible to judge the extent to which this occurs, it is likely to be extremely limited. It would be a fair assumption on the part of a valuer that all auction sales are arm's length transactions on the open market, unless advised otherwise.

Sales also occur between family members. Most of these are transfers or sales "off market" but there are occasions when a vendor will bring land to the market to gauge interest and then negotiate with a family member (such as a niece or nephew) at a reduced price.

It is often difficult to ascertain if any of the above, or alternative, scenarios occur and if they do, the extent to which they impinge on the value. Investigation is required to have confidence that an individual piece of comparable evidence is an arm's length transaction. However, due to its relatively limited occurrence, it is not an issue that often affects a valuation. Nevertheless, if this occurs on the best comparable a valuer can obtain, it may render the valuation misleading.

Verifiable

Valuation practitioners in Ireland are limited by the lack of available verifiable datasets. The literature review highlights that there is no central source of agricultural land sales and rental

data for the Irish market. The data that is available is fragmented. As there is currently no single published database of transactions, valuers tend to use many sources. Valuers use the sales records of their own firm, the records of other firms, and newspaper reports. The *Irish Farmers Journal* undertakes a large annual survey. Estate agents are requested to provide sales data, and the report is widely quoted. However, no single source of verified data is available. Without this, there is always a danger that the reported price may not include all the elements of the transaction or may simply be reported inaccurately. It is always prudent for the valuer to check with the vendor of the comparable piece of land (or more likely their sales agent) to verify the data. This is usually possible. Once this has been verified, the valuer can then make a judgement about the reliability of the data.

Consistent with local market practice

This can apply to a broad range of parameters. In the Irish agricultural land market, it is particularly relevant for a valuer to be aware of the local nuances in different micro markets, for example, those referred to earlier when discussing the importance of assessing the location of the land sale.

The RICS guidance note recognises that "Provided the above criteria are met, it can provide an accurate indication of value for a very wide range of traded assets" (RICS, 2013) All these factors can be allowed for in the analysis of the comparable value. However, the weight that a prudent valuer may attach to a comparable that has been adjusted for so many factors may be limited. The lack of evidence, the heterogeneous nature of land, the many micro markets, and the many factors that need to be adjusted reduce the appropriateness of the comparable method of valuation for the Irish land market. Notwithstanding these limitations, it is also clear that to assess market value a valuer needs to assess the market.

This suggests the need for an alternative approach to improve evidence-based decision-making that combines market analysis and evidence-based techniques. Informed decision-making is important to all stakeholders involved in land valuation. This affects farmers and other stakeholders, such as banks, tax authorities, and parties involved in disputes. This led to the consideration of how data availability could be improved and what valuations methods other than comparables could be considered.

2.7.3 Theoretical framework

Lloyd (1992) notes, in his PhD thesis, that few topics in agricultural economics have generated the level of interest of land market research. He notes its fine academic pedigree, referencing Adam Smith and David Ricardo. Despite this pedigree, he mentions that attempts to address the question at the heart of this (i.e. whether agricultural land prices are justified on the basis of agricultural earning potential) have been largely unsatisfactory. Harvey (1974) also recognises this issue: "The modem explanations [on the concept of the land market] have been extremely brief and do not discuss the nature or role of transactions in any detail" (Harvey, 1974, as cited by Lloyd, 1992, p. 61).

While Harvey (1974) and Traill (1979) present models that represent an advancement of the thinking on the subject, both have their failings. Lloyd notes the limitations of Traill's (1979) econometric model. One of Lloyd's principal criticisms of the Traill model is the inclusion of transaction numbers. He considers the basis of this to be on the back of a "spurious" correlation between price and the number of transactions. Lloyd, however, produces a theoretical model that is a "reduced form" representation of equilibrium price determination, which can be estimated econometrically using time series data.

Microeconomics is about constrained optimisation problems and allows us to analyse how individuals and firms can make themselves as well off as possible, in a state of scarce resources. It is important to build a model of how consumers and producers behave. However, as (Lloyd, 1994) notes, these models are never precise. As models do not provide a complete description of a particular economic phenomenon, the analyst needs to make simplifying assumptions that render the model easier to work with. Lloyd acknowledges that his method is heuristic. While Lloyd's model represents advancement, it still lacks an understanding of how the agricultural land market operates.

The basic microeconomic model of the individual or the firm assumes that consumers wish to maximise utility subject to a budget constraint. At the same time, producers (or sellers) wish to maximise profits. In the property world, the internationally accepted conceptual framework of market value is the closest fit to this. It is therefore the most appropriate framework for this study.

When assessing agricultural land valuations, the market-based model has the advantage of being more soundly based in economic theory as a conceptual framework than the "comparable" approach. While the market-based model is a better representation of reality, it is not a perfect fit and the researcher acknowledges this at the outset. The next section sets out this framework in more detail. It also contains a critical analysis of its weaknesses.

As with Lloyd's work, the model serves to isolate the principal forces and mechanisms at work. It allows analyses and the formation of conclusions about the appropriateness and usefulness of the DCF method for the assessment of the market value of land.

2.7.4 Empirical studies of the land market

In contrast to the UK and Welsh land markets' "long and rich history that has evolved over many centuries" (Lloyd, 1992, p. 1), Ireland's land market was radically reformed in the period of 1870 to 1920. It continued to evolve and reflected some other significant changes, including Ireland's accession to the EEC in 1973, which had a major impact on agriculture.

Between the Norman period in the 11th and 12th centuries and the early 19th century the Irish land market bore some resemblance to that of England and parts of Wales. Lloyd, drawing on Tracy (1982), notes that the UK maintained a custom of passing on all lands to their eldest, so that by the middle of the 19th century, the more productive lands of Great Britain were owned by large landlords and farmed by their tenants in units almost always large enough to permit efficient management (Tracy, 1982). This was not the case in Ireland. From 1870 to 1920, a series of Land Acts radically reformed the market for agricultural land in Ireland. In 1870, no doubt influenced by UK traditions, 95% of all agricultural land in Ireland was leased. By the end of the Land Acts, as has been reported earlier, there was a dramatic change in culture to owner occupation. This trend for owner occupation became the cultural norm, with only slight shifts in trends to approximately 17% by the end of the 20th century.

This change in culture is highlighted by McGrath (2011), who notes that the purchase of land is the ultimate goal of the Irish farmer, with rental being a very distant second. It can be extrapolated from this assertion that the relationship between the sale price of land and the rental price of land may be very different from the sale price and rental price of other assets. This is supported by the data on agricultural land yields (Harrington, 2016; Kelly, 1981;

Nunan, 1987). Agricultural land yields are traditionally much lower than the yield on, for example, a prime retail investment (CBRE/Allsop, 2016). This result is supported by theory.

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Firstly, due to the historical factors and lack of security of tenure, farmers prefer to own land (McGrath, 2011). Due to these historical factors, one would expect a lower yield, demonstrating a preference for buying over renting.

Secondly, land – assuming good husbandry – has an indefinite life, so it should not depreciate in the same way as a building. It is well established in the research that depreciation impacts on the yield of property. Baum (1988) developing (Fisher, 1930 and Gordon 1958) proposes that a yield is made up as follows:

$$k = RFR + r - g + d$$

Where;

k= capitalisation rate
RFR = risk-free rate
r = discount rate
g = net income growth
d = depreciation

Table 2.5 Baum's yield equation for property (Baum 1988, as cited by Baum & Crosby, 2008)

On the assumption of no (or less) depreciation, due to good husbandry, than on a typical property which generally derives most of its value primarily from a building, then one would expect this lower yield.

This formula also provides another key insight that is central to the method of this investigation. This is the relationship of the capitalisation rate with the discount rate. The discount rate is a key element of any DCF calculation. Both researchers and professional bodies (Brennan, 2011 and RICS, 2011) have highlighted the difficulty in assessing the discount rate for the purposes of utilising the method in practice. Identifying an appropriate discount rate for this study is a key challenge to answering the research question and providing further reasons why a study of this nature has not been undertaken to date. However, if the risk-free rate (RFR), the capitalisation rate, and the net income growth are known, it is possible, drawing on Baum's yield equation, to estimate the discount rate that is appropriate for estimating the market value of a property. This key point is further developed in the method section (section 3.6.5).

While generally having a lower yield than other asset classes does not necessarily exclude the investment method of valuation, it does provide reasons why practitioners may have been reluctant to apply it in the past. Practitioners may have considered the low yields incorrect

and veered towards the simpler and easier-to-justify comparable method. In addition, unlike the UK's long-established market with defined rent reviews, the Irish agricultural land market has been dominated by short-term (11-month) agreements, which are often not purely monetary relationships but may involve family relationships or other considerations. Therefore, capitalising the monetary element without assessing the other considerations would be inappropriate.

While other markets often contain incentives such as fit-outs, which can be monetised over several years, the considerations involved in agricultural land rental can be more nuanced and arguably more difficult to monetise. It is often the case that a retired land owner may let their land to a neighbour on an 11-month system for well below the market value, as the neighbour has given him assistance in farming the land in the years before his retirement. Adjusting such a rent is arguably guessing. Capitalising, even an adjusted figure, would be difficult to justify.

While landowners may be prepared to let land at reduced rates, it is less likely they will sell it at anything other than market levels. As McGrath (2011) found, land ownership is the ultimate goal of most farmers in Ireland. It has been well documented that they are reluctant to sell and often wait to transfer land until a son, daughter, niece or nephew comes of age. It is generally when this is not an option that land is put on the market for sale. It follows that when the ultimate decision is made to put the land on the market by the farmer (vendor), or the representatives of their estate, the price obtained must be demonstrably the highest achievable market price before the vendor parts with it. Indeed, the researcher has often considered that the market value definition of "a willing seller" is stretched to its limits in the case of agricultural land sales in Ireland.

The DCF approach arguably fits both the Irish rental and sale market better than the comparable method. While the supply side may be skewed by vendor considerations, it leaves the limited activity in the market to be driven by the demand side, i.e. what a tenant or purchaser is prepared to pay. Numerous studies of the rental market dating back to Smith and Ricardo note that the rental market is inextricably linked to margins and what a tenant can pay. This would suggest that any study of the DCF method should investigate both income and rental inputs respectively. While this may be inflated in an Irish context, due to historical

ties purchasers will nonetheless be constrained by what they can afford to pay. With the improving availability of data and modern valuation techniques, the DCF approach of discounting future net revenues to present values is appropriate for assessing the maximum value a purchaser will be prepared to pay.

It was necessary to select a sample dataset against which to test this. The Smith Harrington dataset was considered the most appropriate sales and rental data for the research. The rationale for selecting the dataset obviously included practical reasons, such as access. Compiling the dataset has allowed the investigation of the research question and has fulfilled the first objective of this research, set out below, to improve the availability and accessibility of agricultural land market data in Ireland. Other considerations included selecting a reasonably large sample size that was representative of the data. A properly drawn sample will have many characteristics of the population from which it is drawn. The accuracy and validity of the data is further explored in the Chapter 3 (methodology).

From an income (margins) perspective, various independent sources were explored. It was considered important to examine a source independent of the dataset, as an input source to the model, to strengthen the findings of the research. The various options and rational for selection of the data are also further explored in Chapter 3.

2.8   Research question

A dilemma in social science is that one often does not know which the appropriate model is. According to Pagourtzi et al. (2003), the procedure in valuation should be to:

1. Reason through the issues.
2. Consult the literature.
3. Consider alternatives.
4. Choose a model.
5. Perform the analysis.
6. Study the results (Pagourtzi et al., 2003).

Pagourtzi et al. conclude that:

> if the results do not give cause to refute the model, appear reasonable and logical, and are in agreement with accepted beliefs, the model is regarded as appropriate (Pagourtzi et al., 2003, p. 399).

This chapter has examined the first four stages of the procedure proposed by Pagourtzi et al. It has emerged from the economic and cultural context that testing the accuracy of the DCF method on Irish agricultural land prices is both appropriate and timely.

Following the aim and objectives set out in Chapter 1, the primary research question which the researcher sought to answer was whether the DCF method could provide supportive evidence in the estimation of the market value of agricultural land in Ireland. The methodology to investigate this and the objectives are set out in Chapter 3.

Chapter 3: Methodology

3.1 Introduction

The previous chapters, *inter alia*, highlighted the lack of data in the agricultural land market in Ireland, the issues with the comparable method of valuation in this context, and the lack of tested alternative methods to value agricultural land. The objectives that emerged from the process of reflection were:

- To improve the availability and accessibility of agricultural land market data in Ireland.

- To identify alternative methods of valuing agricultural land that are compatible with established economic theories, practitioners' bases of value, the historical context, and other relevant factors.

- To assess the accuracy of the selected method(s) in providing supportive evidence in the estimation of the market value of agricultural land in Ireland.

- To determine the most appropriate methods for the valuation of agricultural land in Ireland.

Further, it emerged from the economic and cultural context that testing the accuracy of the DCF method on Irish agricultural land prices is both appropriate and timely. However, it was also noted by different authors that assessing the market discount rate, a critical component of the discount cash flow method, is one of the principal challenges of utilising (or testing) the DCF method (Brennan, 2011 and RICS, 2012) to assess market value. To address this the researcher has highlighted the theoretical link between yields and discount rates (Baum & Crosby, 2008), which provides potential for testing the DCF method to assess the market value of agricultural land in Ireland. This chapter builds on this theory and sets out a systematic, rigorous and replicable method for addressing the objectives set out above, investigating the research question, and in doing so, achieving the aim of this thesis.

This chapter also sets out the researcher's ontological position (underlying beliefs), leading to his epistemological position (approach to the study of knowledge), his methodological considerations, and the research design. These in turn lead logically to the methods employed in this study. The final sections discuss validity, which incorporates accuracy, reliability, and ethics.
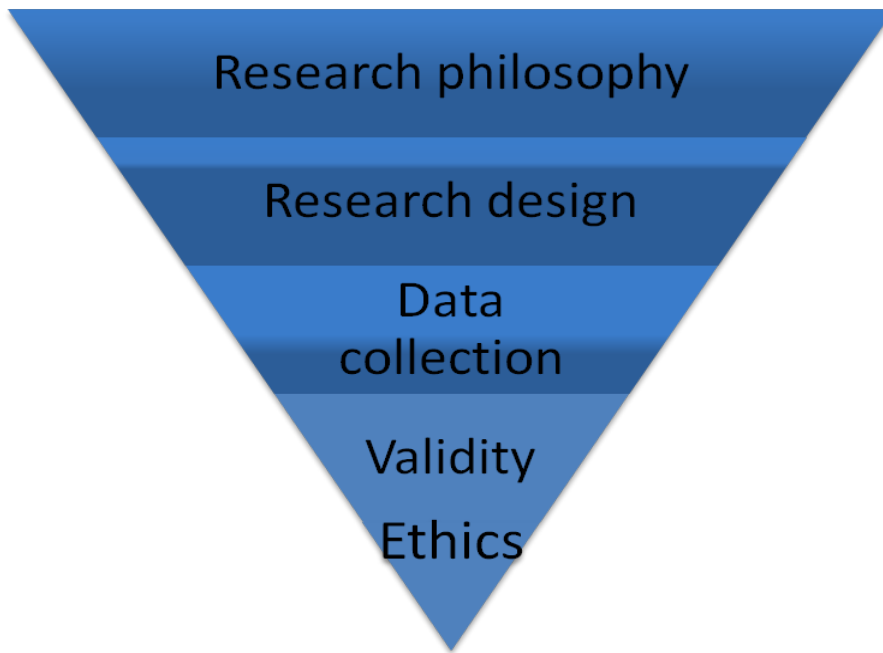
Figure 3.1: Methodological approach

3.2   Research Philosophy

3.2.1   Introduction

A professional doctorate is at Level 8 Framework for Higher Education Qualifications (FHEQ) (or level 10 of the National Framework of Qualifications (NFQ)) (QQI, 2018). A condition of an award of this level is that it involves the creation of new knowledge. A doctoral student therefore needs to have a thorough appreciation of the philosophy of knowledge so that the criteria for what constitutes knowledge can be set clearly set out.

Different texts have different terms for research philosophy. Lincoln, Lynham and Guba (2011) refer to research paradigms and Crotty to ontologies and epistemologies (Crotty, 1998), while Cresswell refers to the researcher's worldview (Cresswell, 2014). In this chapter, the researcher's research philosophy is broken down into his ontological and epistemological positions. The study's "paradigm" encapsulates its overall research philosophy.

A researcher's philosophy influences his or her methodological and design choices. One perspective on the question of "knowledge" is the "introspective" view. Here, the researcher consults their own consciousness, and understands the world to the extent that they are able to represent the facts of their world in their own mind (Robinson, 2013). Sceptics say this view of knowledge may give rise to bias. This is because the researcher's conscience may

well vary between researchers and may have been "informed" differently. Wittgenstein argues that the tools of perception are the only tools we have (Robinson, 2013). To justify this position, he presents the "picture theory." To see the world, we need a camera and every camera needs a lens. Each lens will have different perspectives. There may be some excellent lenses and some poor lenses. There may also be excellent lenses suited to a particular purpose of showing a particular phenomenon and other lenses suited to different phenomena. In simple terms, this theory states that a researcher needs to reveal their own position (their senses or lens) so that external readers can make their own decisions.

To apply this philosophical perspective, Wittgenstein believed that the researcher has to acknowledge that they themselves have a unique, even ultimate, authority on how they view the world (Robinson, 2013). The researcher concurs with Wittgenstein and Robinson's interpretation of this point. He thinks that it is important to set out his ontological paradigm and cognitive biases. This allows the creation of criteria against which the test of "new knowledge" should be measured. The purpose of this section is to set out to the reader the researcher's philosophy or world view. This allows readers to better understand his approach to the research and ultimately to justifying the existence of new knowledge.

3.2.2 *Ontology*

The word ontology comes from the Greek words *Ontos*, which means existence (or being real), and *Logia*, which means science (or study) (James, 2015). It is therefore the study of what exists or what is real. Philosophers use this concept of ontology to gain a better understanding of the ontological status of the world. There are two major branches of ontology in philosophy. One is "ontological materialism", which is a belief that material things such as particles, chemical processes and energy are more real than the human mind. The belief is that reality exists, regardless of a human observer. The other branch is "ontological idealism", which is the belief that the human mind is more real than the material things. Reality is therefore constructed in the mind of the observer (Lofgren, 2013).

Descartes believed that the only method by which we perceive the external world is through our senses, and that because the senses are not infallible we should not consider our concept of knowledge to be infallible (Descartes, 1985).

Given that this thesis involves a mathematical concept (the DCF method), a relevant ontological question arises as to whether mathematics somehow exists independently of our thinking or if it is a construct of our thought.

Dewey believed mathematical concepts to be nothing more than conceptual implements that we use in action (Strathern, 2012). It follows that mathematics has no existence outside its function and therefore differs from our other functions only in its great precision.

The Bourbaki group of (mainly) French philosophers/mathematicians argue that mathematics fits the world perfectly and that there is an absolute truth to seek out (Strathern, 2012). The researcher's position on this question aligns more closely to Strathern's interpretation of this view that two plus two will always equal four, regardless of how far our inductive knowledge progresses. This ontological belief assumes that this (mathematical or scientific) paradigm will always be dominant. This is where the researcher's belief diverges from that of the Bourbaki and more closely aligns with those of Dewey.

Dewey believed that mathematics is practical. It serves a purpose, utilising a mathematical approach when appropriate and employing our senses to allow philosophic scepticism. The researcher concurs with this view that scientific endeavour should always expect to arouse philosophical scepticism. Science or mathematics may be dominant paradigms but this may change over time (Strathern, 2012). So, while the researcher agrees with Bourbaki on elements of their position, he is not an ontological materialist: i.e. he does not believe that reality exists, regardless of the observer. He considers that the appropriate paradigm for this research should follow the pragmatic scientific functionalism proposed by Dewey, that mathematics is a practical tool that can be supplemented by philosophic scepticism. To oversimplify, the computer is not always right.

This ontological position may be considered in more practical terms. Let us consider probability and an example cited in greater detail in *Naked statistics* (Wheelan, 2013). Probability is the study of events and outcomes involving an element of uncertainty. Wheelan notes that investing in the stock market involves uncertainty (Wheelan, 2013). Estimating the price, or market value of a property asset on a specific date (as explored later in this chapter) is also inherently uncertain. It involves risk. Probabilities do not tell us what will happen for

sure. Probability tells us what is likely to happen, and what is less likely to happen. It therefore requires an element of philosophical scepticism from the researcher.

While probability is a specific branch of mathematics (and as the name implies, it is by its nature less precise than other branches), it nonetheless provides a useful example to relate to this point. Mathematics serves a purpose and provides appropriate tools to analyse a study. However, it is critically important for a researcher to employ philosophical scepticism in the interpretation of any statistical analysis, to identify and acknowledge potential limitations. This is the approach that was adopted within this study.

It is generally accepted that an individual's views on the world are established based on experiences in life. The doctoral programme has influenced the researcher's thinking on what constitutes knowledge and how he sees the world. It has encouraged him to reflect on the views of ontological materialists (that reality may exist regardless of human observers) and that of the idealist (that the human mind and consciousness are more real than material things). During this process, the researcher gained and acknowledged a respect for these contrasting worldviews and agreed with certain aspects of both philosophies. It follows that the current research philosophy is most closely aligned to the pragmatic research philosophy and this paradigm guided the selection of a research approach and methodological choices to answer the questions posed.

3.2.3   Epistemology

"Episteme" is the Greek word for knowledge, so epistemology is the debate on what constitutes knowledge. What the researcher believes about the nature of reality will dictate the kind of relationship they have with the research.

Positivism (a philosophy that accepts only things that can be seen and proved) and interpretivism (a philosophy that requires that the true meaning of things that can be seen needs to be interpreted via the researcher in order to arrive at "knowledge") are two generally exclusive paradigms about the nature and sources of knowledge. While many dissertation topics fall broadly within one of these two main paradigms, there is an occasional need for seasoned researchers to modify their philosophical assumptions over time and to move to a new position on the continuum (Collis & Hussey, 2014). As noted in the researcher's ontological stance, his approach to matters (professional, personal or academic) is practical,

logical and pragmatic, respecting and agreeing with elements of both paradigms. This is evident in the philosophers who have influenced his epistemology.

It is perhaps not surprising that Aristotle's writings on knowledge were particularly resonant with a professional doctorate candidate. For example, Aristotle believed that sensations repeat themselves, leading to perception; perceptions repeat themselves, leading to experience; and experiences repeat themselves, leading to knowledge (Thompson, 2003). This early example of turning tacit knowledge gained from experience into new knowledge is one of the reasons why the professional doctorate programme appealed to the researcher starting out on this research journey.

Of the more contemporary philosophers, it was John Dewey who had the greatest influence on the researcher's view of "knowledge." Dewey, in his *Problems of men*, is critical of the Platonic view of the absolute superiority of theory over practice (Hobbs, 2011). He builds on Aristotelian principles of ethics, logic and the principle of converting experiences to knowledge. Dewey argues that we must forget the idea that there is such a thing as thought in general, which attempts to find the true particulars of reality. Instead we should concentrate on the particular problem at hand (Strathern, 2012). Thought is not general, it is specific. It deals with real problems within our real personal experience. What matters is its functional use to resolve problems (Strathern, 2012). In using such a process, Dewey (like James) recognises the need for the research to have moral integrity. He builds on Aristotle's view that:

> it is the quality of one's moral character which constitutes the only real guarantee of moral deliberation being sufficiently impartial, just, and wise (Hobbs, 2011).

Dewey's view of experimentalism has become known as pragmatism, which is essentially a scientific view of the world grounded in common sense. This is despite the attributed comment of Albert Einstein that "common sense is the collection of prejudices acquired by age 18." It believes the ultimate reality is nothing more or less than what we experience in everyday life (Strathern, 2012).

The view that what was observed was observed and how we used this was the truth, resonates with the researcher. Rather than believing that there is only one universal truth waiting to be discovered, he considers that one should instead, prove with a degree of probability, that the

research hypotheses are true or false. This researcher's epistemological views have been heavily influenced by the more logical and practical philosophers, such as Aristotle, Peirce, James, and Dewey. His view of reality is best to summed up by a quote from a former teacher of Dewey:

> The opinion which is fated to be ultimately agreed to by all who investigate, is what we mean by the truth, and the object represented in this opinion is the real (Peirce, 1878, p.15).

This view of reality had a significant influence on the present researcher's methodological choices.

3.2.3.1   *The knowledge hierarchy*

It is useful, at this stage, to refer to the epistemological origins of the knowledge hierarchy. This can be traced back to Plato and his definition of knowledge as justified true belief (Rowley, 2007). Rowley notes that this definition of knowledge has been developed by Aristotle, Descartes, Kant and Polanyi, among many others over the years, and drawing on these debates, Kakabadse, Kakabadse and Kouzmin (2003, p.3) suggest that knowledge "can be conceived as information put to productive use."

The data-information-knowledge-wisdom (DIKW) hierarchy, also referred to as the "knowledge hierarchy", the "information hierarchy" and the "knowledge pyramid", is one of the fundamental, widely recognised and "taken-for-granted" models in the information and knowledge literature (Rowley, 2007). This established tool can be employed to classify the steps the researcher considers are required to move data to information, knowledge, and, where applicable, wisdom.

Figure 3.2: The DIKW hierarchy (Rowley, 2007)

The knowledge hierarchy is further referenced in the data collection section and Chapter 6.

3.3   Axiology

This philosophy studies judgement about value (Saunders, Lewis and Thornhill, 2012). While ontology sets out what is understood to be real and epistemology relates to the confidence that what one thinks is real, axiology broadly examines what should be done about it. More specifically, axiology concerns the impact of the values of a researcher in the whole research process (Saunders, Lewis and Thornhill, 2012). For this research, an assumption had to be made on whether the study was value-free and unbiased, or value-laden and biased (Collis & Hussey, 2014).

The researcher recognises the importance of impartiality in the research process. However, he also recognise Bryman's view that it is not feasible to expect researchers investigating social phenomena to act at all times in a value-free manner (Bryman, 2012). As Wittgenstein identified, the researcher has a unique, even ultimate, authority on how they view the world and this should be acknowledged to allow the creation of criteria against which the test of "new knowledge" should be measured (Robinson, 2013).

As a professional with experience in the valuation of land, it could also have weakened the study if the researcher had attempted to approach the research entirely from an etic (i.e. a general, non-structured and objective) perspective and failed to use this experience. For example, when discussing theories and market trends based on the data, he may have been aware of a market occurrence that had not been reported on or published that may partially have explained a theory. It would therefore not have been feasible for the researcher, as a professional doctorate student, to have adopted an entirely unbiased approach. Pragmatically, it is considered that an emic reflexive approach, when necessary, is the best way to address the subject research question and objectives, to reach credible conclusions.

To do this, the researcher drew on Schön's methodology set out in *The reflective practitioner* (Schön, 1983). Given the quantitative nature of the study, this was not the primary method employed. However, its use strengthened the study and it was particularly useful in setting out the logic of the assumptions that underpin the models employed in the study. This gives increased confidence in the research findings.

Utilising this approach also presents challenges, most notably to ensure that the study is replicable. Peirce's view of truth and reality is useful to draw on in this regard. Peirce believed that opinion, which is fated to be ultimately agreed with by all who investigate, is what we mean by the truth. The object represented in this opinion is the real (Peirce, 1878). This recognises that different researchers may investigate a single phenomenon and they may all approach it from their own perspective, but ultimately, with a rigorous enough critical analysis, they all reach the same truth. If such a thorough and rigorously critical analysis is adopted, the study will be replicable, regardless of the approach or biases of the researcher.

As an emic researcher, utilising reflection to draw on his experience, the researcher needed to critically analyse the options available to him and set out the logic that underpinned his assumptions. This ensured replicability.

3.4   Research approach

The following sections concentrate on the debate on research methods. This is influenced by both practical considerations and the research philosophy. Bryman notes that practical considerations may seem rather mundane when compared to the lofty heights of philosophical debates about epistemology and ontology, but they (practical considerations) are nevertheless important (Bryman, 2012). In empirical research, such as in this study, they are not only important but also essential.

Cresswell notes that pragmatism is not committed to any one system of philosophy or reality and that pragmatists draw from both quantitative and qualitative assumptions, in order to select the best method to answer the question they are investigating (Cresswell, 2014). Saunders et al notes that a pragmatist researcher recognises that there are many ways of interpreting the world and undertaking research and that no single point of view can ever give the entire picture (Saunders, 2012). Indeed, there may be multiple realities. As illustrated in the table below, unlike positivism and interpretivism research philosophies, pragmatism can integrate more than one research approach and research strategy within the same study (Dudovskiy, 2016).

	Research Approach	Ontology	Axiology	Research Strategy
Positivism	Deductive	Objective	Value-free	Quantitative
Interpretivism	Inductive	Subjective	Biased	Qualitative
Pragmatism	Deductive/Inductive	Objective or subjective	Value-free/ biased	Qualitative and/or quantitative

Table 3.1: Positivism, interpretivism and epistemologies (Wilson, 2010)

The primary research question seeks to answer whether the DCF technique can provide supportive evidence for the estimation of the market value of agricultural land in Ireland. To test this hypothesis, it was necessary to build a model with appropriate inputs that reflect reality and therefore apply a deductive research approach.

3.5   Research design

The following subsections set out the appropriate research strategy to address the aim and objectives of this study. They have regard to the researcher's ontological and epistemological positions, together with practical considerations. The researcher's objectives were designed to address the aim of providing insights into the valuation of agricultural land in Ireland, as well as to assist practitioners to make informed decisions. The researcher therefore addressed the various options available and the approach(es) chosen to address each of the four objectives, as outlined below.

Objective 1: To improve the availability and accessibility of agricultural land market data in Ireland.

As was identified in the literature review, there is a significant lack of agricultural land market data available in Ireland. Early in the study, the researcher identified his own firm's records as a potential means of addressing this. His investigations identified over 55,000 rental data entries and over 1,300 sales records between 1901 and 2013. These were date-specific entries which were recorded, date specific, in Excel for the purpose of further research. They were reported annually for this research. This is referred to as the "Smith Harrington" dataset.

Practically, this data was available to the researcher. Compiling this dataset addressed the gap in knowledge and provided the foundation to answer the research question and address the aim of this study. There were no other obvious mechanisms to achieve this objective and, given the time series nature of the data, this also provided the opportunity to test theories over an extended period.

A final consideration was validation. While the comprehensive nature of the data and transcribing from a natural source provided assurance, an alternative data set was sought to assess if the data was representative of the phenomenon that it set out to represent (the Irish agricultural land market). In discussions between the researcher, his local adviser, and his supervisor, it was agreed that it could be validated with reference to the William B. Fitt dataset. This method of compiling the data itself, together with further detail on its validation and checking for accuracy, is discussed in the method section. All these assurances provided the rationale for compiling this dataset as the primary method to answer this objective.

To achieve Objective 3, additional data was produced and/or compiled that would further assist in improving the availability and accessibility of agricultural land market data in Ireland. This included a rental yield series, an income yield series, and two (rental and income) discount rate and risk premium (RP) series. The method of creating, compiling, verifying accuracy and validity, and reporting on this additional series is set out in the section on Objective 3, below.

The compilation of the various datasets and series are considered major contributions to knowledge and comprehensively achieve this objective.

Objective 2: To identify alternative methods of valuing agricultural land that are compatible with established economic theories, practitioners' bases of value, the historical context, and other relevant factors.

This objective, while more straightforward than Objective 1, is of critical importance to the study to provide its theoretical framework. Pragmatists agree that research always occurs in social, historical, political and other contexts and may require a theoretical lens (Cresswell, 2014). The primary method to provide this framework is through a literature search. The literature has been analysed in Chapter 2 and throughout this thesis. From the literature, the

researcher established that the DCF model was the alternative method most compatible with established economic theories, practitioners' bases of value, and the historical context.

In addition to the literature review, the theoretical model referenced in Objective 3, below, provided an additional method to validate whether the DCF method could be used to assess the market value of agricultural land.

Objective 3: To assess the accuracy of selected method (DCF) in estimating the market value of agricultural land in Ireland.

There were various options available to test this. A qualitative approach, for example interviewing practitioners, was considered but ruled out. This approach could have involved selecting a sample of experienced valuation practitioners to undertake the valuation of several parcels of land using the comparable method valuation and a separate sample of valuers to value the same parcels using a DCF model. The results of both methods could then have been compared and assessed.

There was merit in this approach. Many studies, such as Crosby *et al*. (1998) make this case. The researcher agreed with this approach when determining the negligence of the valuer, which was the purpose of Crosby *et al*. However, in the context of examining a new approach to valuing agricultural land, an approach with which valuers would not be familiar, he did not think it seemed an appropriate approach for drawing reasonable claims to knowledge.

Also, it would only be practical to undertake a rather small sample size for such an experiment and attempting to replicate real-world conditions for a valuation that was part of a research project would be difficult. This uncertainty could further undermine any claims to knowledge that were made. This approach was therefore ruled out.

A related issue that this brought to light was the use of the comparable method of valuation as a base from which to compare the results of the model. The comparable method is often not reflective of the actual price which market value attempts to simulate. The results of a method such as this would therefore not answer the objectives of this study but rather, compare the comparable method to the DCF. This would only provide limited insights into the valuation of agricultural land. Furthermore, the analysis of the comparable evidence might take the focus off the primary research question and hypothesis, namely that a DCF model could

provide supportive evidence in the valuation of agricultural land. This would be of limited assistance to practitioners and would not provide theoretical insights. To deal with this concern, the researcher considered it better to utilise prices rather than comparable valuation as evidence, as in Brown's (1986) study.

It was therefore considered more appropriate to utilise a quantitative model, rather than a comparative valuation model, where the results could be compared directly to the source price. The source price is what the market value definition attempts to replicate. This was found to be more appropriate for answering the research question. Due to a lack of data, including prices, this approach would not be available to most researchers. However, as noted in Objective 1, this study has produced a dataset of both rental and purchase prices. As such, a series was available, and for the reasons outlined, it was considered the stronger methodological choice to address the study objective and research question.

The method is described in section 3.6. The general approach involved the following steps.

(1) Theoretical test (assuming perfect foresight). The theoretical test involved:
1. Establishing the appropriate assumptions (including bases of value).
2. Creating a model consistent with the assumptions.
3. Establishing the appropriate inputs.
4. Working out the market discount rates for the respective years of the model.
5. Testing the model to examine if it was theoretically possible to use the discount rate to estimate the market value of agricultural land in Ireland.
(2) Practitioner process test (utilising only inputs from year one of the study – the data that should be available to valuers in practice). The practitioner process test involved:
1. Utilising same DCF model and assumptions as for the theoretical test.
2. Inputs from the first year's data (of the subject year that was to be valued only).
3. Drawing on the implied annual growth rate theory to determine annual growth rates.
4. Analysing the results (net present values) against the actual prices from the subject year.

Table 3.2: Approach to answering research question

Objective 4: To determine whether the selected method of valuation of agricultural land is an appropriate consideration in determining the market value of agricultural land in Ireland.
This was undertaken drawing on statistical analysis of the outputs from Objective 3, together with the critical analysis of the theory from the literature and the researcher's philosophical scepticism based on his experience in practice.

To summarise, the researcher used a longitudinal quasi-experimental research design to address the aim and objectives of the study. The details of the methods used are discussed in section 3.6, below.

3.6   Method

3.6.1   Basis of value

The first step in constructing a model to test the above was to ensure that all inputs and assumptions were well considered and appropriate. The first assumption was the basis of value of the model. It was considered appropriate to draw on theory and practice guidelines to ensure that the DCF model would be consistent with the practitioners' basis of market value set out by the IVS. The IVS has been adopted by the RICS in its *Valuation standards* (*Red book*) (RICS, 2016) and other organisations such as TEGoVA, in their *European valuation standards* (*Blue book*) (TEGoVA, 2016). These practice notes build on the theory proposed by leading authors in this area, such as French (2000). It was therefore considered to be the most appropriate basis.

All inputs to the model, including assumptions, were therefore considered, having regard to this basis of value.

3.6.2   Creating the model

The DCF is not a new financial model. It has its origins in cash flow techniques used by the Egyptians and Babylonians. However, it was not much used until the 1930s, when Irving Fisher and John Burr Williams expressed the DCF method in modern economic terms . During the 1930s, following the stock market crash of 1929, and with the benefit of these studies, the DFC gained popularity as a way of estimating the intrinsic value of stocks. Damodaran (2002) notes it has its foundations in the present value rule. Mathematically this can be expressed as follows:

$$\text{Value} = \sum_{t=1}^{t=n} \frac{CF_t}{(1+r)^t}$$

Where;

n=life of the asset

CF_t= Cash flow in period t

r= Discount rate reflecting the riskiness of the estimated cash flows

Figure 3.3: Present value rule (Damodaran, 2002)

The layout of individual DCF models may appear different. This may be due to the level of detail required for the specific purpose. Nonetheless the principle of the present value rule remains the same. The value of an asset within this model is the sum of future payments discounted back to present value at a discount rate.

$$V = D(1+R)^{-1} + D(1+R)^{-2} + \ldots + D(1+R)^{-n}$$

Where:

V=Value

D=Constant income of an investment

R=Discount rate

Figure 3.4 Mathematical expression of a DCF model (Baum & MacGregor, 1992)

This formed the starting point to create a model to test the approach on the valuation of agricultural land.

The DCF method of analysis can be used to produce two types of results, depending on the practitioner's requirements. These are the net present value (NPV) and the internal rate of return (IRR). To determine the NPV, net present benefits receivable and the net costs incurred from an investment are discounted at a target rate (discount rate) over a selected time series period. The discounted costs are deducted from the benefits to arrive at the NPV. The assumption here is that, all other things being equal, the NPV is the price that a rational investor would pay for an asset. The IRR is the discount rate that equates the discounted future cash flows with the initial outlay. It therefore produces an NPV of 0. It is generally

used to compare alternative investments and is not the focus of this study. Nonetheless, the IRR formula set out below is referred to and adapted to assist in assessing the discount rates later in the study.

$$R_1 + (R_2 - R_1) * \frac{\text{NPV@}R_1}{\text{NPV@}R_1 - \text{NPV@}R_2}$$

Where:

R_1 = Trial rate 1

R_2 = Trial rate 2

$\text{NPV@}R_1$ = Net Present Value at Trial Rate 1

$\text{NPV@}R_2$ = Net Present Value at Trial Rate 2

Figure 3.5: Formula for Internal Rate of Return (IRR) (Isaac & O'Leary, 2012)

To determine the NPV of an agricultural land purchase there are two main approaches to selecting the inputs. The first is the traditional model utilised in property investment appraisal, where the rents received by the owner are inputs to the cash flow, any management costs associated with the project are deducted from the rent, and a sale price at exit is estimated (see Table 3.3, below). All income and expenditure are discounted to present value. The sum of these present values is the value of the assets before costs.

Type of information	Current information	Forecast information
Value	ERVs of both existing building and any prospective changes to the building in the future Passing rent	Rental value forecasts Rental depreciation rates Exit capitalisation rate forecasts for exiting or replacement buildings
Building	Size Costs of maintenance Nature of prospective redevelopment or refurbishment and costs	Changes in building costs Timing of redevelopment or refurbishment
Current leases	Number of tenants Lease expiry or break dates Rent revision dates and type Renewal rights/options	Incidence of future break and renewals Void and future lease incentives
Holding costs	Management costs Rent revision costs Purchase and sale costs	
Other information	Discount rates Taxation Loans: interests and repayments Holding period	

Table 3.3: Typical information requirements for DCF appraisals (Baum & Crosby, 2008, p. 65)

The above table is an extract from Baum and Crosby's classic text, *Property investment appraisal*. As it is focused on property investment, and therefore investors, it focuses on rent as the income receivable by the investors, who are the principal purchasers in the property investment market. While this would be a typical approach utilised in property, Baum et al (2011) notes there is a danger in applying valuation techniques that stray from the underlying logic of how actual buyers price their purchases.

Based on the literature and the researcher's practice experience, it appears that participants in the agricultural land market do not operate in the same way as participants in the investment market. Firstly, it was noted from the literature that in the agricultural land market in Ireland the principal purchasers are owner occupiers (farmers) who operate the farm as a business. This is as opposed to participants in the investment market, who seek out tenants for the assets.

Secondly, it was noted that during the 20th century, participants in the agricultural land market in Ireland have been prepared to purchase land at any cost (limited by what they could afford), based on history and family tradition. It was also noted that DCF methods of investment appraisal are beginning to become more widely utilised by farmers. Farmers must often complete courses involving cash flow analysis to obtain grants. They may also have an awareness of the tools from the valuation of wind farms or forestry. As awareness of this technique grows, it is likely to have a greater usefulness in the valuation of agricultural land. This would support the proposition that the DCF should be used to estimate the value of agricultural land and will become more important in the coming years. Yet, the purchase of agricultural land is still not an investment in the same way that investments are made in other types of property. This needs to be reflected in the model.

Modern farmers, who are now becoming the primary participants in the agricultural land market, are educated in DCF techniques. They tend to employ a rational business-minded approach to their farming. So, it is suggested that a DCF model utilising business (income) inputs would be a more explicit and rational model than the traditional rental model.

The hypothesis is therefore that the price of agricultural land in Ireland is related to the net income generated from the end uses of the asset discounted at the discount rate, reflecting the riskiness of the reflective cash flows. The price of end uses would therefore be the price of

the outputs (such as crops, milk, and beef cattle) and the outgoings would be all inputs that are required to obtain the income (such as seeds, fertiliser and feed).

Both approaches (income DCF and rental-based DCF) have their advantages and limitations. For example, the complexity of the income models (given the varied nature of farm enterprises) makes it difficult to source appropriate data and make projections, particularly for research purposes. However, the income models are likely to be more closely aligned to the value of the asset, due to the reasons outlined above. To be conclusive, both models (rental and income) have been examined in two independent tests in this study and each has been critically analysed in Chapter 5.

While the models themselves are relatively straightforward (based on Figures 3.3 and 3.4 above), it was recognised for the findings to be valid that every element of its structure, assumptions, inputs (including the discount rate) needed to be well considered from a theoretical and practical perspective. It was considered appropriate to examine theory in the first instance and, before undertaking the main study, to set up pilot studies to consider whether the proposed method was testable. A sample of the pilot studies is provided in Appendix 3.

The following sections discuss how the appropriate assumptions and reliable input data for the model were chosen to address the research question and relevant objectives.

3.6.3   *Standard assumptions*

In relation to general assumptions for the valuation of agricultural land, the RICS guidance note on the subject highlights the importance of clarifying, at the outset, the legal interests to be valued (RICS, 2017). While it is acknowledged that farm ownership structures can be complex, it has been assumed for this method that farm is held in one entity trading as a sole trader. It is further assumed that the agricultural use is the sole activity taking place on the asset. Tax has been ignored, as different operators in the market will have different tax structures. As was indicated in section 3.6.1, the basis of valuation is assumed to be market value.

The interest being valued will reflect the financial standing of the business at the valuation date (RICS, 2017). The data was compiled up to 2013. The valuation date for the purposes of

the study is 1 January for the specific year. The market value of the asset or liability was considered as at this valuation date.

These assumptions, together with other assumptions (including basic input data), were tested within the pilot study (see Appendix 3). Minor refinements were made. The result of these refinements was the construction of an experiment that had a stronger theoretical base.

3.6.4 Input data introduction

The input data may be different for each of the respective tests set out set out below. The four sets of input data requiring consideration by the researcher were:

1. Income data for theoretical test.
2. Income data for practitioner test.
3. Rent data for theoretical test.
4. Rent data for practitioner test.

This is because the data for the theoretical test may not be available, in practice, to a valuation practitioner and if this were the case, it is likely that a separate practitioner model would be required for the DCF to be utilised in practice.

One of the most challenging aspects of creating a model was identifying and sourcing the various data inputs that were representative of the bases of market value. From the literature review, it was found that the market value was defined as:

> the estimated amount for which an asset or liability should exchange on the valuation date between a willing buyer and a willing seller in an arm's length transaction, after proper marketing and where the parties had each acted knowledgeably, prudently and without compulsion (IVSC, 2017, p. 18).

The element of this definition that is particularly relevant here, to ascertain the inputs, is the phrase where the parties had each acted "knowledgeably, prudently and without compulsion." Establishing what parties in the market generally consider knowledgeable and prudent may be subjective. However, by breaking it down and drawing on the theories identified in the theoretical framework of the literature review, it becomes clearer.

As noted in Chapter 2, "knowledgably" presumes that both the willing buyer and the willing sellers are reasonably informed about the nature and characteristics of the asset, its actual and potential uses, and the state of the market at the valuation date. From this, it can be assumed that all parties – willing purchasers and willing sellers – are aware that the information is available in the market or will receive advice regarding it. "Prudently" may be more difficult to analyse. However, it is known from previous surveys that most of the participants in the market for agricultural land are farmers. Farming is a commercial occupation and, based on economic theory, commercial decisions to purchase assets will be made based on the future returns that can be achieved from the investment. An assumption can therefore be made that a prudent, willing seller will sell and a prudent, willing purchaser will buy, both having their decisions on their estimations of future returns from the asset. If the offer matches their estimates of future returns, it is likely that a willing purchaser will buy the asset; and a willing seller will sell the asset without compulsion. They will be making the decision "knowledgeably" and "prudently." This was the framework used to identify the most credible data available to all market participants that would satisfy these criteria.

3.6.4.1   *Income data*

The Teagasc National Farm Survey (NFS) data has been collected by Teagasc on an annual basis since 1973. The objectives of the NFS are to:

1. Determine the financial situation on Irish farms by measuring the level of gross output, costs, income, investment and indebtedness across the spectrum of farming systems and sizes.

2. To provide data on Irish farm incomes to the EU Commission in Brussels (FADN – the EU Farm Accountancy Data Network).

3. To measure the current levels of, and variation in, farm performance for use as standards for farm management purposes, and

4. To provide a database for economic and rural development research and policy analysis.

To achieve these objectives, a farm accounts book is recorded for each year on a random sample of farms, selected by the CSO, throughout the country (Teagasc, 2013). The NFS is

designed to collect and analyse information relating to farming activities as its primary objective. Information and data relating to other activities by the household are considered secondary. The sample size varies year on year as the number of farms in the State changes. However, the sample size is over 1,000 farms from a sample population that fluctuates around 100,000 (Teagasc, 2010, 2013). This represents about 1% of the total number of farms.

An annual conference is also held each year. This is aimed primarily at farmers and it publicises the results from the NFS. The purpose of this conference is to inform farmers about the returns from the various sectors so that they can make informed choices about their decisions, regarding their farming enterprises. Their decisions may include capital investments, such as the sale or purchase of land.

It therefore provides information that "a willing buyer and a willing seller in an arm's length transaction may be aware of where the parties had each acted knowledgeably, prudently." From this perspective, it satisfies the market value bases of value.

The Teagasc study is a rigorous survey that has been undertaken since 1973 and provides as close to a perfect assumption that fits the framework for the model as is likely to be found. Notwithstanding this, the researcher did look for alternatives.

An alternative input that was considered was the Food and Agricultural Policy Research Institute (FAPRI) reports. The FAPRI data was produced to replicate the published output, input and income in agriculture estimates provided by the CSO and to provide projections of the key variables in the agricultural sector under different policy scenarios (McQuinn & Riordan, 1998). FAPRI-Ireland is a partnership between FAPRI, which is based at the University of Missouri, Columbia, USA and Teagasc. The FAPRI-Ireland report provides analysis of the prospects for the agricultural and food sectors over respective 10-year periods, commencing in 1998. It produces "baseline" (i.e. no policy change) projections for the major agricultural markets.

In some respects, these projections were better suited to the theoretical framework of the study, in that FAPRI data provides projections on a given date. In other words, it predicts the future incomes and expenditures, as opposed to surveying market participants about their actual income and expenditures. The question then arises as to what market participants place more weight on to predict future incomes and expenditure. Is it what economists predict? It assumptions based on their actual returns? Or, is it a mix of both?

In terms of methodology, the FAPRI-Ireland data represents the output of a multi-period dynamic partial equilibrium econometric model. The projections are based on inputs and assumptions from a variety of statistical sources and agricultural economists and experts. The FAPRI model relies on a series of assumptions. For example, in relation to cereals and feed use in Ireland, there is also an assumption of "normal" weather prevailing in the forecast period (McQuinn & Riordan, 1998). It may be argued that "knowledgeable" and "prudent" purchasers and vendors are assumed to make the same projections. Theoretically, this may be the case, but it is unlikely that market participants or their advisors would be as familiar with this data as they would the Teagasc NFS data.

In considering which data to select, the researcher reflected on his knowledge of market participants and their decision-making. All market participants would have to make assumptions like these, when deciding whether to buy or sell land. The researcher also reflected on practical considerations. The FAPRI data was only established in the 1990s and was not undertaken annually, which provided fewer opportunities to test theories rigorously. Furthermore, it was not broken down in as detailed a fashion as the National Farm Income Survey data. This was a limitation relative to the NFS data, which provided added flexibility to consider additional theories. Finally, the raw data was not readily available for the FAPRI data.

There are other records, such as the price of grain, beef and milk and assumptions could have been made to replicate market conditions. However, it was clear from the researcher's investigations that no other data could match the reliability of the Teagasc NFS data or the FAPRI data. In this end, the validity of the data and the practical considerations outweighed

any potential benefits from the FAPRI data, and the Teagasc NFS data was considered the best methodological fit for this study.

Lloyd, in his study of agricultural land prices in England, noted that assumptions are necessary to test models such as these (Lloyd, 2009). It was considered that the available Teagasc NFS data over a period where records of actual sale prices have been recorded provided extremely reliable assumptions for this purpose. While it had some limitations, this data nonetheless provided well-considered assumptions for inputs to determine the market discount rate.

In deciding what specific data inputs to take from the Teagasc survey, it was necessary to consider the appropriate valuation theory to inform the selection of the appropriate data. Extensive consideration was given to this, but two recent publications were of particular assistance. Firstly, from a practical guidance perspective, it was useful to consider the RICS guidance notes on the use of the DCF method (RICS, 2017). These notes are not mandatory but set out current best practice for practitioners when using these tools. This provides a basis to consider whether the theory supports this guidance in the context of valuing agricultural land in Ireland, drawing particularly from the seventh edition of the income approach to property (Baum, Mackmin, & Nunnington, 2018).

When valuing agricultural land based on input costs and output values, the data from the NFS can be related to the income approach to property valuation. The RICS has published a guidance note on the inputs to a DCF for market value purposes (RICS, 2017), in which it recommends the use of the fair maintainable turnover (FMT) of the reasonably efficient operator (REO). From this the fair maintainable operating profit (FMOP) can be arrived at, which is recommended when using the profits method. To arrive at a FMOP, the valuer needs to adjust the earnings before interest taxation and depreciation amortisation and rent (EBITDAR) from the specific accounts.

The concept on which this (fair maintainable operating profit of a reasonably efficient operator) is based is that a property owner should not be punished for having an underperforming tenant (Baum et al., 2018). The FMOP may include theoretical aspects. In

other words, the valuation may not only consider the business that exists, but also the one that could exist on a commercial basis as at the valuation date (RICS, 2017). The theory is that what is included in a specific set of individual farm level accounts may not represent a reasonable turnover from a typical efficient farmer, and a valuer may need to make a further assumption to adjust the official accounts to reflect this. The Teagasc data is the average data from the survey and it can therefore be inferred that the data represents a typical operation (or reasonably efficient operator) and does not require further adjustment from this perspective.

The Teagasc data provides gross margin data that excludes rent, interest charges, depreciation, and tax. Amortisation is not applicable when valuing a tangible asset like agricultural land. It is therefore necessary for the appropriate data to be incorporated into the model for income purposes.

On a related point, Damodaran (2002) notes that individual companies frequently record expenses differently, which can "skew" individual figures (such as operating profit). He notes the importance in practice of investigating individual farm level accounts for each individual valuation. This could be undertaken at farm level, in practice. Damodaran's point also provides further support for the use of the Teagasc data, in that the gross margin data from the Teagasc report most closely aligns with the market perception of what the RICS is likely to consider the fair maintainable operating profit of a reasonably efficient operator.

A further advantage of the Teagasc dataset is that it categorises farm income into the gross margin data for dairy and tillage respectively. These are two of the predominant uses within the study region. Drawing on the literature review, discussion on market value and worth (section 2.4.2) it is necessary to establish the highest and best use in each given year of the model, to avoid producing a worth calculation, rather than the market value. For this study, the inputs chosen were the higher of the potential agricultural uses for the respective years, to reflect the highest and best use.

There is a well-established school of thought that the FMOP should be split into a profit and rent. Baum et al. note that once figures for FMT and FMOP are calculated, it is possible to

calculate rental values, which can then be capitalised (Baum et al., 2018). As the actual rental data is assessed as part of this study, it was not considered necessary to examine this approach as well. However, it was considered that publishing a rent-to-FMOP ratio would be a further useful contribution to knowledge, which might be of use to researchers and practitioners. This is included in Appendix 5.

Determining the best approach to identify future market inputs that reflect the outlook for the industry was given careful consideration. When valuing land for a specific year, there are three distinct alternative assumptions. The first is to rely entirely on historical data that would be available to the valuer.

The argument for using the historical data is that this data would be available to the valuer. However, it does not account for inflation and/or deflation that an experienced valuer should project on the income in a typical DCF. As a cash flow, by its nature, projects forward, relying entirely on the historical data would not appear theoretically consistent with the market value conceptual framework and was ruled out as an option for this research.

A variant of this approach is to utilise growth rates from the historical data to project inputs forward. While this approach attempts to resolve the issue of not accounting for inflation/deflation, it still suffers from similar limitations to directly utilising the historical data. The assumption this relies on is that growth rates will be the same going forward as they were in the past. While an improvement, it still does not replicate the desired data.

The analyst approach is a further option. This approach draws on general trends in the market and explicitly projects the growth/decline in every year of the cash flow inputs. In doing so, the valuer is attempting to replicate a willing purchaser's thought process. Damodaran (2002) notes the difficulty and volatility of this approach. While it was in theory possible for the researcher to do this, the validity attached to one valuer's judgement would have left the research open to justified scrutiny. For this reason, this approach was ruled out.

A survey of practitioners was also considered. Commenting on the use of surveys to estimate equity premiums, Damodaran concludes that "survey premiums will be more reflections of the recent past, rather than good forecasts of the future" (Damodaran, 2011, p. 17). It is reasoned this is likely to hold true for other inputs. Furthermore, for this purpose it was considered that it would not be possible to undertake a sufficiently large survey of experienced enough practitioners who could recall growth projections for each of the respective years (particularly given the time series 1993-2013 involved), and for these reasons it was also rule out.

The final approach was to assume perfect foresight of the actual occurrences during the cash flow period. For example, the 1993 rental DCF for 10 years requires the rental data for 1993 to 2002, from the Smith Harrington dataset. The advantage of this approach is that input data will be the exact data that a valuer is trying to predict. However, this assumes perfect foresight, which no valuer has. While this is a limitation from a practitioner perspective, it is well suited for the theoretical test, as it accounts for the inflation or deflation that actually occurred. It was therefore considered the most appropriate for this study of all the options considered.

This data was available for income (from the Teagasc dataset) and for rental (from the Smith Harrington dataset) as set out in further detail, in section 3.6.4.2. It was therefore chosen as the input data for both (income and rental) theoretical tests, to determine the theoretical market discount rates.

As noted, this data would not be available to a valuer in practice and it was therefore considered appropriate that another model should be developed, based on data that would be available to a practitioner. The inputs for the practitioner model are discussed in section 3.6.6, below.

It is acknowledged that all these assumptions necessarily have limitations and are simplifications of reality. In future studies, use of FAPRI projections, if the raw data could be obtained and adapted to work with a model, might be of greater validity. However, utilising the actual data that occurred was considered the most appropriate approach for this research that would provide credible theoretical insights.

Other assumptions that were required included the exit sale price at the end of the cash flow. The exit value should reflect the anticipated state of the property, physically and in tenure or leasing terms, at the exit date (RICS, 2010). Growth had been explicitly built in to the cash flow and it was considered appropriate that if the cash flow from the exit year was capitalised, it would be consistent with the DCF model. As it was income (rather than rent), a new income yield series was created (income to sale price). It was considered that the income yield from the year of valuation would provide the best representation of purchasers' expectations on the date of valuation.

3.6.4.2   *Rental data*

The selection of inputs for the rental data was a more straightforward process. It was believed that the newly constructed Smith Harrington dataset would provide rental data for the inputs. The exit yield was assumed as the yield at the date of purchase, to reflect the market's perceptions at the date the asset was to be valued. As with the income series, the perceived growth or decline in the inputs would be explicitly reflected in the exit sale price via the inputs. The accuracy and validity of the data are set out later in this chapter.

All other assumptions, where appropriate, were in line with the income data assumptions.

There was another key assumption, for both the rental and income DCF models, that has proved challenging for practitioners and researchers to assess in the past – the discount rate. Brennan found that the main reason that DCFs were not more widely utilised in the valuation of development land in Ireland was valuers' lack of knowledge of how to assess appropriate discount rates (Brennan, 2011). Brennan's research examined the market for development land and other researchers have found similar challenges in markets, with relatively more data availability. Assessing the discount rate for an agricultural model is therefore particularly challenging.

3.6.5   The discount rate

3.6.5.1   Method

The discount rate is often referred to as the "target rate" or "desired rate of return." For the purposes of this study, it is referred to as the "discount rate", and in specific instances that are defined later in this section, "the market discount rate."

Firstly, the discount rate (and DCF model) is often used to establish the attractiveness of an investment opportunity, as opposed to establishing the price or market value, as set out in the literature review. This study is attempting to establish a discount rate appropriate for establishing the market value of the asset. Alternative terms may be misleading in this regard.

Baum and Crosby (2008) identify three principal methods that can be used to establish a discount rate. These are:

* The capital asset pricing model (CAPM).
* The weighted-average cost of capital (WACC).
* An intuitive approach.

The CAPM, and a related arbitrage pricing model (APM) are widely used in finance to calculate the discount rate. Damodaran notes that both models define the risk of the asset is the risk that cannot be diversified away and therefore the primary assumption in both models is that the marginal investor in the asset is well diversified (Damodaran, 2002).

There has been an argument that investors in real estate are not sufficiently diversified to employ this model (Baum & Crosby, 2008; Damodaran, 2002). The development of funds and Real Estate Investment Trusts (REITs), as Damodaran (2002) notes, has countered many of these arguments in larger real estate investment markets. While more developed real estate investment markets have diversified investors, this is not the case for the marginal investors in the specific asset (agricultural land) under investigation. As previously noted, the primary participants in the market for agricultural land in Ireland are farmers and owner occupiers. Diversifying away risk factors, such as location, is very different from locational risk to investors.

Another criticism of this method assumes that all assets are liquid (Damodaran, 2002). It is well documented (Baum & Crosby, 2008; Damodaran, 2002) that property is not particularly well suited to this method, due to its liquidity issues. While these issues can be addressed (by adjusting the discount rate according to the appropriate level of liquidity risk), it is important to recall that liquidity is a more significant issue in the agricultural land market in Ireland than in other asset classes. This presents a further limitation.

Baum & Crosby also highlight problems with calculating the discount rate in a property context due to data limitations (2008, p.332). While data in the investment property sector has improved in subsequent years, as was noted in the literature review, the data collected in the agricultural land market remains extremely limited. Having consideration for these theoretical inconsistencies and data limitations, this method was not considered appropriate for the subject research purposes.

The WACC establishes a discount rate by considering the cost of a company's borrowing, to establish a discount rate. This is closely related to establishing a target rate and establishing the attractiveness of the investment to a particular company. As it does not generally consider the market as whole, it is not consistent with the purposes of this study and has not been considered to calculate the discount rate within this study. For further discussion on both models, see Damodaran (2002), Baum and Crosby (2008), and Brigham and Ehrhardt (2011).

Baum and Crosby (2008) note that the intuitive approach is most commonly used in property investment. The RICS (2010) concurs with Baum and Crosby and, while this precedent could be challenged, it appears to be the most theoretically consistent with the purpose of this study.

The intuitive approach constructs the discount rate from an RFR and market RP. While this may seem to be a relatively straightforward process, actually determining the RP is more complex (RICS, 2010). The RICS guidance note highlights that some inputs can be estimated quantitatively from historic data, while acknowledging that projecting into the future requires an element of subjective analysis of risk. The guidance note highlights the following factors listed in Table 3.4 as relevant considerations:

1, *RFR of investment.*

2, *Market risks*

    a, *Illiquidity upon sale (e.g. lot size, transaction times, availability of finance).*

    b, *Failure to meet market rental expectations (forecast rental growth).*

    c, *Failure to meet market yield expectations (forecast yield shift).*

    d, *Risk of locational, economic, physical and functional depreciation through structural change.*

    e, *Risks associated with legislative change (e.g. planning/privity of contract, changes in fiscal policy.*

3, *Specific risks*

    a, *Tenant default on rental payment (covenant risk).*

    b, *Risk of failure to re-let (void risks).*

    c, *Costs of ownership and management.*

    d, *Differing lease structures (e.g. rent review structure, lease breaks).*

Table 3.4: Factors influencing discount rate (RICS, 2010, p.9)

The guidance note also mentions that the RFR, also known as the risk-free return, is normally taken to be the gross redemption yield on a medium-dated government gilt, preferably of the same duration as the assumed holding period of the investment (RICS, 2010). To be consistent with this, the researcher obtained a data series of 10-year Irish government bond yields from the Irish Central Bank, which serve as a proxy for the RFR. The bond rate as of 01 July, or closest to the mid-year point,[10] serves as the rate for the given year.

In terms of the risks, "market risks" are those that may affect the market as a whole. For example, an increase in stamp duty rates (a transactions tax) on all commercial property in Ireland from 2% to 6%, which was introduced in Budget 2018 (Revenue, 2018), impacted negatively on the Irish agricultural land market, as it increased purchaser costs. This change was brought in to disincentivise commercial development in Dublin city centre, where the Government considered that insufficient residential development was occurring. The negative consequences for the agricultural land market appear not to have been foreseen by the Government. Increases in purchasers' costs may be unpredictable and difficult to assess but

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[10] In the years where no Irish bonds were issued, the closest date was examined.

they represent one element of "market risks." Their unpredictable nature highlights why "market risks", despite their complexity, should always be considered.

"Specific risks" refer to the risks of individual assets, such as those listed, e.g. tenant defaulting.

As is evident from the wording in the RICS guidance on the subject, the note primarily relates to the investment market. While a similar approach drawing on theory could be considered for the agricultural market, it would be rather subjective for a rigorous testing of theory. While this approach to estimating market discount rates is likely to be drawn upon to construct discount rates in practice,[11] it was not considered an appropriate method for this study. Alternative approaches were therefore considered.

There are several approaches to determining the market discount rate. Many of them are deemed impractical by the RICS. The RICS notes that there are two broad approaches to calculating RPs: (1) *ex post* and (2) *ex ante*. The RICS acknowledges that many investors have attempted to construct *ex ante* estimates of the RPs (RICS, 2010). Some elements can be estimated quantitatively but a significant element is subjective and qualitative. Again, this approach to estimate the discount rate was not considered sufficiently rigorous for the methodology for this research.

The *ex post* approach generally focuses on a historic review of relative property returns (at all property, sector or individual asset levels), to the selected RFR over as long a period as possible (RICS, 2010). While there was no such historic review of agricultural land market discount rates,[12] it occurred to the researcher that it might be possible to work back, utilising the dataset, inputs and model to identify the market discount rates on a rental and income basis respectively. This is what has previously been referred to as the theoretical tests.

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[11] Should the DCF method be shown to be an accurate indicator of market value.

[12] It is important to note that market risks are distinct from the market discount rates. "Market discount rate" represents that actual discount rate (RFR) plus the market RP and specific risk. premium that prevailed for a given year. For this study, the referred to market discount rate (output from the model) incorporates the market risk.

From these theoretical tests, a data set of market discount rates for rent and for income could be constructed, which would assist in answering the aim and objectives of this study. The results from this model could then be analysed against the actual sale prices from the dataset. In theory, this should demonstrate that the DCF method using these well-considered assumptions and market discount rates (reflecting purchasers' perceived risks in the market at that time) could be used to estimate price and therefore market value.

The dataset could also be used to assist practitioners to estimate market discount rates in practice, if required, in line with the RICS guidance note on the subject. This would assist with the practical application of the model. Its use should carry the warning that also appears in the RICS guidance note, that the investors' perception RPs are not stable over time. Drawing on historic (*ex post*) approaches would require valuers in practice to consider appropriate risks at the date of valuation, if undertaking such a valuation. It was considered that this issue could be further considered in the discussion. The benefits of this *ex post* approach led to its selection as the most appropriate for this study.

With the above in mind, the researcher set about considering the potential methods to determine the appropriate market discount rate for the study. Employing the template and assumptions for the DCF previously set out, it was possible to work back to establish the prevailing market discount rate at the time of the transaction. This could be done to estimate the market discount rate based on (1) income (fair maintainable operating profit) and (2) rent providing additional insights.

The most accurate method of doing this was by using a trial-and-error approach, where it could be evidenced that the output of the DCF model matched exactly the sale price for the given year. This would serve the purpose of estimating the discount rate, while also theoretically demonstrating that the DCF method could be utilised to estimate the market value of agricultural land.

Trial and error was a time-consuming process. However, as it could be relied on as the most accurate measure based on the data available, it was selected as the most appropriate way of

assessing the discount rate for this study. This was aided by a novel use of an IRR formula. As it is known from literature to calculate the IRR and net present value that equals 0, the IRR formula, as set out below, was used.

$$R_1 + (R_2 - R_1) * \frac{\text{NPV@}R_1}{\text{NPV@}R_1 - \text{NPV@}R_2} = 0$$

Where:
R_1 = Trial rate 1 to estimate a net present value greater than 0
R_2 = Trial rate 2 to estimate a net present value less than 0
NPV@R_1 = Net Present Value at Trial Rate 1
NPV@R_2 = Net Present Value at Trial Rate 2

Figure 3.7: IRR formula (Isaac & O'Leary, 2012)

However, this enquiry sought to work out the discount rate that relates to the actual price of the land, rather than the rate at which the investment equals 0. The trial rates selected had to be adjusted to estimate the actual price from the relevant year being assessed in the Smith Harrington dataset, rather than 0.

In addition to this element of the formula, it was necessary to amend the minus to a plus symbol on the net present values. This is due to the minus symbol in the original IRR formula being in place to arrive at an NPV of 0: there is one negative NPV and one positive NPV. The two minus symbols therefore cancel each other out, resulting in a positive. For this purpose, it was therefore necessary to adapt this to a plus symbol.

Therefore, the formula could be adapted for the purposes of this study to:

$$R_1 + (R_2 - R_1) * \frac{\text{NPV@}R_1}{\text{NPV@}R_1 + \text{NPV@}R_2} = \text{Actual Price}$$

Where:

R_1 = Trial rate 1 to estimate a net present value greater than the actual price

R_2 = Trial rate 2 to estimate a net present value less than the actual price

NPV@R_1 = Net Present Value at Trial Rate 1

NPV@R_2 = Net Present Value at Trial Rate 2

Figure 3.8: Formula to estimate approximate discount rate for this study

The output of this formula was an approximate market discount rate at which the net present value equalled the actual selling price for the year. As a second stage test, the results of this formula were tested utilising the discounted model. This provided an approximate (but relatively accurate) result that was then refined by utilising trial and error to get it exact, so that the model produced an NPV exactly equal to the actual price in the given year. All these results were cross-checked utilising the Goal Seek function in Excel.

It was now possible to construct a DCF that should theoretically match the actual prices achieved.

	A	B	C	D	E	F	G	H
1								
2	1993	Year	NOI	PV €1 @		Net cash		
3				discount rate of	5.18222%			
4	following 10 years							
5	1993	1	€142.23		0.950731	€135.22		
6	1994	2	€146.90		0.903889	€132.78		
7	1995	3	€140.22		0.859356	€120.49		
8	1996	4	€129.54		0.817016	€105.83		
9	1997	5	€102.38		0.776763	€79.52		
10	1998	6	€107.87		0.738492	€79.66		
11	1999	7	€103.19		0.702107	€72.45		
12	2000	8	€109.53		0.667515	€73.11		
13	2001	9	€107.50		0.634627	€68.22		
14	2002	10	€130.39	1940.75	0.603360	€1,249.64	€2,116.94	Net present value
15							€2,116.94	Actual price
16							5.18222%	Market Discount Rate

Table 3.5: DCF model utilising newly constructed market discount rate for 1993

This example from 1993 demonstrates that it is possible to assess the appropriate market discount rate under the framework set out in this study. A further feature of discounting on this basis is that the discounted cash model can produce NPVs that are in line with the actual prices from the subject year of valuation.

It is, then, possible from these finding to determine if the respective (income and rental) DCF models can, in theory, provide supportive evidence in the estimation of market value of agricultural land. However, this particular model assumes perfect foresight on cash flow growth, which is not a realistic assumption in practice. The insights from this initial study, however, provide the platform for a model that could be adopted for practical use.

3.6.5.2   *The presentation of the results of the DCF method*

As has been previously noted, there are various ways of assessing a discount rate in practice. The approach recommended by many authors for undertaking property valuations is the "intuitive approach" (Baum & Crosby, 2008), together with the "*ex parte*" approach, set out in the RICS guidance note on the subject. The intuitive approach (sometimes referred to as the risk-adjusted discount rate – RADR) involves establishing an RFR and the RP for the specific property or asset class. Therefore:

$R = RFR + RP$

Where:

R = Market discount rate

RFR = Risk-Free Rate

RP = Market risk premium

Figure 3.9: Intuitive approach to establishing discount rate

The determination of the RFR is relatively straight forward. Baum recommends the use of a medium- to long-term government bond as a proxy for RFR (Baum & Crosby, 2008). Ten-year Irish government bond yields were considered most appropriate proxy for the RFR and a dataset to 1991 was acquired from the Irish Central Bank.

As the earlier part of this study produced a historical series of market discount rates (r) it is now possible to establish a historical series of market RPs. It is considered that providing a historical series such as this will assist valuers in calculating appropriate RPs for their valuations. Valuers will still need to consider the market RPs with reference to the prevailing market conditions. Then, considering current market conditions, current RPs could be estimated. Once the RP is established, it is straightforward to acquire the current 10-year government bond rates as the RFR and calculate the appropriate market discount rate that can be used within a DCF for the respective valuation.

It is considered that this element of the method adds considerably to the theoretical insights and relevance of this research, particularly to practitioners.

3.6.6   Practitioner tests method

As practitioners do not have perfect foresight, they will have to make informed opinions on other elements of the inputs to undertake a DCF in practice.

For the practitioner model, the researcher considered the data that was available to him and that which would generally be available to a practitioner on the date of valuation. It was also thought appropriate to consider data produced by this research as possible supplementary data for a potential practitioner model.

	DATA AVAILABLE TO A PRACTITIONER ON THE DATE OF VALUATION	DIRECT SUPPLEMENTAL DATA PRODUCED/IDENTIFIED BY THIS RESEARCH, WHICH WILL SUBSEQUENTLY BE AVAILABLE TO PRACTITIONERS ON PUBLICATION
1	Comparable rental data (transactions that the practitioner may have been involved in or firm may have records on)	Smith Harrington rental data
2	Income data	Teagasc data
3	Comparable sales data (where available)	Smith Harrington sales data
4		From (1) and (3) above, a sales yield would be available
5		From (2) and (3) above, an income yield would be available
6		Discount rate series

Table 3.6: Practitioner model data

The practitioner is likely to have records of rental transactions. These may be through transactions in which they were involved, from the firm's records or comparable data. This could be supplemented by the data from the Smith Harrington dataset (set out below), if required.

As discussed, there are various sources of income data available to the practitioner. They may have knowledge of data on individual farm level. They would at least have access to the Teagasc FSR, as set out above, or data from other similar sources such as the CSO.

While there is limited sales data, it can be assumed that some market evidence would be available either from specific comparable sales or, in their absence, the Smith Harrington sales dataset. With the above information, both rental yield data and income yield data should be available to the practitioner.

And finally, the publication of the Smith Harrington discount rate series provides further data that would be available to the valuation practitioner on the data of valuation. This should assist to make an evidence-based, informed opinion of the discount rate.

The notable exception to this is the growth rate in input (rent or income) data that was available for the theoretical model. However, with the above information, and drawing on models widely utilised in investment theory, it is possible for the practitioner to analyse this data to interpret the growth the market is implying to determine the market value of the asset.

Baum (2008) notes that:

> if a purchaser accepts a particular initial yield for an investment, the yield implies that a particular level of rental growth will be necessary to provide the required rate of return (Baum & Crosby, 2008 p. 126).

While this is particularly relevant to the investment market, the principle may apply to the agricultural market in a similar way. The price paid for land in the market reflects the market's perceptions of the utility of land (which may be income growth and the other utilities previously outlined).

With the benefit of the newly established market discount rate series (r) (together with the other data), it was now possible to determine this implied growth (g) utilising Baum and Crosby (2008):

$$(1 + g)^t = \frac{YP\ perp.@\ k - YP\ t\ years\ @\ r}{YP\ perp\ @\ k * PV\ t\ years\ @\ r}$$

where;

k =	Capitalisation rate	From Smith Harrington dataset
t =	Review pattern	From Smith Harrington dataset (1)
r =	Market discount rate	From Smith Harrington market discount rate series
YP perp. @ k	Years purchase into perpetuity at capitalisation rate	$\frac{1}{k}$
YP t years @ r	Years purchase for the number of years in the review pattern at the discount rate	$\frac{1 - (1 + r)^{-t}}{r}$
PV t years @ r	Present value for the number of years in the review pattern at the discount rate	$(1 + r)^{-t}$

Table 3.7: Implied Annual Growth Rate Formula

The capitalisation rate is available from the newly constructed Smith Harrington dataset. The review pattern is 1 year within the dataset and the market discount rate is also available from the newly constructed dataset. It should therefore be possible to calculate the implied rental growth rate (g). Once g has been determined, a new cash flow can be created.

One of the key advantages of this model in estimating the market value of land is that it should reflect the growth that is implied in the market via the yield. To demonstrate this process, and provide a second stage validation of whether the DCF can provide an accurate estimate of the valuation of agricultural land in Ireland, this process is demonstrated using only the first year data from the dataset, the market discount rate established for the subject

year, and the above formula to project the growth in rent and income respectively. The results of these net present values for each of the study years are be compared to the actual prices for the subject year. Utilising the implied rental growth model, it was anticipated that the results should reconcile.

These results provide a second stage validation (together with the theoretical approach) to inform the answer to the research question as to whether the DCF method can provide supportive evidence in the estimation of market value of agricultural land in Ireland.

As noted, a practitioner utilising this approach should be able to make an informed opinion as to the rent or income and, making the appropriate assumptions, arrive at a net present value of the land. Practitioners can then use this to assist them in arriving at an informed opinion of value.

A further advantage of this approach to a practitioner is that it should provide a more rational basis to advise clients as to how their opinion of value was arrived at. The detail in the calculation (cash flows) is likely to be relatable to the client.

It is important to note that the accuracy of the practitioner approach is determined by the accuracy of the data (set out in Table 3.6: Practitioner Model Data) as at the date of valuation. While this may be considered a limitation of this method, there is no escaping the fact that to estimate the market value of any asset some form of market data will be required. Furthermore, this issue will be partially addressed by the publication of the Smith Harrington datasets. Despite this limitation, it was considered that the addition of a method of valuation should assist practitioners and provide new insights into the valuation of agricultural land.

It was considered that the combination of these methods (theoretical and practitioner approaches) provided the best approach to answer the subject research question and to provide evidence to discuss the aim and objectives.

3.7 Validity

Validity is the extent to which the research conclusions can plausibly be taken to represent a state of affairs in the wider world (Sapsford & Jupp, 2006). Sapsford and Jupp identify two main kinds of validity: (1) population validity and (2) the validity of measurement.

3.7.1   Population validity

3.7.1.1   Introduction

Population validity is the extent to which a sample may be taken as representing or typical of the population from which it is drawn (Sapsford & Jupp, 2006). This section briefly discusses why gathering the data was important. The accuracy and subsequently the validity of the population is also set out.

Investigations into available agricultural land market data found that there was no source of published data appropriate for the study. Original land sale and rental data was available from the records of Smith Harrington Auctioneers and Valuers.[13] An initial review of the Smith Harrington records showed that the data was available from 1869 to 2013. There were approximately 350 sale and rental transactions recorded every year during the period. The initial review also demonstrated that, as would be expected, the vast majority of these transactions were rentals. It was considered that the construction and publication of such a dataset would assist in addressing the already identified problem of data availability. It would also provide a reliable dataset over a significant period for the testing of alternative methods of valuation of agricultural land in Ireland.

Swift (2006) in her chapter on preparing numerical data, notes that the process of transferring raw data to variables does not generally receive sufficient attention in many research reports. She reminds researchers that it is this data that is the basis for research arguments and that the data is constructed by the researcher. This is particularly relevant for survey data where the researcher selects the questions to be asked, but Swift also recognises that other data may be highly structured and may lend itself to being transcribed in a natural format. The Smith Harrington dataset fell into the latter highly structured category.

One of the main choices the researcher had to make before commencing gathering the data was how much data should be recorded – just the necessary date, number of acres and rate per acre required for the study? Or, any additional information? It was decided to record additional information, including the land's location, the rateable valuation (when available), the two parties involved in the transaction, and any other notes made on the description of the

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[13] The researcher's firm.

lands. This additional information might have proved to be relevant for analysis within this study, depending on how the research developed, or for further studies. In September 2014, the researcher began entering these records into an Excel spreadsheet. Data entry was completed in November 2015.

The data available for the period of 1870 to 1895 did not appear to comprise the comprehensive records of the firm. However, from 1895 the records were maintained consistently in the same format. It was therefore concluded that the study period would commence from 1895. There were 57,142 rental entries between 8 January 1895 and 18 December 2013. Of this total, there was a significant number of rentals of "meadows and silage" and for "aftergrass" (grassland available for grazing after a crop of hay or silage had been taken off). As these rentals were very short term (typically about three months) and would distort the average, they had to be removed. In the dataset there were 1,683 meadow lettings and 1,307 aftergrass lettings. There were also 927 incomplete entries. These were made up of entries that did not have acreages or total payment stated. This database of rentals was therefore made up of 53,225 entries.

There were no entries between 5 September 1898 and 25 July 1901, as the relevant manuscripts (in journal format) was unavailable. The writing in the journals were generally excellent and clearly legible. There were 51,827 entries from 25 July 1901 to 18 December 2013. This equates to approximately 458.6 entries per year. There were 1,361 sales entries between 27 February 1895 and 15 November 2013. A significant number of these entries were incomplete in the early years. In the years up to 1939 there were no more than two complete entries in any given year. This is most likely due to the Land Acts. The researcher therefore excluded the years up to 1939.
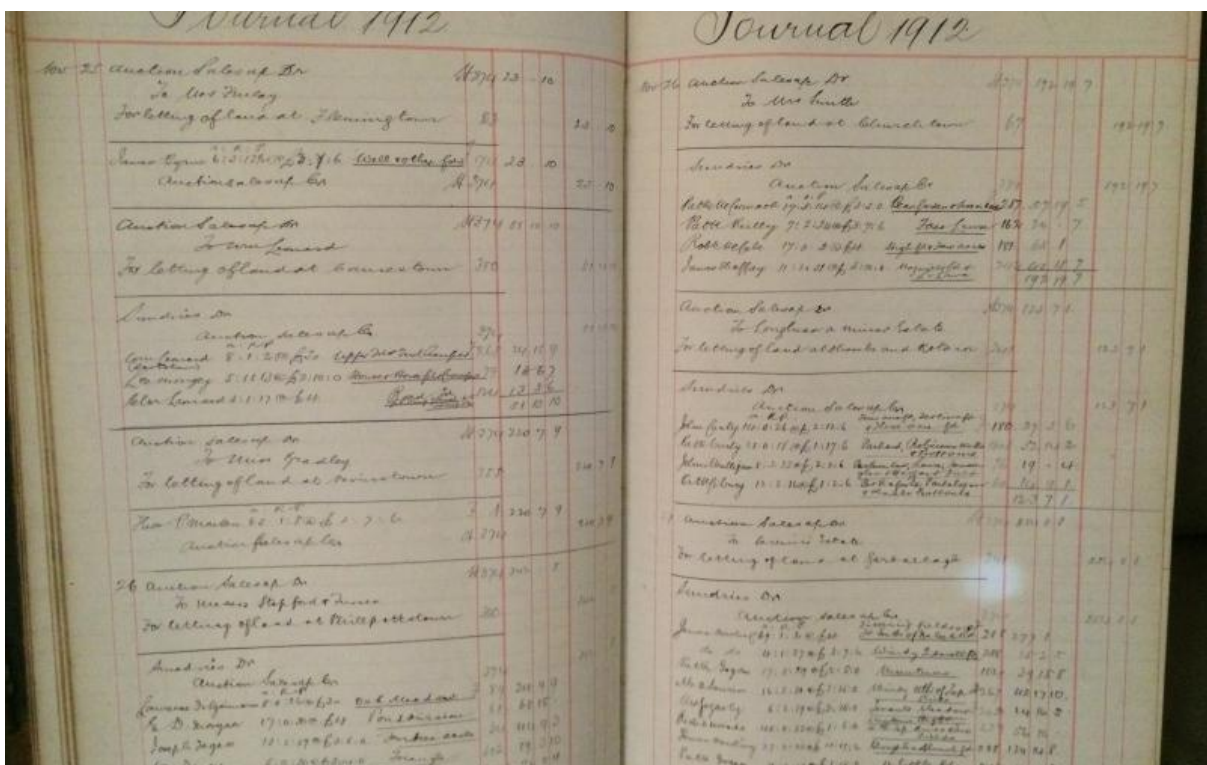
Figure 3.10 Photos of journals

There were 1,121 sales entries from 19 January 1940 to 15 December 2013. A considerable number of the entries related to small plots or sites, which usually have considerably higher rates per acre. The reason for the higher rate per acre is generally that the plots were bought for reasons other than agricultural use. For example, many of these entries were noted as residential sites. Nunan, in his compilation of the William B. Fitt data, excluded all plots under 5 acres (Nunan, 1987), to deal with this issue. To address this issue and be consistent with Nunan's approach, all plots of land of less than 5 acres were excluded. These totalled 148 entries (13.20% of the overall entries).

There were also 18 entries noted as development land. Again, the highest and best (end) use of these sales was not agricultural. Their inclusion in the database was not consistent with compiling a database of agricultural land sales. Therefore, it would not have been appropriate to test the present value methodology of future land values against a database with these included. Development land transactions were also excluded. This left 955 complete agricultural land sales entries between 1940 and 2013. This equates to approximately 12.9 sales per year.

3.7.1.2   *Accuracy*

To validate the accuracy of the dataset, the researcher utilised the random sampling method. A sample is a set of elements selected in some way from a population (Sapsford & Jupp, 2006). Schofield et al. (2006) state that the purpose of sampling is to save time and effort, but also to obtain consistent and unbiased estimates of the population status in terms of whatever is being researched. In simple random sampling, every observation in the main data set has equal probability for being selected. A sample group was selected and checked against the original entries. Depending on the level of accuracy of the sample, the accuracy of the overall database could be deduced.

The sampling frame was identified as the Smith Harrington dataset. Schofield et al. (2006) identify two primary methods of sampling as probability sampling and non-probability sampling. They note that probability samples have considerable advantages over all other forms of sampling. This is as all samples will contain error but probabilistic samples allow the error to be measured more accurately (Sapsford & Jupp, 2006). Probability sampling, and more specifically simple random sampling, was therefore selected as the sampling mechanism. Schofield et al. (2006) note that simple random sampling might not be at all simple to achieve, depending on the circumstances. Having discussed this matter with his local adviser, the researcher decided to utilise a service known as random.org to achieve true randomness.[14] This was considered appropriate for this purpose.

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[14] The service has existed since 1998 and was built by Dr Mads Haahr of the School of Computer Science and Statistics at Trinity College Dublin. The randomness comes from atmospheric noise (RANDOM.ORG, 2016).

In publishing a new dataset, there is a responsibility on the researcher to ensure that the accuracy of the dataset is comprehensively checked. It was important for this research and so that the dataset would also be available for further study. The accuracy of the selections in the Nunan dataset does not appear to have been checked and there was therefore no comparable dataset to compare what an appropriate sample ratio might be. Judgements had to be made based on the need for an authoritative database and the resources available. The sales dataset was arguably more important for this purpose as, due to the smaller number of transactions per year, it was more important that each of the observations was accurate. Fifty of 955 observations would represent 5.24% of all observations being checked. This would be considered a relatively high rate, but it was considered appropriate given the importance of this sample. As the rental database was significantly larger, it was believed that accuracy errors might be smoothed out by the larger sample. Nonetheless, it was considered important to ascertain the accuracy of the dataset, as significant errors would undermine the dataset and the research. It was decided that 500 of the 51,827 observations (0.96% of all observations) would be appropriate to make authoritative deductions on the accuracy of the dataset.

Finally, in relation to this aspect of the dataset, it was considered appropriate that a third party who was not involved in compiling the dataset should check the dataset. An administrator from the researcher's firm (Smith Harrington) undertook the check. The researcher and his local advisor oversaw the process. A random sample of the entries was entered into Excel to check against the original entries in the books. There were two errors in the sales data. This was significant, and the researcher checked the relevant entries. Both errors were recording errors. In one, the data entry clerk had entered one less 0 on the sale price for one of the entries; the other error was a plot of ground entered as 1 acre instead of 18 acres. The errors therefore recorded a significantly low and a significantly high rate per acre respectively. The sample of 500 rentals showed six errors. Checking showed that these were also simple data entry errors. Two of these were similar to those noted above. However, the other four were relatively minor. One error was on a 52-acre letting. The letting value was mis recorded as €6,900 (€132 per acre), rather than €6,400 (€123 per acre).

After correcting the errors in both sets, the (Smith Harrington) data clerk rechecked the entire series for minor data entries. Another sample was undertaken and no errors were noted in the sales set, while only two errors were noted in the rentals series. Again, these were relatively minor and were corrected. The sample of two of 500 (representing 0.4%) was considered an

insignificant proportion in the context of the sample size and would be smoothed out. Nonetheless, it was thought prudent to undertake a visual review of rates per acre, to check if there were any other extreme rates per acre (high or low) that were "out of sync" with the rest of the dataset. Any errors noted were checked and corrected, if required.

3.7.2 Validity

Once the accuracy of the data entry had been checked, the next stage of the process was to validate the dataset. This was necessary, as the data had not been gathered specifically for the study – it was quasi-experimental data. Quasi-experimental data, sometimes known as non-experimental or observational data, is data that is collected naturally, rather than in experimentally selected groups (Sapsford & Jupp, 2006). The data is actual transactions that occurred within the researcher's firm and it was therefore of benefit to validate the sample against another sample to ascertain if it was representative of the wider populations.

As has been shown in the previous section, the sample itself is both the largest known sample (in terms of sample size) and also the longest longitudinal study period of its type for land sales and rentals in Ireland. This provided a level of assurance as to its validity. Nonetheless, to provide further assurance regarding the validity of the dataset a further cross-check was undertaken. The most appropriate method of undertaking this was by examining the Smith Harrington dataset in the context of the Nunan dataset. The Nunan dataset ended in 1986 but the period of 1940-86 could be examined to determine the correlation between the datasets. A simple correlation exercise was considered appropriate. This was undertaken using the Excel Data Analysis Toolpak add on. This was on advice from the researcher's supervisor and experienced econometricians. While some basic statistical training and guidance were required, the researcher was already proficient in Excel. It was considered that this would be the most reliable method, as the researcher would not have to train in a specific statistics package which provided no additional accuracy. This method was chosen as the most pragmatic approach.

The first task was to check the comparability of the datasets. The rates per acre were compiled for the Smith Harrington dataset on a mean average of the individual rates per acre. While the Nunan study does not explicitly state this, it appeared that Nunan used the same method. The only reference in the paper notes that the average prices quoted for farm sales were derived from the totals paid for each holding (Nunan, 1987). This could be constructed

in an alternative way. For example, the average may refer to the total farm sales added up divided by the total acreages for that year. However, it was considered that this would have been explicitly stated if this approach had been undertaken. It was also considered more appropriate to undertake the former approach. Different sized sales might achieve different rates per acre and therefore establishing the mean average rates from the dataset of rates per acre was believed to be more appropriate.

As previously referenced, the same approach was used for exclusions. Nunan confirmed that the sales of land of five acres or less were excluded, as were some high-priced transactions – mainly land purchased for industrial development (Nunan, 1987). Both datasets were converted to euros per acre, to avoid confusion when discussing the analysis.

While the only comparable period (as the Nunan dataset ended when the firm was wound up in 1986) was 1940-86, it was considered that if this period was correlated, conclusions could be drawn as to the validity of the remainder of the dataset. A correlation analysis was undertaken using the Excel Toolpak. It produced a correlation coefficient of 0.958409. This was a particularly reassuring result, given that (1) no two parcels of land are homogeneous and (2) the locations were different. Therefore, it would be virtually impossible for these sets to be perfectly correlated at 1. A figure this close to a perfect correlation was encouraging and strong conclusions as to the validity of the data could be made.

The period for which the datasets were examined was 1940-86. The specific analysis in relation to the DCF focused on the period of 1993-2013, due to the availability of the farm input, output survey and future projection data. The datasets were compiled totally independently of each other by estate agents (William B. Fitt and Smith Harrington respectively) from different sides of the country (South West and North East). For these reasons, it is a rational conclusion that the data was relatively representative of the Irish agricultural land market for the period. It therefore provided the first half of the data required to test the research question, namely "Can the DCF approach provide supportive evidence for valuers in estimating the market value of agricultural land in Ireland?"

3.7.2.1 Generalisability

Generalisability is the extent to which conclusions can be drawn about one thing (often a population) based on the information about another (often a sample) (Vogt & Burke Johnson, 2011). There are two generalisations relevant to this study. The first is how representative the sample is of the general population. The previous section has demonstrated that the sample data set appears to be generally representative of the larger national population.

The second element is the generalisation of the model. The agricultural land market in Ireland is dominated by owner occupiers. Therefore, when land comes on the market the bidders are generally farmers wishing to operate the lands as a farming enterprise. It would be expected that the model, should it be shown to work in Ireland, would be applicable to countries with similar characteristics. In the UK, however, the market is dominated by large landowners who act much like investors. There is also a different legal context, with long-term leases and reviews being predominant. The model does not fit this historical and legal context quite as well and is therefore unlikely to be generalisable (or at least as generalisable) in the UK.

The model was designed for the economic, historical, legal and cultural context in Ireland. Given the economic theory that underpins the model, it is quite likely that it will be generalisable in many other contexts. This research only tests the Irish market and does not claim to be an indicator that the model is representative of other jurisdictions. The model is unlikely to apply in contexts where other characteristics of the market are not present and should not be used without evidence supporting the decision to use it.

3.7.3 Validity of measurement

Validity of measurement is the extent to which we are assured that the measurements in the research do indeed represent what the researcher says they represent and are not produced by the research process itself (Sapsford & Jupp, 2006). In this study, in addition to the reassurances already provided regarding the data, there were two main elements that needed to be addressed to provide assurance on the validity of the measurement. The first was the model itself and the second was the researcher's cognitive biases.

The model itself is theoretically strong and the inputs have been well sourced, as has been set out. The model is based on established economic theory. It is recognised that the model has

its limitations. The model simplifies some economic assumptions. However, as has been set out, this is necessary for a mathematical model of this nature. Such a model will always need to simplify some assumptions in its attempt to replicate the thinking in the wider world. The validity of the measurement was considered robust and fit for this research.

It is recognised that researchers hold cognitive biases and this was no different for the present author. It is important to set these out and discuss how they were addressed for the study to be replicable. The hypothesis was that the model would provide supportive evidence for the process of valuing agricultural land. However, as noted by James, researchers have a moral obligation to apply strong criteria to the proposition to declare it true (James, as cited by Robinson, 2013). The following two sections set out these criteria.

The researcher's initial proposal was to use a focus group as a means of validating the research – a proposal that was subsequently revised for partly the same reasons that it (and survey) were not used to gather the discount rate data. The aim and motivation of the research were consistently to provide insights into the valuation of agricultural land in Ireland and to assist practitioners to arrive at more informed opinions of value. On reflection, the researcher had doubts about whether a focus group was the best means of validating the research.

A major problem with the focus group approach is that valuations are usually undertaken by individual practitioners. While there may be some consultation, the determination of the most appropriate valuation method is the sole responsibility of the practitioner (RICS, 2010). Different approaches may be applied to the same valuation, if they are grounded in consistent theory and supported by appropriate evidence. As practitioners may take different, but equally correct, approaches to the same valuation, different practitioners may also supply different viewpoints on the appropriateness of the DCF technique. Therefore, even if a focus group endorsed the method, the researcher would have had concerns as to whether this strengthened the findings. Primarily, for this reason it was considered that the focus group method was unlikely to be the most appropriate method to validate the research.

Furthermore, while the researcher attempted to present the information in an unbiased fashion, he also had concerns that a focus group of his peers may be supportive and self-validating. While this may have supported the research, he was not convinced that a positive outcome from a focus group would truly improve the validity of the research. It was therefore

the researcher's opinion that statistical analysis was the appropriate method to validate the research. This provided the most reliable method to analyse the results, so that credible conclusions could be drawn about the reliability of the data.

There were several different elements of the study that required consideration as to how best to present and analyse them. The first element was the Smith Harrington dataset itself. In addition to the validity and accuracy measures put in place, it was considered beneficial to consider the collated data against similar data, to provide reassurance on the reliability of the data. The method of undertaking the accuracy and validity checks for this element of the study is set out earlier in this section.

Wheelan (2013, p.109) notes: "for all the elegance and precision of probability there is no substitute for thinking about the calculations we are doing and why we are doing them." The point he emphasises is that there are various complex statistical models that can be employed to analyse theories. However, the complexity of the statistics does not necessarily add to the assurances it can provide. Rather, it is better to consider the most appropriate analysis for the theories being examined. Therefore, before setting out the appropriate statistics to be employed in this study to validate this research, it was important to reflect on the question being asked and the tests (models) undertaken to answer this question.

	PURPOSE	INDEPENDENT VARIABLE (OUTPUT FROM MODELS)	DEPENDENT VARIABLE (SALES PRICE)
THEORETICAL MODELS (INCOME AND RENT RESPECTIVELY)	1. To calculate market discount rates 2. To provide an additional method to validate whether the DCF method could potentially be used to assess the market value of agricultural land	Theoretical model:[15] Net present value € per acre (1993-2013)	Smith Harrington dataset sales prices of agricultural land € per acre (1993-2013)
PRACTITIONER MODELS (INCOME AND RENT RESPECTIVELY)	To assess the accuracy of the DCF method in estimating the market value of agricultural land in Ireland	Practitioner model: Net present value € per acre (1993-2013)	Smith Harrington dataset sales prices of agricultural land € per acre (1993-2013)

Table 3.8: Purpose and outputs of models employed in study, together with the unit of comparison for analysis

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[15] This model also produced a set of discount rates (1993-2013).

Regression analysis (a variety of "analysis of variance"), is an alternative method of validating and testing theories. It is defined as a method of explaining or predicting the variability of a dependent variable using information about independent variables (Vogt & Burke Johnson, 2011). In relation to this study, it was used to assess the change in a dependent variable (sale price) for each one-unit increase in an independent variable output from the models, using rent and the farmers enterprise gross margins [income] respectively.

Regression can provide various metrics to compare the output of the model to the actual sale prices. This research uses linear regression to test the causal inference to test both the theoretical and practice models. When the observations are plotted, and the regression line is drawn (line of least error), the level of correlation can be identified.
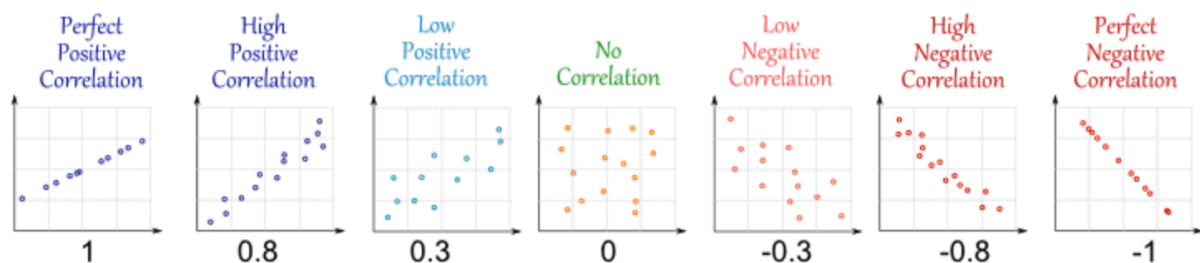
Figure 3.11: Scatter plot examples with various degrees of correlation among variables

This enquiry sought to prove or disprove the hypothesis (in part) by identifying a positive correlation between the outputs from models (independent variables) and sales prices over a long-run (> 20 year) period (dependent variables). To test this hypothesis, another function that linear regression can provide is to calculate R squared. R squared provides a method that will allow the researcher to test the percentage variability in the sales prices of agricultural land, relative to the change in output from the model. This is also examined in the analysis. This can provide a useful initial indication of the relationship between the variables. A strong correlation was anticipated, due to the use of investment theory within the model. This analysis was therefore not considered a strong enough criterion to declare the hypothesis true. Additional measures were also employed.

It was considered that a p-value test might be a more useful measure of validity for this study. The hypothesis of this study was that the two respective models' output would be similar to the Smith Harrington dataset of actual prices for each of the given 21 years studied. The null hypothesis stated that the DCF models output were not equivalent to the actual sale price over

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a 21-year period, while the alternative hypothesis stated that the DCF model outputs and the actual sale prices were equivalent.

One commonly used p-value is 0.05. If the p-value is less than 0.05, there is strong evidence against the null hypothesis. Consequently, a value of this level would allow the researcher to reject the null hypothesis and accept the alternative hypothesis that the DCF model outputs and the actual sale prices are equivalent. Conversely, if the p-value is greater than 0.05, there is weak evidence against the conjecture. In this case, the researcher would fail to reject the null hypothesis and it would be accepted that the DCF was not an indicator of price and therefore market value.

As has been noted, confidence levels in valuations, due to the heterogeneous nature of the asset and the subjectivity of analysis, is generally held by the courts to be in the 80% to 90% range of the median range (Crosby, Lavers, & Murdock, 1998). The median range set is not actual prices as in the subject study. There is therefore an argument that the range could be further extended to account for the comparison with prices. Notwithstanding this, to provide a rigorous analysis and credible conclusions, the researcher would not decrease confidence levels for the hypothesis on this basis.

However, as has been set out in this chapter the primary purpose of the theoretical model was to calculate market discount rates. It did this through, *inter alia*, assuming perfect foresight (for the inputs) and a trial and error approach (solving for the discount rate), comparing the output with the results of the Smith Harrington dataset. It was necessary for the output to equal the results from the Smith Harrington dataset and to have a reliable market discount rate. It consequently follows that the output of the regression analysis is likely to demonstrate that the independent and dependent variables are highly correlated. This does not diminish the need to undertake statistical analysis. While the results can be observed from tables and graphs, it is important for completeness that a rigorous statistical analysis be undertaken to complete the process. In addition, it provides additional metrics (Scatter plot, R squared and P value) to validate the accuracy of the figures.

Notwithstanding the anticipated accuracy of the theoretical model, it does not claim to demonstrate anything beyond the fact that in theory (i.e. the circumstances set out within the

model), the DCF method can provide an output in line with market value (in this case represented by price, based on the results of the Smith Harrington dataset).

The practitioner model, on the other hand, does not assume perfect foresight nor does it utilise trial and error to ensure accuracy. Therefore, the regression analysis is arguably of greater importance for this purpose. However, it does draw on the implied growth rate theory from investment valuations, and if this holds true for agricultural lands it should demonstrate a similar level of accuracy. Again, it is considered that regression analysis (scatter plot, R squared and P value) is the most appropriate mechanism to assess the change in a dependent variable (sale price) for each one-unit increase in an independent variable (output from the models using rent and the farmers enterprise gross margins [income] respectively), based on the practitioner (implied income growth) models. While regression allows various other tests, these were not considered appropriate for this study.

These (rent and income) practitioner models rely only on data that would hypothetically be available to the valuer on the date of valuation (rent, income, sales price, discount rate). The researcher has utilised this data, together with the implied annual growth theory, to imply growth. It should therefore be replicable in practice.

For this research, it has been assumed that the outlined data (rent, income, sales price, discount rate) is available on the date of valuation. If the implied income growth theory holds through, the practitioner model should also be accurate. However, it is important to emphasise that the researcher is not suggesting or anticipating a similar level of accuracy in all valuations that utilise this model in practice. As has been outlined, the agricultural land market has not to date demonstrated the characteristics of a transparent market.

This limitation is acknowledged, but it is also mitigated by the publishing of the various respective datasets outlined in Objective 1. This should improve market transparency and facilitate the use of this model.

Furthermore, regardless of the current limitations of the agricultural land market, the results of the regression analysis metrics selected should provide accurate indicators as to whether the DCF method is accurate at assessing the market value of agricultural land in Ireland in the

specific conditions. The strengths and limitations of this approach are further discussed in Chapter 4 (findings) and Chapter 5 (discussion).

3.8 Ethical Approval

The researcher's supervisor, on his behalf, consulted with the Chair of the College's Research Ethics Committee, who confirmed that the University of Salford required "level 1" ethics for this research. In addition, the researcher sought and received permission from the Principal of Smith Harrington to use the data he collated. The letter confirming permission is provided in Appendix 2.

Together with his supervisor, the researcher obtained level 1 ethical approval and was advised that no formal documentation was required with this submission, save for that stated above. This did not impact on the approach to the research.

3.9 Summary

This chapter has set out the researcher's research philosophy to address the aim of this study, which was to provide insights into the valuation of agricultural land in Ireland and assist practitioners to make informed decisions. It was discussed that the most pragmatic approach to address the aim and objectives of the study was a quantitative, deductive one, drawing on the researcher's professional experience through reflection, where appropriate.

More specifically, the methodology addressed the options available and approach chosen to address each objective individually. It is considered that the proposed publication of the new dataset will improve on the availability and accessibility of agricultural land market data in Ireland. Following the literature review, the DCF method of valuation was identified as compatible with established economic theories, practitioners' bases of value and the historical context, and therefore deemed appropriate in theory for the valuation of agricultural land.

This led on to Objective 3, the primary research question of the study; that is, whether the DCF technique can provide supportive evidence in the estimation of the market value of agricultural land in Ireland. This study identified an existing barrier to testing (and the use of this this model). This barrier was the identification of an appropriate discount rate. This methodology chapter proposed a method to overcome this barrier, namely the construction of

a market discount rate series, derived from the newly published dataset. It further proposed a model to test the hypothesis in theory.

This chapter also identified limitations to utilising the theoretical model in practice. It proposed a further model that could be utilised in practice. This chapter proposed a subsequent test of the practitioner model which could be triangulated with the results of the theory test and actual prices observed from the dataset to both improve the validity of the results, while also presenting a potential usable method for practice. The advantages and disadvantages of different approaches to test this model were set out and it was decided that the best method to adopt for this investigation was a quantitative statistical analysis of the results.

Finally, this chapter noted that Objective 4 ("To determine whether the selected method of valuation of agricultural land is an appropriate consideration in determining the market value of agricultural land in Ireland") could be answered with reference to the results of these results and theory. To quote Wheelan, "there is no substitute for thinking about the calculations we are doing and why we are doing them" (Wheelan, 2013, p.109).

Overall, it was considered that this was a rigorous methodology. It should provide a platform that will allow the reaching of credible conclusions and, importantly, the study will be replicable. It will also permit claims to "knowledge" to be made in the study.

Chapter 4: Findings

4.1   Introduction

In keeping with my pragmatic philosophy, the study findings are presented in an objective focused framework. This section presents the results for each objective separately, as indicated in Chapter 3 (methodology). Chapter 5 (discussion) contains discussion and critical analysis of the results.

4.2   Objective 1

The proposed publication of the new dataset will improve of the availability and accessibility of agricultural land market data in Ireland. Figures and Tables 4.1 to 4.5 respectively present the primary results. The results are presented in euros per acre[16] on a nominal basis representing the population mean of each individual year respectively. Additional references for these results are given in the appendices.
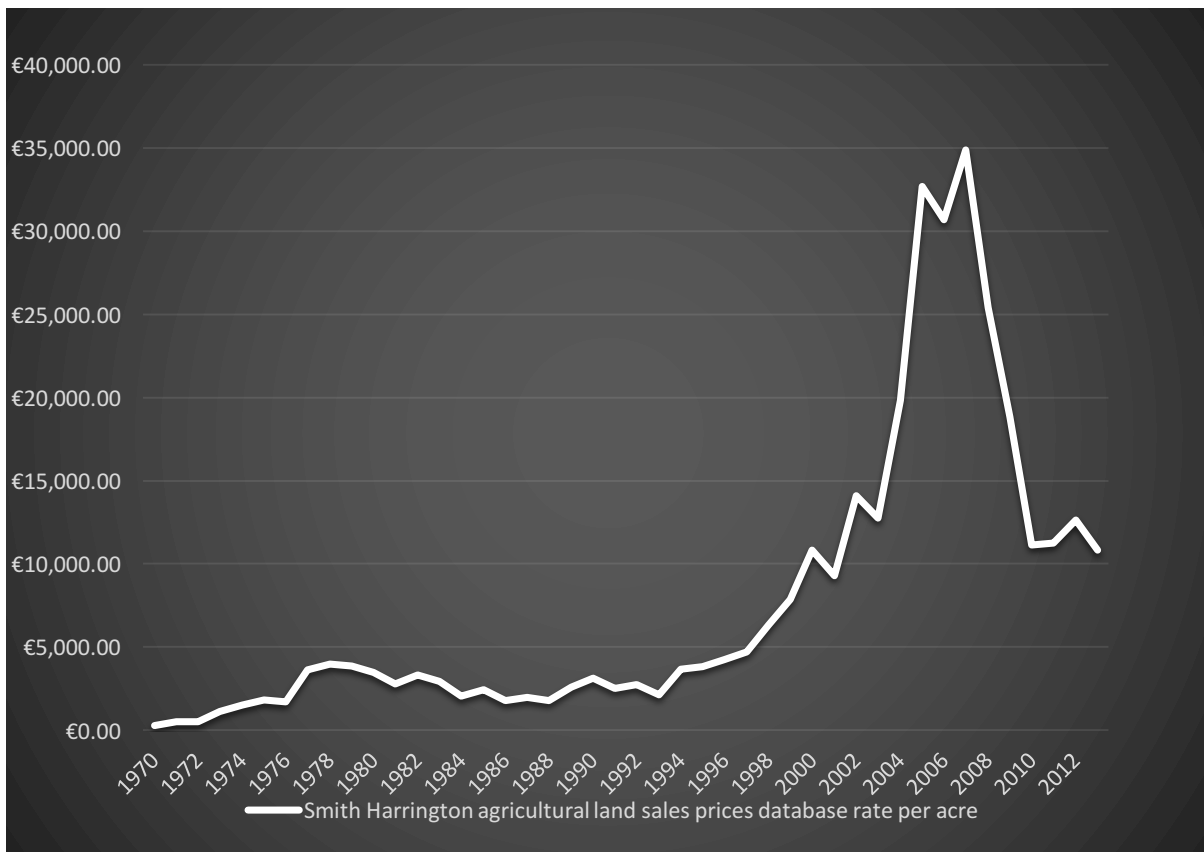
Figure 4.1: Smith Harrington agricultural land sale price graph 1970-2013 (€ per acre)

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[16]And in index form for comparison purposes.

Figure 4.1 presents the results of the Smith Harrington land sale database in graph format. These results are set out for reference (together with an index) in Table 4.1. Analysing the trends in this data does not form part of this study's aim and objectives. It is therefore limited within this study to occasions that advance theory or hypothesis that serve to address the study's aim and objectives.

Year	Smith Harrington agricultural land sales prices database rate per acre	Index	Year	Smith Harrington agricultural land sales prices database rate per acre	Index
1970	€289.98	100.00	1992	€2,743.67	946.15
1971	€498.68	171.97	1993	€2,116.94	730.02
1972	€516.82	178.23	1994	€3,665.22	1263.95
1973	€1,139.62	393.00	1995	€3,828.09	1320.11
1974	€1,518.01	523.48	1996	€4,262.28	1469.84
1975	€1,801.91	621.39	1997	€4,721.77	1628.30
1976	€1,719.27	592.89	1998	€6,309.02	2175.66
1977	€3,632.05	1252.51	1999	€7,858.02	2709.83
1978	€3,988.48	1375.42	2000	€10,816.61	3730.10
1979	€3,869.52	1334.40	2001	€9,269.59	3196.61
1980	€3,489.93	1203.50	2002	€14,112.23	4866.59
1981	€2,800.53	965.76	2003	€12,745.63	4395.32
1982	€3,310.99	1141.79	2004	€19,836.39	6840.56
1983	€2,931.35	1010.87	2005	€32,675.17	11268.00
1984	€2,033.80	701.35	2006	€30,682.56	10580.85
1985	€2,436.92	840.37	2007	€34,877.62	12027.51
1986	€1,777.13	612.84	2008	€25,416.51	8764.86
1987	€1,979.09	682.49	2009	€18,840.10	6496.99
1988	€1,795.09	619.03	2010	€11,136.04	3840.25
1989	€2,609.22	899.79	2011	€11,242.88	3877.10
1990	€3,109.97	1072.47	2012	€12,637.44	4358.01
1991	€2,519.63	868.89	2013	€10,832.79	3735.68

Table 4.1: Smith Harrington agricultural land sale price table 1970-2013

As noted in the methodology, the Smith Harrington dataset was analysed against the only other available published dataset of agricultural land prices for the period, known as the Nunan dataset. A simple correlation analysis was undertaken showing a high level of correlation, which added to the rigour of the study and reliability of the results. These results should be considered in the context of the rationale and limitations outlined in the methodology. They are further referred to in the discussion (Chapter 5).

CORRELATION COEFFICIENT		
	Nunan, price per acre, (euro)	Smith Harrington agricultural land sales prices database price per acre
NUNAN, PRICE PER ACRE, (EURO)	1	
SMITH HARRINGTON AGRICULTURAL LAND SALES PRICES DATABASE RATE PER ACRE	0.958409475	1

Table 4.2: Results of correlation analysis between newly constructed Smith Harrington data set and the "Nunan" dataset 1940-86

Following on from the sales analysis, the next results to present were the rental price data. Figure 4.3 presents this data in graph format. Again, the results are presented in euros per acre[17] on a nominal basis, representing the population mean of each individual year respectively.
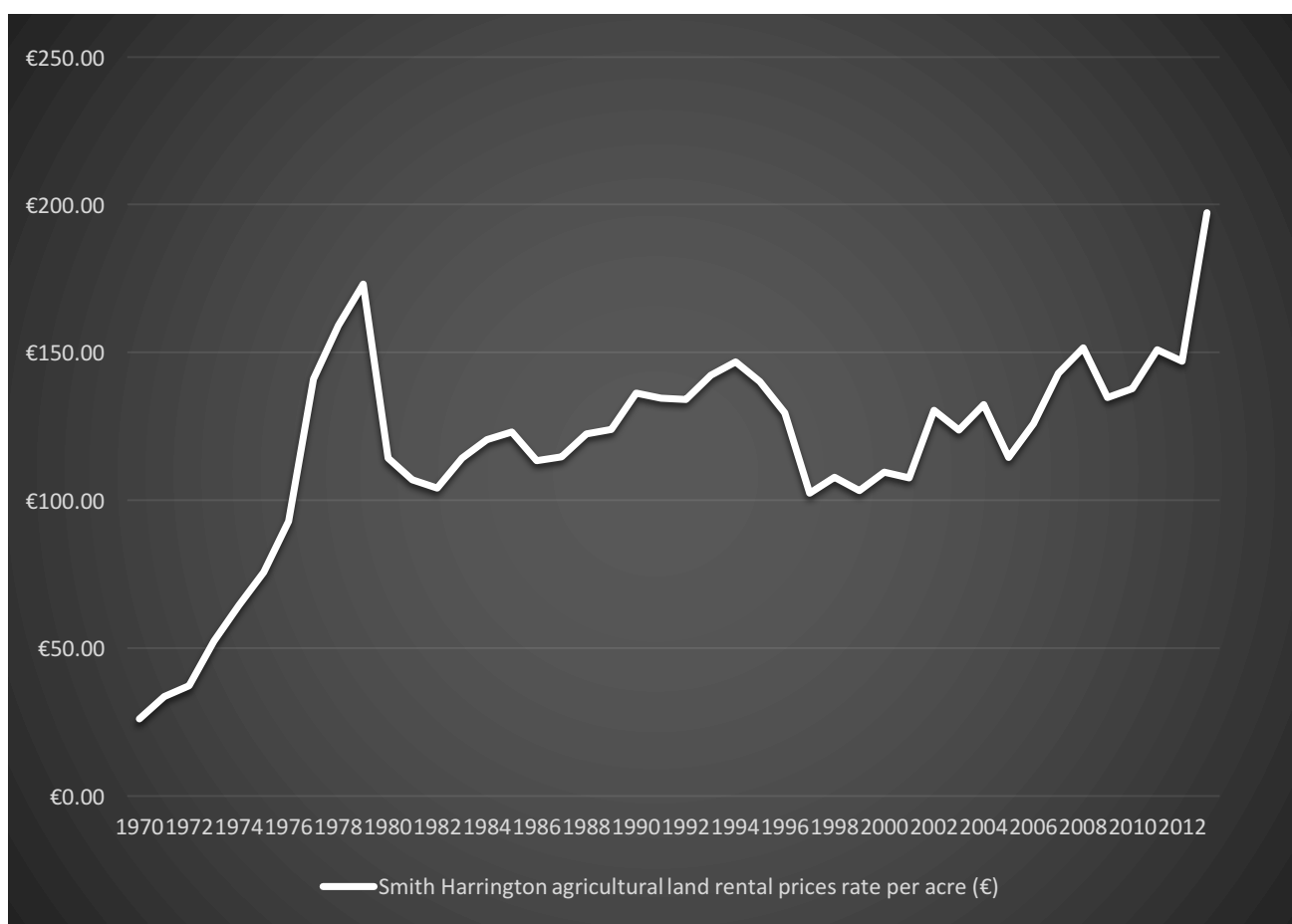
Figure 4.3: Smith Harrington agricultural land rental price graph 1970-2013 (€ per acre)

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[17] And in index form for comparison purposes.

The rental data is presented in Table 4.3 shown, together with growth in rent, rental index and sale price data for ease of reference.

Rental prices	Smith Harrington agricultural land sales prices rate per acre (€)	Smith Harrington agricultural land rental prices rate per acre (€)	Growth in rents	Rental index
1970	€289.98	€26.15		100.00
1971	€498.68	€33.67	28.77%	128.77
1972	€516.82	€37.22	10.56%	142.37
1973	€1,139.62	€52.30	40.51%	200.04
1974	€1,518.01	€64.40	23.13%	246.30
1975	€1,801.91	€75.61	17.41%	289.19
1976	€1,719.27	€92.86	22.82%	355.17
1977	€3,632.05	€140.94	51.78%	539.07
1978	€3,988.48	€159.24	12.98%	609.04
1979	€3,869.52	€173.05	8.68%	661.90
1980	€3,489.93	€114.31	-33.94%	437.23
1981	€2,800.53	€106.92	-6.47%	408.95
1982	€3,310.99	€104.23	-2.51%	398.68
1983	€2,931.35	€114.23	9.59%	436.90
1984	€2,033.80	€120.58	5.56%	461.18
1985	€2,436.92	€123.12	2.11%	470.90
1986	€1,777.13	€113.52	-7.80%	434.18
1987	€1,979.09	€114.62	0.97%	438.40
1988	€1,795.09	€122.48	6.86%	468.47
1989	€2,609.22	€123.90	1.16%	473.88
1990	€3,109.97	€136.29	10.00%	521.27
1991	€2,519.63	€134.65	-1.20%	515.00
1992	€2,743.67	€134.11	-0.40%	512.95
1993	€2,116.94	€142.23	6.05%	543.98
1994	€3,665.22	€146.90	3.29%	561.86
1995	€3,828.09	€140.22	-4.55%	536.29
1996	€4,262.28	€129.54	-7.62%	495.45
1997	€4,721.77	€102.38	-20.97%	391.56
1998	€6,309.02	€107.87	5.37%	412.59
1999	€7,858.02	€103.19	-4.34%	394.70
2000	€10,816.61	€109.53	6.14%	418.93
2001	€9,269.59	€107.50	-1.85%	411.17
2002	€14,112.23	€130.39	21.29%	498.71
2003	€12,745.63	€123.87	-5.00%	473.77
2004	€19,836.39	€132.42	6.91%	506.49
2005	€32,675.17	€114.52	-13.52%	438.01
2006	€30,682.56	€126.00	10.02%	481.91
2007	€34,877.62	€143.04	13.53%	547.10

2008	€25,416.51	**€151.61**	**5.99%**	**579.88**
2009	€18,840.10	**€134.79**	**-11.10%**	**515.54**
2010	€11,136.04	**€137.78**	**2.22%**	**526.98**
2011	€11,242.88	**€150.89**	**9.52%**	**577.12**
2012	€12,637.44	**€147.07**	**-2.53%**	**562.50**
2013	€10,832.79	**€197.33**	**34.18%**	**754.75**

Table 4.3: Smith Harrington agricultural land rental price table 1970-2013

The indexes for both the sales and rental price are presented in the following graph in Figure 4.4. This graph presents interesting results. It illustrates the lack of correlation between the sales and rental datasets, particularly evident during recent high-asset value periods, as may be expected.
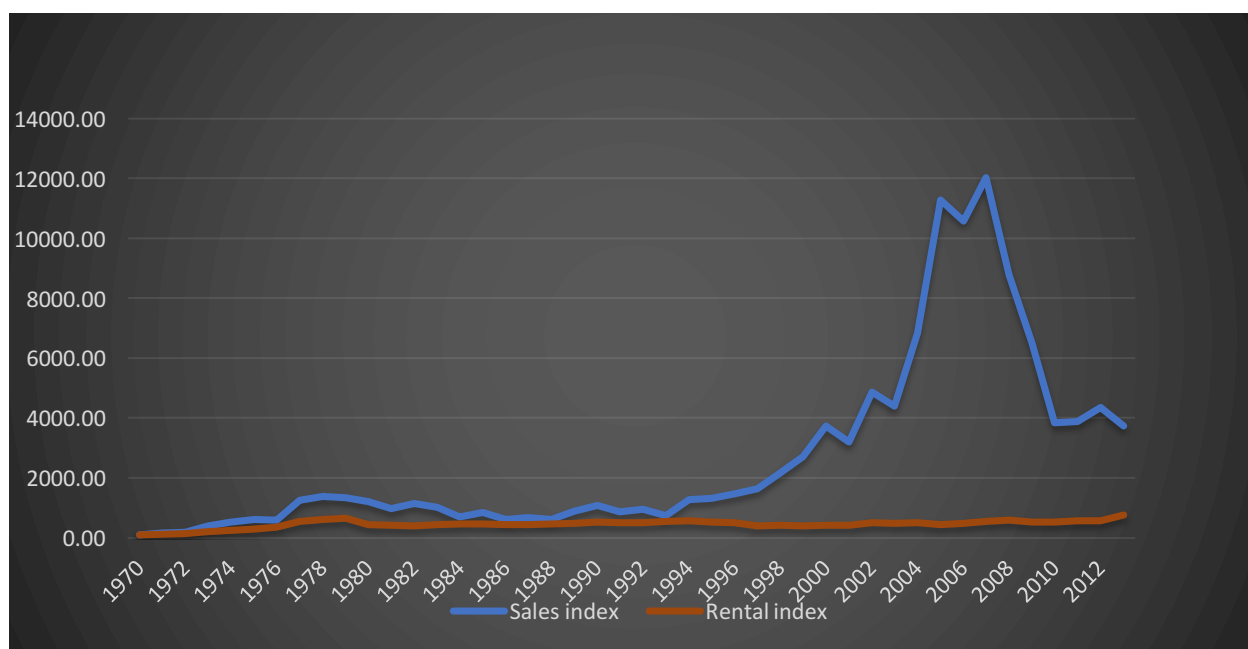
Figure 4.4: Graph showing Smith Harrington sales and rental data 1970-2013

This is further supported by low correlation results presented in Table 4.4 below.

CORRELATION COEFFICIENT		
	Smith Harrington agricultural land sales prices rate per acre	Smith Harrington agricultural land rental prices rate per acre
SMITH HARRINGTON AGRICULTURAL LAND SALES PRICES RATE PER ACRE	1	
SMITH HARRINGTON AGRICULTURAL LAND RENTAL PRICES RATE PER ACRE	0.336230001	1

Table 4.4: Correlation between Smith Harrington sales and rental data

Utilising Table 4.3, a gross yield series was produced. This is presented in graph form in Figure 4.5, while the results are presented alongside the income yield and 10-year Irish government bond rates in Table 4.5, for context.

The data presented in this section provides the basis to undertaking the analysis required to address Objectives 3 and 4 respectively.
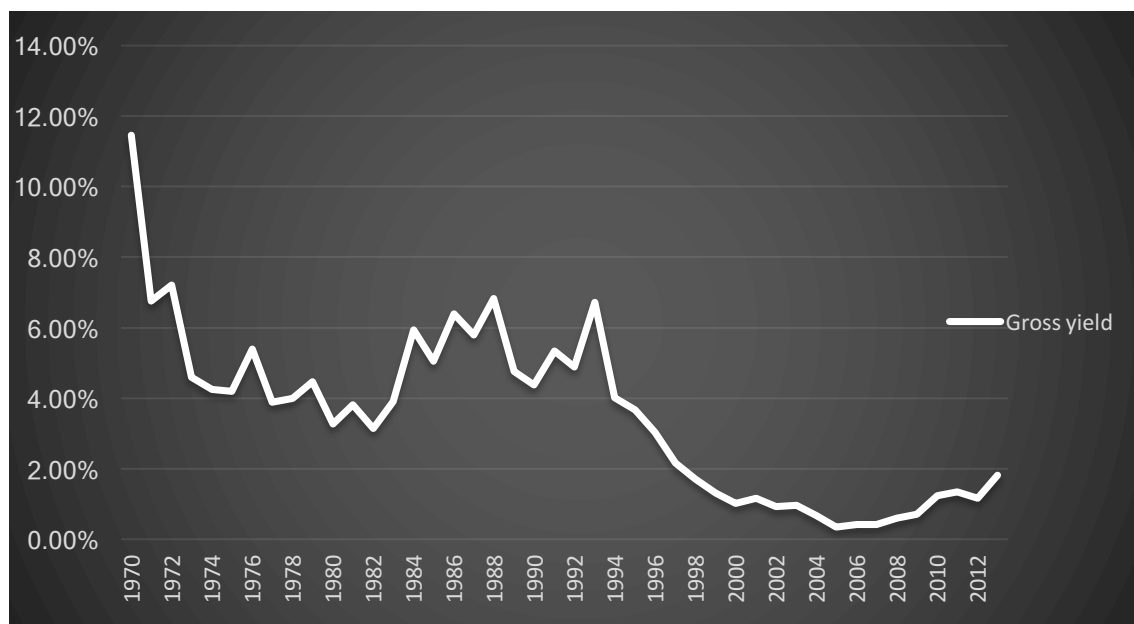
Figure 4.5: Smith Harrington agricultural land gross yield series graph 1970-2013

Years	Gross yield	Income yields[18]	10-year Irish government bond rates[19] (RFR)
1970	11.45%		
1971	6.75%		
1972	7.20%		
1973	4.59%		
1974	4.24%		
1975	4.20%		
1976	5.40%		
1977	3.88%		
1978	3.99%		
1979	4.47%		
1980	3.28%		
1981	3.82%		
1982	3.15%		
1983	3.90%		
1984	5.93%		
1985	5.05%		
1986	6.39%		
1987	5.79%		
1988	6.82%		
1989	4.75%		
1990	4.38%		
1991	5.34%		
1992	4.89%		
1993	6.72%	9.86%	7.42%
1994	4.01%	6.02%	8.79%
1995	3.66%	6.30%	8.82%
1996	3.04%	5.72%	7.63%
1997	2.17%	5.36%	6.46%
1998	1.71%	3.95%	5.04%
1999	1.31%	3.00%	4.81%
2000	1.01%	2.80%	5.49%
2001	1.16%	4.57%	5.28%
2002	0.92%	2.68%	5.20%
2003	0.97%	3.05%	3.85%
2004	0.67%	2.24%	4.48%
2005	0.35%	1.51%	3.18%
2006	0.41%	1.57%	4.06%
2007	0.41%	1.74%	3.91%
2008	0.60%	2.40%	5.04%
2009	0.72%	2.17%	5.71%
2010	1.24%	5.28%	5.47%
2011	1.34%	7.09%	11.62%
2012	1.16%	5.39%	8.21%[20]
2013	1.82%	7.33%	4.08%[21]

Table 4.5 Gross yield, income yield and 10-year Irish government bond series' 1970-2013

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[18] Figures from Teagasc series only available from 1993.
[19] Figures provided by the Irish Central Bank as of closest date to 1 July of given year. Series only available from 1993.
[20] Assumed at 11 October 2011 instead of July 2012.
[21] Re-entered market in March.

4.3   Objective 2

As a result of the literature review, the DCF method of valuation was identified as compatible with established economic theories, practitioners' bases of value, and the historical context and was therefore deemed appropriate in theory for the valuation of agricultural land. While the theory is linked to results in this (the findings chapter), it is not considered necessary to elaborate on it in the results chapter.

4.4   Objectives 3 and 4

Objective 3 is the primary research question of the study. The question is: "Can the DCF method provide supportive evidence in the estimation of the market value of agricultural land in Ireland?" The results of the analysis undertaken in pursuit of Objective 3 are critical to addressing Objective 4. Objective 4 is to determine whether the DCF method of valuation of agricultural land is an appropriate consideration in determining the market value of agricultural land. To avoid repetition, the results for both Objectives 3 and 4 are examined in this section.

The method chosen for the investigation of Objective 3, i.e. the assessment of the accuracy of selected methods of DCF for the estimation of the market value of agricultural land in Ireland, involved two independent validation checks. The first validation check may be described as a theoretical validation check. This was used to check if the model would work in theory. A second validation check was used to illustrate and test the process a practitioner might employ in practice.

The method outlined in detail in section 3.6 can be summarised in the steps shown in Figure 4.6, below.

	(A) Theoretical test (assuming perfect foresight)
1.	Establishing the appropriate assumptions (including bases of value).
2.	Creating a model consistent with the above assumptions.
3.	Establish the appropriate inputs consistent with the above.
4.	Working out the market discount rates for the respective years of the model.
5.	Testing the model to examine if it is theoretically possible to use this discount rate in a DCF to estimate the market value of agricultural land Ireland.
	(B) Practitioner process test (Utilising only inputs from the valuation year-The data should be available to valuers in practice)
1.	Utilising the same DCF model and assumptions as above.
2.	Inputs from the first year's data)Of the subject year that is to be valued)
3.	Drawing on the implied annual growth rate formula to determine annual growth rates and creating a new cash flow with these inputs.
4.	Analysing the results (net present values) against the actual prices from the subject year.

Figure 4.6: Approach to answering research question and objectives

The above empirical tests were undertaken for income data and rent respectively. The results are set out in the following sections.

4.4.1 Rental data

Rental model (theoretical test)

The method section sets out how the researcher established the first three steps, as outlined in Figure 4.6. The first results to present are the market discount rates based on rental data. Tables 4.6 and Figure 4.7 set out the results for the market discount rates for income for the study period, plus the sourced data for the RFR and the RP.

	Risk-free rate	Market discount rate		Risk premium
1993	7.42%		5.18%	-2.24%
1994	8.79%		1.85%	-6.95%
1995	8.82%		2.61%	-6.21%
1996	7.63%		1.64%	-5.98%
1997	6.46%		4.32%	-2.14%
1998	5.04%		4.53%	-0.51%
1999	4.81%		5.25%	0.44%
2000	5.49%		3.17%	-2.32%
2001	5.28%		3.77%	-1.52%
2002	5.20%		2.36%	-2.84%
2003	3.85%		2.72%	-1.13%
2004	4.48%		4.67%	0.19%
2005	3.18%		6.21%	3.03%
2006	4.06%		5.52%	1.46%
2007	3.91%		4.44%	0.54%
2008	5.04%		8.15%	3.11%
2009	5.71%		7.82%	2.11%
2010	5.47%		11.89%	6.42%
2011	11.62%		6.79%	-4.83%
2012	8.21%		4.99%	-3.22%
2013	4.08%		8.43%	4.35%

Table 4.6: Market discount rate based on rental data for study period, together with 10-year Irish government bond yields (RFR) and risk premium (RP) for agricultural land in Ireland 1993-2013[22]

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[22] Risk Free rate is not in bold as it has been sourced. The market discount rate has been calculated as part of this study. The risk premium is an important theoretical concept derive from comparing the market discount rate to the risk free rate. Typically the market discount rate should exceed the risk free rate. Where it is negative (market discount rate is below risk free rate) the risk premium has been shown to be negative and displayed in red.
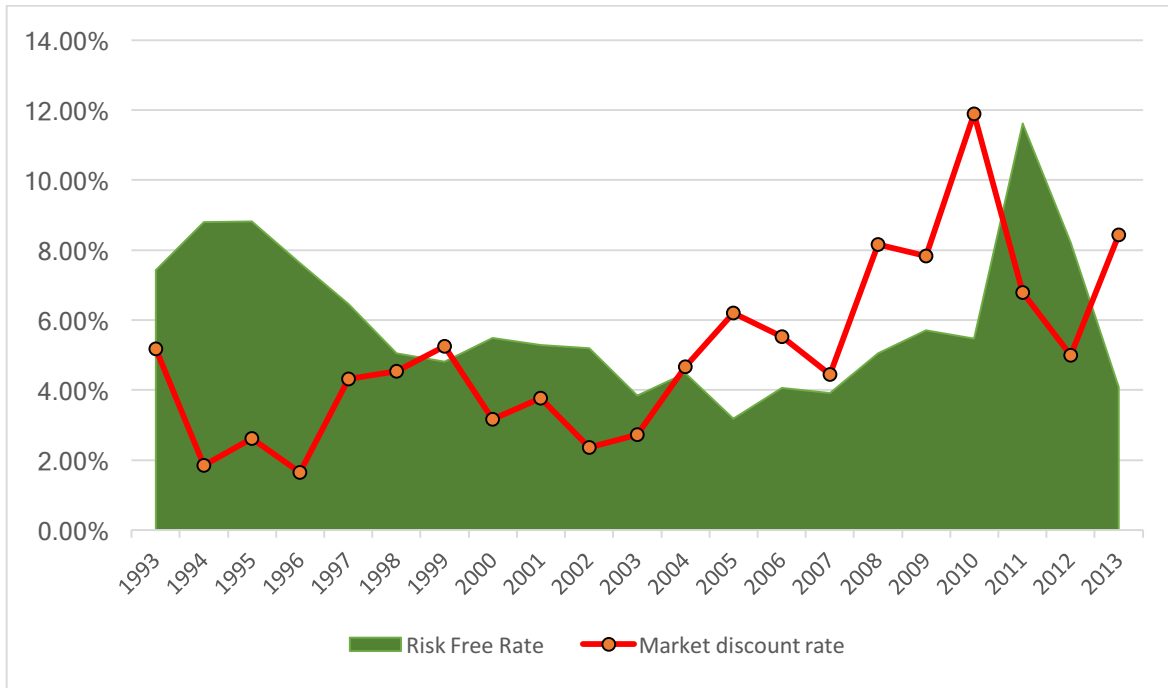
Figure 4.7: Graph illustrating the market discount rate based on rental data for study period, together with 10-year Irish government bond yields (RFR) for agricultural land in Ireland 1993-2013

These are interesting results, particularly when considered in the context of the market discount rates for income later in Figure 4.12, which shows results more in line with typical investment theory such as (Baum & Crosby, 2008). These results are discussed in Chapter 5.

The series of cash flows for this model can be found in Appendix 4 while the results from each of the years is presented below in Table 4.7 and Figure 4.8.

YEAR	Actual prices from Smith Harrington dataset	DCF (NPV) Results
1993	€2,116.94	€2,116.94
1994	€3,665.22	€3,665.22
1995	€3,828.09	€3,828.09
1996	€4,262.28	€4,262.28
1997	€4,721.77	€4,721.77
1998	€6,309.02	€6,309.02
1999	€7,858.02	€7,858.02
2000	€10,816.61	€10,816.61
2001	€9,269.59	€9,269.59
2002	€14,112.23	€14,112.23
2003	€12,745.63	€12,745.63
2004	€19,836.39	€19,836.39
2005	€32,675.17	€32,675.17
2006	€30,682.56	€30,682.56
2007	€34,877.62	€34,877.62
2008	€25,416.51	€25,416.51
2009	€18,840.10	€18,840.10
2010	€11,136.04	€11,136.04
2011	€11,242.88	€11,242.88
2012	€12,637.44	€12,637.44
2013	€10,832.79	€10,832.79

Table 4.7: Results from the first test of the DCF model (rental model theoretical test)
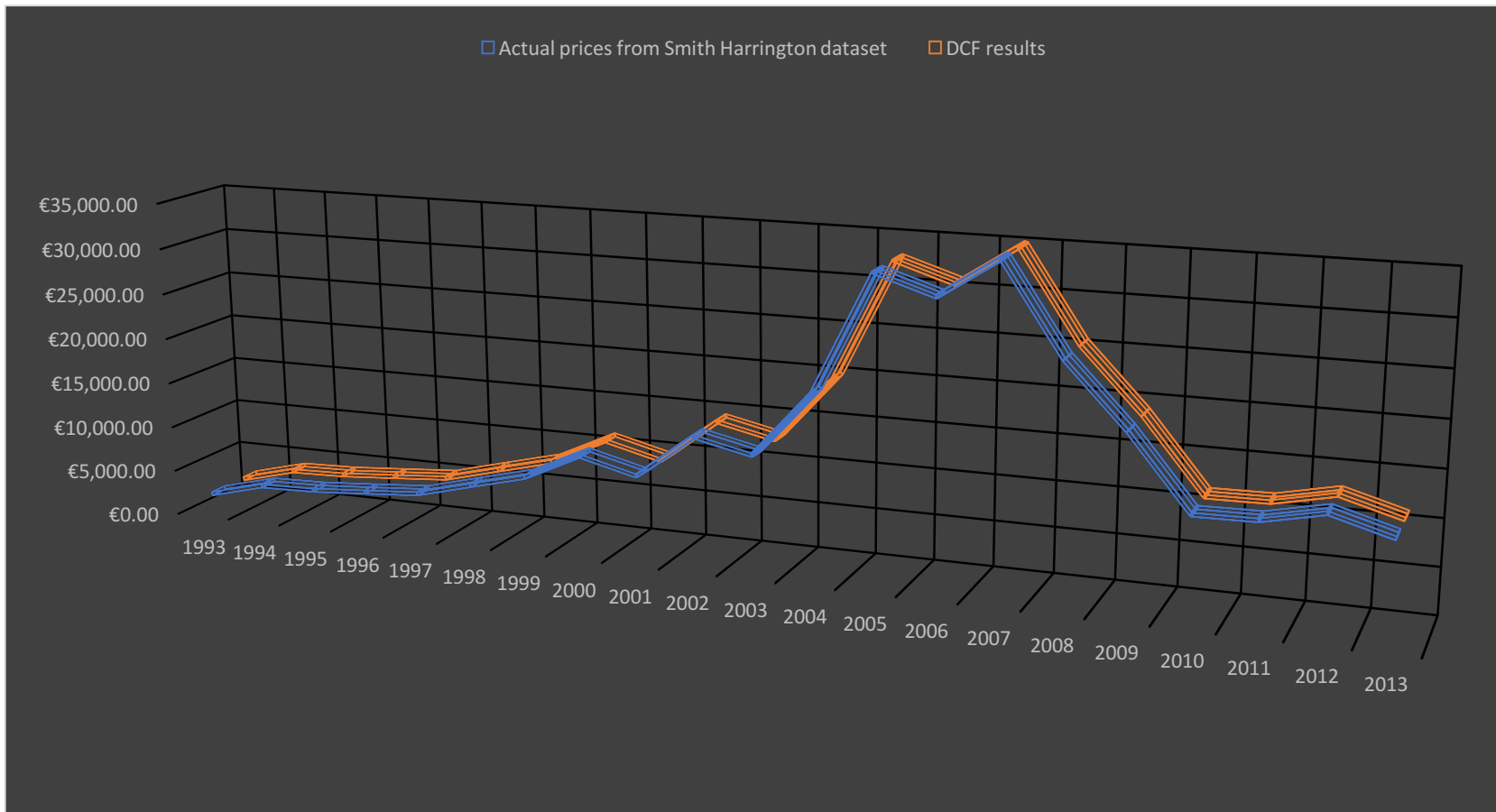
Figure 4.8: Graph showing prices achieved, together with results from the rental (theoretical) DCF model with market discount rates (1993-2013)[23]

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[23] 3D graph presented only because it is difficult to present 2D based on these results.

As was expected, the results of the model matched the actual prices for each given year. For completeness, the simple statistical analysis outlined in Chapter 3 was undertaken. This provided further confirmation[24] that the DCF method can be utilised to estimate the price and therefore the market value of agricultural land, when the inputs to the model are known.

While the findings are discussed in Chapter 5, two of the main points that are readily identifiable from this test are: (1) that at the market discount rates, the net present value of the DCF[25] for the respective years is equal to land price achieved in that year; and (2) when utilising the rental model, market discount rates are often less than the RFR.

Implied annual growth practice model (rental practitioner test)

While the theoretical model demonstrated that the DCF method could, in theory, be utilised to estimate the market value of agricultural land, it was based on the Smith Harrington dataset and perfect foresight, which would not be available in practice. It was therefore considered appropriate to undertake a second stage validation process that could potentially be utilised in practice.

It is important to highlight that, while considerable thought went into setting out a model that could potentially be employed in practice, it is not the only model that could be used, nor is it being advocated that it is the preferred model to be used. Rather, it is a model to test whether the DCF model could be utilised in practice, based on typical data available to the valuer on a date of valuation.

The model and assumptions[26] were retained but only the inputs from the first year of the study were utilised. This was to reflect the fact that practitioners would not have perfect foresight and the income data for the subsequent years of the cash flow.

The next stage of this was to establish the appropriate discount rate. For this study it has been assumed that a valuer in practice would utilise all data sources available at the date of valuation. A valuer may draw upon the published dataset from this study and, having consideration of the relevant theory, RFR and prevailing market risks, make an informed evidence-based opinion. For the purposes of demonstrating and testing this process, the market discount rate (calculated earlier in this study) for the prevailing year was utilised.

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[24] R squared for this test was 1. P value 5.31640669603498E-282.
[25] Under the outlined assumptions.
[26] Excluding perfect foresight inputs.

As set out in the method section of Chapter 3, a significant unknown for the practitioner was the growth rate in input data. However, having established the market discount rate, it was now possible, drawing on investment theory and Baum and Crosby (2008), to establish a growth rate.

Utilising the implied annual growth rate method drawing on Baum & Crosby (2008) shown in Figure 4.9, it was possible, with the benefit of the newly established market discount rate series (r), to determine the implied income growth (g). The results of this analysis are shown in Table 4.8, below.

$$(1 + g)^t = \frac{YP\ perp.@\ k - YP\ t\ years\ @\ r}{YP\ perp\ @\ k * PV\ t\ years\ @\ r}$$

WHERE:		
K =	Capitalisation rate	From Smith Harrington dataset
T =	Review pattern	From Smith Harrington dataset (1)
R =	Market discount rate	From Smith Harrington market discount rate series
YP PERP. @ K	Years purchase into perpetuity at capitalisation rate	$\dfrac{1}{k}$
YP T YEARS @ R	Years purchase for the number of years in the review pattern at the discount rate	$\dfrac{1 - (1 + r)^{-t}}{r}$
PV T YEARS @ R	Present value for the number of years in the review pattern at the discount rate	$(1 + r)^{-t}$

Figure 4.9 Implied annual growth rate formula[27]

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[27] The above implied annual growth rate formula is the practitioner version adapted from Baum and Crosby (2008). This was utilised as this model is aimed at practitioners.

The capitalisation rate is available from the newly constructed Smith Harrington dataset. The review pattern is one year within the dataset and the market discount rate is also available from the newly constructed dataset.

Table 4.8 presents the results of the growth rate from the respective years analysed, obtained from employing this formula.

	(G) From calculation
1993	8.75%
1994	5.79%
1995	6.00%
1996	7.21%
1997	6.87%
1998	9.47%
1999	10.47%
2000	3.85%
2001	3.20%
2002	7.67%
2003	6.04%
2004	6.02%
2005	5.69%
2006	6.86%
2007	5.11%
2008	5.94%
2009	11.76%
2010	8.58%
2011	5.43%
2012	8.70%
2013	7.79%

Table 4.8: Rental growth rates for implied rental growth model

To undertake the DCF (practice model), a final assumption required was the exit sale price at the end of the cash flow. As the valuer would not have perfect foresight, we can only assume they are aware of the prevailing yield in the subject year of analysis (based on analysis of comparable evidence). As the growth rate was estimated, the valuer would, in addition, have access to the cash flow series with a cash flow in the year of exit. Capitalising this cash flow at year of exit with the prevailing yield would explicitly project the growth. This would be the theoretically

correct position in line with the Baum and Crosby models (Baum & Crosby, 2008). This is the approach that has been assumed for the purposes of this study.

Once g and the exit yield had been estimated, a new cash flow was created. The format and results from a selected year (1993) is presented in Figure 4.9, while the overall results from the respective years are presented in Table 4.10 and in graph format in Figure 4.11.

	DCF Approach € 2,117		Actual price €2,117	
Year	Period	Implied rent	PV @ r	Cashflow
1994	1	€142.23	0.9160	€130
1995	2	€145.71	0.8391	€122
1996	3	€149.28	0.7686	€115
1997	4	€152.93	0.7041	€108
1998	5	€156.68	0.6450	€101
1999	6	€160.51	0.5908	€95
2000	7	€164.44	0.5412	€89
2001	8	€168.47	0.4958	€84
2002	9	€172.59	0.4541	€78
2003	10	€176.82	0.4160	€74
2003	10	€2,696.29	0.4160	€1,122
				€2,117

Table 4.9: Rental DCF model utilising the implied annual growth rate formula (1993)

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	Actual prices from Smith Harrington dataset	DCF results at market discount rates (theory)	DCF results utilising implied annual growth rates (practice)
1993	€2,116.94	€2,116.94	€2,116.94
1994	€3,665.22	€3,665.22	€3,665.22
1995	€3,828.09	€3,828.09	€3,828.09
1996	€4,262.28	€4,262.28	€4,262.28
1997	€4,721.77	€4,721.77	€4,721.77
1998	€6,309.02	€6,309.02	€6,309.02
1999	€7,858.02	€7,858.02	€7,858.02
2000	€10,816.61	€10,816.61	€10,816.61
2001	€9,269.59	€9,269.59	€9,269.59
2002	€14,112.23	€14,112.23	€14,112.23
2003	€12,745.63	€12,745.63	€12,745.63
2004	€19,836.39	€19,836.39	€19,836.39
2005	€32,675.17	€32,675.17	€32,675.17
2006	€30,682.56	€30,682.56	€30,682.56
2007	€34,877.62	€34,877.62	€34,877.62
2008	€25,416.51	€25,416.51	€25,416.51
2009	€18,840.10	€18,840.10	€18,840.10
2010	€11,136.04	€11,136.04	€11,136.04
2011	€11,242.88	€11,242.88	€11,242.88
2012	€12,637.44	€12,637.44	€12,637.44
2013	€10,832.79	€10,832.79	€10,832.79

Table 4.10: Results from the DCF rental models utilising the theoretical model and the implied annual growth rate formula

	Actual price	Net present value (theoretical model)	Net present value (practitioner model)
Actual price	1		
Net present value (theoretical model)	1	1	
Net present value (practitioner model)	1	1	1

Table 4.11: Correlation between actual prices, output from net present value (theoretical) income model and output from net present value (practitioner) rental model
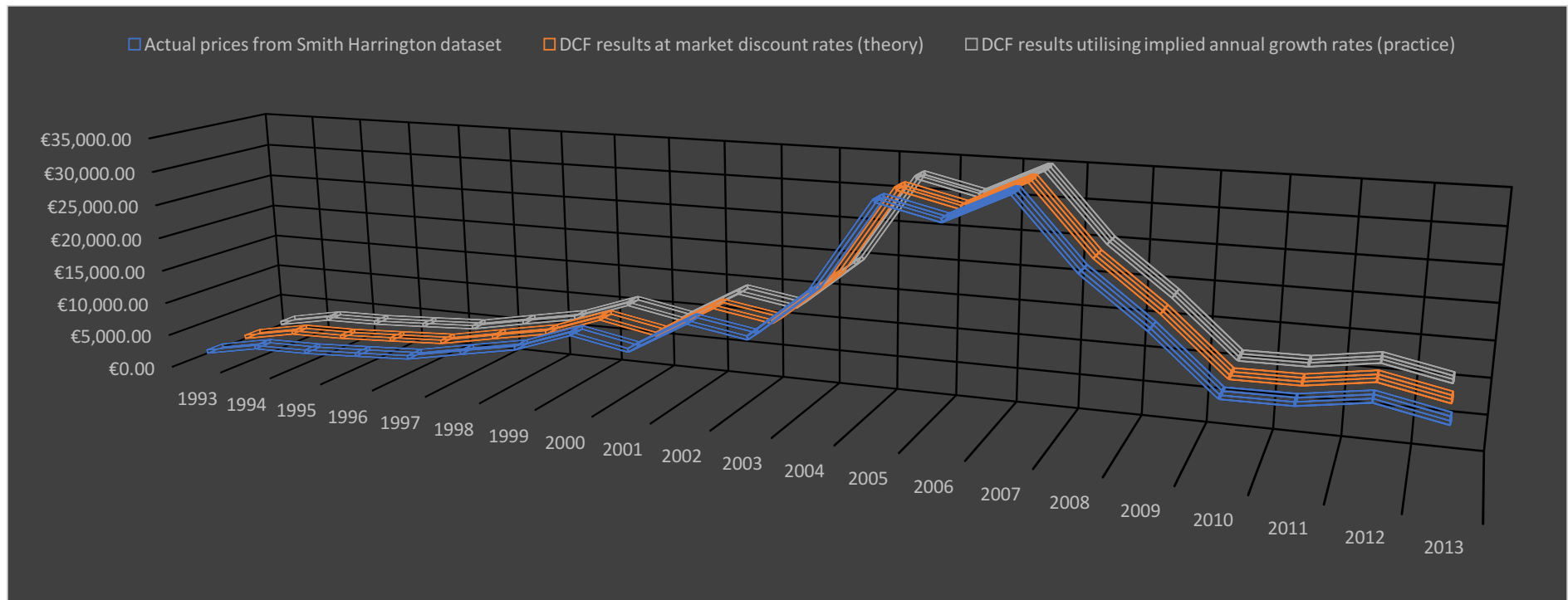
Figure 4.11: Graph showing results from both rental models against the actual observable prices achieved from the dataset 1993-2013

The results from these rental data models[28] suggest that this model can be an indicator of price both in theory and in practice, assuming correct market analysis. However, there are limitations to these findings.

The implications and limitations of these results are discussed in Chapter 5.

4.4.2 Income data

Income model theoretical test

The DCF models utilising the income data, as would be expected, produce similar results. However, as discussed in Chapter 5, the income models may be more useful in practice.

Following the methodology, and for completeness, the results are set out in the same way as in the previous section. The first results presented are the market discount rates based on income data. Table 4.12 and Figure 4.12 set out the results for the market discount rates for income for the study period, plus with the sourced data for the RFR and the RP.

	Risk-free rate (RFR)	Risk premium (RP)	Market discount rate
1993	7.42%	11.19%	**18.61%**
1994	8.79%	3.01%	**11.81%**
1995	8.82%	3.48%	**12.30%**
1996	7.63%	5.31%	**12.93%**
1997	6.46%	5.77%	**12.23%**
1998	5.04%	8.39%	**13.43%**
1999	4.81%	8.66%	**13.47%**
2000	5.49%	1.17%	**6.66%**
2001	5.28%	2.49%	**7.77%**
2002	5.20%	5.15%	**10.35%**
2003	3.85%	5.24%	**9.09%**
2004	4.48%	3.77%	**8.26%**
2005	3.18%	4.02%	**7.20%**
2006	4.06%	4.38%	**8.43%**
2007	3.91%	2.95%	**6.85%**
2008	5.04%	3.30%	**8.34%**
2009	5.71%	8.21%	**13.93%**
2010	5.47%	8.39%	**13.86%**
2011	11.62%	0.90%	**12.52%**
2012	8.21%	5.89%	**14.09%**
2013	4.08%	11.04%	**15.12%**

Table 4.12: Market discount rate (income) for study period, together with 10-year Irish government bond yields (RFR) and risk premium (RP) for agricultural land in Ireland 1993-2013

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[28] For reference, the P value of the implied annual growth series with the actual prices observes is also effectively 0 (5.31640669603498E-282), with the R squared again 1.
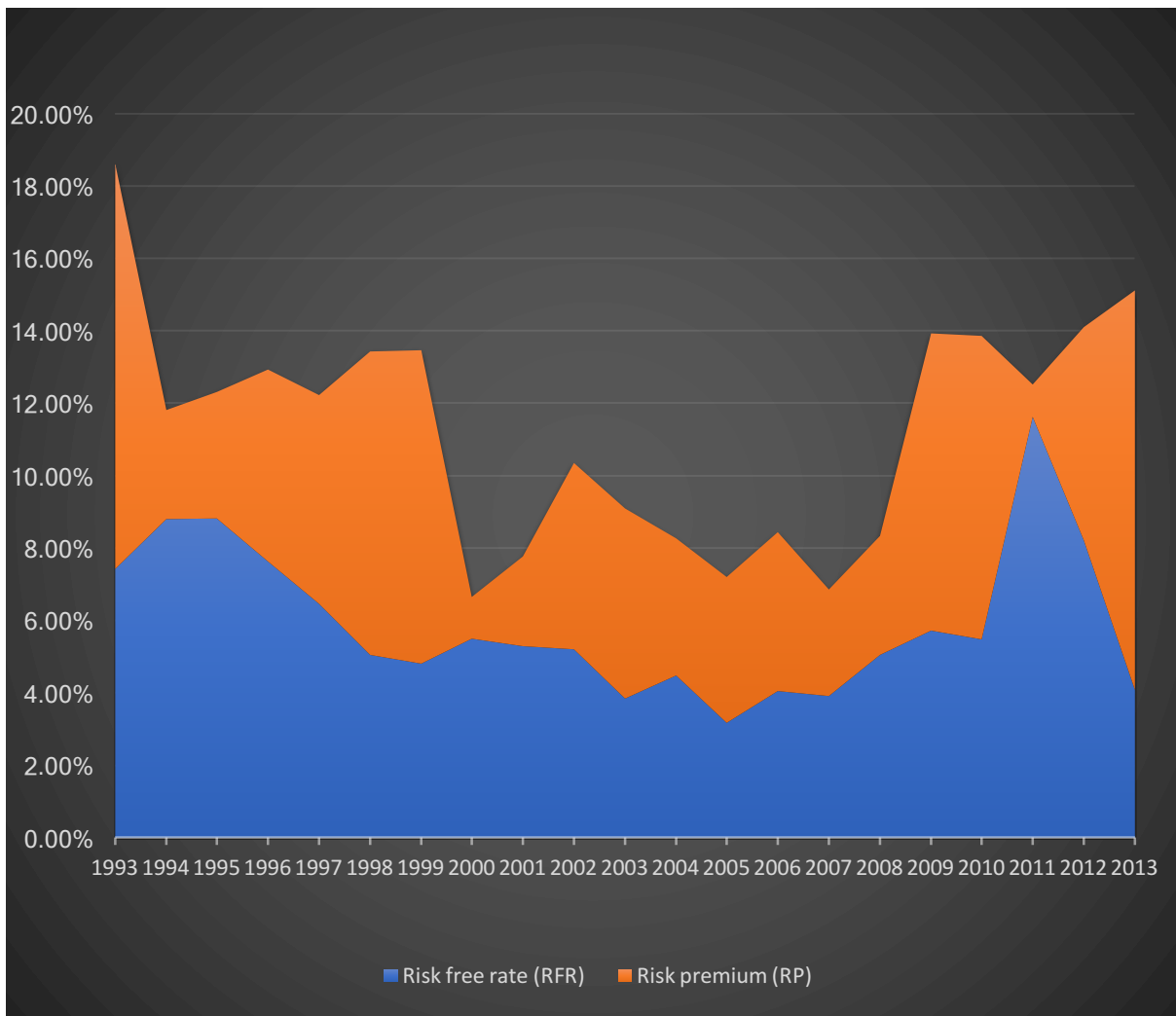
Figure 4.12: Graph illustrating the market discount rate based on income data for study period, together with 10-year Irish government bond yields (RFR) and risk premium (RP) for agricultural land in Ireland 1993-2013

What stands out in Figure 4.12 is that there is a clear RP in excess of the RFR, which was not evident in Figure 4.7. In contrast to the rental market discount rates, the market discount rates for income are more in line with market norms for RPs [RFR + RP = Discount Rate], as proposed by various academics and professionals (Baum & Crosby, 2008, RICS, 2010) and as set out in the earlier chapters of this thesis.

These results strengthen the hypothesis that, intrinsically, income is given more consideration than rents when purchasers in the market are considering buying agricultural land. It also suggests that undertaking an income input cash flow may be more informative for market participants than a rental input cash flow. However, while these results are consistent with the theory, they are not definitive. This issue is discussed more thoroughly in Chapter 5.

Returning to the primary focus of this study, the results from the income model also demonstrate that at these market discount rates, the net present value of the DCF for the respective years, under the outlined assumptions, equalled the actual price for the given year. The series of cash flows for this model can be found in Appendix 4. The results from each of the years are presented below in Table 4.13 and Figure 4.13 respectively.

	Actual Prices from Smith Harrington Dataset	DCF (npv) results
1993	€2,116.94	€2,116.94
1994	€3,665.22	€3,665.22
1995	€3,828.09	€3,828.09
1996	€4,262.28	€4,262.28
1997	€4,721.77	€4,721.77
1998	€6,309.02	€6,309.02
1999	€7,858.02	€7,858.02
2000	€10,816.61	€10,816.61
2001	€9,269.59	€9,269.59
2002	€14,112.23	€14,112.23
2003	€12,745.63	€12,745.63
2004	€19,836.39	€19,836.39
2005	€32,675.17	€32,675.17
2006	€30,682.56	€30,682.56
2007	€34,877.62	€34,877.62
2008	€25,416.51	€25,416.51
2009	€18,840.10	€18,840.10
2010	€11,136.04	€11,136.04
2011	€11,242.88	€11,242.88
2012	€12,637.44	€12,637.44
2013	€10,832.79	€10,832.79

Table 4.13: Results from the theoretical test of the DCF model using income data
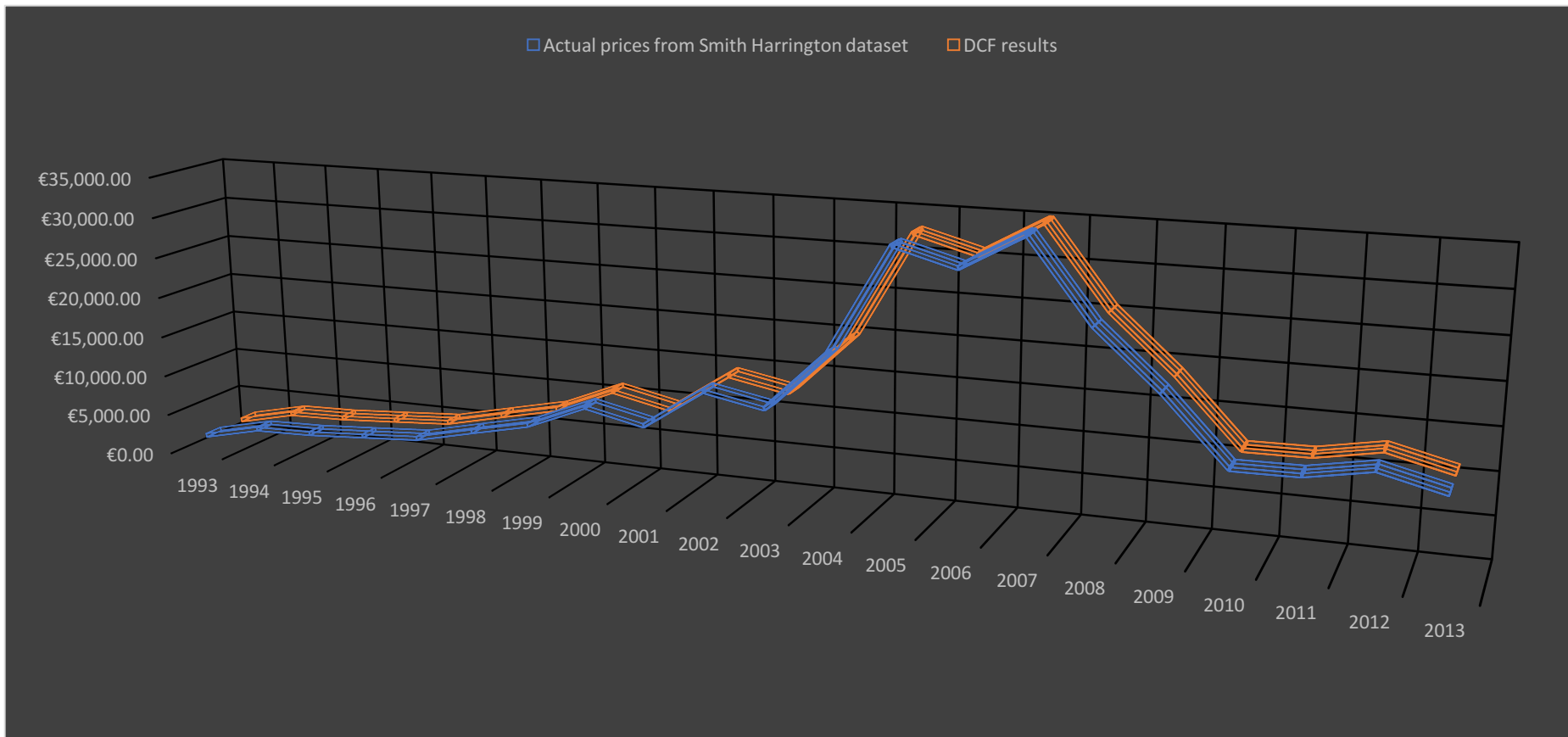
Figure 4.13: Graph showing prices achieved, together with results from DCF theoretical model using income data and market discount rates (1993-2013)

For completeness, a simple regression analysis was undertaken, which provided further support[29] for the assertion that the DCF method can be utilised to estimate the price and therefore the market value of agricultural land, when the inputs to the model are known.

Implied annual growth practice model (income practitioner test)

Again, while the above demonstrated the DCF income model could in theory be utilised to estimate the market value of agricultural land, the above was based on the Teagasc dataset and foresight, which would not be available in practice. As set out in the Chapter 3 (methodology), it was considered appropriate to undertake a second-stage validation process that could potentially be utilised in practice.

The model and majority of the assumptions[30] were retained but only the inputs from the first year of the study were utilised. This was to reflect the fact that practitioners would not have perfect foresight and the income data for the subsequent years of the cash flow.

The next stage of the model was to establish the appropriate discount rate for this purpose. Again, it is envisaged that in practice the valuer may draw on the published dataset and, having consideration for the relevant theory and prevailing market risks, will make an informed, evidence-based opinion. For the purposes of demonstrating and testing this process, the market discount rate for the prevailing year was utilised.

As set out in the method section of Chapter 3, a significant unknown for the practitioner is the growth rate in input data. However, having established the market discount rate, it was then possible, drawing on investment theory and Baum and Crosby (2008), to establish a growth rate.

Drawing on the same the implied annual growth rate model as utilised within the rental data, it was possible, with the benefit of the newly established market discount rate series (r), to

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[29] The r squared again shows a perfect correlation of 1 and the P value of 5.31640669603498E-282 is effectively 0. This, in line with the rental approach, supports the hypothesis of this study.
[30] Except for perfect foresight.

determine the implied income growth (g) for the income cash flows.

$$(1 + g)^t = \frac{YP\ perp.@\ k - YP\ t\ years\ @\ r}{YP\ perp\ @\ k * PV\ t\ years\ @\ r}$$

WHERE:		
K =	Capitalisation rate	From Smith Harrington dataset
T =	Review pattern	From Smith Harrington dataset (1)
R =	Market discount rate	From Smith Harrington market discount rate series
YP PERP. @ K	Years purchase into perpetuity at capitalisation rate	$\frac{1}{k}$
YP T YEARS @ R	Years purchase for the number of years in the review pattern at the discount rate	$\frac{1 - (1 + r)^{-t}}{r}$
PV T YEARS @ R	Present value for the number of years in the review pattern at the discount rate	$(1 + r)^{-t}$

Figure 4.14: Implied annual growth rate formula[31]

The capitalisation rate is available from the newly constructed dataset. The review pattern is one year, as income changes on an annual basis. The income market discount rate is also available from the newly constructed dataset. The results from the respective years are presented below.

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[31] The above implied annual growth rate formula is the practitioner version proposed by Baum and Crosby (2008). This was utilised as this model is aimed at practitioners.

	(G) From calculation
1993	2.45%
1994	3.41%
1995	5.13%
1996	5.78%
1997	5.46%
1998	4.75%
1999	3.73%
2000	3.79%
2001	4.33%
2002	4.36%
2003	4.23%
2004	3.18%
2005	4.13%
2006	2.77%
2007	3.65%
2008	3.31%
2009	4.33%
2010	4.47%
2011	4.13%
2012	10.45%
2013	6.39%

Table 4.14: Implied annual growth rates for income data

In line with the rationale for the rental approach, capitalising this cash flow at year of exit with the prevailing yield (income yield) was considered consistent with the basis of value and the assumptions of this study. This approach was therefore adopted.

Once g and the exit yield had been estimated, a new cash flow for the income model was created. The format and results from a selected year (1993) is presented in Table 4.17, while the overall results from the respective years are presented in Table 4.18.

	DCF APPROACH		ACTUAL PRICE		
	€2,117		**€2,117**		
PERIOD	**Year**		**Implied rent**	**PV @ r**	**Cashflow**
1		1993	€208.79	0.8431	€176
2		1994	€227.06	0.7108	€161
3		1995	€246.93	0.5992	€148
4		1996	€268.54	0.5052	€136
5		1997	€292.04	0.4259	€124
6		1998	€317.59	0.3591	€114
7		1999	€345.38	0.3027	€105
8		2000	€375.61	0.2552	€96
9		2001	€408.47	0.2152	€88
10		2002	€444.22	0.1814	€81
10		2002	€4,897.96	0.1814	€889
					€2,117

Table 4.15: DCF income model utilising the implied annual growth rate formula 1993

	Price	DCF results
1993	€2,116.94	€2,116.94
1994	€3,665.22	€3,665.22
1995	€3,828.09	€3,828.09
1996	€4,262.28	€4,262.28
1997	€4,721.77	€4,721.77
1998	€6,309.02	€6,309.02
1999	€7,858.02	€7,858.02
2000	€10,816.61	€10,816.61
2001	€9,269.59	€9,269.59
2002	€14,112.23	€14,112.23
2003	€12,745.63	€12,745.63
2004	€19,836.39	€19,836.39
2005	€32,675.17	€32,675.17
2006	€30,682.56	€30,682.56
2007	€34,877.62	€34,877.62
2008	€25,416.51	€25,416.51
2009	€18,840.10	€18,840.10
2010	€11,136.04	€11,136.04
2011	€11,242.88	€11,242.88
2012	€12,637.44	€12,637.44
2013	€10,832.79	€10,832.79

Table 4.16: Results from the DCF income model utilising the implied annual growth rate formula
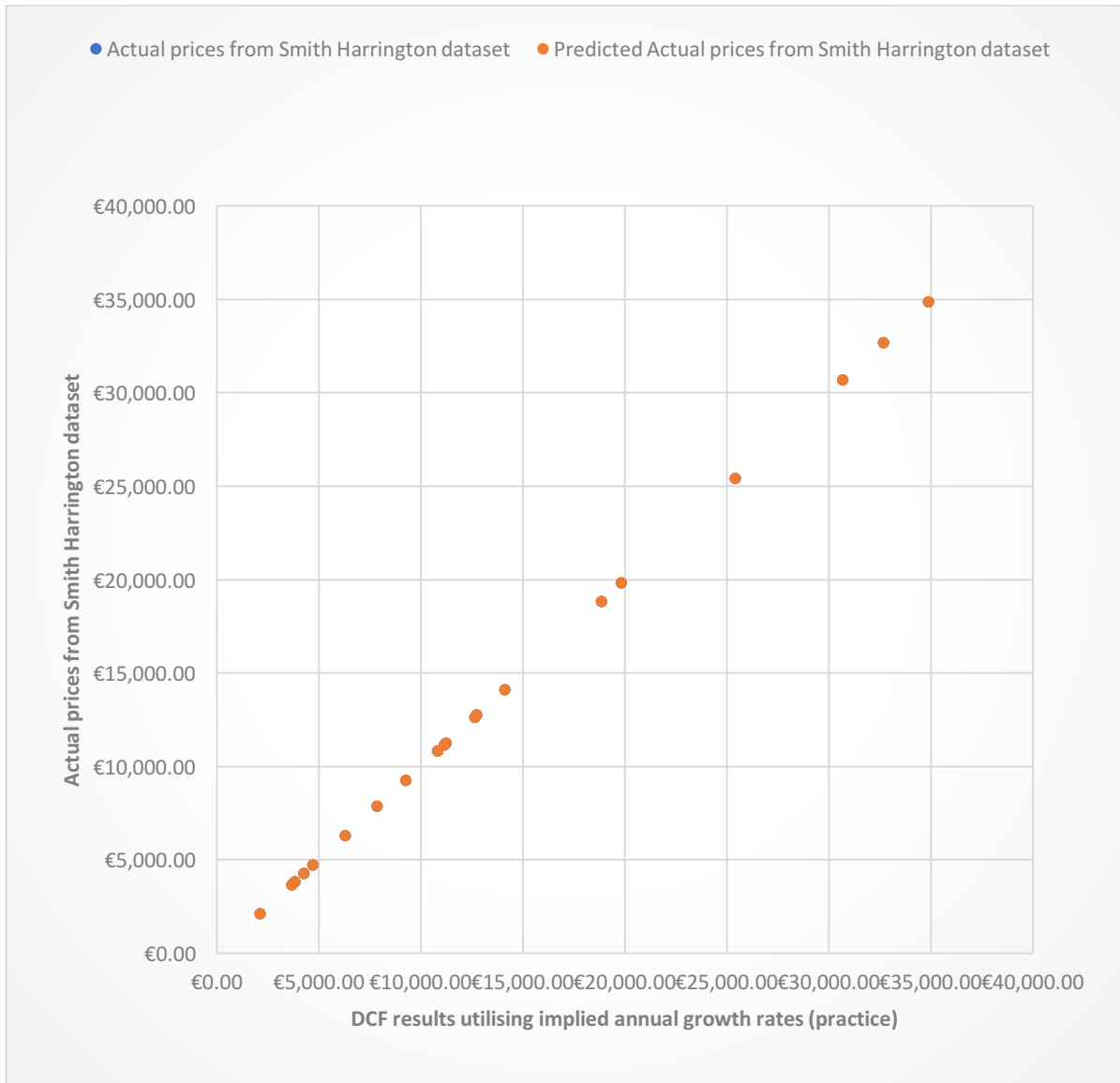
Figure 4.15: Scatter plot illustrating the correlation between the DCF implied annual results model (income) and actual prices observe from Smith Harrington dataset 1993-2013

Figure 4.16: Graph showing results from both income models against the actual observable prices achieved from the dataset 1993-2013

	Actual price	Net present value (theoretical model)	Net present value (practitioner model)
Actual price	1		
Net present value (theoretical model)	1	1	
Net present value (practitioner model)	1	1	1

Table 4.17: Correlation between actual prices, output from net present value (theoretical) income model and output from net present value (practitioner) income model

The above results provide further support to the hypothesis of the thesis that the DCF can be utilised to estimate the market value of agricultural land in Ireland. The statistical analysis again shows a perfect correlation of 1 and P value of 5.31640669603498E-282 (effectively 0). It can be concluded that the income model in this form and under these assumptions is an indicator of price.

It can be inferred from all the analysis undertaken that these models are an indicator of market value and may provide useful evidence to a valuer to support their opinion of market value for agricultural land. Again, drawing on Wheelan's (2013) statistics may be precise but there is no substitute for thinking about the calculations and why they are being done. The implications and limitations of the income results, including a discussion on which model may be appropriate for a valuer to employ in practice, are considered in Chapter 5.

Chapter 5: Discussion

5.1   Introduction

One of the challenges of structuring this thesis and this chapter was the lack of similar comparative studies. However, this provided freedom for the researcher to select the outline that was best suited to the subject study. This chapter is presented in a structured way, with reference to appropriate guides, such as Sampson (2017).

The goal of this chapter is to help the reader understand the findings in relation to the theory and research that have been presented. Sampson, (2017) notes that a discussion chapter should provide an interpretation of the findings of the dissertation within the context of the theory. Then, after utilising theory, or in cases where limited or no theory exists, the researcher may also suggest alternate explanations based on "integrative insights" from his or her understanding of the field (Sampson, 2017). This is in line with the researcher's philosophy, as set out in Chapter 3. This chapter takes this approach, drawing on the results and theory in the first instance. The discussion also draws on the author's insights as a professional doctorate researcher.

5.2   Main findings

5.2.1   Research question

This study's research question is as follows: "Can the DCF method provide supportive evidence in the estimation of market value of agricultural land in Ireland?" This study provides preliminary evidence that the DCF method can be effective in the valuation of agricultural land in Ireland.

The review of literature found that the cash flow methods should be a theoretically sound method of valuing agricultural land: according to Ricardo (as cited by Clarke, 1973, p. 2): "land sells at a price only because people expect to earn a rent from it." However, the methodology found barriers to testing the more modern DCF technique, notably the estimation of market discount rates and an absence of reliable data. Reliable data was addressed in the construction of the dataset and further theory was drawn on to develop a model/test to determine market discount rates.

The first test of this theory involved the construction of a standard DCF model to estimate the market discount rates for each year of the series of market prices. This was undertaken to estimate the market discount rates (1) for rental and (2) for income approaches respectively. The model's inputs for the rental test were based on the Smith Harrington rental series and yield from year of valuation. The input data for income was obtained from the Teagasc data and Smith Harrington sales data. The rationale and appropriateness of this data and model are set out in previous chapters.

In addition to producing a series of market discount rates, the results of this test (see Chapter 4 or summary Table 5.1 below) also demonstrated that the DCF method could be employed to estimate the price of agricultural land in Ireland.

	Sale price from dataset	Market discount rate	NPV from DCF model
1993	€2,116.94	5.18%	€2,116.94
1994	€3,665.22	1.85%	€3,665.22
1995	€3,828.09	2.61%	€3,828.09
1996	€4,262.28	1.64%	€4,262.28
1997	€4,721.77	4.32%	€4,721.77
1998	€6,309.02	4.53%	€6,309.02
1999	€7,858.02	5.25%	€7,858.02
2000	€10,816.61	3.17%	€10,816.61
2001	€9,269.59	3.77%	€9,269.59
2002	€14,112.23	2.36%	€14,112.23
2003	€12,745.63	2.72%	€12,745.63
2004	€19,836.39	4.67%	€19,836.39
2005	€32,675.17	6.21%	€32,675.17
2006	€30,682.56	5.52%	€30,682.56
2007	€34,877.62	4.44%	€34,877.62
2008	€25,416.51	8.15%	€25,416.51
2009	€18,840.10	7.82%	€18,840.10
2010	€11,136.04	11.89%	€11,136.04
2011	€11,242.88	6.79%	€11,242.88
2012	€12,637.44	4.99%	€12,637.44
2013	€10,832.79	8.43%	€10,832.79

Table 5.1: Summary results from theoretical DCF test utilising rental data

The price in this instance is the average of the observed prices per acre of agricultural land from the dataset. The market value definition is:

> The estimated amount for which an asset or liability should exchange on the valuation date between a willing buyer and a willing seller in an arm's length transaction after proper marketing and where the parties had each acted knowledgeably, prudently and without compulsion (IVSC, 2017).

The literature review explains the conceptual framework for this definition in detail. The key phrase in this context is "should exchange", referring to the fact that the market value is not predetermined and is an estimate of the price in a market exchange. This research applied this definition in line with other similar papers (French & Gabrielli, 2005 and Peto, 1997). As the DCF model is compared with actual prices observed in the market it can be inferred, based on the results of this study, that this DCF rental model can, *theoretically* under these assumptions, estimate the market value of agricultural land.

Before discussing the results of the DCF income model, it is appropriate to first discuss the market discount rates. As the literature has highlighted, the discount rate generally comprises the RFR plus an RP (Baum & Crosby, 2008; RICS, 2010). As the RP is an unknown, it is relevant to discuss the derived market discount rates for the rental model, with reference to the RFR.

As outlined in the literature, an RFR is normally taken to be the gross redemption yield on a medium-dated government gilt, preferably of the same duration as the assumed holding period of the investment (RICS, 2010). The DCF model used was 10 years. As noted in the methodology, the researcher obtained a data series of 10-year Irish government bond yields from the Irish Central Bank to serve as a proxy for the RFR. The results are shown again here for reference.

	Risk-free rate	Market discount rate	Risk premium
1993	7.42%	5.18%	-2.24%
1994	8.79%	1.85%	-6.95%
1995	8.82%	2.61%	-6.21%
1996	7.63%	1.64%	-5.98%
1997	6.46%	4.32%	-2.14%
1998	5.04%	4.53%	-0.51%
1999	4.81%	5.25%	0.44%
2000	5.49%	3.17%	-2.32%
2001	5.28%	3.77%	-1.52%
2002	5.20%	2.36%	-2.84%
2003	3.85%	2.72%	-1.13%
2004	4.48%	4.67%	0.19%
2005	3.18%	6.21%	3.03%
2006	4.06%	5.52%	1.46%
2007	3.91%	4.44%	0.54%
2008	5.04%	8.15%	3.11%
2009	5.71%	7.82%	2.11%
2010	5.47%	11.89%	6.42%
2011	11.62%	6.79%	-4.83%
2012	8.21%	5.99%	-3.22%
2013	4.08%	8.43%	4.35%

Table 5.2: Market discount rate based on rental data for study period, together with 10-year Irish government bond yields (RFR) and risk premium (RP) for agricultural land in Ireland 1993-2013

Rather than a RP, in 12 of the 21 years (57.1% of years examined) there is a reverse premium, with the average premium being a negative 0.08%. This implies that the risk involved in purchasing agricultural land in the specific years is less than the risk in purchasing a 10-year government bond yield. Anecdotally, in practice many purchasers make the assertion that land is the least risky of all investments. While this may be based solely on their own personal experiences, these findings suggest that, under these assumptions, purchasers in the agricultural land market in Ireland have considered land a less risky investment than government bonds during the study period. However, it could also be the case that purchasers have other considerations than the rent, when purchasing agricultural land.

As has been highlighted extensively within this study, the DCF technique is not widely used in practice by valuers, when providing advice to purchasers regarding agricultural land. It

could be inferred that as valuers are not utilising these techniques in practice, purchasers are not fully aware of the risks and returns on their purchase. In other words, participants in the market (including purchasers) may be making decisions without the benefit of this analysis. Their decisions are therefore not as well-informed.

Furthermore, the literature also indicated that while valuers may not be utilising DCF techniques, some participants in the farmland market, such as farmers, farm advisers and machinery dealers, use the technique to estimate the value of other assets on the farm. Participants in the land market may be informally employing the DCF technique based on the profits obtained from the land. Therefore, a further study of a DCF model was undertaken which used the gross margin data[32] from Teagasc in the given year and the Smith Harrington sales series. The results of this are also shown (in Table 5.3) below.

	Risk-free rate (RFR)	Risk premium	Market discount rate
1993	7.42%	11.19%	18.61%
1994	8.79%	3.01%	11.81%
1995	8.82%	3.48%	12.30%
1996	7.63%	5.31%	12.93%
1997	6.46%	5.77%	12.23%
1998	5.04%	8.39%	13.43%
1999	4.81%	8.66%	13.47%
2000	5.49%	1.17%	6.66%
2001	5.28%	2.49%	7.77%
2002	5.20%	5.15%	10.35%
2003	3.85%	5.24%	9.09%
2004	4.48%	3.77%	8.26%
2005	3.18%	4.02%	7.20%
2006	4.06%	4.38%	8.43%
2007	3.91%	2.95%	6.85%
2008	5.04%	3.30%	8.34%
2009	5.71%	8.21%	13.93%
2010	5.47%	8.39%	13.86%
2011	11.62%	0.90%	12.52%
2012	8.21%	5.89%	14.09%
2013	4.08%	11.04%	15.12%

Table 5.3: Market discount rate (income) for agricultural land in Ireland 1993-2013, together with 10-year Irish government bond yields (RFR) and risk premium (RP)

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[32] Highest and best use.

In contrast to the rental RPs, the results from this study are more conventional. While this does not prove the income theory, i.e. that the price of land is the net present value of the future stream of income, on its own it is relevant to consider these results in the context of the literature and observations proposed. First, we know that, because of Irish government policy from the early 20th century, most participants in the market for agricultural land in Ireland are owner occupiers running a farming operation (rather than investors). They are likely to be more interested in the profitability of the farm than its investment potential, in the sense of paying a regular dividend, although, of course, these are connected. Second, market participants may be using this approach informally to assist in the bidding process.

In the context of these theories, these results suggest that the income approach to the DCF method may provide a more theoretically sound approach to the valuation of agricultural land in Ireland than the rental method. Returning to Clarke and Ricardo, this is not surprising. While Ricardo notes that, "you pay a price for land because of the rent" (Ricardo, as cited by Clarke, 1973, p. 2), the rent he refers to is the economic rent. Ricardo specifically notes that the rent paid by a tenant to a landlord is likely to be different from the economic rent. He defines the economic rent as follows:

> Rent is the amount by which proceeds actually received exceed the minimum amount which would have been necessary to evoke the supply factors of production (Ricardo, as cited by Clarke, 1973, p. 2).

The economic rent is therefore more closely aligned with the Teagasc income data, which therefore supports these results.

Valuers may prefer using rental-based methods of valuation, as they may be more familiar with them than with the DCF. While theoretical considerations are relevant, there are practical arguments for using the income approach, as well. Firstly, as has been well highlighted in the literature, the agricultural land market in Ireland has no authoritative data source. Although research for this thesis and other work, e.g. Nunan (1987), has provided additional data about the market, there is still a lack of land price information, relative to the abundance of income data available. The Teagasc and CSO data provide excellent sources of income data.

More importantly, given the heterogeneous nature of land highlighted, utilising income data may be a more appropriate choice to reflect the quality of the productivity of individual

parcels of land. Given the limited transparency of the rental market, it is difficult to get two comparable plots to analyse. Utilising income data provides additional flexibility to model a cash flow around a specific parcel of lands projected uses, i.e. potatoes one year, grass the next. While this requires assumptions on prices, the work of Teagasc and FAPRI would be useful in this regard.

Both the rental and income models of modelling farm land prices have proved to be to be equally statistically reliable. However, when viewed in the context of both the theoretical and practical considerations, it is suggested that that the DCF implied annual growth model utilising income data inputs, as outlined, is the more appropriate method for modelling farm land prices in Ireland in practice.

A note of caution is due here. The rationale of the decision-making processes of individual market participants has not been this investigation's primary focus. This finding is being inferred from the results and, while it is also supported by theory, more research on this topic needs to be undertaken, to more clearly understand the motivation of market participants. A better understanding of this market behaviour would be a welcome addition to the body of knowledge.

A recommendation would be that practitioners should not use the DCF method in isolation. It may be used together with the rental model and the comparison approach, to assist in informing a valuer's opinion of market value. This triangulated approach should allow a valuer to provide a client with more informed advice and opinions of value. This should be useful in a less-than-fully transparent market. Limitations are discussed later in the chapter, after the findings related to specific objectives.

5.2.2 Objective 1

To improve the availability and accessibility of agricultural land market data in Ireland.

As has been highlighted in the literature, the lack of data makes agricultural land perhaps the least transparent of all property asset classes in Ireland. In publishing the Smith Harrington sales and rental data from 1901 to 2013 with this research, the author has improved the availability and accessibility of agricultural land market data in Ireland. Although this data has some limitations, its validity has been supported by the checks described in this study.

It is envisaged that this publication will have positive implications for practice and academic research. To further improve the accessibility of the data, the researcher has agreed in principle to update and publish it in the joint SCSI/Teagasc agricultural land market report. The work done in this study was partially responsible for the establishment of this report. Regular and timely publication of this report will improve accessibility of the data and create an awareness among practitioners about current work in valuation.

5.2.3 Objective 2

To identify alternative methods of estimating the market value of agricultural land.

Three key issues that emerged from the investigations into this objective are set out below.

First, the limitations of the comparable method were set out and discussed, in the context of agricultural land market in Ireland.

Second, an analysis of the literature showed that the DCF method was consistent with many of the classic texts on the value of agricultural land. Jones (1979) linked the Ricardo and Von Thünen models, noting that "a decrease in the transportation rate in the Thünen model is equivalent to a fertility improvement in Ricardo's scheme" (Jones, 1979 p. 642). The DCF model is consistent with Jones's ideas to link the theory from these classic models of estimating value of agricultural land.

Given the consistency of theory, it was surprising that the DCF had not already been more widely adopted in practice. It was suggested that this may be owing to historical and cultural factors in the Irish market. However, the literature review also highlighted the third key issue

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that the culture might be changing, as purchasers and sellers become more familiar with DCF techniques, possibly due to widespread agricultural education and training. This is an eligibility requirement for many farm payment schemes. It can thus be suggested that the DCF method represents a way of valuing assets that is gaining traction among the primary purchasers and sellers of agricultural land.

It was therefore concluded that the DCF model set out in this study was consistent with these theories; and that it was an appropriate method to investigate and estimate the market value of agricultural land in Ireland.

The findings of this study support these theories. It is suggested that the DCF model should be used by valuation practitioners, to provide more informed opinions of the market value of agricultural land in Ireland.

5.2.4   Objective 3 and objective 4

Objective 3: To assess the accuracy of the selected method.

Objective 4: To determine whether the selected method of valuation is an appropriate consideration in determining the market value of agricultural land in Ireland.

Objectives 3 and 4, stated above, have been linked, as the results of Objective 3 leads on to a discussion of Objective 4.

Firstly, to deal with Objective 3: the results show that utilising the data, assumptions and theory outlined that the DCF method can provide an accurate representation of the price and thereby the market value of agricultural land. As the results of this have been set out in Chapter 4 and discussed earlier in this chapter, this objective does not require further discussion here.

The conclusions from Objective 3 suggest that the DCF method of valuation is an appropriate consideration in determining the market value of agricultural land in Ireland. However, Objective 4 requires a more nuanced discussion, dealing with both theory and practical considerations. The main conclusions are set out below.

French (1997) stresses that the important factor in the valuation process is using the method that is appropriate for the valuation problem in hand. Sometimes, an implicit model is the most appropriate; sometimes the explicit model. French argues that, regardless of the method chosen, all valuations are subject to uncertainty. The sources of uncertainty are rational and can be identified. Uncertainty should be described in a practical manner and it should be conveyed to clients in an understandable format. This will improve the content and the credibility of the valuer's work (French & Gabrielli, 2004). It is noted that one of the advantages of the model proposed (i.e. the DCF model utilising income data) is that it provides more detail, which allows the valuation practitioner to explain the rationale and therefore the uncertainty involved in the valuation process. Relating value to the income that can be derived from the asset will likely be an understandable concept to most participants in the market. Risk or uncertainty relating to, for example, projections in the cash flow due to adverse weather or changes in relevant markets, should also be more explicit.

The model can be further developed for individual circumstances, to discuss uncertainty. For example, sensitivity analysis could be employed. These are significant advantages of the DCF income model. It was concluded that the DCF method outlined in this study is an appropriate consideration for determining the market value of agricultural land in Ireland.

5.2.5   Summary

In answering these objectives, the researcher, his supervisor and advisors were confident that they provided insights into the valuation of agricultural land in Ireland. There are further implications, together with some limitations, which are explored in the following sections.

5.3   Implications

5.3.1   Implications for theory development

The process of real estate appraisal is intrinsically linked to the cultural and statutory process of the subject market (Graaskamp, 1992). A review of valuation methods undertaken by researchers in the University of Reading and the University of Athens identified that:

> each country will have a different culture and experience, which will determine the methods adopted for any particular valuation (Pagourtzi, Vassilis, Hatzichristos, & French, 2003).

The present study has examined the changing culture and experience of all the stakeholders

involved in the Irish agricultural land market. Its findings suggest that the theory has not developed in line with the culture. While participants and a growing number of valuation practitioners in the Irish agricultural land markets think in terms of cash flow models, the DCF model has yet to be adopted as an accepted model of valuation for agricultural land.

This study has drawn on theory associated with cash flow models and the results show that these theories can apply to the valuation of agricultural land. This step is considered to be important in advancing theory and practice in this area.

5.3.2   *Implications for education, training and policy*

Following on from this finding is a direct implication for education, training and policy.

It is not anticipated that the publication of this research is enough to change valuation practitioners' behaviour. However, the findings provide sufficient evidence for the relevant professional bodies to establish a working group to review the area, with a view to writing a guidance note on the valuation of agricultural land in Ireland. Should a guidance note recommend the approach set out within this thesis as one of the available methods to assist valuation practitioners in forming their opinion of market value of agricultural land, there may be further implications for training.

Graduates of most programmes at undergraduate and master's level will be familiar with DCF techniques and revising module descriptors to include agricultural land valuations should not be necessary, save for specialised programmes. However, prior to practitioners utilising these techniques, it is recommended that the relevant professional bodies should review their guidance notes on agricultural land valuation. They should also consider introducing continuing professional development (CPD) for those practitioners who wish to obtain a deeper understanding of the method.

From an educational perspective, this research provides a valuable and practical data series that may be useful to students. It helps to relate the theory on discount rates to a local asset class with which they may be familiar. It may assist with their understanding of the links between yields and discount rates. This is important for students, and ultimately valuers, to better understand and analyse yields, to construct discount rates, thus helping to dispel some of the myths that Brennan (2011) found would be an important implication for practice.

5.3.3 Implications for practice

This DCF model demonstrates a process a practitioner can employ to assist in forming an opinion of value. It must be stressed that it is not envisaged this model will work as accurately as shown in this study for every valuation. While this study could be replicated with similar results, practice is different. The model proposed does not rely on foresight (to be in line with practice). However, it has the benefit of the market discount rates and prevailing yields. In practice, it would be up to the valuation practitioner to estimate these, having reference to the relevant theory and risks prevailing in the market.

The publication of the series set out in Objective 1 should assist the practitioner in estimating the appropriate discount rate and yield. Drawing on the theory outlined within this research should be of further assistance. However, it is acknowledged that analysing the data remains a challenge in a less-than-fully transparent marketplace, with relatively limited transactions.

Despite this limitation, these results demonstrate a DCF model that can be utilised in practice as an indicator of market value. And, as the market place evolves towards greater transparency, the accuracy of this model in practice should improve.

In addition, some of these limitations may have positive applications. For example, there will always be uncertainty surrounding the inputs to be utilised for income. Drawing on the various sources of data, a valuer should be able to estimate appropriate market inputs. An experienced valuer, with knowledge of the market and "highest and best" criteria, may be able to identify emerging trends. For example, several farmers may have ideas that active management or new market sectors, such as organic production or utilising the land for renewable energy, may bring with it increased income streams. They may therefore out-bid the model. This is a real possibility but an experienced valuer with knowledge of the sector should be in a position to identify such opportunities. They can then build this into the model to determine an efficient FMOP.

5.3.4 Implications for future research

The lack of market data for agricultural land in Ireland appears to be a contributing factor to the low level of academic research carried out. The publication of this dataset should address this by providing the opportunity for future studies. For example, there are still many

unanswered questions about the economic value (or worth) of agricultural land. This research provides the basic data for future papers in this area.

A related theoretical study many examine economic rent to test Ricardian theories with empirical data. Potential research questions for a future study may be structured around whether the theoretical rent matches the rent paid in practice over time, whether there is any correlation between the two, and the reasons for any divergences.

The lack of data has precluded a deeper understanding of trends in the market, a knowledge of which, according to Mackmin (1985), are supplementary to good comparative evidence. Publishing the data should therefore assist practitioners in interpreting comparable data. This research is therefore in keeping the aim of this study, i.e. to provide insights into the valuation of agricultural land in Ireland and to assist practitioners to make informed decisions.

These are significant positive implications for research and practice from the publication of the data itself.

This research also highlights the economic and historical factors that have contributed to imperfect market conditions in the Irish market. The lack of data and therefore comparable evidence has been highlighted. The data may be utilised in conjunction with comparable evidence for the estimation of capitalisation rates for valuation purposes.

This research also provides the platform for further studies, where there is limited comparable evidence to examine FAPRI data (or other similar sources) as inputs to the model, and discount rates and exit yields, drawing on theory to establish an indication of value. While suitable data is not currently available to undertake such a study, it might be possible to use FAPRI (or other similar) data in a future model. This is an important issue for future research that may provide useful insights in specific circumstances, such as to determine the worth of the asset.

The theory investigated in the research question was whether the DCF method could provide an accurate representation of the market value of agricultural land. The DCF method of investment appraisal was developed to value income-producing assets and applied to the

investment assets and development land in the real estate sector. The DCF theory indicates that the present value of the cash flow is the value of the asset. As applied to the current study, this theory holds that the output from the annual results of the model can potentially be correlated to actual prices achieved in the dataset. The results of this study have shown this to be the case. This is an important finding. However, the use of DCF methods in agricultural land valuation could be more far-reaching.

The review of literature identified how the DCF method may provide a more accurate reflection of the intrinsic value of the asset than the "comparable" method of valuation. Following the compilation of the dataset, the initial pilot study identified spikes in agricultural land prices (the most notable recent incidences being the late 1970s and mid-2000s), which may be defined as an agricultural land price bubble. An asset bubble can be defined as an economic cycle characterised by rapid escalation of asset prices, followed by a contraction. It is created by a surge in asset prices unwarranted by the fundamentals (i.e. the flow of returns from the asset) and driven by "exuberant market behaviour" (Investopedia, 2017). Hirano refers to a bubble as a situation in which the price of the asset deviates from its real value (Hirano, Inaba, & Yanagawa, 2015). The question remains as to what the "real value" is.

While the possibility of a "bubble" was briefly reviewed, the publication of the dataset will provide a platform to examine, in greater detail, booms and busts in the Irish agricultural land market over the study period. This could include examining factors influencing the market and may help to identify periods of economic exuberance when market prices are significantly out of line with the intrinsic value of the asset.

An additional DCF model could be constructed to estimate the intrinsic (investment value) of the asset. The literature review identified how the DCF method in some cases could provide a truer reflection of the intrinsic value of the asset.

It could therefore be further hypothesised that, while market prices may deviate from a DCF model during these periods, these outlier prices will ultimately revert to the mean (output from the model), when the exuberant market behaviour ends. If this hypothesis holds true, it may be suggested that a DCF approach can estimate the intrinsic value of agricultural land and should be used by valuers in Ireland, in conjunction with the comparable method of

valuation (or DCF method to estimate market value), to provide more informed opinions on the value of the asset. In these cases, it would likely be necessary to recommend that valuers provide a dual report on both the market value (based on comparable analysis or market based DCF) and the intrinsic value (based on the output of an alternative intrinsic DCF model) of the asset. This could be done in all *Red book* (RICS *Valuations standards*) or equivalent secured lending valuations. It is likely that a model such as this would be favoured by banks seeking long-term mortgage lending values. Crosby and Hughes (2011) found that the use of mortgage lending value and investment value techniques could have provided lenders with tools for more informed and prudent lending. A study of this nature for agricultural land in Ireland would therefore be relevant.

This research has progressed the theory and the availability of data in this subject area. However, there is abundant room for further research into each of the areas that has been identified.

5.3.5   *Limitations in sampling*

From the outset of this study, the researcher was very conscious of the garbage in, garbage out (GIGO) phrase, which notes that nonsense input data produces nonsense output or "garbage." This study has placed great emphasis on ensuring that the data for the model is accurate and representative, as the methodology has set out. However, the data remains a sample of the general population and is therefore limited by its nature.

While the sample benefits from its longevity and comprehensiveness, its primary limitation is its regional nature. The sample data is primarily from the county of Meath, with some additional data from the surrounding counties on the east of the country, in Dublin, Louth, Cavan, Westmeath, and Kildare.

To address this limitation, the researcher obtained a dataset of sales from a similar firm on the west of Ireland, which was available from 1940-86.[33] This showed a 95.8% correlation and a P-value of 3.85E-26, which equated to effectively zero.[34] As we know from the previous two chapters, a P value below 0.05 is regarded as a good predictor. As this is a west-coast firm and the subject data is from the east coast of Ireland, this level of P value suggests that the

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[33] The firm discontinued operations after 1986.
[34] 0.0000000000000000000000000385263002802524.

sample is representative of Ireland's agricultural land sales value during this period. It should be noted that while this gives a regional sample, the quality of land in both sample locations would generally be considered average to above average. A sample of a firm in other parts of the west coast would likely show a significantly lower sale price per acre during the study period. However, based on these results, it should show a similar relationship.

It should also be noted that, as the firm from the east coast[35] no longer exists, it was not possible to analyse the data during the study period itself and the relationship had to be extrapolated, which is a limitation. A national government database of all agricultural land transactions would have a more thorough regional representation. This was not available and, in any respect, would also have had limitations as, due to the historical context outlined in Chapter 2, it may have contained non-market value inter-family transactions.

Notwithstanding these limitations, the analysis undertaken indicated that the input data represented the best data available to the researcher for the respective elements of the model.

5.3.6 *Limitations in the measures and treatment*

It should be noted that some of the theory employed in these models is drawn from the investment paradigm. Gitman, (2006), as cited by Baum and Cosby (2008), noted that the desire for shelter or a place to do business or to enjoy recreation may be contrasted with a desire for a vehicle into which funds can be placed, with the expectation that they will be preserved or increased in value and/or generate positive returns (Gitman, 2006.). The literature review noted that the culture of the Irish land market plays a significant part in land ownership in Ireland and pure returns are not always the sole driver of price. This adds to the uncertainty of the method. However, as noted by French and Gabrielli in their paper on uncertainty in DCF:

> Uncertainty is a universal fact of property valuation. All valuations, by their nature, are uncertain. Yet they are generally reported to the client as a single point estimate without reference to the context or the uncertainty underpinning them. This paper argues that it is possible to inform the client of the reality of uncertainty without impugning the utility of the valuation (French and Gabrielli, 2005, p. 77).

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[35] William B. Fitt.

This research concurs with this viewpoint. The DCF method provides the practitioner with additional tools to explain this uncertainty.

It is acknowledged that there are other drivers of the price of agricultural land, such as historic and cultural factors. It was not the purpose of this study to determine if returns were the sole driver of the price of land. It was hypothesised that, having regard to the changing culture of agricultural land market, particularly the entry of younger more educated market participants, the DCF method could be utilised by experienced practitioners, to assist them in forming opinions of value of agricultural land. The conclusions, having regard to the findings and theory, support this.

5.3.7 *Limitations in the data analysis*

This study benefits from excellent input data for income (gross margin), rent and sales prices. There were however some limitations.

The data available on income was the best available at the time of the study. However, one limitation was that it was the average data from the industry, rather than data taken from a specific farm. This type of data is preferred for research purposes as it provides a more robust foundation to advance theory. The limitation is not specifically the data or data analysis but rather, the practical application. As was illustrated in the literature review, drawing on Ricardo, the quality of the land (together with other factors such as weather) will dictate the productivity and therefore the profitability of the asset.

In practice, this requires valuers to adjust for these factors. This leads to the question, "Are all agricultural land valuers capable of making this assessment?" While some experienced practitioners may be able to make a reliable estimate, it is unlikely that many will be able to make an accurate estimate, based on a typical inspection. Does this make the study of such techniques less relevant? It can be argued that it does not, for two reasons. Firstly, experienced practitioners will be able to judge the general category of the land quality. They do this already in a comparable analysis when they categorise land into, for example, good, average and bad quality land. Further subjective adjustments are often made to this. In some respects, the DCF method provides a more explicit and transparent method that requires less subjective adjustments.

Secondly, the RICS (2017) also states that when employing such methods to value specialised properties, a valuer may consult with the owner or industry specialist to advise on such inputs.

When using the model proposed and drawing on the distinction between market value and worth (2.4.2) it is not necessary for the valuer to go into minute detail of profitability, when determining values for particular parcels of land. In going into specific detail, the valuer may cross the line from estimating a "market value" to assessing the worth of the asset to a particular farmer. Therefore, that categorisation of land as proposed above, together with the use of reliable published data, such as the Teagasc data used this study, may be most appropriate method of estimating market value in practice.

Further improvements to the model are likely to be possible. As data improves, more specific information becomes available for comparison and/or DCF purposes. For example, soil quality data may be a good standard measure of productivity. In addition, the source income data from Teagasc has expanded greatly since its establishment and is likely to be more detailed, as technology allows. This provides potential for further research in this area.

In relation to the weather, this is another uncertainty faced by the valuer when utilising this method. Climate change is a major issue facing farmers. The comparable method does not provide an obvious mechanism to build such risk into a valuation. As all valuation carries with it uncertainty, this is simply a risk component that could be factored into the RP of the DCF method. This, in the researcher's opinion, is a significant advantage of this approach.

There is also an argument that an investor in the agricultural market could diversify some of this risk away, through investing in different worldwide locations. However, in the era of climate change, it is unlikely all this risk can be diversified away, save for perhaps controlled indoor intensive farms. More probably, the increased use of weather data, as well as the use of increasing weather and FAPRI for price projections, should plan and account for these risks.

These considerations provide potential for further studies, such as the impact of extreme weather conditions on agricultural land values. There is also an argument that the historical

data will have incorporated both standard and severe weather conditions and there is no requirement for further adjustments, as this would simply be double counting.

While there is always uncertainty with inputs into the model, the primary uncertainty in this study is, as is so often the case, the estimation of the discount rate. One of the principle limitations of the DCF model, used in any context, is the difficulty assessing the discount rate. As referenced in the literature review, this has been regarded as the reason why the DCF method was not more widely employed in practice in Ireland (Brennan, 2011).

This study, through determining and publishing market discount rates, has advanced the understanding of market discount rates in agricultural land. While it is acknowledged that an element of uncertainty will remain in assessing appropriate discount rates, in practice the rationale for this can be explicitly stated, drawing on this research and existing theory. In this respect, the limitation of assessing a discount rate is an advantage to the valuer.

5.4   Summary

This research has demonstrated, based on both income and rent data, that the DCF can be used to obtain an accurate indication of the market value of agricultural land in Ireland. The purpose of this research was to test this theory and examine a method that could be utilised in practice. The application will likely take time to be adopted and when it is, it may well be refined. Further improvements to technology and data will reduce its limitations. This does not lessen the importance of testing the theory and presenting the results.

The first recommendation of this research is that valuation practitioners undertaking agricultural land valuation instructions should consider utilising this model to provide supporting evidence for their valuation. This recommendation does not mean the DCF method should replace the comparable method of valuation. The research recognises the economic theory that, in perfect market conditions, the comparable method of valuation remains the best method of estimating the market value of agricultural land. However, the DCF approach provides an additional tool to explicitly state the rationale for arriving at the value of the land. This is a more theoretically justifiable method than the comparable method which is simply that: "As this land sold for that price, so your land should sell for this."

Also, the comparable approach fails to consider the asset's intrinsic value. It may therefore influence expectations of actors in the market and so contribute to the asset price "bubbles." Further studies about how the DCF method may be used to investigate this may provide additional insights.

If this model is used in practice, a detailed explanation of all its inputs and assumptions should accompany the valuation. In this study, the results of the model reconciled with the price but this was due to the availability of data. This should also occur in practice, though it is unlikely to be the case. In practice, valuers should dual report results from the analysis before arriving at their individual opinions of market value, based on a considered rationale.

To conclude this chapter, it is acknowledged that these models are just mathematical approximations of complex real-world scenarios. It is not currently possible, nor is it likely in the future, to exactly replicate the thought process of the aggregate population of participants in the agricultural land market in Ireland. While these limitations are acknowledged and should be considered alongside the findings from this study, it is nonetheless argued that the DCF model proposed can provide supportive evidence in the estimation of market value of agricultural land in Ireland.

Chapter 6: Conclusions and Recommendations

6.1   Introduction

This conclusion chapter, drawing on Sampson (2017), summarises and brings together the main parts of the thesis. It also contains an assessment of the significance of the findings and makes recommendations for future work. This chapter and the thesis end with some conclusions and reflections on the research.

6.2   Restatement of aim, objectives and primary research question

The aim of this investigation was to provide insights into the valuation of agricultural land in Ireland and to assist practitioners to make informed decisions. More specifically, this study set out to evaluate the effectiveness of the DCF method in providing supporting evidence for use in the estimation of market value of agricultural land.

The research aim was achieved and the research question answered by provision and attainment of the four study objectives.

These were:

- To improve the availability and accessibility of agricultural land market data in Ireland.
- To identify alternative methods of valuing agricultural land that are compatible with established economic theories, practitioners' bases of value, the historical context, and other relevant factors.
- To assess the accuracy of the selected method(s) in providing supportive evidence for use in the estimation of the market value of agricultural land in Ireland.
- To determine the most appropriate methods for the valuation of agricultural land in Ireland.

6.3   Critical review

The critical review summarises the analysis of the study, assesses the significance of its findings, and makes recommendations about future work.

An early product of the research was the identification of a lack of availability and accessibility of agricultural land market data in Ireland. This is a significant problem for

practitioners, as it limits the transparency of the market and the reliability of valuation techniques, such as the comparable method.

It is also a problem for academics. This study found that a range of academics (ESRI, 1999; Kelly, 1981) had independently identified the lack of a reliable and long-run dataset of agricultural land prices as a barrier to testing theories. This led to the construction of first the objective in this thesis, of improving the availability and accessibility of agricultural land market data in Ireland. This was achieved by the compilation of the Smith Harrington agricultural land sales and rental database.

The construction and publication of the dataset can be considered a contribution to knowledge. The DIKW hierarchy, referred to, *inter alia*, as the "knowledge pyramid", is a widely recognised model in the information and knowledge literatures (Rowley, 2007). This established tool has been employed in this research to classify the steps from data to information, knowledge and wisdom.
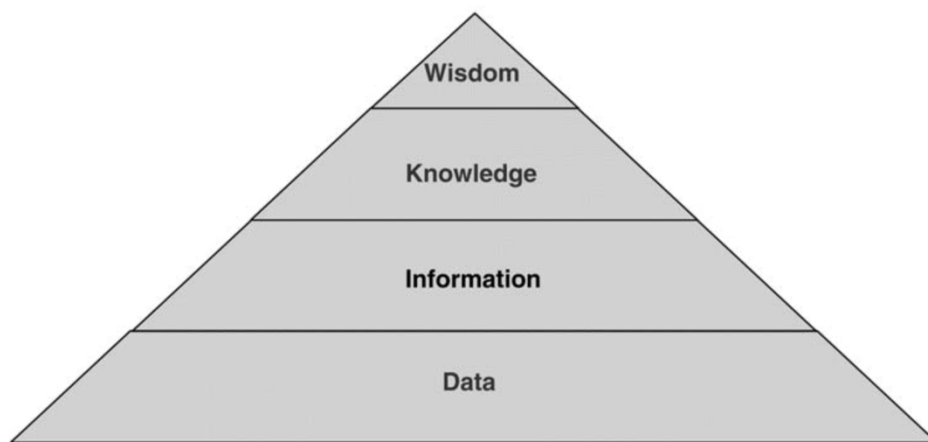
Figure 6.1: The DIKW Hierarchy (Rowley, 2007)

There are differing definitions of the four stages of the DIKW hierarchy (see table 6.1 below). Ackoff belived that "data are defined as symbols that represent properties of objects, events, and their environment" (Ackoff, 1989 as cited by Rowley, 2007, p.136). In the current study the entries in the book keeper's journals could be classified as the symbols which represent the sales and lettings of agricultural land as the events.

	Zeleny [34]	Ackoff [1]
Data	Know nothing	Symbols
Information	Know what	Data that are processed to be useful; provides answers to who, what, where and when questions
Knowledge	Know how	Application of data and information; answers how questions
Understanding		Appreciation of why
Wisdom	Know why	Evaluated understanding
Enlightenment	Attaining the sense of truth, the sense of right and wrong, and having it socially accepted, respected and sanctioned	

Table 6.1 Comparing Ackoff's and Zeleny's definitions of data, information, knowledge and wisdom (Rowley, 2007, p.167)

Ackoff defined information as data that has been processed into a functional use. In the current study this stage of the process may be classified as the physical act of transcribing data from the original book keeper's journals to Excel sheets. The classification of this data requires a thought process. This involved ordering the data into date, size (acres, roods and perches[36]) and price paid (pounds, shillings and pence). The raw data (symbols) could then be decimalised, converted to euro, and the price per acre established. In establishing the price per acre of individual lots and subsequently average annual rate per acre the data has become functional. This step, together with the sampling process to check for accuracy, transferred the raw data into information.

Influenced by the Kolb (1984) learning cycle, it took many months of abstract reflection for the researcher to consider how he could add value to this information. He sourced the William B. Fitt dataset, which allowed him to validate the data. It could then be established that the dataset was likely to be an accurate and valid representation of agricultural land sale and rental values for Meath over the period. It also allowed a check on its representativeness of agricultural land values for Ireland over this period.

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[*] One acre is traditionally defined as the area of one chain by one furlong (66 by 660 feet), which is exactly equal to 10 square chains or 43,560 square feet and approximately 4,047 square metres. A rood was one quarter of an acre and a perch was one fortieth of a rood. Decimalised acres is the unit of comparison selected for this thesis. This is partly for ease of analysis as set out above. The rationale for use of acres is that it is the unit of comparison still used in practice by valuers. As a profofessional doctorate thesis this was preferred over hectares.

No other comparable long-run maintainable database exists for Ireland. This contribution will provide insights and be valuable to both practitioners and academics. It is a valuable doctoral objective and a contribution to knowledge has been achieved.

While this has been a positive development, efforts are needed to continue to improve the availability and access to data. The recent work from the CSO in this area is welcome. When enough data is available from the CSO, an analysis of the newly published Smith Harrington dataset, together with the CSO data, will be welcome. Should this show sufficient correlation, it would further enhance the availability of data for long-run studies of the market and the testing of theories.

A crucial part of the process of achieving the aim and latter objectives of this study was presenting the alternative methods of valuing agricultural land that were compatible with established economic theories, practitioners' bases of value, the historical context, and other relevant factors. The critical analyses and overlap of these theories have been central to contextualising the results and findings of this research. While it is not necessary to restate the summary of findings, they are referenced here in the analyses of Objectives 3 and 4.

Objective 3 of this research was "To assess the accuracy of the selected method(s) in providing supportive evidence in the estimation of the market value of agricultural land in Ireland." This objective links with the research question, "Can the DCF approach provide supportive evidence for valuers in estimating the market value of agricultural land in Ireland?" and consequently Objective 4, "To determine the most appropriate methods for the valuation of agricultural land in Ireland." The results and discussion of these linked objectives and research question have already been described. Conclusions from the investigations into these objectives are set out below.

Firstly, it has been demonstrated that the DCF model proposed within this study can provide supportive evidence in the estimation of the market value of agricultural land in Ireland.

A key strength of this study was the reliability of the data, which has been published as part of this thesis. While the publication of the dataset improves the availability and accessibility of agricultural land market data (sales, rentals and yields), it is unlikely that a practitioner will have access to similar levels of market data on the parcel of land being valued. Therefore, a

practitioner should not anticipate the same levels of data availability or accuracy as those demonstrated in this study. The valuer should draw on all relevant sources and analyse them thoroughly, before using them.

Secondly, while this study has highlighted the accuracy of the DCF method when appropriate data is utilised as inputs to the model, it is also important to reflect on what the input data represents, and perhaps more importantly, what it does not represent. The theory employed in the practitioner model to determine the growth in the respective rental and income input data into the model is drawn from the investment paradigm. Gitman, as cited by Baum and Crosby (2008), notes that the desire for shelter or a place to do business or to enjoy recreation may be contrasted with a desire for a vehicle into which funds can be placed, with the expectation that they will be preserved or increased in value and/or generate positive returns. The literature review noted that cultural factors are important in the operation of the Irish land market. Monetary returns are not likely to be the sole driver of price.

However, it was not the purpose of this study to determine if returns were the sole driver of the price of land. It was hypothesised that the entry of younger more educated market participants could change the significance of "non-economic" factors in the land market. This would mean that the DCF method would have increased usefulness, when used by experienced practitioners. It could assist them in forming opinions of value of agricultural land.

The theory referred to above is the implied annual growth model, shown in Figure 6.2 below. This model projects cash flows for the inputs into the DCF model. In doing so, it tests DCF theory in the context of agricultural land. It is worth critically analysing these cash flows (inputs) in the cultural context outlined in this thesis.

$$(1 + g)^t = \frac{YP\ perp.\ @\ k - YP\ t\ years\ @\ r}{YP\ perp\ @\ k * PV\ t\ years\ @\ r}$$

WHERE:		
K =	Capitalisation rate	From Smith Harrington dataset
T =	Review pattern	From Smith Harrington dataset (1)
R =	Market discount rate	From Smith Harrington market discount rate series
YP PERP. @ K	Years Purchase into perpetuity at capitalisation rate	$\dfrac{1}{k}$
YP T YEARS @ R	Years purchase for the number of years in the review pattern at the discount rate	$\dfrac{1 - (1 + r)^{-t}}{r}$
PV T YEARS @ R	Present value for the number of years in the review pattern at the discount rate	$(1 + r)^{-t}$

Figure 6.2 Implied annual growth rate formula[37]

The literature review found that the cultural context is important in valuations and that "willing purchasers" and "willing sellers" (market participants) in the agricultural land market have traditionally found utility in factors other than cash flows. The results from the DCF model show an almost perfect relationship between the output from the model and the sale prices achieved. However, this does not confirm a cultural shift, such that market participants now solely rely on cash flows when determining the value of agricultural land.

The key element of this formula is k, the capitalisation rate or yield. In analysing the market data to arrive at the yield (k), the researcher or practitioner is assessing what growth the

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[37] The above implied annual growth rate formula is the practitioner version proposed by Baum and Crosby (2008). This was utilised, as this model is aimed at practitioners.

market price implies. This implied growth, by the market, includes both economic and non-economic growth, monetised for assessing the utility or market value of the lands. In other words, a researcher or practitioner can imply the theoretical growth in cash flows that the market is projecting by using this model. This includes the utility market that participants intrinsically project by their purchases for both economic and non-economic (meaning non-monetary), reasons. It may therefore be classified as the utility rent for the asset.

The utility rent concept builds on the review of literature, drawing on McGrath (2011), who highlighted that land owners were more willing to rent their land than sell it. The literature also indicated that in Ireland, purchasers, the other market participants, preferred to purchase land than rent it. Therefore, the cash flow to estimate the market value of the land should reflect the utility rent implied in the practitioner model used to estimate the market value of land.

The utility rent has some likeness to Ricardo's economic rent, in that it incorporates the economic rent. It may also differ from the market rent paid. However, this is where the similarities end. The utility rent differs from the actual, or market rent, because it also includes the non-economic utility attributed by market participants to owning, rather than renting, the land. Some may therefore prefer to refer to it as the utility cash flow. For the purposes of this study, it is called "utility rent."

The utility rent may be more closely related to the concept of imputed rent. The imputed rent is an estimate of the rent a house owner would be willing to pay to live in his or her own house. In this respect, the concepts are similar. However, imputed rents refer to the implied rent of the owner occupier and market rents are used to estimate the value to the property owner. The utility rent in this study reflects the utility obtained by both parties' utility from owning the asset. In this respect, utility rent is more suited to assessing market value than imputed rent.

Actual rent[38]	The rent paid in the market by a tenant to rent the land from the landlord.
Market rent	An estimate of the market rent.[39]
Economic rent	The amount by which proceeds received exceed the minimum amount that would have been necessary to evoke the supply of the factors of the production required.
Imputed rent	An estimate of the rent of an asset that the owner would be willing to pay to own that asset.
Utility rent	A cash flow implied by market transactions to estimate the market value of the asset.[40]

Table 6.2 Rent classifications: An overview

The relevance of the utility rent supports the finding that it is possible to imply growth from analysing the market for agricultural land to estimate the market value of agricultural land. This was not thought possible in the agricultural market in Ireland prior to this study.

The value of estimating this utility rent is significant. While it allows the valuers to estimate the market value of agricultural land, it presents additional mechanisms for testing for bubbles in the agricultural land market.

A study could, for example, be designed to compare the implied growth of incomes from the market to the FAPRI data for the value of agricultural output and costs. If the implied growth from the market were significantly in excess of the FAPRI data (projected income growth), it might suggest that land was trading in excess of its intrinsic value and could therefore suggest the onset of a price "bubble," or at least that agricultural land was "overvalued." Conversely, in times of recession, implied growth below FAPRI projections could suggest that land is "undervalued."

This may draw on imputed rent theory and/or Gordon's growth model to assess asset values. While the utility rent may be anticipated to exceed economic rent, for the reasons outlined, this thesis also argues that the gap should be narrowing. This would be due to the changing mindsets of the market participants. The history outlined becomes of less importance in the decision-making process of future generations of market participants. If the gap widens, this

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[38] See also exchangeable price, Chapter 2, for full definition.
[39] See Chapter 2 for full definition.
[40] See Chapter 2 for full definition.

may raise concerns. Estimation of simple standard deviation and statistical analysis could provide indications of potential overvaluation and undervaluation of the asset.

This may be triangulated with the FAPRI model, which studies the output of such a model previously referenced. For example, pilot studies undertaken as part of this research examined the intrinsic value (worth) of agricultural land. This study has shown that, during the period of 2003-06 (a period of economic boom in Ireland), market prices significantly exceeded the net present values per acre (see Figure 6.3 below). The excesses during this period are unlikely to be attributable to cultural factors alone, as they are "out of line" with the remainder of the study period.
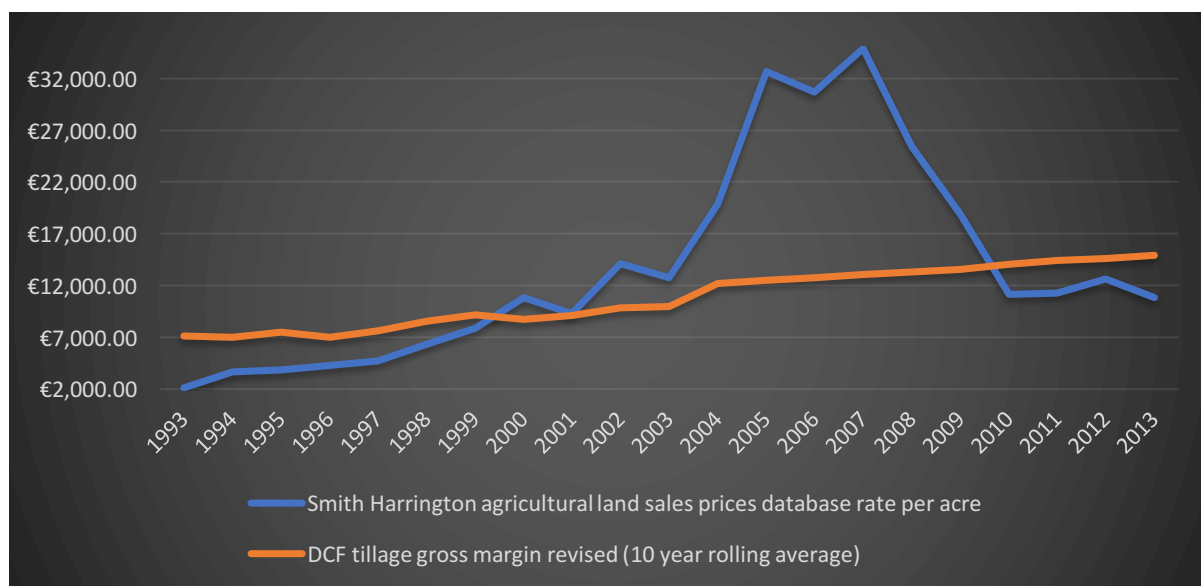
Figure 6.3: Pilot study[41] **showing an early model to investigate intrinsic value of agricultural land based on gross margin (tillage) data 1993-2013**

The above model needs refinement, but for discussing a future study, this demonstrates that the price of land exceeded the intrinsic value of the asset, based on its economic value, only during the period of 2003 to 2009. While, for the reasons previously discussed, this would be expected, further statistical analysis may demonstrate a point where an asset bubble occurred.

A practical example of the reason such an investigation of this phenomenon may be of interest in practice would be in the provision of secured lending. Banks, probably employing

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[41] This pilot study to investigate the intrinsic value of the asset.

valuers, may decide to employ a DCF model to assess the worth of the asset when assessing its appropriateness for use as security on a loan. An obvious conclusion for banks would be not to lend money (on a medium- to long term-basis), with land as security based on the market prices, even if the comparable analysis were to substantiate these market levels. These pilot studies, while presented as part of the earlier submissions as part of the professional doctorate process, have not been included in this submission, as they had significant limitations. Nevertheless, these results provide ideas for future research.

Refining and testing a model to investigate the intrinsic value of agricultural land would have other potential uses. The model could still be utilised by other participants in the markets, such as farmers or investors considering a purchase or sale. A net present value for the land price that was significantly below the market price would be reason not to purchase the land. Similarly, a net present value above the market price would support a purchase. This research has provided a framework for exploration of such a study into the intrinsic value (worth) of agricultural land. Further investigation and experimentation in this area is strongly recommended.

Further research is required to better understand the breakdown of the cash flows that market participants attribute to monetary and other elements of utility. As was noted in the study, the use of FAPRI data[42] could be developed to assist a researcher in such a breakdown. This presents potential for further engagement between the valuation community and the agricultural economics community to develop the FAPRI data, to investigate this phenomenon. A model that could be developed may involve analysing the implied growth determined by the market (such as those from this study) with adapted cash flows from FAPRI data. One would expect, due to the other utility considerations outlined in this research, that the implied cash flows from the market would exceed the FAPRI projections. As has been hypothesised, a long-run study may show the utility decreasing over time, as market participants place less emphasis on cultural and historic factors and give more consideration to cash flows. Interviews with market participants may provide further insights in such a study.

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[42] For clarity, this is a separate study from the use of the FAPRI data in the asset bubble test.

Another question raised by the results of this study relates to the fluctuation of agricultural land yields. Kolbert and O'Brien (1975) identified 14 years purchase (approximately 7.14% yield) in 1880. While some of the earlier yields published as part of this study would be considered generally in line with this and other related property assets, it is interesting to note that in the 21st century, this research shows yields between 54 years purchase (1.82%) and 285 years purchase (0.35%). These results, while not unexpected due to the period being studied, are significantly out of line with traditional returns. This raises interesting questions.

Firstly, it may provide insights into why valuers and academics have been reluctant to use or even examine the DCF method in the determination of market value of agricultural land. The logic here may be that *if* agricultural land capitalisation rates are not in line with other property assets, as was found by Castle and Hoch (1982), then *any* income-based technique, whether implicit or explicit, could not be employed. Rather, the comparable method is more appropriate.

While the publication of the dataset supports the various researchers, such as Castle and Hoch (1982), who found there were periods where agricultural land was out of line with other asset classes, this research also highlighted that this is line with theory. Table 2.5 noted that the yield is made up of several components (see Table 2.5 or Figure 6.4 replicated below for reference). As highlighted by Baum's yield equation (which itself is a development of various academic theories including that proposed by Brown, (1986)), there is a link between yields, the discount rate, and income growth.

$$k = RFR + r - g + d$$

Where:
k = capitalisation rate
RFR = Risk-Free Rate
r = discount rate
g = net income growth
d = depreciation

Figure 6.4: Baum's yield equation for property (Baum, 1988)

Developing this, drawing on Clarke (1973), the literature highlighted that agricultural land,

assuming good husbandry, does not depreciate as much as a typical property in the investment market. Therefore, one would expect lower yields.

In addition to this insight, it is important to note that fluctuating yields do not prohibit the use of explicit valuation techniques, such as the DCF. In the same paper, Brown (1986) notes that the expected value of a property is a function of expected income, return and growth, or alternatively the latter two combined to give a yield, all subject to a subset of information.

Therefore, it is theoretically consistent to draw on the implied rental growth model to imply growth to rental (or other income) data, once the capitalisation rate, discount rate and review pattern are known, as shown in Figure 6.2 above. Thus, it is theoretically appropriate to use the DCF method, applying the model employed in this study, to estimate the market value of agricultural land. The results of this research support this hypothesis.

Secondly, the yield fluctuations raise further questions about potential boom and bust periods in the agricultural land market. Figure 6.5 highlights a rise in prices achieved for land sales, while rents remained relatively stagnant. This provides additional support for a future study of the intrinsic worth of agricultural land.
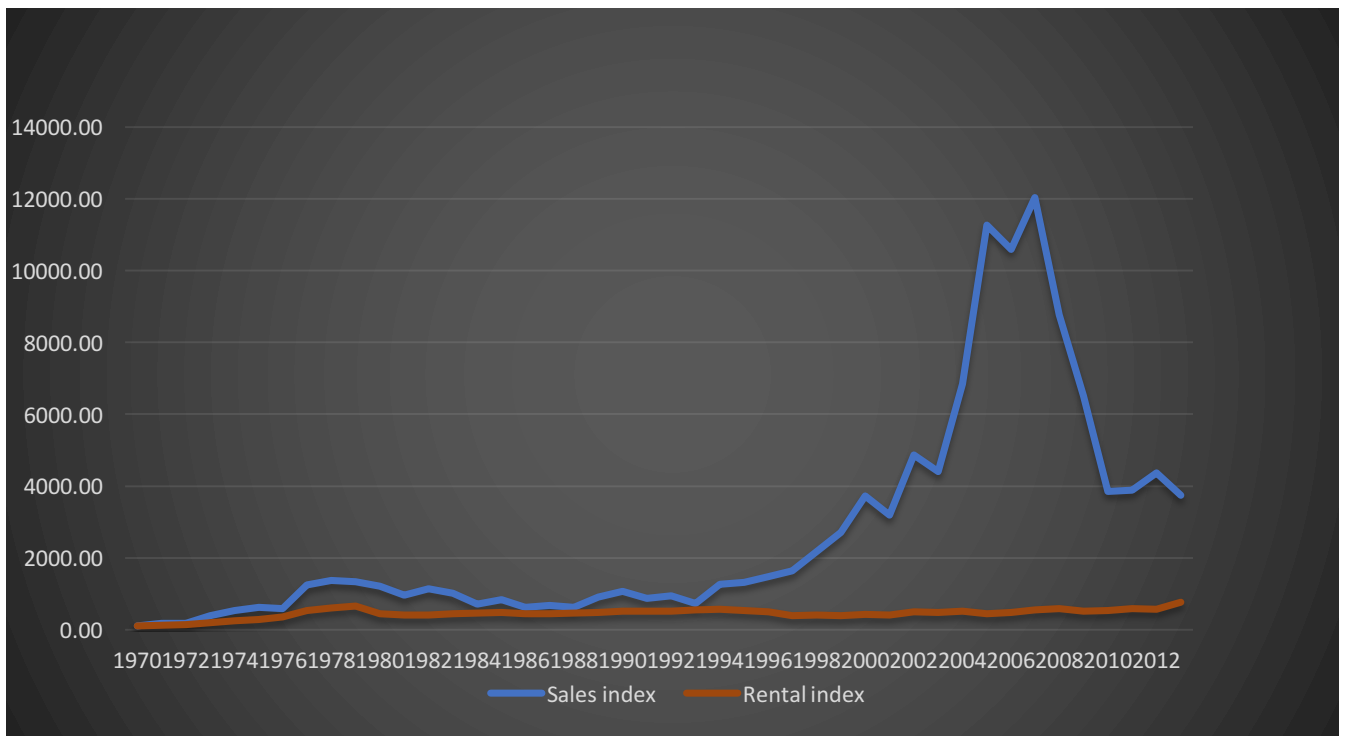
Figure 6.5: Graph showing Smith Harrington sales and rental data 1970-2013

Chapter 4 presented the correlation between the sales and rental datasets for the entire study period (shown below in table 6.2 for reference).

	SMITH HARRINGTON AGRICULTURAL LAND SALES PRICES RATE PER ACRE	SMITH HARRINGTON AGRICULTURAL LAND RENTAL PRICES RATE PER ACRE
SMITH HARRINGTON AGRICULTURAL LAND SALES PRICES RATE PER ACRE	1	
SMITH HARRINGTON AGRICULTURAL LAND RENTAL PRICES RATE PER ACRE	0.336	1

Table 6.2: Correlation between Smith Harrington sales and rental data 1970-2013

Table 6.3 however presents the correlation between sales and rental prices during the period between (1970 and 1993). The contrasting correlation results are clear.

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	SMITH HARRINGTON AGRICULTURAL LAND RENTAL PRICES DATABASE RATE PER ACRE	SMITH HARRINGTON AGRICULTURAL LAND SALES PRICES DATABASE RATE PER ACRE
SMITH HARRINGTON AGRICULTURAL LAND RENTAL PRICES DATABASE RATE PER ACRE	1	
SMITH HARRINGTON AGRICULTURAL LAND SALES PRICES DATABASE RATE PER ACRE	0.860	1

Table 6.3: Correlation between Smith Harrington sales and rental data 1970-2013

While not conclusive, these contrasting results further support the call for a more detailed investigation of the fluctuation of yields and long-run trends in the market. In particular, they support the view that an investigation into the intrinsic value (worth) of agricultural land in Ireland over the long-run may provide insights for theory and practice.

This research has demonstrated how market discount rates and implied growth can be determined to estimate the market value of agricultural land. Future research may be able to build on this model. A model could be developed to determine if land is over or undervalued, given market conditions. It may therefore be suggested that the method which observers were reluctant to use due to unprecedented market conditions could be a useful tool for the analysis of such markets.

6.4   Final reflections and conclusions

This section sets out some of the main conclusions from the research. While there will inevitably be some overlap with the previous section, repetition has been avoided, where possible. Also, as the rationale for this research emerged from a process of reflection on practice, it seems appropriate that the research should conclude with reflections on the research.

The following conclusions have been drawn from this research.

Firstly, this thesis has provided a deeper insight into the valuation of agricultural land in Ireland than has been published previously. It has presented new data and a methodology for estimating the market value of agricultural land in Ireland that may be adopted in practice. This should assist practitioners and provide the base for future academic studies. In doing so, it has addressed the aim of the thesis, which was to provide insights into the valuation of agricultural land in Ireland and assist practitioners to make informed decisions.

More specifically, in addressing the question posed in the title of the study,[43] it is now possible to state that the DCF model proposed within this study can provide supportive evidence in the estimation of the market value of agricultural land. The previous section has highlighted some of the limitations of the model. These limitations should be considered, along with this conclusion.

The DCF method may be useful to valuation practitioners operating in the Irish land market. It should assist them in providing more informed advice to clients. However, this research does not advocate, or permit, the conclusion that the use of the DCF method should be used in preference to all other methods. The literature highlighted that where there are enough comparable transactions, the comparable method is often the best method to estimate:

> the amount for which an asset or liability should exchange on the valuation date between a willing buyer and a willing seller in an arm's length transaction after proper marketing and where the parties had each acted knowledgeably, prudently and without compulsion (IVSC 2013; RICS 2014; TEGoVA 2012).

This thesis also highlighted that these liquid and transparent market conditions are not always, and often seldom, present in the agricultural land market in Ireland.

A disadvantage of the comparable method that was the dated nature of the evidence upon which it relies. It looks back at what has occurred in the market place. In contrast, the DCF model looks forward. This was considered an additional strength in employing the DCF method.

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[43] Whether the DCF method can provide supportive evidence in the estimation of market value of agricultural land in Ireland.

It is difficult to factor risk, particularly changes in risk, into valuations. Risk in general, as defined by Baum and Crosby (2008), can be factored into the DCF via an adjustment to the discount rate.

New changes in markets, such as new rules or changes relating to agricultural products, can take months and even years to factor into comparable evidence. It is likely that market participants (both bidders and vendors) will take current events into account in their behaviour. This suggests that the DCF model provides a better representation of the conceptual framework set out by the IVS and professional bodies in the market value definition cited above, as it better considers what a willing purchaser will pay and what a willing vendor will accept.

Further advantages of the DCF model are likely to be more widely appreciated as the market continues to develop. Comparable analysis has its place in the market and became the dominant method, for reasons outlined in the literature review. However, this research has argued that as new market sectors develop (such as organic, intensive, utilising the land for renewable energy renewable uses), they bring their own challenges. The DCF method provides an additional mechanism to provide supportive evidence in the estimation of market value.

A practical example of this occurred to when the researcher was asked to value a dairy farm for a bank on two different assumptions. The first was to value the farm as it presently is, namely a traditional dairy farm on 140 acres. The second was based on planning permission it had received to upgrade to a modern robotic dairy farm that would be less labour-intensive. The cost of the upgrades was a significant sum. There was limited comparable sale price evidence of traditional dairy farms of that size sold in the locality. There was no comparable evidence at all for the finished robotic dairy farm that was less labour-intensive. A valuer may choose to utilise the depreciated replacement cost method, but for the reasons outlined in the literature review, this does not seem compatible with economic theories of value and practitioner's bases of value. It would appear market participants, and banks, are undertaking decisions based on cash flows.

With an even narrower pool of comparable evidence for these specialised uses, it serves to further highlight the timeliness of a study of the DCF method. In the absence of tested alternative methods to value these two different scenarios, valuers may be relying on valuation methods that are not evidence based. The application of DCF valuation is therefore recommended. But, its use must be accompanied by detailed analysis and explanation of its rationale by experienced practitioners. The practitioners need to have knowledge of the technique and market sectors before they can form valid opinions of market value, using this method.

One of the most important limitations of this study is the requirement for good data inputs. Several studies have highlighted the importance of this. Practitioners always need to be aware that, regardless of the model chosen, if garbage data is used the output will also be garbage.

Conscious of this GIGO from the outset and ensuring that assurance of the quality of the model inputs was an important part of the research process, the researcher was meticulous to ensure that the inputs used to test the model were reliable. A key strength of this study was the reliability of the data that has been published as part of this thesis. The systematic and rigorous process, which guaranteed the accuracy and validity of the data, ensured that its publication will be a valuable contribution to knowledge. It is also a source of pride to the researcher that these records may be utilised by both academic and valuation colleagues in their future work. These records were important to the researcher and generations of his family and it is hoped that their publication and presentation will ensure that they are important to the wider academic and valuation communities with an interest in such matters.

Several possible further studies have been suggested in this research, though these suggestions do not represent an exhaustive list. The researcher has highlighted that the subject area has not received enough academic attention in recent years and the data, findings and recommendations produced in this thesis present excellent opportunities for further enquiry.

In terms of the uniqueness of this research, it is acknowledged the DCF theory is not a new concept. However, the appropriate model to apply the DCF method to estimate the market value of agricultural land in Ireland was not known. Furthermore, the data was not available to test such a model.

This research analysed theory and the context to produce a relevant model. In doing so, it demonstrated, for the first time, that implied annual growth theory can be applied to the valuation of agricultural land in Ireland to estimate market value.

The literature identified that the assessment of the discount rate was a potential barrier to the use of the DCF in practice. This research identified a method to produce a discount rate and, in doing so, also extended the knowledge of the market discount rates employed by market participants in the exchange of agricultural land in Ireland during the study period.

This is the first study to firmly establish that the DCF method can be utilised to estimate the market value of agricultural land in Ireland when enough data is available.

This research has therefore addressed the issue of a lack of data in the market, developed a model, and subsequently tested the model to estimate the market value of agricultural land. It is quite a specific and under-researched area, particularly in an Irish context. This research is therefore relatively unique, makes a significant contribution to knowledge and has several practical implications.

Along with its strengths, the limitations of this study have also been acknowledged. The study has only examined the use of the DCF method to estimate the market value of agricultural land. It does not set out to estimate the intrinsic value (worth) of the land. Suggestions for future research in this area have been made and it is suggested that this study may serve as the basis for this.

The results from this research do not imply that the use of the DCF method will be as accurate in every practice situation as it has been in this study. This research has shown that the theory holds true and has provided a practical model that may be used in practice. The accuracy of the model in practice will be determined by the selection of inputs by the valuer. As noted by Brown: "each valuation is drafted in terms of expectations and is a reflection of the quality and amount of information available" (1986, p. 34). This principle still holds true.

To conclude, French (2012) notes that the crux of the DCF method is transparency. He notes that if the only question is 'what is the value?' then other models will likely be as good at

estimating the price of the property in the market (French, 2012). The DCF approach allows the valuer to provide additional information on the drivers of value of the asset. This research demonstrates how this additional information can be determined. It is one of the most significant contributions to knowledge that has emerged from this thesis.

The aim of this dissertation has remained consistent through the course of this research: "To provide insights into the value of agricultural land in Ireland." Given this aim and the philosophy underpinning the research, it was natural that the valuation method investigated was the most transparent and therefore provided the most insights into the value of agricultural land in Ireland. The process has been both insightful for the researcher and succeeded in providing more insights into the value of agricultural land than the researcher himself had envisaged at the start of this work.

One of the researcher's initial motivations for undertaking this research was to assist my fellow practitioners. In achieving the aim, objectives and testing the primary research question of this study, the researcher believes he has moved forward the body of knowledge and assisted his fellow practitioners, both academic and professional, in some small way.

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<h1 style="text-align:center">Appendices</h1>

Appendix 1: Agriculture in Ireland

Source: www.teagasc.ie

The Irish Agri-Food Industry

The agri-food sector in Ireland in 2016 generated 7% of gross value added (€13.9 billion), 9.8% of Ireland's merchandise exports and provided 8.5% of national employment. When employment in inputs, processing and marketing is included, the agri-food sector accounts for almost 10% of employment.

Contribution of the Agri-Food Sector to the National Economy

The agri-food sector is one of Ireland's most important indigenous manufacturing sectors, accounting for employment of around 167,500 people. It includes almost 700 food and drinks firms throughout the country that export food and seafood to more than 160 countries worldwide. Economic activity in the agriculture and food sector produces a far bigger return than equivalent activity in other traded sectors of the economy. That is because agri-food companies source 74% of raw materials and services from Irish suppliers, compared to 43% for all manufacturing companies.

Data from the Central Statistics Office (CSO) indicates that the agri-food sector (including agriculture, food, drinks and tobacco as well as wood processing) accounts for around 7% of Economy wide GVA with primary agriculture, forestry and fishing accounting for around 1.6% of Ireland's GVA.

Contribution of the Agri-Food Sector to GVA in 2016	€m
GVA at Factor Cost	254,715
GVA in Primary Agriculture, Fisheries and Forestry at Factor Cost	4,093
GVA in Food & Beverages Sector	9,612
GVA in Wood Processing	198
Total	**13,903**
GVA in Primary Sector as a % of Total GVA	1.6%
GVA in overall Agri-Sector as a % of Total GVA	7%
Source: Eurostat National Accounts aggregates by industry nama_10_64	

Employment in the Agri-Food Sector
Composition of Employment in the Agri-Food sector, 2017
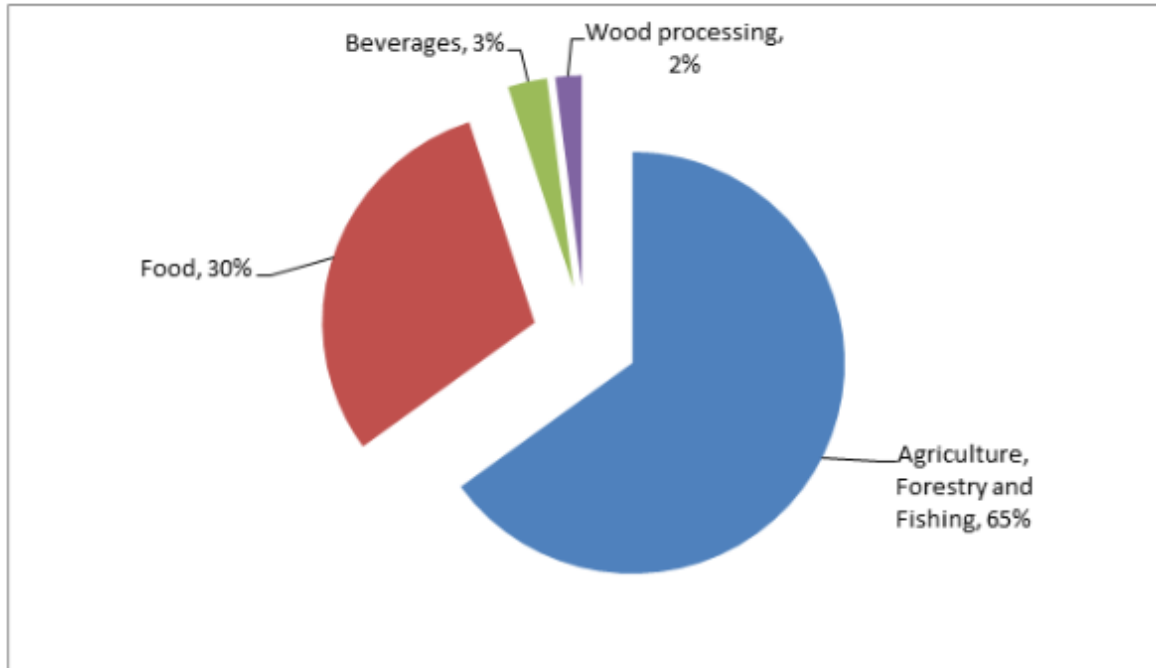
Source: CSO Labour Force Survey 2017

Agri-Food Exports
Agri-food exports account for over 11% of total Irish merchandise exports. However, when the low import content of agriculture and food exports and the low repatriation of profits earned in the agri-food sector are taken into account, it is estimated that the agri-food sector accounted in 2008 for around 40% of net foreign earnings from merchandise exports.
Irish food and drink exports grew dramatically in 2017, increasing by 11.6% and were valued at a record €12.7 billion. Since the period 2007-2009 the value of Irish agri-food exports has increased by over 61%.

Agri-Food Exports 2016-2017

Ireland Agri-food Exports 2016-2017				GB + NI
	All Destinations		GB + NI	% of Total
SITC Section (1 digit) and Division (2 digits)	2016	2017	2017	2017
	EUR million			
0 Food and live animals	10,096	11,360	4,607	41%
00 Live animals other than animals of Division 03	340	447	329	74%
01 Meat & meat preparations	3,596	3,844	1,929	50%
02 Dairy products and birds' eggs	1,760	2,396	836	35%
03 Fish, crustaceans, molluscs and preparations thereof	555	611	60	10%
04 Cereals & cereal preparations	381	416	373	90%
05 Vegetables & fruit	278	299	250	84%
06 Sugars, sugar preparations & honey	212	159	50	32%
07 Coffee, tea, cocoa, spices & manufactures thereof	374	367	245	67%
08 Feeding stuff for animals (excl unmilled cereals)	296	281	212	73%
09 Miscellaneous edible products & preparations	2,317	2,498	300	12%
of which Infant food	1,284	1,291	134	10%
1 Beverages and tobacco	1,310	1,330	289	22%
11 Beverages	1,275	1,326	289	22%
Total food and live animals and beverages	11,371	12,686	4,896	39%
Source: Eurostat COMEXT				

Land Use and Farm Structure
- Irish agriculture is primarily a grass-based industry.
- The Census of Agriculture 2016 showed there were 137,500 farms compared to 139,860 farms in the 2010 Census of Agriculture.
- The utilised agricultural area has declined marginally since the 2010 Census of Agriculture to 4,886,600 hectares. The average size of agricultural holding also decreased to 32 ha.
- Approximately 84% (4.09 million ha) of agricultural area is devoted to grass (silage, hay and pasture), circa 9% (0.44 million ha) is in commonage and rough grazing and the remainder circa 9% (0.35 million ha) is allocated to cereals and other crop production.
- There are approximately 137,500 family farms in Ireland with an average size of 32.4 hectares per holding according to the Farm Structure Survey of 2016.

Number of farms and utilised agricultural area, Farm Structure Survey 2016

Number of farms and utilised agricultural area in 2010 and 2016			
	2010	**2013**	**% Difference**
Number of farms	139,860	137,500	-1.7
Utilised agricultural area excluding commonage (hectares)	4,991,353	4,886,600	-2.1
Average farm size (hectares)	**32.7**	**32.4**	**-0.9**

Main Commodities Output and Exports
Output, Input and Income in Agriculture, 2017
The CSO currently estimates that the operating surplus in agriculture in 2017 increased by over €800m on the level recorded in 2016, a dramatic 31% increase. This very large increase was largely due to a very large increase in the value of agricultural output and relatively stable levels of expenditure on inputs.
Comparing 2017 with 2016 we see that the value of goods output increased largely as a result of large increases in the value of milk output , while subsidy receipts and expenditure on inputs (intermediate consumption remained largely stable).
- Goods output at producer prices: +14% or €992m
- Milk output: 45% or €809m
- Cattle output: 3% or €72m
- Pigs output: 11% or €50
- Sheep output: 3% or €7m
- Cereals output:3% or €6m
- Total intermediate consumption: 4% or €178m
- Fertilisers: 0.4% or €2m.

The value of subsidies less taxes increased by 2%, from €1,608 m in 2016 to €1,637m in 2017.

- The contribution of Primary Agriculture, Fisheries and Forestry (AFF) to the Irish economy in 2017, at 1.2% of GDP, is close to the EU average. Standard macroeconomic measures of the size of the economy (GDP, GNP, GNI) may overstate the size of the Irish economy due to the effect of globalisation. When the size of the economy is measured using the CSO aggregate GNI* that adjusts for these effects the share of the economy accounted for by AFF in 2017 is 1.9%.

- Beef and Cattle production dominate the Irish agricultural economy. Milk and beef output accounted for over 61% of agricultural goods output at producer prices in 2017.

In terms of the destination of Irish food and drink exports in 2017, the United Kingdom at around 38% remained the principal market with sales of €5.2 billion. Continental EU markets account for 30% of food and drink exports with a combined value of almost €4 billion.

Ireland in 2016 net exports of beef accounted for 85% of production, making Ireland the largest beef net exporter in the EU and fifth largest in the world.

Cattle and Beef
- There were 6.7 million cattle in Ireland according to the 2017 December livestock survey, this represents a 1% increase on the 2016 level.
- Irish beef production is predominately a grass based system, with 617 thousand tonnes produced in 2017.
- In 2017, Ireland exported an estimated 537 thousand tonnes of beef worth approximately €1.85 billion.
- In 2017, 189,000 cattle were exported live from Ireland worth approximately €100 million.

Sheep and Sheep meat
- The December 2017 livestock survey indicates that the Irish sheep flock numbered 3.9 million head, with a breeding flock of 2.7 million head.
- During 2017, Ireland exported an estimated 62,000 tonnes of sheep meat which was valued at approximately €284 million.
- France is the main market for Irish sheep meat exports, accounting for approximately one third of total exports in 2017. The UK is also a substantial export market, accounting for almost 19% of exports.

Pigs and Pig meat
- In the December 2017 CSO Livestock Survey there were 1.6 million pigs in Ireland, this represents an increase of almost 6% on 2017 levels.
- In 2017, Ireland exported an estimated 240,000 tonnes worth approximately €792 million.
- In 2017, the non-EU markets accounted for over one third 0f Irish pig meat exports with, the UK accounting for around 60% of the value of exports with the balance deriving from exports to continental EU markets.

Dairy
- In 2017, total milk output (incl. imports) was estimated at 8,075 million litres.
- From this total milk output, 540 million litres was consumed as liquid milk. In addition to this 223,700 tonnes of butter were produced in 2017.
- In 2017, the total value of dairy exports grew by almost 18% over the 2016 value to over €4.6 billion

Agri-Food Sector contribution to the Irish Economy
The agri-food sector makes a very significant contribution the Irish economy. The Annual Business Survey of Economic Impact (ABSEI) for 2016, conducted by Department of Business, Enterprise and Innovation, provides aggregated estimates for all Irish-owned and foreign-owned firms across a range of variables. As part of this survey, Forfás collates data on Irish Economic Expenditure (IEE), taken to consist of wages, Irish raw materials and Irish services. An analysis of expenditures by companies operating in Ireland highlights the close ties the FD sector in Ireland retains with the national economy in terms of IEE as compared to manufacturing in general.

Irish Economic Expenditure accounts for 70% of total expenditure in the FD sector. This compares favourably to the manufacturing sector when taken as a whole, where the equivalent rate of IEE is 38%.

National Farm Survey 2017
In 2017 861 farms participated in the Teagasc National Farm Survey (NFS), these farms are weighted to represent a national population of approximately 84,599 farms. Overall 2017 was a a good year for farming with average farm income up 32%on 2016. Average family farm income in 2017 is estimated at €31,412.
- In 2017 the average value of gross output increased strongly due largely to a large increase in the Irish milk price and higher milk deliveries.
- Overall farm systems input expenditure increased in 2017 with a 2% increase in overhead costs and a 4% increase in direct costs of production.
- Farming in 2017 continued to be reliant on subsidies, subsidies accounted for over 56% of family farm income on average in 2017.
- The strengthening recovery in wider Irish economy and labour market was reflected in a 2% increase in the proportion of farm households with an off-farm employment income source.

Overview of the dairy farm system

There were approximately 15,639 Dairy farms with an average income of €86,059 in 2017. FFI in 2017 was 65 percent higher than in 2016 due to higher milk prices and increased deliveries. Milk prices increased significantly in 2017, with average prices recorded by the Teagasc NFS in 2017 32% higher than in 2016. The positive impact of higher prices on the value of Irish dairy farm output was augmented by ongoing expansion of production in 2017. In 2017 milk production per hectare on the average Irish dairy farm increased by 2%

Figure 8. Components of family farm income on dairy farms 2016 & 2017
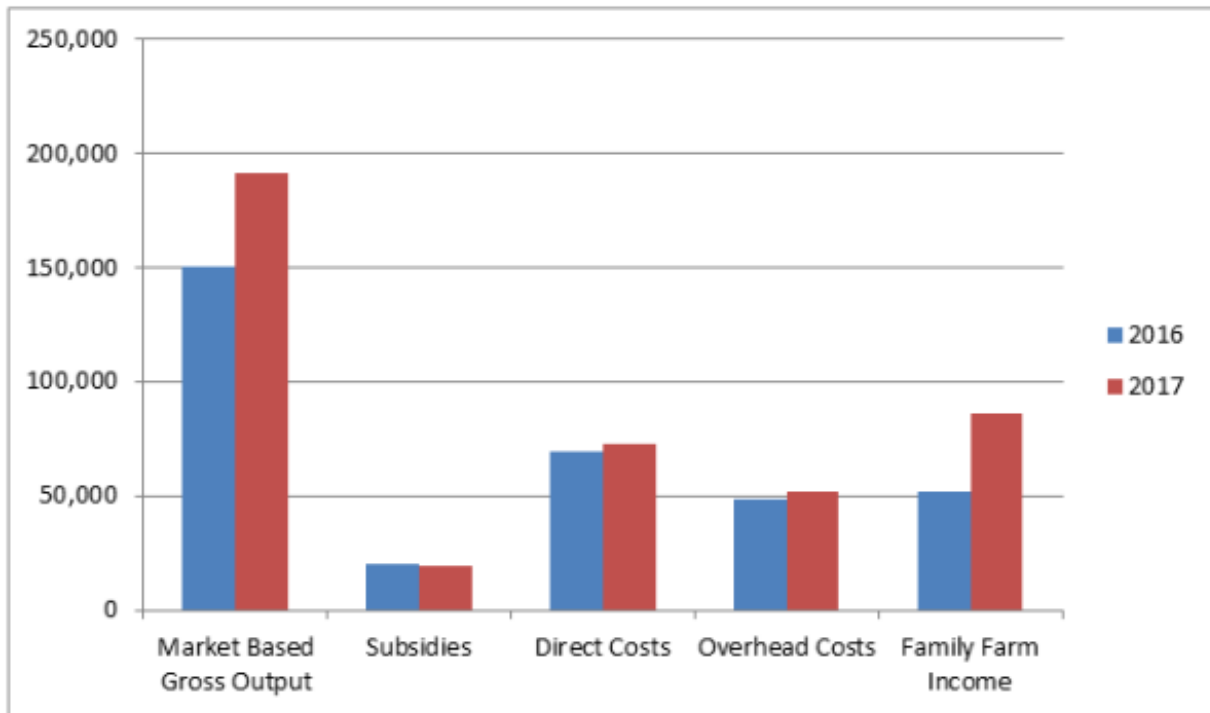
Overview of the cattle rearing system
There were approximately 19,952 cattle rearing farms represented in the NFS in 2017,
suckler cow production is the dominant system on these farms.
The value of output on these farms grew in 2016 due largely to improved cattle pricesin
2017. The value of direct payments on Cattle Rearing farms was mareginally lower (-1%) on
the level 2016 level.

Total costs of production in2 017 were 6% higher than in 2016 with both direct costs (+7%)
overhead costs (+6%) up strongly. The family farm income earned on the average cattle
rearing farm was largely unchanged relative to 2016 with growth in output value offset by
higher costs of production.

Figure 9. Components of family farm income on Cattle Rearing farms 2016 & 2017
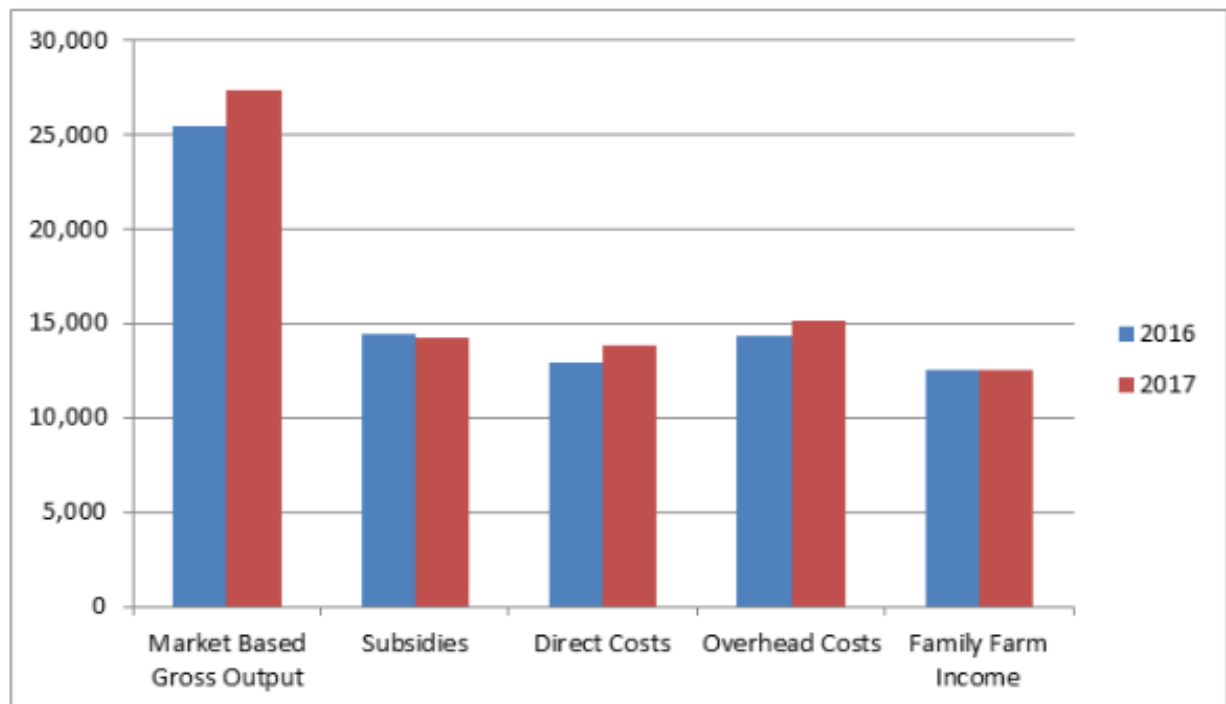
Overview of the cattle other system
There were approximately 27,025 Cattle Other farms represented in the 2017 Teagasc NFS, with an average income of €17,199 in 2017, a 2% increase on 2016. Cattle fattening is the dominant enterprise on these farms.

The value of output increased on these farms increased due to marginally higher finished cattle prices and increased production volumes. The value of direct payments was up 1% on 2016. Input expenditure was 3% higher in 2017, with direct costs up significantly on 2016 (+5%) while overhead costs increased by only 1%.

Figure 10. Components of family farm income on cattle other farms 2016 & 2017
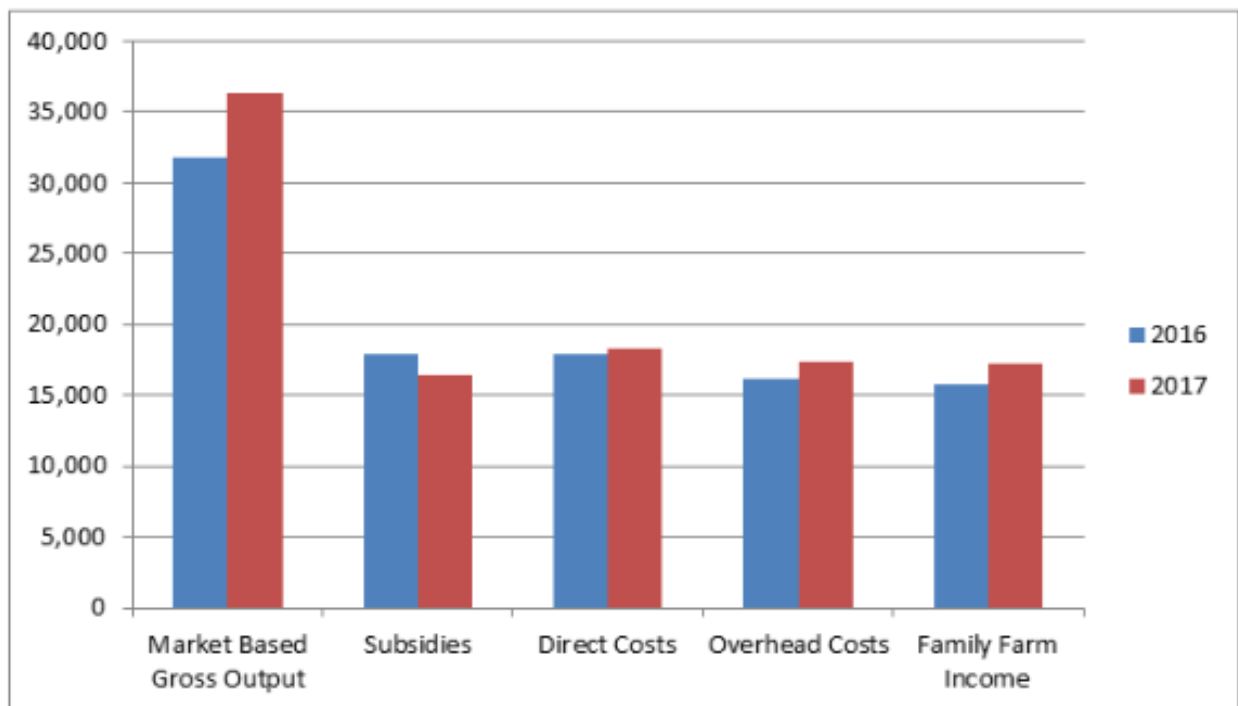
Overview of the sheep farm system
There were approximately 12,758 Sheep farms with an average income of €16,586 in 2016, a
6 percent increase on 2016.

Total farm gross output was largely unchanged Sheep farms, despite a 2 percent increase in
Lamb prices.. Overall input expenditure on Sheep farms was lower in 2017 with direct costs
of production significantly lower (-6%) while overhead costs of production grew modestly
(+2%).

Figure 11. Components of family farm income on sheep farms 2016 & 2017
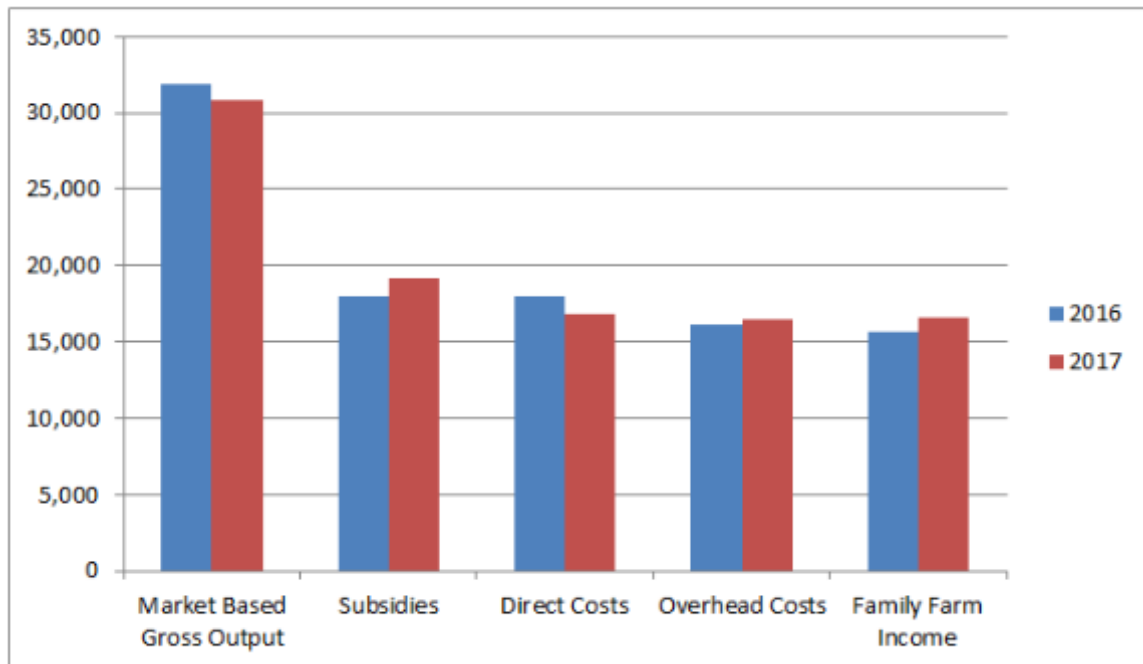
Overview of the tillage system

There were approximately 7,387 Tillage farms with an average income of €37,028in 2017, a 20 percent increase on 2016.

Gross output value on Tillage farms was lower in 2017 despite higher prices and yields. The decline in cereals area on irish tillage farms was reflected in lower output value. The reduction in area planted and harvested was also reflected in lower levels of levels input expenditure.. Both overhead costs and direct costs of production declined significantly on Tillage farms. Total costs declined by 14% on 2016 levels. With the decline in costs of production on the average Irish tillage farm exceeding the decline in the value of output, average family farm income in 2017 increased by 20%.

Figure 12. Components of family farm income on Tillage farms 2016 & 2017
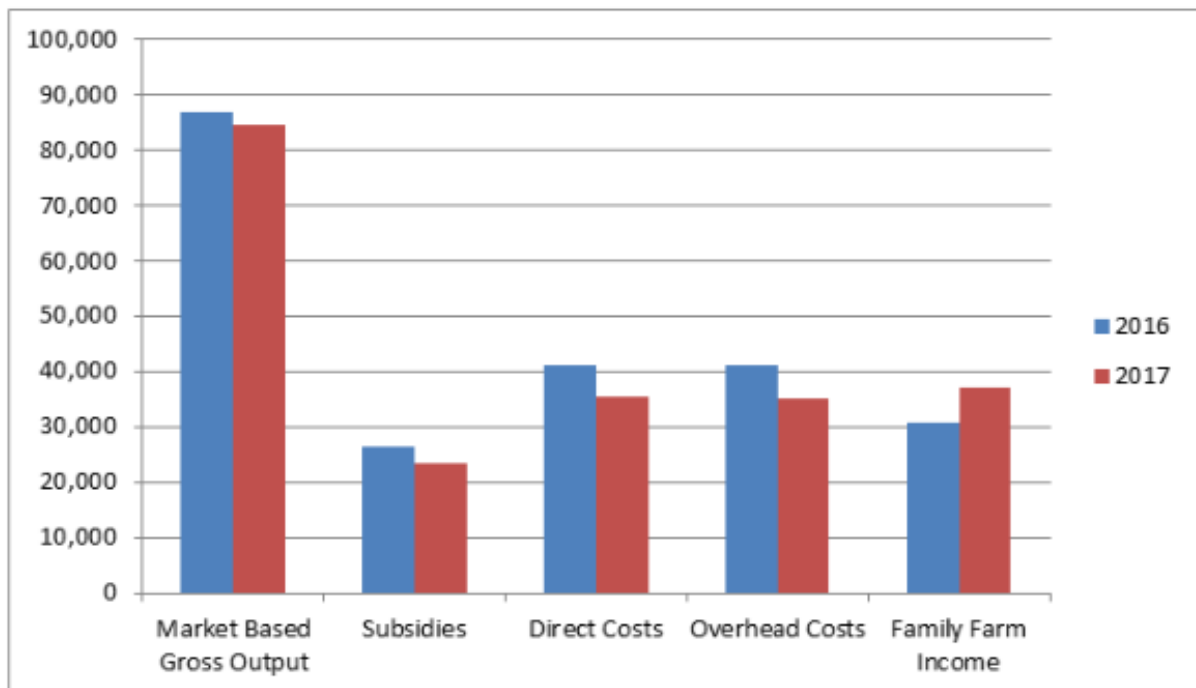
Appendix 2: Ethical approval

Letter from principal partner of Smith Harrington providing permission to use data

Smith Harrington

8/9 Bridge Street,
Navan,
Co. Meath
Tel: 046 9021113
Fax: 046 9021091
info@smithharrington.ie
www.smithharrington.ie

To whom it may concern

11th March 2016.

To whom it may concern,

I authorise Frank Harrington to use any data recorded in Smith Harrington's office. As the principal shareholder in Smith Harrington I am supportive of the research.

Should you require further clarifications please do not hesitate to contact me.

Yours sincerely,

_____
John Harrington FRICS FSCSI
Principal shareholder

Appendix 3: Sample of pilot studies undertaken

Pilot study[44] showing an early model to investigate intrinsic value of agricultural land based on gross margin (tillage) data 1993-2013

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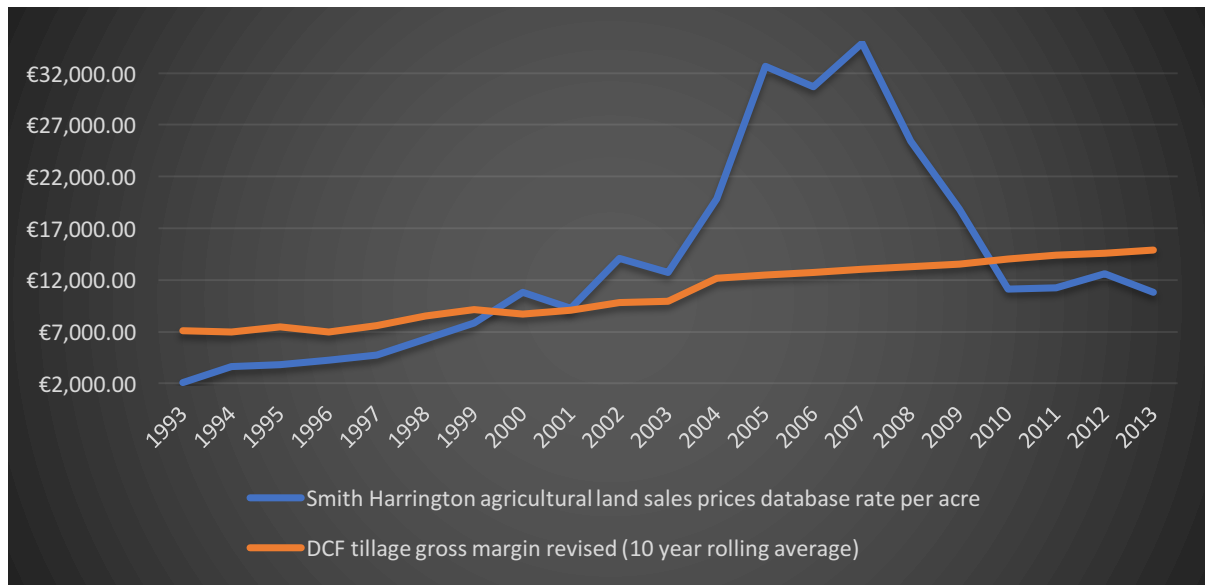
[44] This pilot study to investigate the intrinsic value of the asset.

1993

		Net present value per acre		€	7,121.77
		Average price per acre in	1993 €	2,116.94	

YEAR	PERIOD	Outgoings	Outgoings includes COSTS	Gross Margin	Tax on gross rent	CASHFLOW	PV @	Cashflow
1993	1	0		209		209	0.9575	200
1994	2			221		221	0.9169	202
1995	3			241		241	0.8780	212
1996	4			244		244	0.8407	205
1997	5			253		253	0.8050	204
1998	6			246		246	0.7708	189
1999	7			236		236	0.7381	174
2000	8			271		271	0.7068	192
2001	9			424		424	0.6768	287
2002	10	7,734		378		8,112	0.6480	5,257
Rent	€130.39 in		2002					7,122
Exit	1.69%	in	2002					

2013

		Net present value		€	14,920.81
		Average price per acre in	2013 €	10,832.79	

YEAR	PERIOD	Outgoings	Outgoings includes COSTS	Gross Margin tillage	Tax on gross rent	CASHFLOW	PV @	Cashflow
2013	1	0		794		794	0.9575	760
2014	2			829		829	0.9169	760
2015	3			857		857	0.8780	752
2016	4			886		886	0.8407	745
2017	5			916		916	0.8050	738
2018	6			947		947	0.7708	730
2019	7			980		980	0.7381	723
2020	8			1,013		1,013	0.7068	716
2021	9			1,047		1,047	0.6768	709
2022	10	11,705		1,083		12,788	0.6480	8,287
Rent	€197.33 from		2013					14,921
Exit	1.69%	from	2013					

Appendix 4: Cash flows employed within this study

Appendix 4A: DCF to estimate market discount rate for rental data 1993-2013

1993	Year	NOI	PV €1 @		Net cash		
			discount rate of	5.18222%			
following 10 years							
1993	1	€142.23		0.950731	€135.22		
1994	2	€146.90		0.903889	€132.78		
1995	3	€140.22		0.859356	€120.49		
1996	4	€129.54		0.817016	€105.83		
1997	5	€102.38		0.776763	€79.52		
1998	6	€107.87		0.738492	€79.66		
1999	7	€103.19		0.702107	€72.45		
2000	8	€109.53		0.667515	€73.11		
2001	9	€107.50		0.634627	€68.22		
2002	10	€130.39	1940.75	0.603360	€1,249.64		
					€2,116.94	Net present value	
					€2,116.94	Actual price in	1993
					5.18222%	Market Discount Rate	

1994	Year	NOI		PV €1 @		Net cash	Take the average for the period
				discount rate of	1.84540%		
following 10 years							
1994	1	€146.90			0.981880	€144.24	
1995	2	€140.22			0.964089	€135.18	
1996	3	€129.54			0.946620	€122.62	
1997	4	€102.38			0.929468	€95.15	
1998	5	€107.87			0.912626	€98.45	
1999	6	€103.19			0.896090	€92.47	
2000	7	€109.53			0.879853	€96.37	
2001	8	€107.50			0.863910	€92.87	
2002	9	€130.39			0.848256	€110.60	
2003	10	€123.87	3090.57		0.832886	€2,677.26	
						€3,665.22	Net present value
						€3,665.22	Actual price in 1994
						1.84540%	Market Discount Rate

1995	Year	NOI		PV €1 @		Net cash	
				discount rate of	2.606430%		
following 10 years							
1995	1	€140.22			0.974598	€136.65	
1996	2	€129.54			0.949841	€123.04	
1997	3	€102.38			0.925713	€94.77	
1998	4	€107.87			0.902198	€97.32	
1999	5	€103.19			0.879280	€90.74	
2000	6	€109.53			0.856944	€93.86	
2001	7	€107.50			0.835176	€89.78	
2002	8	€130.39			0.813961	€106.13	
2003	9	€123.87			0.793284	€98.26	
2004	10	€132.42	€3,615.35		0.773133	€2,897.53	
						€3,828.09	Net present value
						€3,828.09	Actual price in 1995
						2.606430%	Market Discount Rate

1996	Year	NOI		PV €1 @		Net cash	
				discount rate of	1.643699%		
following 10 years							
1996	1	€129.54			0.983829	€127.44	
1997	2	€102.38			0.967919	€99.09	
1998	3	€107.87			0.952267	€102.72	
1999	4	€103.19			0.936867	€96.68	
2000	5	€109.53			0.921717	€100.96	
2001	6	€107.50			0.906812	€97.48	
2002	7	€130.39			0.892148	€116.33	
2003	8	€123.87			0.877721	€108.72	
2004	9	€132.42			0.863527	€114.35	
2005	10	€114.52	€3,768.08		0.849563	€3,298.51	
						€4,262.28	Net present value
						€4,262.28	Actual price in 1996
						1.643699%	Market Discount Rate

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1997	Year	NOI		PV €1 @		Net cash			
				discount rate of	4.323650%				
following 10 years									
1997	1	€102.38			0.958555	€98.13			
1998	2	€107.87			0.918828	€99.12			
1999	3	€103.19			0.880748	€90.89			
2000	4	€109.53			0.844246	€92.47			
2001	5	€107.50			0.809256	€87.00			
2002	6	€130.39			0.775717	€101.14			
2003	7	€123.87			0.743568	€92.10			
2004	8	€132.42			0.712751	€94.38			
2005	9	€114.52			0.683211	€78.24			
2006	10	€126.00	€5,811.27		0.654896	€3,888.29			
							€4,721.77	Net present value	
							€4,721.77	Actual price in	1997
							4.323650%	Market Discount Rate	

1998	Year	NOI		PV €1 @		Net cash			
				discount rate of	4.528950%				
following 10 years									
1998	1	€107.87			0.956673	€103.20			
1999	2	€103.19			0.915223	€94.45			
2000	3	€109.53			0.875569	€95.90			
2001	4	€107.50			0.837633	€90.05			
2002	5	€130.39			0.801340	€104.49			
2003	6	€123.87			0.766621	€94.96			
2004	7	€132.42			0.733405	€97.12			
2005	8	€114.52			0.701629	€80.35			
2006	9	€126.00			0.671229	€84.57			
2007	10	€143.04	€8,365.83		0.642147	€5,463.94			
							€6,309.02	Net present value	
							€6,309.02	Actual price in	1998
							4.528950%	Market Discount Rate	

1999	Year	NOI		PV €1 @		Net cash			
				discount rate of	5.245110%				
following 10 years									
1999	1	€103.19			0.950163	€98.05			
2000	2	€109.53			0.902810	€98.89			
2001	3	€107.50			0.857816	€92.22			
2002	4	€130.39			0.815065	€106.27			
2003	5	€123.87			0.774445	€95.93			
2004	6	€132.42			0.735849	€97.44			
2005	7	€114.52			0.699176	€80.07			
2006	8	€126.00			0.664331	€83.70			
2007	9	€143.04			0.631223	€90.29			
2008	10	€151.61	€11,544.91		0.599764	€7,015.16			
							€7,858.02	Net present value	
							€7,858.02	Actual price in	1999
							5.245110%	Market Discount Rate	

2000	Year	NOI		PV €1 @		Net cash			
				discount rate of	3.165360%				
following 10 years									
2000	1	€109.53			0.969318	€106.17			
2001	2	€107.50			0.939577	€101.01			
2002	3	€130.39			0.910748	€118.75			
2003	4	€123.87			0.882804	€109.35			
2004	5	€132.42			0.855718	€113.32			
2005	6	€114.52			0.829462	€94.99			
2006	7	€126.00			0.804012	€101.30			
2007	8	€143.04			0.779343	€111.48			
2008	9	€151.61			0.755431	€114.53			
2009	10	€134.79	€13,311.00		0.732253	€9,845.71			
							€10,816.61	Net present value	
							€10,816.61	Actual price in	2000
							3.165360%	Market Discount Rate	

2001	Year	NOI		PV €1 @		Net cash			
				discount rate of	3.766300%				
following 10 years									
2001	1	€107.50				0.963704	€103.60		
2002	2	€130.39				0.928725	€121.09		
2003	3	€123.87				0.895016	€110.86		
2004	4	€132.42				0.862531	€114.22		
2005	5	€114.52				0.831225	€95.19		
2006	6	€126.00				0.801054	€100.93		
2007	7	€143.04				0.771979	€110.42		
2008	8	€151.61				0.743960	€112.79		
2009	9	€134.79				0.716957	€96.64		
2010	10	€137.78	€11,880.49			0.690934	€8,303.84	€9,269.59 Net present value	
								€9,269.59 Actual price in	2001
								3.766300% Market Discount Rate	

2002	Year	NOI		PV €1 @		Net cash			
				discount rate of	2.362190%				
following 10 years									
2002	1	€130.39				0.976923	€127.38		
2003	2	€123.87				0.954379	€118.22		
2004	3	€132.42				0.932355	€123.47		
2005	4	€114.52				0.910839	€104.31		
2006	5	€126.00				0.889820	€112.11		
2007	6	€143.04				0.869286	€124.34		
2008	7	€151.61				0.849225	€128.75		
2009	8	€134.79				0.829628	€111.83		
2010	9	€137.78				0.810483	€111.67		
2011	10	€150.89	€16,331.17			0.791780	€13,050.16	€14,112.23 Net present value	
								€14,112.23 Actual price in	2002
								2.362190% Market Discount Rate	

2003	Year	NOI		PV €1 @		Net cash			
				discount rate of	2.718560%				
following 10 years									
2003	1	€123.87				0.973534	€120.59		
2004	2	€132.42				0.947768	€125.51		
2005	3	€114.52				0.922685	€105.66		
2006	4	€126.00				0.898265	€113.18		
2007	5	€143.04				0.874491	€125.09		
2008	6	€151.61				0.851347	€129.07		
2009	7	€134.79				0.828815	€111.72		
2010	8	€137.78				0.806879	€111.17		
2011	9	€150.89				0.785524	€118.53		
2012	10	€147.07	€15,132.89			0.764735	€11,685.12	€12,745.63 Net present value	
								€12,745.63 Actual price in	2003
								2.718560% Market Discount Rate	

2004	Year	NOI		PV €1 @		Net cash			
				discount rate of	4.670810%				
following 10 years									
2004	1	€132.42				0.955376	€126.51		
2005	2	€114.52				0.912744	€104.53		
2006	3	€126.00				0.872014	€109.87		
2007	4	€143.04				0.833101	€119.17		
2008	5	€151.61				0.795925	€120.67		
2009	6	€134.79				0.760408	€102.50		
2010	7	€137.78				0.726475	€100.09		
2011	8	€150.89				0.694057	€104.73		
2012	9	€147.07				0.663086	€97.52		
2013	10	€197.33	€29,559.39			0.633496	€18,850.78	€19,836.36 Net present value	
								€19,836.39 Actual price in	2004
								4.670810% Market Discount Rate	

2005

2005	Year	NOI		PV €1 @		Net cash		
				discount rate of	6.208695%			
following 10 years								
2005	1	€114.52			0.941542	€107.82		
2006	2	€126.00			0.886502	€111.70		
2007	3	€143.04			0.834680	€119.39		
2008	4	€151.61			0.785886	€119.15		
2009	5	€134.79			0.739945	€99.74		
2010	6	€137.78			0.696690	€95.99		
2011	7	€150.89			0.655963	€98.98		
2012	8	€147.07			0.617617	€90.83		
2013	9	€197.33			0.581513	€114.75		
2014	10	€202.31	€57,725.93		0.547519	€31,716.82		
						€32,675.17	Net present value	
						€32,675.17	Actual price in	2005
						6.208695%	Market Discount Rate	

2006

2006	Year	NOI		PV €1 @		Net cash		
				discount rate of	5.522689%			
following 10 years								
2006	1	€126.00			0.947663	€119.40		
2007	2	€143.04			0.898066	€128.46		
2008	3	€151.61			0.851064	€129.03		
2009	4	€134.79			0.806523	€108.71		
2010	5	€137.78			0.764312	€105.31		
2011	6	€150.89			0.724311	€109.29		
2012	7	€147.07			0.686403	€100.95		
2013	8	€197.33			0.650479	€128.36		
2014	9	€202.31			0.616435	€124.71		
2015	10	€207.42	€50,511.00		0.584173	€29,628.34		
						€30,682.56	Net present value	
						€30,682.56	Actual price in	2006
						5.522689%	Market Discount Rate	

2007

2007	Year	NOI		PV €1 @		Net cash		
				discount rate of	4.444784%			
following 10 years								
2007	1	€143.04			0.957444	€136.95		
2008	2	€151.61			0.916698	€138.98		
2009	3	€134.79			0.877687	€118.30		
2010	4	€137.78			0.840336	€115.78		
2011	5	€150.89			0.804574	€121.40		
2012	6	€147.07			0.770335	€113.29		
2013	7	€197.33			0.737552	€145.54		
2014	8	€202.31			0.706165	€142.87		
2015	9	€207.42			0.676113	€140.24		
2016	10	€212.66	€51,853.11		0.647340	€33,704.26		
						€34,877.62	Net present value	
						€34,877.62	Actual price in	2007
						4.444784%	Market Discount Rate	

2008

2008	Year	NOI		PV €1 @		Net cash		
				discount rate of	8.149258%			
following 10 years								
2008	1	€151.61			0.924648	€140.19		
2009	2	€134.79			0.854974	€115.24		
2010	3	€137.78			0.790550	€108.92		
2011	4	€150.89			0.730981	€110.30		
2012	5	€147.07			0.675900	€99.40		
2013	6	€197.33			0.624969	€123.33		
2014	7	€202.31			0.577877	€116.91		
2015	8	€207.42			0.534333	€110.83		
2016	9	€212.66			0.494070	€105.07		
2017	10	€218.03	€53,162.35		0.456840	€24,386.32		
						€25,416.51	Net present value	
						€25,416.51	Actual price in	2008
						8.149258%	Market Discount Rate	

2009	Year	NOI		PV €1 @		Net cash
				discount rate of	7.820735%	
following 10 years						
2009	1	€134.79			0.927465	€125.01
2010	2	€137.78			0.860192	€118.52
2011	3	€150.89			0.797798	€120.38
2012	4	€147.07			0.739930	€108.82
2013	5	€197.33			0.686260	€135.42
2014	6	€202.31			0.636482	€128.77
2015	7	€207.42			0.590315	€122.44
2016	8	€212.66			0.547497	€116.43
2017	9	€218.03			0.507784	€110.71
2018	10	€223.53	€37,473.67		0.470952	€17,753.59

€18,840.10 Net present value
€18,840.10 Actual price in — 2009
7.820735% Market Discount Rate

2010	Year	NOI		PV €1 @		Net cash
				discount rate of	11.894013%	
following 10 years						
2010	1	€134.79			0.893703	€120.46
2011	2	€137.78			0.798705	€110.05
2012	3	€150.89			0.713805	€107.71
2013	4	€147.07			0.637929	€93.82
2014	5	€197.33			0.570119	€112.50
2015	6	€202.31			0.509517	€103.08
2016	7	€207.42			0.455357	€94.45
2017	8	€212.66			0.406954	€86.54
2018	9	€218.03			0.363696	€79.30
2019	10	€223.53	€31,244.16		0.325036	€10,228.13

€11,136.04 Net present value
€11,136.04 Actual price in — 2010
11.894013% Market Discount Rate

2011	Year	NOI		PV €1 @		Net cash
				discount rate of	6.791809%	
following 10 years						
2011	1	€150.89			0.936401	€141.29
2012	2	€147.07			0.876848	€128.96
2013	3	€197.33			0.821081	€162.03
2014	4	€202.31			0.768862	€155.55
2015	5	€207.42			0.719963	€149.34
2016	6	€212.66			0.674175	€143.37
2017	7	€218.03			0.631298	€137.64
2018	8	€223.53			0.591148	€132.14
2019	9	€229.18			0.553552	€126.86
2020	10	€234.96	€18,990.97		0.518347	€9,965.70

€11,242.88 Net present value
€11,242.88 Actual price in — 2011
6.791809% Market Discount Rate

2012	Year	NOI		PV €1 @		Net cash			
				discount rate of	4.990319%				
following 10 years									
2012	1	€147.07			0.952469	€140.08			
2013	2	€197.33			0.907197	€179.02			
2014	3	€202.31			0.864077	€174.81			
2015	4	€207.42			0.823006	€170.71			
2016	5	€212.66			0.783887	€166.70			
2017	6	€218.03			0.746628	€162.79			
2018	7	€223.53			0.711140	€158.96			
2019	8	€229.18			0.677339	€155.23			
2020	9	€234.96			0.645144	€151.59			
2021	10	€240.90	€17,949.38		0.614480	€11,177.55	€12,637.44	Net present value	
							€12,637.44	Actual price in	2012
							4.990319%	Market Discount Rate	

2013	Year	NOI		PV €1 @		Net cash			
				discount rate of	8.431103%				
following 10 years									
2013	1	€147.07			0.922245	€135.63			
2014	2	€202.31			0.850535	€172.08			
2015	3	€207.42			0.784401	€162.70			
2016	4	€212.66			0.723410	€153.84			
2017	5	€218.03			0.667161	€145.46			
2018	6	€223.53			0.615286	€137.54			
2019	7	€229.18			0.567444	€130.05			
2020	8	€234.96			0.523322	€122.96			
2021	9	€240.90			0.482631	€116.26			
2022	10	€246.98	€21,222.78		0.445104	€9,556.27	€10,832.79	Net present value	
							€10,832.79	Actual price in	2013
							8.431103%	Market Discount Rate	

Appendix 4B: DCF practitioner model

to estimate market value utilising rental data 1993-2013

	A	B	C	D	E	F	G
1	1993						
2	Market rent	€142.23					
3							
4	r	5.18%					
5	t	1					
6	g	-1.54%	see calculation below				
7	k	6.72%					
8							
9	Sale at year 10						
10	Yield	6.72%					
11	Multiplier (1/k)	14.88					
12	ERV at year 10	€122					
13	Price	€1,813					
14				**DCF Approach**	**Actual price**		
15				€ 2,117	€2,117		
16				Market Value	Actual price		
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow		
21							
22	1994	1	€142.23	0.9507	€135		
23	1995	2	€140.04	0.9039	€127		
24	1996	3	€137.89	0.8594	€118		
25	1997	4	€135.77	0.8170	€111		
26	1998	5	€133.69	0.7768	€104		
27	1999	6	€131.63	0.7385	€97		
28	2000	7	€129.61	0.7021	€91		
29	2001	8	€127.62	0.6675	€85		
30	2002	9	€125.66	0.6346	€80		
31	2003	10	€123.73	0.6034	€75		
32							
33	2003	10	€1,813.31	0.6034	€1,094		
34					€2,117		
40							
41	Value the freehold interest						
42	ERV (Just let-rack rented)			€142.23			
43	Review pattern			1 year			
44	Market yields			6.72% yield			
45							
46	Discount r	5.18%					
47	t	1					
48	g						
49	k	6.72%					
50							
51	To calculate the growth rate Baum uses the following formula			$(1+g)^\wedge t=$	YP into perp @ k - YP t years @ r		
52					YP perp @ k * PV t years @ r		
53							
54	1/k	14.88		14.88	-	0.9507	
55	$1-(1+r)^{-t}$			14.88	*	0.95	
56	r	0.9507					
57	1/k	14.88		$(1+g)^\wedge 1=$	13.9336535699056 =		0.9846377
58	$(1+r)^\wedge -t$	0.95			14.15104568		
59							
60					g= (0.9846)^1 - 1		
63					g= -1.5362%		

	A	B	C	D	E
1		**1994**			
2	**Market rent**	**€146.90**			
3					
4	r	**1.85%**	Discount rate from year end	1993	
5	t	**1**			
6	g	**-2.16%**	see calculation below		
7	k	**4.01%**			
8					
9	*Sale at year 10*				
10	*Yield*	*4.01%*			
11	*Multiplier (1/k)*	*24.95*			
12	*ERV at year 10*	*€118*			
13	*Price*	*€2,945*			
14				**DCF Approach**	**Actual price**
15				**€ 3,665**	**€3,665**
16				**Market Value**	**Actual price**
20	**YEAR**	**PERIOD**	**Implied rent**	**PV @ r**	**Cashflow**
21					
22	1994	1	€146.90	0.9819	€144
23	1995	2	€143.72	0.9641	€139
24	1996	3	€140.61	0.9466	€133
25	1997	4	€137.57	0.9295	€128
26	1998	5	€134.60	0.9126	€123
27	1999	6	€131.69	0.8961	€118
28	2000	7	€128.84	0.8799	€113
29	2001	8	€126.05	0.8639	€109
30	2002	9	€123.33	0.8483	€105
31	2003	10	€120.66	0.8329	€100
32					
33	2003	10	€2,945.46	0.8329	€2,453
34					**€3,665**

	A	B	C	D	E
1		**1995**			
2	**Market rent**	**€140.22**			
3					
4	r	**2.61%**	Discount rate from year end	1994	
5	t	**1**			
6	g	**-1.06%**	see calculation below		
7	k	**3.66%**			
8					
9	*Sale at year 10*				
10	*Yield*	*3.66%*			
11	*Multiplier (1/k)*	*27.30*			
12	*ERV at year 10*	*€126*			
13	*Price*	*€3,442*			
14				**DCF Approach**	**Actual price**
15				**€ 3,828**	**€3,828**
16				**Market Value**	**Actual price**
20	**YEAR**	**PERIOD**	**Implied rent**	**PV @ r**	**Cashflow**
21					
22	1995	1	€140.22	0.9746	€137
23	1996	2	€138.73	0.9498	€132
24	1997	3	€137.27	0.9257	€127
25	1998	4	€135.82	0.9022	€123
26	1999	5	€134.38	0.8793	€118
27	2000	6	€132.96	0.8569	€114
28	2001	7	€131.56	0.8352	€110
29	2002	8	€130.17	0.8140	€106
30	2003	9	€128.79	0.7933	€102
31	2004	10	€127.43	0.7731	€99
32					
33	2004	10	€3,442.39	0.7731	€2,661
34					**€3,828**

1996

	A	B	C	D	E
1		**1996**			
2	**Market rent**	**€129.54**			
3					
4	r	**1.64%**	Discount rate from year end	1995	
5	t	**1**			
6	g	**-1.40%**	**see calculation below**		
7	k	**3.04%**			
8					
9	Sale at year 10				
10	Yield	3.04%			
11	Multiplier (1/k)	32.90			
12	ERV at year 10	€113			
13	Price	€3,703			
14				**DCF Approach**	**Actual price**
15				€ 4,262	€4,262
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1994	1	€129.54	0.9838	€127
23	1995	2	€127.73	0.9679	€124
24	1996	3	€125.95	0.9523	€120
25	1997	4	€124.19	0.9369	€116
26	1998	5	€122.46	0.9217	€113
27	1999	6	€120.75	0.9068	€109
28	2000	7	€119.06	0.8921	€106
29	2001	8	€117.40	0.8777	€103
30	2002	9	€115.76	0.8635	€100
31	2003	10	€114.15	0.8496	€97
32					
33	2003	10	€3,703.49	0.8496	€3,146
34					€4,262

1997

	A	B	C	D	E
1		**1997**			
2	**Market rent**	**€102.38**			
3					
4	r	**4.32%**	Discount rate from year end	1996	
5	t	**1**			
6	g	**2.16%**	**see calculation below**		
7	k	**2.17%**			
8					
9	Sale at year 10				
10	Yield	2.17%			
11	Multiplier (1/k)	46.12			
12	ERV at year 10	€127			
13	Price	€5,844			
14				**DCF Approach**	**Actual price**
15				€ 4,722	€4,722
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1994	1	€102.38	0.9586	€98
23	1995	2	€104.58	0.9188	€96
24	1996	3	€106.84	0.8807	€94
25	1997	4	€109.14	0.8442	€92
26	1998	5	€111.49	0.8093	€90
27	1999	6	€113.89	0.7757	€88
28	2000	7	€116.35	0.7436	€87
29	2001	8	€118.86	0.7128	€85
30	2002	9	€121.42	0.6832	€83
31	2003	10	€124.04	0.6549	€81
32					
33	2003	10	€5,844.16	0.6549	€3,827
34					€4,722

1998

	A	B	C	D	E
1		1998			
2	Market rent	€107.87			
3					
4	r	4.53%	Discount rate from year end	1997	
5	t	1			
6	g	2.82%	see calculation below		
7	k	1.71%			
8					
9	Sale at year 10				
10	Yield	1.71%			
11	Multiplier (1/k)	58.49			
12	ERV at year 10	€142			
13	Price	€8,331			
14				DCF Approach	Actual price
15				€ 6,309	€6,309
16				Market Value	Actual price
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1994	1	€107.87	0.9567	€103
23	1995	2	€110.91	0.9152	€102
24	1996	3	€114.04	0.8756	€100
25	1997	4	€117.26	0.8376	€98
26	1998	5	€120.56	0.8013	€97
27	1999	6	€123.96	0.7666	€95
28	2000	7	€127.45	0.7334	€93
29	2001	8	€131.05	0.7016	€92
30	2002	9	€134.74	0.6712	€90
31	2003	10	€138.54	0.6421	€89
32					
33	2003	10	€8,331.09	0.6421	€5,350
34					€6,309

1999

	A	B	C	D	E
1		1999			
2	Market rent	€103.19			
3					
4	r	5.25%	Discount rate from year end	1998	
5	t	1			
6	g	3.93%	see calculation below		
7	k	1.31%			
8					
9	Sale at year 10				
10	Yield	1.31%			
11	Multiplier (1/k)	76.15			
12	ERV at year 10	€152			
13	Price	€11,556			
14				DCF Approach	Actual price
15				€ 7,858	€7,858
16				Market Value	Actual price
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1994	1	€103.19	0.9502	€98
23	1995	2	€107.25	0.9028	€97
24	1996	3	€111.47	0.8578	€96
25	1997	4	€115.85	0.8151	€94
26	1998	5	€120.41	0.7744	€93
27	1999	6	€125.14	0.7358	€92
28	2000	7	€130.06	0.6992	€91
29	2001	8	€135.18	0.6643	€90
30	2002	9	€140.49	0.6312	€89
31	2003	10	€146.01	0.5998	€88
32					
33	2003	10	€11,555.83	0.5998	€6,931
34					€7,858

2000

	A	B	C	D	E
1		2000			
2	Market rent	€109.53			
3					
4	r	3.17%	Discount rate from year end	1999	
5	t	1			
6	g	2.15%	see calculation below		
7	k	1.01%			
8					
9	Sale at year 10				
10	Yield	1.01%			
11	Multiplier (1/k)	98.75			
12	ERV at year 10	€136			
13	Price	€13,384			
14				**DCF Approach**	**Actual price**
15				€ 10,817	€10,817
16				**Market Value**	**Actual price**

	A	B	C	D	E
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1994	1	€109.53	0.9693	€106
23	1995	2	€111.89	0.9396	€105
24	1996	3	€114.30	0.9107	€104
25	1997	4	€116.76	0.8828	€103
26	1998	5	€119.27	0.8557	€102
27	1999	6	€121.84	0.8295	€101
28	2000	7	€124.46	0.8040	€100
29	2001	8	€127.14	0.7793	€99
30	2002	9	€129.88	0.7554	€98
31	2003	10	€132.67	0.7323	€97
32					
33	2003	10	€13,384.16	0.7323	€9,801
34					€10,817

2001

	A	B	C	D	E
1		2001			
2	Market rent	€107.50			
3					
4	r	3.77%	Discount rate from year end	2000	
5	t	1			
6	g	2.61%	see calculation below		
7	k	1.16%			
8					
9	Sale at year 10				
10	Yield	1.16%			
11	Multiplier (1/k)	86.23			
12	ERV at year 10	€139			
13	Price	€11,990			
14				**DCF Approach**	**Actual price**
15				€ 9,270	€9,270
16				**Market Value**	**Actual price**

	A	B	C	D	E
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1994	1	€107.50	0.9637	€104
23	1995	2	€110.30	0.9287	€102
24	1996	3	€113.18	0.8950	€101
25	1997	4	€116.13	0.8625	€100
26	1998	5	€119.16	0.8312	€99
27	1999	6	€122.26	0.8011	€98
28	2000	7	€125.45	0.7720	€97
29	2001	8	€128.72	0.7440	€96
30	2002	9	€132.07	0.7170	€95
31	2003	10	€135.52	0.6909	€94
32					
33	2003	10	€11,989.83	0.6909	€8,284
34					€9,270

2002 Sheet

	A	B	C	D	E
1		2002			
2	Market rent	€130.39			
3					
4	r	2.36%	Discount rate from year end	2001	
5	t	1			
6	g	1.44%	see calculation below		
7	k	0.92%			
8					
9	Sale at year 10				
10	Yield	0.92%			
11	Multiplier (1/k)	108.23			
12	ERV at year 10	€150			
13	Price	€16,278			
14				**DCF Approach**	**Actual price**
15				€ 14,112	€14,112
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1994	1	€130.39	0.9769	€127
23	1995	2	€132.26	0.9544	€126
24	1996	3	€134.17	0.9324	€125
25	1997	4	€136.10	0.9108	€124
26	1998	5	€138.05	0.8898	€123
27	1999	6	€140.04	0.8693	€122
28	2000	7	€142.05	0.8492	€121
29	2001	8	€144.10	0.8296	€120
30	2002	9	€146.17	0.8105	€118
31	2003	10	€148.27	0.7918	€117
32					
33	2003	10	€16,278.45	0.7918	€12,889
34					€14,112

2003 Sheet

	A	B	C	D	E
1		2003			
2	Market rent	€123.87			
3					
4	r	2.72%	Discount rate from year end	2002	
5	t	1			
6	g	1.75%	see calculation below		
7	k	0.97%			
8					
9	Sale at year 10				
10	Yield	0.97%			
11	Multiplier (1/k)	102.90			
12	ERV at year 10	€147			
13	Price	€15,155			
14				**DCF Approach**	**Actual price**
15				€ 12,746	€12,746
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1994	1	€123.87	0.9735	€121
23	1995	2	€126.03	0.9478	€119
24	1996	3	€128.23	0.9227	€118
25	1997	4	€130.47	0.8983	€117
26	1998	5	€132.75	0.8745	€116
27	1999	6	€135.07	0.8513	€115
28	2000	7	€137.43	0.8288	€114
29	2001	8	€139.83	0.8069	€113
30	2002	9	€142.27	0.7855	€112
31	2003	10	€144.76	0.7647	€111
32					
33	2003	10	€15,155.33	0.7647	€11,590
34					€12,746

2004

	A	B	C	D	E
1		**2004**			
2	**Market rent**	**€132.42**			
3					
4	r	**4.67%**	Discount rate from year end	2003	
5	t	**1**			
6	g	**4.00%**	see calculation below		
7	k	**0.67%**			
8					
9	Sale at year 10				
10	Yield	0.67%			
11	Multiplier (1/k)	149.80			
12	ERV at year 10	€196			
13	Price	€29,372			
14				**DCF Approach**	**Actual price**
15				€ **19,836**	**€19,836**
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1994	1	€132.42	0.9554	€127
23	1995	2	€137.72	0.9127	€126
24	1996	3	€143.24	0.8720	€125
25	1997	4	€148.97	0.8331	€124
26	1998	5	€154.94	0.7959	€123
27	1999	6	€161.14	0.7604	€123
28	2000	7	€167.59	0.7265	€122
29	2001	8	€174.30	0.6941	€121
30	2002	9	€181.28	0.6631	€120
31	2003	10	€188.53	0.6335	€119
32					
33	2003	10	€29,371.83	0.6335	€18,607
34					**€19,836**

2005

	A	B	C	D	E
1		**2005**			
2	**Market rent**	**€114.52**			
3					
4	r	**6.21%**	Discount rate from year end	2004	
5	t	**1**			
6	g	**5.86%**	see calculation below		
7	k	**0.35%**			
8					
9	Sale at year 10				
10	Yield	0.35%			
11	Multiplier (1/k)	285.33			
12	ERV at year 10	€202			
13	Price	€57,738			
14				**DCF Approach**	**Actual price**
15				€ **32,675**	**€32,675**
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1994	1	€114.52	0.9415	€108
23	1995	2	€121.23	0.8865	€107
24	1996	3	€128.33	0.8347	€107
25	1997	4	€135.85	0.7859	€107
26	1998	5	€143.80	0.7399	€106
27	1999	6	€152.23	0.6967	€106
28	2000	7	€161.15	0.6560	€106
29	2001	8	€170.59	0.6176	€105
30	2002	9	€180.58	0.5815	€105
31	2003	10	€191.16	0.5475	€105
32					
33	2003	10	€57,738.27	0.5475	€31,613
34					**€32,675**

2006

	A	B	C	D	E
1		2006			
2	Market rent	€126.00			
3					
4	r	5.52%	Discount rate from year end	2005	
5	t	1			
6	g	5.11%	see calculation below		
7	k	0.41%			
8					
9	Sale at year 10				
10	Yield	0.41%			
11	Multiplier (1/k)	243.52			
12	ERV at year 10	€207			
13	Price	€50,515			
14				**DCF Approach**	**Actual price**
15				€ 30,683	€30,683
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1994	1	€126.00	0.9477	€119
23	1995	2	€132.44	0.8981	€119
24	1996	3	€139.21	0.8511	€118
25	1997	4	€146.32	0.8065	€118
26	1998	5	€153.81	0.7643	€118
27	1999	6	€161.67	0.7243	€117
28	2000	7	€169.93	0.6864	€117
29	2001	8	€178.62	0.6505	€116
30	2002	9	€187.75	0.6164	€116
31	2003	10	€197.35	0.5842	€115
32					
33	2003	10	€50,514.53	0.5842	€29,509
34					€30,683

2007

	A	B	C	D	E
1		2007			
2	Market rent	€143.04			
3					
4	r	4.44%	Discount rate from year end	2006	
5	t	1			
6	g	4.03%	see calculation below		
7	k	0.41%			
8					
9	Sale at year 10				
10	Yield	0.41%			
11	Multiplier (1/k)	243.83			
12	ERV at year 10	€212			
13	Price	€51,800			
14				**DCF Approach**	**Actual price**
15				€ 34,878	€34,878
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1994	1	€143.04	0.9574	€137
23	1995	2	€148.81	0.9167	€136
24	1996	3	€154.81	0.8777	€136
25	1997	4	€161.06	0.8403	€135
26	1998	5	€167.56	0.8046	€135
27	1999	6	€174.32	0.7703	€134
28	2000	7	€181.35	0.7376	€134
29	2001	8	€188.67	0.7062	€133
30	2002	9	€196.28	0.6761	€133
31	2003	10	€204.20	0.6473	€132
32					
33	2003	10	€51,799.74	0.6473	€33,532
34					€34,878

2008

	A	B	C	D	E
1		2008			
2	Market rent	€151.61			
3					
4	r	4.70%	Discount rate from year end	2007	
5	t	1			
6	g	4.11%	see calculation below		
7	k	0.60%			
8					
9	Sale at year 10				
10	Yield	0.60%			
11	Multiplier (1/k)	167.64			
12	ERV at year 10	€227			
13	Price	€38,014			
14				**DCF Approach**	**Actual price**
15				€ 25,417	€25,417
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1994	1	€151.61	0.9551	€145
23	1995	2	€157.84	0.9122	€144
24	1996	3	€164.32	0.8712	€143
25	1997	4	€171.07	0.8320	€142
26	1998	5	€178.10	0.7947	€142
27	1999	6	€185.42	0.7589	€141
28	2000	7	€193.03	0.7249	€140
29	2001	8	€200.96	0.6923	€139
30	2002	9	€209.22	0.6612	€138
31	2003	10	€217.81	0.6315	€138
32					
33	2003	10	€38,014.40	0.6315	€24,005
34					€25,417

2009

	A	B	C	D	E
1		2009			
2	Market rent	€134.79			
3					
4	r	4.54%	Discount rate from year end	2008	
5	t	1			
6	g	3.82%	see calculation below		
7	k	0.72%			
8					
9	Sale at year 10				
10	Yield	0.72%			
11	Multiplier (1/k)	139.77			
12	ERV at year 10	€196			
13	Price	€27,422			
14				**DCF Approach**	**Actual price**
15				€ 18,840	€18,840
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1994	1	€134.79	0.9566	€129
23	1995	2	€139.95	0.9150	€128
24	1996	3	€145.30	0.8753	€127
25	1997	4	€150.86	0.8373	€126
26	1998	5	€156.63	0.8009	€125
27	1999	6	€162.62	0.7661	€125
28	2000	7	€168.84	0.7329	€124
29	2001	8	€175.29	0.7010	€123
30	2002	9	€182.00	0.6706	€122
31	2003	10	€188.96	0.6415	€121
32					
33	2003	10	€27,421.54	0.6415	€17,590
34					€18,840

2010

	A	B	C	D	E
1	2010				
2	Market rent	€137.78			
3					
4	r	24.32%	Discount rate from year end	2009	
5	t	1			
6	g	23.08%	see calculation below		
7	k	1.24%			
8					
9	Sale at year 10				
10	Yield	1.24%			
11	Multiplier (1/k)	80.82			
12	ERV at year 10	€1,099			
13	Price	€88,860			

	DCF Approach	Actual price
	€ 11,136	€11,136
	Market Value	Actual price

YEAR	PERIOD	Implied rent	PV @ r	Cashflow
1994	1	€137.78	0.8044	€111
1995	2	€169.58	0.6470	€110
1996	3	€208.73	0.5204	€109
1997	4	€256.91	0.4186	€108
1998	5	€316.21	0.3367	€106
1999	6	€389.20	0.2709	€105
2000	7	€479.04	0.2179	€104
2001	8	€589.61	0.1753	€103
2002	9	€725.71	0.1410	€102
2003	10	€893.23	0.1134	€101
2003	10	€88,859.77	0.1134	€10,076
				€11,136

2011

	A	B	C	D	E
1	2011				
2	Market rent	€150.89			
3					
4	r	24.51%	Discount rate from year end	2010	
5	t	1			
6	g	23.17%	see calculation below		
7	k	1.34%			
8					
9	Sale at year 10				
10	Yield	1.34%			
11	Multiplier (1/k)	74.51			
12	ERV at year 10	€1,212			
13	Price	€90,333			

	DCF Approach	Actual price
	€ 11,243	€11,243
	Market Value	Actual price

YEAR	PERIOD	Implied rent	PV @ r	Cashflow
1994	1	€150.89	0.8031	€121
1995	2	€185.85	0.6450	€120
1996	3	€228.90	0.5181	€119
1997	4	€281.94	0.4161	€117
1998	5	€347.25	0.3342	€116
1999	6	€427.70	0.2684	€115
2000	7	€526.79	0.2156	€114
2001	8	€648.84	0.1731	€112
2002	9	€799.16	0.1390	€111
2003	10	€984.31	0.1117	€110
2003	10	€90,332.76	0.1117	€10,088
				€11,243

	A	B	C	D	E
1		2012			
2	Market rent	€147.07			
3					
4	r	4.95%	Discount rate from year end	2011	
5	t	1			
6	g	3.79%	see calculation below		
7	k	1.16%			
8					
9	Sale at year 10				
10	Yield	1.16%			
11	Multiplier (1/k)	85.93			
12	ERV at year 10	€213			
13	Price	€18,331			
14				**DCF Approach**	**Actual price**
15				€ 12,637	€12,637
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1994	1	€147.07	0.9528	€140
23	1995	2	€152.64	0.9078	€139
24	1996	3	€158.43	0.8650	€137
25	1997	4	€164.43	0.8242	€136
26	1998	5	€170.66	0.7853	€134
27	1999	6	€177.13	0.7482	€133
28	2000	7	€183.84	0.7129	€131
29	2001	8	€190.81	0.6793	€130
30	2002	9	€198.04	0.6472	€128
31	2003	10	€205.54	0.6166	€127
32					
33	2003	10	€18,331.48	0.6166	€11,304
34					€12,637

	A	B	C	D	E
1		2013			
2	Market rent	€197.33			
3					
4	r	8.43%	Discount rate from year end	2012	
5	t	1			
6	g	6.61%	see calculation below		
7	k	1.82%			
8					
9	Sale at year 10				
10	Yield	1.82%			
11	Multiplier (1/k)	54.90			
12	ERV at year 10	€374			
13	Price	€20,545			
14				**DCF Approach**	**Actual price**
15				€ 10,833	€10,833
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1994	1	€197.33	0.9222	€182
23	1995	2	€210.37	0.8505	€179
24	1996	3	€224.28	0.7844	€176
25	1997	4	€239.10	0.7234	€173
26	1998	5	€254.91	0.6672	€170
27	1999	6	€271.75	0.6153	€167
28	2000	7	€289.72	0.5674	€164
29	2001	8	€308.86	0.5233	€162
30	2002	9	€329.28	0.4826	€159
31	2003	10	€351.04	0.4451	€156
32					
33	2003	10	€20,544.67	0.4451	€9,145
34					€10,833

	A	B	C	D	E	F	G	H	I	J	K
1	1993	Year	NOI			PV €1 @		Net cash			
2						discount rate of	18.61340%				
3	following 10 years										
4	1993	1	€208.79				0.843075	€176.03			
5	1994	2	€220.55				0.710776	€156.76			
6	1995	3	€241.20				0.599237	€144.53			
7	1996	4	€243.87				0.505202	€123.20			
8	1997	5	€253.22				0.425923	€107.85			
9	1998	6	€245.68				0.359085	€88.22			
10	1999	7	€235.87				0.302736	€71.41			
11	2000	8	€271.42				0.255229	€69.27			
12	2001	9	€423.75				0.215177	€91.18			
13	2002	10	€377.74	5622.36			0.181411	€1,088.48	€2,116.94 Net present value		
14									€2,116.94 Actual price in		1993
15									18.61340% Market Discount Rate		

1994	Year	NOI			PV €1 @		Net cash			
					discount rate of	11.80653%				
following 10 years										
1994	1	€220.55				0.894402	€197.26			
1995	2	€241.20				0.799955	€192.95			
1996	3	€243.87				0.715482	€174.48			
1997	4	€253.22				0.639928	€162.04			
1998	5	€245.68				0.572353	€140.61			
1999	6	€235.87				0.511914	€120.75			
2000	7	€271.42				0.457857	€124.27			
2001	8	€423.75				0.409508	€173.53			
2002	9	€377.74				0.366265	€138.35			
2003	10	€388.28	6452.55			0.327588	€2,240.97	€3,665.22 Net present value		
								€3,665.22 Actual price in		1994
								11.80653% Market Discount Rate		

1995	Year	NOI			PV €1 @		Net cash			
					discount rate of	12.30100%				
following 10 years										
1995	1	€241.20				0.890464	€214.78			
1996	2	€243.87				0.792926	€193.37			
1997	3	€253.22				0.706072	€178.79			
1998	4	€245.68				0.628732	€154.47			
1999	5	€235.87				0.559863	€132.06			
2000	6	€271.42				0.498538	€135.31			
2001	7	€423.75				0.443930	€188.11			
2002	8	€377.74				0.395304	€149.32			
2003	9	€388.28				0.352004	€136.67			
2004	10	€443.48	7038.52			0.313447	€2,345.21	€3,828.09 Net present value		
								€3,828.09 Actual price in		1995
								12.30100% Market Discount Rate		

1996	Year	NOI			PV €1 @		Net cash			
					discount rate of	12.93491%		-0.0008295		
following 10 years										
1996	1	€243.87				0.885466	€215.94			
1997	2	€253.22				0.784050	€198.54			
1998	3	€249.26				0.694249	€173.05			
1999	4	€235.87				0.614734	€145.00			
2000	5	€302.97				0.544326	€164.91			
2001	6	€423.75				0.481982	€204.24			
2002	7	€377.74				0.426779	€161.21			
2003	8	€388.28				0.377898	€146.73			
2004	9	€443.48				0.334616	€148.39			
2005	10	€493.95	8633.16			0.296291	€2,704.28	€4,262.28 Net present value		
								€4,262.28 Actual price in		1996
								12.93491% Market Discount Rate		

1997	Year	NOI			PV €1 @		Net cash	
					discount rate of	12.22801%		
following 10 years								
1997	1	€253.22				0.891043	€225.63	
1998	2	€249.26				0.793958	€197.90	
1999	3	€235.87				0.707451	€166.87	
2000	4	€302.97				0.630369	€190.98	
2001	5	€423.75				0.561686	€238.01	
2002	6	€377.74				0.500487	€189.05	
2003	7	€388.28				0.445955	€173.15	
2004	8	€443.48				0.397365	€176.22	
2005	9	€493.95				0.354070	€174.89	
2006	10	€482.23	8992.07			0.315491	€2,989.06	
							€4,721.77	Net present value
							€4,721.77	Actual price in 1997
							12.22801%	Market Discount Rate

1998	Year	NOI			PV €1 @		Net cash	
					discount rate of	13.42575%		
following 10 years								
1998	1	€249.26				0.881634	€219.76	
1999	2	€235.87				0.777279	€183.34	
2000	3	€302.97				0.685275	€207.62	
2001	4	€423.75				0.604162	€256.01	
2002	5	€377.74				0.532650	€201.20	
2003	6	€388.28				0.469602	€182.33	
2004	7	€443.48				0.414017	€183.61	
2005	8	€493.95				0.365012	€180.30	
2006	9	€482.23				0.321807	€155.18	
2007	10	€608.14	€ 15,392.63			0.283716	€4,539.67	
							€6,309.02	Net present value
							€6,309.02	Actual price in 1998
							13.42575%	Market Discount Rate

1999	Year	NOI			PV €1 @		Net cash	
					discount rate of	13.46954%		
following 10 years								
1999	1	€235.87				0.881294	€207.87	
2000	2	€302.97				0.776679	€235.31	
2001	3	€423.75				0.684482	€290.05	
2002	4	€377.74				0.603230	€227.86	
2003	5	€388.28				0.531623	€206.42	
2004	6	€443.48				0.468516	€207.78	
2005	7	€493.95				0.412900	€203.95	
2006	8	€482.23				0.363886	€175.48	
2007	9	€608.14				0.320691	€195.03	
2008	10	€609.22	20295.99			0.282623	€5,908.29	
							€7,858.02	Net present value
							€7,858.02	Actual price in 1999
							13.46954%	Market Discount Rate

2000	Year	NOI			PV €1 @		Net cash	
					discount rate of	6.65582%		
following 10 years								
2000	1	€302.97				0.937595	€284.06	
2001	2	€423.75				0.879085	€372.51	
2002	3	€377.74				0.824226	€311.34	
2003	4	€388.28				0.772791	€300.06	
2004	5	€443.48				0.724565	€321.33	
2005	6	€493.95				0.679349	€335.56	
2006	7	€482.23				0.636954	€307.16	
2007	8	€608.14				0.597205	€363.18	
2008	9	€609.22				0.559937	€341.12	
2009	10	€408.98	14601.26			0.524994	€7,880.29	
							€10,816.61	Net present value
							€10,816.61	Actual price in 2000
							6.65582%	Market Discount Rate

2001	Year	NOI			PV €1 @		Net cash			
					discount rate of	7.77368%				
following 10 years										
2001	1	€423.75				0.927870	€393.18			
2002	2	€377.74				0.860943	€325.21			
2003	3	€388.28				0.798844	€310.17			
2004	4	€443.48				0.741224	€328.72			
2005	5	€493.95				0.687759	€339.72			
2006	6	€482.23				0.638152	€307.73			
2007	7	€608.14				0.592122	€360.09			
2008	8	€609.22				0.549412	€334.71			
2009	9	€408.98				0.509783	€208.49			
2010	10	€587.93	12861.10			0.473013	€6,361.57	€9,269.59	Net present value	
								€9,269.59	Actual price in	2001
								7.77368%	Market Discount Rate	

2002	Year	NOI			PV €1 @		Net cash			
					discount rate of	10.34905%				
following 10 years										
2002	1	€377.74				0.906215	€342.31			
2003	2	€388.28				0.821226	€318.86			
2004	3	€443.48				0.744208	€330.04			
2005	4	€493.95				0.674412	€333.12			
2006	5	€482.23				0.611163	€294.72			
2007	6	€608.14				0.553845	€336.82			
2008	7	€609.22				0.501903	€305.77			
2009	8	€408.98				0.454832	€186.02			
2010	9	€587.93				0.412176	€242.33			
2011	10	€797.18	€29,782.85			0.373520	€11,422.25	€14,112.23	Net present value	
								€14,112.23	Actual price in	2002
								10.34905%	Market Discount Rate	

2003	Year	NOI			PV €1 @		Net cash			
					discount rate of	9.08938%		-0.0043053		
following 10 years										
2003	1	€388.28				0.916679	€355.92			
2004	2	€443.48				0.840301	€372.65			
2005	3	€493.95				0.770287	€380.48			
2006	4	€482.23				0.706106	€340.50			
2007	5	€608.14				0.647273	€393.63			
2008	6	€609.22				0.593342	€361.47			
2009	7	€408.98				0.543904	€222.44			
2010	8	€587.93				0.498586	€293.13			
2011	9	€797.18				0.457044	€364.35			
2012	10	€681.70	22377.72			0.418963	€9,661.04	€12,745.63	Net present value	
								€12,745.63	Actual price in	2003
								9.08938%	Market Discount Rate	

2004	Year	NOI			PV €1 @		Net cash			
					discount rate of	8.25814%				
following 10 years										
2004	1	€443.48				0.923718	€409.65			
2005	2	€493.95				0.853255	€421.46			
2006	3	€482.23				0.788167	€380.08			
2007	4	€608.14				0.728044	€442.75			
2008	5	€609.22				0.672508	€409.70			
2009	6	€408.98				0.621207	€254.06			
2010	7	€587.93				0.573820	€337.36			
2011	8	€797.18				0.530048	€422.55			
2012	9	€681.70				0.489615	€333.77			
2013	10	€794.18	35522.92			0.452266	€16,425.01	€19,836.39	Net present value	
								€19,836.39	Actual price in	2004
								8.25814%	Market Discount Rate	

2005

	Year	NOI			PV €1 @		Net cash			
					discount rate of	7.19719%				
following 10 years										
2005	1	€493.95				0.932860	€460.78			
2006	2	€482.23				0.870228	€419.65			
2007	3	€608.14				0.811801	€493.69			
2008	4	€609.22				0.757297	€461.36			
2009	5	€408.98				0.706453	€288.92			
2010	6	€587.93				0.659022	€387.46			
2011	7	€797.18				0.614775	€490.09			
2012	8	€681.70				0.573499	€390.96			
2013	9	€794.18				0.534995	€424.88			
2014	10	€861.07	€56,960.63			0.499075	€28,857.38	€32,675.17	Net present value	
								€32,675.17	Actual price in	2005
								7.19719%	Market Discount Rate	

2006

	Year	NOI			PV €1 @		Net cash			
					discount rate of	8.43464%		-0.00086915		
following 10 years										
2006	1	€482.23				0.922215	€444.72			
2007	2	€608.14				0.850480	€517.21			
2008	3	€609.22				0.784325	€477.82			
2009	4	€408.98				0.723316	€295.82			
2010	5	€587.93				0.667052	€392.18			
2011	6	€797.18				0.615165	€490.40			
2012	7	€681.70				0.567314	€386.74			
2013	8	€794.18				0.523186	€415.50			
2014	9	€861.07				0.482489	€415.46			
2015	10	€933.60	€ 59,401.70			0.444959	€26,846.72	€30,682.56	Net present value	
								€30,682.56	Actual price	2006
								8.43464%	Market Discount Rate	

2007

	Year	NOI			PV €1 @		Net cash			
					discount rate of	6.85399%				
following 10 years										
2007	1	€608.14				0.935856	€569.13			
2008	2	€609.22				0.875827	€533.57			
2009	3	€408.98				0.819649	€335.22			
2010	4	€587.93				0.767074	€450.98			
2011	5	€797.18				0.717871	€572.27			
2012	6	€681.70				0.671824	€457.98			
2013	7	€794.18				0.628731	€499.32			
2014	8	€861.07				0.588402	€506.65			
2015	9	€933.60				0.550660	€514.09			
2016	10	€1,012.23	€58,052.61			0.515338	€30,438.39	€34,877.62	Net present value	
								€34,877.62	Actual price in	2007
								6.85399%	Market Discount Rate	

2008

	Year	NOI			PV €1 @		Net cash			
					discount rate of	8.34154%				
following 10 years										
2008	1	€609.22				0.923007	€562.31			
2009	2	€408.98				0.851942	€348.43			
2010	3	€587.93				0.786348	€462.32			
2011	4	€797.18				0.725805	€578.60			
2012	5	€681.70				0.669923	€456.69			
2013	6	€794.18				0.618344	€491.07			
2014	7	€861.07				0.570736	€491.44			
2015	8	€933.60				0.526793	€491.81			
2016	9	€1,012.23				0.486234	€492.18			
2017	10	€1,097.49	€ 45,787.11			0.448797	€21,041.66	€25,416.51	Net present value	
								€25,416.51	Actual price in	2008
								8.34154%	Market Discount Rate	

2009 — following 10 years

Year	#	NOI		PV €1 @ discount rate of 13.92586%	Net cash
2009	1	€408.98		0.877764	€358.99
2010	2	€587.93		0.770469	€452.98
2011	3	€797.18		0.676290	€539.13
2012	4	€681.70		0.593623	€404.67
2013	5	€794.18		0.521061	€413.81
2014	6	€861.07		0.457368	€393.83
2015	7	€933.60		0.401461	€374.80
2016	8	€1,012.23		0.352388	€356.70
2017	9	€1,097.49		0.309314	€339.47
2018	10	€1,189.93	€54,815.51	0.271504	€15,205.72

€18,840.10 Net present value
€18,840.10 Actual price in 2009
13.92586% Market Discount Rate

2010 — following 10 years

Year	#	NOI		PV €1 @ discount rate of 13.86015%	Net cash
2010	1	€587.93		0.878270	€516.36
2011	2	€797.18		0.771359	€614.91
2012	3	€681.70		0.677462	€461.83
2013	4	€794.18		0.594995	€472.53
2014	5	€861.07		0.522566	€449.97
2015	6	€933.60		0.458954	€428.48
2016	7	€1,012.23		0.403086	€408.02
2017	8	€1,097.49		0.354019	€388.53
2018	9	€1,189.93		0.310924	€369.98
2019	10	€1,290.15	€24,436.97	0.273075	€7,025.44

€11,136.04 Net present value
€11,136.04 Actual price in 2010
13.86015% Market Discount Rate

2011 — following 10 years

Year	#	NOI		PV €1 @ discount rate of 12.51920%	Net cash
2011	1	€797.18		0.888737	€708.49
2012	2	€681.70		0.789854	€538.44
2013	3	€794.18		0.701973	€557.49
2014	4	€861.07		0.623869	€537.19
2015	5	€933.60		0.554456	€517.64
2016	6	€1,012.23		0.492765	€498.79
2017	7	€1,097.49		0.437939	€480.63
2018	8	€1,189.93		0.389213	€463.13
2019	9	€1,290.15		0.345908	€446.27
2020	10	€1,398.82	€19,727.88	0.307421	€6,494.79

€11,242.88 Net present value
€11,242.88 Actual price in 2011
12.51920% Market Discount Rate

2012 — following 10 years

Year	#	NOI		PV €1 @ discount rate of 14.09229%	Net cash
2012	1	€681.70		0.876483	€597.50
2013	2	€794.18		0.768223	€610.11
2014	3	€861.07		0.673335	€579.79
2015	4	€933.60		0.590167	€550.98
2016	5	€1,012.23		0.517271	€523.60
2017	6	€1,097.49		0.453380	€497.58
2018	7	€1,189.93		0.397380	€472.85
2019	8	€1,290.15		0.348297	€449.36
2020	9	€1,398.82		0.305276	€427.03
2021	10	€1,516.64	€28,115.51	0.267570	€7,928.66

€12,637.44 Net present value
€12,637.44 Actual price in 2012
14.09229% Market Discount Rate

2013	Year	NOI			PV €1 @		Net cash			
					discount rate of	15.11887%				
following 10 years										
2013	1	€794.18				0.868667	€689.88			
2014	2	€861.07				0.754583	€649.75			
2015	3	€933.60				0.655481	€611.95			
2016	4	€1,012.23				0.569395	€576.36			
2017	5	€1,097.49				0.494615	€542.83			
2018	6	€1,189.93				0.429656	€511.26			
2019	7	€1,290.15				0.373228	€481.52			
2020	8	€1,398.82				0.324211	€453.51			
2021	9	€1,516.64				0.281631	€427.13			
2022	10	€1,644.38	€22,429.76			0.244644	€5,889.59	€10,833.79	Net present value	
								€10,832.79	Actual price in	2013
								15.11887%	Market Discount Rate	

Appendix 4D: DCF practitioner model

to estimate market value utilising income data 1993-2013

	A	B	C	D	E	F
1	1993					
2	Income	€208.79				
3						
4	r	18.61%				
5	t	1				
6	g	8.75%	see calculation below			
7	k	9.86%				
8						
9	Sale at year 10					
10	Yield	9.86%				
11	Multiplier (1/k)	10.14				
12	ERV at year 10	€483				
13	Price	€4,898				
14				**DCF Approach**	**Actual price**	
15				€ 2,117	€2,117	
16				**Market Value**	**Actual price**	
17	YEAR	PERIOD	Implied rent	PV @ r	Cashflow	
18						
19	1993	1	€208.79	0.8431	€176	
20	1994	2	€227.06	0.7108	€161	
21	1995	3	€246.93	0.5992	€148	
22	1996	4	€268.54	0.5052	€136	
23	1997	5	€292.04	0.4259	€124	
24	1998	6	€317.59	0.3591	€114	
25	1999	7	€345.38	0.3027	€105	
26	2000	8	€375.61	0.2552	€96	
27	2001	9	€408.47	0.2152	€88	
28	2002	10	€444.22	0.1814	€81	
29	2003	10	€4,897.96	0.1814	€889	
30					€2,117	
31				0.00%	€0	
32					€2,117	
33						
34						
35						
36						
37	Value the freehold interest					
38	Income			€208.79		
39	Review pattern			1	years	
40	Market yields			9.86%	yield	
41						
42	Discount r	18.61%				
43	t	1				
44	g					
45	k	9.86%				
46						
47	To calculate the growth rate Baum uses the following form		(1+g)^t=		YP into perp @ k - YP t years @ r	
48					YP perp @ k * PV t years @ r	
49						
50	1/k	10.14		10.14	-	0.8431
51	1- (1+ r) ^-t			10.14	*	0.84
52	r	0.8431				
53	1/k	10.14	(1+g)^1=	9.2957919934623	=	1.087503651
54	(1+r)^-t	0.84		8.547826012		
55						
56				g= (1.0875)^1 - 1		
58				g= 8.7504%		

	A	B	C	D	E
1		1994			
2	Income	€220.55			
3					
4	r	11.81%	Discount rate from year end	1993	
5	t	1			
6	g	5.79%	see calculation below		
7	k	6.02%			
8					
9	Sale at year 10				
10	Yield	6.02%			
11	Multiplier (1/k)	16.62			
12	ERV at year 10	€387			
13	Price	€6,434			
14				**DCF Approach**	**Actual price**
15				€ 3,665	**€3,665**
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1994	1	€220.55	0.8944	€197
23	1995	2	€233.32	0.8000	€187
24	1996	3	€246.83	0.7155	€177
25	1997	4	€261.11	0.6399	€167
26	1998	5	€276.23	0.5724	€158
27	1999	6	€292.22	0.5119	€150
28	2000	7	€309.14	0.4579	€142
29	2001	8	€327.04	0.4095	€134
30	2002	9	€345.97	0.3663	€127
31	2003	10	€366.00	0.3276	€120
32	2004	10	€6,434.43	0.3276	€2,108
33					€3,665

	A	B	C	D	E
1		1995			
2	Income	€241.20			
3					
4	r	12.30%	Discount rate from year end	1994	
5	t	1			
6	g	6.00%	see calculation below		
7	k	6.30%			
8					
9	Sale at year 10				
10	Yield	6.30%			
11	Multiplier (1/k)	15.87			
12	ERV at year 10	€432			
13	Price	€6,856			
14				**DCF Approach**	**Actual price**
15				€ 3,828	**€3,828**
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1995	1	€241.20	0.8905	€215
23	1996	2	€255.67	0.7929	€203
24	1997	3	€271.01	0.7061	€191
25	1998	4	€287.27	0.6287	€181
26	1999	5	€304.51	0.5599	€170
27	2000	6	€322.78	0.4985	€161
28	2001	7	€342.15	0.4439	€152
29	2002	8	€362.68	0.3953	€143
30	2003	9	€384.44	0.3520	€135
31	2004	10	€407.51	0.3134	€128
32	2005	10	€6,855.70	0.3134	€2,149
33					€3,828

1996

	A	B	C	D	E
1		**1996**			
2	Income	**€243.87**			
3					
4	r	**12.93%**	Discount rate from year end	1995	
5	t	**1**			
6	g	**7.21%**	see calculation below		
7	k	**5.72%**			
8					
9	*Sale at year 10*				
10	*Yield*	5.72%			
11	*Multiplier (1/k)*	17.48			
12	*ERV at year 10*	€489			
13	*Price*	€8,553			
14				**DCF Approach**	**Actual price**
15				€ **4,262**	**€4,262**
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1996	1	€243.87	0.8855	€216
23	1997	2	€261.46	0.7840	€205
24	1998	3	€280.32	0.6942	€195
25	1999	4	€300.54	0.6147	€185
26	2000	5	€322.22	0.5443	€175
27	2001	6	€345.46	0.4820	€167
28	2002	7	€370.38	0.4268	€158
29	2003	8	€397.10	0.3779	€150
30	2004	9	€425.74	0.3346	€142
31	2005	10	€456.45	0.2963	€135
32	2006	10	€8,553.27	0.2963	€2,534
33					**€4,262**

1997

	A	B	C	D	E
1		**1997**			
2	Income	**€253.22**			
3					
4	r	**12.23%**	Discount rate from year end	1996	
5	t	**1**			
6	g	**6.87%**	see calculation below		
7	k	**5.36%**			
8					
9	*Sale at year 10*				
10	*Yield*	5.36%			
11	*Multiplier (1/k)*	18.65			
12	*ERV at year 10*	€492			
13	*Price*	€9,172			
14				**DCF Approach**	**Actual price**
15				€ **4,722**	**€4,722**
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1997	1	€253.22	0.8910	€226
23	1998	2	€270.60	0.7940	€215
24	1999	3	€289.18	0.7075	€205
25	2000	4	€309.03	0.6304	€195
26	2001	5	€330.25	0.5617	€185
27	2002	6	€352.92	0.5005	€177
28	2003	7	€377.15	0.4460	€168
29	2004	8	€403.04	0.3974	€160
30	2005	9	€430.71	0.3541	€153
31	2006	10	€460.28	0.3155	€145
33	2006	10	€9,172.09	0.3155	€2,894
34					**€4,722**

1998

	A	B	C	D	E
1		**1998**			
2	**Income**	**€249.26**			
3					
4	r	**13.43%**	Discount rate from year end	1997	
5	t	**1**			
6	g	**9.47%**	see calculation below		
7	k	**3.95%**			
8					
9	Sale at year 10				
10	Yield	3.95%			
11	Multiplier (1/k)	25.31			
12	ERV at year 10	€616			
13	Price	€15,599			
14				**DCF Approach**	**Actual price**
15				€ **6,309**	**€6,309**
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1998	1	€249.26	0.8816	€220
23	1999	2	€272.88	0.7773	€212
24	2000	3	€298.73	0.6853	€205
25	2001	4	€327.04	0.6042	€198
26	2002	5	€358.02	0.5326	€191
27	2003	6	€391.95	0.4696	€184
28	2004	7	€429.08	0.4140	€178
29	2005	8	€469.74	0.3650	€171
30	2006	9	€514.24	0.3218	€165
31	2007	10	€562.97	0.2837	€160
32	2007	10	€15,599.39	0.2837	€4,426
33					**€6,309**

1999

	A	B	C	D	E
1		**1999**			
2	**Income**	**€235.87**			
3					
4	r	**13.47%**	Discount rate from year end	1998	
5	t	**1**			
6	g	**10.47%**	see calculation below		
7	k	**3.00%**			
8					
9	Sale at year 10				
10	Yield	3.00%			
11	Multiplier (1/k)	33.31			
12	ERV at year 10	€638			
13	Price	€21,265			
14				**DCF Approach**	**Actual price**
15				€ **7,858**	**€7,858**
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	1999	1	€235.87	0.8813	€208
23	2000	2	€260.56	0.7767	€202
24	2001	3	€287.84	0.6845	€197
25	2002	4	€317.97	0.6032	€192
26	2003	5	€351.25	0.5316	€187
27	2004	6	€388.02	0.4685	€182
28	2005	7	€428.64	0.4129	€177
29	2006	8	€473.51	0.3639	€172
30	2007	9	€523.07	0.3207	€168
31	2008	10	€577.83	0.2826	€163
32	2008	10	€21,265.40	0.2826	€6,010
33					**€7,858**

2000

	A	B	C	D	E
1	2000				
2	Income	€302.97			
3					
4	r	6.66%	Discount rate from year end	1999	
5	t	1			
6	g	3.85%	see calculation below		
7	k	2.80%			
8					
9	Sale at year 10				
10	Yield	2.80%			
11	Multiplier (1/k)	35.70			
12	ERV at year 10	€442			
13	Price	€15,789			

	DCF Approach	Actual price
14		
15	€ 10,817	€10,817
16	Market Value	Actual price

	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
20					
21					
22	2000	1	€302.97	0.9376	€284
23	2001	2	€314.65	0.8791	€277
24	2002	3	€326.78	0.8242	€269
25	2003	4	€339.38	0.7728	€262
26	2004	5	€352.46	0.7246	€255
27	2005	6	€366.04	0.6793	€249
28	2006	7	€380.16	0.6370	€242
29	2007	8	€394.81	0.5972	€236
30	2008	9	€410.03	0.5599	€230
31	2009	10	€425.83	0.5250	€224
32	2009	10	€15,789.15	0.5250	€8,289
33					€10,817

2001

	A	B	C	D	E
1	2001				
2	Income	€423.75			
3					
4	r	7.77%	Discount rate from year end	2000	
5	t	1			
6	g	3.20%	see calculation below		
7	k	4.57%			
8					
9	Sale at year 10				
10	Yield	4.57%			
11	Multiplier (1/k)	21.88			
12	ERV at year 10	€581			
13	Price	€12,704			

	DCF Approach	Actual price
14		
15	€ 9,270	€9,270
16	Market Value	Actual price

	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
20					
21					
22	2001	1	€423.75	0.9279	€393
23	2002	2	€437.32	0.8609	€377
24	2003	3	€451.32	0.7988	€361
25	2004	4	€465.77	0.7412	€345
26	2005	5	€480.69	0.6878	€331
27	2006	6	€496.08	0.6382	€317
28	2007	7	€511.97	0.5921	€303
29	2008	8	€528.36	0.5494	€290
30	2009	9	€545.28	0.5098	€278
31	2010	10	€562.74	0.4730	€266
32	2010	10	€12,704.42	0.4730	€6,009
33					€9,270

2002 table

	A	B	C	D	E
1		2002			
2	Income	€377.74			
3					
4	r	10.35%	Discount rate from year end	2001	
5	t	1			
6	g	7.67%	see calculation below		
7	k	2.68%			
8					
9	Sale at year 10				
10	Yield	2.68%			
11	Multiplier (1/k)	37.36			
12	ERV at year 10	€791			
13	Price	€29,556			
14				**DCF Approach**	**Actual price**
15				€ 14,112	€14,112
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	2002	1	€377.74	0.9062	€342
23	2003	2	€406.72	0.8212	€334
24	2004	3	€437.92	0.7442	€326
25	2005	4	€471.52	0.6744	€318
26	2006	5	€507.70	0.6112	€310
27	2007	6	€546.65	0.5538	€303
28	2008	7	€588.59	0.5019	€295
29	2009	8	€633.75	0.4548	€288
30	2010	9	€682.37	0.4122	€281
31	2011	10	€734.73	0.3735	€274
32	2011	10	€29,555.59	0.3735	€11,040
33					€14,112

2003 table

	A	B	C	D	E
1		2003			
2	Income	€388.28			
3					
4	r	9.09%	Discount rate from year end	2002	
5	t	1			
6	g	6.04%	see calculation below		
7	k	3.05%			
8					
9	Sale at year 10				
10	Yield	3.05%			
11	Multiplier (1/k)	32.83			
12	ERV at year 10	€698			
13	Price	€22,918			
14				**DCF Approach**	**Actual price**
15				€ 12,746	€12,746
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	2003	1	€388.28	0.9167	€356
23	2004	2	€411.74	0.8403	€346
24	2005	3	€436.62	0.7703	€336
25	2006	4	€463.01	0.7061	€327
26	2007	5	€490.99	0.6473	€318
27	2008	6	€520.66	0.5933	€309
28	2009	7	€552.12	0.5439	€300
29	2010	8	€585.48	0.4986	€292
30	2011	9	€620.86	0.4570	€284
31	2012	10	€658.38	0.4190	€276
32	2012	10	€22,918.33	0.4190	€9,602
33					€12,746

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2004

	A	B	C	D	E
1		**2004**			
2	**Income**	**€443.48**			
3					
4	r	8.26%	Discount rate from year end	2003	
5	t	1			
6	g	6.02%	see calculation below		
7	k	2.24%			
8					
9	Sale at year 10				
10	Yield	2.24%			
11	Multiplier (1/k)	44.73			
12	ERV at year 10	€796			
13	Price	€35,599			
14				**DCF Approach**	**Actual price**
15				€ 19,836	**€19,836**
16				**Market Value**	**Actual price**
20	**YEAR**	**PERIOD**	**Implied rent**	**PV @ r**	**Cashflow**
21					
22	2004	1	€443.48	0.9237	€410
23	2005	2	€470.19	0.8533	€401
24	2006	3	€498.50	0.7882	€393
25	2007	4	€528.52	0.7280	€385
26	2008	5	€560.35	0.6725	€377
27	2009	6	€594.10	0.6212	€369
28	2010	7	€629.88	0.5738	€361
29	2011	8	€667.82	0.5300	€354
30	2012	9	€708.03	0.4896	€347
31	2013	10	€750.68	0.4523	€340
32	2013	10	€35,599.31	0.4523	€16,100
33					€19,836.39

2005

	A	B	C	D	E
1		**2005**			
2	**Income**	**€493.95**			
3					
4	r	7.20%	Discount rate from year end	2004	
5	t	1			
6	g	5.69%	see calculation below		
7	k	1.51%			
8					
9	Sale at year 10				
10	Yield	1.51%			
11	Multiplier (1/k)	66.15			
12	ERV at year 10	€859			
13	Price	€56,803			
14				**DCF Approach**	**Actual price**
15				€ 32,675	**€32,675**
16				**Market Value**	**Actual price**
20	**YEAR**	**PERIOD**	**Implied rent**	**PV @ r**	**Cashflow**
21					
22	2005	1	€493.95	0.9329	€461
23	2006	2	€522.03	0.8702	€454
24	2007	3	€551.71	0.8118	€448
25	2008	4	€583.08	0.7573	€442
26	2009	5	€616.23	0.7065	€435
27	2010	6	€651.27	0.6590	€429
28	2011	7	€688.29	0.6148	€423
29	2012	8	€727.43	0.5735	€417
30	2013	9	€768.78	0.5350	€411
31	2014	10	€812.49	0.4991	€405
32	2014	10	€56,803.06	0.4991	€28,349
33					€32,675.17

2006

	A	B	C	D	E
1		2006			
2	Income	€482.23			
3					
4	r	8.43%	Discount rate from year end	2005	
5	t	1			
6	g	6.86%	see calculation below		
7	k	1.57%			
8					
9	Sale at year 10				
10	Yield	1.57%			
11	Multiplier (1/k)	63.63			
12	ERV at year 10	€937			
13	Price	€59,589			
14				**DCF Approach**	**Actual price**
15				€ 30,683	€30,683
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	2006	1	€482.23	0.9222	€445
23	2007	2	€515.32	0.8505	€438
24	2008	3	€550.69	0.7843	€432
25	2009	4	€588.48	0.7233	€426
26	2010	5	€628.87	0.6671	€419
27	2011	6	€672.03	0.6152	€413
28	2012	7	€718.15	0.5673	€407
29	2013	8	€767.44	0.5232	€402
30	2014	9	€820.10	0.4825	€396
31	2015	10	€876.39	0.4450	€390
32	2015	10	€59,588.73	0.4450	€26,515
33					€30,683

2007

	A	B	C	D	E
1		2007			
2	Income	€608.14			
3					
4	r	6.85%	Discount rate from year end	2006	
5	t	1			
6	g	5.11%	see calculation below		
7	k	1.74%			
8					
9	Sale at year 10				
10	Yield	1.74%			
11	Multiplier (1/k)	57.35			
12	ERV at year 10	€1,001			
13	Price	€57,412			
14				**DCF Approach**	**Actual price**
15				€ 34,878	€34,878
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	2007	1	€608.14	0.9359	€569
23	2008	2	€639.22	0.8758	€560
24	2009	3	€671.89	0.8196	€551
25	2010	4	€706.22	0.7671	€542
26	2011	5	€742.31	0.7179	€533
27	2012	6	€780.25	0.6718	€524
28	2013	7	€820.12	0.6287	€516
29	2014	8	€862.03	0.5884	€507
30	2015	9	€906.08	0.5507	€499
31	2016	10	€952.39	0.5153	€491
32	2016	10	€57,411.86	0.5153	€29,587
33					€34,878

	A	B	C	D	E
1		2008			
2	Income	€609.22			
3					
4	r	8.34%	Discount rate from year end	2007	
5	t	1			
6	g	5.94%	see calculation below		
7	k	2.40%			
8					
9	Sale at year 10				
10	Yield	2.40%			
11	Multiplier (1/k)	41.72			
12	ERV at year 10	€1,085			
13	Price	€45,280			
14				**DCF Approach**	**Actual price**
15				€ 25,417	€25,417
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	2008	1	€609.22	0.9230	€562
23	2009	2	€645.43	0.8519	€550
24	2010	3	€683.80	0.7863	€538
25	2011	4	€724.45	0.7258	€526
26	2012	5	€767.52	0.6699	€514
27	2013	6	€813.14	0.6183	€503
28	2014	7	€861.48	0.5707	€492
29	2015	8	€912.69	0.5268	€481
30	2016	9	€966.95	0.4862	€470
31	2017	10	€1,024.43	0.4488	€460
32	2017	10	€45,279.79	0.4488	€20,321
33					€25,417

	A	B	C	D	E
1		2009			
2	Income	€408.98			
3					
4	r	13.93%	Discount rate from year end	2008	
5	t	1			
6	g	11.76%	see calculation below		
7	k	2.17%			
8					
9	Sale at year 10				
10	Yield	2.17%			
11	Multiplier (1/k)	46.07			
12	ERV at year 10	€1,243			
13	Price	€57,247			
14				**DCF Approach**	**Actual price**
15				€ 18,840	€18,840
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	2009	1	€408.98	0.8778	€359
23	2010	2	€457.05	0.7705	€352
24	2011	3	€510.78	0.6763	€345
25	2012	4	€570.82	0.5936	€339
26	2013	5	€637.92	0.5211	€332
27	2014	6	€712.91	0.4574	€326
28	2015	7	€796.72	0.4015	€320
29	2016	8	€890.37	0.3524	€314
30	2017	9	€995.03	0.3093	€308
31	2018	10	€1,112.00	0.2715	€302
32	2018	10	€57,247.41	0.2715	€15,543
33					€18,840

2010

	A	B	C	D	E
1	**2010**				
2	**Income**	**€587.93**			
3					
4	r	13.86%	Discount rate from year end	2009	
5	t	1			
6	g	8.58%	see calculation below		
7	k	5.28%			
8					
9	Sale at year 10				
10	Yield	5.28%			
11	Multiplier (1/k)	18.94			
12	ERV at year 10	€1,339			
13	Price	€25,366			
14				**DCF Approach**	**Actual price**
15				€ 11,136	€11,136
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	2010	1	€587.93	0.8783	€516
23	2011	2	€638.38	0.7714	€492
24	2012	3	€693.15	0.6775	€470
25	2013	4	€752.63	0.5950	€448
26	2014	5	€817.21	0.5226	€427
27	2015	6	€887.33	0.4590	€407
28	2016	7	€963.47	0.4031	€388
29	2017	8	€1,046.14	0.3540	€370
30	2018	9	€1,135.91	0.3109	€353
31	2019	10	€1,233.38	0.2731	€337
32	2019	10	€25,366.16	0.2731	€6,927
33					€11,136

2011

	A	B	C	D	E
1	**2011**				
2	**Income**	**€797.18**			
3					
4	r	12.52%	Discount rate from year end	2010	
5	t	1			
6	g	5.43%	see calculation below		
7	k	7.09%			
8					
9	Sale at year 10				
10	Yield	7.09%			
11	Multiplier (1/k)	14.10			
12	ERV at year 10	€1,353			
13	Price	€19,075			
14				**DCF Approach**	**Actual price**
15				€ 11,243	€11,243
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	2011	1	€797.18	0.8887	€708
23	2012	2	€840.46	0.7899	€664
24	2013	3	€886.08	0.7020	€622
25	2014	4	€934.19	0.6239	€583
26	2015	5	€984.90	0.5545	€546
27	2016	6	€1,038.37	0.4928	€512
28	2017	7	€1,094.74	0.4379	€479
29	2018	8	€1,154.17	0.3892	€449
30	2019	9	€1,216.82	0.3459	€421
31	2020	10	€1,282.88	0.3074	€394
32	2020	10	€19,074.96	0.3074	€5,864
33					€11,243

2012

	A	B	C	D	E
1		2012			
2	Income	€681.70			
3					
4	r	14.09%	Discount rate from year end	2011	
5	t	1			
6	g	8.70%	see calculation below		
7	k	5.39%			
8					
9	Sale at year 10				
10	Yield	5.39%			
11	Multiplier (1/k)	18.54			
12	ERV at year 10	€1,570			
13	Price	€29,099			
14				**DCF Approach**	**Actual price**
15				€ 12,637	€12,637
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	2012	1	€681.70	0.8765	€598
23	2013	2	€741.00	0.7682	€569
24	2014	3	€805.45	0.6733	€542
25	2015	4	€875.51	0.5902	€517
26	2016	5	€951.66	0.5173	€492
27	2017	6	€1,034.43	0.4534	€469
28	2018	7	€1,124.41	0.3974	€447
29	2019	8	€1,222.21	0.3483	€426
30	2020	9	€1,328.51	0.3053	€406
31	2021	10	€1,444.07	0.2676	€386
32	2021	10	€29,098.74	0.2676	€7,786
33					€12,637

2013

	A	B	C	D	E
1		2013			
2	Income	€794.18			
3					
4	r	15.12%	Discount rate from year end	2012	
5	t	1			
6	g	7.79%	see calculation below		
7	k	7.33%			
8					
9	Sale at year 10				
10	Yield	7.33%			
11	Multiplier (1/k)	13.64			
12	ERV at year 10	€1,681			
13	Price	€22,931			
14				**DCF Approach**	**Actual price**
15				€ 10,833	€10,833
16				**Market Value**	**Actual price**
20	YEAR	PERIOD	Implied rent	PV @ r	Cashflow
21					
22	2013	1	€794.18	0.8687	€690
23	2014	2	€856.03	0.7546	€646
24	2015	3	€922.69	0.6555	€605
25	2016	4	€994.55	0.5694	€566
26	2017	5	€1,072.00	0.4946	€530
27	2018	6	€1,155.48	0.4297	€496
28	2019	7	€1,245.46	0.3732	€465
29	2020	8	€1,342.46	0.3242	€435
30	2021	9	€1,447.00	0.2816	€408
31	2022	10	€1,559.69	0.2446	€382
32	2022	10	€22,931.38	0.2446	€5,610
33					€10,833

Appendix 5: Rents to highest and best use gross margin

	A	F		G		H
1		Highest and best use gross margin		Rent		
2	1993	€	208.79	€	142.23	68.12%
3	1994	€	220.55	€	146.90	66.61%
4	1995	€	241.20	€	140.22	58.13%
5	1996	€	243.87	€	129.54	53.12%
6	1997	€	253.22	€	102.38	40.43%
7	1998	€	249.26	€	107.87	43.28%
8	1999	€	235.87	€	103.19	43.75%
9	2000	€	302.97	€	109.53	36.15%
10	2001	€	423.75	€	107.50	25.37%
11	2002	€	377.74	€	130.39	34.52%
12	2003	€	388.28	€	123.87	31.90%
13	2004	€	443.48	€	132.42	29.86%
14	2005	€	493.95	€	114.52	23.18%
15	2006	€	482.23	€	126.00	26.13%
16	2007	€	608.14	€	143.04	23.52%
17	2008	€	609.22	€	151.61	24.89%
18	2009	€	408.98	€	134.79	32.96%
19	2010	€	587.93	€	137.78	23.43%
20	2011	€	797.18	€	150.89	18.93%
21	2012	€	681.70	€	147.07	21.57%
22	2013	€	794.18	€	197.33	24.85%
23	Mean					35.75%