University of Reading
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Behavioural determinants of the adoption of Financial Price Risk Management Tools by wheat farmers in England

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This thesis is presented for the Degree of
Doctor of Philosophy

February 2014

‘Declaration

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

……………………………………..

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February 2014

Abstract

Wheat farmers in England have little experience of Financial Price Risk Management (FPRM) strategies to stabilize income. On-farm advice and research is limited and adoption rates remain slow. Selling crops at prevailing market prices exposes farmers to volatile price movements that have increased in recent years. This research examines the behavioural intentions towards adoption of FPRM using a mixed method approach combining interviews, focus groups and a survey of 2273 farmers in England. Interviews and focus groups informed the national questionnaire which was based on the Theory of Planned Behaviour (TPB). Of the 802 responses there were 673 usable, giving a response rate of 29.6%. Constructs in the TPB model of attitude, social norm and perceived behavioural control were decomposed into sub-constructs and farmer specific data was collected. The results showed that whilst farmers were aware and concerned about volatility few had used FPRM tools. All three major constructs of TPB were significant as were the decomposed sub-constructs except risk and academic advice. Some Internal Farm Factors were also significant predictors of intention to adopt; age, education, size of arable area and whether the respondent had children. To provide further inference factor and cluster analyses were conducted and provided four categories of farmers (Strategic strategists, Passive strategists, Weakly insular, Strongly insular) each with distinctive characteristics and behavioural intent. This study has contributed to the literature by confirming the significance of the three major constructs of TPB as well as the sub-constructs. *Post-hoc* analysis contributes as it shows how such data can be further used in explaining behaviour. The study has contributed to agriculture in general by confirming farmers' perceptions of volatility and negative attitudes towards the grain trade, in particular merchants. It also provides evidence to effectively target resources to increase adoption rates.

Acknowledgements

This thesis could not have been written without the support and help of many people. I would like to especially thank the following people and institutions for their help over the past five years.

My supervisors, Professor Richard Bennett and Mr Richard Tranter, for guiding me through both the concepts and technicalities of this research project and dragging a 30 year out of date academic mind screaming into the 21st century.

Professor N. Wareham, Dr. S. Horrell and Dr. M. Vaudin, for initially encouraging my PhD proposal, without whom this journey of discovery would not have begun. Joanna my then long-suffering partner for foregoing her free time while I studied. Thanks to the members of my staff at work for covering for me in my many hours of commuting between Cambridge and Reading. Dr C. Yates for advice concerning TPB questionnaire construction and Teresa Hicks for administrating the questionnaire replies. A special thank you to all in-depth interview and Focus Groups participants, questionnaire triallists and respondents for their time and enthusiasm. Thanks to the HGCA/AHDB for part-funding this research, the use of their national database and mailing the questionnaire.

Sally Ward for assisting with the focus groups and Hannah Kershaw for helping with questionnaire data entry and diagrams. Jack Watts at the HGCA for market research, Sam Tyler at the University of Reading library for his reference detective work and other library staff, especially Tim Chapman, for EndNote help. Members of Cambridge University Maths department, University of Reading ITS department, various individuals with practical SPSS suggestions.

I am extremely appreciative of friends and family that have helped in some positive way by providing their time, information and moral support to encourage and convince me at times that I could fulfil this life long goal of mine.

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Abbreviations / Acronyms

ABARE	Australian Bureau of Agricultural Resource Economics
ACP	African, Caribbean and Pacific
ADAS	Agricultural Development and Advisory Service
AHDB	Agricultural and Horticultural Development Board
AIC	Agricultural Industries Confederation
AMTA	Agricultural Market Transition Act
APH	Actual Production History
ARMS	Agricultural Resource Management Study
ASCS	Agricultural Stabilisation and Conservation Service
Att	Attitude construct
CAPM	Capital Pricing Asset Models
CARPE	Common Agricultural and Rural Policy for Europe
CFTC	Commodity Futures Trading Commission
COF	Cattle on feed
CP	Compromising Programming
CRP	Compromise Risk Programme
DAP	Disaster Assistance Program
DEFRA	Department of Environment, Food and Rural Affairs
DTPB	Decomposed Theory of Planned Behaviour
ERM	Enterprise Risk Management
ERS	Economic Research Service
FAIR Act	Federal Agricultural Improvement and Reform Act
FBS	Farm Business Survey
FCIRA	Federal Crop Insurance Reform Act
FPRM	Financial Price Risk Management
FSA	Financial Services Authority
FSRIA	Food Security and Rural Improvement Act
GATT	General Agreement on Tariffs and Trade
GRIP	Canadian Gross Revenue Insurance Program
HGCA	Home Grown Cereals Authority

IACS	Integrated Administration and control System
ICE	Intercontinental Exchange
IMF	International Monetary Fund
LIFFE	London International Financial Futures & Options Exchange
MATIF	Merche a Terme International de France
MCDM	Multiple Criteria Decision-making
MIFID	Markets in Financial Instruments Directive
MOTAD	Minimisation of Total Absolute Deviation
MPCI	Multi Peril Crop Insurance
NASS	National Agricultural Statistics Service
NFI	Net Farm Income
NFU	National Farmers Union
NYSE	New York Stock Exchange
OLS	Ordinary Least Squares
OTC	Over the Counter
OTM	Out of the Money
PBC	Perceived Behavioural Control construct
PEG	Producer Entitlement Scheme
PRM	Price Risk Management
RAROC	Risk adjusted return on capital
RBR	Rural Business Research
RMA	Risk Management Agency
SFP	Single Farm Payment
SII	The Securities and Investment Institute
SN	Subjective Norm construct
SOLL	Standard of Living Line
TAA	Transitional Adjustment Assistance
TAG	The Arable Group
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
UAA	Utilised Agricultural Area
UKASTA	United Kingdom Supply Trade Association

URAA	Uruguay Round Agreement on Agriculture
USDA	United States Department of Agriculture
WASDE	World Supply and Demand Estimates
WTO	World Trade Organisation

Introduction

The area of wheat grown in England is greater than that of any other arable crop, whilst the price is subject to some of the largest variation, thus the influence of the wheat crop on farm profitability, production patterns and farmer behaviour is very important. In particular, it is the interaction between this price volatility and farmer behaviour that is the central focus of this thesis. That is, what measures, if any, do farmers use to mitigate the effects of this volatility and why are the uptake of price risk management (PRM) and in particular, financial price risk management (FPRM) tools, futures and options contracts, so low?

The recent increase in the price volatility of wheat has occurred in a relatively short span of time since 2007 (Wiggins et al., 2010). This thesis discusses the numerous reasons for this sudden change, including the effects of world markets, governments and policy, insurance, climate, uncertainty and the usual farm specific strategies such as diversity, liquidity and technology that can be used to mitigate this effect. This discussion will form the basis of a research methodology and, latterly, a behavioural model that will seek to explain the underlying motivations and actions of farmers in England.

Two behavioural models are considered in the thesis: Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1980); and, Theory of Planned Behaviour (TRB) (Ajzen, 1991). In addition, the Diffusion of Innovations (Rogers, 1995) was considered in order to create a model representative of the behaviour of wheat farmers in England. To inform the development of this model, and the creation of hypotheses, this study used a mixed methodology approach (Creswell, 2002; Teddlie and Tashakkori, 2003).

As a first stage to this mixed methodology approach, qualitative research was used to extract the key factors influencing FPRM use. This qualitative research took the form of eighteen in-depth farmer interviews, seven ‘grain trade’ interviews, followed by three farmer focus groups. Using the results from this research it was possible to identify the most salient factors that influence farmers in respect to FPRMs. In particular, the key beliefs, motivations, barriers, drivers and outside influences were derived by examining the most common responses and statements made during these interviews and focus groups.

In the next stage of this mixed approach a postal survey was conducted. The questionnaire was based on the TPB and included questions on beliefs, attitudes, behavioural controls, social norms, behavioural intention and actual behaviour. Additionally, there was a set of questions used to distinguish basic farmer/farm characteristics. In total, 2273 farmers were surveyed with a ‘usable response’ (the number of surveys that were returned with usable data, divided by the total number of surveys sent out) of 29.6%. Tranter et al. (2009) details questionnaire response rates as 5-35%. A model to predict the probability of the intent to adopt FPRMs was constructed and then modified following data analysis. In particular, this approach identified the key aspects that influence this decision and, as such, could be exploited to increase the uptake of these tools.

Thesis outline

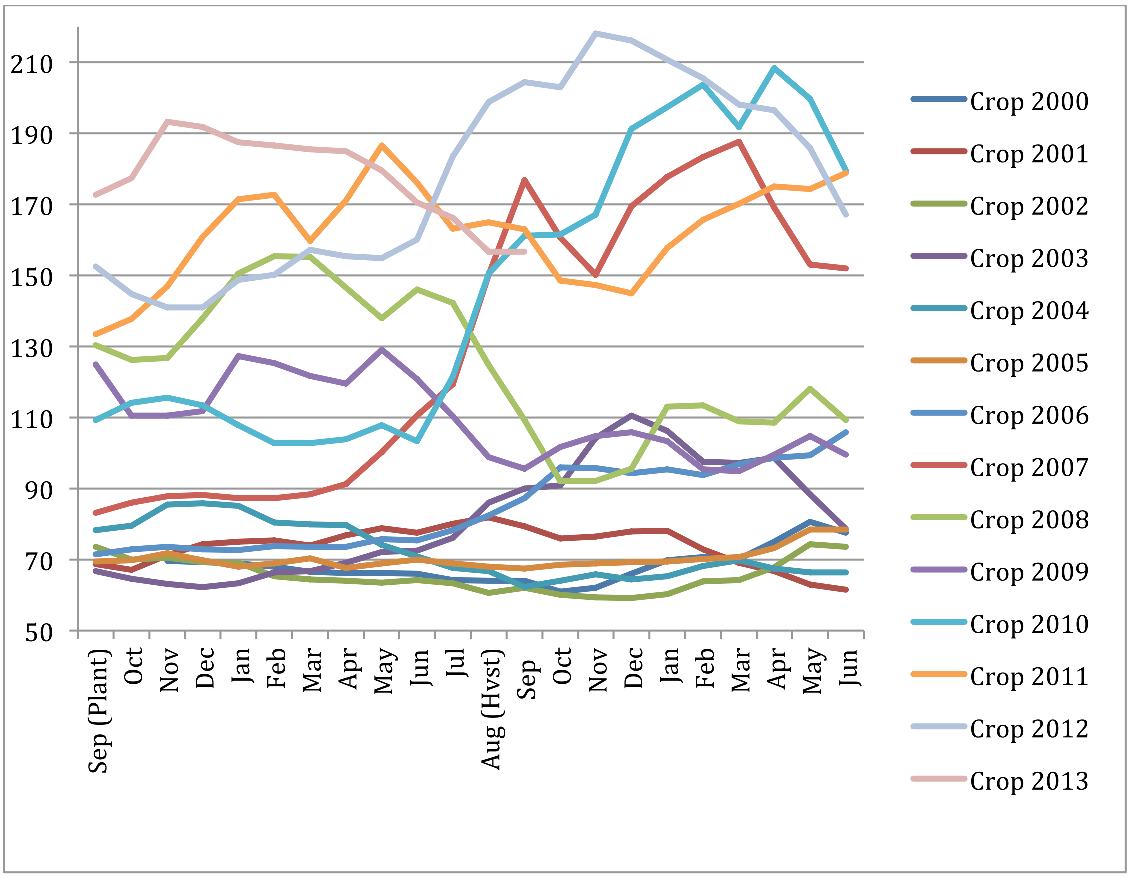
The remainder of this chapter will provide a very brief overview of the wheat market and its history, the theoretical background and aims and objectives of this research including its relevance. In Chapter 2, wheat production, marketing and risk are reviewed with emphasis on the factors that affect price volatility as well as the methods used to sell wheat. Chapter 3 discusses and explains in detail the role and use of FPRMs in wheat marketing in England. The theoretical background to the TRA, TPB and diffusion models are discussed in Chapter 4 and their relevance and applicability to this study examined. The key hypotheses are tested in Chapter 5, whilst the research model, based on these hypotheses, is fully developed in Chapter 6. Chapter 7 details the analysis of the questionnaire data with Chapter 8 presenting the Data analysis and results. Chapter 9 details the thesis conclusions, further research potential and this thesis’s contribution to agriculture in England and agriculture more widely.

1 UK wheat market history

Agricultural production is subject to production lags with producers and government policy makers making decisions based on imperfect knowledge of future price (Blandford and Currie, 1975; Lapan, 1988). This results in supply and demand misallocations and thus induces price fluctuations. The problem being: the ‘wants’ from an ever-increasing global demand from an ever increasing and affluent population. Food supply is being limited by available land, water, energy and global warming issues (Brown, 2003).

The last 25 years have seen some major changes in the way the English farming industry functions. Sckokai and Antón (2005) noted the ‘decoupling’ of the wheat market in England after the EU’s widespread Intervention policy in the 1980-90s, MacSharry’s review in the mid 1990s and the Mid Term Review during the 2000s. That is, the UK wheat market price has become more linked to the vagaries of the international grain market. This, and the virtual cessation of Government Intervention storage and Marketing Boards (Gilbert, 2007), has resulted in more emphasis on market price and exporting to determine the final destination of the crop, control surpluses and determine wheat prices in the domestic English market.

However, it does not appear that arable farmers have responded to these changes, with respect to preservation and stability of income, with the same methods and timing of marketing remaining virtually unchanged. This has resulted in marked income fluctuations between marketing seasons as shown in Figure 1.1. Recently, there have been few advances in the area of PRM in the grain market in England. This can be attributed directly and indirectly to the relative unimportance of the historical need for such tools. There was deemed little need for such strategies as the market price movements were relatively small (as is shown in Figure 1.1) and infrequent in occurrence and in the 1980s and early 1990s EU wheat intervention prices were available, providing a minimum wheat price. The effect has been of changing cropping programmes which, with better decisions, may not have needed to be so radical and so affect both the individual enterprise and aggregate UK farming.



Source: HGCA

Figure 1.1. LIFFE wheat futures prices by harvest year 2000-13.

The arable farmer in England has adopted new technological advances since World War II and improved both production and technological efficiencies. Increased legislation, along with much lower prices for wheat since the mid 1990s, and EU CAP reforms have forced farmers to become very cost conscience. This has driven down cost of production and increased output so that arable farmers in England are amongst the most efficient in the world (Barnes et al., 2010). However, the sale or marketing of their product lags behind this technological and production innovation. Compared to marketing strategies available, and used by other global agri-businesses, marketing in the UK agriculture combinable crop[1] commodity sector is basic (Moschini and Hennessy, 2001).

[1] A crop that can be harvested using a combine harvester.

From this research's in-depth interviews and focus groups, one of the main reasons for this is that farmers believe it is their role to grow their produce at the highest quality for the lowest price but it is someone else's role to market the produce from the farm gate. The former they do very well, amidst a growing quantity of regulation. In broad terms, during WWII households and farmers were encouraged by Lord Wooton to 'Dig for Victory' to increase agricultural and food output to reduce the need for imports (Smith, 2011). This continued after the war and with increased world trade and economic prosperity, farmers were guaranteed a market for all their supplies. The late 1970s and 1980s saw the rise of the EU's intervention legislation, effectively creating a minimum price for wheat in the EU and thus also for England. The costs and publicly perceived huge stored stocks of many products, including wheat, were seen as politically unacceptable and intervention has been progressively reduced until today it is no longer a feature of the English wheat market.

The UK wheat market is now subject to the unpredictability of world supply and demand, and all their determinants, for the first time for several generations. This has led to the situation that most farmers, using their traditional methods of marketing wheat, (spot sales, forward contracts, pools and buy-back contracts) are ill equipped to cope with market price volatility, and a more volatile marketplace. This is causing difficulty in budgeting and results in an undesirable fluctuation in net incomes, as depicted in the Home Grown Cereals Authority (HGCA) income model shown in Figure 1.2. Figure 1.2 shows that over the period 1993-2011 even if a farmer sold their wheat at the average annual price (the red line), that average varies dramatically over time. This has the effect of producing a large fluctuation in net farm income (blue blocks), even when an average annual price of wheat is achieved.

This is not due to farm production being inefficient but due to the market for their wheat crop dramatically moving, to their advantage or their detriment. It is this factor that is making the most significant differences between the highest and lowest margin producers, not the costs of production.

Figure 1.2. Farm Income Model.

This research concentrates on the feed wheat market in England, not the milling wheat market, as the annual production of feed wheat is far larger in tonnage terms, 13-17m tonnes versus 2m tonnes (DEFRA, 2012b).

There are many examples of agricultural enterprises that have undertaken marketing strategies and achieved improved margin by horizontal and vertical enterprise integration. In England, this is seen by agri-businesses such as Cargill, ADM, Glencore, Ranks and Warburtons. However, they are not farmers and, in general, the arable farmer in England remains the primary producer competing on the world market against other competing and complementary commodities. Margins are, therefore, squeezed as market efficiencies tend towards removing all excessive profits and marginal revenues equal to marginal costs (Spengler, 1950; Hall, 1988). At the farm level there is some vertical integration by contract farming (Rehber, 1998) and retailing to the public.

The UK wheat market is well established, with a network of trade buyers (merchants and consumers) and has associated with it a regulated futures market. Ninety per cent of merchant traders are represented by the organisation Agricultural Industries Confederation (AIC) (www.agindustries.org.uk). The market for futures and options is regulated by the

Euronext exchange (www.euronext.com), although this is still known as London International Financial Futures and Options Exchange (LIFFE). The LIFFE is a futures exchange based in London, which opened in 1982. LIFFE is now part of the New York Stock Exchange (NYSE) following its takeover of the Euronext in January 2002 and Euronext's merger with NYSE in April 2007 (Euronext, 2010). In this thesis futures and options will be referred to as Financial Price Risk Management (FPRM) tools.

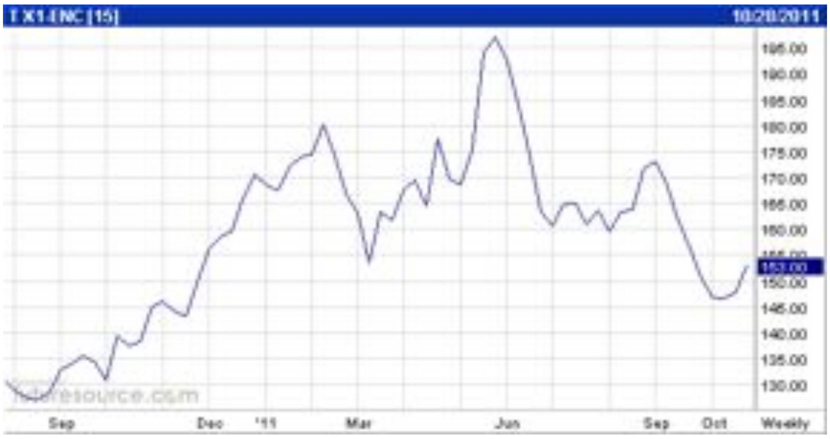
From the in-depth interviews and focus groups in this research, it is clear that the use of the futures market is, in the main, the preserve of the merchant trade. Futures are little used by farmers in England, even though ex-farm prices[2] are mainly determined by the wheat futures price indications on any day (DEFRA and HGCA, 2009). At any point, wheat futures are tradable up to two seasons in the future. This equates to approximately 28 months ahead. For example the November 2013 LIFFE wheat future opened in July 2011. This means that farmers in England can clearly see, and lock into, forward prices for their wheat crop before, during or post-drilling. The advantage of this is that margins can also be assessed, compared and assured versus other possible cropping choices before the crop is finally committed to, i.e. drilled. This business advantage is not available to other industries in which a futures market doesn't exist or a price cannot be agreed before the risky production decision is made.

Price fluctuations over the futures contract's 28-month duration have, especially during the past decade, been as great as 100% increases and 50% reductions from their initial opening valuations, as seen in both Figure 1.1 and Figure 1.3. However, 90% of farmers in England have not adopted the use of futures and options systems into their daily marketing routine (HGCA, 2014). This not only asks the question, are the futures truly reflecting the spot price in the future but, more importantly, to an individual decision-making farmer, what is the income expectation from farming enterprises?

FPRM tools can be adopted to secure a minimum price, or can be used to achieve a wheat price when there is no actual buyer of physical wheat at the moment the farmer wishes to

[2] The price per tonne the farmer receives from a buyer, for wheat collected from the farm

sell. Both mitigate the farmer's wheat price volatility when used as a 'hedge', to reduce the speculative wheat price risk.



Source: Interactive Data/Futuresource.com

Figure 1.3. Graph of LIFFE November 2013 Wheat futures.

Such is the extent of the effect of this volatility on farm incomes that decisions on drilling and marketing can appear illogical and prove to be financially ruinous. The effect on net farm incomes from 'good', 'bad' or 'lucky' selling is disproportionate to the efficiency of farming enterprise and so could be having some other more macro agri-industry structural effects. With an increasingly volatile marketplace, the question remains why are so few farmers in England not using FPRM tools more widely to hedge and mitigate this volatility (Barnard and Nix, 1973; Musser et al., 1996). Kingwell (2000) concluded that whilst at present many farmers are prepared to accept the price risk management undertaken by marketers in terms of pooling and averaging, their acceptance of such management in the future is itself an uncertainty. Although this was the conclusion of wheat farmers in Australia the same conclusion can be drawn about wheat farmers in England.

1.1 Research aims and objectives

Farmers in England, despite the recent volatility of the wheat market and its consequences for stable farm profitability, continue to use traditional methods for marketing wheat (DEFRA and HGCA, 2009). The key objective of this thesis is to investigate this behaviour, and ask why farmers in England are reluctant to adopt FPRM tools. In particular, it will examine the impact of farmer beliefs and attitudes surrounding FPRMs as well as the drivers and barriers to adoption and the role of significant organisations or social groups.

A secondary aim is to study and identify key factors in the diffusion and adoption of FPRM tools as well as examining whether individual users' characteristics and differences are important in explaining adoption.

These key objectives can be broken into more precise sub-objectives:

- With reference to wheat growing farmers in England, investigate the determinants of using FPRM tools, when marketing their wheat crop;
- Find the dominant characteristics of the wheat market in England and its selling systems;
- Find the determinants of behaviour that give rise to the adoption, or not, of the use of FPRM tools within the arable farmers portfolio of selling/marketing techniques;
- Gather, extract and make conclusions about the adoption behaviour of farmers in England towards the use of FPRM;
- Create an adoption model of FPRM tools in the wheat market of England; and
- Advance the knowledge of wheat-growing arable farmers in England and the broader agricultural sector of FPRM methods.

In order to realise these objectives, a mixed-method approach combining qualitative and quantitative research methods was used. (Teddlie and Tashakkori, 2003). It resulted in the method for conducting the one-to-one in-depth interviews, focus groups and the England wide survey. A national survey was constructed based on the data elicited from the qualitative phase. Dillman (2009) suggests methods to minimise survey error (coverage, sampling, non-response and measurement) and so reflect accurately the views of arable farmers in England.

These insights lead to certain goals:

- A literature review of the types of PRM tools available to farmers throughout the world and how they can be applicable to the farmers in England;

- The characteristics determining the use of FPRM, especially futures and options, of wheat farmers in England, by in-depth interviews and focus groups, then an extensive national survey;
- Development of hypotheses and an adoption model;
- Testing the robustness of the model;
- Propose the wider use of FPRM tools as a way of effectively stabilising income, at the farmer's SOLL[3] or above, and increasing the margins of UK wheat producers; and
- To enhance the marketing decisions of UK wheat farmers and subsequently the broader futures-based commodity producers.

1.2 An overview of the theoretical background

The methodology developed in this thesis to model the attitudes and behaviour towards the use and uptake of FPRM tools draws upon three behavioural models: The Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1980); its extension, the Theory of Planned Behaviour (TPB) (Ajzen, 1985; Ajzen and Driver, 1991); and, Diffusion of Innovation Theory (Rogers, 1995). These models are covered in detail in Chapter 4, which provides the background, theoretical framework and context for determining and predicting the adoption behaviour of FPRM by wheat growing arable farmers in England. However, as will be shown, these models are not sufficient as they fail to capture many exogenous constructs specific to this research (Bagozzi et al., 1992; East, 1993; Fliegel, 1993; Bagozzi and Kimmel, 1995; Beedell and Rehman, 1999; 2000; Burton, 2004). Therefore, in order to assimilate these important external factors into the modelling framework of this research the methodologies of an extended TPB model (Taylor and Todd, 1995a) and an Australian study on wool producers (Jackson, 2008) are further developed.

The TRA was first introduced by (Fishbein, 1967) and refined by Fishbein and Ajzen (1975) and again by Ajzen and Fishbein (1980). The assumption underlying this theory is that

[3] The SOLL, Standard of Living Line, is a theoretical conservative price, first proposed by Agricole Ltd in 1996, determined by an individual farmer for their enterprises individual crops. It gives a guide to a price at which to sell their produce. It is above the 'go bust' price, higher than the 'cost of production' break-even price. It is a price that is deemed acceptable, derived from the income the farm needs from any crop. It is based on a crop yield of 80% of a 5-year average, so producing a base price that is artificially high. It is used as an early warning price on a falling market.

human beings make rational decisions using the information they have available and that they consider the implications of a given behaviour before performing that behaviour. The principal objective of the TRA is to predict intended behaviour, sometimes referred to as Behavioural Intention (BI). This intended behaviour is considered to be influenced by two factors. The first factor is Attitude towards the behaviour (Att), which is determined by the person's own behavioural belief that the behaviour leads to certain outcomes and their evaluations of these outcomes. The second factor is the Subjective Norm (SN), which considers the influence of various social referents have on an individual's decision to perform a given behaviour. Intentions are also influenced by the relative importance of the attitude and normative beliefs.

The TRA was extended by Ajzen (1985) and revised in 1991 to form the TPB (Ajzen, 1991). An additional factor, Perceived Behavioural Control (PBC), was included as an exogenous variable. The original TRA model was unable to incorporate behaviours over which individuals have incomplete volitional control (Ajzen, 1991). That is, the intention to perform behaviour is not only influenced by attitudes and social norms alone, but by the confidence of an individual to perform that behaviour both in terms of aptitude of the individual and the resources required (Madden et al., 1992).

Comparisons between TRA and TPB and how they have been used in a multitude of diverse agricultural arenas are well documented (Madden et al., 1992; Willock et al., 1999a; Beedell and Rehman, 2000; Burton and Rob, 2004). For example, policy makers require methodologies that are standardised and repeatable (Beedell and Rehman, 1999) and 'Behavioural approaches' to investigating uptake of agricultural policy, for example financial incentives to switch to more environmental schemes (Morris and Potter, 1995).

The Theory of Innovation (Rogers, 1995), was the culmination of adoption research which began in the 1940s concerning Iowa corn farmers and their adoption of hybrid seed (Ryan and Gross, 1943). The process by which a technology or innovation is disseminated over time through different channels of communication amongst the members of a social group was described as Diffusion (Rogers, 1995). If the TRA and TPB relate to behaviour of individuals, then diffusion theory can be seen as relating to the behaviour of many individuals who share a common characteristic, such as farming. The central tenet of diffusion theory is communication and how it is used to provide mutual understanding and benefit (Rogers, 1995). As early adopters gain and communicate experience and benefit from a new technology, this influences the attitudes, beliefs and behavioural controls of others.

These methodologies are ideally suited for this research in which the primary focus is to study the attitudes and behaviours of farmers in England towards adopting FPRMs for marketing wheat. Many researchers have suggested the use of these methodologies for such studies (Morris and Potter, 1995; Burton and Rob, 2004; Garforth and Rehman, 2006; Rehman et al., 2007; Sutherland, 2010) as they have the ability to encapsulate non-economic factors such as motivations that are part of the decision making process.

1.3 Outcome

The practical and theoretical outcomes of this research come from the development of a theoretical model that will contribute to knowledge and be particularly applied to agriculture. Much effort has been involved in identifying the factors affecting the way farmers in England sell and market their wheat in their individual businesses. As yet there is no research into why farmers choose to use these methods. Those that should benefit from this research are: farmer producers; the wider advisory and English grain trade; and broader still, Government grain policy-makers.

2 Overview of wheat production, marketing and risk in England

Introduction

The objective of this chapter is to put this research into context with respect to the broader world agricultural market. The wheat market in England is reviewed together with the factors that affect risk in that market. The first section gives a brief overview of the wheat market in England and its relationship with the global wheat market. In the next section, factors affecting wheat prices, volatility and risk are discussed. These are divided into 'internal' and 'external' factors. The third section discusses farmers' attitudes and risk. This is followed by a brief introduction to current wheat selling methods in England. The final section gives a more detailed overview of FPRM tools and how they are used in the wheat market in England.

2.1 Overview of the wheat market in England

2.1.1 The world wheat market

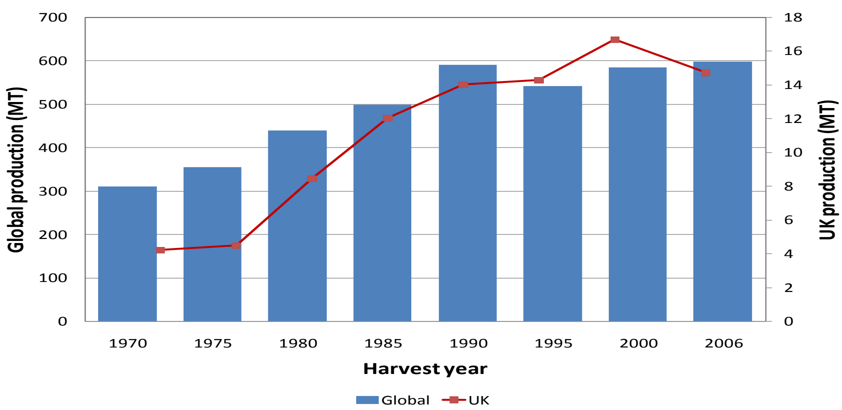
To understand the factors affecting the wheat market in England it is necessary to describe this market in the context of the larger EU, World and other significant agricultural markets that impact on wheat. Clearly, both markets will impact upon the decision making process of producers in England: firstly through the UK's membership of the EU and the effects of the CAP and secondly, the World market in terms of supply and demand. This section introduces many market attributes that impact on the wheat market with detailed discussion in later sections.

Table 2.1 shows the trade statistics for the major wheat producing countries. The US is the world's leading wheat exporter, with Canada, Australia, the EU-27, Russia, Ukraine, Kazakhstan and Argentina accounting for about 90% of world wheat exports. UK wheat production accounts for only 2.3% and the UK is therefore a price-taker, as its production will have little impact on supply and demand. The proportion of wheat production compared to total world production has increased since 1970 but the overall proportion is still small, as detailed in Figure 2.1.

Table 2.1. World wheat production, imports, exports and stocks

Country	Production 2012/13 (millions tonnes)	Imports	Exports	Closing Stocks
Argentina	11.0	0.0	6.5	0.6
Australia	21.5	0.0	20.0	0.6
Canada	26.7	0.0	18.8	4.3
China	120.0	2.5	0.5	54.4
EU-27	122.4	3.8	17.3	9.7
India	93.9	0.0	6.0	21.4
Kazakhstan	10.5	0.0	7.0	2.5
Russia	39.0	0.8	10.0	5.5
Ukraine	14.2	0.0	5.9	3.0
USA	61.8	3.5	29.9	19.2
Total	654.4	134.2	134.2	173.0
UK	15.2	0.9	2.3	1.8

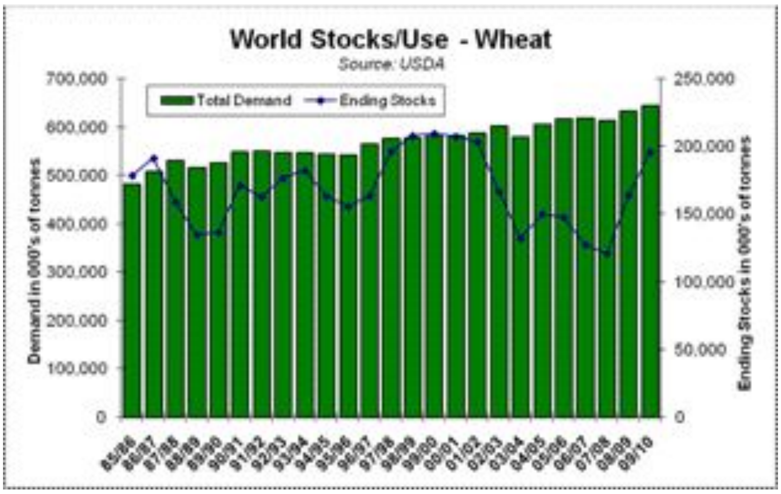
Source: (International Grains Council, 2012)



Source: HGCA (2013)

Figure 2.1. UK wheat production; UK versus World since 1970

The level of world wheat stocks and the stocks-to-use ratio, shown in Figure 2.2, is an important indicator of likely future price trends. Wiggins et al. (2010) defines the stocks-to-use ratio as an indicator of the level of carryover stock for any given commodity as a percentage of the total demand or use. A low stocks-to-use ratio tends to drive prices upwards as the market reacts to shortage in supply. The importance of the stocks-to-use ratio with respect to price volatility is discussed more fully in section 2.3.2.1.



Source: USDA (2013)

Figure 2.2. World stocks: use ratio – Wheat

Another important factor that influences the world wheat markets is government policy. Since WWII the world wheat market has adapted to many changing policies but can broadly be divided into the earlier protectionist policies (tariff barriers, quotas and international commodity agreements) of the 1950s to 1970s, through stock controls and guaranteed prices (Intervention buying e.g. wheat) of the 1980-1990s, to the more free-market orientated 'decoupled' policies of today. The latter policies leave the world wheat market subject to the effects of supply and demand of both wheat and other crops, especially competing and complementary crops such as corn/maize. A fuller description of how this shift in policy has affected price volatility is detailed more fully in section 2.3.1.2.

Corn is the world's staple food crop, both for humans and livestock. It is the supply, demand and price of corn that ultimately determines the price of other competing and complementary commodities in the global food market. It is the major complementary and competing commodity to wheat. Their prices tend to positively correlate over time with wheat trading at a higher price, detailed in Figure 2.3, based on its 5-7% higher feeding energy value (North Carloina State Universirty, 2014).

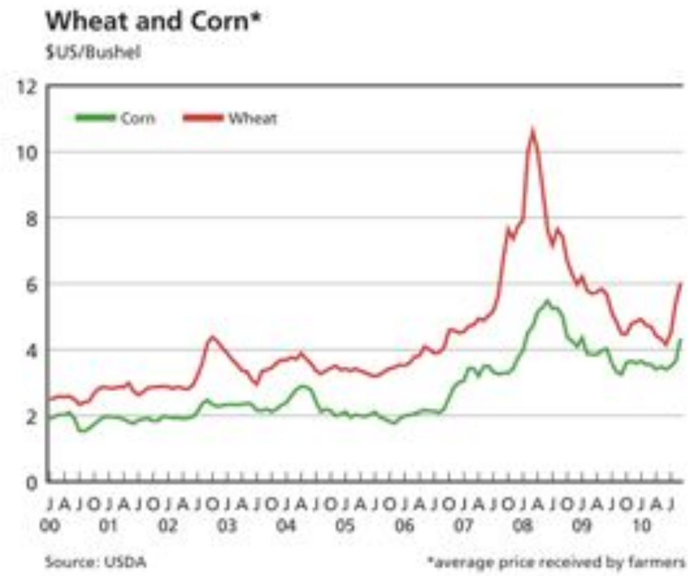


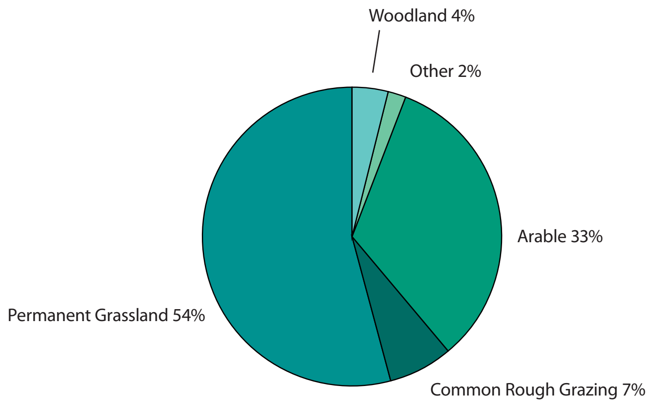
Figure 2.3. US corn and wheat prices 2000-10

In recent years, changes to the US corn market due to subsidies for ethanol production, have led to higher corn demand and as a consequence higher prices for corn. The diversion of corn away from food to fuel usage has also driven up wheat prices. This, coupled with a low stocks-to-use ratio for corn, has lead to increase price volatility in both wheat and corn since then (Hertel and Beckman, 2011).

2.1.2 An overview of the wheat industry in England

In this section the wheat industry in England is reviewed in terms of its relationship to the UK agricultural sector as a whole and at a regional production level. The industry's structure is described and the supply chain and marketing mechanisms predominantly used are discussed.

The Utilised Agricultural Area (UAA), in the UK was 17.2m hectares which is 70% of the UK's land area DEFRA (2012a). The UAA does not include woodland or other non-agricultural land. A third of the UAA is considered cropped arable area, 3m hectares, was devoted to cereal production, of which 2m hectares was for wheat production, shown in Figure 2.4. The total labour force on commercial holdings (including farmers and spouses) was 481,000. Agriculture's contribution to the UK economy has declined from 15% of GDP in 1870 to 6% by 1907 Solomou and Wu (1999), down to 6% in 1950 and 3% by 1970 Hill and Ingersent (1982). In 2008 it was 0.69% and in 2012 0.68%. Agriculture contributes 0.65% to the UK economy (Office of National Statistics, 2013).

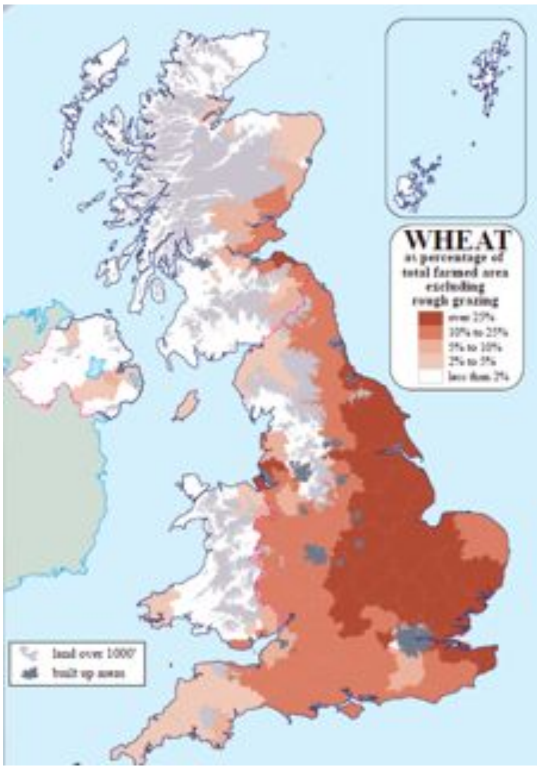


Source: Land Based Colleges National Consortium (2011)

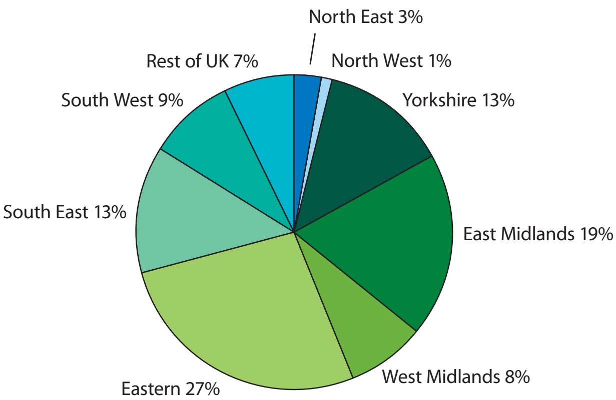
Figure 2.4 Land-use in UK Agriculture

Wheat is grown on two fifths of the UK's arable land, as shown in Map 2.1. The arable crop production regions of England are mainly situated to the South, East Anglia and East of the Pennines, where temperatures are generally warmer, topography flatter and with fewer livestock farms, as shown in Figure 2.5. These regions account for 80% of the wheat production. Annual UK production of wheat ranges from 12-17 million tonnes. Domestic usage is 13.5mt and the average annual export of wheat is 2 to 2.5mt. Stocks carried over from one year to the next are approximately 1.5-2mt. Exports vary from 0.5mt to 4mt per annum and are exported mainly to the EU, Figure 2.6.

Map 2.1. Map of cereal growing areas in UK.



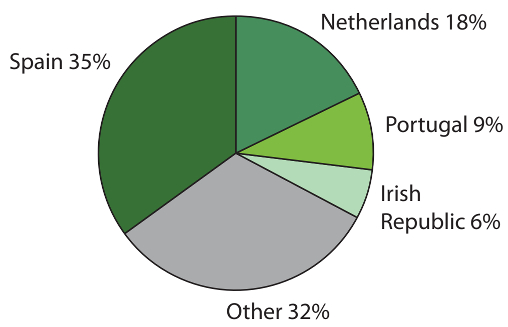
Source: HGCA (2013)



Source: HGCA (2013)

Figure 2.5. UK wheat production by region 2009/10

The UK wheat crop is divided into four categories, each with different characteristics, usages and specifications. They vary from the highest quality Group 1 and 2 varieties, for premium flour milling grists, Group 3 for a range of biscuit, cake and batter flours, and Group 4 varieties for animal feed (NABIM, 2014).



Source: DEFRA (2011)

Figure 2.6. Chart showing export trade in unmilled UK wheat 2010.

The Agricultural Industries Confederation (AIC) governs the UK's internal wheat trade. The AIC promotes the benefits of commercial agriculture in the UK and supports collaboration throughout the food chain (AIC, 2010). The AIC contract is the industry standard contract, based on the older United Kingdom Supply Trade Association (UKASTA) contract. Most producers in England use it when selling to the merchant trade. It allows for, and is often modified to encompass, individual farmers' requirements, and is therefore very flexible. These requirements typically include; payment dates, movement-by dates, weighbridge charges, and pre-agreed fall-backs for lower quality (NFU, 2009).

The merchant trade in England is the dominant conduit by which wheat, from a farmer, is transferred into the supply chain, for domestic use or export. In 2013 there were approximately 40 merchants in England, but four merchants with national coverage dominate the trade (Bojduniak, 2013). These are Cargill, Glencore, Gleadell and Openfield. The first three of these are backed by international shipping organisations and the last is a farmer-owner co-op. Further details on these companies can be found in Appendix 1.

These four companies trade ten million tonnes of England's wheat (Bojduniak, 2013). They own, or operate, most of the national network of grain stores and grain import/export facilities. They also own, part own or supply the new ethanol industry plants in England, requiring some two million tonnes per annum of wheat or corn to operate. This is equivalent to the entire UK wheat exports in some seasons. A reduced harvest in England could lead to the UK being a net importer of wheat, rather than the usual net exporter of 2-4mt per annum, a phenomenon that first occurred during the 2012-13 season and repeated in 2013-14 too producing both a demand and supply effect.

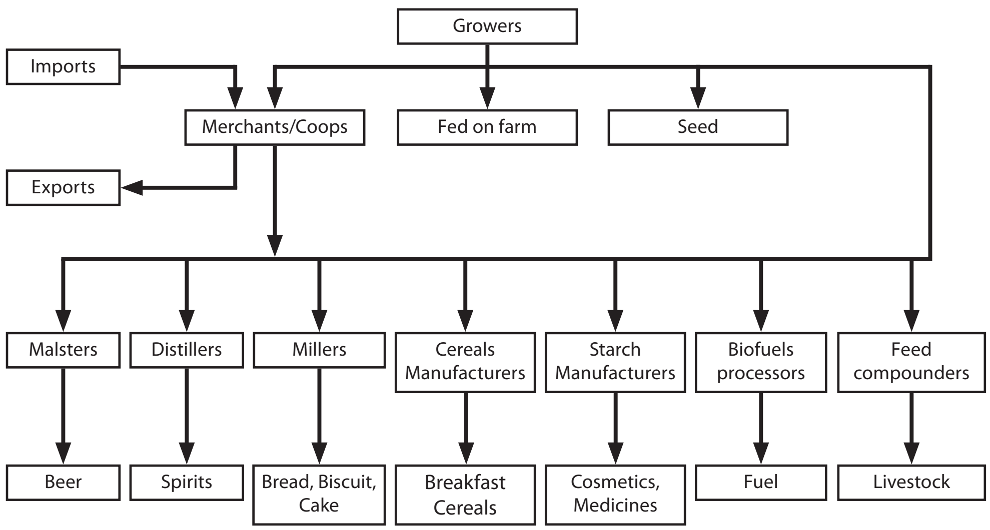
The remaining trading firms, merchants and co-ops are smaller entities, regional and local, with a smaller client base and financial structure (Bojduniak, 2013), detailed in Table 2.2. There is a very well defined supply chain for cereal production in England and this is detailed in Figure 2.7. It is an efficient mechanism for the physical movement of wheat from farmer producer to end-user (human consumption, animal feed or export). The merchant trade has many functions (Kohls and Uhl Joseph, 2001). Firstly, matching the wheat produced by farmers, of which there are many specifications, to specific end user destinations. Secondly, price formation on a daily basis, which allows the producer/end user to sell/buy wheat every day. Thirdly, price risk management of their trading positions, to allow the provision of daily pricing and buying of wheat, known as the 'market liquidity'. Without these the grain trade would cease to function. This is because if a farmer wishes to sell some wheat, be it for the current 'spot' month or two years ahead, but there is no end-user buyer, the merchant has to either not buy the wheat offered to them or buy the wheat and expose themselves to market movements (advantageous or disadvantageous) until they are able sell the wheat onto an end user. Similarly, but opposite, is if an end user wants to buy wheat but there is no farmer seller. Again, the merchant can sell the wheat to the end user, but again they will be exposed to movements in the wheat market.

Table 2.2. Tonnage of wheat traded by merchant.

Crop traders' league	Estimated volumes (Million tonnes)
Company	
Frontier	4m-4.5m t
Openfield	3.2-3.6m t
Gleadell Agriculture	2-2.3m t
Glencore	1.2-1.5m t
Nidera/G.Clark/Unwin	1.2-1.5m t
	'000s of tonnes
Grainco/Farmway/Tynegrain	750-800 t
Fengrain/HEG/SamCo	600-650 t
Wellgrain	400-450 t
ADM Direct	380-410 t
Dalmark/Barnes & Maney	290-340 t
Wessex Grain	280-300 t
McCreath Simpson Prentice	270-310 t
Harlow AG. Merchants	250-280 t
Alexander Inglis & Son	250-280 t
W N Lindsay	250-280 t
United Oilseeds	250-280 t
Criddle & Co	240-260 t
Wynnstay/Shropshire Grain	210-250 t
Scotgrain	200-250 t
Grain Harvesters	190-210 t
Bartholemews	180-200 t
North Herts Farmers	180-200 t
Saxon Grain	150-190 t
Geo Davies	150-180 t
Robin Appel	150-170 t
Heart of England Grain	130-160 t
Western Arable Services	120-150 t
Geoff Williams & Co	120-150 t
Mole Valley Farmers	120-150 t
Argrain	100-120 t
Framlingham Farmers	100-120 t
Humber Grain	100-120 t
Johnson & Saunt	100-120 t
Isaac Poad	100-120 t
Countrywide	90-110 t
WM Lillico & Son	90-110 t
Coastal Grains	80-100 t

*Of 18 million tonnes of grain and oilseed sold off farms

Source: Bojduniak (2013)



Source: HGCA (2011)

Figure 2.7. UK supply chain diagram for UK cereals.

2.1.3 Price volatility in the English wheat market

Volatility is a directionless measure of the extent of the variability of a price or quantity (Gilbert and Morgan, 2010). Prices do vary due to the seasonality of a commodity and if there are no further external influences, such as CAP reform or government intervention, these trend price movements are more predictable. For instance, lower prices during the harvest period as there is usually greater supply than demand. Weather and other random events (politics, international relations and exchange rates) are unpredictable and cause a 'supply shock', leading to unexpected changes in price and increased volatility.

The LIFFE wheat futures market, the futures market that is used to determine and hedge the wheat crop and the associated ex-farm price in England, has experienced increased price volatility since the mid-2000s (HGCA, 2011). There were price spikes, for example, in 2007, 2010, 2011 and 2012 when the wheat price rose by 45-100% whilst 2008 saw a 40% price fall. These price movements have previously been shown in Figure 1.1.

In England there are no strategic government wheat stocks to even out production variability, whilst there is a significant increase in new internal wheat demand from the new developing ethanol sector. This could have the effect of reducing wheat stock levels in

England to near zero in low wheat production years, as the ethanol demand is up to 1-2 million tonnes, and could result in greater volatility.

Gilbert and Morgan (2010) observe that although food price volatility has not increased over recent years, the volatility of the major grains have. Although this does not imply that these volatilities will remain high, it does highlight the concern that there is an increased likelihood of further sharp price movements for these products.

2.2 Factors affecting wheat prices, volatility and risk

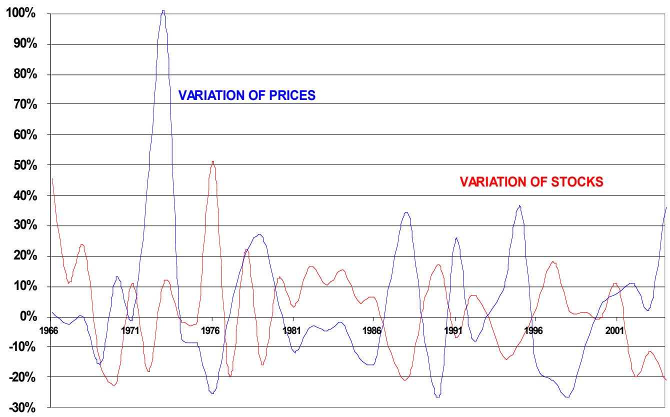
As demonstrated in Chapter 1, the level of price volatility in the wheat market has increased. In this section the various factors that contribute to, and mitigate this volatility are discussed. These factors can be broadly divided into external and internal factors associated with the English wheat market. The external factors include world markets for competing and complimentary commodities, government policy interventions, insurance of crops, environmental factors, uncertainty and risk. The internal farm factors that mitigate price volatility include the individual farming unit's diversification strategy, off-farm and non-farm income, financial liquidity and attitude and use of technology.

2.2.1 External factors

2.2.1.1 World markets

Commodities are subject to the effects of supply and demand. In the case of wheat there is a very specific relationship between supply, demand and price volatility. O'Brien (2011) states that global wheat markets have been strongly influenced by a small number of wheat exporters and importers. Of the world's wheat production, ten countries produce 84%. The top ten exporting countries account for 92% of world wheat exports, while the top twelve importing countries account for half the world's imports of wheat. The top ten wheat stock-owning countries account for 77% of world's wheat stocks. China and India concentrate on domestic usage and at present sell little of their surpluses onto the world market. The consequence of this is that a smaller number of countries are capable, and willing, to export surpluses to a larger number of importing countries. Competition for supplies is therefore intense.

As shown in Figure 2.8, in general when the world stocks of wheat fall, the price rises, and vice versa, showing the covariance between stocks and price. It can also be seen that low stocks tend to cause larger proportional rises than when stocks are high. This is because wheat is a storable commodity and supplies can be taken off the market and stored during periods of over production. Perishable non-storable crops, such as salad crops, have to be sold on the open market in times of overproduction, pressurising the price downwards. Increased prices encourage the draw down of stocks, so moderating price changes that would otherwise have been caused by supply and demand shocks. However, once stocks have been drawn down, the system is vulnerable to any further supply or demand shocks. In the absence of a buffer stock, the price variation will tend to be greater than if stocks were available. As noted, in England there are no real government price protection policies at present and no buffer stocks.



Source: Offre et Demand Agricole (2006)

Figure 2.8. Relationship between world stocks and prices of wheat 1996-2007

World supply of wheat since 1987/8 has increased from 590 to 645 million tonnes at 0.7 tonnes per annum average (yields have increased by 0.033 t/ha) (Hafner, 2003). However, demand has increased by over 6 million tonnes per annum, causing stocks to fall. This can be observed by the world percentage stock-to-use ratio, which has been decreasing at an average rate of 0.4 since 1987/8 although there is annual variability between countries and regions with regards to their own wheat supplies.

The world percentage stock-to-use is presently greatly influenced by China's wheat use and storage policy. During 1997/8-2000/1 China held 47% of world ending stocks. In February 2012 the United States Department of Agriculture (USDA) World Agricultural Supply and Demand Estimate (WASDE) reported 31%, 55 million tonnes out of 176 million tonnes. These lower stock-to-use are manifesting themselves in price volatility, especially when there is a 'supply shock'. According to the United Nations (UN) this situation of lower stock to use ratios is set to deteriorate due to a rising world population, which is expected to rise from 7 billion in 2013 to 9 billion in 2050 (United Nations, 2008) and increased demand for livestock products. It is suggested by the Food and Agriculture Organisation (FAO) that this growth in demand will make food commodity prices more volatile in the future (Food and Agriculture Organisation, 2011).

Corn underpins and influences the other cereals grown in the world, especially wheat, and consequently affects the livestock markets too. It is the world's largest cereal crop based on production and it is also the leading feedstuff for humans and livestock (USDA, 2013). In the US and South America corn and wheat compete for land, based on gross margins perceived at drilling time. Similar to wheat, global corn production and consumption are converging, so the levels of stocks are reducing and thus the price volatility of corn is also increasing. As a consequence, Westcott and Hoffman (1999) noted that events that affect the market conditions for corn and wheat and the prices of those crops, are carefully watched throughout much of the agricultural sector.

Agricultural supply and demand variables are interlinked, diverse and the intensities of the links vary. The instability of the world markets means that the signals they send become less useful, or useless. Agricultural commodities are particularly difficult as many are essential staples for life, have different production cycle lengths, growing seasons and storage abilities. Instability reduces total welfare for both producer and consumer (O.E.C.D., 1980). The effects of changes in supply can be exacerbated when the commodity is price-inelastic, that is the commodity will be bought at almost any price, as when the product is essential to a production process or a staple food item, such as wheat or corn. Since 2007, world markets commodity prices have undergone a series of dramatic swings. During the summer of 2008 food prices reached their highest levels for 30 years. Prices collapsed the following winter, before rapidly rising again in the months that followed. Food prices today remain high, and are expected to remain volatile (Food and Agriculture Organisation, 2014)

As an example of how world markets interact to produce price volatility the world commodity price increase of 2007/8, the first and greatest rise over the past 10 years, was caused by several factors coinciding. Wiggins et al. (2010) suggest this was the culmination of factors evolving over the previous five or so years. Firstly, lower supply; a combination of poor wheat harvests, higher oil prices and lower cereal stocks. Secondly, by greater demand; Chinese and Indian demand, developing biofuel industry and world economic growth. Thirdly, Government policies; export bans/restrictions and reduced import tariffs; and, lastly, depreciation of US dollar and speculation on the futures markets.

The world markets for agri-commodities have a direct impact on the English wheat market. The FAO suggests domestic supply and demand of a commodity is very important and formulates a general direction in prices (Food and Agriculture Organisation, 2011). However, supply and demand are also overlaid by world price influences; supply, demand, trade policies, economic growth, weather events, bio fuel promotion, increased use of futures markets and currency relationships. These aspects will be discussed more fully in this chapter. As a result, wheat prices in England cannot be looked at in isolation or purely on the basis of supply and demand within England.

2.2.1.2 Governmental Policy

Westcott and Hoffman (1999) stated that government action in the agricultural markets is probably the most influential factor that can both constrict and facilitate the producer's decision-making process. It has been an important objective of governments from both developed and developing countries to reduce price volatility. The consequences and development of government intervention is best understood by considering the policies adopted during the post-War period. Such policies are broadly divided into two groups, those handling stocks of a commodity through buffer stocks and marketing boards and those that do not such as trade tariffs, subsidies and guaranteed prices. However, as will be shown, the trend has been towards less government intervention and more towards a free market.

One of the purposes of government intervention is to eliminate uncertainty as producers are generally risk averse (Blandford and Currie, 1975). Massell (1969) discusses the negative impacts price volatility can have on either producers or consumers and concludes that price stability results in a net gain to society as a whole. However, achieving price stability is not the only objective of a government policy, which must also consider the consequences of a given policy for all stakeholders.

To achieve price stability in the past 50 years, governments have pursued various policies and strategies. The subject of price stabilisation is well documented (Adams and Klein, 1978; Newbery and Stiglitz, 1981).

Knudsen and Nash (1990) describe how tariffs and subsidies can be distorting as import barriers and domestic subsidies can make crops more expensive on a countries internal market. This may encourage over-production and, if the world market price is lower than the domestic price, an export subsidy would typically be needed to remove surplus. The exporting country would be producing and exporting more than normal under these trading conditions. Knudsen and Nash (1990) recommend a minimalist approach to price stabilisation, relying when possible on market mechanisms and the avoidance of handling the physical commodity.

Strategic buffer stocks are used for the reduction or elimination of price fluctuations by strategic government stocks based about a known long-run price level (Gilbert, 1996). These policies were implemented and run by the ‘buffer stock agencies’ Marketing Boards (Anderson et al., 1977). That buffer stocks are needed implies that private sector storage is inadequate by itself to regulate price fluctuations. However, the long-term price may change, so any such policy needs reappraising, due to production costs or consumer tastes. Even with a reappraisal, the government may lack the will or resources to keep the price within the acceptable range. The latter was the main cause of the collapse of the International Tin and International Cocoa Agreements (Gilbert, 2007). Even if the agencies were run well, the fact that there were spasmodically very large price movements, meant that the agencies could not react quickly enough to these changes due to the lumpiness of the commodity's supply (and there is no such thing as negative stocks). As a result the funds therefore tended to run out of money and fail (Deaton and Laroque, 1992). The major benefits of a stabilisation policy was questioned as the marketing boards appeared as a quasi-tax system that was not clearly defined (Bauer and Paish, 1952). Newbery and Stiglitz (1981) concluded that the overall benefits were exaggerated and that price stabilisation was not really practicable and not wanted either. Producers had lower earnings, with little effect on consumers. All International Commodity Agreements had ceased to function by 1996, being replaced by a more market orientated method of risk management, the futures market, in which the industry players are expected to manage the market risk themselves (Gilbert, 1996; Gilbert, 2007). Over the past 20 years there has been a shift from government protectionism to producers' own price risk management (Westcott and Hoffman, 1999).

McKinnon (1967) found the idea of using the futures market was not new and concluded that Governments' stabilisation schemes fail, because they over emphasise the effect of the present market, and not the longer term, with forward pricing mechanisms. Two decades later Gilbert (1985) in his work on futures and stabilisation schemes, suggested that economists should look more closely at the use and role of the futures market in 'primary' commodity markets as they have the benefit of providing an element of insurance, negating some of the risk benefit of price stabilisation schemes, making them less worthwhile. Concurrently, Gemmill (1985) concluded that futures markets could be significantly less costly than traditional buffer stocks and an appealing method for hedging the risk of export earnings. Private stock holding, as a buffer, were also discussed. Others found commodity price stabilisation policies adversely affected stability and that technical change, futures markets and private savings should be used to manage risk (Kannapiran, 2000).

At the beginning of the 1980s there was a call for greater market intelligence and forecasting, more flexible national structures and international dealings (O.E.C.D., 1980). This was because there was not only a need to alleviate the possible welfare problems of price volatility (to buyers/sellers, consumers/producers) but also to address the constantly changing marketplace (Newbery and Stiglitz, 1981). The World Bank described, in five volumes, the negative effects of many government interventions (Krueger, 1992). Part of the EEC's CAP infrastructure was Intervention prices for wheat. In practice this was effectively a minimum price guarantee for its farmers. Due to the quantity and cost of wheat (and other agri-commodities) in store within the EU, the minimum prices were reduced and intervention standards increased (Ackrill, 2008). Intervention has now ceased to be an effective or widely used alternative to free market pricing in the EU but is there if prices fell to world price. Due to higher current prices and higher quality standards, English feed wheat is no longer eligible for intervention.

The mid-1990s saw a change in government policy, away from Government intervention and towards market forces. In the US, the Farm Act of 1996 (Federal Agricultural Improvement and Reform Act) acted to shift price risk to the producer from the existing government income support program (Young and Westcott, 1996). This was superseded by the Farm Security and Rural Investment Act of 2002, FSRIA, or commonly termed The 2002 US Farm Bill (Sumner, 2003).

From the EU perspective it was felt that reform was needed in the 1960s with calls for agricultural support to be removed (Nash et al., 1965). By 1970 the Agri Study Group established by the Federal Trust for Education and Research called for Temporary Auxiliary payments to facilitate adjustment to compensate farmers. The Atlantic Institute, also in 1970 proposed a reduction in CAP support prices with direct aid compensation (Uri, 1970). The Producer Entitlement Scheme (PEG), to support farm income while reducing or eliminating international trade distortions, would entitle each farmer a pre-set limit on the quantity of produce eligible to receive support payments Blandford et al. (1989) with production above the allotted quantity not receiving compensation. Tangermann (1991) advanced as part of farm reform, full de-coupling of production and payments. It was in the form of a bond scheme for supporting farm incomes in a report for the Land use and Food Policy Inter-Group of the European Parliament (Beard and Swinbank, 2001). A Common Agricultural and Rural Policy for Europe (CARPE) was discussed (Buckwell et al., 1997). One CARPE measure, Transitional Adjustment Assistance (TAA) payments would be decoupled from production, non-distorting to competition, and subject to the respecting of environmental conditions.

The Punta del Este declaration, 1986, launched the Uruguay Round of GATT negotiations (Josling et al., 1996; Swinbank and Tanner, 1996; Tangermann, 1996). The Agreement on Agriculture 1994, which formed an integral part of the Uruguay Round agreed commitments on domestic support. During the Uruguay Round, Ray MacSharry, the EU's then Commissioner for Agriculture, launched a set of reform proposals in 1991 that was adopted in part by the Council of Agriculture Ministers in May 1992 (Swinbank, 1993). The 'MacSharry reforms' and the 1992 Blair House Accord concluded between the US and the EU, concluded the Uruguay Round in December 1993. For cereals, farmers were entitled to claim a flat-rate area payment on each hectare planted while support prices were reduced. In order to qualify for the arable area payments farmers had to set aside a fixed proportion of their arable land.

Agenda 2000 sought to deepen the 1992 reforms and the need for CAP reform to cope with the difficulties experienced with the existing policy, the challenges of proposed EU enlargement, and to prepare for the next round of WTO trade negotiations by establishing a coherent policy framework for the period 2000-2006. Under the Agenda 2000 reforms the 'MacSharry' payments were subsequently increased. There was a need to compensate farmers for an income loss, so the scheme was designed to reimburse a reduction in farm revenues from the sale of cereals. (Beard and Swinbank, 2001).

As trade barriers are removed new markets would emerge providing increasing opportunities for EU farmers (Swinbank, 1999). By bringing the price of EU agricultural products closer to world prices, competitiveness on both domestic and world markets would be enhanced. For cereals there was a further reduction in the support price, but an increase in the existing area aid to compensate for half this price cut. The final agreement was a much weaker version of CAP reform than that proposed by the Commission, or provisionally agreed by the Council of Agriculture Ministers (Swinbank, 1999). Agenda 2000 seeked to strengthen the environmental provision of the CAP and to integrate them in a more systematic way into a broader policy for rural development. This was borne out by the fact that agri-environmental measures are the only compulsory component of the Member States' rural development programs submitted to the Commission. Member States may also make direct payments conditional on compliance with environmental targets (‘cross-compliance’). Payments may be reduced or cancelled in the case of non-compliance. The Agenda 2000 agreement gives Member States the opportunity to modulate direct payments made to farmers under the CAP based on criteria (European Commission, 1999).

On 26 June 2003, EU farm ministers adopted a fundamental reform of the CAP, based on ‘decoupling’ subsidies from particular crops. The new ‘single farm payments’ are subject to ‘cross-compliance’ conditions relating to environmental, food safety and animal welfare standards. Many of these were already either good practice recommendations or separate legal requirements regulating farm activities. The aim is to make more money available for environmental quality or animal welfare programs. Details of the UK scheme were still being decided at its introductory date of May 2005.

The most recent reform, ‘The CAP towards 2020’ was made in 2013 by Commissioner Dacian Ciolos and applies for the period 2014 to 2020 (European Commission, 2013). The EU’s Common Agricultural Policy is undergoing major reform towards greater market orientation. Tighter budgets as well as environmental and trade considerations have led to the reduction of market interventions. Direct payments provide a basic level of income to farmers in Europe, a basic income payment to those farmers. Rural development measures to ensure high-quality practices and rural development support facilitates structural adjustment of farms in Europe. The decoupled direct payments while providing income support, ensure farmers respond to market signals, while also contribute to sustainable farming and economic viability via structural adjustment. The responsibility to manage risks is increasingly in farmers’ hands. Market instruments are used to provide market safety nets as intervention prices are set at low levels, especially for wheat. Perhaps it is now timely for wheat farmer in England to engage as deeply with wheat financial price risk management as they do in the growing of their wheat crop by exploring the variety of private risk management tools available to them. Most likely, they will increasingly use financial derivatives and insurance products. Policy makers may consider encouraging the use of derivatives to cope with price volatility by promoting training, ensuring availability of information and ensuring judicious regulation on these products.

Figure 2.9 gives a timeline of the CAP reform process.

1957	**Treaty of Rome**
1958	**European Economic Community Inaugurated (EEC)**
1960 - 1970	**Common Agricultural Policy (CAP) Introduced** • To create a single market in agricultural produce in the EEC • Treaty of Rome (Article 39) • Ensuring availability of supplies & a fair stand of living for the EEC's Agricultural Community
1973	**Accession of UK to the EEC** • The UK adopts the CAP
1980	**'Price and market support' mechanisms** • Surplus Removal • Export subsidies • Variable Levees on Imports • Overproduction
1986	**Launch of Uraguay Round of GATT** • CAP & GATT reform
1992	**MacSharry Reforms** • Reduced Subsidies but farmers compensated by direct payments • Setaside Introduced
1999	**Reforms of CAP 'Agenda 2000'**
2005	**'Decoupling' of payments from production** • Single Farm Payment introduced, not linked to production but environmental management, food safety & animal welfare
2008	**'Health Check'** • More changes as shortages of supply of food • Removal of Setaside & milk quotas
2013	**"CAP towards 2020"**

Figure 2.9 Timeline summary of CAP reforms

The current rules and regulations for international trade are governed by the WTO with the rules importantly agreed by the multi-government members. The broad principles concerning the trading of 'goods' are agreed under the General Agreement on Tariffs and Trade (GATT). However, the GATT had provisions for non-tariff measures such as subsidies and import quotas, which still distorted agricultural markets. The Uruguay Round agreements were developed as the first multinational agreements between 1986-1995 and are the basis of the current WTO system. These include the lowering of tariffs and other trade barriers. The objective of the GATT is to make the policies more market orientated and apply to: market access, domestic support and export subsidies. Governments can support their agricultural sector but through less trade distorting policies, and has flexibility in the way their commitments are implemented. Further policy developments were continued via the Doha Conference 2001, under the Doha Development Agenda, and it continues to progress major trade reform (World Trade Organisation., 2014).

Any policy that sets out to stabilise prices must take into account the often conflicting objectives and issues of the different stakeholders. Such intervention policies can be justified on the grounds of a more unified income and welfare distribution (Blandford and Currie, 1975; Chambers, 1989). However, the difficulty of balancing the outcomes with respect to all the stakeholders has driven the trend towards less intervention (Varangis et al., 2002)

Post-WW2 and up until the UK joined the EEC in 1973, its government agri-policy was funded by the taxpayer via deficiency payments and not directly at the cost of the consumer. Guaranteed prices were fixed annually following an annual agricultural review. On accession to the EU and adopting the EEC's policies there was a major shift in policy and the trading environment for farmers in England, with intervention policies guaranteeing prices above the world price and encouraging over-production. Agricultural protection was borne largely by the consumer and not the UK Treasury. Farmers in England had little need of price risk management, as it was effectively provided by the EEC, via intervention payments. Following the 1992 Reforms, Agenda 2000 and the CAP reform of 2003 the intervention pricing policy was in effect removed to leave very little EU wheat price regulation. The farmer in England has to react to the wheat prices that are prevailing on the day, for spot movement or future movement periods. Only the SFP is present as an income enhancing distortion but is based on hectares grown, not production or crop prices. However, managers are more concerned with variability in losses and less in variability in gains (Mao, 1970; Adams and Montesi, 1995) or 'downside risk' and 'upside potential' respectively (Lee and Rao, 1988). Having the SFP may effectively provide the farmer with a stronger balance sheet, so reducing the downside risk and therefore the need to use FPRM tools (Lien and Tse, 1998).

2.2.1.3 Environmental factors

The weather is a major contributor to the fluctuations in yields of crops. It is this variation in production that affects eventual supply availability. This leads to supply distortions, which consequently give rise to greater price volatility. This, in turn, is reflected in the quantity of the crop that can be internally consumed within the country of production, the quantity available to trade, exports to third countries, and the level of carryover stocks available from one year to the next (United States Environmental Protection Agency, 2013).

The greater the range of temperature, sunshine hours, rainfall, both within a growing season and between seasons, then the greater the effect on yields (Schlenker and Roberts, 2008). This variation also affects the acres planted of all crops competing for available land. This range tends to increase as production moves from a temperate to tropical climate. It is also more varied within large landmasses such as North America, the Former Soviet Union (FSU) and China, where the difference between summer and winter temperatures is greater than temperate climates.

In England, due to the more temperate climate, the risks of catastrophic loss is low and is not a feature in a risk assessment calculation when considering growing crops, especially wheat. The weather effects of global warming could lead to increased yield variation and become a more important issue to producers of wheat in the future (Wheeler, 2009).

As an example of the profound impact the weather can have on grain quality, Wiggins et al. (2010) state that environmental factors were one of the key drivers of the 2007 commodity price rise. Similarly, the 2011/12 wheat price rise developed from the very hot and dry summer weather in the FSU states, reducing its supply and its export ability. This manifested itself in greater demand for EU crops filling the shortfall and the subsequent market rise. This coincided with a 100-day drought (March to the end May 2011) in the northern EU, including England, which further drove up the wheat price.

A second more recent example was in 2012, corn and wheat prices rose by 25%. This was initially caused by a severe drought in the corn growing regions of the Mid-West of the USA and further exaggerated by very low stock levels. This combination of factors increased both corn and wheat prices globally. In addition, England experienced a very wet and cold summer, which produced a wheat crop which was of very poor quality, lower yield, and lower production, which further increased domestic prices (HGCA, 2012).

Therefore it is these environmental factors, be they a world or to a lesser extent an internal event in England, which affect the wheat market and its price in England.

2.2.1.4 Insurance

The insurance of agricultural commodities against environmental factors and yield reductions are designed to mitigate negative impacts on individual farmer incomes. However, the consequences with respect to price volatility are not so clear or indeed positive. Although there is no widely used mechanism for insuring the wheat crop in England, in terms of production or margin, the consequences of insurance in other large wheat producing countries still impacts on the domestic English wheat market.

Insurance in other countries is often part of a larger mechanism for limiting the risk associated with production and price variability. These mechanisms include revenue insurance, yield insurance, futures, and options contracts (Miranda and Glauber, 1997; Mahul, 1999; Mahul and Wright, 2003). The key assumption is that the scale of the perceived and actual risk is quantifiable and known. Surveys often ascertain the perceived risk, as in the case of Californian fresh tomatoes (Hueth and Ligon, 1999), Swedish land investment (Lence, 2000) and USA farmers' attitude to time preference and risk (Lagerkvist, 2005), but not the actual risk. Goodwin (2001) concluded that crop insurance is not always effective at removing risk, not due to a market failure, but because farmers are not strongly risk averse and therefore do not have a very high willingness to pay for insurance. The willingness to pay is not greater than the cost of providing the service.

The consequence of this lack of risk aversion suggests the intervention of government to subsidize the private sector for the true cost of the insurance (Goodwin (2001) or perhaps the government should not interfere at all. For example, during the period 1981-99 for each \$1 paid by USA farmers in insurance premiums, \$1.88 was paid out in insurance claims (Miranda, 1991; Deng et al., 2007). Other reasons for government intervention are the perennial global problems, when dealing with wide universal yield insurance, of 'moral hazard' and 'adverse selection' issues (Chambers, 1989; Coble et al., 1997; Just and Calvin, 1999). Concerning moral hazard, farmers' actual yields for insured wheat, sorghum and corn were lower than expectations (Coble et al., 1997). Just and Calvin (1999) reported that due to limited information, US corn and soya farmers taking up government insurance were the ones with higher expected indemnities. Farms with lower expected indemnities felt premiums were too high and did not insure. More accurate records are needed for verification and thus avoid the moral hazard and adverse selection issues that plague such schemes, for example corn yields in the Parana region of Brazil (Ozaki et al., 2008). The level and scope of fraud by producers is high (Atwood et al., 2006).

The net effect of these insurance schemes is the production of crops on less suitable ground and establishing the crop at a non-optimal time (Horowitz and Lichtenberg, 1993). By having insurance, or even the existence of the SFP in England, the producer is less risk averse in their production decision-making. This leads to an eventual yield that is more variable than the norm and so affects supply so potentially leading to increased price volatility within the country of production and in turn is affecting global prices. The effect of insurance on the rates of use of fertilizer and agricultural chemicals in the mid-west of US has also been researched (Horowitz and Lichtenberg, 1993); the results showed that both were used more when an insurance policy is attached.

Due to the cost to the USA government of fraudulent claims by 'yield switching' between units (over or under reporting of yields), there were increasing claims by producers, and resulting higher premiums. Even policies subsidised by 2/3rds are not always taken up by producers and that 1-5% of claims in some States were fraudulent (Atwood et al., 2006). The increasing complexity of the insurance policies will undoubtedly lead to more disputes. Halloran et al. (2009) predicted that there would be more disputes between the farmer and the insurance companies if global warming disturbances adversely affect crop yields and therefore margins.

Weather insurance is important in world agriculture where weather is volatile, extreme and a significant factor in yield variability. Insurance has two major obstacles to overcome to be effective and meaningful and to gain widespread product sector acceptance. They are defining the relevant specific weather event and pricing of the product at the time of that event (Zeng, 2000; Richards et al., 2004). This insurance does have the advantage over crop yield insurance schemes in terms of a near zero moral hazard issue, as it is based on quantified weather events based on the conditions recorded by local weather stations and not 'reported' crop yields (Rubinstein and Yaari, 1983; Chambers, 1989; Coble et al., 1997). Turvey et al. (2006) discuss its application to the ice-wine industry of Ontario, where the grapes have to be picked in a frozen state, insurance is based not only on harvestable hours but also when they occur. The weather is an economic instrument for price risk management as harvesting the grapes at the right time enables the wine to be sold for four times the normal price.

2.2.1.5 Information

From Adam Smith to today it is recognized by economists that efficient markets depend on information and its availability. Fama (1970) defines an efficient market as one where prices fully reflect all the market's information. Just et al. (2002) highlighted information as a valued tool and noted that decision-makers have learned that gathering, analysing and turning information into action, is a process that takes great skill and some cost. It can deliver large rewards. To take action without it, risks taking inappropriate action and, potentially, the wasting of valuable resources, effort and a lower profit. Information regarding the volatile wheat market is required to avoid these pitfalls.

The value of information can be measured by the extra profits from having information versus profits without. Babcock (1990) looked at weather information and Sumner and Mueller (1989) considered USDA market information regarding harvest futures prices. Both were comparing individual and groups to see if there was any difference in the information value gained. They both showed some winners and some losers. Lave (1963) showed that Californian raisin growers would be better off with less than perfect weather forecasts, as even a modest increase in supply from weather protection would lower overall industry profits because of the inelastic demand of raisins. Sumner and Mueller (1989) showed that there was a significant gain from the use of the USDA harvest forecasts as they affect market price movements.

It is one thing to have access to information but another to process and interpret the information. Schultz (1975) explored how education and experience influenced the efficiency of people to perceive, interpret and take appropriate action to reallocate their resources. That is, a person's 'allocative ability' and their ability to cope with 'disequilibria'. It was noted that people were heterogeneous and so they receive and need information in different forms for the best results. Just et al. (2002) studying USA agri-business, concluded that education was positively related to data use. The higher the education level, the more raw data analysis was undertaken. The agri-trade used more formal, public information and analysed the raw data more than farmers.

Tin the context of agriculture, there are many types of management and pricing information available, and used, by farmers as part of their businesses. They are broadly divided into private and public information. Information can come from public sources, government agencies, but also from private trade associations, professional organisations, social contact or private consultants. However, it is unclear as to the relative importance to an individual between private and public information (Just, 1983; Salin et al., 1998; Wolf et al., 2001).

Private information

Much of the advice and information comes from subscription 'market advisory services'. For a fee they provide pricing advice on when to sell, how much to sell and levels of hedging on the futures and options markets. The farmer hopes to achieve a higher margin as a result. Farmers also require market related information, government reports, market commentary and analysis, and help in actually applying these trades (Patrick et al., 1998; Davis and Patrick, 2000; Katchova and Miranda, 2004; Pennings and Garcia, 2004). Also farmers used more specialised private information, tailored to their business and less public information. How farmers specifically use this information is open to debate (Pennings et al., 2001).

In England there are many sources of private agri-business and marketing advice. Some is 'free' from the merchant trade, but how unbiased and independent it is, is open to debate. Merchant information is usually in the form of a weekly email, supplemented by text messages and emails to inform the farmer of price changes. Other marketing information is chargeable, such as the Farm Brief Magazine (Bojduniak, 2013), or provided by independent private companies, such as Agricole (Agricole Ltd, 2014), or 'whole farm' crop marketing from land agents, such as Bidwells (Bidwells, 2014), Strutt & Parker (Parker, 2014) and Savills (Savills, 2014). Quasi-governmental, farmer and merchant trade funded businesses, such as the Home Grown Cereals Authority (HGCA), now part of the broader Agricultural and Horticultural Development Board (AHDB), provide much valued independent research information to farmers. The HGCA sends out many crop reports and marketing advice notes directly to all levy paying farmers, as well as having a very comprehensive and informative website (HGCA, 2014). The HGCA does much highly rated independent research on a wide range of aspects of crop production, diseases and storage (HGCA, 2011). Over the past five years it has introduced a benchmarking system for farmers and holds many seminars around the country on FPRM techniques. However, the HGCA does not give specific farmer advice on a one-to-one farm level or help with selling/marketing directly.

Public information

This information source is both long and short termed. Many reports are regular and scheduled. The long-term market information would include macro-economic events. These include political unrest, impending war, elections or economic cycles. They can be watched as they develop and their various consequences analysed, if not totally anticipated. The shorter termed are regular market information via government reports e.g. USDA in the USA (USDA, 2014), Department for Environment, Food and Rural Affairs (DEFRA) in the UK (DEFRA, 2014) and Australian Bureau of Agricultural Resource Economics (ABARE) in Australia (ABARE, 2014). They have known announcement dates, and are awaited by market participants. Farmers make market decisions based upon their content, e.g. monthly USDA Crop production reports and the USDA's WASDE report. The commitment and importance of providing information to the agricultural sector is clearly seen from the development of the US National Agricultural Statistical Service (NASS), in 1992. It had a budget of $82m, 10% of total expenditure for all federal statistics to provide information to agriculture (Garcia et al., 1997). It releases five revisions per year for corn and soya. These reports are available to all with access to the internet and are not just the preserve of the hedge funder or corporate trader. The reports are an important part of the individual farmers' marketing strategy. It is the interpretation and speed of reaction that differs between recipients of the information. Wheat farmers used public USDA information, as it is regarded as reliable, and they had many years of experience of using it. Farmers also used more informal information than did the agri-trade (Pennings et al., 2001).

Early work on predicting movements of USA share prices found that prices only changed with the emergence of information that was considered unpredictable and that the resulting changes in prices were unpredictable (Kendall and Hill, 1953). Fama et al. (1969) analysed the USA stock market and concluded that the markets were 'efficient', in that the prices of stocks adjusted very quickly to market information. The USA hog market saw a response to USDA information, the response time differed between short-term contracts and longer ones, the former reacting the fastest to new news (Miller, 1979). Hoffman (1980) examined quarterly livestock reports on cattle and hog prices. It was shown that futures prices moved less than the cash prices, the authors concluded the former was more efficient and had estimated the market supply better. There is little evidence, especially looking at corn, soya and wheat in the USA, that advisory information seminars outperform market benchmarking, suggesting these crops are operating in efficient markets (Zulauf and Irwin, 1998). This is contrary to the theory that markets are inefficient and do provide opportunities for enhanced profits from advisory services (Wisner et al., 1998). This could be due to the fact that farmers can now have access to similar information to their advisors. However, even though advisors cannot achieve a better return than the market all the time, they potentially aid the farmer in improving their chance of a better return. Perhaps this is by encouraging the farmer to be more proactive when marketing and also seeking appropriate information at key moments in the trading season.

In the wheat market in England, information from official government sources is scarce. The UK government information, from DEFRA, is infrequent and the time lags are greater than the USA reports. This potentially has the effect of making them somewhat irrelevant, as the reported details are by then somewhat historic, and the market has already reacted to them. This researcher can find no research, equivalent to the USA research, on the value or effect of advice/reports for the wheat futures market in England. At present much information available to the farmer in England is via merchant operations, with their inherent bias, supplemented by regular but less timely information from DEFRA and HGCA.

This lack of information is somewhat tempered by the large array of information available from the internet. Farmers' in England acceptance of the web and computer use has now become almost universal, with 98% having access to a computer (DEFRA, 2013). There are now many sites providing information on farming issues and business but there is also much 'extraneous' information for the browsing customer (Just and Just, 2006). The problem now is filtering the complex array of information available, into a readily digestible form and then transforming it for use in the decision making process, to help reduce the risk to the farmer's business. Only the specialist paid-for advisory sector adds recommendations to their reports, suggesting what the farmer should do and provide their farmer customers with better guidance and consistency in their decision-making process and so enable them to achieve greater margins.

2.2.1.6 Uncertainty and Risk

Hardaker et al. (2004) summarises uncertainty as imperfect knowledge, while risk is uncertain consequences. Uncertainty is when an unexpected event happens, its likely occurrence is 'unmeasurable'. If an event can be expressed as a probability or a frequency, it is no longer an uncertainty but a risk. When there is little or no empirical evidence and so impossible to apply a meaningful probability or frequency to the outcomes, that is uncertainty instead of risk (Gigerenzer, 2002). Knight (1921) commented that the observed difference between actual and theoretical competition is due to uncertainty not risk. Theoretical competition is when the value of goods equals their costs, whereas actual competition tends towards this equilibrium. The two are separated by a margin of 'profit', positive or negative. It may not be possible to measure but uncertainty can be assessed and managed via worst-case scenario planning and then the risk transferred to another form, such as insurance.

Developed nations with established international trading policies are more open to world price effects and therefore have a greater concern over price volatility (Gilbert and Morgan, 2010). Global price volatility of agricultural commodity markets is being transmitted to the wheat market in England. This is increasing uncertainty and the risk of making poor wheat-marketing decisions for the farmer in England. In common parlance, risk and uncertainty are regarded as the same phenomenon. They both have a negative connotation and are not viewed as an opportunity as they could be. A thorough review of farmer decision-making and attitudes towards uncertainty and risk is given in section 2.4.

In an agricultural context, many risks and uncertainties are due to the vagaries of the weather, resulting in uncertainty of output. This makes farming a very financially risky occupation as harvest intervals are in many cases long. The consequences of decisions made at, for example wheat drilling time, may not be clear until harvest, nearly a year later. This is because the growing period for wheat is nearly a year, and the prices and yield of the crop change during that time. A sale a year ahead may turn out to have been the correct decision, if the price falls, but not if the price rises. Selling a set tonnage of physical wheat forward may be the wrong decision if eventual harvested yields are reduced and the wheat is not available as contracted. This shortfall, to meet the contract terms, is usually filled by the grain merchant. They will buy-in the shortfall quantity from another farmer or merchant. A 'buying-in' charge (the difference between the original contract price and the current price) is often the result, and is passed to the original contracted farmer. That farmer therefore has two costs, a lower yield and a price penalty.

Increasing volatility in the agricultural commodity markets, as represented by increasingly unknown/uncertain probabilities of specific outcomes, results in a greater variation of possible price outcomes, thus increasing financial risk. Hazell (1985) postulated that a more realistic indicator of the trend in world food security is the probability with which aggregate production can fall substantially below the trend line. The variance of world cereal production is directly attributable to changes in the variances and co-variances of crop yields (Hazell, 1985), also world cereal production is likely to continue to become more variable in the years ahead (Irwin et al., 2009).

Commenting on the commodity fluctuations in 2007-8, it has been concluded that there is little evidence that a speculative bubble drove the boom and bust in commodity prices (Irwin et al., 2009). Empirical evidence of available data did not show that speculation by 'long-only' index funds impacted on commodity futures prices. A better explanation for the movements in commodity prices was due to economic fundamentals (Wiggins et al., 2010).

It can therefore be seen that there are many external factors affecting the agricultural market in general and the wheat price in particular which contribute to risk and uncertainty. These influences should perhaps be included in any model to explain the farmer's behaviour towards price risk management as they influence their day-to-day input costs and output prices of their business and wider business environment.

2.2.2 Internal factors that mitigate the effects of price volatility and risk

In this section the various factors that contribute to mitigation of price variation are discussed. These factors can broadly include the individual farming unit's diversification strategy, off-farm and non-farm income, financial liquidity and attitude and use of technology.

2.2.2.1 Diversification

The building of a resilient business by diversification means the business's income is not totally dependent on just one enterprise. Lin (2011) in the context of climate change, stated that producers are moderately risk-averse and they would benefit from diversifying enterprises to reduce risk. Developing best practices on a farm scale can buffer the harmful effects of climate change, maintain high yields and provide economic benefits (Lin, 2011).

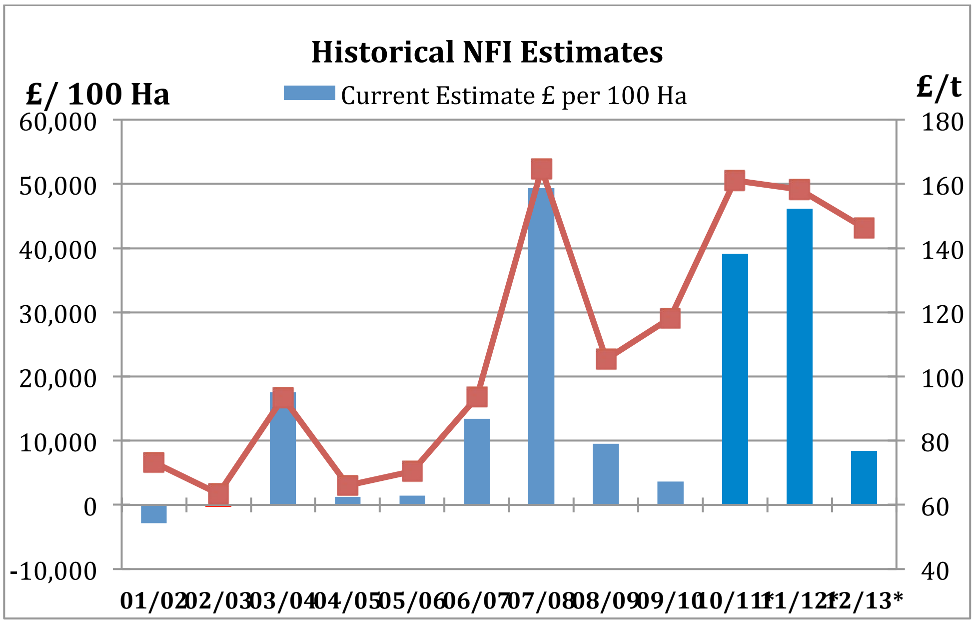
Assuming perfect knowledge, a producer will try to achieve two things. Firstly, substitute different 'goods' (enterprises or crops) to get their marginal revenues equal. That is the substitution of 'good X' for 'good Y', but maintaining their overall 'utility' (satisfaction/risk/income) constant (Hicks, 1946). This also take into account any positive or negative effects of these new combinations. It is another way of expressing the opportunity cost of producing one more unit of one good versus using another good. Secondly, the producer will try to reduce the variance of outcome of any enterprise/crop combination, i.e.

there is no point having a combination which results in a likely repeated loss. This is particularly relevant to crops where price and yield variations are great. These two are obviously related. The problem is that it can also reduce average returns.

Income variability from diversification depends on the correlation between products, variability will reduce if the products/crops concerned are negatively correlated. There will be a trade-off between increasing income and reducing income variability depending on the producers' risk attitudes towards these two aspects. Some producers may forgo large possible incomes to guarantee an acceptable minimum level of income. These trade-offs are well documented (Heady, 1952; Stovall, 1966; Johnson, 1967; Robison and Brake, 1979).

The USA Federal Crop Insurance Reform Act 1994 (FCIRA) was used as the subject of research to see if there was any effect of insurance on levels of farm diversification (O'Donoghue et al., 2009). Prior to FCIRA most farmers did not buy significant levels of crop insurance, depending instead on a combination of crop rotations, capital and labour combinations, spot, forward and some futures contracts. Farmers also used cash, credit and loans (Pope and Prescott, 1980). Following FCIRA there was indeed a rise in the take up of insurance policies, mainly due to their subsidised nature. Depending on the crop, there was between a one to two thirds increase. However, the increased specialisation of enterprise that was anticipated from effectively having a safety net, so reducing the risk of a bad income year, was muted. It was at best 2%, so FCIRA only marginally influenced farmers' crop-allocation decisions (O'Donoghue et al., 2009). Lence (1996) found that if farmers have a more diversified investment portfolio, then their optimal hedging ratio is lower. Second, other risk management strategies or instruments are also likely to reduce the level of hedging that farmers prefer (e.g., government-sponsored price and income support; (Mahul and Vermersch, 2000).

Specifically within wheat marketing in England, as there is no equivalent to FCIRA, there is a range of selling techniques to mitigate selling at a low price, such as spot, forward, minimum priced and pool contracts. These techniques were used by farmers as a reaction to the perceived increased wheat price volatility since 2007, (the strategy of selling 'a little and often' was practised by most respondents in this qualitative research, see Appendix 7), in the belief of achieving the average price during the season and so stabilising net farm income (NFI). It can be seen that this is not the case, as the average price of wheat over time is not constant. This was previously detailed in Figure 1.2 showing the NFI per 100 hectares and wheat prices from 1993/4 to 2007/8, with projections until 2010/11. Figure 2.10 shows the NFI and wheat prices from 2001/2 to 2012/13 in more detail, with the associated current estimate NFI per 100 ha.



Source: (HGCA, 2013)

Figure 2.10. Relationship between average wheat price and net farm income 2001/2 to 2012/3.

2.2.2.2 Off-farm / non-farm income

Earning a living from off-farm working and generating revenue streams from non-farm income sources can be seen as another form of farm diversification to protect, enhance and allow the longevity of the farm enterprise. It should be seen as the use of the farm's assets, its human capital and physical assets, to generate an income stream. This is not a new idea and was first discussed concerning firm-household utility (Heady, 1952). When studying Kansas farmers it was concluded that off-farm income significantly helped in averaging out income streams (Mishra, 1997). USA research suggests risk-averse farmers with variable revenues will tend to have a greater percentage of more guaranteed or stable off-farm income.

The 2007 USDA's Economic Research Service (ERS) highlighted the issue that the household's economic balance, performance and production decisions were affected by the managerial time of the farm owner and spouse competing with on-farm and off-farm activities (Nehring et al., 2004). The report found that smaller farms had more off-farm employment, spent more hours off-farm and had larger off-farm income than larger farms. Since 1960 in the USA, the level of real on-farm income has remained at near $20,000 but the real off-farm income has risen from under $20,000 to approximately $70,000 pa. Its percentage share of total income has risen from 55% to 80% over the same period.

In England it is estimated that £42-100/hectare of an arable farmers' income comes from non-farm income. The greater the net margin of the producer the lower the contribution to income is from non-farm income (Nix, 2011; Farm Business Survey, 2014). However, when wheat prices were below £100/t, the most efficient farmers had a higher percentage of non-farm income (Churchgate Accountants Ltd, 2012).

2.2.2.3 Liquidity

The ability of a business to generate sufficient cash to meet all its current debt is a function of its liquidity. It is very difficult for the smallest family unit to the largest Government to have a perfect synchronisation of receipts and expenditures (Tobin, 1958). According to Separation Theory, if capital markets are efficient (borrowing and lending rates are virtually the same) then the farm crop mix will not be affected by attitudes towards risk and so there would be no need to enter the futures markets unless for speculative reasons. Although the usual existence of differences between borrowing and lending interest rates reduces the power of the explanation (Tobin, 1958). Many businesses, farming included, are asset rich but cash poor, and it may take some time to convert some assets into cash. Commodity selling can quickly convert an asset into cash. Land or property sales usually take longer, which could cause a short-term cash-flow problem for the business. In extreme cases, this could result in the business becoming insolvent. It is therefore very important for the business to try to match expected future cash requirements with the sale of assets, e.g. sale of grain in November, to provide cash in December, to pay for fertiliser or agro-chemicals purchases (Barry et al., 1981).

The more indebted the firm, the more important the timing of this liquidation into cash is, as there will be specific dates where cash is required to meet repayment schedules. Not meeting them could result in penalty charges, increased credit charges in the future or removal of the credit line altogether. There is a trade off between being liquid, especially if interest rates are low, and the revenue that could be earned from being less liquid, such as more land, machinery or livestock.

If there is a period of low margins and known future cost commitments, then investments in extra less liquid capital items should be put off or postponed. This will allow capital to be replenished faster and so reduce indebtedness. If the business has a good relationship with its bank and an existing line of credit, then a forced sale of assets, possibly far below their true market value, can be avoided. More importantly, a good relationship with the bank avoids any upheaval of the farm's illiquid asset portfolio, which is usually the structural framework of the business, and reduces the costs associated with becoming liquid (Barry et al., 1981). In the US it was shown that the bank actually insisted on some form of FPRM strategy to be in place to guarantee the loans repayment, in the form of Multi Peril Crop Insurance (MPCI), hail insurance and forward contracts (Knight et al., 1989).

2.2.2.4 Technology innovation, adoption and diffusion

Adoption is defined as when a certain technology is chosen to be used by an organisation or individual. Innovation is when a new technology is adopted. Diffusion refers to the process by which the technology spreads and is adopted by the greater population. The central focus of this thesis is the understanding of the consequences of the adoption process by mitigation of price variation of using hedging, FPRM, tools. Therefore, the adoption of new technologies is discussed in greater detail in section 2.4.3 and the tools themselves in Chapter 3, whilst this section gives a brief summary of their use for mitigating the effects of price volatility.

Pampel Jr and van Es (1977) suggest there are different factors influencing the adoption of commercial ‘profitable’ practices, compared to conservationist ‘unprofitable’ practices. Other studies have looked at the influence of the ‘relative advantage’ of a decision. (Nowak, 1987; Cary et al., 1989; Vanclay, 1992). They have been used to study the behaviour of farmers towards land conservation, in Western Australia, (Gorddard, 1991; 1992; 1993) and in Bedfordshire, England (Beedell and Rehman, 1999; 2000). Other examples of technology adoption in agriculture are; strawberry production in Florida (Lynne et al., 1995), tree planting in Pakistan (Zubair and Garforth, 2006) and wool future’s use in Australia (Jackson, 2008).

From a wheat marketing perspective in England, the use of FPRM tools, futures and options, are still perceived as a relatively new technology to mitigate wheat price variation (DEFRA and HGCA, 2009). FPRM tools can be adopted to secure a minimum price, or can be used to fix a wheat price when there is no actual buyer of physical wheat at the moment the farmer wishes to sell. Both mitigate the farmer’s wheat price volatility however ‘relative advantage’ and other positive factors, mentioned above, are not fully explained by the grain trade and so appreciated by farmers. As a result, there is a low level of adoption and penetration after many years of information dissemination by Government and private businesses alike (DEFRA and HGCA, 2009).

2.3 Farmers’ attitude to risk

In the previous section, the factors that affected price volatility and some of the measures that were available to farmers to mitigate these effects were discussed. Of particular importance is the role of farmer decision-making in managing uncertainty, risk and adapting to market conditions. In this section this complex interaction is broken down into: attitudes, values and goals of the farmer; risk management strategies; and, attitudes towards new technology adoption, in particular FPRM tools.

2.3.1 Attitudes, values, goals and behaviour.

This section gives an overview of farmers’ attitudes, values and goals in general rather than specifically those regarding risk management and technology adoption. Ultimately, it is these attitudes, values and goals that form the basis for behavioural intention (BI) and actual intention (Ajzen, 1991). Whilst human behaviour is seen as a complex mix of reflex actions, impulses, habits, customs etc (Viner, 1925) it is the objective of research to construct theories that realistically portray the decision-making process and thus predict behaviour (McGuire, 1964).

Fundamentally, economic theory would suggest that individuals make decisions that increase their overall 'utility' or 'well being'. This increase takes many forms, and the levels will differ between individuals and over their lifetime. However, utility is very difficult to quantify in real everyday situations as it's so varied; the feeling of seeing the first daffodil in your garden, a child's first step or making a profit. This utility concept is most commonly measured in business, in monetary terms, in terms of profit / loss from a decision.

However therefore, criticisms of the pure economic theory of profit maximisation because it fails to include either sufficient or the most relevant variables, and that firms do not in fact maximize profits (McGuire, 1964). As profit maximising is an unattainable procedure other guidelines are used, or needed, to determine what is 'satisfactory' (McGuire, 1964). 'Satisficing' (a satisfactory or adequate outcome is accepted, rather than the optimal one) is more likely (Simon, 1979). Individuals are more likely to be satisficing than optimising (Gasson and Errington, 1993) in terms of goals.

Yet it is important to acknowledge that there is a difference between farmers' goals and their values. Gasson (1973) describes that 'goals' are ends or states to which the individual desires to be or wishes to achieve, now or in the more distant future. They often change over a person's life, depending on circumstances. 'Values' are more permanent traits of an individual, less liable to change with time or circumstances than goals. They are governed by reason, ethics or aesthetic judgement.

Many agricultural models assume farmers are rational utility/profit maximisers (Norton and Schiefer, 1980; Moxey, 1995; Wallace and Moss, 2002). While this is not always true, it does give broad predictions. When the financial factors in a decision-making process decline and become less important, so too does the profit maximising assumption, and the usefulness of the models. Other 'basic sociological constraints', non-financial ones, take precedence as people try to maximise their utility instead (Edwards-Jones, 2006). In an agricultural context, this is important where government policies are often concerned with non-financial issues, such as environment, animal welfare and access to opportunities in rural areas. There has been substantial research into why farmers farm, and the results suggest it is not just based on profit and loss or financial reward. Such research has been undertaken in many countries including Scotland (Austin et al., 1996; Austin et al., 2001), in Ireland (Gillmor, 1986) and UK versus USA aspirations (Gasson, 1969). Sociology and psychology are increasingly being drawn upon within agricultural economics (Edwards-Jones, 2006).

It is these attitudes and goals that not only affect decision-making and business practices but also, as will be discussed in section 2.4.3, affect the adoption of technology. Pampel Jr and van Es (1977) suggests there are different factors influencing the adoption of commercial 'profitable' practices, than influence 'unprofitable' practices, such as conservation. Other studies have looked at the influence of the 'relative advantage' of a decision. (Nowak, 1987; Cary et al., 1989; Vanclay, 1992).

Why farmers farm and why people work has been the subject of literature from the 1920s (Ashby, 1926). There followed a myriad of research projects on farmer behaviour and adoption of new ideas and practices. A study of 80 farmers from North Carolina, Wilkening (1950a), revealed that a farmer's decisions in his daily activities are influenced not only by the ideas, ethics, and beliefs to which he subscribes but also his social interactions. Values, with their degree of permanence, tend to underpin an individual's goals and are more abstract in nature. Wilkening (1954) researched the techniques for studying values. They can only be studied indirectly through observed behaviour or verbal responses to questions. This has the disadvantage of interpretation of the answers by the questioner. The respondent may give answers they feel they ought to, in order to fit social norms they believe the questioner would like to hear. Careful question phrasing is required.

Gasson (1973), studying farmers in East Anglia, concluded that 'dominant values' associated with the occupation of farming are classified into four headings: instrumental, social; expressive; and, intrinsic. Instrumental is described as making money and having security in a pleasant working environment. Social is described as personal interactions with family, staff, community and other peers. Expressive is described as a means of personal fulfilment, pride and to be creativity. Finally, intrinsic is described as the value of farming in its own right, including, for example, the outdoor life and independence. How these are ordered, relative to one another, influences farmers' decision choices. Her pilot studies suggest that East Anglian farmers have a predominately intrinsic orientation to work, valuing the way of life, independence and actual process of performing farming tasks above any other financial aspects (Gasson, 1973).

In a later study, Kerridge (1978) also describes these phenomena in a survey of 71 wheat and sheep farmers of Western Australia, which was carried out to explore farmer 'value orientations' in four classes of value, as related to farm performance and the personal characteristics of the farmers. The questionnaire used was based on earlier work (Gasson, 1973). Kerridge (1978) concluded that it was the older farmers and those on small farms that strongly valued farming as a 'way of life' and were most likely not to leave farming even when incomes are low. Larger, more efficient farms, once they reach a certain level of affluence, sought more aesthetic pleasures from farming and life than just money. This echoes the 'Hierarchy of Needs Theory' (Maslow, 1946).

This current research into the behavioural determinants of the use of FPRM tools in England will specifically use the principles of TRA (Fishbein and Ajzen, 1975), TPB (Ajzen, 1991), Diffusion of Innovations (Rogers, 1995), and an extension, The Decomposed TRB Model (Taylor and Todd, 1995a). They have been used to study previously the behaviour of farmers towards land conservation, in Western Australia, (Gorddard, 1991; 1992; 1993) and in Bedfordshire, England (Beedell and Rehman, 1999; 2000). They have also been used to study technology adoption in Florida (Lynne et al., 1995), tree planting in Pakistan (Zubair and Garforth, 2006) and the use of wool futures in Australia (Jackson, 2008). This research uses the above three theories, to understand the attitudes, values and goals of farmers in England towards FPRM techniques in their businesses to manage wheat price movements.

The literature above shows the various attitudes and goals that farmers have in relation to their businesses. From this research's responses in-depth interviews, Appendix 2, and focus groups, Appendix 7, there is a clear influence on farmers' decision-making process by social and economic factors, such as the family, their peers, education levels, farm size and indebtedness. However, there is divergence between what the theoretical economic literature suggests and what actually takes place, in practice, at farm level. There is no current literature on the use of FPRM, as applied to the farmer in England, nor on the behavioural determinants of the use of these hedging tools.

2.3.2 Attitude, risk and risk management strategies

A large change, such as a weather-related supply 'shock', increases the short-term volatility in commodity prices (Gilbert and Morgan, 2010). The farmer has to react by making decisions in the context of these changes and can use different tools, such as forward selling, futures markets and insurance (Moschini and Hennessy, 2001). How the farmer reacts depends upon their assessment of the risk involved, their attitude towards risk and the outcomes of any decision and subsequent action they take. This section gives an overview of risk, risk management strategies and attitudes of farmers towards risk and risk management.

Risk is often associated with adverse effects or loss of welfare (Bodie and Merton, 1998; Harwood et al., 1999). That is the probability of an undesirable event occurring through a particular set of circumstances and decision-making. Knight (1921) identified that risk can originate from both within and outside of a business and that it is not always possible to avoid all risk and as such states it is necessary to find a balance between the risks and rewards of different outcomes. A thorough discussion on risk and risk analysis is given by Boehlje (1998) and in particular with reference to agriculture by Moschini and Hennessy (2001).

Section 2.3 has already discussed the risk factors that can affect price volatility. However, in general, these factors also affect other aspects, such as yields, as well as price volatility. Harwood et al. (1999) identified five factors concerning agricultural risk. The first is yield and production risk that includes many random effects such as weather, disease and pests. As discussed previously, the farmer can have little control over weather events, but can introduce technology to mitigate disease and pests. The second, price risk, which has also been discussed previously, concerns the changes in prices, costs of the product and inputs for an agricultural enterprise and can significantly affect net margins (Tomek and Peterson, 2000). Similarly, the effects of imports and exports due to production levels can cause large price movements (Blandford and Schwartz, 1983). The third factor, policy risk is related to the consequences of government policy, although discussed in general in a previous section, specific policies, for example regulating the use of pesticides, can also have an immediate effect on the risk associated with an enterprise. Human or personal risk (the fourth factor) covers injury, death and changes in circumstances that have an impact on the farm business. Human and personal risk also encompasses theft and fire. Finally, financial risk is also cited as a key factor, and results from the way the farm's capital is obtained and financed. This covers interest rates, borrowing and cash flow.

Analysing the risk in any sector involves identifying the risk factor, or multiple factors, that appear to be adversely affecting the business. Once risk is identified the effects can be measured and thus the risk can be systematically assessed. However, as discussed previously, account must be made for the situation when the risk becomes uncertainty and can no longer be measured. This uncertainty is based on the idea of inherent unpredictability of the factors in any business environment and not merely the fact of ignorance (Crouhy et al., 2006). Although risk can be disaggregated into its constituent components, it is often necessary to consider the wider agricultural environment as whole (Barker, 1981; Mehra, 1981; Hazell, 1984). For example, the adverse effect of weather and disease must take into account other factors such as how changes to input prices can affect their use. Further, Hartman (1972) says risk is not confined to one season and that inter-temporal decision-making must also be investigated.

To be successful, any (farm) business is required to understand and assess the risks involved and identify those that have the greatest impact on expected returns and other key objectives or goals. In the context of the wheat market in England the most significant risk factors with respect to financial returns over the past ten years have been the yield, as influenced by the weather, and price volatility. The weather is largely unpredictable and uncontrollable whilst price risk, seen as an added economic cost to the producer, can be controlled through FPRMs (Hardaker et al., 2004). However, because of the uncontrollable elements of risk and uncertainty associated with farming no strategy can completely mitigate the adverse effects.

Within any economically "optimal" management system, there is a set of alternatives that are only slightly less attractive than the optimum. Often these alternatives are large and with wide profit plateaus (Pannell, 2006). In economic production models with continuous decision variables, the width and flatness of the profit plateau varies, but the presence of a profit plateau is almost universal. Among production economists, the existence of flat payoff functions in agriculture was well recognized in the past (Hutton and Thorne, 1955; Doll, 1972; Bhalotra, 1998).

Relative to a risk-neutral decision maker, risk aversion on the part of a decision maker generally only makes a modest difference to optimal decisions. Modest differences to decisions often translate into very small benefits to the decision maker when payoff functions include wide flat regions. From the point of view of a decision analyst, this can mean that inclusion of risk aversion in models for decision support is of low priority (Pannell, 2000). Consideration of complexities such as risk aversion, which due to the 'flatness' phenomenon, only change the optimal strategy by moderate amounts, and does not greatly affect farmer welfare. Thus it is not the case that risk aversion does not affect the farmer's optimal plan, but that the impact of the changes on farmer welfare is small. (Pannell, 2000).

The sources and consequences of risk with respect to price volatility have already been discussed in section 2.3, but how a farmer measures and perceives risk has not. It is this measurement, perception and subsequent behavior that were identified by Lin et al. (1974) as an important factor in economic decision-making. Decisions are based upon complete knowledge of the probability of any future outcome occurring and its consequences to the business. There are two parts to the decision; the action is only as good as the opinion of the decision-maker of that action and their confidence in that opinion (Ajzen, 1991). For example, Blandford and Currie (1975) discuss producer decision making under imperfect knowledge of future prices. These value judgment decisions are constantly being made. Because this complete knowledge is incomplete, it can vary over time as the market environment changes, but inevitably leads to problems because of this incompleteness (Blandford and Currie, 1975).

Typically, decision-makers use previous situations to estimate the likely consequences of any strategy followed. This type of decision, based on subjective experience and observation and not on real unbiased data, will give rise to a degree of deviation from the intended outcome, both positively and negatively. Crouhy et al. (2006) contended this would be different for each decision-maker and that risk management and risk taking is intrinsically related. This view was also shared by Drynan (1981), who suggests that the differences in views are due to personal characteristics. Coupled to this subjective assessment of the outcomes of a given decision or strategy are the influences and opinions of social referents such as family and peers as well as the perceived ability of the decision-maker to carry out a strategy (Fishbein and Ajzen, 1975; Ajzen, 1991). Gasson (1973) asserts that goals are ends or states to which the individual desires to be or wishes to achieve, now or in the more distant future.

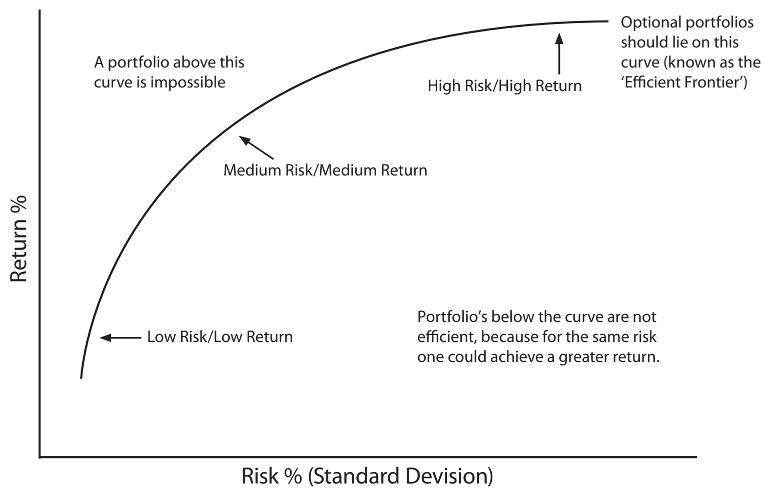
How farmers actually manage risk is largely determined by their attitudes towards, and willingness to take, risks. Research has shown that these attitudes affect aggregate commodity supply response (Chavas and Holt, 1990; Holt and Moschini, 1992; Chavas and Holt, 1996), financial structure (Gwin, 1994), marketing decisions (Musser et al., 1996), the farm business and other agricultural characteristics (Barry, 1984; Hardaker et al., 1997). Knowing how farmers react to risk is important to all stakeholders including farmers, industry and policy makers (Bard and Barry, 2001). There have been many studies and research into addressing farmers' attitudes towards risk and utility using different theories such as the modified von Neumann-Morgenstern and Ramsey procedures (Halter and Mason, 1978). Expected utility theory has been the most widely used technique for eliciting farmers' attitudes towards risk (Lin et al., 1974). Dillon and Scandizzo (1978) classified the methods of measuring risk behaviours under different approaches as: economic anthropology; econometrics; farm risk programming; sectoral risk programming; and expected utility and safety-first theory. A more comprehensive discussion of the approaches to measuring risk are given by Antle (1987) and Just and Pope (1979).

Farmers operate on a scale from risk averse to risk taking and which group farmers are in varies according to their inherent characteristics and are revealed through their decision making concerning risk (Drynan, 1981). Most studies suggest farmers are risk neutral to risk averse in their attitudes and actions. Roe (2013) asks how well farmers tolerate risk compared to non-farm business owners and the general population. The differing attitudes to risk were compared between German and USA farmers (Howard and Roe, 2011). Bond and Wonder (1980) used risk coefficients to measure attitudes and concluded Australian farmers were risk averse. They suggested farmers avoid low asset to debt ratios, are slow to adopt new technology/ideas and most look at on and off-farm diversification and forward selling and should increase the use of financial instruments. Similar conclusions were expressed by (Bond and Wonder, 1980; Austin et al., 1998b; Carter, 1999; Pennings and Leuthold, 2000; Tomek and Peterson, 2000; Tomek and Peterson, 2001; Jackson, 2008).

Of particular relevance to this thesis are behaviours towards price risk Barnard and Nix (1973); Tomek and Peterson (2001); Geman (2008) looked at the impacts of price uncertainty on USA wheat marketing margins and discusses the sources and modes of transmission of price risk. Brorsen (1995) also poses the question of whether this price volatility is desirable, or not, as does Adams and Klein (1978). Sandmo (1971) showed that, based on a hypothesis of expected utility maximisation, risk adverse farmers produce less output when there is a price risk. This was also the conclusion of Ishii (1977). In a study that examined the relationship between farmers' attitudes and the future contracts to manage price risk it was shown that perceived risk reduction may differ from actual risk reduction (Pennings and Leuthold, 2000).

Risk management concerns managing unexpected variation in those factors that have a direct, or indirect, effect on the financial performance and viability of the business. Importantly some factors can be managed internally through the use of technology and diversification but some risks must be transferred out of the business, for example by the use of insurance or FPRMs. The literature on farm risk management strategies is large and reveals that farmers manage risk through production decisions and through the use of market-based and informal risk-management mechanisms.

Varangis et al. (2002) states that the reward for risk-taking is profit, which implies decision-makers have to make a trade-off between risk and reward. Reward is measured as an average return of investment, whilst risk is measured as the variance about the average that is considered acceptable (Fiegenbaum and Thomas, 1988; Weber et al., 2004). Notwithstanding the complexities of farmers' goals discussed in the previous sections, if reward is simplified to expected profit and risk to expected variance of that profit, with a higher variance signifying higher risk, this leads to the question of how expected profit can be optimised (Levy and Markowitz, 1979; Chalfant and Collender, 1990). Markowitz (1952) shows how these two measures can be shown graphically as an efficient frontier that informs the decision-making process, see figure 2.11.



Source: Adapted from Markowitz (1952)

Figure 2.11 Diagram to represent an E-V frontier

A strategy is said to lie on the efficient frontier if, given any other possible strategy, either the mean is higher or the variance lower. The decision-maker is left with the choice of all strategies lying on the efficient frontier, which implies that only by increasing risk can a higher return be achieved or conversely a lower return is the only way to reduce the risk of any action. Drynan (1981) argues that because decision-makers have different views of risk, due to their own personal characteristics, they choose strategies which will maximize their expected utility in the future by some appropriate level of return, maximizing the individuals risk-return ideas (Johnson, 1960). There are different strategies that can be used for different farming goals. Pampel Jr and van Es (1977) suggest there are different factors influencing the adoption of risk management strategies towards financial objectives than towards other non-financial objectives. Examples of research that have studied these strategies include the behaviour of farmers towards land conservation, in Western Australia, (Gorddard, 1991; 1992; 1993) and in Bedfordshire, England (Beedell and Rehman, 1999; 2000). Other studies examined technology adoption in Florida (Lynne et al., 1995), tree planting in Pakistan (Zubair and Garforth, 2006) and wool futures' use in Australia (Jackson, 2008).

For farmers that are optimistic about spot prices, risk-takers reduce the optimal use of futures through increasing the speculative component of the decision (Pannell et al., 2008). Conversely, risk-taking farmers increase the use of futures if pessimistic about spot prices, again through reducing their reservations on speculation. In this case, higher use of futures would be motivated by increases in expected profit, rather than reductions in risk. The minority of farmers observed by Pennings et al. (2004) making very extensive use of futures were either highly risk averse, or pessimistic about spot prices (Pannell et al., 2008). So, the speculative element of FPRM tools is similar to the hedging component, and potentially more important to farmers with more risk-taking attitude.

Further it may be perceived by farmers that the benefits of hedging are not large enough to motivate them to participate. This may be especially relevant to farmers who are not already experienced in the operations of the futures market, given the learning costs that they would need to bear in order to participate and therefore the 'transaction' costs, are a probable explanation for low use of FPRM tools by some farmers: those who are optimistic that the price will rise. Results suggest that more risk-taking farmers may have little to gain by hedging, and so little motivation to bear the associated learning costs (Pannell et al., 2008).

In conclusion risk, risk attitudes, risk management and assessment of farmers regarding these factors are extremely complex. Farmers are constantly balancing risks using their own risk-reward combination. In the section 2.5 the methods available and used for selling wheat are reviewed and evaluated in terms of their ability to effectively manage risk.

2.3.3 Attitudes towards new 'technology' adoption

This section gives an overview of farmers' attitudes towards the adoption of a new 'technology' in their business environment, with particular reference to FPRM tools. It also investigates the influences that affect the farmer's perceptions of using an innovation and their perceptions of the innovation itself. As this research is concerned with the adoption and use of FPRM tools, it is these perceptions and influences that are particularly important in determining the attitudes that form the basis for BI and actual intention (Ajzen, 1991). However, the literature on technology adoption is extensive and diverse, with over 3000 publications appearing before 1983 (Longo, 1990). The complexity of the subject is discussed by Austin et al. (1998a) and covers many disciplines; sociology, rural economics, psychology and statistics. Austin also discusses the role of objectives, other than purely economic ones, in adopting new technology.

Research exploring the rate of adoption of new ideas, acceptance of new policies and technologies is well documented (Ryan and Gross, 1943; Griliches, 1957; Jones, 1963; Rogers, 1995). One of the first important studies looked at the diffusion process of adopting hybrid corn by Iowa farmers from 1936-1939 (Ryan and Gross, 1943). This study showed that two thirds of the farmers adopted this new technology during this period, which the authors considered counter intuitive given the perceived conservative nature of farmers towards change. To explain this result, it was first noted that the technology itself was considered to provide real economic benefits as well as being good farm practice. The seed salesman initially drove adoption. As the benefits became apparent to potential adoptees, it was their interactions and recommendations with other farmers that provided the impetus for widespread adoption. The influence of the salesman subsequently disappeared. Griliches (1957) suggests that farmers only adopt when it is profitable for them to adopt and when they have information that it is the case, making a distinction between economic and more 'social' reasons for adoption.

One of the most widely used, and accepted, theories in understanding the attitudes to 'technology' adoption with regards to the rural environment is the Diffusion of Innovation theory (Rogers, 1995). This theory is described more fully in Chapter 4 as it forms one of the core components of this research. In brief, the theory describes the rate of adoption over a period of time assigning characteristics to the actors that adopt the technology. Rogers (1958) first developed this theory by comparing two sets of Iowa farmers and showed that the adoption distribution was normal and, from that, was able to describe the five groups.

Copp et al. (1958) used the above theory to show how various sources of information were prominent at various stages of the adoption process, describing this information as being either macro, such as mass-media, or micro, face-to-face meetings and individual interactions between farmers. In their study of the Pennsylvanian dairy industry, he found that farmers who cited other farmers as sources of information during the early stages of adoption were less likely to adopt early than farmers that used other sources of information. Copp et al. (1958) concludes that this may be due to inaccurate and selective information transference. Learning and experience over time will lead to the probability distributions of new technological parameters shifting over time. The payoffs will shift from a low to higher level, so increasing the use of the innovation (Hiebert, 1974). Lindner (1987) showed that improving the accuracy and rate of information transference increases the uptake of a technology. A similar conclusion was achieved by Fischer and Arnold (1996) who showed that the adoption rates of new wheat varieties in South Australia were increased by both the quantity and quality of information.

Fliegel and Kivlin (1962) examined the relationship between the attributes of a technology and its rate of adoption in a study of Pennsylvanian dairy farmers. They showed that less complex technologies that were also compatible with existing business processes and saved time tended to be adopted rapidly. However, the cost of the technology did not significantly affect the rate of adoption. In researching Kenyan dairy farms, Batz et al. (1999), found that complexity of a technology was inversely proportional to the rate of adoption but suggested that higher education levels lessened the effect of complexity. They also showed the same relationship between the risk associated with a technology and its adoption, although if the technology reduced the production risk relative to traditional technologies it was more likely to be adopted. Flett et al. (2004) developed a Technology Acceptance Model in a study of New Zealand dairy farms, which included ‘perceived usefulness’ and ‘perceived ease of use'. They showed these factors helped to explain attitude and behaviour toward technology adoption, with farmers having higher perceived usefulness and perceived ease of use scores being more likely to adopt.

Apart from the factors discussed by (Rogers, 1995) in his Theory of Innovation and the additions of other researchers (Gorddard, 1993; Flett et al., 2004; Katchova and Miranda, 2004), individual farm and farmer characteristics can also affect the adoption process. Feder and Umali (1993) found that farm size, credit, tenure and education were critical determinants in the initial phases of adoption. However, they also found that these factors were less important in the later stages of diffusion. Other factors have been found to be important in the adoption process, such as farm business and household structure, social environment and the innovation itself (Jones, 1963; Potter and Gasson, 1988; Brotherton, 1991; Willock et al., 1999a). Other studies concluded that income, education, farm size and age were found to be the main determinants in innovation (Fliegel, 1993; Rogers, 1995). Age, family situation, education, social pressure, advisory group membership have been found to be important in the adoption process (Wilkening and Guerrero, 1969; Ervin and Ervin, 1982; Rahm and Huffman, 1984; Feder and Umali, 1993; Beedell and Rehman, 1999; 2000; Upadhyay et al., 2002; Burton et al., 2003). Individual farm characteristics too are important in innovation adoption, including specific agronomic, rotational and individual farm's characteristics (Rahm and Huffman, 1984; Harper and Rister, 1990). Other studies concentrated on the financial aspects of farming practice and innovation; the individual's income, perception of profitability of adoption and net returns (Kislev and Shchori-Bachrach, 1973; Lee and Stewart, 1983; Rahm and Huffman, 1984; Nowak, 1987; Saltiel et al., 1994; Fisher et al., 2000; Bergevoet et al., 2004). However, market type, government policy and type of technology were also important (Feder and Umali, 1993). Also key were respected peers' positive results from the use of new technologies usage. Upadhyay et al. (2002) in a study of North-Western USA farmers' adoption of wind erosion techniques identified three criteria which have emerged to explain conservation practice adoption; income, utility and innovation adoption.

It can be seen from the literature that attitudes to adoption by the rural community are complex, fragmented and dependent on the innovation itself. Studies have found that the rate of adoption fundamentally depended on the level of actual benefit perceived by the adopter of the innovation (Lindner, 1987). This built on earlier research (Griliches, 1957; Feder and O'Mara, 1982). Innovation research is multi-disciplinary and conducted under the banners of economics, sociology, psychology, health promotion, marketing, agricultural extension and anthropology (Pannell et al., 2006). Importantly, correctly specifying the 'informational' variables, such as the cost of providing the information, proximity to nearest adopter, availability of training services and farm size, when the estimating a model, greatly enhanced the explanation of individual adoptive behaviour (Lindner et al., 1982). Pannell et al. (2006) suggest innovations need to be 'adoptable', i.e. attractive to the farming group in question. Therefore for FPRM tools to be adopted, there is a need to see that there is a relative advantage, ease of trialability, and lack of complexity (Pannell et al., 2006). There also has to be an assessment by the farmer of how much benefit, financial or otherwise of the use of the FPRM tool. This needs to be greater than the costs of learning about and affecting the practice. It is thus important to consider the magnitude of the expected gain from hedging under various circumstances (Pannell et al., 2008). Promotion of an innovation is the stage after confirming that an innovation is adoptable in the first place, otherwise frustration from all parties will result.

2.4 UK Wheat Selling Methods

2.4.1 Introduction

In this section the main methods by which wheat in England is marketed and sold are discussed, as well as their relative advantages and disadvantages. Standard economic theory suggests that farmers will try to maximise their economic returns, which according to Lipsey (1975) can be expressed as a set of formal rules. These rules imply that a firm will only produce a good or service if total revenue equals or is greater than total variable costs. That is, production will increase until maximum profit is attained when marginal revenue is equal to marginal cost. More simply, the added revenue from producing one more unit is equal to the cost associated with producing that unit, assuming both the increase in revenue and cost are positive. Further adjustments to this theory to include risk can also be made (Sandmo, 1971).

There are four main selling methods available to farmers marketing wheat in England. These are (i) spot, (ii) forward, (iii) pool and (iv) futures and options. In all these markets, the farmer is a price-taker, as they do not have sufficient quantity to affect the market place. The seller either accepts the price offered and the crop is sold or otherwise the crop remains unsold.

2.4.2 Spot Sales

The spot price is the current price at which an asset/commodity can be bought/sold on any particular day (Ouchi, 1980; Williams, 1986; Gorton and Rouwenhorst, 2004). In a farming context, spot sales are those that are made once the crop has been harvested, so quantity and quality are known. A contract is agreed between the farmer and the merchant/end-user buyer, with agreed price, quantity, quality specification, payment date and any other specific terms. Spot selling removes downward price uncertainty but does not allow for further price increases after the sale has been made.

Spot selling has very little risk of over-selling or selling on the wrong specification as both quantity and quality are known, and therefore there is little risk of a financial claim or a costly rejection and redirection at the end-user destination (e.g. flour or feed mill, port, chicken farm). When the buyer makes a claim, the load is accepted at the end destination but at a reduced price due to the incorrect contract specification. Incorrect protein, hagberg falling number[4], kilogrammes per hectolitre bushel weight, moisture levels or insect infestation are the common problems. A rejection is when the buyer refuses the load, as it is deemed outside the contract specification and, importantly, considered unsuitable or unusable for its contracted purpose. The load has to be either returned to the farm (transport costs to the farmer) or sold to a consumer or merchant store that can take it immediately that day. Invariably, the farmer producer obtains a much lower price for that load. Spot sales account for 25% of UK ex-sales on average. This figure varies depending on farm size,

[4] For the milling wheat market, the Hagberg Falling Number value of grain samples is very important. This value is primarily a measure of the alpha-amylase enzyme activity in grains which can be a varietal characteristic or caused by sprout damage due to poor conditions prior to harvesting. Alpha-amylase activity is crucial for final product quality of bread, pasta, noodles etc. Values in excess of 250 are required for wheat samples destined for bread making; lower values may be acceptable for other wheat flour based products. NIAB (2014). Produce Quality.

geographical region and farm type (DEFRA and HGCA, 2009). In Chapter 6 the results from the in-depth interviews and focus groups reinforce this conclusion and show that risk-averse farmers often use this method.

Spot selling is a very simple and often *ad hoc* way of marketing. Farmers may sell when they feel the 'price is right' during the season. Spot selling is often used as a way of averaging the crop's price over time, typically over a season from one harvest to another, by selling a proportion of production every month. The 'season', from many farmers in England's points of view, is six months before harvest (August/September) and by the following May, when the actual production level is known or estimated with confidence. However, LIFFE wheat futures prices (and therefore ex farm prices in England) begin trading two years before any season's wheat crop is harvested. This means that the preceding 24 months of potential marketing of the wheat crop has been missed and therefore, many marketing opportunities using spot selling are potentially being forgone so exposing the margin for that crop to additional risk.

Spot contracts are very common, used in many situations and is often used as a selling method when a problem arises; at harvest time when production exceeds storage capacity or immediate quality issues such as pests or moisture problems or when cash-flow dictates funds are needed in a month's time. Spot selling is selling the crop at the prevailing price on the day, not marketing the crop, and is not based on the farmer's own budget and SOLL. Often the seller has run out of time to market the wheat crop (the barn or cash may be needed) therefore, this method of selling is often a reaction to a short-term problem that has arisen rather than the result of a marketing strategy.

2.4.3 Forward sales

A forward contract is agreed between a seller, the farmer, and the buyer, the merchant/end-user, for future collection/delivery at an agreed price, quantity, quality specification, payment date and any other specific terms. A forward sales price for wheat is the price of wheat a farmer can obtain for their wheat collected from their farm at a specified month in the future (Barnard and Nix, 1973; Williams, 1986; Varangis et al., 2002). It is not the same as the futures price for wheat in the future. Forward contracts are not standardised and are more tailored to the needs of the individual buyer and seller. Jarrow and Oldfield (1981) comment that forward contracts and futures contracts are very similar and often taken as synonymous. However, they further show, mathematically, how the two are not the same.

Forward selling allows a producer to secure a price for their crop, or potential crop, in the future. Some, or all, of crop is sold before, or after, it is actually harvested, for collection in some future month. This is possible to achieve as the wheat futures market in England, Euronext LIFFE, has futures contracts trading 24 months ahead at any point (Euronext, 2010). This enables buyers, be it merchant traders and end-users, to put a value on the wheat crop in the future, and so in turn, quote a farmer an ex-farm price for their produce at a month in the future. Wheat growers in England can therefore market their produce over a longer period than just the twelve-month harvest-to-harvest period associated with a spot sale. This is because the crop for any harvest can be sold anytime during the 24 months before it is harvested and the 12 months it could be in store (harvest to the following harvest), 36 months in total.

Forward selling is therefore a mechanism by which the farmer and the buyer indicate their future needs to each other, a two-way information exchange. Goss (1987) states that if the market place providing forward trading facilities is efficient then current spot and forward prices, under certain circumstances, can be expected to be unbiased anticipations of subsequent spot prices. This argument was further discussed by others (Leuthold and Hartmann, 1979; Jarrow and Oldfield, 1981; Fama and French, 1987; Carter, 1999; Bessembinder and Lemmon, 2002).

A forward contract allows the producer to eliminate both the price and basis risk[5] in one transaction (Varangis et al., 2002). There is no risk of declining prices, as the price is set, subject to quantity and quality specifications.

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[5] The basis is the difference between the forward ex-farm bid from the merchant and the forward futures price for the same month and represents the cost of haulage, storage and interest. Basis tends to decrease the shorter the contract time into the future. The difference between the two points in time is, in theory, the risk or cost of forward contracting.

Forward contracts are the most commonly used method of trading in the wheat trading market in England (DEFRA and HGCA, 2009). Forward contracting is preferred by farmers to futures contracts in England, which concurs with earlier USA data (Blank and Carter, 1997; Carter, 1999; Carter, 2013). This may be because it is practically easier to do, involves no complicated regulatory paperwork and is simply more easily understood and the traditional way of doing business, eliminating basis risk (Miller, 1986).

Forward sale contracts accounted for 37-54% of contracts over the 2004-09 period in the UK, varying by farm type and size (DEFRA and HGCA, 2009). Worldwide, the use of forward contracts, as a form of PRM, is popular for many commodities, for instance, in the USA 73% of hogs are sold this way (Lawrence and Rhodes, 1997). The forward price ratios (proportion of crop sold forward as a proportion of total crop produced) found in most USA research is rising (Davis et al., 2005). The ratios have risen over time, from 12% in the early 1970s (Hill, 1976), to 42% by the mid 1980s (Asplund et al., 1989), 45% by the early 1990s (Goodwin and Schroeder, 1994), 70% by the late 1990s (Sartwelle III et al., 2000; Davis et al., 2005). Half of the users did not use futures or options, in association with forward contracts, supporting previous research findings of (Patrick et al., 1998). Davis et al. (2005) also indicated that the ratio would increase over time as non-users indicated that they were intending to use the technique in the future. There was strong evidence to show regional differences in adoption of forward contracts, suggesting the level and depth of training was different in different regions. Two thirds of cotton in Australia, 60% New Zealand wool but only 11% of Australian wool are sold via forward contracts (Coad, 2000; Jackson, 2008). Therefore, from these examples, it can be seen that there are discrepancies between countries and commodities using forward contracts, this is due to the advantages and disadvantages listed below:

How much is forward contracted is also influenced by:

- Transaction costs. Transaction costs are more costly than using futures and transactions are hard to set up beyond 180 days ahead (Townsend and Brorsen, 2000; Pannell et al., 2008) (Townsend and Brorsen, 2000);
- Adoption / Diffusion theory. The rate of adoption of the practice is defined by the characteristics of the practice and the adopting agent. The producers' view of and

effectiveness of marketing methods in meeting their own objectives will have a major impact on the rate of adoption of a new technique (Rogers, 1995); and,

- Other factors are age, education, experience, attitude to risk, level of indebtedness, level of specialisation, degree of diversification within the farm business (Goodwin and Schroeder, 1994; Musser et al., 1996).

Jordaan and Grové (2008) found that farmers need to be less risk averse to adopt forward pricing methods. Although farmers may experience forward pricing as risky, once they had adopted forward pricing methods the quantity that they will forward price is positively related to their level of risk aversion. The authors state that research that places emphasis on the factors affecting the adoption of forward pricing is needed to change farmer's perception and promote adoption.

The advantages of using a forward contract to market wheat are:

- It allows the producer/seller to secure a price now for collection in some future month, thus reducing uncertainty regarding margins, although costs may still vary. The producer is therefore in the position of being able to set a margin for their crop before it is drilled. This should enable the producer to fully invest time and capital into their crop from drilling to harvest, knowing the more that can be produced, the higher their income;
- With a known price in the future the producer can aim for an optimal input to yield combination rather amend agronomic input levels to save money in response to price changes that may occur over the growing period; and,
- Forward contracting also enables the consumer/buyer to put a value on their input commodity, in the future. This has the benefit, to them, of being able to value their inputs months before delivery is due or production is needed, thus reducing uncertainty regarding margins.

The disadvantages or downsides of using forward contracts to market wheat are as follows.

- A risk of an upward price move following a sale. The original sale price is unaffected and would presumably have been set to allow a positive margin for the producer when the sale was made. It does not, however, allow for a greater margin to be captured from any price rise. In 2007, 2010 and 2012 the wheat market prices in England doubled over six months, leaving many farmers wishing they had not sold forward.

- The quantity and/or quality of the wheat when harvested can be below contract specification. Either can result in a claim. If there were a quantity shortfall and the market price had moved up since the earlier sale there would be a buying–in charge from the buyer to the seller, to replace the wheat that cannot now be supplied. This situation was particularly important during the 2007 harvest in England when yields were up to 25% lower than expected. This coincided with the preceding harvest wheat price in England rising by over 100% from £75/t to over £180/t. Farmers that could not meet the quantity specifications faced buying-in charges of up to £100/t. In some cases the claims were more than the value of the original sale. Although this was an extreme, many farmers had to pay £20-50/t. When a low quality issue arises the buyer has the right to make a claim, reject the load or in extreme cases, ask the producer to replace the quantity contracted with wheat of the required specification. From this research h's in-depth interviews and focus groups these are the main reasons why the percentage of forward sales are lower than would be deemed optimal, even when a farmer can see that a positive margin could be achieved and secured in advance. Unlike in the USA there are no yield or quality insurance programmes for wheat in England.
- Counterparty risk in which one party defaults and may result in major costs to the other party. Although rare, this counterparty risk is significant to a farmer. It can result in a farmer not selling forward at all, even when a forward price seems acceptable, selling less than they feel optimal, and selling only to the larger, national merchants that are perceived as safe. This risk therefore distorts the marketing decision process towards shorter time-framed forward selling, making it similar to a spot-selling scenario. This risk may have led to a higher basis risk, which represents a security premium for trading with larger buyers, rather than the wider range of outlets possible if the counterparty risk was reduced.
- Forward contracting farmers may receive a discounted price as the basis risk and costs of their transaction have to be transferred to a third party. In the context of the wheat market in England, this risk is usually borne by the grain merchant. The basis

risk for selling today for collection in a week is less than the risk of selling forward for collection a year head, as the buyer incurs hedging and transaction costs. This is reflected in the price offered to the farmer.

These potential disadvantages in the forward contract, and the continued volatility of the wheat price over the past six years, have seen farmers in England adopting a rather more traditional and conservative selling policy; selling 'a little and often', and selling a greater percentage of their crop once the crop is safely harvested.

2.4.4 Futures and Options

Futures

The earliest evidence of futures trading is from Babylon, where traders used tokens to make future commitments to supply goods. In the 13th to 14th century, the Knights acted as arbitrators between traders across Europe (Futures-trading-mentor.com, 2007). The first organised futures exchange began in 1710 at the Dojima Rice Exchange in Osaka, Japan (Moss and Kintgen, 2009). The Chicago Board of Trade began in 1848 by a group of businessmen that wanted to stabilise farm prices, in the Midwest's chaotic grain market (CME Group, 2013). The forward contract was the precursor for the formalised derivatives markets of futures and options (Fundinguniverse.com, 2001). Although the original purpose of futures was to guarantee supply and stabilise prices they have become subsequently financial instruments. For approximately a century before the early 1970s, the market in futures was mainly limited to agricultural products and metals, not financial instruments. In 1970, 12.6 million futures contracts were traded on the principal US exchanges, 60% in grains and oilseeds, by 1983 137.2 million were traded (Peck, 1985); most of this increase was due to the financial markets.

Futures contracts are similar to forward contracts, as previously stated, but are standardised contracts traded in high volumes on a central exchange (Williams, 1986; Brooks et al., 2001; Varangis et al., 2002; Gorton and Rouwenhorst, 2004). Futures contracts have a buyer and a seller for a specific quantity of a commodity, at an agreed predetermined price and future delivery date. All other terms relating to quality specification are standard. Both parties have an obligation to buy/sell and there is no counterparty risk, as the exchange cannot default because of the way they are organised and funded. The only variables are the price and delivery month, everything else is constant. There is no possibility of a claim for quality (as with a forward contract) and price uncertainty is turned into price certainty (Barnard and Nix, 1973). Most futures contracts are closed out (a sale is bought back or a purchase is sold back) before delivery and so they do not involve the physical delivery of the commodity. This is because futures are generally ‘paper’ trades used for hedging or speculative purposes. This is by a cash settlement of the price difference between the price of the commodity when the contract was set up and the price when the contract is closed out. This results in a purely financial gain or loss to both parties. Importantly, there is unlimited liability with a futures contract, both for losses and gains, until the contract is closed out or expires.

The futures contract however, is an obligation to buy or sell. This obligation will have to be met (by either ownership of the physical commodity in a futures store or delivery must be made to a futures store) if the futures are not closed out by the contracts predetermined expiry date. This section provides a brief introduction to the subject of futures and options but a more detailed description is given in Chapter 3. HGCA (2014) found that under 5% of farmers used futures as a marketing or FPRM tool.

Options

Another major type of FPRM contract available to farmer sellers is the futures contract derivative, the option contract. Options are based on a futures contract, but differ significantly in that options do not have the obligation clause or the unlimited liability.

An option is a derivative of a futures contract. That is a contract derived from the futures contract of the commodity concerned. The returns of a derivative are dependent on the movements of some other underlying asset (Merton, 1973; Ross, 1976; Williams, 1986). Options are based on a futures contract, but do not have the obligation clause, as per a futures contract, and are treated very much like an insurance policy. The farmer has the right (option), but not the obligation, to buy or sell a commodity for a future time at a specific price but only if it suits them. The farmer pays a premium for this, which is the maximum loss possible, as in insurance. It can be viewed very much like an insurance policy, where a premium is paid for the right to claim should some specified event occur in a specified period. If there is no event, there is no payment to the insured person and the premium is forfeited. Unlike a futures contract, options allow producers to take advantage of advantageous price movements, both up and down, while at the same time protecting against disadvantageous ones.

There are two types of wheat option contract. A ‘call’ option protects against a rising market, following a physical grain sale. A ‘put’ option protects against a fall in the market if no sale was made/cannot be made.

The premium of an option is based on the length of time the option will run, the volatility of the market and the value of the asset being covered (Black and Scholes, 1973). Generally it can be assumed, logically, that the premium for an option running for two years ahead will be higher than one covering just twelve months, as there are more days for the option seller/granter to be at risk. The higher the perceived volatility of the market in question the higher the premium. Finally, the higher the underlying futures value, the higher the premium. As stated, option premiums are very similar to most types of insurance policy and claimed upon only when appropriate (Stoll and Whaley, 1985).

With a call option, when the current futures value is above the ‘strike’ price (the futures value that was agreed when the contract was set up), the farmer can ‘strike out’ and claim the difference between the strike price and the current price or can wait for the current price to potentially rise further. With a put option, it is when the futures price is below the strike price. Once this futures movement is greater than the premium paid, the contract is called ‘in the money’, and if the contract is struck out the difference is paid to the option holder’s account. Should there be a downward price movement with a call option (or up with a put option), no action is taken (it would be like trying to claim on your car insurance if you had not crashed your car).

The premium can be reduced, like any insurance policy, by having ‘excesses’ applied to the policy. This is called going ‘out of the money’ (OTM). This means that the farmer agrees to set the Strike price above the prevailing futures price, with a call option, and below for a put option. This means the futures price has to deviate more from the current value before any benefit is accrued. The further OTM the option is (the bigger the excess) the cheaper the option becomes. By inference, it is less likely that the farmer can claim on the insurance. So like any insurance policy there is a risk: reward calculation (premium paid versus maximum loss to accept) before a claim can be made.

There are many variations on the types of options traded depending on the exchange and commodity in question. Option contracts can vary in their terms; expiry times, time periods for striking out and futures price over the lifetime of the option (averaging or price maximising).

(DEFRA and HGCA, 2009)found the option contract is used by 10% of wheat farmers in England. However, this probably a slightly inflated figure as this percentage encompasses both exchange-traded and grain merchant ‘option’ contracts. The latter are generally a physical wheat sales contract with a merchant ‘option’ attached and are termed ‘minimum priced contracts’. The ‘option’ part of the minimum contract is not an exchange-traded option. These contracts operate in a similar way to exchange traded options but with key differences, which are more fully discussed in Chapter 3.

2.4.5 Pools

Pool selling allows a third party to sell some or all of a farmer’s expected production for a fee per tonne. Pools have the basic principles that they are compulsory, a third party marketing organisation is granted monopoly powers of marketing and they are grower orientated (Whitwell et al., 1991; Watson, 1999). This third party is typically a co-operative or merchant but can also be a marketing agency or land agent (Openfield, 2013a). Therefore pools are a method by which the producers effectively remove themselves from the selling/marketing process of the crop in the pool. The pools are broadly split into short, medium and long pools. This equates to harvest sales, post-harvest to pre-Christmas and post-Christmas to June. Payment dates are agreed and money can be advanced if necessary to suit the farmer’s cash flow. Grain is committed for the forthcoming harvest but most commonly just six months ahead of harvest, for marketing over the following 18 months. It is estimated 20% of the wheat crop in England is marketed this way (DEFRA and HGCA, 2009; HGCA, 2013).

Pool marketers incorporate spot and forward selling but their views of risk may differ from that of the farmer's. The marketer does not take the farmer's risk profile into consideration. This is easier to accommodate by a smaller, more personal relationship with an advisor, operating a smaller pool or specific tailored advice. There is a lack of data on the methods used by traders to market wheat or on the level and sophistication of any FPRM techniques employed during the marketing period.

The use of pools tends to provide the farmer with the average price over the duration of the contract because of the aggregate effect of selling over this period. While this may reduce the chances of a low price there is no mechanism for the farmer to take advantage of market movements by instructing the pool manager to sell any remaining unsold tonnage. Also the short duration of the contract, 6-12 months, does not provide the same level of marketing opportunities as forward, futures and option contracts. Further, the choice of the appropriate pool for the farmer to use is difficult as it is difficult to compare between pools based on past performance. This is because the pools all have differing start and finishing dates and other contract terms. There is no published data exactly comparing pool results that can be used by the farmer to make an informed choice of which could be the most suitable for their purposes.

2.4.6 Other contracts

Buy-back contracts

These contracts are a way of the producer partially or fully locking into a margin for the crop in question before it is drilled. Often the seed is bought from the merchant and the crop bought back during the following harvest season, at some pre-agreed set price. For example, a discount / premium to the futures market or the HGCA published price for the region crop is grown at the time of movement. These contracts are often associated with a supply contract from the merchant to an end-user, or shipper to a specialist market, where a future guaranteed supply is needed. This provides a secure market for the grower and comes with its own growing protocols and agronomy advice (Farmers Weekly, 2010). One of the most recent buy-back contracts has been milling wheat contract to supply Warburtons, a bread manufacturer, via the merchant Openfield. This entails the farmer growing a specified seed variety, sold to them by Openfield, and the farmer contracted to supply the produce of that drilled acreage back to Openfield which is supplied to Warburtons to produce flour for their bread making process. The farmer is guaranteed a premium above the prevailing Group 1 milling wheat price for their area.

These contracts have the advantages of guaranteeing a market and a future price to both farmer and merchant, so a future margin can be fixed. The disadvantages can be the cost of the seed to the farmer, as it is often a specialist non-mainstream variety, exclusive to that merchant, so it is more expensive than home saved seed. As there is only one buyer, it is important to have a pre-agreed pricing mechanism, to avoid disputes over the final price.

Buy back contracts have become more popular as they promote the idea of known quality, traceability and integration within the food chain.

Trackers

These are specialised versions of a pool (Wellgrain, 2013; Openfield, 2013a). The wheat price is tracked and averaged over the duration of the contract and based on the LIFFE wheat contract for the pre-agreed collection month. An agreed formula equates the futures price to an ex-farm price (a form of basis calculation). The tracked price is based on a regular time period over the contract duration, typically daily, weekly or monthly. Similar to the ordinary pool contract the farmer has no pricing control once the contract is in place, a disadvantage with a falling market. The tracker contract gives a good approximation to the average wheat price over its lifetime but as the average price varies from season to season, as detailed previously in Figure 1.2, this does not necessarily achieve a stable margin/income for the producer. This is not due to farm production being inefficient but due to the market for their wheat crop dramatically moving, to their advantage or their detriment. It is this factor that is making the most significant differences between the highest and lowest margin producers, not the costs of production.

3 Futures and options

3.1 Background

Domanski and Heath (2007) noted that since 2002 there has been a sharp increase in commodity prices, especially for energy and base metals. The motivations and strategies of the commodity markets players are now similar to those in the financial markets. This mirrored the growing derivatives market activity. A derivative is a contract between two parties, with its price dependent upon, or derived from, an underlying asset. Wheat futures and options are derived from the price of physical wheat. The number of contracts in exchange-traded commodity derivatives almost tripled from 2002 to 2005 and the notional value of all 'over the counter' (OTC) derivatives traded globally at the end of December 2012 was $644 trillion (Bank of International Settlements, 2013).

Hedging can be defined as a method of reducing the risk of adverse price movements in a commodity, currency or security. The hedging process transfers the risk from the asset holder to the market or a speculator. Hedging usually involves taking equal and opposite risks in two different markets, such as the current spot market and the futures market (Business Directory, 2013).

Hedging, with options and futures in various scenarios, is covered in detail by Lapan et al. (1991); Moschini and Lapan (1992); (1995); and Vercammen (1995). However Carter (1999) suggests that there appears to remain a divergence between theory and practice regarding the use of futures and hedging tools. Danthine (1978) found that the optional level of hedging is the probability distribution of likely possible future prices. In the USA, a Commodity Futures Trading Commission (CFTC) survey in 1997 found only 7% of USA farmers used futures and many were not hedging but speculating (Carter, 1999). In England only 5% is suggested by a recent survey (DEFRA and HGCA, 2009).

The volume of literature on futures and options is enormous and it is not the goal of this thesis to discuss this in detail. Some examples are; Working (1942) who concluded that futures prices afford forecasts of changes that will probably occur in response to some form of influence but no such forecast from other forms of influence. Houthakker (1957) showed that professional large speculators show definite evidence of forecasting skill in both long and short timescales but non-professional small speculators should confine themselves to longer run futures. Carter (1999) reviews the literature on commodity futures markets and why so few farmers hedge. Liquidity, volatility and convergence, three attributes of futures contract behaviour, were investigated before and after the CBOT increased the position limits for corn, soya and wheat in 2005. Post 2005 there were generally increased speculative positions (Irwin et al., 2007).

The reduction of risk by hedging with futures and option contracts is well covered by the literature see for example; Stein (1961); McKinnon (1967); Danthine (1978); Feder et al. (1980); Anderson and Danthine (1983). The level of hedging required to achieve a lower risk goal, the 'optimal hedging ratio', is the ratio of the value of a position being protected via a hedge divided by the overall value of the position. Peck (1975) showed that hedging a substantial proportion of expected production could significantly reduce a producer's exposure to risk as well as showing the usefulness of a futures market to producers interested in more stable incomes. Increase of the farm size and participation in seminars explaining hedging techniques in the futures and options markets increased their take up (Goodwin and Schroeder, 1994). Welch et al. (2013) broadly concurred with these findings when researching whether concerns over the futures market integrity had impacted on producer FPRM practices. Farmers tended to use FPRM tools the older they were and larger farms used FPRM tools more. It was also concluded that those producers that had been trained via the Master Marketer program seminars hedged more, increased their use of FPRM tools as well as using other forms of risk management and were less likely to stop using FPRM tools in the future.

Standard models of the decision about optimal hedging show that it is negatively related to basis risk, to quantity risk, and to transaction costs. Farmers have lower optimal levels of hedging if they have less uncertainty about prices and a diversified portfolio of investments. Finally, in terms of risk reduction, farmers who have low levels of risk aversion have little to gain from hedging (Pannell et al., 2008).

Factors that have been recognized as potential contributors to low hedging ratios include production uncertainty (Lapan and Moschini, 1994; Lence, 1996), basis risk (Pennings and Meulenberg, 1997), transaction costs associated with purchasing and selling futures contracts (Bond and Thompson, 1985), and government programs that provide a substitute method of risk reduction (e.g., crop revenue insurance, but not crop yield insurance; (Mahul, 2003). (Hardaker et al., 1997) Hardaker et al. (1997) noted that low usage of futures by some farmers may be due in part to an expectation that the cash (or spot) price will be above the futures price when the product is sold. Conversely, if expectations about cash prices are below the futures price, then farmers have an increased incentive to use futures.

It is difficult to reach a consensus on the best way to model commodity price movements, as there are so many variables. They need to encapsulate intra and inter-seasonal price changes, seasonal supply and demand, production lags, geographical distribution, fund activity, national and international political intervention and, of course, random change. Tomek and Peterson (2000) concluded that despite all the research into commodity price analysis, consensus is yet to be reached regarding the systemic component of commodity price movement. Price volatility is therefore a risk and needs to be managed. Regarding pricing and marketing strategy, a reduction in the variance of returns can be achieved by routine hedging, for a relatively small cost. The development of pricing models to achieve a competitive return to their production or storage decisions should be an aim (Tomek and Peterson, 2005). However it was shown that for a risk averse farmer, there was little extra value of a recommendation derived from a model that represented risk aversion, compared to a model based on risk neutrality. Risk appears to be of secondary importance (Pannell, 2000).

3.2 Futures contracts

For futures markets to operate and be used with confidence, the market has to be ‘efficient’. This is a huge subject but the premise is that prices, at any point in time, should fully reflect all the available information (Fama, 1970). It is easier to estimate a futures price of commodities with continuous supply, such as corn or wheat, rather than those with discontinuous supply, such as potatoes. This is because there is more pricing information available at planting and also in the event of a surplus, wheat and corn can be stored from one season to another, whilst storing potatoes is more difficult (Tomek, 1997). The decision to sell or not, and hedge or not, is associated with the market information available at that time. The subject of futures has been well documented by Carter (1999), who discusses the work of many studies (McKinnon, 1967; Cox, 1976; Peck, 1976; Danthine, 1978; Stein, 1987; Grossman, 1989; Crain and Lee, 1996).

One of the futures market's main purposes is to create a link between current cash/spot/physical prices and forward quoted futures prices and to also allow for a return on storage over time (Working, 1942; 1948; 1949). The relationship of hedging to the development of futures trading was later discussed by Working and he concluded there were businesses experience reasons for hedging: facilitating buying and selling decisions; greater freedom of business action; gave a reasonable basis for storing commodity surpluses and reducing business risk (Working, 1953; 1953a). For storable crops, it was found that the use of the futures markets did indeed generally reduce the effect of a volatile market on the spot prices and were therefore very useful to the primary producer (Gray and Rutledge, 1971). Some early work suggested that optimal hedging was large, relative to cash/spot/physical positions (Tomek, 1987). However, when the real situation on the ground was surveyed it was found not to be case and a far lower level of hedging was actually happening. This was investigated with regards to corn marketing in Michigan (Heifner, 1966), post the 1996 Farm Act (Harwood et al., 1999), cost of storage calculations (Wright and Williams, 1989) and larger Mid-West US farmers (Patrick et al., 1998). In a survey of issues in futures markets it was concluded that futures markets did generally stabilise cash prices and did provide reliable indications of future spot prices (Kamara, 1982).

According to Santos (2008) the futures contract has three main purposes:

- To enable hedgers to shift the price risk, an asset's price volatility, to another party, a speculator. So hedging is normally regarded as taking the opposite position in the futures market than the cash/physical asset market. Speculators have no underlying asset to balance the risk, they take a futures position in the belief the market will move in their favour to achieve a profit.
- An efficient futures market should provide businesses with information about the expectations of the market in the future. This information will be used to make

decisions now, which will affect the business in the future. If the market is inefficient, these futures prices will be distorted or incorrect, lead to misinformation and adverse effects on the business.

- Futures markets provide a cheap form of collateral, like cash. It is much cheaper and easier to achieve by holding futures contracts than having stocks of the physical asset.

3.3 Option contracts

The theory of option pricing was first expounded by Bachelier (1900), based on share prices moving in a Brownian motion. There are many academic contributions to this option theory (Merton, 1973). For a simpler explanation of options see Lutgen (1999). The trading of options in agricultural commodity futures began again, as a pilot scheme, on 31st October 1984 after due consideration by the CFTC. Options had been banned since the Great Depression of the 1930s as it was claimed they abused and manipulated the marketplace (Lower, 1978; Tomek and Peterson, 2000; Urcola, 2007). By 2005, the volume of options traded in the corn, soyabeans and wheat markets had increased by 17, 93 and 200 times respectively (Urcola, 2007).

Like a futures contract, options are a means of dealing with uncertainty. Options are hedging tools as they are used to eliminate or reduce the risk associated with producing and marketing a product. An option allows producers to take advantage of advantageous price movements, both up and down, while at the same time protecting against disadvantageous ones. Protection against an unforeseen price rise is by the use of a ‘call’ option. Protection against an unforeseen price fall is by the use of a ‘put’ option. The farmer has the right, but not the obligation, to buy or sell a commodity for a future time at a specific price but only if it is advantageous (Stoll and Whaley, 1985). The farmer pays a premium for this, which is the maximum loss possible, as in insurance. This is unlike a future where there is unlimited up and downside exposure. The premium is a function of the time until maturity of the future, the volatility of the asset concerned, interest rates, the strike price (the futures price the option is based on at the time of the contract is negotiated) and the underlying future’s market price (Boness, 1964; Black and Scholes, 1973; Merton, 1973; Black, 1976).

Therefore the buyer of the option must evaluate whether the premium reflects the right it allows.

Options are a useful mechanism to insure against a price risk in an open speculative position, for example when a producer has a crop to sell but has not agreed a price on it (Lapan et al., 1991). This is very applicable in a situation where yield is uncertain but a definite minimum price is desired for some or all of the expected production. The inclusion of production uncertainty always makes it optimal for the producer to use put options and under-hedge on the futures (Sakong et al., 1993). This is because if the yield was subsequently lower than expected, the producer would be liable to a revenue risk, by having the contract bought in against them and thus incurring a loss (Arrow, 1981). Stoll and Whaley (1985), when discussing option markets, found options are useful investment tools because they provide a means of limiting or decreasing the risk of a portfolio.

For agricultural producers and agribusinesses attempting to reduce price risk, options on agricultural futures offer an opportunity to create a countless number of risk and return profiles (Hauser and Eales, 1986). More research is needed into useful benchmarks for individual decision makers, that is the quantification of the 'objective' risk and return (Hauser and Neff, 1985).

Many farmers do not use options as they are deemed to be too expensive and/or affect their businesses' cash flow (Irwin, 1990). The perceived expense is, however, more to do with cash flow than the farmer's perception of future price distributions and probability (Urcola, 2007). In general, producers believe prices will be higher than they actually achieve and that market volatility will be lower than is actually seen (Kenyon, 2001). The cash flow aspect is an issue as the premium is paid 'up front' when initially setting up an options strategy, so 'risk-reward' needs to be calculated at the same time (Zulauf et al., 2001).

3.4 Futures and options in practice in England

Broadly, FPRM tools used by farmers in England can be divided in two. Firstly, futures and options traded via a FSA regulated broker on a regulated exchange, in the farmer's name and secondly, 'futures' and 'options', traded via the agricultural merchant trade but not in the farmer's name. The grain traders in England produce marketing products that have the features of futures and option contracts but are not actually a 'real' future or option contract. They are sometimes referred to as an 'over the counter' (OTC) contract. The two are not the same, and should not be confused, even though they are similar.

There are several uses of these FPRM tools to the market players, farmer sellers and merchants/consumer buyers. This thesis concentrates on the farmer seller, but opposite actions could be taken by a buyer[6].

- The futures market enables the farmer with some physical crop to sell to fix a price for that crop. The farmer always has some crop to sell, they are always 'long' of physical commodity (be it undrilled but intended to be drilled that season, growing in the field or in the shed once harvested). A farmer is never knowingly 'short', i.e. selling more than he believes he will have (growing/in the shed), as that would be speculation. However in a low yielding year this may happen.

- Futures enable a farmer to set a price in the future for their produce at a time when it is difficult to find a buyer (normally a grain merchant) or the price offered is deemed to be too low, compared to the 'normal' ex-farm discount to the futures price, the basis. In the context of the English market, this could be two years ahead. Futures help the farmer in a situation when they may want to sell forward, lock into a price, and therefore a margin, but cannot find an immediate buyer.

- The futures markets are always trading on the days the exchange is open and the prices are clearly visible and readily tradable. Merchant or end-user buyers may not always be buying, or willing to price wheat, especially when looking over a year ahead.

[6] These are the perceptions gained from experience in the grain trade in England and from the one to one interviews and focus groups conducted during this research.

3.4.1 Exchange traded futures

Before trading can begin in exchange traded FPRM tools, an account has to be set up with a regulated broker. In England this is a broker that operates on the London exchange, NYSE LIFFE. Trades are cleared by ICE Clear Europe Ltd (NYSE Euronext, 2013). This process takes about two weeks and involves some regulatory paperwork. It covers money laundering regulations, proving identities and that all the Partners or Directors of the trading entity accept liability for the trades (Her Majesty's Treasury, 2007). The broker then sets up a client account. For the use of futures, an ‘initial margin’ must be transferred into it. At present, September 2013, for LIFFE traded feed wheat, it is £14/t. As the futures are traded in 100 tonne lots, that is £1400/ lot. The initial margin varies over time, reflecting the current volatility of the wheat market. The initial margin is designed to cover the worst daily adverse swing in the market that would still leave the account holder able to pay their ‘daily margin calls’. At the end of each trading day the farmer’s account is either credited or debited, depending on the market’s movement on that day. This continues until the future is closed or it expires, when one final payment/deposit is made. If the initial margin is depleted, then the account holder must deposit more money into the client account. If this is not possible, the broker closes the futures position automatically at the end of that trading day. Futures have unlimited upside and downside risk (New York Stock Exchange, 2013a).

3.4.2 Exchange traded options:

The same regulatory procedure is followed to set up an option account except there is no initial margin requirement. An option account has a liability limited to the premium paid, so it is only the premium that is paid initially to set up the account. There are no further liabilities to the account holder (New York Stock Exchange, 2013b).

There are two types of option contract. A wheat call option protects against a rising wheat market, following a physical wheat sale. A put option protects against a fall in the wheat market if no sale is made/cannot be made but the current wheat price of the asset is deemed acceptable. The form of call and put options traded on the LIFFE market in England are ‘American’ options. That is, the option can be decided, ‘stuck out’ on any day from inception to expiry at the buyers option (New York Stock Exchange, 2013b). There are many styles of option contract; European, Bermudan, Asian, Barrier, Binary, Exotic and

Vanilla, all with varying expiry times, averaging and maximising characteristics (Peskir and Uys, 2003; Linetsky, 2004; Eberlein and Papapantoleon, 2005; Glover et al., 2010; Peskir and Samee, 2011; 2013).

Hypothetical call option example: if a producer sells their wheat for £150/t for a year ahead but is concerned that the market may rise during that time they may rather pay a premium to have the right to sell their wheat again at the higher price, rather than accept the higher fixed price now. If the premium was £10, then a minimum price of £140 is created. If the market rose to £200, the farmer would resell his wheat at £200 - £10 premium and receive a new price of £190. If the price of wheat fell to £100, then the farmer would take no action, but take the £140 minimum price agreed a year ago.

Hypothetical put option example: a producer decides not to sell their wheat/cannot sell wheat for reasons of uncertain yields but thinks the forward wheat price of £150/t for a year ahead is good. However, the producer is concerned that the market may fall during that time, pays a premium to have the right to sell their wheat again at the current price. If the premium was £10, then a minimum price of £140 is created. If the market fell to £100, the farmer would sell his wheat when yield known (at harvest) at £100, gain £50 (£150 - £100) from the option and deduct the £10 premium and so receive £140, the minimum price agreed a year ago. If the price of wheat rose to £200, then the farmer would take no action with the option, but sell the physical wheat for £200 and deduct the £10 premium and so receive a new price of £190/t. This hypothetical example is shown in tables 3.1, 3.2 and 3.3.

Table 3.1 Call Option – set-up phase

An "at the money" basis Nov '14 futures	
Assume 100t wheat is being sold, as price/basis good	
Nov '14 futures	£156.00/t
Nov '14 ex-farm price Assumes Basis = -£6	£150.00/t
Buy call option at strike price	£156.00/t
Option Premium	£10.00/t
Total obligation	£1000
Net price (£150.00 - £10 option)	£140.00/t min

Table 3.2 Call Option - A subsequent price rise

A Call Option basis Nov '14 futures	
Nov Futures (14th June '14)	£196.00/t
Action: Exercise call Option at	£196.00/t
Profit on call (£196.00 - £156.00 = £40.00)	£40.00/t
Gross value of physical sale	£150.00/t
Original Option Premium	£10.00/t
Net value of physical sale (£150 sale + £40.00 profit on call - £10 Option premium)	£180.00/t

Table 3.3 Call Option - A subsequent price fall

A Call Option basis Nov '14 futures cont...	
Nov '14 Futures (14th June '14) (so ex farm £106 - £6 basis = £100)	£106.00/t
Action: Abandon call option	
Profit on Call Option	£00.00/t
Gross value of physical sale	£150.00/t
Original option premium	£10.00/t
Net value of physical purchase (£150 - £10 Option premium)	£140.00/t

A put option removes the risk of selling physical wheat forward, which may never be produced and reduces the effect of a price fall. A put option is a way of locking into a forward price, with yield no longer such an issue.

Option premiums, like insurance premiums, can be reduced if an 'excess' is applied. This is called going 'Out of the money' (OTM), so the buyer accepts a higher strike price in return for a lower option premium. Table 3.4 shows a hypothetical example of how the premium can be reduced from £10 to £6 by going OTM. As the option granter now has less risk of being claimed against, the premium can be reduced, as the market price movement required before a claim is possible is increased. Also, with a lower premium there is a higher guaranteed minimum price (less premium deducted from the physical wheat price). In this example the minimum price achieved being £5 OTM (strike price £105) would be £2 higher than with an ATM option with a strike price of £100. This flexibility allows almost any premium, and so minimum price of the physical wheat, to be agreed. As an extreme example, on any day an option premium could be hypothetically reduced to £1/t, but would be so far OTM that there would be little chance of any gain, but the guaranteed minimum would be high, a trade-off.

Table 3.4. Hypothetical examples of premiums with differing strike prices for a call Option.

Premium £/t	Strike price, £/t		Gain point
10	100	At the Money	110
8	105	£5 out the Money	113
6	110	£10 out the Money	116

When studying wheat, corn and soyabean options in the USA, it was found that these option markets were 'efficient' and that the mis-pricing claims were caused by biases in the agents' perception of futures price distribution (Urcola, 2007).

The use of exchange traded (FSA regulated) FPRM tools has several advantages and disadvantages. These are some perceptions gained from experience in the grain trade in England and from the one to one interviews and focus groups conducted during this research and include:

Advantages

- Full backing of the FSA regulations, including the Financial Services Compensation Scheme, should the regulated broker go into receivership.
- Trades concluded directly with the Exchange traders.
- All trades time-stamped. Important in a rapidly moving market.
- All trades recorded for security.

Disadvantages

- No advice from the FSA regulated broker on future and option use to farmer.
- Time consuming setting up an account.
- 'Initial margin' or premium must be paid before trading allowed, so potential cash flow implications to the farmer;.
- Often several hours/days delay in granting an option as market often illiquid, especially when looking over one year ahead.
- Brokers fees for setting up a future, and the option premium.

3.4.3 Merchant ‘futures’

Due to the unlimited liability nature of the futures contract, most merchants do not grant these types of contracts with their farmer clients, unless they have a close previous trading relationship. Most will include a pre-set ‘stop-loss’ built into the contract, which if reached will automatically close the farmer’s position, stopping any further losses. Some merchants insist on a physical grain contract, with no price agreed, to be placed in association with the future, as collateral.

3.4.4 Merchant ‘options’

Call options are more readily granted and form a ‘minimum priced contract’, as physical grain is sold to the same merchant at the same time. In the context of the wheat market in England, calls are felt by the grain trade in England to be within the scope of the merchant’s trading activities of buying grain and so do not cross FSA rules on trading ‘financial instruments’ (Financial Services Authority, 2013). Most merchants in England will not grant puts. A put could be construed by the FSA as speculation, not part of the merchant’s trading activities, as no grain is associated with the contract. However in reality, a merchant would only grant a put to a farmer they knew and as part of a hedging strategy.

This is very restricting from a farmer’s PRM perspective as a downward price movement is difficult to protect against if all (unless ‘simple’ futures used), or the maximum quantity that can be safely sold before harvest (as yield unknown), has been reached. In that scenario, the farmer has no alternative but to just watch the price falling and accept the loss. Additionally, if a contract can only be priced at the time of the wheat movement (like many seed contracts are) but the farmer believes the market will fall before then, a higher price cannot be locked into or guaranteed. By using only forward trades, if the physical wheat tonnage is not eventually produced, and the price has risen, a ‘buying-in’ penalty may be applied by the merchant to the farmer (Porter, 2012).

These merchant OTC contracts have advantages and disadvantages which each individual producers needs to weigh up before entering into them. These are the perceptions gained from experience in the grain trade in England and from the one to one interviews and focus groups conducted during this research and include:

Advantages

- Not having to go through the regulatory paperwork phase.
- Not having to pay initial margins when first setting up the futures contract or the daily requirement of margin calls associated with daily futures contract price movements.
- Not having to pay the option premium until a forward physical sale is actually moved, the premium being deducted from the proceeds of the sale.
- Trading via an organisation/person that the farmer already knows and trusts.
- There is time to take advice about why these tools are being used.
- The costs of setting up an OTC future or the option premium is often cheaper as the merchant combines the FPRM tools with a physical wheat sale, which maybe is used to 'subsidise' the FPRM tool's true cost.
- The FPRM tool and physical grain are often amalgamated to for a variety of 'minimum priced contracts', removing many of the FPRM tools' terms.

There are however real disadvantages:

- Counterparty risk. The farmer has to make a value judgement of the advantages versus the chance of such a merchant default. Merchants are also concerned with counterparty risk, if the farmer cannot pay any losses that may occur if the market moves against them.
- Increasingly tighter FSA regulations, post MIFID (Markets in Financial Instruments Directives) in November 2007, many merchants in England believe it may be illegal to offer FPRM instruments, as none are at present FSA regulated (Financial Services Authority, 2007).
- The merchant may not be setting up the same FPRM tool as they are selling the farmer. It depends on the wider overall 'position' the merchant has in the wheat market.
- The FPRM tool, if in fact set up by the merchant at all, is in the name of the merchant not the farmer. This is because the merchant does have a FSA regulated account and can therefore set up a 'real' future/option in their own name. In the case of a merchant default, the farmer's FPRM tool via the merchant could be worthless.

- No recording of conversations, important in a dispute.
- No time-stamping of trade, important in a volatile market.

3.5 Futures and option use in by farmers in England

In the UK, only 5% of arable farmers use futures and 4% use options as part of their PRM mechanisms (DEFRA and HGCA, 2009). This concurs with USA agriculture (Carter, 1999) and personal communication (Carter, 2013). Reasons stated by the HGCA for this non uptake; understanding of how futures work, 13%, their high cost, 10%, perceived high-riskiness, 9%, not necessary, 34%, or not applicable, 27% (DEFRA and HGCA, 2009). "In the USA most row crop farmers (corn, soybeans, wheat etc) take out (highly) subsidized 'revenue insurance' that pays out if (futures) prices fall between planting time & harvest. The government pays a large share of the premium & therefore the sign-up rates are high. So there is much less need for them to use futures/options on their own" (Carter, 2013).

3.6 Summary

This section has presented, in detail, what futures and options are and how they are practically used by farmers as FPRM tools within a farming enterprise to mitigate wheat price volatility. It has described the differences between exchange traded and merchant futures and options and, in particular, the advantages and disadvantages of both.

4 Theoretical background and review of studies

4.1 Theoretical background

When studying human behaviour it is advisable to include the effects of the micro and macro environment to capture the full extent of important determinants on that behaviour. When studying Behavioural intention (BI) as a proxy for predicting actual behaviour there is a requirement to identify the determinants of intention: personal attitude, 'social norms', and ease of performing that behaviour and infrastructure (Davis, 1989; Mathieson, 1991; Hartwick and Barki, 1994; Taylor and Todd, 1995a). This research will encompass three main theories: Theory of Reasoned Action (Fishbein and Ajzen, 1975); Theory of Planned Behaviour (Ajzen, 1985; 1991); and the Diffusion of Innovations (Rogers, 1995). Also used are the TRA/TRB derivatives: the Technology Acceptance Model (Davis et al., 1989; Davis, 1993); and the Decomposed TRB model (Taylor and Todd, 1995a). The TPB has been previously used as the base for predicting human behaviour in many different arenas: for example medicine (Randall and Gibson, 1991); agriculture (Jackson, 2008); leisure (Ajzen and Driver, 1992); consumer behaviour (Berger, 1993); weight loss (Schifter and Ajzen, 1985); and the adoption of new technologies (Mathieson, 1991). However, it has been shown in social psychological research that attitudes do not always predict behaviour (Wicker, 1969; Terry and O'Leary, 1995).

The basic social model of behaviour is the Expectancy-Value model, or E-V Model, where attitude is the result of the multiplication of an individual's beliefs in a particular behaviour with the value they attach to those beliefs. A form of rational choice theory, EV theory assumes an individual aims to maximise the chance of a favourable outcome, while minimising the chance of an unfavourable one (Fishbein, 1967). Given the choice between two alternatives, individuals choose the one with the most desirable outcome (the one deemed most advantageous). This evaluation, or attitude, is derived from the perceived prospect that the alternatives have a number of key characteristics, weighted by the valuation of these outcomes (Conner and Armitage, 2006). Concerning this thesis, it is the outcome associated with using FPRM tools to market their wheat.

TRA and TPB are examples of an E-V model but there are other used models such as The Health Belief Model (Rosenstock, 1974) and The Protection Motivation Theory (Rogers, 1975). Like TRA, both HBM and PMT construe behaviour as a decision making process. Both assume behaviour to involve planning ahead, based on outcome expectations (EV models can thus also be called means-end theories). They may be considered multi-linear, as multiple factors are shown to contribute to behavioural outcomes (Darnton, 2008).

4.1.1 Theory of Reasoned Action

The TRA was developed through Fishbein (1967) and later refinements added by Fishbein and Ajzen (1975) and Ajzen and Fishbein (1980). The concept of BI is central to the TRA and has been the basis of many studies over the past 30 years (Van den Putte et al., 1991). Fishbein and Ajzen (1975) based their research on the premise that behaviour is a function of a person's intention and that intention depends on the person's attitude toward the behaviour and the SN of the wider community.

Sarver (1983) commented that social action is a causal sequence leading from beliefs, through Att, SN and BI, to behaviour. Referring to TRA, Bagozzi (1992) stated that it is a fundamental model for explaining social action and has shown remarkable resilience over years, testament to its power and versatility. Allport (1935) states that attitude is probably the most distinctive and indispensable concept in social psychology, a view that is supported by Fishbein and Ajzen (1975). TRA was the first model to produce consistent results suggesting a link between measured attitudes towards undertaking a behaviour, and the performance of the behaviour itself (Burton and Rob, 2004). Armitage and Conner (2001) defined attitude as a positive or negative evaluation of behaviour. A greater positive attitude towards performing a given behaviour implies a more positive intention to perform the behaviour. Underlying intentions are Att, general evaluations of behaviour and SN, general perceptions of social pressure, determined by underlying behavioural and normative beliefs, respectively (Armitage and Conner, 1999b).

Att and SN are expected to take into account the effects of any other influences on intentions and behaviour. Regarding the attitude concept, it is characterised by confusion and ambiguity, with little agreement on definition (Fishbein and Ajzen, 1975). It appears academics agree to differ on a definition and they choose one to fit with their individual study. The period 1968-70 produced 500 procedures designed to measure attitude (Fishbein and Ajzen, 1972).

An explicit definition of Att appears to be a minimum prerequisite for the development of valid measurement procedures (Fishbein and Ajzen, 1975). They conclude that a person's attitude to any object, issue, behaviour or event is determined by their salient beliefs[7] linking the object to various attributes and by their evaluations of those attributes. Further, a person's attitude was found to be the totality of their beliefs but not necessarily to any particular belief they hold (Fishbein and Ajzen, 1975).

The TRA is based on the assumption that human beings are rational and make logical use of the information they have available. Also, that an individual considers the implications of their actions before they decide to engage, or not, in a given behaviour (Ajzen and Fishbein, 1980). Intention is formed by two factors, attitude towards the behaviour and his evaluations of these outcomes. The attitude towards the behaviour is determined by the person's belief that the behaviour leads to certain outcomes; this is referred to as 'behavioural belief' and is expressed as Equation 1 below. In the case of attitudes towards a behaviour, each belief links the behaviour to a certain outcome, or some other attribute such as the cost incurred by performing the behaviour (Ajzen, 1991). These outcomes are given a positive or negative value, and so favour behaviours that give a desirable consequence. The outcomes' subjective value contributes to the attitude in direct proportion to the strength of the belief (Ajzen, 1991).

$$\text{Att} = \sum b_i e_i \qquad \text{Equation 1}$$

Where Att = attitude to a behaviour or object;
b_i = belief that performance of an act will lead to consequence I;
e_i = evaluation of the consequence i;
i = number of salient beliefs .

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[7] A belief that is sustained over a long period of time, regarding an object, action or event. They form part of the many beliefs an individual may have but are one of an individual's few core-unchanging beliefs.

For example, in a questionnaire, each belief (*b*) question, such as ‘Hedging tools enable the setting of a minimum market price for my wheat’, could use a Likert scale to score 1-7 (strongly disagree-strongly agree with the statement). Each evaluation (*e*) question, ‘How important is it to set a minimum price for your wheat crop?’ could also have a score of 1-7 (strongly disagree-strongly agree with the statement). The resultant Att score would be b x e and have a minimum of 1 x 1 = 1 and a maximum of 7 x 7 = 49.

TRA connects attitudes and behavioural outcomes by using the construct of Intention. It is assumed that intention leads directly to behaviour. However, other factors also affect the intention such as the SN, which is constructed to capture social influences. Underlying SN are normative beliefs, the perceived social pressure. An individual’s perception of others’ beliefs that he or she should or should not perform from salient referents multiplied by the motivation to comply with those referents (Armitage and Conner, 1999a). Therefore, the SN takes into account what an individual, specific individuals or groups think that they should or should not perform a given behaviour, as well as the individual’s motivation to comply with these specific referents. As was the case with measuring Att, these two components are multiplied together.

$$SN = \sum nb_i m_i \qquad \text{Equation 2}$$

nb_i = normative beliefs

m_i = motivation to comply

So, an example could be, ‘Would a merchant recommend the use of hedging tools?’ (score *n*: 1-7) x ‘How motivated would you be to comply with the merchant’s advice?’ (score *m*: 1-7). The resultant SN score would be *n* x *m* and, as before, have a minimum of 1 x 1 = 1 and a maximum of 7 x 7 = 49.

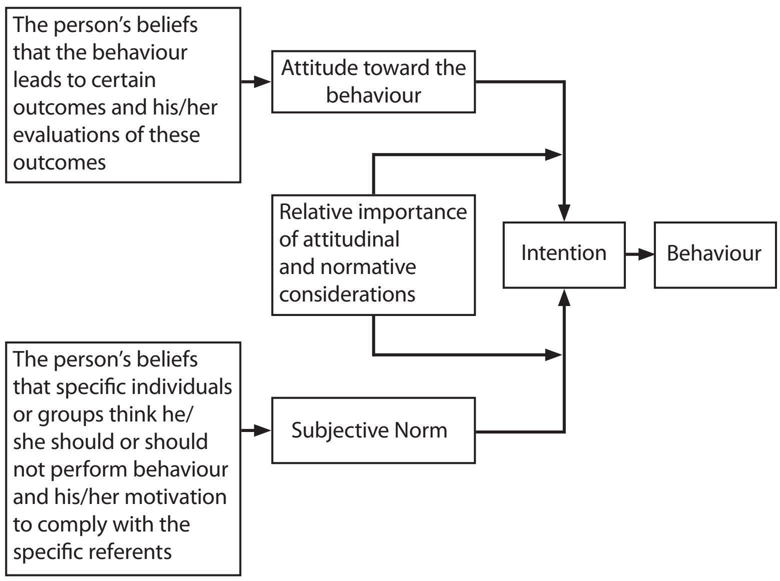
Beliefs, may also lead to the formation of normative beliefs concerning behaviour. Att to a behaviour and SN determine the person’s intention to perform the behaviour in the future, and this intention leads to performance or non-performance of the behaviour (Ajzen and

Fishbein, 1980), see Figure 4.1. They stated that there are three types of belief, which are summarised by (Ryan, 1982) below:

1 Descriptive belief, derived from direct experience;

2 Informational belief, formed by accepting information from some source; and,

3 Inferential belief, derived through a process of inference from descriptive, informational, or other inferential beliefs.

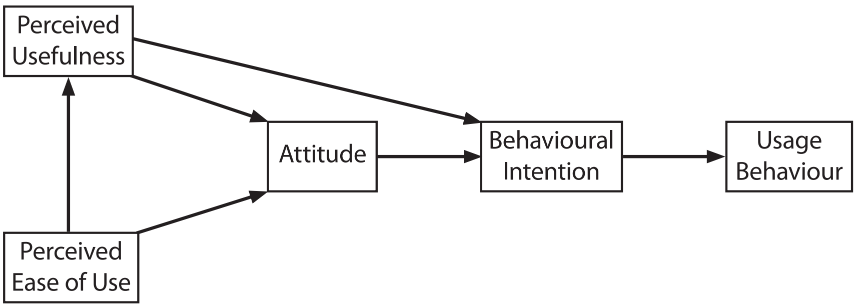


Source: Ajzen & Fishbein (1980)

Figure 4.1. A representative diagram of the TRA.

To strengthen the predictive relationship between intentions and behaviour of single-act criteria, Fishbein and Ajzen (1975) stated that this model required two prerequisites in addition to the assumption that most human behaviour is under volitional control. Intention has to be measured at the same level of specificity as the behavioural criterion and the measure of intention must reflect the person's intention at the time they perform the behaviour (Fishbein and Ajzen, 1975).

The Technology Acceptance Model, TAM was derived from the TRA and represents the antecedents of performing a behaviour through beliefs about two factors: the perceived ease of performing a behaviour; and, the perceived usefulness of the behaviour (Davis, 1989; Davis et al., 1989; Davis, 1993), see Figure 4.2. The model designer has some control over the key factors of ease of use and perceived usefulness. Their direct and in-direct effects and attitude towards usage determine intention to use. Most of the variance in intention and self-reported usage is explained by TAM (Davis, 1989; Davis et al., 1989; Mathieson, 1991; Davis, 1993; Hubona and Geitz, 1997).



Source: Adapted from Davis et al. (1989)

Figure 4.2. The Technology Acceptance Model (TAM).

BI is included in both the TRA and TAM frameworks as a predictor of actual behaviour and is assumed necessary in the absence of actual behaviour observations. The predictive power of the TRA and TAM is significantly increased by the inclusion of intention (Fishbein and Ajzen, 1975). In the case of TAM, Usage behaviour (B) is a direct function of BI and is expressed in Equations 3, 4 and 5 (Taylor and Todd, 1995a). Thus,

$B = BI = w_1 Att + w_2 PU$; Equation 3

$Att = w_3 PU + w_4 E$; Equation 4

$PU = {}_5E$. Equation 5

Where:

BI is a weighted function of Att and perceived usefulness (PU);

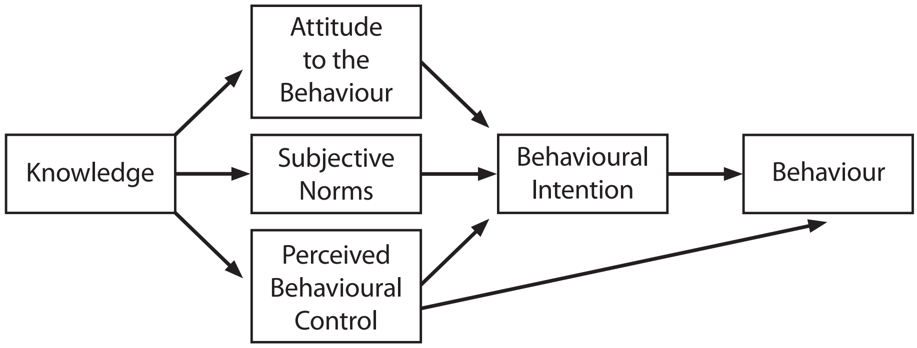
Att relates to the level of favourableness or unfavourableness towards use;
PU relates to the belief that using the technology will boost performance;
E relates to ease of use (E);
w_x relates to the weight associated with each factor.

TAM differs from TRA, as it does not include social influences or SN. Only E and PU factors affect Att, any other influences are assumed to be directly affecting E or PU. For example, one may have a negative attitude to a work system but may still use it if the system strengthens job performance (Davis et al., 1989). It is a purposefully simple model with a small number of understandable factors that can be easily manipulated and implemented. Results support the importance of perceived usefulness as a direct determinant of intention. Ease of use was less clear and mediated by perceived usefulness (Taylor and Todd, 1995a).

4.1.2 Theory of Planned Behaviour (TPB)

The TPB (Ajzen, 1991), an extended model of TRA (Fishbein and Ajzen, 1975), was first described by (Ajzen, 1985). It was necessary following criticisms of the original TRA's limitations and inability to fully take into account the behaviours over which people had incomplete volitional control. Although, as before, the concept of intention is the main element of the theory, the construct of perceived behaviour control (PBC) was now included, and refers to the person's perception of the ease, or not, of performing the particular behaviour of interest. An individual may have a positive Att and SN with regard to a particular behaviour, but may be prevented from carrying out the behaviour due to circumstances beyond their control (Ajzen, 1985; Ajzen and Madden, 1986; Ajzen, 1991; Ajzen and Driver, 1991; Madden et al., 1992). This is presented in Figure 4.3.

In terms of this research, the PBC construct could be particularly pertinent in relation to the use of FPRM tools. A producer may wish to use FPRM tools but may be prevented from doing so by their lack of self-belief in their ability to use the FPRM tool, due to lack of information, training, lack of a third party to transact them or not having the financial resources to actually set one up.



Source: Ajzen (1991)

Figure 4.3. The Theory of Planned Behaviour Model

PBC is also assumed to be a function of beliefs, beliefs about the presence or absence of factors that facilitate or impede performance of the behaviour (Ajzen, 2005) and detailed in Equation 6.

Behaviour is a direct function of BI and PBC:

$B = {}_{w1}BI + {}_{w2}PBC$ Equation 6

w_x relates to the weight associated with each factor.

BI is a function of the individual's Att, SN, and PBC. Att exhibits the individual's sense of the rightness of performing the behaviour. SN is a function of the inclination of the individual's social group/peers/superiors that the individual performs the behavior. PBC is a function of constraints, both internal and external, on performing the behaviour. This is described in Equation 7.

$BI = {}_{w3}Att + {}_{w4}SN + {}_{w5}PBC$ Equation 7

w_x relates to the weight associated with each factor.

Each of Att, SN and PBC is determined by underlying belief structures (Fishbein and Ajzen, 1975): attitudinal beliefs (b_i), normative beliefs (nb_j) and control beliefs (cb_k). They in turn have a weight attached to each, indicating the strength of the willingness to perform the behaviour:

For Att, evaluation of the desirability of an outcome e_i;
For SN, motivation to comply with the peer groups mc_j;
For PBC, facilitating the behaviour pf_k.

Att is calculated as the sum of the attitudinal beliefs multiplied by the evaluation of the outcome and shown in Equation 8, thus:

$$\text{Att} = \sum b_i e_i \qquad \text{Equation 8}$$

For example, an individual may believe that using FPRM tools will result in better wheat marketing performance (b_i) and may consider this a desirable outcome (e_i).

Similarly SN is calculated by summing the normative beliefs multiplied by motivation to comply:

$$\text{SN} = \sum nb_j mc_j \qquad \text{Equation 9}$$

For example, an individual may believe that their peers/superiors grouping think that they should use FPRM tools (nb_j) and that complying with their wishes is important (mc_j).

SN has been shown to be more important in influencing BI during the earlier stages of adopting a new technology when the individual has limited use or actual experience of the technology. However, it has also been found that if there is no real consequences of use or external pressure to perform the behaviour, SN has no significant relationship to BI (Hartwick and Barki, 1994).

PBC is the person's perception of the ease, or not, of performing the particular behaviour of interest. An individual may have a positive Att and SN with regard to a particular behaviour, but may be prevented from carrying out the behaviour due to circumstances (internal or external) that are beyond their control (Ajzen, 1985; Schifter and Ajzen, 1985; Ajzen and Madden, 1986; Ajzen, 1991; Ajzen and Driver, 1991; Madden et al., 1992; Terry and O'Leary, 1995). External conditions needed to carry out the behaviour are denoted as 'facilitating conditions' (Triandis, 1979). Internal conditions of the individual, their self confidence in their ability to perform the behavior, are referred to as 'self efficacy' (Bandura, 1977; Bandura, 1982). In dentistry, self-efficacy was found to be a diagnostic predictor of intentions to brush and floss, but not the actual behaviour (McCaul et al., 1988). However, Triandis (1979) comments that an individual may perceive few external constraints to performing a behaviour but still may lack confidence in their own ability (Terry and O'Leary, 1995). A person's motivation to perform the behaviour is weakened with low levels of PBC. For example, the learned helplessness model of depression (Abramson et al., 1978).

Formally, PBC can be calculated as shown in Equation 10:

$$\mathrm{PBC} = \sum cb_k\, pf_k \qquad \text{Equation 10}$$

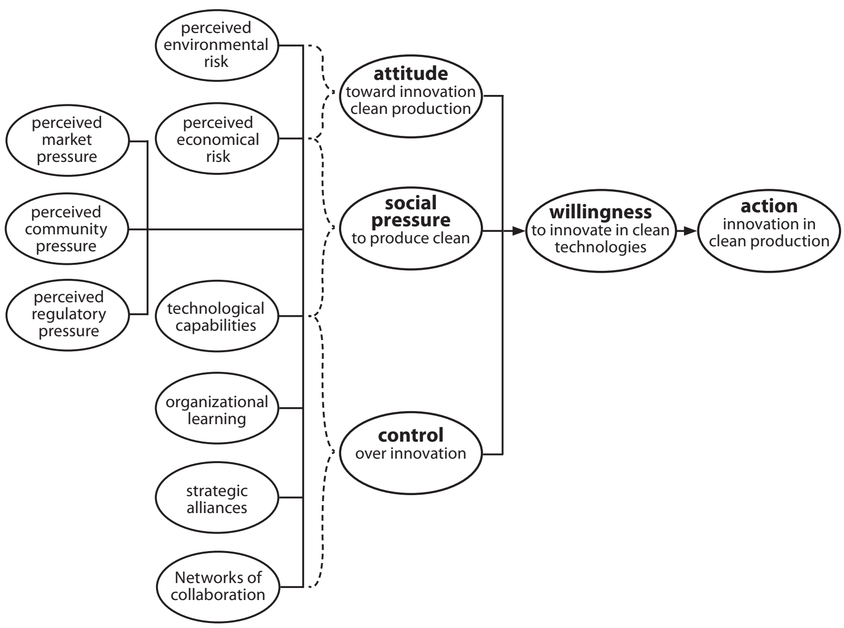
For example, the individual does not have the confidence or necessary knowledge required to use FPRM tools (cb_k) and that having that knowledge is important to determining their use (pf_k).

Ajzen compares this new construct, PBC, with other conceptions of control of intentions and actions such as the perceived locus of control (Rotter, 1966), the theory of achievement motivation and expectancy of success (Atkinson, 1964) and the perceived self efficacy (Bandura, 1977; Bandura et al., 1980). Ajzen's (1991) own definition is an individual's perception of the ease or difficulty of performing a behaviour of interest. Whereas locus of control (Rotter, 1966) is a general expectancy that remains stable across situations and forms of action. PBC can, and usually does, vary across situations and actions (Ajzen, 1991). Also, TPB is in principle, open to the inclusion of additional predictors, if it can be shown that they capture a significant proportion of the variation in intention or behaviour after the theory's current variables have been taken into account (Ajzen, 1991). These could be habit, moral obligation and self-identity. Ajzen (1991) gives two rationales to support this; if intention is held constant, the effort expended to bring a course of action to a successful conclusion is likely to increase with perceived behavioural control. Secondly, another reason for expecting a direct link between PBC and behavioural achievement is that PBC can often be used as a substitute for a measure of actual control.

Behaviour is thus predicted by the Att to the behaviour, SN and PBC. PBC has two influences on behaviour. Firstly directly, via the intention to perform the behaviour (BI) (Ajzen, 1991) and secondly, indirectly, a link between PBC and behaviour itself, via increased or decreased motivation (Madden et al., 1992; Sheeran and Abraham, 2003). The PBC measure, although central to the TPB, it is argued, is only really achievable if the person involved has volitional control over the behaviour.

Following the publication of the TPB, Bagozzi and Kimmel (1995) analysed four different theories: TRA, TPB, theory of Self-regulation (Bagozzi, 1992) and Theory of Trying (Bagozzi and Warshaw, 1990), on their ability to predict exercise and dieting, both relatively low in perceived behavioural control. It was concluded that they were not true predictors of behaviour. SN was found not to predict intention, and PBC failed to predict intentions or behaviour (Bagozzi and Kimmel, 1995). They continued that leading theories of goal-directed behaviour were incomplete. The significance of the influence of past behaviour on both intentions and subsequent performance of the target act implies that additional social psychological variables are in need of specification (Bagozzi and Kimmel, 1995). Various caveats were stated and the theories should not be discredited or disregarded as a result. Other authors have criticised SN too, arguing behaviour is impacted by norms to a greater degree than SN (Van den Putte et al., 1991; Conner and Sparks, 1996). The addition of 'self identity' to TPB has been proposed to capture the complexities of normative behaviour (Sparks and Shepherd, 1992; Terry and Hogg, 1996; Armitage and Conner, 1999b). The greater an individual's perception of fulfilling a certain role in society, the greater the influence of self-identity has on intention (Charng et al., 1988; Conner and Armitage, 1998). Indeed, PBC may more usefully be divided into 'perceived control over behaviour' and self-efficacy (Armitage and Conner, 1999b; 1999c), that is, the greater the person's perception that a particular process is controllable weighed against that person's confidence in their ability to handle that process (Terry, 1991; 1994; Terry and O'Leary, 1995).

Ajzen (1991) acknowledged weaknesses in his new theory conceding that intentions and perceptions of behavioural control are useful predictors, but only additional research can determine whether these constructs are sufficient to account for all or most of the systematic variance in behaviour. Of particular concern are correlations of only moderate magnitude that are frequently observed in attempts to relate belief-based measures of the theory's constructs to other, more global measures of these constructs. These issues were taken up in later research (Ajzen and Driver, 1991). The addition of more constructs was reiterated and shown in subsequent papers (East, 1993; Bagozzi and Kimmel, 1995; Corral, 2002; 2003; Burton and Rob, 2004). In particular the adoption of new environmental technologies in Mexico produced a complex pattern of constructs (Corral, 2003), as shown in Figure 4.4.



Source: Corral (2003)

Figure 4.4. Explaining and predicting the firm's willingness to innovate in clean technologies.

In conclusion, the relationship between Att, SN and PBC is not well understood (Ajzen, 1991). Firstly, the belief constructs are too large and one-dimensional (Taylor and Todd, 1995a) and not related to Att, SN and PBC consistently (Miniard, 1979; Bagozzi, 1981; Miniard and Cohen, 1981; Bagozzi, 1982; Shimp and Kavas, 1984). Secondly, being very personal to the individual, Att is difficult to measure, which is why TAM disaggregates attitude into ease of use and perceived usefulness, making it more generically applicable (Davis, 1989). In section 4.1.4 the DTRB further sub-divides Att, SN and PBC (Taylor and Todd, 1995a).

However, despite criticisms the TPB was found to be a satisfactory method of predicting a myriad of intentions and behaviours in many reviews (Ajzen, 1991; Van den Putte et al., 1991; Sparks, 1994; Conner and Sparks, 1996; Conner and Armitage, 1998). Specifically, this was so when measuring farmer behaviour: hedge management by farmers in Bedfordshire (Beedell and Rehman, 1996; 1999; 2000) and min-till in Australia (Gorddard, 1991; 1993). Beedell and Rehman (2000) stated that there is much to recommend the use of socio-psychology models in studying farmer behaviour as they provide a structured and theoretically rational, replicable methodology. This also recommends these models as they can identify beliefs that form attitudes and motivations as well as relate behaviour to its underlying beliefs. However, they also provide caveats that researchers need to be aware of, such as self-estimates of behaviour, which are open to bias. Further, a time series of data will be better than just a single time frame although it is time consuming and questions need to be precise to avoid self-interpretation of answers by respondents.

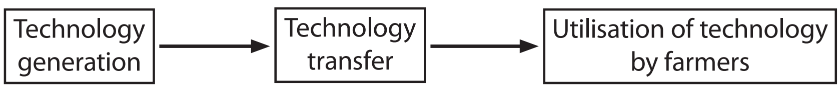
The concepts reviewed here would suggest that various economic and psychological factors may be pertinent in a model aiming to predict those that will use FPRM tools as part of a marketing strategy for farmers in England when selling their wheat. It may also help in understanding why, despite there being large wheat price volatility and increased information and training in the use of FPRM tools, many producers still do not use these tools when marketing their wheat.

In relation to this study, the beliefs underlying PBC would be an appropriate way to assess the relative strength of the economic control factors in relation to the behaviour of using

FPRM tools to market wheat in England. For example, a producer may wish to use FPRM tools but lacks the confidence, or self-efficacy, to use them. Also, the facilitating conditions of the wheat market in England, the grain trade, may not be present for the producer to actually use the FPRM tools and lead to a desired outcome. This is known as 'outcome expectancy' (Bandura, 1977; 1982). Self-efficacy and outcome expectancy may not have the same type of effects on behavioural decision making (Terry and O'Leary, 1995). That is the individual's beliefs in themselves may not be enough to achieve the desired behaviour if the facilitating conditions are not present too.

4.1.3 Diffusion of Innovations

Rogers (1995), was the fourth edition of his work called Diffusion of Innovation, first published in 1962, following from his work in the 1950s (Rogers, 1958). Rogers (1983) 'classical' approach defines diffusion as the process by which an innovation is communicated through certain channels over time among the members of a social system (Fliegel and Kivlin, 1966; Fliegel, 1993) shown as a linear process in Figure 4.5. It is a special type of communication, in that the messages are concerned with new ideas. Communication is a process in which participants create and share information with another in order to reach a mutual understanding (Rogers, 1995).



Source: Fliegel (1993)

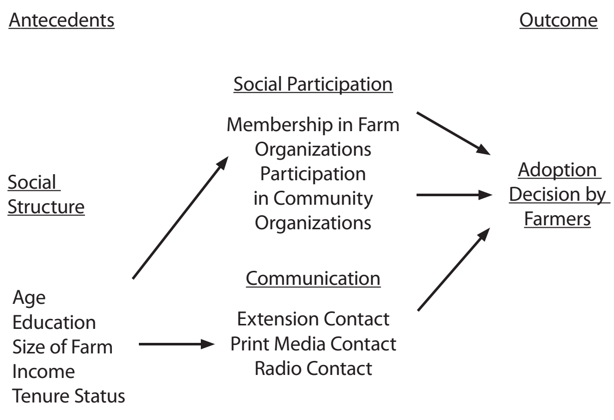
Figure 4.5. Diffusion 'Classical' approach.

As this communication involves a new idea, there is also an element of uncertainty associated with diffusion. Uncertainty suggests alternative outcomes may occur, and it is the perception of these alternatives and their relative probabilities that affects adoption. Information, as an important factor in reducing this uncertainty, has been understood since the 1950s (Wilkening, 1950a; Copp et al., 1958). Innovation represents information and thus reduces uncertainty about cause-effect relationships in problem solving (Rogers, 1995).

Rogers (1995) states that diffusion alters the structure and function of the social system it is in, be it planned or spontaneous. Diffusion and adoption are different. Diffusion is a process by which a new idea is communicated to new users, while adoption is a more personal decision, of whether to adopt or reject the new idea (Fisher et al., 2000). Firstly, the person or organisation has to make the decision on the adoption of the innovation. Information on the innovation is collected and this leads to perceptions about the innovation and then finally, to make a decision to adopt or not. The benefits of the new innovation is only experienced once it has been incorporated into the business and used within it.

Rogers (1995), and others, view the diffusion process as linear (Ryan and Gross, 1943; Ajzen and Fishbein, 1980; Quaddus and Xu, 2005). Diffusion can also be determined by perceptions of the innovation, in particular the primary characteristics of an innovation, which are in turn determined by other internal and external factors (Fliegel, 1993), see

Figure 4.6. However, behaviour of individuals is predicted by how they perceive primary attributes because different adopters might perceive primary characteristics in different ways, so their eventual behaviours may differ (Moore and Benbasat, 1991).

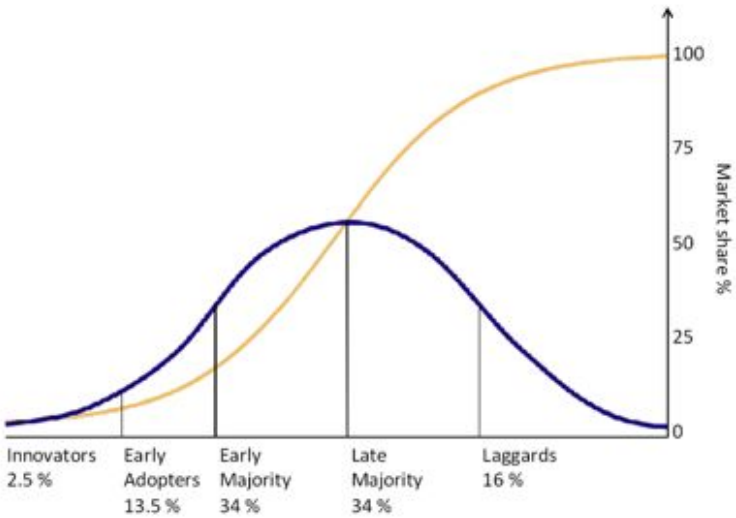


Source: Fliegel (1993)

Figure 4.6. Fliegel's Diffusion approach to agricultural innovation.

The early studies, in an agricultural context, looked at farm inputs i.e. sprays, fertiliser and seed innovations. In particular research on diffusion began with a study into the uptake and use of hybrid corn by Iowa farmers. This study showed the importance of communication and also showed that the acceptance of hybrid seed followed a normal, or bell shaped, curve (Ryan and Gross, 1943). Rogers (1995) divided the bell shape into regions, determined by the samples' mean +/- multiples of its standard deviation, from -2 to +2 standard deviations, see Figure 4.7. The regions were given names to describe the adopting farmers; Innovators, Early Adopters, Early Maturity, Late Maturity and Laggards. In reality these breaks in the innovativeness continuum do not actually occur. These concepts were also researched as Farming Styles Theory (Van der Ploeg, 1994).

The cumulative frequency adoption curve was 'S' shaped, Figure 4.7, as similar to those identified previously with various studies of biological and social growth (Pemberton, 1936). Pemberton (1936) claims the time of trait acceptance in any given case is determined by the chance combination of factors for and against adoption. From Figure 4.7 with successive groups of consumers adopting the new technology (blue line), its market share will eventually reach a saturation level (yellow line). Feder and O'Mara (1982) have empirically confirmed these results.



Source: Rogers (1995)

Figure 4.7. Rogers' 'Normal' and 'S' shaped adoption curves.

It can be seen from the bell shaped curve Figure 4.7, which although it is itself symmetrical, the adopter classification is not, as there are three categories to the left of the mean and only two to the right. This is because Laggards are regarded as a homogenous category, but could, if desired, be divided into early and late Laggards.

Rogers (1995) describes the five-adopter categories as follows:

- 'Innovators' are the 2.5% of the population that are -2 or more standard deviations from the mean, are the most obsessed with innovation and they appear to have a 'venturesomeness' gene and have a desire for risk taking (Rogers, 1995). They are uninhibited by the fact that those inside their local social sphere may not understand or approve of their actions and often associate and communicate with others outside their local sphere, so become 'cosmopolites'. They form a 'clique of innovators' that all understand the complexities and intricacies of the new concepts. They thrive on risk, accept setbacks and even failure of the new technology, and often have the financial assets to withstand these setbacks. The very important feature of innovators is that they manage to 'import' the new technology into their local social system, a type of 'gatekeeper'.

- 'Early adopters' are between -1 and -2 standard deviations from the mean and represent 13.5% of the population. They exist in their local social environment and are therefore 'localites'. The importance of this group in society is that potential adopters look at early adopters for information and guidance on the new technology. Early adopters appraise and give a subjective view of the new technology, so disseminating information, speeding up the diffusion process and reducing the risks of adoption to others.

- The next group is the 'Early majority', lying between -1 standard deviation and the mean and represent 34% of the population. This is a group of followers and not leaders. They have a longer period of evaluation, 'innovation-decision period', than early adopters but are just ahead of the average member of their social system.

- The ‘Late majority’ group represents 34% of the population too, and lies from the mean to +1 standard deviation from the mean. Adoption will only occur once most of the risks associated with the new idea have been removed, social pressure from their peers or group to adopt is great and where there is an ‘economic necessity’ to adopt. The sheer number of organisations adopting an innovation can cause a trend that non-adopters fear, by appearing too different from the many adopters (Abrahamson and Rosenkopf, 1993).

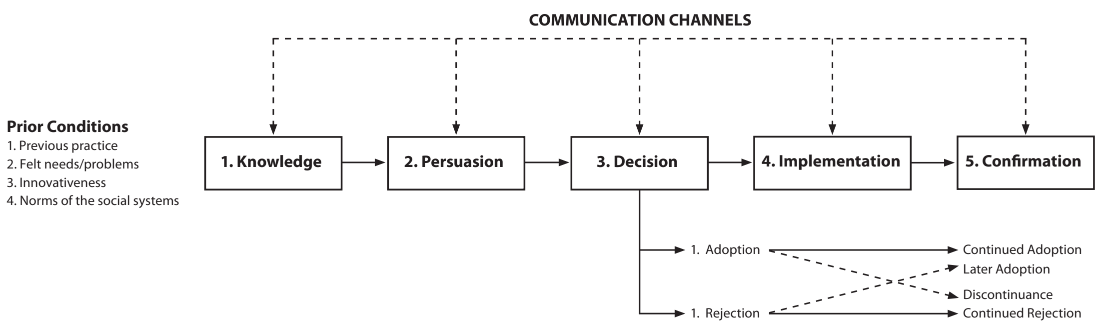
- The fifth group are the ‘Laggards’, or late adopters, who are 16% of the population and are +1 standard deviation or more from the mean. These are traditionalist, comparing everything to the past, with no opinion making characteristics for the group and suspicious of change. They are hard-core localites. They are risk averse and extremely cautious and will not adopt an innovation in a hurry and not unless they are certain it will not fail, as often their resources are limited.

Rogers (1995) produced five characteristics of innovations that affected the different rates of adoption, which can be put into the context of FPRM for wheat:

- Relative Advantage; the degree to which an innovation is perceived as being better than its precursor and so benefitting the adopter, e.g. allows for a minimum wheat price to be formed but also offers the advantage that if the market moves in the producers favour, an extra margin can be locked into.
- Compatibility; the degree to which an innovation is perceived as being consistent with existing values, needs, and past experiences of potential adopters, e.g. fits in with the usual pattern of selling of wheat, and accommodates market movements.
- Complexity; the degree to which an innovation is perceived as being difficult to use, e.g. do hedging tools have many more terms and conditions compared to the usual methods of selling?
- Trialability; the degree to which an innovation can be experimented with, before full adoption takes place, e.g. can hedging tools be used on a percentage of the total wheat crop, as a test-run?

- Observability; the degree to which the results of an innovation are observable to others, e.g. can the results from using hedging tools be quantified?

Rogers also has two further constructs, ‘Image’ and ‘Voluntariness of use’. The former, which can be considered as part of relative advantage, is the desire of individuals that use the new innovation to gain social status within their social sphere. Some researchers have found the effect of image great enough to be a separate construct (Holloway, 1977) and that some individuals believe they should use the innovation because of appropriateness to their position in the social structure (Burt, 1987). Voluntariness of use is defined as the degree to which use of an innovation is perceived as being voluntary, or of free will (Moore and Benbasat, 1991). It is the real, and not theoretical, ability of the individual to freely adopt or reject an innovation. It is probably the actual voluntariness or the perception of voluntariness that finally influences behaviour. Rogers’ five characteristics are all based, not on the actual use of an innovation, but on the perceptions of the innovation. For example, an innovation may be used as it shows a financial gain, even though the innovation itself may be perceived by the user as onerous. The attitude to using the innovation would however be positive. The innovation-decision process for adoption and use is detailed in Figure 4.8.



Source: Adapted from Rogers (1995)

Figure 4.8. Innovation-decision process for adoption and use.

It is, therefore, the decisions of, and communication between, individuals to adopt an innovation that cause innovations to spread and diffuse. It is clear from Rogers’s theory and Ryan and Gross (1943), that communication is an integral and important part of the diffusion of innovation process. Communication is a process in which participants construct and share information with another in order to reach a mutual understanding (Rogers, 1995). It is not the perceptions of the innovation by potential adopters, but the perceptions of the innovation by those using the innovation, the adopters, that facilitate diffusion (Moore and Benbasat, 1991). The more open to demonstration the innovation is, and the more visible its advantages are, the more likely it is to be adopted (Zaltman et al., 1973).

4.1.4 Decomposed TRB

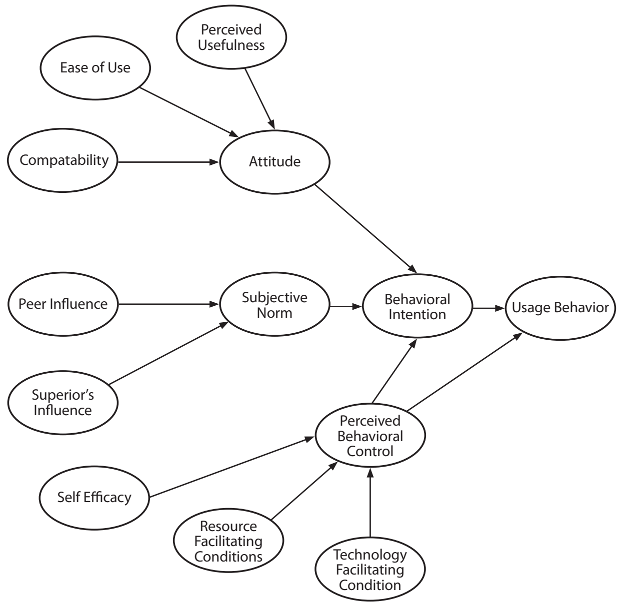
The decomposed TPB model (DTPB) (Taylor and Todd, 1995a) unites the TRA (Fishbein, 1967), and its adaptation TAM (Davis, 1993), TPB (Ajzen, 1991) and Diffusion of Innovations (Rogers, 1995) together and more clearly identifies the factors determining Att, SN and PBC by breaking them down more into further component parts/beliefs.

Taylor and Todd's (1995a) reasoning behind this were that:

- the factors within the large belief structures (Att, SN and PBC) will not always be related to the precursors of BI (Bagozzi, 1981; Shimp and Kavas, 1984);
- decomposition provides a stable set of factors that can be applied across a variety of settings;
- the model is more managerially relevant by focusing on specific belief factors that may influence adoption and usage, and that can be altered and refined during the development process; and
- the increased number of factors should provide a greater understanding of usage than the simpler models.

The research reported here uses these to identify what may influence usage of FPRM tools, the determinants of intention to predict usage such as attitudes, social influences and facilitating conditions. TAM emerged as a potent and parsimonious way to represent the forerunners of system usage through beliefs about two factors; the perceived ease of use and the perceived usefulness of an information system (Taylor and Todd, 1995a). As stated previously, see section 4.1.3, TAM explains much of the variance in usage intention (Davis, 1989; Davis et al., 1989; Davis, 1993).

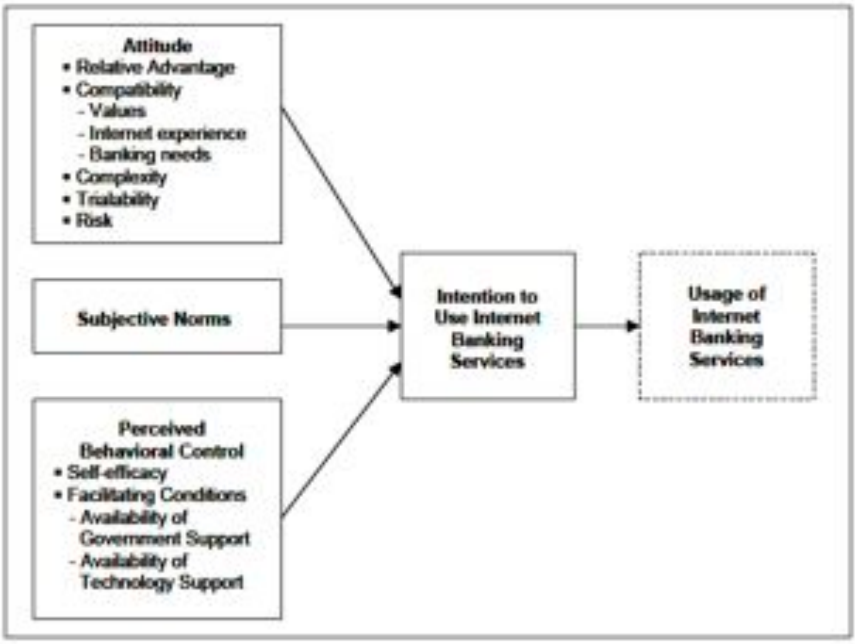
The DTPB is a more comprehensive model than TAM for explaining usage even though they both have factors which identify salient beliefs. The DTPB includes the effect of significant others, perceived ability and control and facilitating conditions, which have been shown (Fishbein and Ajzen, 1975; Bandura, 1977; Ajzen, 1991) to be key determinants of behaviour, see Figure 4.9.



Source: Taylor & Todd (1995)

Figure 4.9. The Decomposed Theory of Planned Behaviour.

The five characteristics of innovation, relative advantage, compatibility, complexity, trialability and observability (Rogers, 1995) can be added to the Att construct to facilitate the discovery of the drivers of a new concept. This was shown by research by (Tan and Teo, 2000) into the concept and adoption of internet banking and incorporated in the DTPB. They concluded Att and PBC had more influence on intention to use Internet banking than social influence. Relative advantage, compatibility, trialability and risk towards the Internet were the significant drivers to the adoption of Internet banking. Government support and confidence were also influences. Tan's work is also used as the base for utilising self-efficacy and technical support needed to measure PBC. This is presented in Figure 4.10.



Source: Tan and Teo (2000).

Figure 4.10 Framework for the adoption of Internet Banking

BI is therefore to be determined by using the three constructs of: Att, SN and PBC. The TPB uses the intention to perform a given behaviour to predict actual behaviour (Jackson, 2008). The DTPB has the advantages of TAM in that it identifies specific salient beliefs but additionally looks more fully into the different social aspects forming SN and PBC not present in TAM, but shown to be salient determinants of behaviour (Ajzen, 1991). This model uses constructs from the innovation characteristics literature and more completely encompasses SN (i.e. social influence) and PBC by decomposing them into specific belief items (Taylor and Todd, 1995a). It was also found that using separate measures of self-efficacy and PBC revealed that the self-efficacy component of PBC influenced BI (Ajzen and Madden, 1986; Ajzen, 1988; 1991), a finding that was obscured when the combined measure was employed (Terry and O'Leary, 1995). Evidence for a distinction between self–efficacy and PBC has been shown in several different studies: a low fat consumption (Armitage and Conner, 1999c), academic achievement (Manstead and Eekelen, 1998), for blood donation (Giles et al., 2004), in Aids prevention (Terry, 1993), for regular exercise (Terry and O'Leary, 1995; Sparks et al., 1997) and with substance abuse by adolescents (Tavousi, 2009).

4.2 Review of Empirical Studies

The previous section presented a theoretical discussion of the TRA (Fishbein and Ajzen, 1975), the TPB (Ajzen, 1985), Diffusion of Innovations (Rogers, 1995), and the DTPB (Taylor and Todd, 1995a). This section presents a review of recent research in the agricultural arena in the context of these theoretical frameworks.

4.2.1 Theory of Reasoned Action

There is extensive research on the TRA in marketing (Farley et al., 1981; Ryan, 1982) and consumer behaviour (Ryan and Bonfield, 1975) but less so in the agricultural sector (Jackson, 2008). Despite the lack of literature, the TRA has been used in predicting human intention and behaviour such as; Toothpaste use by church going women in SE USA (Ryan, 1982), a consumer panel' attitude toward and trial of a new appetite suppressant product (Oliver and Bearden, 1985), modifications of the original TRA model to account for goal intentions, choice situations and differences between intention and estimation measures (Sheppard et al., 1988), influences on intention to reduce dietary intake of fat and sugar (Saunders and Rahilly, 1990), social and attitudinal influences of drinking wine (Thompson and Vourvachis, 1993). Other studies include: on social category and adoption behaviour in Ohio (Brown, 1980); on Florida strawberry farmers (Lynne et al., 1995); on Louisiana wetlands (Luzar and Diagne, 1999); on attitudes to conservation/environmental practices uptake (Carr and Tait, 1991; Falconer, 2000).

TRA has been incorporated into general frameworks to justify the relationships between attitude and behaviour in agricultural situations. UK dairy farmers were studied by Thompson and Panayiotopoulos (1999), and attitude was found to be the main predictor of intention, far more than SN. The inference was that farmers as decision makers are extremely independent and self-reliant and less worried about social attitudes. Similar results were found by two other studies (Thompson et al., 1994; Thompson and Panayiotopoulos, 1999). The first of these studies looked at the adoption of olive oil usage in UK kitchens and showed that attitudinal belief was the best predictor of intention. However, normative social factors were not found to be a good indicator of olive oil usage. The second study of Thompson and Panayiotopoulos (1999) researched the attitude of feedstuff buying by small UK dairy farmer units. It was clear that attitude was the best predictor of intention with the addition of SN to the model predicting intention also being statistically significant. The conclusion was that buying animal feed was a routine process and that the farmers had considerable knowledge of animal nutrition. Only those new to farming or becoming the main feed buyer would be influenced by beliefs of salient referents. It was also concluded that there was a difference between purchase decisions in large organisations and those made in small businesses where the decision maker has power and responsibility independent of the beliefs or expectations of other people.

Gorddard (1992) researched Western Australian farmers' conservation behaviour and their barriers to adoption of min-till or direct drilling techniques. All TRA constructs were statistically significant and it was found that the addition of a PBC construct did not enhance the prediction of intention. The study showed the importance of constraint beliefs, which were beliefs that inhibited conservation behaviour. Gorddard (1992) further showed that economic-technical and non-market factors are important in conservation behaviour. The use of the TRA in studying adoption Rehman et al. (2007) examined the uptake of new technologies on dairy farms in South West England. They showed the importance of attitude in successful adoption of a new technology, which included the effective promotion of the new technology. Also channelling of information via the right referents has a major effect on BI. The importance of attitude in adoption of technologies was also observed by Garforth et al. (2004) in a study that looked into improving knowledge transfer strategies aimed at farmers following concerns about their slow uptake of seemingly beneficial technologies. It was shown how the TRA can help with the targeting of knowledge more effectively and that communication planning is required so the information is transferred efficiently. Further, different farming sectors needed different channels of communication, such as the local vet or agricultural college.

In a study of an English Nature wetland scheme, Burgess et al. (2000) found that the strength of individuals' identity as farmers provided resistance to enrolment in the scheme. The study showed that farmers perceived their primary role in society as food producers and not as conservationists. This demonstrates an interaction between attitude and social norm. This supports the findings of Ryan (1982) who concluded that intentions were formed from interdependent, yet separable attitudinal and normative variables, referred to as 'cross over' effects. Oliver and Bearden (1985) extended the TRA model further by investigating these crossover effects in relation to 'confidence and self-esteem', 'familiarity effects', 'innovativeness effects', 'involvement effects' and 'age and gender effects' of a new appetite suppressant product. They concluded the underlying structure of the TRA is richer in content and more complex than is often presumed, particularly with regard to the normative component (Oliver and Bearden, 1985).

4.2.2 Theory of Planned Behaviour

The TPB is the extension of TRA and as shown in section 4.1.2, adds the construct of PBC (perceived behavioural control) in predicting the intention of behaviour, potentially superseding the importance of SN and Att. Several studies have looked into agricultural related applications of TPB but like TRA there are very few such studies. Within an agricultural context Burton and Rob (2004) criticise the approach of the TRA as being too simplistic a representation of behaviour. Beedell and Rehman (1999) and Edwards-Jones (2006) also recognise this shortfall but suggest that the use of TRA meets the needs of policy-makers as it provides standardised, repeatable and tangible results. However, within agriculture farmers are subject to fluctuations in the physical, economic and political environments. Burton and Rob (2004) suggests that the PBC construct therefore is an important determinant of intention and thus behaviour. The inclusion of the PBC has been supported in several studies including: changes within agriculture concerning the reduced commitment to family succession and increased environmental awareness (Ward and Lowe, 1994); women working in agriculture (Bokemeier and Garkovich, 1987); woodland management (Potter et al., 1991); capital constraints and technology adoption (Feder and Umali, 1993); and, organic conversion (Tutkun et al., 2006).

Lynne et al. (1995) compared the TPB with the Theory of Derived Demand (Hicks, 1932; Sato and Koizumi, 1970; Marshall, 2009) in water saving micro-technology in Florida's strawberry industry. Lynne et al. (1995) showed that the farmers' total capital base determined behaviour and their level of actual control. The greater the financial resources and the greater the perceived/actual farmers (internal) control, the greater the adoption rate.

Sutherland (2010) researched farmer responses to agri-environmental schemes, with respect to Single Farm Payments. In a qualitative survey of Scottish farmers, the decision making process was assessed with reference to the role of environmental regulations and grant schemes. Using TPB as a framework, three mechanisms were identified as factors that were assisting the widespread uptake of the scheme: existing activities of the farm, physiological impetus of modulation; and the 'opportunistic culture' embedded in a farmer's decision-making process.

Farmer conservation practices in Australia showed that including a PBC factor as well as a risk factor significantly increased the power to predict intention (Gorddard, 1993). While modest, the improvements in predictive power, as measured by increased R-squared values, are better than those found in most previous studies of the adoption of conservation practices (Gorddard, 1991; 1993). Previous to this study, farmers' adoption of conservation practices were characterised by very poor predictive outcomes, relative to the quite respectable results reported from innovation in commercial practices (Gorddard, 1991). Research has also suggested the adoption of profitable commercial practices was different to those of unprofitable conservation practices (Pampel Jr and van Es, 1977).

Studies of Bedfordshire farmers used TPB to examine how and why farmers manage their existing wildlife and hedges (Beedell and Rehman, 1999; 2000). The study compared two groups of farmers: those that were part of wildlife advisory groups and those that were not. Farmers that were part of these groups felt that the benefits of hedge management are more likely to be true and also feel social pressure to manage hedges on their farms more so than the other farmers. However, the TPB concluded that, whilst the Att and SN factors were different for these two groups the PBC was not. In the follow up paper (Beedell and Rehman, 2000), the same farmers were studied to ascertain differences between the two groups in how farmers manage the environment features on their farms and, if TPB provided a good framework for explaining these differences. The study also included a 'moral obligation' factor. It concluded that farmers felt an internal motivation to carry out conservational behaviours rather than a social influence. Again, the attitudinal factors differed between the two groups but the PBC did not.

TPB was used to test the hypothesis that the goals, objectives and attitudes of Dutch dairy farmers are the determinants of strategic and entrepreneurial behaviour, and that this will result in different herd sizes, as expressed in the size of milk quota (Bergevoet et al., 2004). Factor analysis was used as part of the data analysis, to get insight into the common factors underlying the specific goal statements of the farmer.

Further additions to the methodology included past behaviour, barriers and skills (Bergevoet et al., 2004). Although the predictive power was relatively low compared to other studies it was increased when these new attributes were added. This was a more complex analysis than previously modelled and shows how the TPB can be developed and adapted. Although the findings of this study showed similarities to other TPB studies, they also showed differences (Lee and Stewart, 1983; Makus et al., 1990; Beedell and Rehman, 1999; 2000). The conclusions were that farm size is not relevant for fulfilling social goals but instead is mainly explained by farmers' instrumental goals. Therefore, to ascertain the goals, Att, SN and PBC of the farmer are of vital importance in giving advice to achieve both economic and non-economic goals (Bergevoet et al., 2004).

Tutkun and Lehmann (2006) studied Swiss farmers' decisions to become organic and to convert to an animal friendly housing system using the TPB and structural equation modelling (SEM). A direct payment from the Government was available for that conversion but only 8% of the farmers had converted. One of the weaknesses of TPB demonstrated by this research is the inability to model the individual decision-making as a process. To this end Diffusion of Innovation Theory was included in the model. Communication about a given behaviour was added as a relevant variable in the decision-making process as it was believed that the more communication there was, the more information was available and so uncertainty of a decision was reduced. The results from both organic conversion and to an animal friendly stabling system showed the increased ability of the model to predict intentions from the addition of communication. The results also showed that farmers who had converted have more favourable attitudes towards conversion. These results, using an extended TPB model, show that adding external behavioural factors improves results and they concur with other studies such as; Government control in strawberry production (Lynne et al., 1995), financial incentives in agri-environmental schemes (Morris and Potter, 1995), CAP environment policy and on-farm environmental schemes (Beedell and Rehman, 1999)and environmental policy (Corral, 2002).

In a study of farmers' perceptions and attitudes to disease control in UK pig production Alarcon et al. (2013) highlighted lack of industry communication as a major barrier to knowledge transfer and a reason for a feeling of isolation amongst farmers. There was also reported a lack of awareness of relevant academic work unless presented to farmers by veterinarians or trade bodies. This lack of knowledge transfer has been seen in other agricultural studies (Garforth et al., 2004; Heffernan et al., 2008). Disease control and economic loss were eclipsed by worries about feed costs and the low pig price. In another study of attitudes to disease risk management in sheep and pigs in England (Garforth et al., 2013), most farmers felt that they were doing what they could and all that was necessary to reduce disease risk. This study incorporated the TRA, TPB and the Health Belief Model (Rosenstock, 1974).

4.2.3 Diffusion of innovations

Early research on diffusion began with Ryan and Goss (1943) and their study into the uptake and use of hybrid corn by Iowa farmers, as previously discussed in section 4.1.3. The study showed the importance of communication in the model, both from neighbours and sales of the seed. The research found that the acceptance profile of hybrid seed followed a bell shaped pattern. This showed a time dimension to adoption. They conceded that the bell shaped curve was not always normal, as it was skewed by the rate of communication between farmers in the local community. It was central in showing the importance of the opinions held on the adoption of an innovation by farmers (Jackson, 2008).

Some criticism exists of this theory and the acknowledged 'S' and bell-shaped curves, when considering individual small family farming units, versus larger corporate entities (Jensen, 1979; 1982; 2001; van Everdingen and Wierenga, 2002), developing countries technologies (Goss, 1979; Ruttan, 1996) and the speed of technological adoption (Fliegel and Kivlin, 1962; Lindner, 1987; Fisher et al., 2000). Rogers (1995) also agreed the shape of the adopter distribution for an innovation ought to be regarded as an open question, to be determined empirically.

Research by Wilkening (1950a) with North Carolina farmers, showed the importance of communication by the use of mass media (radio, motion pictures and transportation facilities) and other agricultural agencies (commercial, private and Government). Farmers with a higher socio-economic status were more likely to access formally organised sources of information while those of lower socio-economic status were more likely to use word of mouth and anecdotal information (Wilkening, 1950b). Later studies support these findings: in the adoption of new practices in crop and animal breeding in Brazil (Longo, 1990); and sustainable agricultural practices in Montana (Saltiel et al., 1994).

Other studies have found more local factors most important in communicating new ideas. The degree of dependence of gaining information from their neighbourhood or kinship ties (Wilkening, 1950a). Farmers were divided into groups; 'relatively independent', 'dependent', or 'strongly dependent'. Those in a community that had the strongest neighbourhood and kin attachments were less likely to accept the ideas and methods expounded by formal organised agricultural training/seminars (Wilkening, 1950a). In another paper Wilkening (1950b) describes how widespread acceptance of an innovative practise requires effectively transmitted information about it. The adopter needs to receive it, understand it, and regard the information as a valid step forward. Later studies support these findings (Copp et al., 1958; Longo, 1990; Saltiel et al., 1994). Pennsylvanian dairy farmers reported that peer influences, as information sources, in the early stages of the adoption process would make slower progress towards adoption than farmers using other outside sources (Copp et al., 1958). However in the later stages of adoption word of mouth and peer influence were the most important (Copp et al., 1958). Other factors which were shown to be statistically significant in the innovation adoption process are farm size and social classification of class (Wilkening, 1950b; Feder and Slade, 1984).

The work of (Griliches, 1957) and subsequently (Griliches, 1960) were amongst the first economic studies of innovation adoption in rural areas concerning the uptake of a new hybrid seed. The studies showed that a farmer adopted when there was a financial gain and when information also confirmed it was right to adopt. It was one of the first studies to attempt to encompass adaptation to varying biological conditions as a vital element to the diffusion process (Agarwal, 1983). Rogers (1958) used data from a 1955 study of 148 Iowa farmers and from a 1957 study of 104 Ohio farmers to show that the adoption results were a good approximation to the normal curve. Rogers disagreed with Ryan and Goss's premise of non-normality caused by personal influence, applied by earlier adopters upon later adopters. Rogers (1958) findings have subsequently been used as the base for many studies concerning the speed of adoption and categorisation of people by their adoption behaviour (Fliegel, 1993; Rogers, 1995; Fisher et al., 2000; Knudson et al., 2004).

Fliegel and Kivlin (1962) followed Roger's research, looking at Pennsylvanian dairy farming practices. They studied the relationships between attributes of innovations in one segment of agriculture and the rate at which farm operators had accepted those innovations. They named eleven attributes that would affect adoption rates: initial cost; continuing cost; rate of recovering cost; divisibility, mechanical attraction; complexity; compatibility; association of practice with major enterprise; saving of physical discomfort; and advantage. This built on the five attributes suggested by Rogers (1995). The results were surprising in that high initial cost, high continuing costs and rate of recovering costs through increased earnings, were not statistically significant or in the direction expected. Nor was the ability to try the innovation on a small scale significant. The most important factors were 'saving time', 'advantage', 'compatibility' and 'complexity'. This shows the relevance of certain attributes to the speed of adoption and how new inventions or ideas need to be marketed to succeed. Many similar studies have concerned environmental practices and their take up (Pampel Jr and van Es, 1977; Ervin and Ervin, 1982; Lee and Stewart, 1983; Rahm and Huffman, 1984; Nowak, 1987; Feder and Umali, 1993; Saltiel et al., 1994; Sutherland, 2010).

In a review of innovation adoption research (Rosenberg, 1976), it was found that the poor predictive power of sociological models was due to the lack of emphasis of economic variables (Marra et al., 2003). Relevant to this thesis although not using the traditional adoption modelling is the work by Makus et al. (1990) who studied the factors influencing the probability of producers and landowners using futures and options for commodity marketing in the late 1980s. He reported that there was increased interest in the subject of economics and tools designed to enhance producer understanding of alternative marketing strategies. This was reported as being due to: greater commodity price volatility; greater experience of and effects of world supply and demand conditions; a more market–driven farm policy; and, periods of farm financial stress. Ruttan (1996) noted that economics had superseded sociology in adoption research and that diffusion was a transition between equilibrium levels influenced by changing economic circumstances, such as price, and environmental factors, such as crop yields (Marra et al., 2003).

Makus (1990) reported on a telephone survey that was part of a futures and options marketing program. The survey targeted individuals who had attended futures and options training seminars in 22 states of the US to determine the factors influencing the level of use of futures and options in commodity marketing. A Probit model was used and the results showed four of the eight variables included in the model were statistically significant. The significant variables were whether a farmer had participated in forward selling, belonged to a marketing club, education and gross farm sales. Farmers participating in forward selling, belonging to a marketing club, with a high level of education and with higher gross farm sales were more likely to adopt futures and options than other farmers. Other researchers have used a Tobit model (Shapiro and Brorsen, 1988) on Indiana farmers or a Logit model when investigating futures and options use by Iowa farmers' (Edelman et al., 1990).

Other agricultural studies have covered the subjects of:

- Technological developments in the grain growing industry; Wheat varieties in Canada (Walburger et al., 1999); new farm technology to dry farming regions in India (Rajesh and Varadarajan, 2000) and large scale farms in Washington (Forte-Gardner et al., 2004).

- Land conservation adoption; Soil conservation in Illinois (Pampel Jr and van Es, 1977), review of adoption literature (Feder and Umali, 1993) and large scale integrated cropping systems in Washington (Forte-Gardner et al., 2004).

- Developing countries and their adoption of modern farming techniques; Soyabean production in Brazil (Sousa and Busch, 1998), diffusion of farm technology in India (Mishra and Hossain, 2000), crop cover in Honduras (Neill and Lee, 2001), social learning with wheat and rice in India (Munshi, 2004), education to increase production in Ethiopia (Weir and Knight, 2004), crossbred cows in Tanzania (Abdulai and Huffman, 2005), cash for new innovations in Africa (Masters, 2005) and hybrid pearl millet in India (Matuschke and Qaim, 2008).

- Adoption of bio-technology in highly developed countries; GM corn and soya (Hategekimana and Trant, 2002) and chemical pesticide reduction in the US (Stewart et al., 2002).

- Adoption of land conservation and biotechnology; Factors limiting diffusion of GMO's into Brazil (Pelaez and Schmidt, 2002) and effects of insect resistant Bt cotton on pesticide use in Argentina (Qaim and De Janvry, 2005).

- The economics of risk, uncertainty and learning in the adoption of new agricultural technologies; Marra et al. (2003) concluded that the adoption process is greatly affected by risk-related issues such as farmers' attitude to risk, attitude to the riskiness of the new technology, importance of trialling and learning and the consequences of delaying adoption.

- The role of education in facilitating risk-taking and innovation in agriculture; The impact of education on farmers' attitudes toward endogenous risk in rural Ethiopia (Knight et al., 2003). Education of the household head is found to decrease risk-aversion. Schooling encouraged farmers to adopt innovations and risk-aversion discouraged. Education encourages innovation not only directly but also indirectly, through its effect upon attitudes toward risk to the extent that educated farmers are early innovators and are copied by those less educated.

- Applying diffusion of innovation theory to intervention development; It has increasingly been applied to agricultural, international development, public health, and educational interventions, classical diffusion of innovation theory is evolving into a science of dissemination (Dearing, 2009).

- Extension: object of reform, engine for innovation; Extension activities in the USA are being pulled in many directions, and are being called on to respond more effectively to the needs of farmers to produce and to forge links with markets. A key objective in reforming extension is to make it a better instrument, or engine, for the promotion of innovation, the dissemination of knowledge and the facilitation of development (Rivera and Sulaiman, 2009).

4.2.4 Decomposed TPB (DTPB)

Attitudinal models such as the TRA (Fishbein, 1967) and TPB (Ajzen, 1991) have been used widely in explaining adoption innovations and diffusion of information. Building on Rogers (1995), and as an extension of TRA, is the Technology Acceptance Model (TAM) (Davis et al., 1989). The DTPB model (Taylor and Todd, 1995a) was first used to explain technology usage in the computer industry, as shown previously in Figure 4.9. DTPB unites the attitude dimensions of perceived usefulness and ease of use from the TRA and its adaptation TAM with the SN and PBC constructs of the TPB. The aim of the model is to more clearly identify the factors determining Att, SN and PBC by disaggregating them into component parts or beliefs (Uzoka et al., 2007; Zschocke et al., 2013).

An example of the use of a decomposed model was given by Jackson et al. (2008; 2009) and Jackson (2008) when researching the determinants of behaviour towards the use of forward contracts in the Australian Wool industry. The Att, SN and PBC structures were broken down into 'Internal' and 'External' farm factors and were additional significant influences on an individual's intention to perform the behaviour in question. Another example is a study of behavioural influences on e-commerce in developing countries (Uzoka et al., 2007). The decomposed constructs included perceived advantages, Internet and complexities, accessibility and management support. All of these decomposed constructs were statistically significant in influencing the decision to adopt e-commerce. A further study using this theory examined the readiness to use e-learning for agricultural higher education in sub-Saharan Africa (Zschocke et al., 2013). The results indicated that beliefs about the usefulness, ease of use of e-learning and user experience positively affected attitudes toward teaching on-line. Ultimately, those that believed in their own ability and the usefulness of e-learning were more likely to use it, than those without such strong beliefs.

4.3 Summary

This chapter comprehensively reviews applicable literature concerning the three theories forming the framework of this research: TRA, TPB, and The Diffusion of Innovation theory. TPB builds on TRA as it allows for behaviours not under volitional control. The DTPB model unites the TRA, and its adaptation the TAM Model with TRB and Diffusion of Innovations.

The above theories show the key factors that will form the foundations of the behavioural model used in this research, the grain market in England, with particular emphasis on the wheat growing and marketing farmer, and the characteristics of the wheat market selling mechanisms.

A representative review of the literature concerning farmer behaviour was presented. This gave a good indication of the behavioural determinants of farmers. 'Agricultural' studies have found that show that Att, SN and PBC are significant predictors of intention and behaviour. As can be seen, although there has been much literature produced concerning behavioural determinants, there is a void when considering the behavioural determinants of wheat farmers in England and their use of FPRM techniques. This study contributes to the agricultural literature by filling that void.

Finally, a review of agriculturally related theoretical studies was presented. This showed numerous studies that used TRA and TPB without modifications. However, the statistical significance of the basic constructs differed dependent on the behaviour being studied. This implies that the simpler models will not be fully representative of Att, SN and PBC and suggests that the DTPB is a more appropriate method for modelling behaviour. Although there were relatively few studies using DTPB in agriculture, the results showed empirical statistical evidence in support of this methodology. However, it can be criticised for presupposing the decomposition and independence of the major constructs. That is, the actual underlying behavioural components are likely to be more complicated and inter-related and therefore suggest a *post-hoc* analysis to reveal them. Findings from other studies suggest that managers implementing effective 'technology' adoption should not treat the ‘work force’ as a homogenous group and, if they fail to define ‘who the user is’ within the group, they are likely to fail (Morris and Venkatesh, 2000).

5 Research Questions, Objectives and Methodology

5.1 Introduction

The purpose of this chapter is to present the research questions, objectives and methodology, including a preliminary model that will inform the subsequent development of the methodology. This builds upon the literature review presented in Chapter 4 and empirical evidence from previous behavioural studies in agriculture. These will provide the theoretical grounding to understanding the behaviour of the farmer towards FPRM tools. In particular, the use of TRA, TPB, Diffusion of Innovations and the DTPB is validated as a basis to create the behavioural model applicable to the objectives and questions appropriate and relevant to this research.

5.2 Research questions and preliminary model

5.2.1 Research questions

Despite the continued volatility of the wheat price in England, between and within an individual marketing season, farmers in England mostly continue to market their wheat using the traditional methods of spot, forward and pools contracts (DEFRA and HGCA, 2009), as discussed in Chapters 2 and 3.

The research addresses the following question:

- What are the determinants of behaviour that give rise to the adoption, or not, of FPRM within England's arable farmers' portfolio of selling techniques? This question was the primary focus of research and this thesis concentrated on gathering, extracting and making conclusions about the adoption behaviour of farmers towards the use of FPRM.

5.2.2 Research objectives

To answer the above questions a set of objectives was derived:

- With reference to England's wheat growing farmers, to investigate the determinants of using FPRM tools, (futures, options and their OTC variants), when marketing their wheat crop.

- Based on these determinants, to create an adoption model of FPRM in England's wheat market.
- Advance the knowledge of England's wheat growing arable farmers and the broader agricultural sector of FPRM methods by defining those farmers most likely to adopt FPRM tools.

5.2.3 The preliminary research model

The framework for this study is based on the DTPB model (Taylor and Todd, 1995a) and adapted from research by Jackson et al. (2006); (2008); Jackson (2008); Jackson et al. (2009). The justification for using the DTPB is that it provides a more detailed description of the behavioural constructs than the TRA and TPB. In addition, the inclusion of factors external to the constructs of the DTPB, such as age and gender, are included for their potential to further explain the behaviour of farmers.

These external factors can be separated into factors that are the same for all farmers, such as price volatility, and those that are specific to an individual farmer. The universal factors are discussed in Chapter 2 but are not under investigation in the remainder of this thesis. Moreover, it is the effects of factors specific to an individual farmer that are of key importance in understanding behaviour. Such factors that would influence the use of FPRM tools are:

- Farm factors: size, diversification, importance of a crop to overall farm viability.
- Social structure factors: age, farm size, education, income.
- Channels of communication factors: printed media, radio/TV/internet.
- External farm advice: dedicated farm advisor, membership of farming and community organisations, use of independent marketing advisors, use of a wheat broker, use of academic literature.

Following on from the behavioural constructs of Att, SN and PBC in the TPB, the DTPB separates each of these constructs into sub-constructs. The Att construct was decomposed based on Rogers' Diffusion theory resulting in the five sub-constructs of innovation; relative advantage; compatibility; complexity; ease of use (trialability, observability); and, risk. In decomposing the SN construct, the sub-constructs of peers and superiors proposed by Taylor and Todd (1995) were replaced with peers, merchants, independent advisors, press and academia as these were thought to be more relevant to the behaviour being studied. Similarly, the decomposed PBC proposed by Taylor and Todd (1995) was replaced by more relevant sub-constructs of training, information and support. This approach will be adapted in Chapter 6.

5.3 Research methodology and design

5.3.1 Introduction

In the previous section, the research questions and objectives were presented. This section describes the methodology used in answering them. A mixed-method approach (Teddlie and Tashakkori, 2003) was adopted as it combines both qualitative and quantitative methodologies. The former explains basic exploratory questions, while the latter method answers confirmatory questions. This methodology resulted in conducting one-to-one in-depth interviews, focus groups and an England-wide farmer questionnaire. The methodology draws upon methodologies presented in numerous works describing qualitative and quantitative research methods (Kish, 1965; Krueger, 1994; Yin, 1994; Alreck and Settle, 1995; Gladwin, 1997; Creswell, 1998; Berg, 2001; Bryman, 2001; Mason, 2002; Sekaran, 2003; Saunders et al., 2009). The statistical analysis techniques are well expressed by Tabachnick and Fidell (2007); Mazzocchi (2008); Field (2009); Pallant (2010).

5.3.2 Research methodology

The first objective of this research is to define the behavioural determinants of the use of FPRM by farmers in England in marketing wheat. A behavioural model was developed based on the literature but also on real-life attitudes and opinions from actual wheat farmers in England. This was achieved by individual in-depth one-to-one farmer interviews and focus groups concerning current wheat-marketing methods and tools and risk management strategies and subsequently by a national survey of arable farmers in all key wheat growing regions of England. The resulting model was then tested on wheat farmers in England to see if it does, indeed, fully encompass and mirror the current context in England.

Morris and Potter (1995) suggest behavioural research should focus on the decision-making processes of individual farmers, their motives, values and attitudes. In fact, behavioural research is a largely questionnaire based methodology but ‘actor-orientated’ and that continue that the ‘behaviour approach’ refers to broad range of studies that employ actor-orientated quantitative methodologies to the investigation of decision-making and that behaviour research also covers a variety of disciplines, including economics and sociology (Burton and Rob, 2004). Morris and Potter (1995) classified behaviour studies as those which:

- seek to understand the behaviour of individual decision-makers;
- focus on psychological constructs such as attitudes, values and goals but also commonly gather additional relevant data on farm structure, economic situation, successional status etc. and,
- employ largely qualitative methodologies for investigating psychological constructs.

Saunders et al. (2009) suggest research also draws upon the concepts of ‘positivism’ and ‘interpretivism’. Positivism reflects working with an observable social reality and produces law-like generalisations similar to those produced by physical and natural scientists (Saunders et al., 2009). Positivist characteristics can be used from data originally collected from in-depth interviews. This research used existing theories to develop hypotheses, which were tested and confirmed and only observable phenomena were used to lead to credible data to build on. A highly structured methodology was used in order to allow for replication. Statistical analysis lead from the quantifiable data (Saunders et al., 2009). Interpretivism states that rich insights are lost if the social side of business is based totally on law-like generalisations. It is therefore a necessity to recognise the differences between humans in the way they react to outside influences and the greater social environment (Saunders et al., 2009).

A mixed-method approach in a single study, i.e. the use of both qualitative and quantitative methods, is often used in agricultural research (Beedell and Rehman, 1999; Bailey et al., 2005; McEachern and Warnaby, 2005). Krueger (1994) suggested that there are benefits of combining qualitative and quantitative procedures, resulting in greater methodological mixes that strengthen the research design. This approach results in three phases to the research process shown in Figure 5.1. The first of these phases was a literature review and a qualitative approach to the development of the research questions and objectives, followed by one to one interviews and focus groups. The second phase implemented the findings of the first in the development of a behavioural model, which was tested using a national survey. The final phase concerned the analyses of the data and the formation of conclusions and recommendations.

Phase 1
Literature review Research questions and objectives Preliminary research model In-depth interviews and focus groups (Qualitative/Interpretivist) - Manual Content Analysis Collect qualitative data from in depth interviews and Focus groups (Qualitative/Interpretivist) Modified research model - Manual Content Analysis Hypotheses and questionnaire development
Phase 2
Pre-Pilot study Pilot study Full study (Quantitative/Positivist)
Phase 3
SPSS analysis of national questionnaire (descriptive analysis) (Quantitative/Positivist) Interpretation of results Conclusion

Source: Adapted from Jackson (2008)

Figure 5.1. Phases of the research process.

5.3.3 Research process

This section provides greater detail of the research process and can be described as a series of six sequential steps as follows:

Step 1: Understanding the wheat market and marketing systems in England was achieved by literature searches, industry knowledge and author's personal experience over the last 30 years in England's agricultural industry and wheat brokerage trade. Additional information was gathered from personal communications with industry participants.

Step 2: After a literature review, see Chapter 4, the first qualitative phase included in-depth one to one farmer interviews and focus group discussions with arable wheat growers in England. The aim was to improve the behavioural model that was developed from the TRA, TPB, Diffusion of Innovation and extended TPB theories discussed in the literature review. This exploratory phase was used to build constructs for subsequent hypothesis testing. In-depth interviews (Berg, 2001; Creswell, 2002), and focus groups (Basch, 1987; Krueger, 1994; Sekaran, 2003; Zikmund and William, 2003; Wilkinson, 2004) were identified as effective ways of eliciting information on the attitudes of wheat producers in England to selling their wheat. Structured in-depth interviews are conducted when it is known, or fairly well known at the outset, what information is needed. Pre-determined questions focused on factors that were considered relevant to the research with the same questions asked of each respondent. However, the researcher did take a proactive role from the respondents' answers and ask other relevant questions that were not on the interview script. By allowing this digression/deviation, new factors might be identified, resulting in a deeper understanding (Sekaran, 2003). The ability to recognise these answers and their importance depends on the questioner's ability and knowledge of the subject. This is why the researcher was the questioner in this case, and not a paid interviewer with little knowledge of the subject.

The eighteen arable farmers were selected from the customer database of Agricole Ltd, an independent farmers' grain broker. A further seven non-farmer 'advisors' from the English grain trade/independent advisors/land agents were also individually interviewed.

The focus groups were primarily organized via an individual farmer in each of the Suffolk, Kent and Hampshire regions, who had originally been contacted as part of the Agricole Ltd's database about the focus groups. Each of the three farmers recruited other farmers, local to him, to participate in the focus groups. The information was then manually tabulated and analysed to describe, quantify and identify the important factors to help evolve a model to answer the research questions. The focus group meetings were conducted as an open forum for discussion but directed by the researcher broadly following the same questions as the in-depth interviews. Due to the larger number of participants a broader range of views and experiences were expressed and also allowed an unbiased and free discussion (Sekaran, 2003; Zikmund and William, 2003; Fisher and Buglear, 2007). The focus groups were analysed using the interpretivist approach to understand the motives and intentions of the farmers being studied (Saunders et al., 2009).

Step 3: The Confirmatory Phase began by the development of a behavioural model from the literature review, in-depth interviews and focus groups.

Step 4: The development and testing phase involved a pre-pilot survey sent to six farmers followed by a pilot questionnaire sent to 30 farmers, to ensure questions were clear, concise, unambiguous and that the questionnaire was of a length that would be returned fully completed.

Step 5: Distribution of the full questionnaire was to a selected, stratified list of 2273 farmers in England. The questionnaire was a three paged, doubled sided, A4 size, (stapled in the top left hand corner) with a separate explanatory introduction sheet. The questionnaire was posted to individual farmers at the same time but in two distinct groups. Two thousand farmers were identified from a HGCA database and were anonymous to the researcher and posted out by the HGCA. A further 273 farmers (the total farmer database of Agricole Ltd) were identified and were known to the researcher and posted out by the researcher. It was recognised that some farmers could be in both mailing lists. It was believed that if two questionnaires were received from the different sources, then each farmer participant would fill in only one questionnaire.

Step 6: Analysis of the national questionnaire: After cleaning the data, it was analysed using SPPS 20 to test for reliability and validity of the model, factor analysis, cluster analysis and testing the hypotheses. This phase also allowed the research to draw conclusions and make recommendations for increasing the use of FPRMs amongst farmers.

5.4 Summary

This chapter has presented the research model and paradigm together with a brief overview of the research process and steps involved. Some of these initial steps such as literature review and understanding of the English wheat marketing system have already been discussed in detail in earlier chapters. The remainder of this thesis provides the necessary detail and results from the remaining steps in this process namely the qualitative field study, the national questionnaire and the research model.

6 Qualitative field study analysis and research model

6.1 Introduction

The previous chapter detailed the methodology of the qualitative research. This chapter presents the findings and results of the qualitative methods and develops a modified research model specifically aimed at explaining the selling behaviours of wheat producers in England. It amalgamates the decision-making dimensions of the individual farmer with the theoretical frameworks detailed in Chapter 4. The qualitative phase of this research consisted of 18 one to one in-depth interviews with wheat-growing farmers in England and seven members of the English grain trade and agricultural advisory services and three focus groups. Findings from the literature review and this new primary data were combined to develop a behavioural model applicable to discovering the reasons behind wheat farmers in England's intention to adopt FPRM tools as part of their wheat marketing strategy. This model was used as a basis for the national farmer questionnaire.

6.1.1 In-depth interviews

Following previous research protocols, a semi-structured set of interview questions was formed to elicit the relevant information with respect to the research questions and any other pertinent information (Yin, 1994; Gladwin, 1997; Eisenhardt and Graebner, 2007). Eisenhardt and Graebner (2007) encourages the use of multiple respondents as it enables comparisons and contrasts between participants and clarifies whether views were simply idiosyncratic or followed a general theme. Multiple cases also create a more robust theory as the suggestions are verified by greater empirical evidence. Constructs and relationships are also more accurately defined because it is easier to determine exact meanings from multiple cases (Eisenhardt and Graebner, 2007).

The questionnaire used for these in depth interviews is presented in Appendix 2. Questions were based on a process outlined by Quaddus and Xu (2005). Firstly, simple basic farm details and farmers' perception of the state of the arable sector in England in general. Questioning then moved to the conditions surrounding the wheat market in England, how the farmers sold their wheat, the type of contracts used and the pros and cons of each. Finally questions concerning the use of FPRM tools were asked, to ascertain which tools, their pros and cons, and why they were, or were not, part of the farm's wheat marketing practice. The questions also attempted to define what are the barriers and drivers to the use of FPRM and the farmer/decision maker's view of FPRM tools. Included in the interview was a short 'word-association' section consisting of 10 words. These covered current emotive subjects and were designed to give instant responses/attitudes to these subjects.

Information was collected by direct questioning at the farmers' and grain traders'/advisors' place of work, from a pre-set script following this University's Ethics Committee approved questions, and recorded by digital Dictaphone and hand written notes by the researcher. All participants were known to the researcher. The interviews ran for approximately 1.5-2 hours each. Key words/phrases from each interview were manually collated to give an impression of the depth and range of responses. These farmer, grain trade and advisors' responses are summarised in Appendix 10 on a CD.

The responses can be summarised as:

- the market had become more volatile and unpredictable during the 2000s;
- this volatility had been particularly noticeable since the 2007 harvest;
- adaptations to the operation of their business were needed in general to make allowances for this;
- farmers had very little clear understanding of FPRM tools, and
- very few had used FPRMs and where unclear of where to find advice on their use.

It was found that 80% of farmer respondents had used forward contracts. This is much higher than the 37-54% found by research over the 2004-09 period in the UK. However, there was little or no mention made of the use of FPRM tools/contracts to overcome some of the problems for marketing wheat in the volatile market of the past five years.

The grain traders agreed with the farmers with regard to the wheat market in general. However, when it came to the use of FPRM tools there was a marked difference in opinion. Within the grain trade the merchants demonstrated considerable knowledge of FPRM tools, how they worked and their advantages in reducing the effects of price volatility whilst the farmers did not. Grain trade merchants stated that: FPRM tools were essential to their business; they could make money out of their use in their business; and they were a mechanism associated with the increased purchase of physical grain. Land agent advisors knew of FPRM tools but mostly didn't recommend them and suggested going to a merchant. This was principally due to a lack of knowledge of how FPRM tools worked, their nuances and applications. As a result their customers were not being advised on their practicalities to their business. Land agents also did not feel that this was part of their remit and so only a basic theoretical knowledge was acceptable.

Table 6.1 shows a summary of the responses to the 'word association' section of the interviews from the farmers and grain trade. The full responses are detailed in Appendix 3 and Appendix 4 respectively. There were some similarities and some noticeable differences. Both groups associated volatility with the subject of wheat price. In response to 'futures' farmers expressed concerns over their lack of understanding as well as being sceptical or confused about them. The grain trade also acknowledged the lack of understanding from farmers but also added futures were essential (to their merchanting business). These responses of scepticism and confusion were repeated, by farmers, for 'hedging' and 'options' with the addition of their expense, in relation to the premium paid for options. 'Wheat marketing' was also similar with farmers expressing opinions of complexity and difficult and the grain trade agreeing that farmers didn't understand. However, both groups acknowledged the importance of marketing. The subject of 'merchants' provided some differences, with farmers expressing concerns of trustworthiness, whilst the grain trade used words such as honest. The grain trade acknowledged some negative opinions of farmers towards them.

Table 6.1. Summary of responses to word association from in-depth interviews.

Subject	Farmer responses	Grain trade responses	Focus groups
Wheat price	Volatility	Volatility	Volatility
Futures	Scary, don't understand, sceptical, confusing, risky	Essential, misunderstood, complicated	Expensive, dangerous, complicated, risky, useful
Wheat marketing	Difficult, complex, important	Misunderstood, seasonal, strategy, essential	Essential, difficult, challenging
Merchants	Evil necessity, too many penalties, dishonest, good and bad	Variable, honest, too few, ill thought of, tricky, uncertain	Wanted their pound of flesh, information, necessary evil, con men, too powerful
Hedging	Good, scary, complex, not understood	Essential, misunderstood	Difficult, insurance, no experience, useful
Options	Expensive, not understood, ought to use, flexible, insurance	Premium, misunderstood	Interested, should use, useful, costly, second chance

6.1.2 Focus Groups

The purpose of the focus groups was to develop and explore the constructs for the behavioural model. Yin (1994) suggests that when looking at current real life phenomena, 'when', 'how' and 'why' questions should be posed, especially when the investigator has little control over responses and events. Kruegar (1994) states that with focus groups there is no one right way to conduct analysis. The focus group identifies major themes better than the microanalysis and subtle differences more apparent from in depth interviews. It has the advantages though of group interaction and a greater insight into why certain opinions are held. Transcript-based analysis is a comprehensive analysis tool in focus group research, but is slow, cumbersome and very expensive. For these reasons this was not conducted for this research.

Each focus group consisted of one farmer known to the researcher, an Agricole Ltd's customer, and local farmers 'recruited' by them and not known to the researcher. Each of the three focus groups was conducted in the form of direct questioning to groups of 8-10 farmers, by the researcher. The groups were documented by Dictaphone, hand written notes by the researcher and an assistant recording points on a flip chart. The whole process was also videoed with each group lasting 2 to 2.5 hours. Upon arrival at the focus group venue, and before the focus group began, a pre-discussion questionnaire was completed by participants collecting basic demographic details and the word-association section as used from the in-depth interview questionnaire.

Each focus group's questions broadly followed the same questions from the in depth questionnaire. The first questions concerned simple basic farm details and the farmers' perception of the state of the UK arable sector in general. Questioning then moved to the conditions surrounding the UK wheat market, how the farmer sold their wheat, the type of contracts used and the pros and cons of each. Finally, questions concerning the use of FPRM tools were asked, to ascertain which tools, their pros and cons, and why they were, or were not, part of the farm's wheat marketing policy. The responses are summarised in Appendix 5.

From the three focus groups, totalling 27 participants, 82% were over 40 years old and 56% were over 50 years old; 63% ran a business that was defined as a sole trader or partnership and 30% were limited companies. Ninety three per cent of participants were the primary or joint decision maker in the business and 89% had been running their business for over 10 years. The majority (88%) described their businesses as predominantly arable with 80% farming over 500 acres and 48% farming over 1000 acres. The wheat crop represented over 75% of the crops grown for 84% of the attendees. No participants had a futures account with a FSA regulated broker, only 32% used futures type contracts and only 30% used options type contracts as part of their FPRM process, via the merchant trade.

Appendix 6 shows the detailed responses to the word association for the focus groups. The responses were similar to the in depth interviews with the farmers but showed some useful additions. In particular the groups showed that there were differences in the levels of understanding of futures, options and hedging and although complex, there were responses that showed that some farmers understood that these tools could be useful. The groups shared the same opinions towards merchants as the farmers from the in depth interviews with respect to honesty.

The main discussion of the focus group concentrated on specific questions about the UK arable agricultural market in general, recent wheat price changes in England, attitudes towards risk and the use of FPRM tools. The questions and responses are detailed in Appendix 7, but can be summarised in Table 6.2 as:

Table 6.2 Focus Group questions and answers summary

What are your views of the state of UK agriculture at present?		
o Profitable/optimistic	o Increased power of speculators/supermarkets	o Higher input costs beginning to reduce margins
o Lots of red tape	o Very controlled	o Vulnerable
o Volatile prices		
What are the goals and needs of your business?		
o Make a profit	o Pride in the job	o Maximisation of acres
o Make a living	o Decent return on investment	o Pay off debt
o Return to stake holders	o Happiness and job satisfaction	o Expansion
How important is the family in these decisions?		
o Very	o Don't let the family down	o Ownership important
o Keep for next generation	o Long term view	o Majority consult the family for key decisions
Which are the most profitable crops at present?		
o OSR	o Wheat	
What are the changes seen in the English wheat market over the past 5 years?		
o More volatile	o Fewer outlets to sell to	o Increased global influence on English wheat market
o More but often conflicting information	o Increasingly difficult to budget	
What effect have these market changes had on the farm?		
o Review and remove costs	o Increase productivity	o Harder to budget, more frequent budgeting, greater attention to cash-flow
o Increase diversity	o More cautious	
o Try to reduce risk	o Higher input costs	
What effect have these market changes had on attitude to selling?		
o Sell above cost of production	o Sell forward for a profit	o More worry
o Spread selling	o Cash-flow influencing selling	o More cautious
o Look for minimum priced contracts	o Avoid selling to smaller companies	o Manage risk
What effect have these market changes had on how wheat is sold?		
o More sold forward	o More use of FPRM tools	o Pools, as a benchmark against other selling methods
o More spot selling	o Divided about more/less via Pools	
What is the importance of the wheat crop to the farm business?		
o Crucial	o Diversification if carried out has reduced reliance on wheat crop	
o Over 50% of the crop grown		
What is the effect of the wheat price change?		
o Bigger effect than the changes in input costs	o 10% change in wheat price is £100/ha	o Effect delayed for a year
How do you look to increase margin?		
o Increase yield	o Achieve higher prices	o Lower costs
o Add value		

How can a negative margin be avoided?		
○ Lower costs	○ Planning	○ Work harder
○ Sell at a profit	○ Fix forward price	○ Luck
Who do you market wheat to?		
○ Merchants and shippers	○ Some limited end users	
What are the selling triggers?		
○ Cash flow	○ Fear	○ Owner
○ Storage	○ Gut feeling	○ Merchant's approach
○ Price	○ Bank	○ Tax
○ Greed	○ Family	○ Rent due
What marketing tools are used to reduce risk?		
○ Spot sales	○ Forward	○ Options and futures few used
○ Pools - all used		
What is your view of FPRM tools: futures and options?		
○ Keeps you in the market	○ Selling un-priced to a merchant	○ Lack of understanding of how they work
○ Second 'bite of the cherry'	○ Complex	○ Expensive
○ Guaranteed minimum	○ Risky	○ Unproven
○ No storage costs	○ Unclear explanations	○ Trust needed
○ No storage risks	○ Hard work	○ Time consuming
○ Cost of premium	○ Second guessing the market	
Family/other stakeholders' views of FPRM tools?		
○ Out of their depth	○ No experience	○ Use would affect responsibility to family
○ Been burnt by them	○ Don't understand	
Peers' views of FPRM tools?		
○ Fashionable	○ Expensive	○ Lack of independent advice
○ Complicated	○ A business tool	○ Peers would influence use
Participants' views of FPRM tools?		
○ Merchants don't like them	○ Fear of fraud	○ Lack of knowledge
○ Lack of independent advice	○ Fear of advice	
What would help you use FPRM tools?		
○ Help	○ Independent advice	○ Training and information

In the next section the results from the in-depth interviews and focus groups are used and analysed to produce a research model and were the basis for the national questionnaire.

6.2 Research model

The recurring themes from the in-depth interviews and focus groups produced the relationships between factors and variables. These results allowed for a deductive phase of the analysis, the formation of a combined model of factors and variables that flowed out of the in-depth interviews and focus groups. The model also took into consideration the elements of the three theories discussed earlier in Chapter 4, TRA, TPB and Diffusion of Innovations.

This was enabled by adapting research by Quaddus and Xu (2005), and:

- the literature review (TRA, TPB and Diffusion of Innovation, from Chapter 4, focusing on the agriculturally concerned literature);
- collating the factors, the variables and their relationships from the in depth interviews and focus groups to uncover key patterns/themes and produce key words/phrases. (Inductive process);
- produce labels/categories for these key words/phrases;
- look at relationships amongst the factors from each interview;
- create a flow chart, showing these relationships;
- add elements from previous studies. (Deductive process);
- combine similar variables and give them common name and retain unique variable(s);
- develop final tables of factors, variables and their links, and
- produce a model showing factors and behaviours that will explain wheat producers' in England's intention to adopt the use of FPRM tools to aid the marketing of their wheat.

Based on the format of Quaddus and Xu (2005) and Jackson (2008),

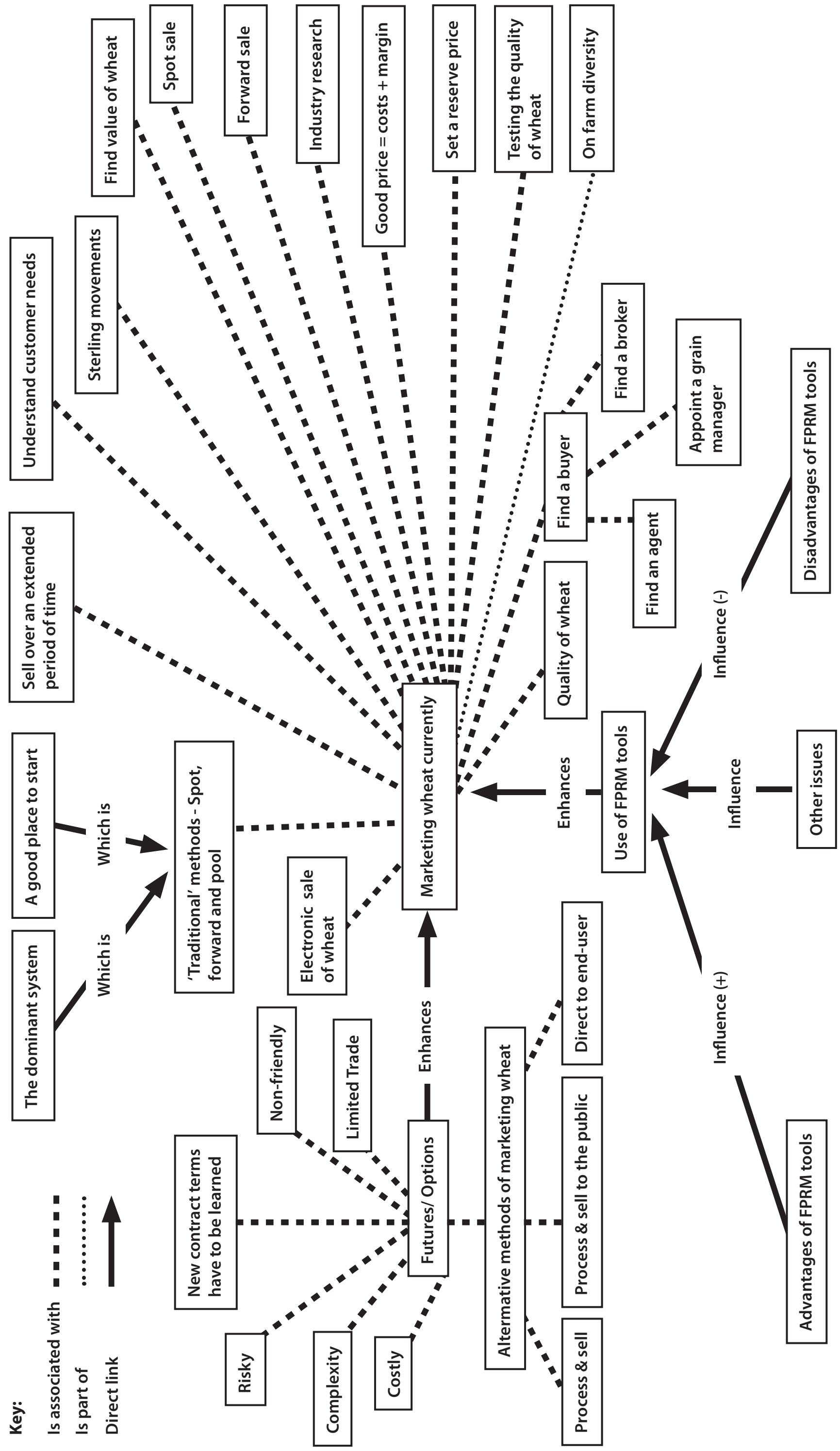
Table 6.3 shows a summary of the findings from the qualitative research. Key factors from the in-depth interviews and focus groups were used as headings, with the range of answers forthcoming from the discussions detailed under each heading. Firstly, the various methods of selling wheat in the UK market are detailed. Secondly, the factors and variables associated with the adoption of FPRM tools when selling wheat are shown. Finally, other issues that affect the use and adoption of FPRM tools at play within the individual farming entity and the broader farming environment. It can be seen that there is a combination of selling techniques employed by wheat producers in England but that there are also important other issues. Figure 6.1 gives a visual representation of the results from Table 6.3.

Table 6.3. FPRM adoption - factors and variables of FPRM tool adoption.

Issues				
Methods of selling wheat	Alternative ways of selling wheat	Advantages of using FPRM	Disadvantages of using FPRM	Other issues
Forward selling *Sub-issue: more smaller sales*	Sell direct to mill/end user	Make more profit	Lack of understanding	Not our job *Sub-issue: growing crops is*
Spot selling	Process on farm	Maximise profit	Expensive	Bench mark versus others
Buy back contracts	Niche market	Make more money	A cost	Experience
Pools		Provides a known income/margin	Have to 'sell' twice *Sub-issue: putting off decision*	Confidence
Futures		Known cost	Lose money	Opinion of family
Options		Helps with budgeting	Counter-party risk	Opinion of peers
Min-Max contracts		Min price guarantee	Contract complexity	Cash flow
Exchange rate fluctuations		Price transparency	Contract risk	Tax implications
Use of a broker		Second 'bite of the cherry'	Yield uncertainty	Risk management versus making money
Use of an agent/advisor		Risk management	No economic gain	Different to physical selling
Grain quality		Less worry	Training needed	New way of marketing
Customer requirements		Flexible	Trade ambivalence	State of the world market
Pool manager		Easy. *Sub-issue: once understood*	Trade's other objectives	State of the UK market
Sell over an extended time		Reduces volatility of margin	Trade's lack of knowledge	
Price transparency		Positive experience *Sub-issue: once understood*	Dominance of spot/forward selling	
Set a target date		Work best if volatile market price	Lack of price transparency	
Little and often *Sub-issue: price uncertainty*		Yield not an issue	Paperwork	
Merchant trade		Standard contract	Not a common practice	
		No quality issues	Fine print	
		Paper transaction only	Few pushing the concept	
		Not related to physical grain quality	Independent advice *Sub-issue: where from?*	
		Peace of mind	Contract rules	
		No obligation to provide physical wheat	What are advantages?	
			When to bail out of the hedge	
			Speculative	
			Scary	
			Somebody else making a profit	
			Setting up a futures a/c. *Sub-issue: paperwork*	

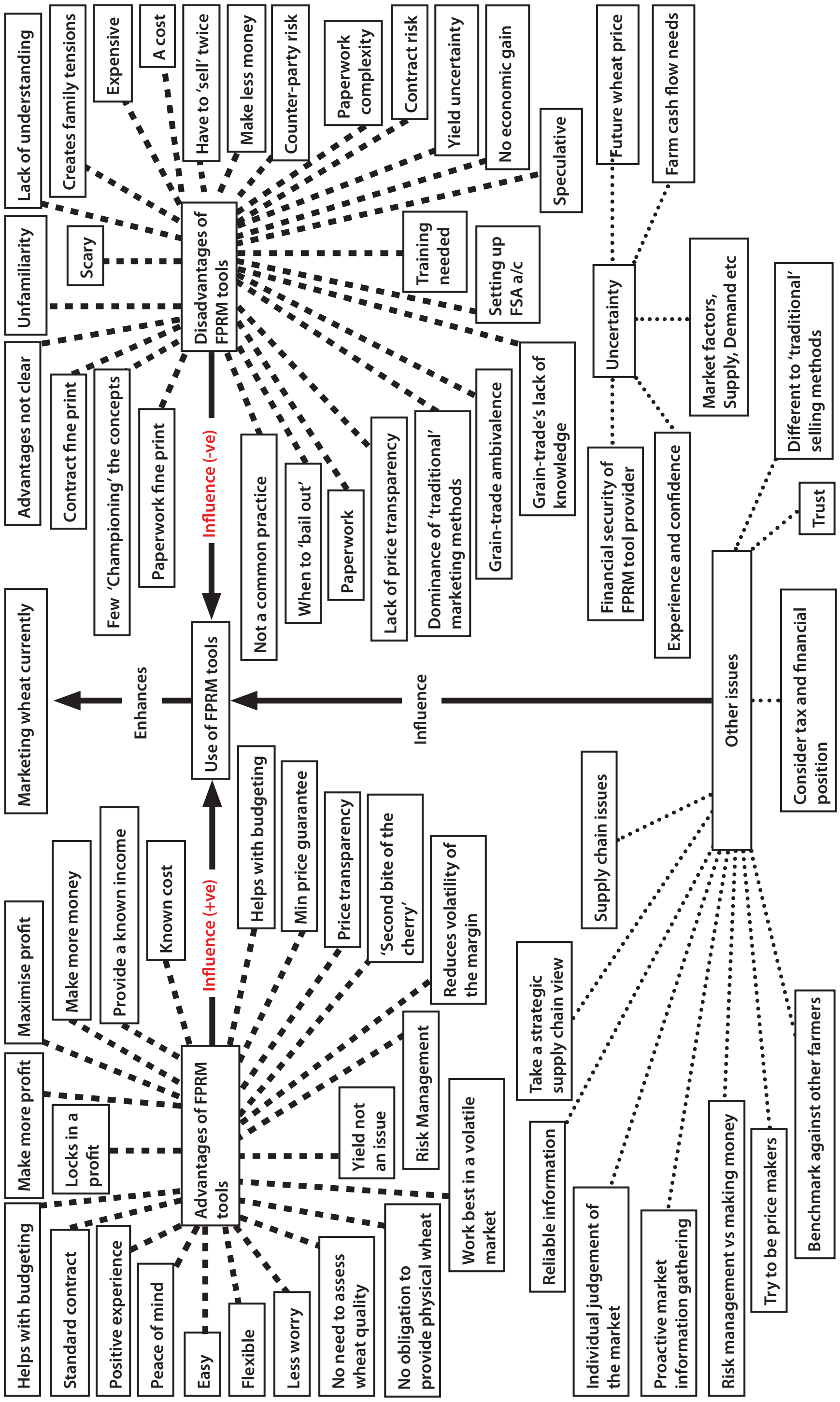
Source: Adapted from Jackson (2008)

Figure 6.1. Combined factors and variables for explaining FPRM adoption



Source: Adapted from Jackson (2008).

Figure 6.1 continued.



(Adapted from Jackson (2008).

Much of the discussion during the in-depth interviews and focus groups concerned the selling and marketing of wheat, its associated methods of selling, market structure and its key players. Also, understanding cost of production, margins, pricing of wheat, yields, and currency and market information. Again, little was mentioned of FPRM when marketing wheat. Responses from the qualitative analysis suggest the use of FPRM tools were dominated by merchant options, with few using exchanged traded futures or options contracts. Issues mentioned by participants as to why they did not use FPRM tools were broadly due to a lack of: understanding, experience of use; trustworthy independent advice; and help with setting the FPRM tool up in practice. Participants stated that whilst information was available to explain the workings of FPRM tools, the quality of this information was varied and often biased. The information did not help in the crucial process of setting up a FPRM contract and applying them to an individual specific farm situation. Other ways of selling and marketing grain, such as spot sales, forward sales and buy-back contracts were mentioned more often than FPRM.

The use of FPRM tools as a way of actually selling and marketing grain was only mentioned by a third of the participants. The risk of defaulting on a contract, due to over selling against anticipated yield, and having a possible associated buying-in payment, was a real reason why many did not sell more forward, even when the price was deemed attractive. No alternative method of securing a wheat price, apart from selling some crop against a subsequent downward price movement, was mentioned as an alternative method.

Few had used the techniques despite having had some sort of training. The actual execution of a FPRM tool was a perceived problem. More and continued training, with someone to guide farmers through the initial use of FPRM tool usage was expressed. Some continued to feel that FPRM was too costly to use.

There were 23 stated advantages of using FPRM tools. The most often cited were making a profit, maximising profit, providing a known minimum income and getting a ‘second bite of the cherry’, less income volatility and less worry. Also, FPRM tools, unlike spot or forward contracts, had no yield issues, as they were only paper trades, so do not involve the physical supply of wheat.

There were 27 disadvantages of using FPRM tools expressed. Their cost, lack of understanding and difficulty in actually setting up a FPRM tool were most often cited as reasons why FPRM tools were not used and embraced. Other issues included that some farmers preferred the old mechanisms of spot and forward selling, counter-party risk, yield risk and "having to sell the grain again at some point". Bench-marking versus others, cash flow and tax implications were also mentioned.

Confidence in the farmer's own understanding and using these 'non-normal' tools was cited as a barrier to FPRM use. The beliefs, perceptions and experiences of other family members associated with running the business and the views of friends and others influential peers were mentioned. There was also a perceived need to have someone, or an organisation, that are trusted by the farmer, to guide them through their first practical use of the FPRM tool. The UK grain trade's ambivalence to the subject was seen as a major barrier too, which would make actual implementation of a FPRM tool difficult, even if the farmer has understood the concepts.

The three focus groups mentioned disadvantages more than advantages, inferring a negative attitude to FPRM tools. The other issues seemed to concern the wheat market in general, confidence in the use of FPRM and the beliefs, perceptions and experiences of other family members associated with running the business and the views of friends and others influential peers. Manual content analysis revealed a range of factors that influence the use of FPRM tools. These were: pricing; complexity; the practical process of applying FPRM tools; confidence; and happiness with existing methods of marketing.

Table 6.4 details a summary of the perceived advantages and disadvantages of using FPRM tools (in not particular order) expressed by farmer, grain trade and land agents.

Table 6.4 Summary of advantages and disadvantages of using FPRM tools

Advantages of using FPRM tools	Disadvantages of using FPRM tools
Helps with budgeting	Advantages not clear
Standard contract	Contract fine print
Positive experience	Few ‘championing’ the concepts
Peace of mind	Paperwork fine print
Easy to use	Not common practice
Flexible	When to ‘bail out’.
Less worry	Paperwork
No need to assess wheat quality	Lack of price transparency
No obligation to provide physical wheat	Dominance of ‘traditional’ marketing methods
Works best in a volatile market	Grain trade ambivalence
Yield not an issue	Grain trade’s lack of knowledge
Risk management	Setting up a FSA account
Reduces volatility of margins	Training needed
‘Second bite of the cherry’	Speculative
Price transparency	No economic gain
Minimum price guarantee	Contract risk
Helps with budgeting	Paperwork complexity
Known cost	Counterparty risk
Provides a known income	Make less money
Make more money	Have to ‘sell’ twice.
Maximise profit	A cost
Make more profit	Expensive
Locks in a profit	Creates family tensions
	Lack of understanding
	Unfamiliarity
	Scary

6.2.1 Factor relationships

Content analysis of the raw data extracted from the in-depth interviews and focus groups, enabled the construction of a behavioural model for the intention by wheat growers in England to adopt the use of FPRM tools. When used in conjunction with TRA, TPB, DTPB and Diffusion of Innovations, some modifications to these frameworks were deemed necessary to fully represent the complexity of individual farm level decision-making. The in-depth interviews and focus groups' factors and variables have been grouped to correspond to the independent variables from the framework of TRA, TPB, DTPB and Diffusion constructs in Table 6.5.

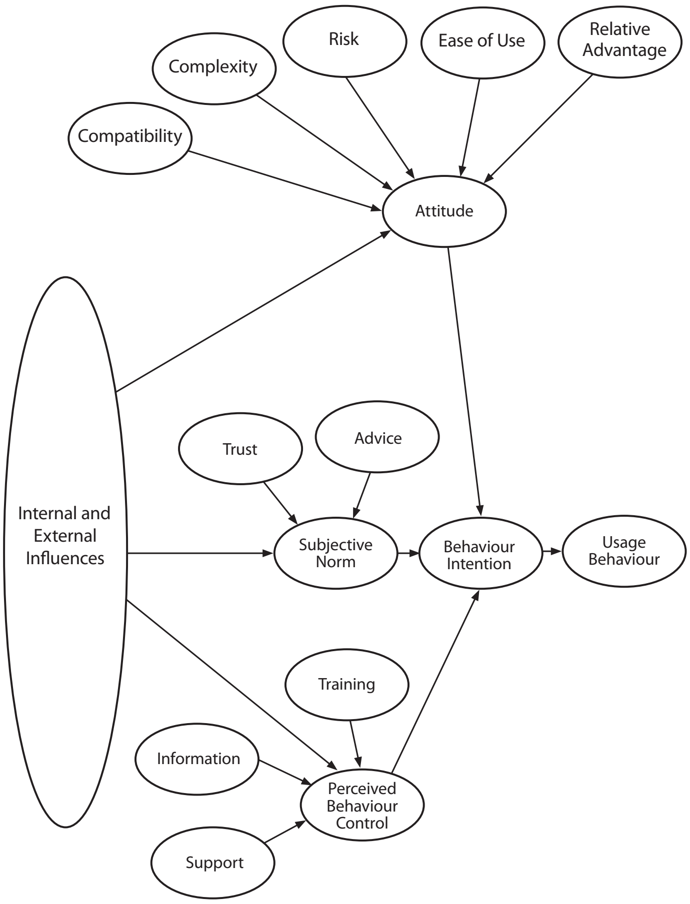
Table 6.5 Theoretical independent variables (factors and variables) in-depth interviews and focus groups

TPB/Diffusion independent variable	**Factors and variables from interviews and focus groups**
Attitude and use of FPRM tools	
Relative advantage	Guarantees income
	Buying time
	Decreases exposure to market volatility
	Shows what would have received
	Helps with budgeting
	Risk management
	Peace of mind
	Positive experience
	Reduces worry
Compatibility	Like to use
	Not 'natural' concept
	Lower prices
	Useful
Complexity	Paper work
	Unfamiliarity
	Contract rules
	Not 'natural'
	Make believe
	Cash flow
Ease of use	Unfamiliarity with concepts
	Risk management versus making money
Risk	Uncertainty of wheat prices
	Uncertainty of positive price movement
	Uncertainty of wheat yields
	Lower price in the end
	Counterparty risk
	No economic gain
Compatibility	Like to use
PBC and use of FPRM tools	
Training	Experience
	Help when beginning
	Continued help
Support	Who to trust?
Information	Where to obtain independent advice?
Subjective norms and use of FPRM tools	
Trust	Family problems
	Benchmark versus other farmers?
Advice	Peers, family, grain trade, academia and press

Source: Adapted from Jackson (2008).

This is diagrammatically shown, with arrows to indicate the direction of dependence between variables in Figure 6.2 and shows how the theoretical frameworks are combined with the responses elicited from the in depth and focus groups regarding actual decisions made by wheat producers. It follows research by both Quaddus and Xu (2005) and Jackson (2008).

Figure 6.2 The Combined model for the adoption of FPRM used in this research



The Att construct, is the belief that one's performance would increase using the application (Ramayah and Ignatius, 2005). In Chapter 4 it was detailed how Rogers (1995) divided the Att construct into five sub-constructs: relative advantage; complexity; compatibility; observability; and, trialability. The first three constructs have been used in this research model. However, in the context of this research, it was not possible to include the latter two constructs and these were replaced by an ease of use construct. The reason for substituting observability and trialability with ease of use is because the use of FPRM tools can take a significant length of time. Typically a single transaction can take between 6-18 months, thus making trialling and observing very difficult. This feature of FPRM tools tends, from this qualitative research, to reduce adoptees enthusiasm and hence the rate of adoption. The market environment in which the producer operates changes over time and will change their perception of the usefulness of FPRM tools. The new sub-construct, ease of use, was incorporated as it was repeatedly highlighted by farmers' responses during the qualitative research. A new sub-construct of risk was added to Att, as suggested by Tan and Teo (2000), as it was repeatedly highlighted by farmers' responses during the qualitative research. These two new sub-constructs should therefore be included, as they are believed to be important in determining the attitude towards adoption.

Of the five factors that are considered here, three are expected to have positive relationships with the constructs of the TRA, TPB and Decomposed theories. These are: relative advantage, compatibility and ease of use. These positive relationships for all three factors have been demonstrated in previous research (Fliegel and Kivlin, 1962; Lynne et al., 1995; Thompson and Panayiotopoulos, 1999; Bergevoet et al., 2004; Tutkun and Lehmann, 2006).

The complexity of the innovation limits trialability. This point was picked up by both the in-depth interviews and focus groups. Complexity is mentioned during the in-depth interviews and focus groups as a reason for not using FPRM tools, as when it's perceived complexity increases, so does the negative perception (Rogers, 1995). This was recognised as a limiting factor in trialling FPRM tools. Increasing complexity is also found to reduce the rate of innovation (Fliegel and Kivlin, 1962; Lodge, 1991; Batz et al., 1999; Tiller, 2000; Pannell et al., 2006).

Risk is also mentioned by in-depth interviews and focus groups as a factor in the attitude towards the use of FPRM tools. In particular was the risk of not making a financial gain from using FPRMs after the initial costs of setting them up. The risk factor is anticipated to be a negative influence (Fliegel and Kivlin, 1962; Tan and Teo, 2000).

The qualitative phase of this research highlighted an issue of trust between the farmer and advising organisations. Respondents indicated that the more the farmer trusts those giving the information about FPRM tools and, that the advising party will not exploit their lack of knowledge on the subject, the more likely they are to use them. This idea of trust and adoption is well documented in the literature (Köenig and Van Wijk, 1991; Barney and Hansen, 1994; Fritz and Fischer, 2007). In addition, it is this trust that builds up an expectation, following previous personal experience, of future behaviour. It also leads to a reduction in complexity of the future decision-making process (Luhmann, 2000) and so lowering future transaction, control costs and monitoring costs (Wilson and Kennedy, 1999; Dyer and Chu, 2000). Given that FPRM tools are seldom used and that the relationship with the producers is much more established it is anticipated by this researcher that the trust aspect is very important at this early stage of adoption (Hinde, 1987; Gambetta, 2000).

Results from the in-depth interviews and focus groups show differences in the perception of FPRM tools depending on the source of advice. This advice is now not just domestic but global. This includes world traders of physical commodities, fund-managers trading agri-commodity futures, international supply, demand and stock figures. The perception is, from this research, that these influences and the advice/signals they seem to give cannot be trusted to give a true and correct indication of the overall supply and demand of agricultural products. That is, they have vested interests, ulterior commercial motives and a short-term outlook. Further, each source of information will have their own motivation for providing help and information to a farmer (such as merchants recommending traditional methods as it is easier from them to administer and is also more profitable). It is also clear from the qualitative responses that each of these groups can have a significant influence over a farmer's behaviour and is thus an important component of the SN.

PBC is defined as a person's perception of the ease or difficulty of performing the behaviour in question (Ajzen, 1991). It takes into account some of the realistic constraints that may exist in real life (Ajzen, 2005). It is the term used to describe a person's assessment of how easy, or not, it will be for them to carry out the behaviour (Manstead and Eekelen, 1998). It is the main difference between the TRA (Fishbein and Ajzen, 1975) and the theory that developed from it, TPB (Ajzen, 1991). The 'ease of performing the behaviour' is different from the ‘ease of use’ sub-construct in the Att construct, as there may be certain reasons that make it harder for the behaviour to be performed. For instance, with FPRM tools, a computer, setting up an account with a FSA regulated broker and knowledge of the regulatory rules will be needed. However, once these are in place, the process of applying the FPRM tool, from this research’s in depth interviews and focus groups is actually quite straightforward. The findings of this research thus far have indicated that PBC is a significant barrier to using FPRMs, that is, their use is seen as difficult. This barrier to adoption is further reinforced by findings from earlier research that farmers are both conservative in adopting new technologies (Willock et al., 1999b) and also risk averse (Bond and Wonder, 1980; Pannell, 2000).

To be better understand PBC, and based on the qualitative research, PBC will be split into three components, ‘training’, ‘information’ and ‘support’. Training and information were cited as key elements to adoption of FPRM tools from the in-depth interviews and focus groups. Support was termed as ‘facilitating conditions’ (Taylor and Todd, 1995a). These elements differ from those discussed in Chapter 4 but it was felt by this researcher that the ‘self-efficacy’ was deemed to be too broad and better described by information, training and support. As the focus groups and in-depth interviews clearly mentioned this need, it was felt that separate sub-constructs would bring out a clearer picture of which parts of ‘self-efficacy’ were the most significant.

Training is used here as a sub-construct of the PBC and is provided by the agricultural merchant and advisory services. Adoption rates of new concepts or practices have been shown to be positively influenced by the availability and use of advisory services (Wilkening, 1950b; Copp et al., 1958; Longo, 1990; Fliegel, 1993; Saltiel et al., 1994; Rogers, 1995; Storer and Murray-Prior, 2001; Ngathou et al., 2005; 2006). As discussed in Chapter 6, the merchants, traders and advisory groups generally only provide training concerning traditional selling methods. Only independent advisors or quasi-government organisations, via farmer meetings and training seminars, are seen as actively providing some form of training in using FPRM tools. From this research it is clear that more training would encourage the use of FPRM tools and thus it is important to include this aspect as part of the PBC.

The information construct is mainly derived from agricultural merchant and advisory services, although additional information is available through mass media services, especially the Internet. Information or moreover, the lack of information, is clearly a major factor in determining the PBC. In the context of this research, there was felt to be a serious lack of information available especially from the mass media channels. Lack of information has a negative effect on adoption (Wilkening, 1950a; Copp et al., 1958; Longo, 1990; Fliegel, 1993; Saltiel et al., 1994; Rogers, 1995; Storer and Murray-Prior, 2001; Ngathou et al., 2005; 2006) and is a vital component of the PBC.

In the context of this model ‘support’ can be defined as being the help needed/offered to farmers to enable them to use FPRM tools, including practical assistance. Typically this support is derived from the merchant and advisory services. This research has found that support in the use of FPRM tools, in the form of initial and continued training was clearly highlighted as necessary but lacking. Additionally, the need for a trusted third party to practically enable the FPRM tool to be implemented and monitored over time was also highlighted. This demonstrated the importance of ‘support’ as a component of PBC. Research on the adoption of internet banking (Tan and Teo, 2000) and the Australian wool industry (Jackson, 2008) also concur with these findings.

From the in-depth interviews and focus groups conducted in this research, it is clear that there are many factors, specific to the internal and external structure of a farming enterprise which effect the Att, SN and PBC towards the use of FPRM tools and the intention to use them. Those factors relate to both the farmer decision-maker themselves, structure and type of business they are managing and how the wider macro-world political, economic and agricultural markets affect them.

Farm and farmer attributes are described in this research as ‘Internal farm factors’, IFFs, and relate to both. Farmer characteristics may include attitude to risk, objectives from farming, rate of adoption of new technologies, market knowledge and level of management skills, age, length of time in farming and generations the family have been in farming (McLeay and Zwart, 1998; Willock et al., 1999b; Jackson et al., 2008; Jackson, 2008; Jackson et al., 2009). Farm attributes include size of the farm, location and the dependence on wheat as a source of income, tax and debt positions, farm enterprise mix and resource availability (Fliegel, 1993; Beedell and Rehman, 1999; 2000). All of these factors have been demonstrated to exert influence over all the constructs of the TPB and are expected to also exert influence over the sub-constructs described above. However, when using a questionnaire, it is not possible to measure every conceivable factor, otherwise response rates would be too low to obtain meaningful results. Therefore, the internal factors have been limited to the most readily measureable such as age, size of farm, farm type, education level, years in the family business and number of children.

External factors include market volatility, supply and demand and agricultural policy. It can be argued that it is precisely these factors that have driven the need for risk management that has been discussed in Chapter 2. Further, it is difficult to account for these external factors as the study is not longitudinal, that is, the results will be for a single time period only. In this instance, because all study farms are within England, the external factors are identical for each and thus no statistical inference can be drawn from this. However, it is important to include these within the general construct although it is acknowledged that it is not possible to measure their influence within the scope of this research.

The TPB is primarily concerned with predicting the behavioural intention that, it is argued, is a proxy for actual behaviour, and also for identifying the key drivers to this intention. However, FPRM tools have been available for use for some time. Therefore, it is important to include an actual measure of the usage, and that of other selling mechanisms. In this research, this is described as ‘current behavioural variables’, CBV. Thus it is possible to compare intention with actual usage and to further interrogate actual usage using the responses from all of constructs of the TPB and the internal factors measured in the survey.

6.3 Conclusion

This Chapter shows how farmers in England, when marketing their wheat crop, relate factors and variables to the intention to adopt the use of FPRM tools. Qualitative mixed methods were used to capture the information. Twenty-five in-depth interviews, with both farmers and those in the grain trade and three farmer focus groups were carried out throughout the major wheat growing regions of England. All participants had experience of selling wheat but not all had had experience of using FPRM tools to market their wheat.

The major variables revealed by the respondents that affect their use of FPRM tools were:

- other ‘normal’ selling/marketing methods;
- their price;
- their complexity;
- the procedure required for their use in reality;
- unfamiliarity of the concepts, not a usual part of their business practices; and
- the merchant trade as a barrier to use.

Endogenous variables were contained in:

- PBC and SN - from TRA/TPB/DTPB; and
- Att - Relative advantage, compatibility, complexity, application, risk and self-efficacy - from Diffusion of Innovations.

Exogenous variables included;

- Att and SN, internal and external influences on the farm business - from TRA/TRB/DTPB.

A behavioural model was developed from the key factors discovered and was combined with the TRA/TPB/DTPB and theory of Diffusion of Innovations. In the next stage of the research, the statements of formal hypotheses are given and the subsequent development of the national questionnaire is presented to reflect the findings of the qualitative stage.

7 Hypothesis and National questionnaire development

7.1 Hypotheses development

Following from the theories previously discussed, TRA, TPB, Diffusion of Innovations and the DTPB from Chapter 4 and the Combined Model developed in Figure 6.2, this chapter focuses on the development of hypotheses (Taylor and Todd, 1995a; Igbaria et al., 1997; Willock et al., 1999a; Willock et al., 1999b; Quaddus and Hofmeyer, 2007; Jackson, 2008) and the subsequent construction of the national questionnaire. The first part of this chapter presents the hypotheses relating to Att, SN and PBC of farmers in England. All the hypotheses to be tested using the Combined Model will include influences on them relating to internal and external factors. For example, size of farm and the effect of the wider wheat market in general. These constitute a set of *a priori* hypotheses, however, it is anticipated that *post hoc* analysis will reveal further hypotheses for testing. In the second part of this chapter the national process used to derive it are discussed.

7.1.1 Hypothesis 1 - Attitude hypothesis

This hypothesis looks into the effect of the Att construct on BI, which can be further disaggregated into a more distinct set of sub-hypotheses relating to the different components of Attitude:

H1a Relative Advantage is hypothesised to have a positive influence;
H1b Ease of Use is hypothesised to have a positive influence;
H1c Risk is hypothesised to have a negative influence;
H1d Complexity is hypothesised to have a negative influence; and
H1e Compatibility is hypothesised to have a positive influence.

7.1.2 Hypothesis 2 - PBC hypothesis

This hypothesis looks into the effect of the PBC construct on BI, which can be further disaggregated into a more distinct set of sub-hypotheses relating to the different components of PBC:

H2a Training is hypothesised to have a positive influence;

H2b Information is hypothesised to have a positive influence; and

H2c Support is hypothesised to have a positive influence.

7.1.3 Hypothesis 3 - SN hypothesis

This hypothesis looks into the effects of different components of the SN construct on BI. Additionally, each social referent is hypothesised to have a unique influence on BI. This influence will also include the effects of trust the farmer has in the advice from each referent as well as the advice itself. This hypothesis is disaggregated into two distinct sub-hypotheses:

H3a Trust is hypothesised to have a positive influence; and

H3b Advice is hypothesised to have a positive influence.

7.1.4 Hypothesis 4 - Interactive hypothesis

This hypothesis proposes that Attitude, SN and PBC affect BI and therefore eventual behaviour:

H4a Attitude is hypothesised to have an influence;

H4b PBC is hypothesised to have an influence; and

H4c SN is hypothesised to have an influence.

7.2 National Questionnaire Development

7.2.1 Developing the questionnaire

The questionnaire was based on the information and responses given during the in-depth interviews and focus groups. Four main hypotheses were developed in the previous section to provide a rational for design of the national questionnaire. The design of the questionnaire was developed to meet four criteria:

1. compatible with the structure of the theoretical models;
2. understanding by, and participation of, respondents;
3. simplicity; and
4. theoretically and scientifically robust.

Dillman (2009) suggests a four-step method to ensure a concise and ordered approach to the structure of a questionnaire:

1. a review of the questionnaire by people well acquainted with the subject to ensure that relevant questions were asked, there are no redundant questions and questions are relevant to the research model;
2. carry out interviews to evaluate the questionnaire;
3. perform a small pilot-study to exactly mimic the main survey procedure to give a true idea of projected response rate; and
4. check and complete the questionnaire by people that were not associated with the research. This is to eliminate any errors that may have been missed by those associated with the development of the questionnaire.

However, because of the perceived complex nature of FPRMs, as detailed to this researcher when communicating with farmers, a modified procedure was conducted to ensure reliable results and a sufficiently high response rate:

1. Construction of original questionnaire and review by researcher and supervisors. The conclusions were to reduce the number of questions, amalgamate some questions and structure the questionnaire into sections that approximated the research model after a small pre-pilot survey.

2. Pre-pilot survey using six farmers known to the researcher. Each farmer was sent the questionnaire by post and asked to complete and make comments. The researcher then visited the farmers to discuss the questionnaire and their comments. The conclusions were that the questionnaire was too long, some questions were similar and some seemed irrelevant.

3. Based on the conclusions above, an amended questionnaire was sent by post to a group of twenty farmers known to the researcher. This questionnaire contained a feedback comments form, which the farmers were also asked to return. The

conclusions were that the questionnaire was still too long and some questions were similar.

4. Following revisions, a pilot-questionnaire was distributed by the HGCA by post to 30 farmers not known to the researcher. The sample database was chosen to include farmers in the major wheat growing regions of England. It was then further constrained to only include farms with over 500 acres of arable crops. The farm businesses targeted were predominantly arable based and the wheat produced was not consumed on the farm by an animal enterprise. There was included a stamped addressed envelope to be returned to the Centre for Agricultural Strategy at the University of Reading. After a month the non-responders were re-sent a duplicate questionnaire. It was concluded were that the very low response rate was due to the length of the questionnaire and perceived repetitiveness of some questions.

5. The questionnaire was shortened considerably and several questions were combined following the results of the pilot survey. Three non-farmers as well as supervisors reviewed this and decided that there were no further corrections needed. Due to time and budgetary constraints it was not possible to conduct a repeat of the pilot process, thus this revised questionnaire was adopted as the final national questionnaire.

The final questionnaire was designed not only to elicit data on the use of FPRM tools but also farmer demographics, farm business and structure. Previous use of FPRM tools was not a necessary prerequisite of eligibility to participate in the survey as the use by farmers is estimated at 5 to 15% (DEFRA and HGCA, 2009) and this would have reduced the number of possible participants. The location of the farms surveyed was limited to the major wheat growing and selling regions of England, that is, regions where the wheat crop is predominantly a cash crop for selling off the farm, not for feeding the producers' livestock. Questions were a mixture of Likert-style, tick boxes and free text. In the following section the sampling process and questionnaire format is described.

7.2.2 National survey

7.2.2.1 Introduction

The questionnaire was formulated and based on research, the model developed in Chapter 6 and the questionnaire development phase. Farm-specific questions were a simple choice from a range of possible responses. The questions were designed to elicit information concerning the use of FPRM tools when selling wheat, farmer demographics and business functioning.

7.2.2.2 Sampling process

Two databases of arable farmers in England were used. The first was drawn from the national database of the HGCA. The sample database was chosen to include farmers in the major wheat growing regions of England. It was then further constrained to only include farms with over 500 acres (200 ha) of arable crops. That is the farm businesses targeted were predominantly arable based and the wheat produced was not consumed on the farm by an animal enterprise. From a potential sample population of 3350 a random sample of 2000 was selected. An anticipated 20% response rate was predicted giving a usable sample population of 400. From previous agricultural literature the usable response rates vary from 5-35%. Garforth et al. (2006) showed 29% usable responses, Rehman et al. (2007) 29%, Tranter et al. (2009) 5-35% and Sottomayor et al. (2011) 34%. The questionnaire was distributed by post, directly from the HGCA in late September 2012. The second sample consisted of 273 farmers in the Agricole database and was independently posted simultaneously with the HGCA mailings. The analysis will differentiate between the two samples and will be testing for any differences that may result. A reply paid envelope was provided. Completed questionnaires were returned to the University of Reading, Centre for Agricultural Strategy. A reminder letter was sent out to 'non-responders' from the two databases after five weeks of the original mailing in early November 2012.

7.2.2.3 Questionnaire format

The questionnaire was divided into six sections, directly related to the major components of the research model and is detailed in Appendix 8. However, the titles to the sections in the questionnaire do not exactly equate to the actual names of the components to avoid the use of technical terms, which may have deterred the respondents from answering. The following gives the major sections of the questionnaire whilst Chapter 8 presents the questionnaire in more detail.

Section A: Current behavioural variables.

In the questionnaire the CBVs were labelled as 'Factors regarding the selling or marketing of wheat'. The aim of this section was to elicit information about the farmers' current behaviour and attitudes towards the grain trade in England, methods of selling wheat, use of FPRM tools, how an acceptable wheat price was derived and importance of the wheat crop to overall farm income. The questions used are shown in Table 7.1 and were derived from the in-depth interviews and focus groups as well as from the literature (Fliegel, 1993; McLeay and Zwart, 1998; Beedell and Rehman, 1999). The questions were designed to cover current selling practices including whom they sell to, how they market and set prices and their attitudes towards the wheat industry. Further questions asked if they had used FPRMs and their experiences of them. Some questions required the respondent to choose from a list, some yes/no and others used a Likert Scale.

Section B: Attitude factors.

In the questionnaire, the Att factors were labelled as 'Factors relating to the use of hedging tools when selling or marketing of wheat'. The factors forming Att were represented by: relative advantage; compatibility; complexity; ease of use (trialability and observability); and, risk and are constructed from the responses recorded during the qualitative phase of the research.

Table 7.1 Variables relating to current behaviour

Question	How to measure
Type of grain trade used	Choose from a list
I feel I am actively encouraged to sell my wheat by various methods	Likert Scale
It is important to have an on going relationship with the organisation that gives me selling advice	Likert Scale
I try to use independent advisory services to sell my wheat	Likert Scale
Spot, forward and Pools are the only ways I can market my wheat	Likert Scale
With large wheat price volatility I am looking for a method of selling wheat which reduces the risks of a 'bad' sale	Likert Scale
I would like a way of marketing wheat that can adapt to global factors that affect my wheat price, both positively and negatively.	Likert Scale
I tend to trade with those I have a strong personal bond / had a previous trading relationship	Likert Scale
Have you ever used hedging tools, formal exchange traded futures and options, when you have sold the following crops?	Yes/No
Have you ever used hedging tools, 'futures' and 'options' type contracts via the merchant trade, when you have sold the following crops?	Yes/No
Which of the following statements describes your experience with hedging tools?	Choose from a list
How do you set a price for your wheat to achieve an acceptable return	Choose from a list
Indicate the frequency of use per year, over the past 5 years, of selling methods from a list	Choose from a list
My farm's long term sustainability relies on the income from the wheat crop	Likert Scale
I am committed to my wheat producing enterprise	Likert Scale
I take a strategic macro view of the wheat market when choosing how to sell wheat	Likert Scale
I know the quality of my wheat crop from one season to the next	Likert Scale
I know the quantity of my wheat crop from one season to the next	Likert Scale
I consider my tax and/or financial situation when selling my wheat	Likert Scale
I know what revenues my crop will bring in 2012	Likert Scale
It would have been advantageous to my business to have used a hedging tool this year	Likert Scale

The questions used to extract the Att factors are shown in Table 7.2 and were derived from the literature (Rogers, 1995; Tan and Teo, 2000; Quaddus and Hofmeyer, 2007) as well as the in-depth interviews and focus groups. The table shows that each of the sub-constructs has been decomposed into questions relating to various aspects associated with that sub-construct. For instance, relative advantage consists of budgeting and price discovery amongst others. Each of these factors is composed of a belief and evaluation question according to TRA and TPB theory. For example the questionnaire asks if FPRMs help with annual budgeting (belief) and how important annual budgeting is to the respondent (evaluation). All questions are measured using a Likert scale.

Table 7.2 Factors related to the Attitude construct of FPRM tools

Sub-construct	Belief/ Evaluation	Question used
Relative advantage Specific topic:		
Budgeting	Belief	Hedging tools help with annual budgeting and making a profit
	Evaluation	How important is annual budgeting to your business?
Price discovery	Belief	Hedging tools enable the setting of minimum market price
	Evaluation	How important is it to set a minimum price for your wheat crop?
Market price volatility	Belief	Hedging tools reduce the adverse effects on income of volatile wheat market price movements
	Evaluation	Is it important to reduce adverse income effects in your business?
Second chance to market crop	Belief	Hedging tools enables me to have a second chance at marketing my crop
	Evaluation	How important is it to have a second chance when marketing?
Reduces price reduction	Belief	Hedging tools remove the chance of a price reduction, due to quality and quantity issues, after the contract is agreed
	Evaluation	Removing the chance of a price movement, due to quality and quantity issues is important to me
Price comparison	Belief	I will achieve a better price than other farmers I know not using hedging tools
	Evaluation	Achieving a better price than other farmers I know is important to me
Compatibility Specific topic:		
Business cash flow requirements	Belief	Hedging tools fit in well with business cash flow requirements
	Evaluation	How important is business cash flow to you?
Alternative to 'traditional' selling methods	Belief	Hedging tools are an alternative to 'traditional' selling methods
	Evaluation	How important are 'traditional' selling methods to your business
Complement 'traditional' selling methods	Belief	Hedging tools are a complement to 'traditional' selling methods
	Evaluation	How important is it to have other methods to sell your wheat?
Use of existing wheat trade contacts	Belief	I use my existing wheat trade contacts to set up hedging tools
	Evaluation	How important are your existing grain trade contacts to you?
Good and fit for my business	Belief	Overall, adopting the use of hedging tools to market my wheat would be good and fit well with my overall farm business
	Evaluation	How important is it that a new selling method fits well with your existing business?
Complexity Specific topic:		
Experience and confidence	Belief	Hedging tools require experience & confidence
	Evaluation	Experience and confidence is important when using a new marketing method
Easy to use	Belief	Hedging tools are easy to use
	Evaluation	A new marketing method that was easy to use would encourage me to use it
Terminology	Belief	Hedging tools have more jargon to learn than 'traditional' selling methods
	Evaluation	A new marketing method with many contract terms and jargon would deter me from its use
Ease of use Specific topic:		
Easy to use	Belief	Are easy to use
	Evaluation	A new marketing method that was easy to use would encourage me to use it
Risk Specific topic:		
Less/lose money risk	Belief	I am worried that using FRPM tools will give me less money or even lose my business money than using 'traditional' selling methods
	Evaluation	A risk of making less money than 'traditional' selling methods is a concern
Quality and quantity risk	Belief	I am worried about not meeting contract quality and quality specifications, which could result in a financial penalty
	Evaluation	The risk of a financial penalty from not meeting contract quality or quantity terms is a concern to me
Good risk management strategy	Belief	Using hedging tools are a good risk management strategy being a trade-off between risk management and maximising revenue
	Evaluation	Having a good risk management strategy (risk v reward is important to me)

Section C: SN factors.

In the questionnaire the SN factors were labelled as ‘Factors relating to social influences to your use of hedging tools when selling wheat’. The SN included questions relating to five social groups identified from in-depth interviews, focus groups and literature (Ajzen, 1991; Fritz and Fischer, 2007) and are: merchants; independent advisors; farmer peers; farming press; and, academia. Respondents were asked the same four questions for each of these groups. These questions followed the standard format of TRA and TPB and asked if the social referents would recommend the use of FPRMs and if they felt motivated to comply with this, measured using a Likert scale. However, because of the consistent response during the focus groups of the issue of trust, the questionnaire also included two further Likert scale based questions on whether the respondent trusted the advice on both the wheat market and FPRMs.

Section D: PBC factors.

In the questionnaire the PBC factors were labelled as ‘Questions relating to training, support and information on your use of hedging tools when selling wheat’. PBC is represented by training, information, and support and represents the overall ‘self-efficacy’ and ‘facilitating conditions’ of the producer. The questions used to extract the PBC factors are shown in Table 7.3 and were derived from the literature (Ajzen, 1991; Tan and Teo, 2000) as well as in-depth interviews and focus groups. The table shows that each of the sub-constructs has been decomposed into questions relating to various aspects associated with that sub-construct. For instance training consists of technical and one to one seminars. Information consists of Internet and Press. Support consists of practical help and monitoring. Each of these factors is composed of a belief and evaluation question according to TRA and TPB theory. For example the questionnaire asks if technical seminars would encourage the use of FPRMs (belief) and how important technical seminars are to the respondent (evaluation). All questions are measured using a Likert scale.

Table 7.3 Factors related to the PBC of FPRM tools

Sub-construct	Specific topic	Belief/Evaluation	Question used
Training	Technical seminars	Belief	Technical seminars would encourage me with my decision to use hedging tools
		Evaluation	Training from technical seminars is important to me
	1-2-1 seminars	Belief	One-to-one seminars would encourage me with my decision to use hedging tools
		Evaluation	Training on a one-to-one basis is important to me
Information	Internet	Belief	On-line information would encourage me to use hedging tools
		Evaluation	On-line information is important to me
	Press	Belief	Good information from the farming press would encourage me to use hedging tools
		Evaluation	Information in the farming press is important to me
Support	Practical help	Belief	Having good practical help with setting up hedging tools would encourage me to use them
		Evaluation	Practical help is important to me
	Monitoring	Belief	Monitoring and reviewing hedging tools over their 'life time' would encourage me to use them
		Evaluation	A monitoring and reviewing process is important to me

Section E: Behavioural Intentions.

In the questionnaire the Behavioural Intentions were labelled as 'Questions relating to Behavioural Intention on your use of hedging tools when selling wheat'. This section aims to assess the current views on FPRM tools and what is the intention to use in the future. However, rather than considering BI solely as the intention to adopt FPRMs, BI has been decomposed into five separate intention factors.

Intention to adopt is a fundamental part of the TRA, TAM, TPB and DTRB models and so the factors represented here are adapted from previous studies (Sultan et al., 1990; Frambach et al., 1998; Marcil et al., 2001; Christian and Armitage, 2002; Quaddus and Hofmeyer, 2007). The first factor shown in Table 7.4 asks if the use of hedging tools would have been good and fit well with the overall business. The second two factors ask if the respondents intend to use FPRM tools as part of their wheat marketing in the next year as either the main method or just to use but not as the main method. The final two factors show how responsive wheat producers are to using FPRM tools with a change in market price and relate to the issue of whether producers trying to secure a perceived higher price or protect against a subsequent price fall. The price movement, derived from the LIFFE wheat futures market, was used to indicate the price movements over the six months (180 days) previous to the questionnaire being distributed. The maximum LIFFE futures price was £204, the minimum £148. The variation over the period was therefore [100 x (204-148)/180] = 31%. For the questionnaire, a 20% variation was used to test these final two intention questions.

Table 7.4 Questions relating to behavioural intention to use hedging tools

Intent factor	Question
Good fit to business	Overall, adopting the use of hedging tools to market my wheat would be good and fit well with my overall farm business
Main method of marketing wheat	I intend on making hedging tools my main way I market my wheat over the next year
Adoption intention	I intend to use a hedging tool, in the next year, to market my wheat
Adoption intention if price rises	I intend to use a hedging tools if I believe the price will rise over 20% in the next 6 months
Adoption intention if price falls	I intend to use a hedging tools if I believe the price will fall over 20% in the next 6 months

Section F: Internal farm factors

In the questionnaire IFFs were labelled as ‘Questions relating to you and your farm business’. It was very clear from the qualitative research that IFFs were potentially major factors affecting the farmer’s intention to used FPRM tools. The questions were therefore based on the qualitative research as well as the literature reviewed in Chapter 4.

The questions were:
Gender
Age
County principal farm business located
No of children
Successor for business identified (or not)
Position in the farm business
Years actively involved in the business
Highest level of education
Size of cropped arable area
Type of farm business
Area of wheat grown

Tonnes of wheat produced this season

Proportion of each wheat category grown this season

Proportion of farm income attributable to wheat sales.

7.3 Summary

This chapter has presented the major hypotheses, the process used to construct the national questionnaire and its format. It was recognised that apart from the major hypotheses *post hoc* analysis would enable further inference to be made. However, it was the requirement to answer these hypotheses that facilitated the development of the questionnaire. Due to the complexity and apparent reluctance of farmers to answer questions on FPRMs an extended development process was required to arrive at a questionnaire that would elicit an adequate response rate.

8 Data Analysis

8.1 Introduction

This chapter details the findings from the data analysis from the national questionnaire of 802 respondents in a logical sequence. The response rates from the survey are detailed followed by descriptive statistics of the current behaviour of farmers with respect to wheat marketing, individual farmer characteristics and TPB variables. Cronbach analyses for reliability and consistency were carried out on the TPB direct measures of Att, SN and PBC. TPB variables were then investigated to establish their relationship with BI using correlation analysis. Analysis of variance (ANOVA) was used to test for effects of the farm factors and some CBVs followed by general linear modelling to derive a model to predict BI. Further analyses using Factor Analysis (FA) and then finally Cluster Analysis (CA) were conducted to achieve a more parsimonious model.

The data set was cleaned prior to analysis to avoid erroneous results using SPSS 20. The data set was checked for data entry errors, outliers, missing data, data outside ranges and superfluous data. Individual questionnaires were revisited to check any oddities. For a detailed account of the screening and cleaning process see Tabachnick and Fidell (2007). Some manipulation of the data was carried out using Excel and SPSS 20, such as addition and multiplication of scores for TPB analysis.

8.1.1 Response rate

The usable response rate from this survey was 673 or 29.6%, as detailed in Table 8.1which can be considered as satisfactory for returning valid statistical results.

Table 8.1 Questionnaire response rate

	N	Percentage %
Total Questionnaires	2273	100.00
Total replies	802	35.28
Excluded- Spoilt replies *	63	2.77
Excluded replies**	66	2.90
Usable replies	673	29.60

* Defaced, largely incomplete.

** Outside England, under 200ha (500a), not selling their wheat, mainly livestock or horticulture, wheat income under 10% of farm's income.

8.2 Descriptive statistics

Pallant (2010) gives several reasons for the use of descriptive statistics. The primary purpose is to describe and give an overall impression and demographic distribution of the sample population. Another reason for using descriptive statistics is to check variables for any violations of assumptions underlying the statistical tests being used and to address specific research questions.

8.2.1 Gender

From Table 8.2 it can be seen that most respondents were male, 97.9%.

Table 8.2 Survey respondents by gender.

Gender	Frequency	Response %
Male	659	97.9
Female	14	2.1
Total	673	100

8.2.2 Age

The age of the respondents ranged from 21 to 80 years, the results are shown in Table 8.3. The mean age was 53.8 years old and the largest category of respondents was the 56 to 65 years age range. The results also show that 79.7% of respondents were over 46 years old.

Table 8.3 Survey respondents by age.

Age	Frequency	Response %
Under 25	9	1.4
26-35	33	5.0
36-45	93	14.0
46-55	215	32.3
56-65	234	35.2
Over 65	81	12.2
Total	665	100

8.2.3 Principal farm location

The region with the highest response was the East, 35.8%. The East, S. East and W. Midlands accounted for nearly three quarters, 71.6% of respondents. These regions are mainly arable crop growing areas of England. The respondents and the original sampled survey percentages by location are very similar, suggesting that the respondents are a true and correct representation of the spread of farmers surveyed, not withstanding some minor inconsistencies from the supplied sample, e.g. N.West. The results are presented in Table 8.4.

Table 8.4 Survey respondents by farm location and original sampled farm locations.

Principal Farm location	Frequency	Response %	Survey frequency	Survey farms %
East	222	35.7	1189	35.4
E. Midlands	123	19.8	674	20.1
N. East	20	3.2	112	3.3
N. West	6	1.0	0	0
S. East	100	16.1	583	17.4
S. West	52	8.4	276	8.2
W. Midlands	39	6.3	172	5.1
Yorkshire & Humberside	59	9.5	354	10.5
Total	621	100	3360	100

8.2.4 Children in family

The results in Table 8.5 show that the majority of 88.8% of respondents had children. Just over one third had children under 18 years old.

Table 8.5 Survey respondents by children in family.

Number of children	Frequency	Response %
None	76	11.2
Under 18 years old	226	33.4
18 - 30	275	40.7
Over 30 years old	183	27.1
Children in multiple age categories	80	11.8

8.2.5 Successor to business identified

The results in Table 8.6 show that just under half of the businesses sampled had identified a successor.

Table 8.6 Survey respondents by identified successor

Successor identified	Frequency	Response %
Yes	338	47.6
No	307	52.4
Total	645	100

8.2.6 Position in the family business

Nearly two thirds of respondents sampled were the primary decision-makers in the business, compared to 30.7% that were joint decision-makers, and detailed in Table 8.7.

Table 8.7 Survey respondents by identified successor.

Position in business	Frequency	Response %
Primary decision maker	415	66.3
Secondary decision maker	19	3.0
Joint decision maker	192	30.7
Total	626	100

8.2.7 Years in the business

The number of years in the business, presented in Table 8.8 ranged from 1 to 63 years and are very similar to those for age and show that the majority of respondents (74.8%) have been involved in the business for over 20 years.

Table 8.8 Survey respondents by years involved in the business.

Years in the business	Frequency	Response %
Under 10	69	10.3
11 - 20	94	13.8
21 - 30	159	23.4
31- 40	219	32.3
41 - 50	106	15.6
Over 50 years	24	3.5
Total	671	100

8.2.8 Level of education

The results in Table 8.9 show that 78.9% have been educated to at least degree level.

Table 8.9 Survey respondents by educational level.

Highest Education level	Frequency	Response %
Secondary school	139	20.9
Degree level	463	69.6
Post-graduate	63	9.3
Total	623	100

8.2.9 Cropped arable area

Cropped arable areas are presented in Table 8.10. The average size of the respondents' cropped area was 573.4 hectares (1416 acres), with 91.4% of the respondents reporting cropped areas over 200 hectares (500 acres). Further, 45.8% had a cropped area over 400 hectares (1000 acres).

Table 8.10 Survey respondents by size of cropped arable area.

Cropped area (ha)	Frequency	Response %
200 hectares or less	56	8.4
201 - 400	306	45.8
401 - 800	198	29.6
801 - 1200	65	9.7
Over 1200 hectares	43	6.4
Total	673	100

8.2.10 Farm business type

Table 8.11 shows that over two thirds of farm businesses were mainly arable businesses. This implies that most of the respondents will have had experience of growing and selling wheat as part of their business activities.

Table 8.11 Survey respondents by type of business.

Farm type	Frequency	Response %
Livestock & arable	211	31.4
Mainly combinable crops	462	68.6
Total	673	100

8.2.11 Area of wheat grown

The mean area of wheat grown was 264 hectares (652 acres) with the range from 16 to 3000 hectares. Table 8.12 shows a very similar distribution to that for cropped area with 43.8% of respondents growing over 200 hectares (500 acres) of wheat grown.

Table 8.12 Survey respondents by area of wheat grown.

Area of wheat grown	Frequency	Response %
Under 200 hectares	383	57.2
201 - 400	198	29.6
401 - 800	67	10.0
801 - 1200	13	1.9
Over 1200 hectares	9	1.3
Total	670	100

8.2.12 Tonnage of wheat produced

The range of wheat produced was from 130 to 24,000 tonnes with a mean production of 1953 tonnes. The results in Table 8.13 again show a similar distribution to that of cropped area and area of wheat grown.

Table 8.13 Survey respondents by area of wheat produced.

Wheat produced (tonnes)	Frequency	Response %
Under 1000	221	33.9
1001 - 2000	249	38.1
2001 - 4000	131	20.1
4001 - 6000	31	4.7
Over 6000	21	3.2
Total	653	100

8.2.13 Category of wheat grown

Table 8.14 shows the distribution of categories of wheat grown. Groups 1 and 2 are categorised as milling wheat with Group 1 being the highest quality. This shows that higher quality wheats tend to be grown as a smaller percentage of total wheat area. From Table 8.15 the mean Group 1 wheat grown was 16.7% of all wheat grown and for Group 2 was 14.2%. Groups 3 and 4 are categorised as feed wheat and had means of 29.17% and 39.03%, respectively. This indicates that the milling varieties account for about a third of the wheat area.

Table 8.14 Survey respondents by category of wheat produced.

Type of wheat grown	Number of farmers growing under 25% of wheat Group	Response %	Number of farmers growing 25-50% of wheat Group	Response %	Number of farmers growing 51-75% of wheat Group	Response %	Number of farmers growing over 75% wheat Group	Response %
Group 1	499	73.5	88	13.3	32	4.8	43	6.5
Group 2	518	78.2	97	14.7	19	2.9	28	4.2
Group 3	380	57.5	146	22.1	45	6.8	90	13.6
Group 4	304	46.0	136	20.6	68	10.3	153	23.1

Totals may not add to 100% due to rounding

Table 8.15 Type of wheat grown, %.

Type of wheat produced	Mean %	Standard deviation
Group 1	16.63	20.1
Group 2	14.13	51.0
Group 3	29.19	25.9
Group 4	39.11	3.0

8.2.14 Proportion of annual farm income from the sale of wheat

The proportion of annual farm income from the sale of wheat ranged from 10 to 90% and is shown in Table 8.16. The mean proportion of annual farm income from the sale of wheat was 43.2% with 79.9% of respondents relying on the wheat crop for over 25% of their income and with 28.9% of respondents relying on the wheat crop for over 50% of their income.

Table 8.16 Survey respondents by category of wheat produced.

% Income from wheat production	Frequency	Response %
Under 25	128	20.1
26 - 50	325	51.0
51 - 75	165	25.9
Over 75	19	3.0
Total	637	100

8.3 Current behaviour

This section reports the current behaviour of the respondents with respect to their wheat marketing and corresponds to Section A of the national questionnaire as described in section 7.2.2.3.1.

8.3.1 Which members of the 'grain trade' are used to market wheat?

The data presented in Table 8.17 shows that the nearly 90% of the 669 farmers responding to this question use a merchant to market their wheat. Nearly a third (32.3%) use a merchant pool and 16% use an independent wheat broker. A combination of the grain trade channels was used by 43.9% of farmers to market their wheat.

Table 8.17 Types of grain trade player used by respondents.

Grain trade	Frequency	Response %
Advisor/Consultant	51	7.6
Merchant	581	86.8
Wheat broker	108	15.9
Wheat pool manager	216	32.3
Land agent	9	1.3
Agronomist	14	2.1
Other	61	9.1
Multiple	294	43.9

8.3.2 Attitudes towards the advice given/feelings about the grain trade

Respondents were asked to score an appropriate response to statements using a seven point Likert scale with 1 corresponding to ‘strongly disagree’ and 7 to ‘strongly agree’. The most positive responses were to: trading with a member of the grain trade that the farmer trusted and had traded with before; had an on-going relationship with; were looking for a method to avoid a ‘bad’ sale; and, using a marketing method that would adapt to global factors. The results are presented in Table 8.18.

Table 8.18 Attitudes towards the advice given/feelings about the grain trade.

Attitude to advice or feelings about the grain trade	Number of respondents	Mean response (1-7)	Standard deviation
Encouraged to sell wheat using different methods	626	4.06	1.73
Importance of having an on-going relationship with wheat advising organisation	647	5.49	1.54
Try to use independent organisation to sell wheat	623	3.79	1.89
Only sell wheat using spot, forward and pools	634	3.35	2.18
Looking for method of selling to avoid ‘bad’ sale	648	5.02	1.65
Use marketing method which adapts to global factors	629	4.81	1.55
Trade with those I have strong personal bond or previous trading relationship	661	5.59	1.54

8.3.3 Use of hedging tools, futures and options, when marketing wheat

8.3.3.1 Which organisations were employed to facilitate the use of using hedging tools

The questionnaire asked for a simple yes/no answer to whether respondents had used hedging tools before and the results are presented in Table 8.19. The results show that over a quarter (28.1%) had used a FSA regulated broker compared to 41.2% who had used merchants to arrange their wheat hedging tools. However, the proportion of farmers using a FSA regulated broker is much higher than the 5% reported by the HGCA (2009) and also contradicts the results of the qualitative research and personal experience of this researcher trading with farmers. This could imply that the respondents did not fully understand the question presented to them.

Table 8.19 Organisation used for implementation of hedging tool.

Organisation used for hedging tool	No of respondents	Frequency	%
Hedging tool via FSA regulated Broker			
Wheat	672	189	28.1
OSR	651	74	11.4
Hedging tool via Merchant trade			
Wheat	672	277	41.2
OSR	650	115	17.7

8.3.3.2 Statements which best described the farmers' experience of using hedging tools

Respondents were asked to tick as many statements that they felt appropriate corresponding to their experience of using hedging tools. The results presented in Table 8.20 show that 46.1% of farmers had never used hedging tools. Only 15.8% found them easy to use but over a third (34.4%) thought they were a good idea, with 16% believing there was not enough information about hedging tools.

Table 8.20 Experience of using hedging tools

Experience of using hedging tools	Number of respondents	Frequency	Yes Response %
Easy to use	609	96	15.8
Good idea	608	209	34.4
Too much paperwork	608	35	5.8
Too risky	608	93	15.3
Not enough information available	608	97	16
I have not used hedging tools	608	280	46.1

8.3.4 How do you set a price for your wheat to achieve an acceptable return?

Respondents were asked to tick as many statements that they felt appropriate with respect to achieving an acceptable return. The results are presented in Table 8.21 and show that the respondents are more likely to take advice from an independent broker or advisor (39%) than someone in their business (13.9%). Over half (59%) of respondents used cost of production and an acceptable margin as the benchmark of an acceptable wheat price, while over a quarter use the current price or what the market gives them (30% and 27.9%, respectively). This result suggests that about 30% of farmers are just reacting to the market and not to a predetermined budgeted price when selling their wheat.

Table 8.21 How do you set a price for your wheat to achieve an acceptable return?

How do you set a price for your wheat to achieve an acceptable return?	No of respondents	Frequency	Yes Response %
Advice from someone in my business	671	93	13.9
Advice from broker/ independent advisor	671	262	39
Use current wheat price	671	201	30
Current wheat price + a margin	671	116	17.3
Cost of production	670	227	33.9
Cost of production + margin	670	395	59
Take what market gives	672	187	27.9
Other	672	63	9.4
Multiple answers	670	443	66.1

8.3.5 How many times per year, over the past five years was each marketing method used?

Respondents were asked to tick a box that most accurately reflected the number of times they used various wheat-marketing methods over the past five years. The results in Table 8.22 show that forward and spot contracts are by far the most popular form of selling method with 53.4% and 60.4% respectively of respondents using them more than 5 times in the last five years. Approximately one sixth (15.5%) of respondents had used Pool sales, 6.4% of respondents had used futures or futures type contracts and 6.5% of respondents had used a option or option type contract more than 5 times in the last five years. The least used methods of wheat marketing are direct sales to the public, processing of wheat and sales via the Internet at 2.4%, 2.2 and 3.5% respectively. These results suggest that most of the wheat marketed in England is via the traditional merchant channels with the use of hedging tools and direct sales to consumers being marginal activities.

Table 8.22 Number of times each selling method used in past five years, % of respondents.

Number of times a selling method used over past five years, %.	Never	1-5	6-10	11-15	16-20	Over 20	Over 5
Spot sales via merchant trade	3.5	42.9	25.4	10.8	6.2	11.3	53.4
Forward sales via the merchant trade	3.0	36.6	26.6	15.1	7.2	11.5	60.4
Committed tonnage to a merchant pool	33.9	50.6	9.5	2.7	0.7	2.5	15.5
Buy-back contract via merchant/end-user	54.1	37.8	5.0	1.9	0.6	0.6	8.1
Futures via FSA broker/Merchant	68.9	24.7	3.0	1.7	0.2	1.5	6.4
Options via FSA broker/Merchant	66.4	27.1	4.1	1.5	0.7	0.2	6.5
Direct sale to a Mill (spot, forward, pool)	61.1	24.6	7.7	1.9	1.9	2.8	14.3
Direct sale to the public	84.1	13.5	1.8	0.0	0.2	0.4	2.4
Processing wheat to sell to public via third party	94.6	3.2	1.1	0.2	0.2	0.7	2.2
Selling via the internet to a merchant/end-user	92.4	4.0	1.8	0.4	0.4	0.7	3.5

8.3.6 Importance of wheat production to the farm business

Respondents were asked to score an appropriate response to a statement on a seven point Likert scale with 1 corresponding to 'low importance' and 7 to 'High importance'. The results presented in Table 8.23 indicate the high importance of wheat production to the farm business. A total of 90.5% positively responded (response 4 or more) that the farm's long-term sustainability relies on the income from the wheat crop with 94.1% positively responding that they were committed to their wheat producing enterprise.

Table 8.23 Importance of wheat production to the farm business.

Importance of wheat production to the farm business	No of respondents	Mean Response (1-7)	Standard deviation
My farm's long term sustainability relies on the income from the wheat crop	659	5.67	1.47
I am committed to my wheat producing enterprise	655	6.06	1.31

8.3.7 Farmers' attitudes towards marketing of the wheat crop

Respondents were asked to score an appropriate response to a statement on a seven point Likert scale with 1 corresponding to 'low importance' and 7 to 'high importance'. The results presented in Table 8.24 shows the highest mean score was the attitude towards taking a strategic view of selling the wheat crop with 88.5% having a score of 4 or greater. Knowing the quality, knowing the quantity, considering the tax implications and overall wheat revenue all exhibited positive scores. Attitudes to the use of hedging tools over the past marketing season were generally neutral, indicating that respondents were unsure of whether hedging tools would have been useful or not. Although attitude to taking a strategic view was positive, beliefs that using FPRM tools this year would have been advantageous were weakly negative.

Table 8.24 Attitudes to marketing of wheat.

Attitudes to marketing of wheat	No of respondents	Mean Response (1-7)	Standard deviation
I take a strategic wheat market view when choosing how to sell	639	5.24	1.42
I know the quality of my wheat from one season to the next	632	4.14	1.99
I know the quantity of my wheat from one season to the next	631	4.23	1.90
I consider my tax and/or financial situation when selling wheat	636	4.08	1.85
I know what revenues my wheat crop will produce in 2012	632	4.35	1.72
It would have been advantageous to have used a hedging tool this year	618	3.44	1.98

8.4 Reliability analysis

It is important to remember that the scales used in the questionnaire to measure the components of TPB are proxies to the true measurement of these components, which are unknown. Therefore a major issue is internal consistency, that is, are all the factors measuring the same underlying construct. If a component is constructed by adding the numerical responses from several questions, are these questions indeed measuring the same construct? As the true score is not known, a measurement error is used where the lower the error the higher the reliability (Mazzocchi, 2008). To check for this internal consistency Ajzen (1988) suggests the use of Cronbach alpha analysis (Cronbach, 1951). The analysis produces a coefficient that provides a reference to the reliability of the scales used and typically is recommended to be above 0.7 as a good indication to reliability (Nunnally, 1978; DeVellis, 2003). It is common to find lower Cronbach values if the scales have fewer than two factors, then the mean inter-item correlation (0.2 to 0.4) is recommended to be reported (Briggs and Cheek, 1986; Pallant, 2010). The results are presented in Table 8.25 and show the Cronbach alpha for the main constructs of TPB as well as the sub-constructs defined in section 6.2. The scores all show good internal consistency with Att and PBC well above the prescribed 0.7. SN gave a score of 0.678, which can be considered as acceptable as it is very close to 0.7.

Table 8.25 Cronbach alpha scores for TPB model

Construct		No of Items	Cronbach Alpha
Total Attitude		17	0.851
Attitude sub-components	RA	6	0.850
	CB	5	0.843
	CX	2	0.660
	EU	1	n/a
	RK	3	0.505
Total SN		5	0.678
Total PBC		6	0.888
PBC sub-components	Information	2	0.729
	Training	2	0.827
	Support	2	0.921

RA = Relative advantage, CB = Compatibility, CX = Complexity, EU = Ease of use, RK = Risk

8.5 TPB analysis

In this section the survey data is analysed according to the model developed in section 6.2. The first part of this section explores the differences between the IFFs and the constructs from TPB using Analysis of Variance (ANOVA), for instance the effect of age on BI to use FPRM tools. The second part of this section examines the relationship between the Att, SN and PBC with BI using correlation analysis. In the final part of this section General Linear Modelling (GLM) is used to develop a model to predict BI that combines the IFFs with the TPB constructs.

8.5.1 Exploring differences between TPB constructs and IFFs

8.5.1.1 Introduction

This section statistically analyses the differences in Att, SN and PBC and BI scores for each of the IFF variables using ANOVA. ANOVA is similar to a *t*-test in the fact that the differences between the group means are calculated. Both are used to test the null hypothesis that all group means are equal. A *t*-test is generally used when there are two groups and calculates a *t*-statistic. If there are more than two groups then an ANOVA, which calculates an *F*-statistic is preferred. However, ANOVA can also be used for two groups as the *F*-statistic is equivalent to the *t*-statistic in that instance. ANOVA is called 'one-way' as the analysis is looking at the impact of only one independent variable on a dependent variable. ANOVA compares the variation of the scores between different groups, due to the independent variable, with the variation within each group believed to be due to chance (Field, 2009). The key assumptions are that the data are independently and identically distributed so that variability of each group is similar.

8.5.1.2 Results

This analysis investigated several comparisons regarding the intention to use hedging/FPRM tools in the following season's wheat marketing as well as Att, SN and PBC with the IFFs. For the purposes of this analysis most IFFs were assigned into categories to avoid the assumption of a linear relationship (for example, avoiding the assumption that the change in attitude with respect to an increase in age between 20 and 21 is the same as between 40 and 41 or 60 to 61). For a number of variables, such as age, a visual inspection of the data suggested that the relationship was indeed non-linear. Changing the variable to a categorical one has the disadvantage of reducing the residual degrees of freedom. However, the sample size is sufficiently large so that is not a problem. The TPB variables of interest are the BI, Att, SN and PBC as well as the sub-constructs developed in section 6.2. This includes the addition of Trust as part of the SN component.

i) BI, Att, SN and PBC

The results of the ANOVA are detailed in Table 8.26 and show the mean and standard deviation, with significant results in bold.

Behavioural Intention

BI measured by the statement 'I intend to use hedging tools, in the next year, to market my wheat'. BI is the dependent variable favoured for TPB as it is seen as the direct precursor of behaviour (Ajzen, 1991). It was scored from 1 to 7 on a Likert scale with 1 corresponding to strongly disagree and 7 strongly agree. A neutral score would be 4. The mean BI score was 2.81. This implies that for the respondents in general they are unlikely to use FPRM tools.

When comparing with the IFFs: age; years in the business; highest level of education; farm type and size of farm were significant variables. BI decreased with both age (*F*-test 4.70: *p*-value <0.001) and years in business (*F*-test 6.57: *p*-value <0.001. BI increased with the level of education (*F*-test 9.88: *p*-value <0.001). BI was higher in mainly arable farms (*F*-test 14.95: *p*-value <0.001) and also increased with cropped area (*F*-test 7.28: *p*-value <0.001), wheat area grown (*F*-test 8.9: *p*-value <0.001) and tonnes of wheat produced (*F*-test 6.4: *p*-value <0.001). Despite the *F*-tests showing significant results, the low R^2 values show that a lot of variation is unaccounted for. This observation is repeated for all significant relationships found in these analyses and shows there is a high level of variation found in the sample. However, the large sample size has removed this problem and allowed the analysis to detect significant relationships.

The factors of whether farmers had children or not and a successor for the business were also significant (p<0.01) although not as significant as IFFs discussed in the previous paragraph (p<0.001). BI increased if there were no children (*F*-test 12.17: *p*-value <0.01) and decreased with a known successor (*F*-test 11.08: *p*-value <0.01).

Attitude

The Total Att scores were obtained using the methodology described in section 4.1 as well as the five sub-components. Thus Total Att score was derived from summing the product of 17-paired questions (belief x importance) using a seven point Likert scale to achieve a score from 17 to 833. Therefore, a neutral response to all questions is given a score of 4 x 4 x 17 = 272. The mean Att score was 367, was higher than the neutral score and implies that respondents in general have a high attitude towards the use of FPRM tools.

When comparing with the IFFs only children or not and highest level of education, were significant. Att decreased if the respondent had children (*F*-test 12.17: *p*-value <0.001) but increased with education level (*F*-test 5.34: *p*-value <0.01).

SN

The Total SN scores were obtained using the methodology described in section 4.1. Thus Total SN score was derived from summing the product of 5-paired questions (belief x motivation to comply) using a seven point Likert scale to achieve a score from 5 to 245. Therefore, assuming a neutral response to all questions is given, a score of 4 x 4 x 5 = 80 would be obtained. The mean SN score was 71.51, which implies that the respondents in general were only moderately influenced by external advice on the use FPRM tools.

When comparing with the IFFs; age, years in business and percentage of Group 1 wheat grown were significant. SN scores increased with; years in business (*F*-test 5.31: *p*-value <0.001) and Age (*F*-test 2.4: *p*-value <0.05). SN scores also generally increased with the greater the percentage of Group 1 wheat grown (*F*-test 3.24: *p*-value <0.05) up to 75%, but decreased for over 75%.

PBC

The total PBC scores were obtained using the methodology described in section 4.1 as well as the three sub-components. Thus total PBC score was derived from summing the product of 6-paired questions (belief x importance) using a seven point Likert scale to achieve a score from 6 to 294. Therefore, a neutral response to all questions gives a score of 4 x 4 x 6 = 96. The mean PBC score was 131.2, which implies that the respondents in general that PBC is an important factor in the adoption of FPRM tools for the respondents in general.

When comparing with the IFFs; age, level of education and principle farm location were significant. PBC scores decreased with age but were highest in the 31-40 age group (*F*-test 4.28: *p*-value <0.001). PBC scores increased with education levels (*F*-test 4.99: *p*-value <0.01). PBC scores were highest where principal farm location was in the North East and South West and lowest in the North West (*F*-test 2.25: *p*-value <0.05).

Table 8.26 Aggregated scores for TRB direct measurements and intention by IFFs (mean (SD))

		Variable			
		BI	Att	SN	PBC
Overall Mean		2.81 (1.76)	366.96 (106.41)	71.51 (32.19)	131.20 (61.27)
Gender					
	Male	2.81 (1.75)	365.94 (104.68)	70.94 (31.44)	131.11 (60.31)
	Female	3.00 (2.11)	409.60 (155.70)	89.92 (56.15)	134.86 (93.85)
	F-test -test	0.17	1.67	**4.07***	0.05
	R^2	0.00	0.03	0.08	0.00
Age					
	Under 20	3.50 (1.07)	390.50 (144.89)	79.00 (55.79)	143.00 (88.76)
	21-30	3.44 (1.90)	385.29 (125.93)	78.00 (28.23)	143.17 (56.06)
	31-40	3.33 (1.84)	382.41 (85.88)	77.25 (32.45)	148.26 (54.94)
	41-50	2.84 (1.79)	370.92 (110.01)	73.98 (30.82)	135.70 (57.47)
	51-60	2.67 (1.63)	367.27 (101.21)	69.68 (31.05)	126.63 (59.02)
	Over 60	2.20 (1.69)	336.27 (103.95)	60.44 (33.92)	106.61 (76.22)
	F-test	**4.70***	1.46	**2.40***	**4.28***
	R^2	0.09	0.03	0.05	0.09
Principal farm location					
	East	2.90 (1.90)	369.68 (110.84)	72.46 (30.65)	129.62 (61.03)
	E. Midlands	2.64 (1.75)	352.03 (107.03)	68.93 (30.66)	123.59 (65.17)
	N. East	3.00 (2.00)	378.69 (106.04)	81.00 (47.48)	153.81 (75.02)
	N. West	3.33 (1.97)	418.00 (66.55)	70.75 (22.79)	78.60 (87.07)
	S. East	2.78 (1.65)	352.04 (104.87)	69.70 (29.99)	125.41 (53.89)
	S. West	2.78 (1.46)	369.49 (100.50)	76.50 (42.47)	152.22 (59.36)
	W. Midlands	2.76 (1.62)	360.44 (90.78)	69.00 (26.75)	132.82 (56.12)
	Yorkshire & Humberside	2.55 (1.61)	368.88 (105.23)	74.63 (33.18)	140.51 (57.38)
	F-test	0.51	0.56	0.53	**2.25***
	R^2	0.01	0.01	0.01	0.04
Children or not					
	Yes	2.73 (1.73)	361.46 (105.02)	71.16 (32.19)	130.21 (61.67)
	No	3.51 (1.92)	406.76 (109.70)	74.11 (32.96)	139.89 (58.50)
	F-test	**12.17****	**9.54***	0.42	1.46
	R^2	0.24	0.19	0.01	0.03

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

Table 8.26 (Cont) Aggregated scores for TRB direct measurements and intention by IFFs (mean (SD))

		Variable			
		BI	Att	SN	PBC
Successor					
	No	3.01 (1.76)	365.19 (108.09)	71.99 (30.32)	133.66 (59.60)
	Yes	2.54 (1.69)	366.74 (104.25)	70.32 (33.51)	127.42 (63.28)
	F-test	**11.08****	0.03	0.32	1.45
	R^2	0.22	0.00	0.01	0.03
Position in business					
	Primary	2.84 (1.72)	368.53 (107.12)	71.20 (33.53)	133.66 (61.20)
	Secondary	3.47 (2.10)	397.38 (130.72)	73.38 (41.98)	147.33 (69.92)
	Joint	2.62 (1.79)	359.60 (104.73)	70.64 (29.91)	122.84 (61.26)
	F-test	2.23	0.87	0.05	2.36
	R^2	0.04	0.02	0.00	0.05
Years in business					
	Under 10	3.51 (1.86)	399.47 (109.17)	84.84 (34.23)	155.52 (61.22)
	11-20	3.41 (1.92)	370.62 (96.87)	73.84 (29.70)	134.90 (56.07)
	21-30	2.77 (1.64)	365.62 (99.51)	73.44 (30.98)	133.61 (54.90)
	31-40	2.55 (1.60)	359.11 (106.73)	70.85 (31.91)	128.03 (58.58)
	41-50	2.44 (1.69)	373.34 (118.62)	59.97 (31.07)	117.96 (68.23)
	Over 50	2.22 (2.13)	303.20 (103.84)	49.08 (34.74)	93.50 (90.48)
	F-test	**6.57*****	2.43	**5.31*****	1.45
	R^2	0.13	0.05	0.11	0.03
Highest Education					
	Secondary	2.20 (1.43)	336.37 (91.29)	68.37 (30.09)	116.54 (62.86)
	Degree	2.98 (1.79)	376.92 (107.22)	72.74 (32.89)	136.43 (59.77)
	Post-Grad	3.04 (1.98)	362.66 (115.27)	68.93 (31.41)	135.79 (61.26)
	F-test	**9.88*****	**5.34****	0.87	**4.99****
	R^2	0.20	0.11	0.02	0.10
Cropped area					
	Under 200 hectares	2.57 (1.70)	359.29 (89.42)	71.39 (36.50)	131.41 (62.48)
	201 - 400	2.48 (1.51)	363.30 (102.57)	70.08 (32.01)	128.84 (61.43)
	401 - 800	3.02 (1.88)	372.43 (116.08)	70.66 (33.29)	131.96 (61.42)
	801 - 1200	3.36 (1.88)	357.17 (101.32)	74.64 (30.53)	134.20 (60.75)
	Over 1200 hectares	3.61 (2.07)	395.81 (96.87)	81.12 (25.98)	146.15 (57.34)
	F-test	**7.28*****	0.98	0.99	0.74
	R^2	0.15	0.02	0.02	0.01

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

Table 8.26 (Cont) Aggregated scores for TRB direct measurements and intention by IFFs (mean (SD))

		Variable			
		BI	Att	SN	PBC
Farm type					
	Mixed	2.41 (1.60)	352.89 (106.85)	68.40 (36.33)	129.41 (64.26)
	Mainly arable	2.99 (1.80)	372.69 (105.85)	72.82 (30.25)	131.98 (59.99)
	F-test	**14.95*** **	3.48	0.87	0.22
	R^2	0.30	0.07	0.02	0.00
Wheat area grown					
	Under 200 hectares	2.53 (1.60)	366.83 (103.14)	70.95 (33.41)	127.34 (61.81)
	201 - 400	2.93 (1.73)	363.15 (108.90)	71.89 (31.76)	135.06 (59.10)
	401 - 800	3.62 (2.09)	375.12 (119.22)	72.70 (30.86)	141.12 (64.87)
	801 - 1200	4.50 (2.28)	390.18 (95.67)	75.90 (20.60)	153.54 (58.25)
	Over 1200 hectares	3.00 (2.00)	403.50 (62.57)	64.86 (30.98)	121.50 (58.38)
	F-test	**8.90*** **	0.43	0.16	1.37
	R^2	0.18	0.01	0.00	0.03
Tonnes of wheat produced					
	Under 1000	2.59 (1.59)	361.82 (101.52)	69.55 (33.93)	128.68 (61.71)
	1001 - 2000	2.67 (1.61)	368.20 (99.65)	74.71 (32.15)	133.00 (60.66)
	2001 - 4000	3.12 (1.96)	371.08 (115.71)	68.51 (31.58)	127.71 (61.02)
	4001 - 6000	3.83 (2.31)	376.08 (142.18)	78.08 (30.43)	158.45 (58.65)
	Over 6000	3.80 (2.09)	398.71 (78.56)	74.12 (24.96)	143.40 (59.68)
	F-test	**6.40*** **	0.54	1.09	1.84
	R^2	0.13	0.01	0.02	0.04
Group 1 wheat %					
	Under 25%	2.88 (1.76)	369.73 (104.76)	70.74 (32.36)	133.98 (60.08)
	26-50%	2.89 (1.94)	369.06 (118.28)	81.63 (30.68)	127.47 (61.82)
	51-75%	2.23 (1.36)	337.95 (99.12)	74.19 (36.10)	116.64 (70.10)
	Over 75%	2.60 (1.58)	361.00 (92.41)	62.88 (29.07)	123.44 (62.37)
	F-test	1.52	0.67	**3.24** **	1.14
	R^2	0.03	0.01	**0.06**	0.02

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

Table 8.26 (Cont) Aggregated scores for TRB direct measurements and intention by IFF's (mean (SD))

		Variable			
		BI	Att	SN	PBC
Group 2 wheat %					
	Under 25%	2.88 (1.76)	367.07 (107.09)	70.96 (31.64)	131.18 (60.23)
	26-50%	2.89 (1.94)	370.80 (104.40)	79.93 (35.95)	136.19 (63.66)
	51-75%	2.23 (1.36)	350.25 (71.50)	64.71 (23.47)	103.17 (49.90)
	Over 75%	2.60 (1.58)	377.53 (106.17)	65.91 (33.13)	144.00 (70.21)
	F-test	0.59	0.19	2.11	1.79
	R^2	0.01	0.00	0.04	0.04
Group 3 wheat %					
	Under 25%	2.77 (1.73)	359.73 (102.44)	72.88 (30.85)	129.87 (60.68)
	26-50%	2.94 (1.89)	383.10 (97.82)	74.19 (33.93)	135.91 (60.85)
	51-75%	3.00 (1.77)	381.00 (97.61)	70.55 (33.88)	128.38 (58.66)
	Over 75%	2.77 (1.69)	369.54 (131.39)	63.02 (34.00)	132.66 (64.56)
	F-test	0.46	1.44	1.80	0.35
	R^2	0.01	0.03	0.04	0.01
Group 4 wheat %					
	Under 25%	2.77 (1.74)	364.83 (110.47)	71.14 (34.10)	128.19 (64.77)
	26-50%	2.83 (1.80)	371.57 (97.86)	68.86 (31.03)	132.84 (56.05)
	51-75%	3.02 (1.83)	376.31 (98.42)	77.55 (33.47)	141.42 (62.22)
	Over 75%	2.85 (1.74)	365.07 (107.60)	73.20 (28.73)	132.19 (57.12)
	F-test	0.34	0.24	0.97	0.83
	R^2	0.01	0.00	0.02	0.02
% income from wheat					
	Under 25%	3.00 (1.93)	366.11 (96.76)	69.90 (33.07)	127.01 (65.44)
	26-50%	2.77 (1.70)	364.57 (103.04)	70.85 (30.27)	127.99 (57.51)
	51-75%	2.76 (1.68)	374.52 (120.69)	72.59 (33.41)	139.23 (62.86)
	Over 75%	2.50 (1.72)	380.58 (105.44)	83.00 (37.66)	144.29 (54.51)
	F-test	0.77	0.30	0.77	1.58
	R^2	0.02	0.01	0.02	0.03

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

ii) Sub-components of Att, SN and PBC

From the literature discussed in Chapter 4 it was apparent that by subdividing the major components of Att and PBC a deeper understanding of the differences between groups was achieved. Further, the SN construct is composed of the results from five individual social referents. The means of calculating these scores are given in section 4.1 and briefly described in the previous section. The individual component of Att, SN and PBC question scores (minimums, maximum and means) and Standard Deviations are detailed in Appendix 9.

a) The sub-components of Attitude

The results of the ANOVAs for testing differences in IFFs are detailed in Table 8.27. The results show the mean and standard deviation with significant results in bold.

Relative Advantage (RA)

Scores were obtained from asking six two-part questions, each of which provided a product by multiplying the belief by the motivation to comply with that belief. The six products were then added together to achieve a score from 6 to 294. A neutral score would be 4 x 4 x 6 = 96. The mean RA score was 112. This implies that the respondents in general see the use of FPRM tools a giving as high RA.

When comparing with the IFFs age, years in business and level of education were most significant. RA scores decreased with age (*F*-test 3.83: *p*-value <0.001) and years in business (*F*-test 5.932: *p*-value <0.001). RA scores increased with levels of education (*F*-test 7.23: *p*-value <0.001), if farmers had children (*F*-test 7.56: *p*-value <0.01) and cropped area (*F*-test 2.74: *p*-value <0.05). Despite the F tests showing significant results, the low R^2 values show that a lot of variation is unaccounted for. This observation is repeated for all significant relationships found in these analyses and shows there is a high level of variation found in the sample. However, the large sample size has removed this problem and allowed the analysis to detect significant relationships.

Compatibility (CB)

Scores were obtained from asking five, two-part questions. The five products were then added together to achieve a score from 5 to 245. A neutral score would be 4 x 4 x 5 = 80. The mean CB score was 101. This implies that for the respondents in general they see the use of FPRM tools a giving a high CB.

When comparing with the IFFs; age, years in business and farm type were most significant. CB scores decreased with age (*F*-test 4.13: *p*-value <0.001) and years in business (*F*-test

4.95: p-value <0.001). CB scores were higher for an arable business (F-test 9.01: p-value <0.001). Less significant were levels of education and 'farm size' factors. CB scores increased with education (F-test 4.85: p-value <0.01), cropped area (F-test 2.71: p-value <0.05) and wheat area grown (F-test 2.63: p-value <0.05). CB scores decreased when wheat area exceeded 1200 hectares.

Complexity (CX)

Scores were obtained from asking two, two-part questions. The two products were then added together to achieve a score from 2 to 98. A neutral score was 4 x 4 x 2 = 32. The mean CX score was 58. This implies that respondents in general felt that increased complexity would deter them from using FPRM tools.

When comparing with the IFFs; only 'percentage of a farms income earned from wheat' and 'successor known' were significant. CX scores increased with the importance of wheat income (F-test 4.94: p-value <0.001), except for the 'over 75%' range and for 'successor known' (F-test 4.44: p-value <0.05).

Ease of Use (EU)

Scores were obtained from asking one, two-part question. The product gave a score from 1 to 49. A neutral score was 4 x 4 x 1 = 16. The mean EU score was 19.89. This implies that respondents in general felt that increased ease of use would encourage them to use FPRM tools.

When comparing with the IFFs, only age and principle farm location displayed any significance (age (F-test 2.28: p-value <0.05); principle farm location (F-test 2.09: p-value <0.05)). The EU scores however, did not show any clear pattern.

Risk (RK)

Scores were obtained from asking three, two-part questions. The products were added together to give a score from 3 to 147. A neutral score was 4 x 4 x 3 = 48. The mean RK score was 69.56. This implies that respondents in general felt that increased risk from the use of FPRM tools use would deter them from using FPRM tools.

When comparing with the IFFs, years in business and cropped area were the most significant. RK scores decreased with years in business (*F*-test 4.30: *p*-value <0.001) and cropped area (*F*-test 4.75: *p*-value <0.001), except for the 'over 1200 hectares' category.

Less significant were age, wheat area grown and tonnes of wheat produced. RK scores increased with age (*F*-test 2.42: *p*-value <0.01) but scores decreased with wheat area grown (*F*-test 3.60: *p*-value <0.01), except for the 'over 1200 hectares' category.

Least significant were whether farmers had children or not and tonnes of wheat produced. RX scores were higher with no children (*F*-test 4.64: *p*-value <0.05) but scores decreased with wheat produced (*F*-test 2.42: *p*-value <0.05).

Table 8.27 ANOVA results for sub-components of Attitude

		RA	CB	CX	EU	RK
Overall Mean		112.00 (49.72)	101.05 (44.24)	58.00 (23.01)	19.89 (10.68)	71.29 (28.17)
Gender						
	Male	111.68 (48.97)	100.92 (43.77)	58.01 (22.86)	19.83 (10.66)	71.31 (28.07)
	Female	127.45 (66.00)	104.08 (61.56)	59.93 (29.47)	21.14 (10.73)	72.31 (35.46)
	F-test	1.10	0.06	0.10	0.21	0.02
	R^2	0.02	0.00	0.00	0.00	0.00
Age						
	Under 20	135.11 (71.25)	123.13 (36.27)	48.75 (16.18)	17.00 (9.56)	67.13 (23.42)
	21-30	130.62 (45.98)	112.93 (46.80)	52.67 (24.96)	22.39 (11.96)	67.87 (31.42)
	31-40	125.57 (40.77)	114.33 (35.53)	52.74 (18.28)	22.24 (9.73)	63.31 (24.94)
	41-50	114.41 (50.04)	101.38 (44.99)	60.39 (22.03)	19.34 (10.39)	71.18 (27.86)
	51-60	106.84 (48.87)	98.99 (44.10)	59.22 (24.25)	20.29 (11.02)	74.30 (28.53)
	Over 60	97.74 (50.89)	84.24 (45.35)	58.72 (24.31)	17.43 (10.06)	75.81 (27.63)
	F-test	**3.83*****	**4.13*****	2.15	**2.28***	**2.42****
	R^2	0.08	0.08	0.04	0.05	0.05
Principal farm location						
	East	110.37 (52.72)	100.34 (45.14)	59.66 (22.04)	20.50 (11.35)	69.56 (27.15)
	E. Midlands	105.59 (45.30)	95.71 (42.23)	54.61 (24.85)	17.56 (9.45)	72.69 (29.65)
	N. East	108.64 (54.98)	107.88 (46.01)	56.88 (20.26)	23.44 (9.04)	67.84 (26.01)
	N. West	146.25 (24.50)	130.25 (34.06)	57.50 (31.09)	19.67 (11.33)	55.83 (29.78)
	S. East	112.20 (46.85)	100.00 (43.29)	56.53 (23.16)	18.07 (9.71)	65.72 (25.41)
	S. West	116.09 (49.05)	106.80 (48.44)	56.31 (22.76)	21.71 (11.33)	74.76 (27.01)
	W. Midlands	110.83 (52.47)	97.50 (42.58)	54.87 (22.88)	22.91 (9.86)	73.72 (28.31)
	Yorkshire & Humberside	109.50 (51.05)	96.70 (45.39)	62.11 (24.95)	19.07 (11.15)	78.02 (31.21)
	F-test	0.53	0.67	0.89	**2.09***	1.55
	R^2	0.01	0.01	0.02	0.04	0.03
Children or not						
	Yes	109.87 (49.04)	99.84 (44.77)	57.86 (22.94)	19.85 (10.61)	70.50 (27.63)
	No	128.23 (52.57)	110.64 (39.65)	59.12 (23.89)	20.41 (11.27)	78.08 (31.36)
	F-test	**7.56****	3.37	0.18	0.17	**4.64***
	R^2	0.15	0.07	0.00	0.00	0.09
Successor						
	No	114.21 (49.61)	103.49 (44.71)	55.97 (23.19)	20.40 (10.74)	69.35 (27.23)
	Yes	108.14 (49.71)	97.57 (43.47)	60.01 (22.86)	19.22 (10.45)	73.79 (29.26)
	F-test	1.91	2.35	**4.44***	1.78	3.57
	R^2	0.04	0.05	0.09	0.04	0.07
Position in business						
	Primary	112.86 (49.73)	102.33 (44.51)	57.03 (23.10)	19.76 (10.57)	70.08 (28.92)
	Secondary	126.67 (56.55)	112.64 (43.48)	54.00 (21.43)	22.41 (10.98)	75.38 (31.54)
	Joint	105.83 (49.48)	95.90 (44.36)	60.73 (23.29)	19.81 (10.71)	74.25 (27.07)
	F-test	1.75	1.61	1.75	0.51	1.38
	R^2	0.04	0.03	0.04	0.01	0.03

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

		RA	CB	CX	EU	RK
Years in business						
	Under 10	138.15 (50.25)	117.74 (38.79)	53.46 (18.70)	21.96 (11.55)	71.13 (27.24)
	11-20	120.33 (44.57)	110.56 (39.22)	55.86 (21.57)	21.01 (10.16)	63.11 (23.46)
	21-30	111.73 (46.46)	100.61 (44.60)	58.48 (22.39)	19.25 (9.97)	70.62 (26.98)
	31-40	107.16 (46.58)	98.20 (42.50)	58.39 (22.62)	19.49 (10.47)	70.74 (28.14)
	41-50	102.79 (59.02)	93.39 (50.58)	61.57 (27.84)	20.19 (12.21)	82.21 (31.85)
	Over 50	82.87 (39.39)	69.71 (48.41)	59.11 (25.43)	17.47 (10.05)	69.72 (26.64)
	F-test	**5.93*** **	**4.95*** **	1.13	1.06	**4.30*** **
	R^2	0.12	0.10	0.02	0.02	0.09
Highest level of Education						
	Secondary	96.48 (45.62)	89.69 (43.95)	59.08 (23.09)	18.96 (10.89)	72.53 (30.65)
	Degree	117.21 (50.13)	103.87 (43.74)	58.52 (23.27)	20.20 (10.58)	71.98 (27.55)
	Post-Grad	110.33 (48.26)	107.72 (46.41)	54.59 (19.25)	20.00 (10.93)	67.29 (27.22)
	F-test	**7.23*** **	**4.85** **	0.82	0.61	0.78
	R^2	0.14	0.10	0.02	0.01	0.02
Cropped area						
	Under 200 hectares	105.30 (46.46)	91.23 (39.45)	57.90 (18.65)	21.71 (11.86)	77.23 (27.89)
	201 - 400	106.58 (48.43)	97.51 (45.08)	60.01 (23.88)	19.53 (10.41)	75.33 (28.97)
	401 - 800	117.07 (52.48)	104.06 (44.61)	57.81 (23.02)	20.39 (10.97)	68.74 (28.32)
	801 - 1200	113.83 (47.15)	105.04 (39.37)	54.78 (20.60)	17.73 (9.09)	62.23 (21.85)
	Over 1200 hectares	131.14 (46.91)	117.66 (44.54)	53.76 (23.01)	21.93 (11.19)	63.90 (24.13)
	F-test	**2.74***	**2.71***	1.17	1.54	**4.75*** **
	R^2	0.05	0.05	0.02	0.03	0.09
Farm type						
	Mixed	106.43 (48.02)	92.45 (42.39)	56.41 (23.39)	19.73 (10.70)	71.54 (29.12)
	Mainly arable	114.40 (50.31)	104.71 (44.55)	58.69 (22.84)	19.96 (10.68)	71.19 (27.78)
	F-test	2.94	**9.01*** **	1.26	0.06	0.02
	R^2	0.06	0.18	0.03	0.00	0.00
Wheat area grown						
	Under 200 hectares	108.74 (48.14)	96.64 (44.81)	59.81 (23.24)	20.04 (10.89)	74.72 (28.73)
	201 - 400	113.59 (51.56)	104.59 (41.97)	56.92 (22.73)	19.61 (10.23)	69.23 (27.94)
	401 - 800	119.75 (55.26)	110.59 (46.62)	54.30 (21.41)	20.10 (10.68)	62.31 (24.83)
	801 - 1200	128.27 (30.06)	124.69 (34.67)	57.77 (22.83)	21.77 (12.70)	60.38 (23.43)
	Over 1200 hectares	133.83 (38.48)	102.38 (50.59)	54.78 (25.94)	20.11 (11.95)	70.00 (22.88)
	F-test	1.30	**2.63***	1.05	0.15	**3.60** **
	R^2	0.03	0.05	0.02	0.00	0.07
Wheat produced (t)						
	Under 1000	108.98 (47.89)	94.65 (42.70)	58.72 (23.65)	19.66 (10.31)	74.86 (30.43)
	1001 - 2000	111.02 (45.70)	102.45 (42.85)	58.40 (22.82)	20.74 (10.88)	72.03 (26.65)
	2001 - 4000	116.50 (55.35)	107.03 (45.97)	57.98 (22.84)	19.50 (10.58)	67.43 (26.42)
	4001 - 6000	119.64 (66.68)	106.52 (54.14)	55.30 (20.69)	19.36 (10.28)	63.41 (28.18)
	Over 6000	131.24 (30.61)	118.55 (40.62)	56.38 (24.21)	22.48 (11.72)	63.48 (23.86)
	F-test	1.20	**2.37***	0.17	0.68	**2.42***
	R^2	0.02	0.05	0.00	0.01	0.05

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

Table 8.27 (Cont) ANOVA results for sub-components of Attitude

		RA	CB	CX	EU	RK
Group 1 wheat %						
	Under 25%	113.54 (48.97)	102.13 (44.06)	58.60 (22.69)	19.98 (10.65)	71.01 (28.34)
	26-50%	117.62 (52.70)	103.99 (45.86)	56.38 (20.99)	21.18 (10.61)	70.84 (26.13)
	51-75%	96.24 (47.57)	89.52 (45.40)	63.66 (24.21)	16.76 (9.32)	80.80 (26.72)
	Over 75%	105.22 (49.09)	97.25 (41.96)	56.67 (27.96)	18.98 (10.80)	69.85 (27.96)
	F-test	1.49	0.83	0.80	1.34	1.02
	R^2	0.03	0.02	0.02	0.03	0.02
Group 2 wheat %						
	Under 25%	111.97 (49.43)	101.20 (44.46)	58.40 (23.52)	19.62 (10.70)	71.96 (28.21)
	26-50%	117.40 (50.85)	103.44 (45.38)	58.26 (20.20)	21.24 (10.10)	68.45 (26.43)
	51-75%	108.00 (35.49)	103.36 (36.62)	57.24 (21.73)	18.71 (8.80)	66.80 (21.36)
	Over 75%	114.00 (57.28)	98.05 (41.65)	60.17 (22.31)	21.74 (11.66)	71.96 (32.60)
	F-test	0.31	0.10	0.06	0.87	0.53
	R^2	0.01	0.00	0.00	0.02	0.01
Group 3 wheat %						
	Under 25%	108.74 (49.12)	100.16 (42.43)	58.20 (22.66)	19.98 (10.50)	69.53 (27.58)
	26-50%	122.04 (45.59)	105.31 (43.85)	59.54 (23.31)	19.62 (10.51)	73.31 (27.66)
	51-75%	119.05 (48.13)	105.41 (42.46)	56.38 (22.24)	20.57 (10.53)	71.20 (25.46)
	Over 75%	111.68 (56.58)	98.62 (52.60)	58.51 (23.96)	19.84 (11.47)	75.76 (30.86)
	F-test	2.23	0.59	0.23	0.09	1.39
	R^2	0.04	0.01	0.00	0.00	0.03
Group 4 wheat %						
	Under 25%	111.90 (51.91)	100.53 (46.21)	57.42 (23.21)	20.11 (10.51)	71.69 (27.14)
	26-50%	115.86 (46.23)	100.72 (42.40)	58.45 (22.95)	19.78 (10.91)	72.86 (28.62)
	51-75%	117.25 (42.18)	102.84 (41.36)	58.67 (23.61)	19.03 (10.30)	69.27 (28.07)
	Over 75%	109.45 (50.95)	103.37 (43.62)	60.23 (22.06)	20.12 (10.75)	70.36 (29.14)
	F-test	0.50	0.14	0.46	0.20	0.31
	R^2	0.01	0.00	0.01	0.00	0.01
% income from wheat						
	Under 25%	115.13 (47.71)	105.69 (42.37)	54.73 (23.10)	20.51 (9.88)	68.93 (30.07)
	26-50%	112.99 (47.88)	99.39 (44.22)	57.13 (22.15)	19.23 (9.96)	71.24 (27.03)
	51-75%	108.37 (52.19)	100.80 (46.85)	64.27 (22.82)	20.95 (11.77)	73.97 (28.68)
	Over 75%	121.13 (57.72)	95.81 (39.46)	52.84 (26.13)	20.72 (11.56)	80.65 (23.90)
	F-test	0.58	0.60	**4.94***	1.05	1.32
	R^2	0.01	0.01	0.10	0.02	0.03

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

b) The individual social referents of SN (merchants, independent advisors, peers, press and academia).

These social referent scores were obtained from asking paired questions, as previously outlined. Of each of the five social referent groups it was asked if they 'would recommend the use of hedging tools' and would the respondent be 'motivated to comply with that advice'. Both questions were scored from 1 (strongly disagree) to 7 (strongly agree) and multiplied together to give an 'influence' score of the particular group. The product gave a score from 1 to 49, with an expected neutral score of 4 x 4 x 1 = 16. The results of the ANOVA are detailed in Table 8.28. The results state the mean and standard deviation with significant results are in bold.

Influence of the merchant

The mean merchant influence score was 13.20. This implies that respondents in general felt that the merchant did not positively influence them to use FPRM tools. When comparing with the IFFs years in business and tonnes of wheat produced were the only significant factors. SN scores decreased with years in business (*F*-test 2.52: *p*-value <0.05) but SN scores generally increased with tonnes of wheat produced but no real pattern (*F*-test 2.42: *p*-value <0.05).

Influence of the independent advisor

The independent advisor score was 19.69. This implies that for the respondents in general felt that the independent advisors did positively, but not overwhelmingly, influence them to use FPRM tools. This score was however, the highest in the SN sub-components, indicating that independent advisors had the most influence regarding FPRM tool use.

When comparing with the IFFs, age, years in business and the percentage of Group 1 wheat produced were the most significant factors. SN scores decreased as age increased from 50 onwards (*F*-test 3.66: *p*-value <0.001) and similarly as years in business increased SN scores decreased (*F*-test 5.29: *p*-value <0.01). Scores increased with the percentage of Group 1 (milling) wheat produced, up to 50% grown but then decreased where 50% grown (*F*-test 8.29: *p*-value <0.01). A less significant factor was level of education. SN scores generally increased with higher education with degree level associated with the highest score (*F*-test 3.26: *p*-value <0.05).

Influence of peers

The mean influence of peers score was 10.53. This implies respondents in general felt that peers did not positively influence them to use FPRM tools. Peer influence regarding hedging tools was the lowest of all the five groups surveyed. When comparing with the IFFs there were no significant factors reported.

Influence of the press

The mean influence of press score was 12.72. This implies the respondents in general felt that the press did not positively influence their use of FPRM tools. When comparing with the IFFs, gender was the only one significant factor. SN scores were higher for female respondents (*F*-test 9.45: *p*-value <0.05).

Influence of academia

The mean influence of academia score was 16.07. This implies that respondents in general felt that academia was a neutral influence on respondent to use FPRM tools. Academia was however, the second most influential group regarding FPRM tool use after independent advisors. When comparing with the IFFs, gender and years in business were the only significant factors. SN scores were higher for female respondents (*F*-test 5.19: *p*-value <0.05), whilst scores decreased with years in business (*F*-test 2.70: *p*-value <0.05).

Table 8.28 ANOVA results for social referents of SN

		Influence of Merchants	Influence of Independent Advisors	Influence of Peers	Influence of Press	Influence of Academia
Overall mean		13.20 (8.90)	19.69 (11.43)	10.53 (8.65)	12.72 (8.82)	16.07 (11.23)
Gender						
	Male	13.21 (8.82)	19.60 (11.43)	10.54 (8.63)	12.54 (8.61)	15.83 (11.03)
	Female	13.36 (12.48)	20.62 (12.27)	11.67 (10.53)	20.42 (14.74)	23.25 (16.26)
	F-test	0.00	0.10	0.20	**9.45*** **	5.19*
	R^2	0.03	0.01	0.01	0.04	0.01
Age						
	Under 20	11.88 (6.66)	16.13 (7.62)	10.50 (11.93)	20.38 (17.13)	20.13 (16.69)
	21-30	15.15 (11.30)	20.38 (10.41)	10.56 (10.04)	11.92 (7.04)	16.48 (10.16)
	31-40	12.85 (8.90)	22.46 (10.93)	10.28 (8.13)	13.84 (8.99)	18.22 (10.24)
	41-50	14.05 (8.95)	21.20 (10.66)	10.55 (8.85)	13.01 (8.58)	16.01 (10.33)
	51-60	12.90 (8.42)	18.91 (11.41)	11.09 (8.41)	12.30 (8.44)	15.62 (11.77)
	Over 60	10.90 (7.68)	15.49 (13.37)	9.35 (8.48)	11.45 (9.35)	14.27 (12.42)
	F-test	1.57	**3.66*** **	0.39	1.89	1.20
	R^2	0.03	0.01	0.01	0.04	0.01
Principal farm location						
	East	13.51 (8.75)	20.82 (11.85)	10.92 (9.45)	11.78 (8.23)	15.93 (11.14)
	E. Midlands	11.86 (8.80)	19.13 (12.03)	9.62 (7.98)	12.09 (8.87)	16.48 (11.82)
	N. East	15.28 (12.75)	17.11 (9.99)	11.79 (9.60)	17.50 (12.52)	18.68 (13.91)
	N. West	12.50 (6.35)	17.50 (7.55)	10.00 (2.31)	17.25 (6.40)	13.50 (15.61)
	S. East	12.04 (8.63)	18.62 (11.56)	9.76 (8.76)	13.76 (8.01)	17.49 (11.34)
	S. West	16.00 (9.47)	20.18 (12.33)	11.46 (8.41)	13.56 (10.71)	16.45 (11.94)
	W. Midlands	12.48 (7.65)	18.29 (9.26)	11.72 (7.57)	12.36 (6.64)	13.96 (8.86)
	Yorkshire & Humberside	13.83 (8.92)	19.93 (8.90)	10.98 (6.91)	15.14 (10.00)	15.83 (10.62)
	F-test	1.36	0.62	0.52	1.97	0.49
	R^2	0.03	0.01	0.01	0.04	0.01
Children or not						
	Yes	13.05 (8.57)	19.85 (11.57)	10.49 (8.65)	12.61 (8.75)	16.11 (11.45)
	No	14.33 (11.33)	18.52 (10.50)	10.85 (8.77)	13.51 (9.46)	15.60 (9.49)
	F-test	1.17	0.73	0.09	0.55	0.11
	R^2	0.02	0.01	0.00	0.01	0.00
Successor						
	No	13.81 (8.76)	20.06 (11.28)	10.27 (8.42)	12.75 (8.47)	15.80 (10.35)
	Yes	12.51 (8.87)	19.12 (11.39)	10.73 (9.02)	12.57 (9.26)	16.27 (12.21)
	F-test	2.92	0.88	0.37	0.06	0.22
	R^2	0.06	0.02	0.01	0.00	0.00

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

Table 8.28(Cont) ANOVA results for social referents of SN

		Influence of Merchants	Influence of Independent Advisors	Influence of Peers	Influence of Press	Influence of Academia
Position in business						
	Primary	12.87 (8.87)	19.92 (11.77)	10.03 (8.79)	12.70 (9.27)	15.97 (11.48)
	Secondary	15.20 (9.47)	15.36 (8.99)	10.86 (10.30)	15.47 (11.67)	16.21 (12.73)
	Joint	13.20 (8.84)	18.73 (10.88)	11.52 (8.72)	12.75 (7.82)	15.86 (11.15)
	F-test	0.53	1.46	1.50	0.69	0.01
	R^2	0.01	0.03	0.03	0.01	0.00
Years in business						
	Under 10	15.50 (10.18)	22.15 (10.52)	12.26 (9.31)	14.84 (10.60)	19.08 (10.52)
	11-20	13.07 (10.07)	22.32 (11.12)	8.74 (7.15)	13.65 (8.80)	17.85 (10.88)
	21-30	13.88 (8.75)	20.70 (10.51)	10.11 (7.86)	12.68 (8.12)	16.39 (10.41)
	31-40	13.08 (8.13)	19.46 (11.75)	11.56 (9.76)	12.64 (8.23)	14.87 (11.06)
	41-50	11.25 (7.40)	14.43 (10.49)	10.04 (8.43)	10.92 (9.25)	14.97 (13.17)
	Over 50	9.06 (6.85)	15.47 (15.42)	9.53 (6.32)	10.07 (10.65)	9.93 (11.28)
	F-test	**2.52***	**5.29*****	1.87	1.76	**2.70***
	R^2	0.05	0.11	0.04	0.04	0.05
Highest level of Education						
	Secondary	12.91 (8.99)	17.31 (10.90)	10.78 (7.51)	12.28 (7.92)	15.80 (11.74)
	Degree	13.47 (8.82)	20.52 (11.41)	10.66 (8.83)	12.84 (8.98)	16.07 (11.06)
	Post-Grad	12.40 (9.59)	19.53 (12.35)	8.26 (9.10)	12.94 (9.60)	17.33 (12.01)
	F-test	0.44	**3.26***	1.80	0.18	0.32
	R^2	0.01	0.07	0.04	0.00	0.01
Cropped area						
	Under 200 hectares	11.88 (8.11)	20.29 (12.60)	11.15 (10.83)	14.23 (8.46)	14.24 (10.76)
	201 - 400	13.16 (8.18)	18.44 (10.62)	10.57 (8.46)	12.30 (8.65)	15.76 (11.73)
	401 - 800	13.42 (10.27)	20.48 (12.12)	9.76 (8.24)	12.79 (9.54)	15.81 (11.12)
	801 - 1200	12.79 (8.38)	19.98 (11.97)	11.84 (9.37)	13.51 (8.23)	18.46 (10.91)
	Over 1200 hectares	15.11 (8.51)	24.03 (10.37)	10.74 (7.78)	12.71 (8.12)	18.57 (9.12)
	F-test	0.72	2.26	0.71	0.56	1.41
	R^2	0.01	0.05	0.01	0.01	0.03
Farm type						
	Mixed	12.70 (9.23)	18.53 (11.85)	10.16 (8.47)	12.79 (9.55)	15.92 (12.15)
	Mainly arable	13.41 (8.76)	20.18 (11.24)	10.69 (8.73)	12.69 (8.51)	16.14 (10.85)
	F-test	0.76	2.35	0.43	0.01	0.04
	R^2	0.02	0.05	0.01	0.00	0.00

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

Table 8.28 (Cont) ANOVA results for social referents of SN

		Influence of Merchants	Influence of Independent Advisors	Influence of Peers	Influence of Press	Influence of Academia
Wheat area grown						
	Under 200 hectares	13.13 (8.71)	18.98 (11.33)	10.62 (8.82)	12.96 (8.68)	15.78 (11.60)
	201 - 400	13.09 (9.08)	19.81 (11.40)	10.44 (8.87)	13.08 (9.44)	16.75 (11.19)
	401 - 800	14.34 (9.90)	21.24 (11.89)	11.32 (7.68)	11.00 (8.34)	15.79 (10.70)
	801 - 1200	13.31 (7.18)	26.40 (11.06)	7.36 (6.15)	11.09 (8.62)	19.55 (7.52)
	Over 1200 hectares	13.38 (10.35)	22.38 (12.25)	9.67 (10.08)	12.56 (6.21)	10.50 (5.98)
	F-test	0.24	1.53	0.51	0.73	0.96
	R^2	0.00	0.03	0.01	0.01	0.02
Tonnes of wheat produced						
	Under 1000	12.54 (8.15)	18.40 (11.62)	10.79 (9.42)	13.03 (8.95)	15.42 (11.52)
	1001 - 2000	14.31 (9.11)	20.33 (10.49)	10.60 (8.10)	13.43 (8.87)	16.73 (11.51)
	2001 - 4000	12.19 (9.31)	20.44 (12.64)	10.16 (9.07)	11.38 (8.81)	15.72 (11.06)
	4001 - 6000	16.56 (9.72)	20.78 (11.38)	11.50 (6.44)	13.30 (9.66)	18.32 (11.40)
	Over 6000	14.50 (9.62)	23.50 (11.23)	9.05 (8.48)	12.16 (7.27)	16.22 (7.98)
	F-test	**2.42***	1.36	0.32	1.06	0.60
	R^2	0.05	0.03	0.01	0.02	0.01
Group 1 wheat %						
	Under 25%	13.39 (8.99)	19.60 (11.23)	10.68 (8.76)	12.56 (8.76)	15.79 (11.52)
	26-50%	14.13 (9.54)	24.32 (11.74)	10.23 (8.71)	14.61 (9.30)	18.13 (9.88)
	51-75%	11.44 (8.22)	19.79 (12.71)	11.32 (8.42)	14.43 (10.21)	16.09 (11.72)
	Over 75%	11.10 (7.12)	12.94 (8.81)	10.44 (8.12)	11.36 (7.16)	15.80 (11.13)
	F-test	1.38	**8.29*****	0.11	1.74	0.92
	R^2	0.03	0.17	0.00	0.03	0.02
Group 2 wheat %						
	Under 25%	13.33 (9.04)	19.43 (11.33)	10.40 (8.38)	12.79 (8.63)	15.74 (11.30)
	26-50%	13.87 (9.07)	22.49 (11.57)	12.39 (10.62)	13.49 (10.15)	18.90 (11.89)
	51-75%	11.47 (6.98)	16.87 (10.14)	10.21 (6.75)	9.53 (5.74)	14.73 (8.44)
	Over 75%	10.39 (7.06)	19.26 (13.30)	9.00 (7.41)	13.75 (9.21)	14.75 (9.52)
	F-test	1.13	1.95	1.48	0.94	1.93
	R^2	0.02	0.04	0.03	0.02	0.04
Group 3 wheat %						
	Under 25%	12.72 (8.32)	20.10 (11.40)	10.51 (7.89)	13.08 (8.51)	16.36 (10.85)
	26-50%	13.62 (9.24)	20.52 (10.71)	10.39 (9.41)	13.43 (9.27)	17.43 (12.07)
	51-75%	14.95 (10.33)	20.17 (12.46)	12.74 (9.47)	11.80 (9.21)	13.10 (9.47)
	Over 75%	13.94 (10.06)	16.90 (12.18)	10.20 (10.07)	11.22 (9.15)	14.39 (12.39)
	F-test	1.08	1.70	0.93	1.21	2.08
	R^2	0.02	0.03	0.02	0.02	0.04

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

Table 8.28 (Cont) ANOVA results for social referents of SN

		Influence of Merchants	Influence of Independent Advisors	Influence of Peers	Influence of Press	Influence of Academia
Group 4 wheat %						
	Under 25%	13.49 (9.64)	19.22 (12.28)	10.55 (9.05)	12.56 (9.22)	16.10 (11.33)
	26-50%	13.87 (8.54)	19.21 (10.60)	9.53 (8.47)	11.49 (8.36)	16.35 (12.31)
	51-75%	11.16 (6.63)	21.32 (10.79)	12.25 (9.43)	14.95 (9.48)	18.08 (10.98)
	Over 75%	13.20 (8.75)	20.80 (10.77)	11.02 (7.65)	13.60 (7.91)	14.92 (10.25)
	F-test	1.37	0.93	1.41	2.41	1.04
	R^2	0.03	0.02	0.03	0.05	0.02
% income from wheat						
	Under 25%	12.72 (8.76)	19.55 (11.60)	9.78 (8.36)	12.77 (8.74)	16.59 (11.67)
	26-50%	12.88 (8.42)	19.65 (11.49)	10.01 (7.51)	12.73 (8.56)	15.76 (10.73)
	51-75%	13.97 (9.14)	19.56 (10.56)	11.36 (9.54)	12.56 (8.92)	16.26 (11.81)
	Over 75%	18.44 (13.99)	23.00 (15.01)	14.20 (11.86)	12.87 (9.77)	15.21 (10.79)
	F-test	2.42	0.43	2.01	0.02	0.18
	R^2	0.05	0.01	0.04	0.00	0.00

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

c) The sub-components of PBC (training, information and trust)

These sub-components' scores were obtained from asking six paired questions: two questions relating to 'training' (technical seminars and one-to-one seminars); two for 'information' (on-line and press); and, two for 'support' (practical help and monitoring/reviewing of hedging tools). The two parts were multiplied together and the two questions for each sub-component were added together to give training, information and support scores ranging from 2 to 98. A neutral score would be 4 x 4 x 2 = 32. The results of the ANOVA are detailed in Table 8.29. The results state the mean and standard deviation, with significant results in bold.

Training - Technical and one to one seminars

The mean Training score was 44.21. This implies the respondents in general felt that training would weakly encourage them to use FPRM tools. When comparing with the IFFs age, years in business and level of education were the most significant influences. PBC scores decreased with age, except in the youngest age group, ‘under 20’ (F-test 4.28: p-value <0.001) and years in business (F-test 5.10: p-value <0.001) but scores increased with education (F-test 7.92: p-value <0.001). Tonnes of wheat produced was the next significant (F-test 3.16: p-value <0.01). PBC scores increased with tonnage, except for the largest category, ‘over 6000 tonnes’. This was perhaps due to the small number of respondents in that category.

The least significant were principal farm location and wheat area grown. There was no clear pattern but the highest PBC score was from farms in the S. West and lowest in the N. West. (F-test 2.43: p-value <0.05). Scores increased with wheat area grown (F-test 3.10: p-value <0.05) except with the largest category, ‘over 1200 hectares’. This was perhaps due to the small number of respondents in that category.

Information - On-line and press information

The mean Information score was 34.63. This implies that for the respondents in general felt that ‘information’ would neither encourage nor discourage them to use FPRM tools. When comparing with the IFFs, gender, age, years in business and tonnes of wheat produced were significant influences. Scores for females were the highest (F-test 5.03: p-value <0.05). Scores decreased with age (F-test 2.38: p-value <0.05) and with tonnes, except for the 401-800 hectare category (F-test 2.38: p-value <0.05).

Support - Practical help and monitoring

The mean Support score was 54.91. This implies that respondents in general felt that ‘support’ would encourage them to use FPRM tools. When comparing with the IFFs there were no significant differences reported.

Table 8.29 ANOVA results for the sub-components of PBC (training, information and trust)

		Total Training	Total information	Total support
Overall mean		44.21 (24.74)	34.63 (20.63)	54.91 (82.41)
Gender				
	Male	44.37 (24.51)	34.27 (20.20)	83.45 (3.41)
	Female	40.21 (33.00)	46.71 (31.39)	34.53 (9.23)
	F-test	0.39	**5.03***	0.10
	R^2	0.01	0.00	0.00
Age				
	Under 20	43.63 (31.49)	40.14 (29.99)	60.86 (35.08)
	21-30	50.81 (25.63)	35.93 (16.30)	53.38 (24.40)
	31-40	50.91 (23.84)	39.09 (19.16)	57.54 (22.80)
	41-50	46.32 (23.17)	35.36 (19.07)	62.98 (137.39)
	51-60	40.98 (23.21)	34.14 (21.91)	51.40 (24.48)
	Over 60	36.30 (29.43)	28.22 (22.71)	41.37 (28.45)
	F-test	**4.28*****	**2.38***	0.85
	R^2	0.08	0.05	0.02
Principal farm location				
	East	45.00 (25.17)	32.56 (20.03)	60.93 (138.41)
	E. Midlands	42.36 (25.66)	32.99 (21.81)	47.29 (26.24)
	N. East	51.00 (27.46)	40.38 (27.71)	61.76 (26.70)
	N. West	25.50 (24.82)	26.50 (29.85)	27.40 (29.78)
	S. East	40.57 (22.60)	33.97 (18.54)	51.25 (24.16)
	S. West	54.90 (24.75)	40.18 (20.45)	57.14 (23.02)
	W. Midlands	43.00 (23.11)	38.18 (17.54)	51.76 (23.38)
	Yorkshire & Humberside	46.09 (24.11)	37.98 (19.49)	55.59 (22.47)
	F-test	**2.43***	1.60	0.39
	R^2	0.05	0.03	0.01
Children or not				
	Yes	43.57 (24.34)	34.63 (20.92)	54.99 (87.17)
	No	49.58 (27.53)	34.77 (18.53)	54.71 (24.91)
	F-test	3.62	0.00	0.00
	R^2	0.07	0.00	0.00

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

Table 8.29 (cont) ANOVA results for the sub-components of PBC (training, information and trust)

		Total Training	Total information	Total support
Successor				
	No	45.70 (24.82)	34.33 (19.21)	59.33 (118.62)
	Yes	42.10 (24.78)	34.80 (22.09)	50.49 (25.35)
	F-test	3.05	0.08	1.60
	R^2	0.06	0.00	0.03
Position in business				
	Primary	44.96 (24.90)	35.17 (21.30)	58.01 (103.11)
	Secondary	46.94 (30.30)	41.11 (23.03)	59.28 (23.98)
	Joint	41.31 (24.59)	33.33 (18.98)	48.27 (25.44)
	F-test	1.36	1.30	0.76
	R^2	0.03	0.03	0.02
Years in business				
	Under 10	53.85 (26.45)	41.06 (21.42)	59.41 (24.02)
	11-20	45.63 (22.90)	36.28 (19.50)	52.31 (22.84)
	21-30	45.93 (22.06)	35.10 (18.65)	64.77 (158.54)
	31-40	42.44 (23.51)	33.52 (20.21)	51.59 (25.44)
	41-50	37.94 (26.34)	31.54 (22.83)	47.93 (27.20)
	Over 50	29.06 (31.94)	28.06 (27.48)	37.12 (32.95)
	F-test	**5.10*** **	**2.26***	0.83
	R^2	0.10	0.05	0.02
Highest level of Education				
	Secondary	36.82 (24.70)	33.71 (20.91)	45.55 (26.63)
	Degree	46.30 (24.15)	35.42 (20.58)	58.51 (97.07)
	Post-Grad	48.82 (25.57)	34.22 (20.40)	52.09 (26.22)
	F-test	**7.92*** **	0.36	1.18
	R^2	0.16	0.01	0.02
Cropped area				
	Under 200 hectares	43.43 (24.40)	37.02 (21.62)	50.58 (24.01)
	201 - 400	41.90 (24.09)	34.24 (20.23)	51.35 (25.82)
	401 - 800	45.64 (25.18)	34.44 (21.25)	52.13 (25.87)
	801 - 1200	47.86 (25.30)	33.63 (21.19)	83.97 (250.24)
	Over 1200 hectares	51.71 (24.43)	37.39 (19.59)	57.12 (23.39)
	F-test	2.06	0.41	2.12
	R^2	0.04	0.01	0.04

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

Table 8.29 (cont) ANOVA results for the sub-components of PBC (training, information and trust)

		Total Training	Total information	Total support
Farm type				
	Mixed	44.16 (26.59)	33.40 (20.53)	50.58 (25.27)
	Mainly arable	44.24 (23.91)	35.18 (20.68)	56.77 (97.10)
	F-test	0.00	0.97	0.73
	R^2	0.00	0.02	0.01
Wheat area grown				
	Under 200 hectares	41.82 (24.13)	34.03 (20.97)	50.76 (25.17)
	201 - 400	45.87 (25.01)	35.13 (18.61)	63.99 (145.23)
	401 - 800	52.72 (26.83)	35.30 (23.55)	52.47 (25.60)
	801 - 1200	51.31 (20.18)	41.38 (25.73)	60.85 (22.05)
	Over 1200 hectares	43.44 (22.90)	34.38 (18.91)	45.13 (30.06)
	F-test	**3.10***	0.46	0.83
	R^2	0.06	0.01	0.02
Tonnes of wheat produced				
	Under 1000	42.11 (23.36)	35.42 (20.68)	50.74 (24.99)
	1001 - 2000	44.12 (25.44)	35.23 (20.30)	53.09 (25.00)
	2001 - 4000	45.03 (24.84)	30.29 (19.63)	67.10 (176.75)
	4001 - 6000	59.03 (25.16)	43.03 (22.15)	56.38 (25.09)
	Over 6000	48.10 (21.80)	40.30 (22.37)	55.35 (25.55)
	F-test	**3.16****	**3.04***	0.80
	R^2	0.06	0.06	0.02
Group 1 wheat %				
	Under 25%	45.16 (24.33)	35.36 (20.25)	57.38 (95.19)
	26-50%	44.09 (26.55)	32.88 (20.66)	49.44 (24.77)
	51-75%	36.89 (27.01)	30.03 (21.52)	47.23 (31.81)
	Over 75%	41.25 (22.25)	32.72 (22.87)	50.53 (25.84)
	F-test	1.23	0.98	0.36
	R^2	0.02	0.02	0.01

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

Table 8.29 (cont) ANOVA results for the sub-components of PBC (training, information and trust)

		Total Training	Total information	Total support
Group 2 wheat %				
	Under 25%	44.32 (24.25)	34.56 (20.20)	56.17 (93.50)
	26-50%	46.75 (26.29)	34.93 (21.15)	53.59 (25.61)
	51-75%	32.78 (20.58)	27.61 (20.69)	42.78 (23.23)
	Over 75%	45.08 (27.87)	39.04 (24.47)	55.17 (27.32)
	F-test	1.61	1.08	0.16
	R^2	0.03	0.02	0.00
Group 3 wheat %				
	Under 25%	43.78 (24.83)	34.35 (20.46)	56.80 (108.16)
	26-50%	46.89 (24.31)	35.02 (20.13)	53.65 (25.73)
	51-75%	42.09 (21.85)	35.90 (20.31)	50.28 (24.66)
	Over 75%	44.15 (26.06)	33.78 (21.71)	54.46 (27.03)
	F-test	0.64	0.13	0.11
	R^2	0.01	0.00	0.00
Group 4 wheat %				
	Under 25%	42.39 (25.45)	33.45 (21.87)	51.53 (26.97)
	26-50%	46.12 (23.13)	34.83 (18.77)	51.16 (24.53)
	51-75%	49.11 (24.79)	35.65 (19.32)	56.76 (25.11)
	Over 75%	44.62 (24.19)	35.88 (19.82)	66.24 (168.99)
	F-test	1.58	0.51	1.07
	R^2	0.03	0.01	0.02
% income from wheat				
	Under 25%	44.15 (26.57)	32.60 (20.66)	49.91 (27.18)
	26-50%	43.08 (22.86)	33.47 (19.93)	57.74 (115.41)
	51-75%	46.25 (25.62)	37.44 (21.09)	54.24 (25.52)
	Over 75%	46.11 (27.02)	37.78 (21.33)	56.59 (21.02)
	F-test	0.59	1.77	0.25
	R^2	0.01	0.04	0.01

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

iii) The new SN variable for Trust

The TPB includes the SN as a core component in explaining behaviour. However, following the results from the one-to-one interviews and focus groups it was thought that this component did not fully explain the complexity of the SN. It was felt that there was an important trust element in relation to whom the farmer was discussing wheat selling and FPRM tools. Not only did the advice need to be deemed of good quality and the producers feel motivated to comply, but also that the advice needed to be trusted.

The two questions from section C of the questionnaire; Do you the producer 'trust advice on wheat selling' and 'trust advice on hedging tools' were scored and added together. This sum was then multiplied by the farmers' motivation to comply with that advice to provide an overall Trust score for each farmer. Each individual question was scored from 1 (strongly disagree) to 7 (strongly agree), which implies that scores could range from 2 to 98 for each influencer group (e.g. (1 + 1) x 1 = 2 and (7 + 7) x 7 = 98), with a neutral score of (4+4) x 4 = 32. Therefore the total score across all five groups could range from 10 to 490, with a neutral score for Total Trust of (4 + 4) x 4 x 5 = 160. The results are detailed in Table 8.30.

Total SN Trust

The mean Total SN Trust score was 137.10. This implies that respondents in general did not trust the groups they use for advice with respect to the use of FPRM tools. When comparing with the IFFs, only the years in business and the percentage of Group 2 wheat grown were significant. SN Total Trust scores generally decreased with years in business (F-test 3.65: p-value <0.001) and increased with percentage of Group 2 wheat grown but peaked in the 51-75% category (F-test 2.81: p-value <0.05).

Total merchant Trust

The mean Total merchant Trust score was 29.92. This implies that respondents in general were ambivalent to their merchant's advice with respect to the use of FPRM tools. When comparing with the IFFs, only the years in business and the percentage of income from wheat grown were significant. Total merchant Trust scores generally decreased with years in business (F-test 2.98: p-value <0.01) but increased with percentage wheat grown (F-test 2.81: p-value <0.05).

Total independent advisor Trust

The mean Total independent advisor Trust score was 36.24. This implies that respondents in general did trust their independent advisor's advice with respect to the use of FPRM tools. This SN score was the highest scored of all the advising groups polled, inferring that independent advisors were the most trusted group with respect to FPRM advice. When comparing with the IFFs, age, years in business and the percentage of Group 1 (milling) wheat grown were significant. Total independent advisor Trust scores increased until the 50 year category, then decreased (*F*-test 4.35: *p*-value <0.001). Scores generally decreased with years in business (*F*-test 5.53: *p*-value <0.001) and increased to 50% percentage of income from Group 1 wheat grown, then decreased (*F*-test 2.81: *p*-value <0.05).

Total peer Trust

The mean Total peer Trust score was 22.19. This implies the respondents in general did not trust their peers' advice with respect to the use of FPRM tools. This score was the lowest scored of all the advising groups polled, inferring that peers were the least trusted group with respect to FPRM advice. When comparing with the IFFs there were no significant factors.

Total press Trust

The mean Total press Trust score was 22.91. This implies that respondents in general did not trust the advice they read in the press with respect to the use of FPRM tools. This score was the second lowest scored of all the advising groups polled, virtually the same as peer advice trust. When comparing with the IFFs, Total press Trust scores were highest in females (*F*-test 7.82: *p*-value <0.01).

Total academic Trust

The mean Total academic Trust score was 27.65. This implies the respondents in general had a neutral trust opinion to academia with respect to the use of FPRM tools. However, this score was the second highest scored of all the advising groups polled, inferring that academic advice was relatively highly trusted with respect to FPRM advice. When comparing with the IFFs, gender, level of education and years in business were the only significant factors. Total academic Trust scores were highest with females (*F*-test 5.4: *p*-value <0.05). Scores decreased with years in business (*F*-test 2.65: *p*-value <0.05).

Table 8.30 ANOVA for the new SN Trust variable and IFFs.

		Total SN Trust	Total Merchant Trust	Total Independent Advisor Trust	Total Peer Trust	Total Press Trust	Total Academic Trust
Overall mean		137.10 (64.72)	29.92 (18.20)	36.24 (21.68)	22.19 (17.53)	22.91 (17.29)	27.65 (21.66)
Gender							
	Male	136.18 (63.30)	30.01 (18.13)	36.05 (21.62)	22.23 (17.49)	22.60 (16.90)	27.19 (21.28)
	Female	167.17 (112.82)	27.57 (22.10)	38.00 (23.12)	23.50 (20.76)	36.67 (29.16)	41.83 (32.92)
	F-test	2.68	0.25	0.10	0.06	**7.82****	5.40*
	R^2	0.05	0.01	0.00	0.00	0.16	0.11
Age							
	Under 20	159.63 (102.53)	28.50 (11.16)	34.00 (11.60)	22.13 (23.69)	36.75 (31.68)	38.25 (31.36)
	21-30	143.82 (57.86)	32.75 (20.60)	37.33 (21.82)	22.35 (19.69)	21.60 (13.67)	29.48 (19.90)
	31-40	147.35 (61.67)	29.68 (18.41)	41.93 (20.91)	20.95 (14.88)	24.66 (16.66)	30.57 (19.15)
	41-50	140.78 (64.43)	31.87 (17.81)	39.05 (20.97)	23.06 (18.44)	23.01 (17.19)	26.30 (19.94)
	51-60	135.71 (64.13)	29.32 (17.35)	34.87 (21.38)	22.99 (17.00)	22.68 (17.24)	28.42 (23.71)
	Over 60	114.95 (63.46)	25.02 (18.52)	26.85 (23.06)	18.92 (16.95)	20.75 (17.52)	23.46 (21.47)
	F-test	2.12	1.58	**4.35*****	0.69	1.42	1.39
	R^2	0.04	0.03	0.09	0.01	0.03	0.030
Principal farm location							
	East	136.01 (65.23)	29.99 (16.61)	37.56 (22.00)	22.48 (19.04)	20.66 (16.36)	26.49 (21.55)
	E. Midlands	138.39 (62.20)	28.98 (19.48)	36.14 (22.67)	20.38 (15.62)	22.40 (17.21)	29.87 (23.90)
	N. East	153.47 (88.77)	33.22 (25.49)	28.68 (18.50)	23.16 (18.95)	32.33 (25.13)	33.53 (27.71)
	N. West	122.25 (54.80)	20.00 (13.37)	27.00 (14.38)	19.00 (8.25)	32.25 (8.18)	24.00 (32.17)
	S. East	134.32 (55.52)	28.17 (16.83)	35.68 (21.96)	21.23 (17.29)	24.95 (17.50)	28.16 (21.03)
	S. West	140.78 (81.28)	33.57 (19.82)	36.50 (22.67)	23.15 (16.73)	23.69 (18.72)	28.92 (20.52)
	W. Midlands	137.00 (60.34)	27.53 (19.03)	34.21 (18.73)	25.20 (17.13)	23.39 (13.51)	24.07 (16.58)
	Yorkshire & Humberside	142.45 (66.75)	31.73 (18.99)	36.40 (18.14)	24.87 (16.47)	26.93 (18.57)	27.80 (19.55)
	F-test	0.26	0.79	0.59	0.51	1.92	0.56
		0.01	0.02	0.01	0.01	0.04	0.01
Children or not							
	Yes	136.91 (64.60)	29.62 (17.64)	36.53 (21.84)	22.16 (17.61)	22.73 (17.29)	27.73 (22.15)
	No	138.18 (67.27)	32.23 (22.29)	34.18 (20.75)	22.49 (17.23)	24.00 (17.65)	26.68 (17.71)
	F-test	0.02	1.18	0.64	0.02	0.29	0.12
	R^2	0.00	0.02	0.0	0.00	0.01	0.00
Successor							
	No	134.53 (59.24)	31.37 (18.09)	36.41 (20.74)	21.52 (17.41)	22.12 (15.85)	26.04 (19.46)
	Yes	138.24 (69.32)	28.44 (18.29)	35.50 (22.13)	22.79 (18.07)	23.60 (18.87)	29.12 (23.84)
	F-test	0.40	3.50	0.23	0.68	0.92	2.57
	R^2	0.01	0.07	0.00	0.01	0.02	0.05

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

		Total SN Trust	Total Merchant Trust	Total Independent Advisor Trust	Total Peer Trust	Total Press Trust	Total Academic Trust
Position in business							
	Primary	134.57 (66.54)	29.22 (18.51)	36.34 (22.07)	21.06 (17.77)	22.17 (17.75)	26.73 (21.77)
	Secondary	144.08 (84.00)	32.07 (15.93)	30.07 (19.20)	24.29 (19.75)	22.83 (17.92)	29.60 (25.49)
	Joint	140.20 (62.64)	30.27 (17.26)	34.96 (20.98)	24.50 (17.40)	27.40 (24.05)	28.83 (22.14)
	F-test	0.44	0.32	0.70	0.70	0.54	0.55
	R^2	0.01	0.01	0.01	0.01	0.01	0.01
Years in business							
	Under 10	162.27 (66.69)	34.15 (17.59)	42.72 (21.47)	24.02 (18.25)	26.98 (19.64)	34.29 (20.21)
	11-20	136.82 (58.05)	29.00 (19.50)	41.09 (20.18)	18.21 (13.37)	24.13 (17.29)	29.18 (20.47)
	21-30	144.13 (62.74)	33.12 (19.39)	38.59 (20.81)	22.48 (16.72)	22.11 (15.03)	28.04 (20.62)
	31-40	133.08 (64.21)	28.71 (16.05)	35.12 (22.10)	24.58 (19.89)	22.72 (16.32)	25.26 (21.31)
	41-50	120.64 (71.10)	25.29 (16.75)	27.03 (20.17)	20.29 (17.10)	21.30 (20.41)	27.93 (26.19)
	Over 50	109.40 (51.80)	26.47 (20.78)	28.13 (24.83)	19.20 (11.28)	19.07 (20.20)	15.27 (14.18)
	F-test	**3.65*** **	**2.98** **	**5.53*** **	1.94	1.08	**2.65***
	R^2	0.07	0.06	0.11	0.04	0.02	0.05
Highest level of Education							
	Secondary	133.35 (61.71)	27.42 (18.18)	30.97 (19.90)	23.56 (15.20)	23.86 (17.26)	29.11 (23.87)
	Degree	139.25 (66.31)	31.01 (18.06)	38.03 (21.89)	22.24 (17.78)	22.80 (17.42)	27.12 (21.07)
	Post-Grad	131.36 (60.98)	29.45 (19.49)	35.94 (22.74)	17.32 (18.26)	22.49 (17.31)	30.06 (22.96)
	F-test	0.54	1.72	**4.38 ***	2.28	0.18	0.64
	R^2	0.01	0.03	0.09	0.05	0.00	0.01
Cropped area							
	Under 200 hectares	136.36 (71.92)	29.28 (16.49)	42.00 (35.43)	24.07 (19.86)	26.23 (15.57)	24.98 (19.68)
	201 - 400	136.39 (67.78)	29.70 (18.02)	241.00 (34.16)	22.79 (17.50)	23.04 (18.22)	27.56 (23.53)
	401 - 800	134.64 (65.51)	30.73 (19.99)	166.00 (37.82)	21.01 (17.08)	22.30 (17.67)	26.25 (20.76)
	801 - 1200	141.55 (55.11)	27.03 (15.11)	56.00 (37.75)	22.65 (17.89)	23.00 (15.57)	32.46 (19.99)
	Over 1200 hectares	147.44 (47.42)	34.21 (16.86)	36.00 (42.58)	19.66 (14.75)	21.37 (14.04)	31.05 (17.05)
	F-test	0.34	1.01	1.63	0.60	0.53	1.22
	R^2	0.01	0.02	0.03	0.01	0.01	0.02

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

		Total SN Trust	Total Merchant Trust	Total Independent Advisor Trust	Total Peer Trust	Total Press Trust	Total Academic Trust
Farm type							
	Mixed	131.97 (69.76)	29.05 (20.73)	34.73 (22.58)	21.91 (17.17)	23.30 (18.11)	27.13 (22.12)
	Mainly arable	139.23 (62.49)	30.29 (17.02)	36.88 (21.29)	22.31 (17.70)	22.74 (16.96)	27.86 (21.50)
	F-test	1.33	0.56	1.11	0.06	0.12	0.13
	R^2	0.03	0.01	0.02	0.00	0.00	0.00
Wheat area grown							
	Under 200 hectares	136.98 (68.71)	29.88 (18.30)	34.71 (21.46)	22.77 (18.05)	24.06 (17.84)	27.44 (22.70)
	201 - 400	138.67 (63.49)	30.15 (18.35)	36.63 (21.51)	22.67 (18.00)	23.08 (17.79)	28.46 (21.25)
	401 - 800	134.36 (55.30)	29.53 (18.19)	40.48 (23.58)	20.98 (14.24)	18.05 (13.60)	27.05 (19.40)
	801 - 1200	132.70 (29.27)	32.62 (16.41)	43.10 (17.68)	12.55 (11.79)	16.45 (14.94)	30.18 (14.33)
	Over 1200 hectares	127.63 (50.38)	32.00 (21.57)	43.88 (22.01)	18.67 (17.75)	21.67 (10.91)	18.25 (11.18)
	F-test	0.10	0.11	1.44	1.10	1.81	0.49
	R^2	0.00	0.00	0.03	0.02	0.04	0.01
Tonnes of wheat produced							
	Under 1000	135.50 (67.95)	30.18 (17.96)	33.56 (21.53)	23.19 (18.94)	24.23 (17.74)	27.74 (22.71)
	1001 - 2000	143.35 (68.11)	30.50 (18.45)	37.77 (20.77)	23.00 (16.85)	24.44 (18.27)	28.38 (22.69)
	2001 - 4000	129.88 (59.45)	28.50 (18.52)	37.04 (23.55)	20.56 (17.52)	19.52 (15.91)	26.32 (20.48)
	4001 - 6000	147.44 (57.63)	34.21 (17.17)	40.26 (23.64)	21.46 (12.80)	21.67 (16.98)	30.75 (20.67)
	Over 6000	135.67 (40.19)	34.86 (19.91)	41.22 (17.88)	16.79 (16.15)	20.21 (12.66)	26.67 (13.31)
	F-test	0.93	0.93	1.39	0.96	1.87	0.30
	R^2	0.02	0.02	0.03	0.02	0.04	0.01
Group 1 wheat %							
	Under 25%	136.28 (64.66)	30.76 (18.69)	36.18 (21.31)	22.69 (17.76)	22.59 (17.21)	27.24 (21.93)
	26-50%	154.18 (64.02)	30.37 (18.18)	44.85 (22.40)	21.45 (17.38)	26.53 (17.96)	30.35 (19.99)
	51-75%	134.45 (71.07)	25.04 (16.02)	34.13 (23.55)	23.68 (16.35)	23.57 (18.73)	24.52 (23.43)
	Over 75%	120.47 (62.16)	24.54 (13.84)	23.40 (16.53)	20.31 (17.14)	21.58 (16.18)	28.86 (22.65)
	F-test	2.42	2.04	**8.24*** **	0.32	1.20	0.63
	R^2	0.05	0.04	**0.16**	0.01	0.02	0.01

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

		Total SN Trust	Total Merchant Trust	Total Independent Advisor Trust	Total Peer Trust	Total Press Trust	Total Academic Trust
Group 2 wheat %							
	Under 25%	135.49 (64.33)	30.28 (18.36)	35.77 (21.49)	21.79 (16.73)	22.81 (16.65)	26.87 (21.58)
	26-50%	156.27 (71.11)	31.31 (17.61)	41.56 (23.05)	26.70 (22.45)	25.72 (21.35)	32.96 (24.51)
	51-75%	123.64 (46.80)	23.93 (13.95)	31.87 (18.97)	21.43 (13.18)	16.27 (9.44)	26.40 (17.24)
	Over 75%	122.55 (55.22)	24.30 (20.59)	33.17 (21.16)	19.67 (15.18)	24.13 (17.49)	25.16 (16.00)
	F-test	**2.81***	1.48	2.02	1.96	1.45	1.86
	R^2	0.06	0.03	0.04	0.04	0.03	0.04
Group3 wheat %							
	Under 25%	138.32 (59.96)	29.03 (16.77)	36.65 (21.36)	22.14 (15.96)	23.46 (16.87)	27.82 (20.49)
	26-50%	140.36 (70.02)	29.86 (19.99)	37.98 (20.49)	21.48 (18.59)	23.88 (18.05)	29.56 (23.96)
	51-75%	139.95 (60.96)	35.71 (19.23)	37.69 (24.55)	27.76 (20.04)	20.90 (15.93)	25.15 (21.64)
	Over 75%	127.31 (78.88)	31.40 (20.58)	31.68 (23.44)	21.83 (20.58)	21.26 (18.88)	24.85 (23.23)
	F-test	0.62	1.78	1.36	1.46	0.60	0.88
	R^2	0.01	0.04	0.03	0.03	0.01	0.02
Group 4 wheat %							
	Under 25%	137.20 (70.56)	29.41 (19.59)	35.47 (23.37)	22.13 (19.01)	23.04 (18.13)	27.87 (22.03)
	26-50%	135.15 (59.84)	32.68 (17.30)	36.04 (20.01)	20.64 (16.15)	21.04 (17.48)	28.78 (24.84)
	51-75%	150.21 (69.63)	27.36 (16.13)	39.33 (19.24)	25.49 (18.85)	26.64 (18.69)	31.69 (21.20)
	Over 75%	134.13 (54.09)	29.98 (17.36)	37.23 (20.99)	23.10 (15.10)	23.38 (14.55)	23.91 (17.52)
	F-test	0.86	1.38	0.56	1.09	1.37	1.92
	R^2	0.02	0.03	0.01	0.02	0.03	0.04
% income from wheat							
	Under 25%	129.44 (64.34)	27.17 (16.22)	35.89 (21.84)	20.45 (16.47)	22.14 (16.95)	27.57 (21.63)
	26-50%	136.77 (60.10)	29.82 (18.35)	36.55 (21.91)	21.17 (15.58)	23.15 (16.76)	26.95 (20.27)
	51-75%	140.92 (69.75)	31.34 (17.41)	35.86 (20.98)	24.24 (19.19)	22.74 (17.59)	28.03 (23.18)
	Over 75%	156.40 (80.20)	40.13 (30.02)	38.80 (23.52)	28.27 (23.93)	25.33 (19.64)	27.27 (22.64)
	F-test	1.05	**2.81***	0.11	1.98	0.19	0.08
	R^2	0.02	**0.06**	0.00	0.04	0.00	0.00

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

iv) Agricole versus TPB components

This analysis was run to determine any effect on intention due to farmers being Agricole Ltd customers (see Table 8.31). Agricole is an independent grain market advisor, providing a weekly subscription report on the combinable crop market in England. The 'Agricole' factor was found to be significant for intention ($p<0.001$) but not significant for Att, SN or PBC. This is probably due to the fact that Agricole is an independent source of information on wheat marketing and the use of FPRM tools. Therefore, those farmers that are members of Agricole have a higher intention to use FPRM tools than other farmers because of their exposure to impartial FPRM advice. However, there is no difference between the Agricole farmers and others in terms of their Att, SN or PBC beliefs. This implies that it is important to include Agricole membership as a factor in determining intention when using statistical modelling but it is not necessary to include an interaction between Agricole membership and the TPB constructs. Because this survey only considered membership of one independent advisor it is not possible to extend this result to the general case of any independent advisor, although the qualitative research suggests that this may be the case.

Table 8.31 Intention versus Agricole membership F-test results for BI.

Factor	BI	Att	SN	PBC
Agricole membership	**0.224*** **	0.033	0.005	0.085

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

8.5.2 Exploring the relationships between variables

8.5.2.1 Correlation

Correlation analysis is used to describe the strength and direction of the linear relationship between two variables (Pallant, 2010). That is, as one variable increases then the other also increases (or decreases) in a uniform manner. This analysis produces a correlation coefficient that can take values from -1 indicating a negative relationship, through 0, indicating no relationship, to +1, indicating a positive relationship. Typically the Pearson correlation coefficient is used, as is the case with this analysis. Further, visual inspections of scatter plots were used to test for assumptions of using a correlation coefficient, for example, that the relationship, if not random, was indeed linear and also for any outliers that could then be verified using the original responses.

i) Correlations between direct TPB measures and behavioural intention

Correlation analysis produced a matrix detailing the relationship between the direct TPB measures and BI. When these Total Att, Total SN and Total PBC are sub-divided into their 13 component variables, a more complicated picture emerges as detailed in Table 8.32.

Table 8.32 Correlations between BI and TPB direct measures and sub-components.

Construct		Pearson's Correlation (r)	Significance
Total Attitude		0.505***	< 0.001
Attitude sub-components	RA	0.568***	< 0.001
	CB	0.572***	< 0.001
	CX	-0.114**	0.005
	EU	0.352***	< 0.001
	RK	-0.800	0.052
Total SN		0.284***	< 0.001
SN sub-components	Merchant influence	0.193***	< 0.001
	Ind Advisor influence	0.395***	< 0.001
	Peers influence	0.124**	0.004
	Press influence	0.139**	0.001
	Academic influence	0.073	0.090
Total PBC		0.338*	< 0.001
PBC sub-components	Training influence	0.323***	< 0.001
	Information influence	0.276***	< 0.001
	Support influence	0.288***	< 0.001

* Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed);

*** Correlation is significant at the 0.001 level (2-tailed)

The results above show that all the component variables for direct TPB measures and BI were positively and significantly correlated. Total Att showed the strongest relationship ($r = 0.505$, $p<0.001$) compared to PBC ($r = 0.338$, $p<0.05$) and SN the least ($r = 0.284$, $p<0.001$). However, when these main components were sub-divided into their 13 component variables a more complicated picture emerges:

Attitude

Although all the five sub-components, except risk, were significant some displayed a negative relationship. Total RA, total CB and total EU all had a positive relationship with BI whilst total CX and total RK displayed a negative relationship. These results are as expected, increasing the advantage, compatibility or ease of use can be expected to increase BI whilst increasing complexity or risk would reduce the incentive to use FPRM tools.

SN

All of the five SN sub-variables, except academic influence, were significant but the correlations ranged from the highest for ‘independent advisors influence’ ($r = 0.395$) to the lowest for ‘academia’s influence’ ($r = 0.073$). These results confirm the belief that SN has a positive effect on intention to use FPRM tools with influences and advice from all referents being positive. These results appear to indicate that respondents are influenced more by advice from those in the agricultural trade that are giving independent advice, than those such as merchants, and not that strongly influenced by their peers’ or academic advice.

PBC

All of the three PBC sub-variables were significant ($p < 0.001$), with the correlations in a narrow range ($r = 0.323$ to 0.276). These results confirm that the individual components of PBC have a positive effect on the intention to use FPRM tools.

SN Trust

The results for the SN trust sub-components are presented in Table 8.33. From this table it can be seen that the Total independent advisors’ Trust is positively correlated and significant ($p<0.001$). It is positively correlated and significant ($p<0.01$) for Total merchant Trust. Total press Trust, Total peer Trust and Total academia Trust were all weakly positively correlated but not significant.

Table 8.33 Correlations between BI and the new Trust sub-component measures.

Construct		Pearson’s Correlation	Significance
SN Trust		.217 ***	< 0.001
SN sub-components	Total merchant Trust	.146**	0.01
	Total ind advisor Trust	.397***	< 0.001
	Total peer Trust	.066	0.124
	Total press Trust	.080	0.062
	Total academia Trust	.081	0.059

* Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed);

*** Correlation is significant at the 0.001 level (2-tailed)

These results confirm the belief that Total Trust is an important SN factor in the intention to use FPRM tools. Independent advice is the most trusted ($p < 0.001$), followed by the merchants ($p = 0.001$). Tot al peer, press and academic Trust are not significant which could be due to the farmer not believing that these groups either understand or have practical experience of using FPRM tools.

8.5.3 Prediction of Intent using GLM

8.5.3.1 Introduction

The General Linear Modelling (GLM) process was first developed by Nelder and Wedderburn (1972) to fit linear models based on likelihood. Correlations are useful in measuring the relationships between two variables but do not directly provide a quantitative model to predict one variable in relation to another. This can be achieved for continuous variables by regression analysis. Regression analysis is a way of predicting the outcome, or dependent, variable from one or more predictor, or independent, variables. If there is only one independent variable the analysis is simple regression, and if there are multiple predictor variables it is called multiple regression (Field, 2009). Regression can be either linear, where the impact of an independent variable on the dependent variable is assumed to be linear, or non linear where the relationship between the dependent and independent variables are assumed to be non-linear.

In this case the model would have a general form of:

Outcome = model + error

In the case of simple regression a model being fitted to continuous data, plus an error, can predict the outcome trying to be described for any respondent. In regression if the model is assumed to be linear a straight line is fitted that best describes the data, using the 'least squares' method or Ordinary Least Squares, OLS. This method gives a line that best fits the data by minimising the total sum of square residuals (SS_R), the 'line of best fit'. The straight line has a gradient, commonly denoted by b_1 and a point where the line crosses the y-axis, called the intercept, b_0. In non-linear regression a curve is fitted, again minimising the total sum of square residuals. The equation below shows the case for simple linear regression.

$Y_i = (b_0 + b_1 X_i) + \varepsilon_i$

Where ε_i is the error associated with respondent *i*.

The SS_R or deviation is calculated as:

SS_R = Deviation = $\sum$ (observed-model)^2 = $\sum \varepsilon_i^2$

To assess how good a fit the model provides it must be compared to the most basic model that can be fitted which is simply the mean of the dependent variable. In this instance we calculate the total sum of squares (SS_T) using:

$SS_T = \sum$ (observed-mean)^2

The improvement in the prediction resulting from using the regression model over the basic mean model is the difference between the SS_T and SS_R and is denoted by the model sum of squares, SS_M (Field, 2009). The regression model can be seen to be an improvement on the basic model by having a large SS_M. The proportion of improvement due to the regression model is represented by dividing SS_M by SS_T, to give a R^2 value. When multiplied by 100, this gives the percentage improvement. R^2 represents the amount of variance in the outcome explained by the model, SS_M, relative to how much variance there was in the first place, SS_T. It should also be noted that the square root of R^2 is the same as the Pearson's correlation coefficient. So the Pearson's coefficient gives a good estimate of the goodness of fit of a regression model and the R^2 value shows the size of the relationship (Field, 2009).

When there are multiple independent predictor variables and the model is assumed to be linear, a multiple linear regression is used.

$Y_i = (b_0 + b_1X_1 + b_2X_2 + \ldots + b_nX_n) + \varepsilon_i$

The predicted outcome is Y_1. b_1 is the coefficient of the first predictor, X_1. b_2 is the coefficient of the second predictor, X_2. b_n is the coefficient of the *n*th predictor, X_n. ε_i is the difference between the predicted and observed value of Y for the *i*th observation (Field, 2009). The same method of using the sums of squares described above can be used to evaluate this model for an overall fit. However, it is important to determine if the individual *b* coefficients are significantly different from zero. To do this a *t*-test is used which tests the null hypothesis that the *b* value is significantly different to zero. The *t* value is calculated as the *b* value by its standard error and then compared to the critical values of the *t*-distribution.

For OLS regression to be applicable across a general population it must meet certain underlying assumptions given by the Gauss-Markov theorem and the Best Linear Unbiased estimator (BLUE) of the coefficients. This infers that on average the regression model from the sample is the same as the population model.

- The predictor variables should not correlate too highly - Multicollinearity
- The variance of the residual term should be constant for each level of the predictor variable – Homoscedasticity
- The residuals in the model are normally distributed with a mean of zero
- The values of the dependent variable are independent
- The relationship of the model is a linear one

With multiple regression the phenomenon of multicollinearity occurs when two or more predictors in a regression model have a strong correlation. This is because the values of *b* for each variable would be the interchangeable for the predictors that were perfectly correlated. Perfect collinearity is rare but less than perfect collinearity is not. Field (2009) suggests the three problems of collinearity are:

- Untrustworthy *b*s; As when collinearity increases so do the standard errors of the *b* coefficients and so the *b* coefficient is less likely to represent the population

- Limits the size of the R value: When variables are very correlated, much of the variance explained by both variables is the same. They may both explain a high proportion of the total variance (R=0.8) but the second variable may only explain very little extra variance (R=0.02, the give a total of 0.82), they 'overlap' each other. If the two variables were less correlated the second one may explain less variance (R=0.15) but together they explain a larger total variance (R= 0.95)
- Importance of predictors: If the predicting variables are highly correlated and account for similar variance, how do you tell which one is the most important?

A look at the correlation matrix will highlight correlations of 0.8 or above and the use of the Durbin-Watson test will indicate if multicollinearity is a problem (Field, 2009). There are various methods for dealing with this phenomenon. The first method is to remove all but one of the correlated variables from the model, this has the disadvantage of excluding potentially useful inference. Another method is to use a technique call ridge-regression to remove the collinearity but is not often supported by statistical software. There is no mention of collinearity and the design of TPB surveys in the literature but multicollinearity is dealt with when performing the analysis. If multicollinearity is to be avoided the questionnaire should avoid asking similar questions, which in the context of TPB is very difficult if not impossible. The aspects of behaviour being studied will almost certainly be correlated and this correlation is of interest. The important issue is how the data is analysed, e.g. factor analysis to transform the independent variables into a set of uncorrelated factors that can be used instead of the original correlated variables.

In this instance the TPB components are continuous and can be fitted as the independent variables in a multiple regression model to predict the dependent BI variable. However, there are also categorical variables that should be included in the model. In the next section the method of ANOVA is described which deals with the case where the independent variables are categorical as well as GLM, where both continuous and categorical variables are used.

Categorical variables

ANOVA is used to build models to predict the independent variable from categorical variables, as used in section 8.5.1.2, such as gender or age groups. Regression is not appropriate as the variables are not continuous. GLMs combine the continuous (regression analysis) and the categorical (ANOVA) variables into one model. This technique allows one to look at the individual and joint effect of independent variables on one dependent variable (Tabachnick and Fidell, 2007; Pallant, 2010). ANOVA allows for the simultaneous test for the effect of each independent variable on the dependent variable. It can also test for interaction effects, that is, how the effect of one independent variable on the dependent variable depends on the level of the other independent variables (Ai and Norton, 2003). For example, ANOVA allows the researcher to test for gender differences in BI, differences in age groups and BI and also the interactions between these two variables of gender and age (i.e. to explore whether there is a difference in the effect of age on BI for males as compared to females). A detailed explanation of the interaction effect can be found in Ai and Norton (2003). However, unlike multiple regression or ANOVA, GLM does not use the R^2 statistic as a measure of goodness of fit (McCullagh and Nelda, 1989).

For example: A model with one categorical variable,

e.g. 'What is the predicted BI for different age groups'?

$Y_i = d_0 X_0 + d_1 X_1 \ldots d_n X_n$

Where;

$Y_i = BI$

d_0 = Dummy variable equals 1 if respondent is in the 20 to 30 age group and 0 if it is not.

d_1 = Dummy variable equals 1 if respondent is in the 30 to 40 age group and 0 if it is not.

d_n = Dummy variable equals 1 if respondent is in the n^{th} age group and 0 if it is not.

X_n = Mean for the n^{th} age group.

Further categorical variables can be included by adding further dummy variables. The GLM takes this one stage further by the addition of continuous variables in the equation.

To illustrate how this method is applied a simple example is given of using attitude (continuous) and gender and age (both categorical) as independent variables to predict BI (the dependent variable). In simple form this is:

BI = Attitude + Gender + Age

The parameter estimates from fitting this model through GLM are shown in Table 8.34. However, other information such as R^2 and significance levels are not shown as this is simple example of how to use the parameter values to predict BI.

Table 8.34 ANOVA parameter estimates with two categorical variables and a continuous variable

Parameter	B
Intercept	-0.920
Gender - Male	0.590
Gender - Female	0[a]
Age Category – Under 20	0.761
Age Category – 21-30	0.903
Age Category – 31-40	0.794
Age Category – 41-50	0.295
Age Category – 51-60	0.156
Age Category – Over 60	0[a]
Total Attitude	0.008

a This parameter is set to zero as it is relative to other parameters

The results can then be used to predict BI. As an example to predict BI for a 32-year-old male with an Attitude score of 200.

BI = Intercept + Attitude of 200 + male + 32 years old
BI = -0.920 + (0.008 x 200) + 0.590 + 0.794
BI = 2.064, which indicates on a scale of 1-7, with 7 being most likely and 4 being the neutral score, a 32 year old male is unlikely to use FPRM tools in the next year.

8.5.3.2 Building a model

When building a model it is important not to put all the continuous and categorical variables into the model at the same time because:

- too many degrees of freedom are used up, reducing the number of variables in the calculation that can be varied, so potentially reducing the validity of the analysis;
- not all the variables are significant, so should not be included in the model; and
- some variables will be related to each other, so one will be dominant and mask the effects of others.

The goal in producing a model is to infer the underlying process that generated the observed data (Myung and Pitt, 1997). That is, the least complex model that describes the data is the best. The purpose is to find a model that only uses significant variables and that they best describe the data set. This process may not be simple because if there are many variables, it is possible to produce several models containing different significant variables. Also the random noise of the data may make model identification difficult. It is, therefore, the skill of the researcher to evaluate each and choose the most appropriate. There are three dimensions of a model that contribute to its complexity: the number of parameters, the functional form of the model and extension of the parameters' space (Myung and Pitt, 1997).

- Number of parameters: There is a trade-off, as a complex model with many variables may fit the data-set impeccably but will not correctly reflect more generally or encapsulate the processes that generated the data. The best fit should be preferred when it is not achieved at the expense of extra parameters (Myung and Pitt, 1997).

- Functional form: This involves the capturing of irrelevant patterns of data, i.e. the way in which parameters are combined in the model equation. Two models with the same number of parameters but a different functional form may very well give different results. One will be more flexible in fitting data noise and have a better model fit (Myung and Pitt, 1997). This was shown in a comparison of two models of perception (Cutting et al., 1992).

- Extension of parameter space: Consider two models with the same functional form but different parameter ranges; model 1 with a range of $-X$ to X, and model 2 with a range of 0 to X. Model 1 has a parameter range twice that of model 2. The parameter in model 1 can be positive or negative but only positive in model 2. Due to a larger parameter range, model 1 will fit data showing a decreasing pattern better than model 2 (Myung and Pitt, 1997).

In this research, the models are constructed by successively adding variables, running the ANOVA analysis and then removing those variables that are the least significant (one at a time or in groups), until a model results containing only significant variables. This is sometimes referred to as Step-wise regression or a process of reductive recursion, that is, returning to the base state (Soare, 1996).

The resultant models have to be assessed to see intuitive answers and to find relationships within the data. When conducting the ANOVA reduction analysis the analyst can retain some variables until it is felt that their retention can no longer be justified. For instance, keeping Att, SN and PBC in the model until all other non-significant IFF or CBV variables have been removed, then further reducing the model if any are not significant. The result is a parsimonious model, a model that is 'simple'. That is, it explains the data well with the least number of variables. This concept of simplicity in model definition dates back to the Middle Ages with Occam's Razor Theory: that entities should not be multiplied beyond necessity (Myung and Pitt, 1997; Domingos, 1999).

The questionnaire contained five statements regarding BI:

- Overall, adopting the use of hedging tools to market my wheat would be good and fit well with my overall business;
- I intend to make hedging tools my main way in which I market wheat over the next year;
- I intend to use hedging tools in the next year to market my wheat;
- I intend to use hedging tools if I believe the price of wheat will rise over 20% in the next 6 months; and

- I intend to use hedging tools if I believe the price of wheat will rise over 20% in the next 6 months.

However, it was decided that question 1 was really not a true intention statement and was therefore discarded. Question 2 was discarded, as it was believed that this level of intention was unrealistic. Questions 4 and 5 were discarded as it was felt that these intentions would be covered adequately from Question 3. Therefore, only Question 3 was chosen to further develop as the BI.

It was further decided that of all the nine CBV questions (containing 46 sub-questions), only two, past use of FPRMs via an FSA broker or merchant, should be used in the analysis and they were the questions directly related to current behaviour towards the use of hedging tools. The other CBV questions related to other aspects of current behaviour or farming practice.

8.5.3.2.1 Main components model

The components of Total Att, Total SN, Total PBC and Total SN Trust were modelled first and then the 18 IFF, two CBV questions and membership of Agricole were added to see their effects. The significance levels of Total Att, Total SN, Total PBC and Total SN Trust were disregarded at first and left in the analysis until all of the IFF and CBV factors were sequentially analysed. The least significant IFF and CBV results were removed with each recursion until only significant ones remained. The Total Att, Total SN, Total PBC and Total SN Trust components were then removed in turn, again based on their significance until only significant factors remained, as shown in Table 8.35.

Table 8.35 Main component model tests of Between-subject effects.

Source	df	F	Sig
Intercept	1	1.349	.389
Total Att	1	48.931	**.000*** **
Total PBC	1	14.873	**.000*** **
Future/Option use via merchant trade	1	27.089	**.000*** **
Children or not	1	6.732	**.017***
Cropped area	1	2.856	**.018***
Farm type	1	5.961	**.014***
Agricole customer	1	7.450	**.001****

* p-value< 0.05; ** p-value< 0.01; *** p-value< 0.001

Total Att, Total PBC and using the merchant trade to set up a FPRM tool were highly significant (p<0.001). Having children or not, cropped area and farm type were significant (p<0.005). Further, being a member of Agricole was also significant (p<0.01). The parameter estimates and marginal means are shown in Table 8.36. From this analysis it can be seen that increasing Total Att, Total PBC and cropped area over 800 hectares all increase the BI to use FPRM tools. The factors reducing BI are: not having used a merchant to set up a FPRM tool; having children; being a mixed farm; and, having a cropped area under 800 hectares.

Table 8.36 Main model parameter estimates

Parameter	Estimated marginal means	B	Std. Error	t	Sig
Intercept		1.908	.405	4.713	**0.000*** **
Total Att		0.005	0.001	7.140	**0.000*** **
Total PBC		0.005	0.001	3.926	**0.000*** **
Future/Option use via merchant = no	2.881	-0.903	0.133	-6.794	**0.000*** **
Future/Option use via merchant = yes	3.783	0^a			
Children = yes	3.095	-0.473	0.197	-2.400	**0.017***
Children = no	3.568	0^a			
Cropped area – Under 200 hectares	3.199	-0.267	0.349	-0.765	0.445
Cropped area – 201- 400 hectares	2.996	-0.471	0.256	-1.838	0.067
Cropped area – 401 – 800 hectares	3.367	-0.100	0.260	-0.384	0.701
Cropped area – 801 – 1200 hectares	3.631	0.165	0.312	0.528	0.598
Cropped area – Over 1200 hectares	3.467	0^a			
Farm type - Mixed	3.157	-0.349	0.141	-2.478	**0.014** **
Farm type - Arable	3.507	0^a			
Agricole customer – no	3.058	-0.548	0.166	-3.297	**.001** **
Agricole customer - yes	3.606	0^a	.	.	.

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

8.5.3.2.2 Sub-component model

The sub-components of Att and PBC as well as the individual referents for SN and SN Trust were also modelled with the IFFs, two CBV questions and membership of Agricole to predict BI using the same approach as above. The results are shown in Table 8.37 and Table 8.38.

Table 8.37 Sub-component model tests of Between-subject effects.

Source	df	F	Sig
Intercept	1	5.088	**0.077***
Total RA	1	9.027	**0.003****
Total CB	1	15.314	**0.000*****
Total CX	1	7.015	**0.008****
Total EU	1	13.237	**0.000*****
Total RX	1	3.884	**0.049***
Press trust	1	5.083	**0.025***
Academic Trust	1	5.358	**0.021***
Total independent advisor Trust	1	15.445	**0.000*****
Total press Trust	1	4.138	**0.043***
Total information	1	5.947	**0.015***
Future/Option use via merchant trade	1	16.473	**0.000*****
Children or not	1	9.097	**0.003****
Farm type	1	7.759	**0.006****

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

Total CB, Total EU, Total independent advisor Trust and using the merchant trade to set up a FPRM tool were highly significant (p<0.001). Total RA, Total CX, Total RX, press Trust, academic Trust, Total press Trust, Total information, having children or not and farm type were also significant (p<0.01). The parameter estimates are shown in Table 8.38. From this analysis it can be seen that Total RA, Total CB, Total EU, press Trust, independent advisor Trust and Total information all have positive B values, increasing the BI to use FPRM tools. The factors reducing BI are: Total CX; Total RK; academic trust; Total press trust; not having used a merchant to set up a FPRM tool; having children; and, having a mixed farming enterprise. Interestingly, membership of Agricole was not significant. It could be that the combinations of other variables are masking the effect of membership or accounting for it.

Table 8.38 Sub-component model parameter estimates

Parameter	B	Std. Error	t	Sig
Intercept	1.938	.355	5.455	**0.000*** **
Total RA	.006	.002	3.005	**0.003** **
Total CB	.009	.002	3.913	**0.000*** **
Total CX	-.009	.003	-2.649	**0.008** **
Total EU	.025	.007	3.638	**0.000*** **
Total RK	-.005	.003	-1.971	**0.049* **
Press trust to use FPRM	.038	.017	2.255	**0.025* **
Academic trust to use FPRM	-.018	.008	-2.315	**0.021* **
Total Independent advisor trust	.015	.004	3.930	**0.000*** **
Total Press Trust	-.018	.009	-2.034	**0.043* **
Total Information	.010	.004	2.439	**0.015* **
Future/Option use via merchant trade = no	-.561	.138	-4.059	**.000*** **
Future/Option use via merchant trade = yes	0[a]	.	.	.
Children = yes	-.592	.196	-3.016	**0.003** **
Children = no	0[a]	.	.	.
Farm type - Mixed	-.386	.139	-2.785	**0.006** **
Farm type - Arable	0[a]	.	.	.

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

a. This parameter is set to zero because it is relative to other parameters

8.5.4 Conclusion

Section 8.5.3 introduces the concepts of GLM and how it is useful to estimate both categorical and continues variable in a data set and described the best model for both the main components of TPB and the DTPB. ANOVAs were run on both the major and sub-constructs, with the addition of the IFFs, two CBV's and Agricole members on BI, expressed as the question, "I intent to use hedging tools in the next year to market my wheat". The analysis found that when considering only the main constructs in total only Total Att and Total PBC were significant in the final model, and of the IFFs children or not, cropped area, farm type and being an Agricole member were the only significant factors. The use of futures/options via the merchant trade was also significant.

When analysing the sub-constructs the final model revealed a more complex model, with not all of the sub-constructs being retained as significant. It is noticeable that all the Att sub-constructs were retained, indicating the great importance of the overall attitude toward the use of FPRM tools and the small negative B values of complexity and risk. However, not all the SN, Total SN Trust and PBC sub-construct were retained, of particular interest was the non-retention of significant merchant influence. Children or not, futures/options via a merchant and farm type were significant again, but this time being an Agricole customer was not.

It was therefore decided to carry out Factor Analysis (FA) and Cluster Analysis (CA) as *post hoc* analysis. The primary reason for using these techniques was the failure of GLM to incorporate many of the independent variables that were intuitively affect the BI but because of high correlation that exists between the variables, the GLM technique could only produce a model with a limited number of significant variables and satisfy the conditions for using OLS. As will be shown the techniques of FA and CA enable more information to be retained and to reduce the number of variables to build a better picture of the relationships between factors and also group factors into similar categories.

8.6 Factor Analysis

8.6.1 Introduction

Factor analysis is a statistical technique that reduces a set of variables into a smaller number of factors (Pallant, 2010). Each derived factor represents a latent variable that can be interpreted and then used in subsequent analysis such as regression or GLM. Often variables in a data set are correlated which presents problems for techniques such as regression as one variable tends to dominate over others and information is lost when constructing prediction models (Bowerman and O'Connell, 1990). This is because the value of the regression coefficient for one variable changes depending on which other variables are used in the equation (Mallarino et al., 1999). Tests of significance become unreliable when variables are highly correlated. FA and also principal component analysis (PCA) create a set of new uncorrelated, or nearly uncorrelated factors (Mallarino et al., 1999). By reducing a data set from a group of interrelated variables to a set of factors FA achieves parsimony by explaining the maximum amount of common variance in a correlation matrix using the smallest number of explanatory constructs (Field, 2009). FA can be exploratory or confirmatory. Exploratory is to explore the interrelationships among a set of variables at the early stage of the research process. Confirmatory is more complex and used later in the research process to confirm specific theories or hypotheses underlying a set of variables.

A number of issues need to be considered when embarking on FA: the choice of factor model; the number of factors to retain; the rotation method; the interpretation of the factor solution; and, the sample size (Ford et al., 1986; Raven, 1994). FA can be divided into common FA and component FA (Ford et al., 1986). The former assumes the variance in a variable can be divided into common and unique components whilst the latter does not. Common FA is more appropriate when the variables are assumed to be a linear function of latent variables, which is the case here. A component model is used when the goal is to explain the variance of observed variables (Tucker et al., 1969; Ford et al., 1986; Raven, 1994).

When assessing the strength of the intercorrelations among the variables the correlation matrix produced should give correlations of over 0.3 (Tabachnick and Fidell, 2007) or FA may not be appropriate. SPSS 20 produces two statistical measures to assess the factorability of a data set: Bartlett's test of sphericity (Bartlett, 1954); and, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (Kaiser, 1970; Kaiser and Rice, 1974). The Bartlett's test of sphericity should be significant ($p < 0.05$) whilst KMO ranges from 0-1 with 0.6 considered the minimum to use FA (Tabachnick and Fidell, 2007).

The next stage in FA is factor extraction and is used to determine the smallest number of factors that can be used to represent the interrelationships amongst a set of variables (Ford et al., 1986). A commonly used approach is that of PCA although there is no precise method and relies on the researcher experimenting with a different number of factors until a satisfactory solution is found (Tabachnick and Fidell, 2007). Various criterion rules often result in different solutions (Humphreys and Ilgen, 1969; Humphreys and Montanelli Jr, 1975; Ford et al., 1986). The result must balance the conflicting needs of achieving a simple model with as few factors as possible and the need to explain as much of the variance of the original data set as possible (Pallant, 2010).

Kaiser's criterion, scree tests and parallel analysis are used to help in the decision as to which is the most appropriate number of factors to choose (Zwick and Velicer, 1986; Pallant, 2010). Kaiser's criterion uses 'eigenvalues' to explain how much of total variance of the data that is explained by the factor. Only factors with eigenvalues of over 1.0 are acceptable and should be retained for use in FA (Tucker et al., 1969; Weiss, 1976a; Kim and Mueller, 1978). Scree tests (Cattell, 1966; Ford et al., 1986) involve plotting the eigenvalues and assessing where there is a sharp point of inflection on the graph (Field, 2009). Cattell (1966) recommends retaining all factors to the left but excluding the turning point as these factors explain most of the variance of the dataset. Scree slope plots are considered a reliable criterion for factor selection when there is a sample of more than 200 participants (Stevens, 2002). Parallel analysis or Horn's parallel analysis (Horn, 1965) compares the size of the eigenvalues from the data set with those generated from a random data set of the same size. Only eigenvalues greater than those randomly generated should be used. This method has been shown to be more accurate than the Kaiser's criterion and scree test (Zwick and Velicer, 1986; Hubbard and Allen, 1987).

Rotation of the factors is used to achieve a simple structure to the model (Thurstone, 1947). The process of rotation is to improve the meaningfulness, reliability and reproducibility of factors (Weiss, 1976b; Ford et al., 1986; Raven, 1994). It presents the factor loadings, or weights of each of the original variables within each derived factor, in a manner that is easier to interpret. Rotation maximises the loading of each variable on one of the extracted factors while minimising the loadings on all other factors (Field, 2009). However, it is up to the researcher to interpret the analysis based on their knowledge of the variables within each factor. There are two types of rotation, orthogonal (uncorrelated) or oblique (correlated) (Ford et al., 1986; Raven, 1994). Before rotation, all factors are independent and are uncorrelated. Orthogonal results are easier to report but the researcher must assume that the underlying constructs are independent (not correlated) which may not be true. Oblique are more difficult to report but allows for the factors to be correlated (Tabachnick and Fidell, 2007; Pallant, 2010). Within each of these methods are several variations that can be used.

The choice of rotation depends on whether there is a theoretical reason for supposing that the factors should be related or independent and how the variables cluster on the factors before rotation. Oblique rotation should only be used if there are good reasons to suppose that the underlying factors could be related in theoretical terms (Field, 2009). Oblique rotation adds statistical complexity but also further information due to the factor intercorrelations (Ford et al., 1986). Oblique rotation therefore more accurately reflects the real world situation (Harman, 1960; Raven, 1994). In this research, involving human behaviour, it is most likely that factors correlate and so orthogonal rotations seem inappropriate and an oblique rotation is used.

Once a factor structure has been found, it must be decided which variables comprise which factors. Ford et al. (1986) suggest factor loadings of at least 0.4 whilst others suggest factor loadings of a minimum of 0.3 but this may vary with sample size (Stevens, 2002). It is recommended that for FA to be meaningful, and for the coefficients among the variables to be reliable, that as large a sample as possible is best (Stevens, 2002). In this analysis the sample size is considered large so a minimum of 0.3 can be used. As previously stated the aim is to produce a model so each variable will be strongly loaded onto one component and each component is represented by a number of strongly loaded variables. However, before a final decision is made on factor retention, the resulting factors should be evaluated and understood based on the researcher's knowledge of the variables and the investigation of all factor loadings (Raven, 1994)

8.6.2 Analysis of data, SPSS20

FA was applied to the seventeen questions used to elicit Att, the ten for SN and SN trust and the six for PBC. It was decided to retain the distinction between the main TPB constructs rather than group all variables together in a single analysis. Initial checks of the correlation matrices showed that they satisfied the above KMO and sphericity tests so factor analysis was considered appropriate. The choice of how many factors and the most appropriate rotation was made simultaneously by examining the results of different combinations of factors and rotations as well as the results of the initial results of the unrotated PCA. Interpretation of output follows broadly the steps outlined in Pallant (2010) and Field (2009).

8.6.2.1 FA and Att components

Initial PCA of the Att variables revealed how many components (factors) to extract by Kaiser's criterion of eigenvalues of 1 or more. Three were over 1 (6.499, 2.360, 1.118) and the fourth was 0.919. The three components explained 58.69% of total variance, 38.23%, 13.88% and 6.58% respectively. The fourth explained 5.40%. The results are summarised in Table 8.39. However, the scree plot, detailed in Figure 8.1 suggests a clear break after the third component, suggesting the retention of only two components (Cattell, 1966). This was further supported by the results of Parallel Analysis (Watkins, 2000). The 17 eigenvalues from the analysis are compared with another 17 eigenvalues generated from 100 sets of random data of the same size as the real data set (see Table 8.40). If the real eigenvalue is larger than the randomly generated criterion values, then the factor is accepted. Analysis showed only two components with eigenvalues exceeding the corresponding criterion values for a randomly generated data matrix.

Table 8.39 Total variance explained – Attitude.

	Initial	Eigenvalues	
Component	Total	% of Variance	Cumulative %
1	6.499	38.227	38.227
2	2.360	13.883	52.109
3	1.118	6.579	58.688
4	.919	5.403	64.092
5	.843	4.958	69.050
6	.790	4.646	73.696
7	.685	4.031	77.727
8	.634	3.728	81.455
9	.538	3.165	84.620
10	.461	2.715	87.334
11	.425	2.502	89.837
12	.380	2.238	92.075
13	.352	2.073	94.148
14	.324	1.906	96.054
15	.254	1.494	97.548
16	.216	1.272	98.820
17	.201	1.180	100.000

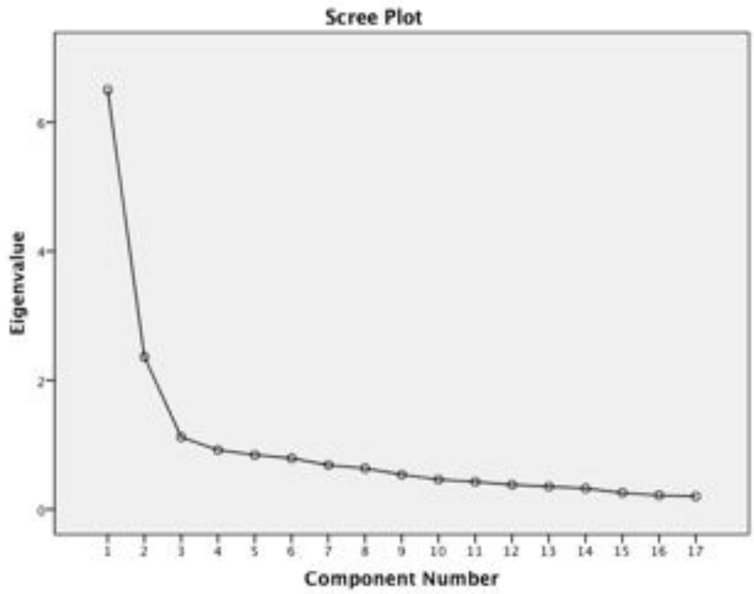


Figure 8.1 Scree plot for Attitude component.

Table 8.40 Comparison of eigenvalues from data file and those of Parallel Analysis

Component number	Actual eigenvalue	Value from parallel analysis	Decision
1	6.499	1.283	Accept
2	2.360	1.225	Accept
3	1.118	1.1817	Reject
4	0.919	1.1468	Reject

The PCA was re-run using only two components; however, but the results did not provide any meaningful interpretation. Therefore, to achieve a meaningful structure various combinations of factor numbers and rotations, based on the criteria described above, were tried before a final set of factors was reached. In the case of Att this resulted in choosing four factors with a Promax rotation. The four-component Promax solution explained 64.09% of the total variance, with components 1 to 4 contributing 38.22%, 13.88%, 6.58% and 5.40% respectively. The final factor loadings are shown in Table 8.41.

Table 8.41 Variables for each of the components and factor loadings from Promax rotation.

Factor name	Variables	Factor loading
Financial strategy	Importance of budgeting	0.936
(% of variance 38.22)	Importance of a min price	0.899
	Importance of negative effects of marketing	0.880
	Importance of cash flow	0.661
	Importance of second chance of marketing	0.634
	Importance of a good business fit of new selling method	0.520
	Importance of a good risk management strategy	0.472
	Importance of other selling methods	0.406
	Importance of experience & confidence	0.413
Trading strategy	Importance of 'traditional' selling methods	0.769
(% of variance 13.88)	Importance of existing trading relationships	0.735
	Importance of ease of use of new method	0.607
	Importance of other selling methods	0.579
	Importance of a good business fit of new selling method	0.387
	Importance of a good risk management strategy	0.372
Risk/Fear	Importance of experience & confidence	0.781
(% of variance 6.58)	Importance of not having quality and quantity penalties	0.762
	Importance of not having less money than using trad methods	0.752
	Importance of lack of complexity of new method	0.678
Income securement	Importance of having a better price than other farmers	0.839
(% of variance 5.40)	Importance of known income	0.718

The results showed that the Att component was sub-divided into four factors. This differs from the five sub-constructs of the proposed model in section 5.2.3. When considering the nine variables in the Financial strategy factor (in order of factor loading), the first five variables are all associated with budgeting, the remaining four factors with price risk reduction in wheat marketing or for the overall business. The budgeting variables have the highest factor loading (over 0.6) and are therefore the most important for this factor grouping.

When considering the six variables in the Trading strategy factor (in order of factor loading) the first four variables are associated with selling methods and relationships. The final two variables are associated with good business fit and a good risk management strategy. The selling methods and existing trading relationships variables have the highest factor loading (over 0.5) and are therefore the most important for this factor grouping.

The four variables in the Risk/Fear factor (in order of factor loading) are; experience and confidence: not having quantity and quality problems; not having less money than traditional selling methods; and, the complexity of a new method. These Risk/Fear variables have factor loading of over 0.65 and are all therefore very important for this factor grouping but in the overall context only explained 6.58% of total variance, so of less importance than the first two factors.

The factor, Income securement, (in order of factor loading) is the importance of: having a better price than other farmers and, a known income. These Income securement variables have factor loadings of over 0.7 and are therefore very important for this factor grouping but in the overall context only explained 5.4% of total variance, so of less importance than the first two factors.

8.6.2.2 SN and Total SN trust

Initial PCA analysis revealed how many components (factors) to extract by the Kaiser's criterion of eigenvalues of 1 or more. Four were over 1 (4.39, 1.73, 1.42 and 1.24). The four components explained 87.94% of total variance, 43.91%, 17.31%, 14.24% and 12.47% respectively, as shown in Table 8.42. However, the scree plot was less clear suggesting a break after the first, fourth and sixth components and the retention of only one, three or five components (Cattell, 1966), as shown in Figure 8.2.

Table 8.42 Total variance explained – SN and Total SN Trust.

	Initial	Eigenvalues	
Component	Total	% of Variance	Cumulative %
1	4.392	43.918	43.918
2	1.731	17.313	61.231
3	1.424	14.243	75.474
4	1.247	12.470	87.944
5	.679	6.794	94.738
6	.213	2.135	96.873
7	.126	1.261	98.134
8	.082	.822	98.956
9	.058	.578	99.534
10	.047	.466	100.000

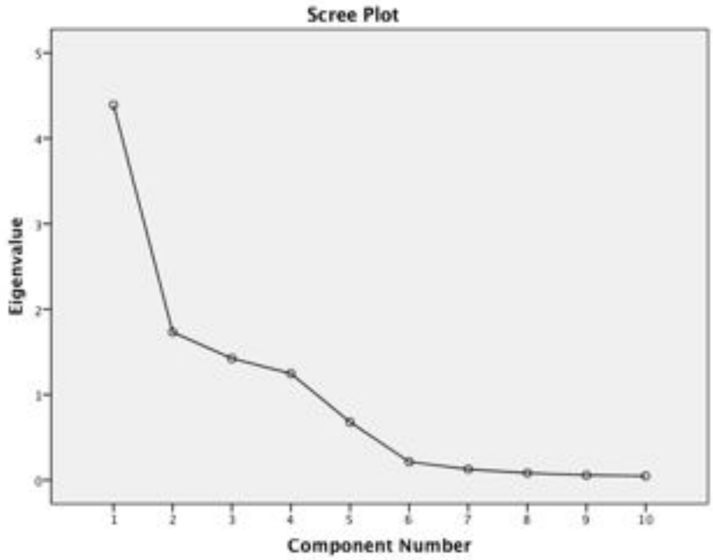


Figure 8.2 Scree plot for SN and Total SN Trust component.

The four factor solution was further supported by the results of Parallel Analysis (Watkins, 2000). The 10 eigenvalues from the analysis are compared with another 10 eigenvalues generated from 100 sets of random data of the same size as the real data set, detailed in Table 8.43. Analysis showed four components with eigenvalues exceeding the corresponding criterion values for a randomly generated data matrix.

Table 8.43 Comparison of eigenvalues from random data file and those of Parallel Analysis.

Component number	Actual eigenvalue	Value from parallel analysis	Decision
1	4.392	1.201	Accept
2	1.731	1.136	Accept
3	1.424	1.0900	Accept
4	1.247	1.048	Accept
5	0.679	1.015	Reject

However, as was the case with Att, the results of using these four factors did not provide an adequate interpretation of the data. Therefore, the same procedure as section 8.6.2.1 was followed to extract the most appropriate factors. This resulted in choosing four factors with a Promax rotation. Each component showed two very strong loadings, except component 1, which had four very strong loadings as shown in Table 8.44.

Table 8.44 Variables for each of the components and factor loadings from Promax rotation.

Factor name	Variables	Factor loading
Non-farming advice	Total press Trust	0.907
(% of variance 43.92)	Influence of academia advice	0.893
	Total academia Trust	0.883
	Influence of press advice	0.857
Independent advisor advice	Influence of independent advisor advice	0.988
(% of variance 17.31)	Total independent advisor Trust	0.962
Peer advice	Influence of peer advice	0.98
(% of variance 14.24)	Total peer Trust	0.968
Merchant advice	Total merchant Trust	0.955
(% of variance 12.47)	Influence of merchant advice	0.943

It was interesting how the factors were divided and differentiated into factor groups almost corresponding to the five sub-components of SN in the national questionnaire of: press and academia (non-farming); independent advice; peers; and, merchants. The factor loadings were very high in all the groups, all over 0.85.

When considering the factor Non-farming advice, the variables of press and academia's Trust and advice had factor loading of over 0.85. When considering the factor Independent advisor's advice, the variables of independent advisor's Trust and advice had factor loading of over 0.95. When considering the factor Peer advice, the variables of peer's Trust and advice had factor loading of over 0.95. When considering the factor Merchant advice, the variables of merchant's Trust and advice had factor loading of over 0.90.

8.6.2.3 PBC

Initial PCA analysis revealed how many components (factors) to extract by the Kaiser's criterion of eigenvalues of 1 or more. Only one component is over 1 and is shown in Table 8.45. The scree plot too showed a break after the second component, suggesting only the retention of one component (Cattell, 1966), as shown in Figure 8.3.

Table 8.45 Total variance explained – PBC.

	Initial	Eigenvalues	
Component	Total	% of Variance	Cumulative %
1	3.842	64.031	64.031
2	.859	14.320	78.351
3	.506	8.441	86.792
4	.412	6.874	93.665
5	.245	4.088	97.753
6	.135	2.247	100.000

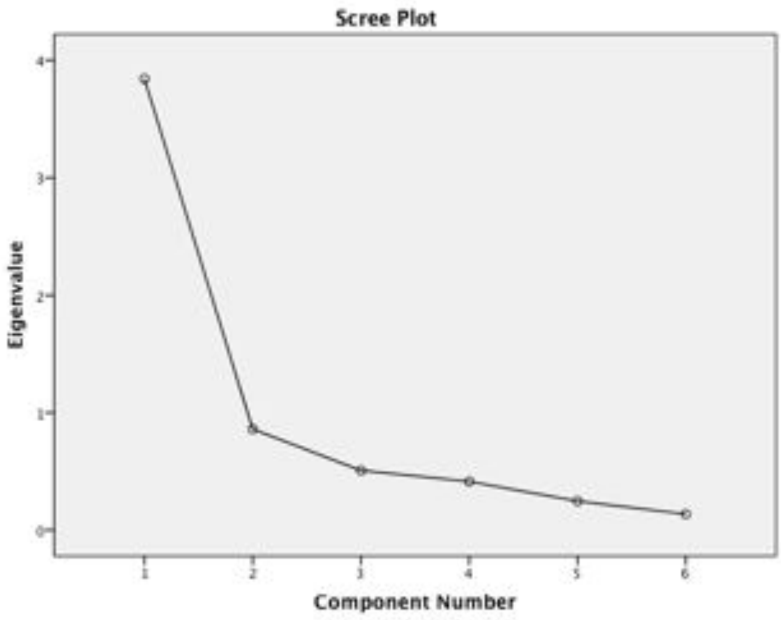


Figure 8.3 Scree plot for PBC

This was further supported by the results of Parallel Analysis (Watkins, 2000). The six eigenvalues from the analysis are compared with another six eigenvalues generated from 100 sets of random data of the same size as the real data set. Analysis showed one component with an eigenvalue exceeding the corresponding criterion value for a randomly generated data matrix, as detailed in Table 8.46.

Table 8.46 Comparison of eigenvalues from data file and those of Parallel Analysis.

Component number	Actual eigenvalue	Value from parallel analysis	Decision
1	3.842	1.127	Accept
2	0.859	1.067	Reject
3	0.506	1.019	Reject
4	0.412	0.9780	Reject

The resulting output, however, with one component was not considered meaningful because it showed no differentiation of variables and therefore potentially loses a lot of information. Therefore, the same procedure as above was used to find a more appropriate solution. In the case of PBC this resulted in choosing two factors with a Promax rotation. Component 1 showed four very strong loadings and component 2 showed two strong loadings, as shown in Table 8.47.

Table 8.47 Variables for each of the components and their factor loadings from Promax rotation.

Factor name	Variables	Factor loading
Verbal help (% of variance 64.03)	Influence of one to one seminars in use of FPRM tools	0.966
	Influence of practical help in use of FPRM tools	0.890
	Influence of monitoring & reviewing when using FPRM tools	0.889
	Influence of technical seminars in use of FPRM tools	0.703
Verbal help (% of variance 14.32)	Influence of good press information in use of FPRM tools	0.959
	Influence of on-line information in use of FPRM tools	0.791

From FA the factors were divided and differentiated into factor groups of Verbal help and Written help, rather than the three PBC sub-constructs of training, information and support from the model. The factor loadings of all factor variables ranged from 0.7 to 0.966.

When considering the factor Verbal help, the variables of 'one to one seminars', 'practical help' and 'monitoring and reviewing' had factor loadings of over 0.88. This shows the importance placed on a close personal relationship when discussing FPRM tools. When considering the factor 'technical seminars', a factor loading of 0.703 was found. This suggests that, although being an important variable, having FPRM tool information disseminated in a group environment is of less importance than one to one help.

When considering the factor Written help, the variable ‘influence of good press information’ had a factor loading of 0.959, showing the importance of good press information when discussing FPRM tools. When considering the factor, ‘on-line information’, a factor loading of 0.791 was found. This suggests that, although being an important variable, having FPRM tool information disseminated on-line is of less importance than the physical print media.
The % of variance explained by each factor clearly shows that factor 1, ‘Verbal help’ is more important than the ‘written help’, so suggests the face-to-face contact with farmers when explaining FPRM tools most likely to affect the BI to use FPRM tools.

8.6.2.4 Factors versus Behavioural Intent analysis

Correlation analysis was conducted on the factors and intention to use FPRM tools in the next year and compared with the correlation results from the TPB sub-constructs. The results are shown in Table 8.48. From the correlation table it was found that all the ten newly formed factors from Att, SN and PBC were significant ($p<0.05$). Seven were significant at $p<0.001$. The Att and PBC constructs were the most significant ($p<0.001$). Nine factors were positively correlated. Only the Att ‘Risk/fear’ factor was negatively correlated. This seemed intuitively correct, suggesting that the higher the risk/fear of using FPRM tools, the less the intention to use them. The factors of ‘Financial/budgeting strategy’ and ‘Trading strategy’ had the highest correlation coefficients of over 0.5. The factors with correlations over 0.3 to 0.5 were for ‘independent advisor advice’ and ‘verbal information’.
Comparing the TPB sub-constructs with the newly formed factors from FA show that some factors are similar such as ‘risk’ and ‘merchant advice’, for example. Others are distinctly different, such as ‘verbal information’ and ‘inancial/budgeting strategy’ and provide an alternative description of behaviour.

Table 8.48 Pearson correlation between the new factors and intention compared to 'old' scores in Table 8.32 to use FPRM next year.

Construct	FA - Factor name	Pearson correlation	Sig	TRB – Factor Name	Pearson correlation	Sig
Attitude	Financial/budgeting strategy	0.616 ***	< 0.001	RA	0.568***	< 0.001
	Trading strategy	0.523 ***	< 0.001	CB	0.572***	< 0.001
	Risk/fear	-0.284 ***	< 0.001	CX	-0.114**	0.005
	Income securement	0.292 ***	< 0.001	EU	0.352***	< 0.001
				RK	-0.800	0.052
SN	Non-farming advice	0.09 *	< 0.05	Merchant influence	0.193***	< 0.001
	Ind advisor advice	0.406 **	< 0.001	Ind Advisor influence	0.395***	< 0.001
	Peers advice	0.105 *	<0.05	Peers influence	0.124**	0.004
	Merchant advice	0.152 **	<0.01	Press influence	0.139**	0.001
				Academic influence	0.073	0.090
				Merchant influence	0.193***	< 0.001
PBC	Verbal information	0.324 ***	< 0.001	Training influence	0.323***	< 0.001
	Written information	0.26 ***	< 0.001	Information influence	0.276***	< 0.001
				Support influence	0.288***	< 0.001

Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed);
*** Correlation is significant at the 0.001 level (2-tailed)

8.6.2.5 Factors versus farmer characteristics IFF

ANOVA was conducted on the factors and the IFFs and the output is detailed in Table 8.49. From Table 8.49 it is seen that only: gender; age; number of children; years in the business; level of education; cropped area; farm type; percentage Group 1 wheat grown; and, farm size factors were producing significant *F*-test results (p<0.05). Gender showed a significant result for the SN 'Non-farming advice' (p<0.001) and the PBC 'Written help' (p<0.05). Age showed a significant result for Att factors of 'Financial/budgeting' strategy (p<0.001), 'Trading strategy' (p<0.001) and 'Risk/fear factor' (p<0.001). The scores for all these factors reduced with age, which may indicate that older farmers practised less budgeting, had less of a trading strategy, were less fearful and had a higher risk-taking attitude than younger farmers. Older farmers also placed importance on the use of 'Independent advisor advice' (p<0.001). The number of children showed a significant result for Att factors of 'Financial/budgeting strategy' (p<0.05) and 'Trading strategy' (p<0.05). Those with children had higher scores suggesting that having dependants meant that having a trading strategy to achieve certain budgets was more important than if there were no dependants. This is possibly due to the fact that farming is often perceived as a long-term inter-generational occupation with long timescales, so that business preservation and succession are seen as very important.

Table 8.49 Aggregated scores for new FA Factors and IFFs (Mean (Standard deviation)).

		Attitude New Factors				SN New Factors				PBC New Factors	
		Financial /budgeting strategy	Trading strategy	Risk/Fear	Income securement	Non-Farming advice	Independent Advisors advice	Peer advice	Merchant advice	Verbal help	Written help
Overall Mean		0.03 (1.00)	0.07 (0.96)	-0.01 (0.96)	0.00 (0.96)	0.00 (0.99)	-0.02 (0.97)	-0.01 (0.98)	-0.02 (0.97)	0.01 (1.00)	-0.01 (0.99)
	F-test	**48.87 *****	**33.28 *****	**9.07 *****	**8.99 *****	1.72	**16.63 *****	**2.93***	**3.99 *****	**14.01*****	**9.19 *****
Gender											
	Male	0.03 (0.99)	0.07 (0.95)	-0.02 (0.95)	-0.02 (0.94)	-0.03 (0.96)	-0.03 (0.97)	-0.02 (0.97)	-0.02 (0.96)	0.02 (0.99)	-0.02 (0.98)
	Female	0.23 (1.24)	0.17 (1.43)	0.38 (0.95)	0.46 (1.43)	0.83 (1.73)	0.10 (1.11)	0.12 (1.23)	-0.06 (1.43)	-0.17 (1.41)	0.55 (1.50)
	F-test	0.39	0.11	1.73	2.42	**8.91 *****	0.20	0.22 (0.64)	0.02	0.47	**4.45 ***
Age											
	Under 20	0.36 (1.17)	0.37 (0.72)	-0.40 (0.63)	0.50 (1.63)	0.71 (1.86)	-0.24 (0.59)	0.02 (1.40)	-0.10 (0.73)	0.16 (1.40)	0.26 (1.46)
	21-30	0.33 (1.02)	0.24 (1.02)	-0.36 (0.97)	0.31 (0.92)	0.06 (0.78)	0.19 (1.00)	-0.12 (0.70)	0.31 (1.28)	0.25 (1.01)	0.03 (0.80)
	31-40	0.37 (0.82)	0.32 (0.92)	-0.35 (0.85)	-0.08 (0.86)	0.17 (0.95)	0.27 (0.98)	-0.07 (0.86)	-0.09 (0.95)	0.28 (0.94)	0.22 (0.90)
	41-50	0.09 (1.01)	0.06 (0.98)	0.01 (0.90)	0.00 (0.99)	-0.02 (0.94)	0.13 (0.93)	0.00 (1.04)	0.05 (0.96)	0.10 (0.97)	0.01 (0.91)
	51-60	-0.09 (1.00)	0.08 (0.91)	0.18 (1.01)	0.01 (0.91)	-0.05 (1.00)	-0.12 (0.93)	0.04 (0.97)	-0.04 (0.94)	-0.08 (0.92)	0.00 (1.07)
	Over 60	-0.28 (0.97)	-0.25 (0.96)	0.10 (0.93)	-0.13 (1.03)	-0.12 (1.09)	-0.51 (1.01)	-0.15 (0.99)	-0.25 (0.87)	-0.37 (1.21)	-0.32 (1.12)
	F-test	**3.94 *****	**2.52 ***	**4.34 *****	1.23	1.53	**5.90 *****	0.42	1.47	**4.27 *****	**2.30 ***
Principal farm location											
	East	0.05 (1.06)	0.11 (1.00)	0.02 (0.91)	-0.05 (0.97)	-0.08 (0.94)	0.06 (0.98)	0.03 (1.08)	-0.02 (0.96)	0.03 (1.01)	-0.13 (0.96)
	E. Mids	-0.12 (0.98)	-0.04 (0.85)	-0.01 (1.08)	-0.08 (0.86)	0.05 (1.03)	-0.06 (1.04)	-0.13 (0.89)	-0.12 (1.04)	-0.12 (1.04)	-0.07 (1.07)
	N. East	0.12 (0.99)	0.21 (0.74)	-0.12 (0.56)	0.10 (1.13)	0.41 (1.40)	-0.28 (0.88)	0.17 (1.17)	0.31 (1.33)	0.38 (1.10)	0.26 (1.34)
	N. West	0.46 (0.43)	0.56 (0.87)	-0.40 (0.82)	1.08 (1.04)	0.18 (1.04)	-0.36 (0.65)	-0.09 (0.25)	-0.30 (0.74)	-0.96 (1.17)	-0.34 (1.65)
	S. East	0.01 (1.01)	-0.03 (0.93)	-0.18 (1.01)	-0.08 (0.90)	0.09 (0.94)	-0.07 (1.00)	-0.16 (0.88)	-0.16 (0.91)	-0.11 (0.94)	0.01 (0.88)
	S. West	0.07 (0.95)	0.09 (0.98)	-0.10 (0.76)	0.13 (0.97)	0.05 (1.15)	0.02 (1.11)	0.03 (0.97)	0.19 (1.08)	0.35 (0.95)	0.24 (0.97)
	W. Mids	0.00 (1.03)	0.02 (0.93)	-0.09 (0.97)	0.02 (0.92)	-0.15 (0.68)	-0.05 (0.77)	0.21 (0.91)	-0.06 (0.99)	-0.03 (0.95)	0.18 (0.83)
	Yorkshire & Humberside	-0.05 (0.94)	-0.02 (1.14)	0.25 (0.94)	0.01 (1.10)	0.10 (1.10)	-0.03 (0.79)	0.09 (0.86)	0.08 (0.96)	0.14 (0.95)	0.17 (0.94)
	F-test	0.40	0.53	1.02	1.05	0.83	0.46	0.80	0.96	2.40 (0.02)	1.58 (0.14)
Children or not											
	Yes	-0.01 (0.99)	0.04 (0.97)	-0.04 (0.96)	-0.03 (0.94)	-0.01 (1.00)	-0.01 (0.98)	-0.03 (0.98)	-0.05 (0.93)	-0.01 (1.00)	0.00 (1.01)
	No	0.33 (1.01)	0.31 (0.88)	0.16 (0.90)	0.20 (1.08)	0.04 (0.97)	-0.09 (0.93)	0.04 (1.03)	0.19 (1.29)	0.19 (1.04)	0.01 (0.90)
	F-test	**5.89 ***	**4.31 ***	2.16	3.09 c	0.12	0.35 (	0.22	3.02 c	2.38	0.01
Successor											
	No	0.06 (1.05)	0.10 (0.99)	-0.12 (0.92)	-0.04 (0.94)	-0.04 (0.90)	0.02 (0.95)	-0.06 (0.94)	0.03 (0.95)	0.07 (1.00)	-0.01 (0.92)
	Yes	-0.03 (0.95)	0.03 (0.92)	0.12 (0.97)	0.03 (0.99)	0.02 (1.08)	-0.08 (0.97)	0.02 (1.04)	-0.09 (0.98)	-0.07 (1.00)	0.01 (1.08)
	F-test	1.10	0.74	**7.47 ***	0.48	0.49	1.16	0.75	1.78	2.96	0.09
Position in business											
	Primary	0.07 (1.01)	0.10 (0.96)	-0.04 (0.92)	-0.03 (1.00)	-0.03 (1.00)	0.00 (1.04)	-0.06 (1.03)	-0.07 (1.00)	0.05 (1.00)	0.03 (1.04)
	Secondary	0.43 (1.05)	0.34 (1.03)	-0.26 (0.88)	0.21 (1.44)	0.21 (1.44)	0.20 (1.42)	0.01 (1.19)	0.17 (0.89)	0.24 (1.09)	0.26 (1.09)
	Joint	-0.12 (0.98)	0.00 (0.97)	0.11 (1.02)	0.02 (0.87)	0.02 (0.87)	-0.03 (0.90)	0.08 (0.91)	0.01 (0.95)	-0.14 (1.01)	-0.06 (0.92)
	F-test	2.84 c	1.02	1.69	0.43	0.32	0.92	0.98	0.56	2.50	1.00
Years in business											
	Under 10	0.47 (0.91)	0.29 (0.87)	-0.26 (0.85)	0.34 (1.12)	0.34 (1.07)	0.32 (0.96)	0.07 (0.89)	0.28 (1.09)	0.40 (1.01)	0.28 (1.02)
	11-20	0.30 (0.93)	0.19 (0.99)	-0.36 (0.80)	-0.20 (0.87)	0.11 (0.99)	0.21 (0.92)	-0.25 (0.78)	-0.20 (1.01)	0.06 (0.92)	0.06 (0.94)
	21-30	0.03 (0.97)	0.01 (0.95)	-0.01 (0.97)	0.01 (0.89)	-0.01 (0.88)	0.11 (0.95)	-0.01 (0.93)	0.12 (1.00)	0.06 (0.91)	0.01 (0.90)
	31-40	-0.08 (0.96)	0.03 (0.88)	0.05 (0.90)	-0.05 (0.95)	-0.06 (0.95)	-0.08 (0.97)	0.13 (1.14)	-0.08 (0.87)	-0.04 (0.97)	-0.03 (0.98)
	41-50	-0.18 (1.15)	0.07 (1.12)	0.41 (1.07)	0.10 (0.99)	-0.18 (1.13)	-0.50 (0.86)	-0.13 (0.95)	-0.22 (0.89)	-0.21 (1.08)	-0.13 (1.14)
	Over 50	-0.58 (0.82)	-0.41 (1.11)	0.03 (0.94)	-0.36 (0.98)	-0.37 (1.14)	-0.66 (1.14)	-0.09 (0.71)	-0.26 (0.70)	-0.61 (1.39)	-0.41 (1.33)
	F-test	**5.56 *****	1.74	**5.88 *****	**2.83 ***	**2.49 ***	**7.61 *****	1.84	**3.07***	**4.35 *****	1.99
Highest level of Education											

	Secondary	-0.38 (0.87)	-0.16 (0.87)	0.11 (1.01)	0.08 (0.97)	0.00 (0.96)	-0.25 (0.90)	0.04 (0.84)	-0.06 (1.03)	-0.29 (1.03)	-0.03 (1.01)
	Degree	0.15 (1.01)	0.12 (0.97)	0.00 (0.94)	0.00 (0.95)	-0.01 (1.00)	0.06 (0.99)	-0.02 (0.98)	0.00 (0.95)	0.11 (0.97)	0.04 (0.99)
	Post-Grad	0.13 (0.97)	0.21 (0.96)	-0.32 (0.89)	-0.23 (1.10)	0.06 (1.07)	-0.04 (0.98)	-0.33 (1.10)	-0.16 (1.09)	0.12 (0.99)	-0.02 (1.01)
	F-test	**10.61 *****	**3.42 ***	**2.86 c**	1.49	0.08	**3.93 ***	2.50 c	0.61	**7.61 *****	0.23
Cropped area											
	Under 200 hectares	-0.13 (0.90)	-0.09 (0.77)	0.23 (0.73)	-0.04 (0.97)	0.02 (0.99)	-0.02 (1.06)	0.07 (1.24)	-0.09 (0.93)	-0.05 (0.96)	0.16 (1.04)
	201 - 400	-0.12 (0.94)	0.05 (1.00)	0.15 (0.95)	0.00 (0.95)	-0.02 (1.03)	-0.12 (0.93)	0.03 (0.99)	-0.02 (0.91)	-0.04 (1.01)	0.00 (0.98)
	401 - 800	0.15 (1.09)	0.10 (0.97)	-0.07 (1.01)	-0.02 (0.94)	-0.07 (1.02)	0.06 (1.03)	-0.13 (0.88)	-0.01 (1.11)	0.04 (1.01)	-0.02 (1.04)
	801 - 1200	0.10 (0.93)	-0.03 (0.85)	-0.32 (0.71)	0.15 (0.93)	0.15 (0.90)	0.03 (1.01)	0.03 (1.05)	-0.14 (0.90)	0.12 (0.97)	-0.10 (1.01)
	Over 1200 hectares	0.59 (0.84)	0.44 (0.91)	-0.46 (0.90)	-0.10 (1.14)	0.15 (0.80)	0.33 (0.83)	-0.13 (0.84)	0.16 (0.93)	0.29 (0.97)	0.09 (0.92)
	F-test	**4.92 *****	1.78	**5.65 *****	0.39	0.69	1.94	0.86	0.55	1.18	0.54
Farm type											
	Mixed	-0.12 (0.94)	-0.08 (0.96)	0.04 (0.96)	-0.02 (0.93)	-0.03 (1.06)	-0.14 (1.01)	-0.02 (1.01)	-0.14 (0.99)	-0.01 (1.05)	-0.05 (1.00)
	Mainly arable	0.10 (1.02)	0.13 (0.95)	-0.03 (0.95)	0.00 (0.98)	0.01 (0.96)	0.03 (0.96)	-0.02 (0.97)	0.02 (0.97)	0.02 (0.98)	0.02 (1.00)
	F-test	**5.20 ***	**4.94 ***	0.58	0.06	0.11	3.25 c	0.00	2.83	0.08	0.60
Wheat area grown											
	Under 200 hectares	-0.05 (0.95)	0.03 (0.96)	0.15 (0.92)	-0.03 (0.92)	0.01 (1.02)	-0.10 (0.96)	0.03 (1.03)	-0.01 (0.95)	-0.06 (0.99)	-0.01 (1.02)
	201 - 400	0.05 (1.05)	0.07 (0.94)	-0.11 (0.99)	-0.01 (0.98)	0.03 (1.01)	0.02 (0.97)	-0.04 (0.97)	-0.05 (1.00)	0.09 (1.01)	0.02 (0.89)
	401 - 800	0.27 (1.08)	0.12 (1.00)	-0.36 (0.76)	0.27 (1.11)	-0.14 (0.91)	0.16 (1.04)	-0.07 (0.77)	0.03 (1.12)	0.23 (1.00)	-0.03 (1.13)
	801 - 1200	0.63 (0.72)	0.46 (1.09)	-0.53 (1.01)	-0.47 (0.68)	0.02 (0.75)	0.50 (0.82)	-0.64 (0.58)	-0.10 (0.81)	0.36 (0.86)	0.29 (1.25)
	Over 1200 hectares	0.66 (0.65)	0.60 (0.35)	-0.50 (1.02)	-0.19 (1.12)	-0.22 (0.59)	0.09 (0.99)	-0.18 (1.18)	-0.11 (1.07)	-0.16 (1.09)	-0.11 (0.85)
	F-test	**2.82 ***	1.05	**5.43 *****	1.75	0.40	1.69	1.24	0.11	1.85	0.34
Tonnes of wheat produced											
	Under 1000	-0.07 (0.90)	-0.05 (0.87)	0.13 (0.94)	0.01 (0.93)	0.02 (1.04)	-0.17 (0.97)	0.06 (1.10)	-0.06 (0.86)	-0.06 (0.97)	0.05 (1.00)
	1001 - 2000	-0.01 (0.98)	0.14 (0.96)	0.04 (0.97)	-0.06 (0.87)	0.05 (1.03)	0.06 (0.92)	0.00 (0.87)	0.09 (1.01)	0.04 (1.02)	0.03 (0.99)
	2001 - 4000	0.15 (1.13)	0.11 (1.01)	-0.14 (0.91)	0.04 (1.04)	-0.13 (0.93)	0.05 (1.04)	-0.12 (1.01)	-0.18 (1.04)	0.04 (1.01)	-0.22 (0.95)
	4001 - 6000	0.37 (1.19)	-0.02 (1.14)	-0.39 (0.77)	0.44 (1.28)	0.15 (1.03)	0.13 (1.10)	-0.09 (0.66)	0.29 (1.07)	0.42 (0.92)	0.37 (1.08)
	Over 6000	0.67 (0.61)	0.60 (0.77)	-0.56 (0.97)	-0.37 (0.84)	-0.04 (0.61)	0.22 (0.84)	-0.28 (0.99)	0.10 (1.07)	0.17 (0.97)	0.21 (1.06)
	F-test	**3.32****	2.19 c	**3.88 *****	2.12 c	0.68	1.83	0.91	2.03	1.63	**2.87 ***
Group 1 wheat %											
	Under 25%	0.07 (0.97)	0.08 (0.95)	-0.01 (0.94)	0.00 (0.95)	-0.04 (0.99)	-0.03 (0.95)	-0.01 (0.98)	-0.01 (0.98)	0.06 (0.98)	0.03 (0.98)
	26-50%	0.08 (1.12)	0.08 (0.98)	-0.09 (0.93)	0.11 (1.03)	0.23 (0.99)	0.41 (1.00)	-0.06 (1.02)	0.07 (1.08)	-0.04 (1.02)	-0.06 (1.00)
	51-75%	-0.37 (1.06)	-0.20 (1.08)	0.32 (1.00)	-0.22 (0.93)	0.09 (1.13)	0.01 (1.09)	0.11 (0.93)	-0.22 (0.89)	-0.19 (1.18)	-0.23 (1.04)
	Over 75%	-0.07 (0.95)	0.21 (0.94)	-0.07 (1.05)	-0.08 (0.99)	-0.03 (0.95)	-0.57 (0.77)	-0.02 (0.98)	-0.25 (0.78)	-0.12 (0.99)	-0.08 (1.11)
	F-test	1.50	0.84	1.08	0.74	1.57	**8.53 *****	0.16	1.16	0.98	0.82
Group 2 wheat %											
	Under 25%	0.03 (0.99)	0.08 (0.96)	0.00 (0.96)	-0.02 (0.97)	-0.02 (0.97)	-0.05 (0.95)	-0.03 (0.95)	131.18 23)	0.02 (0.99)	-0.01 (0.98)
	26-50%	0.11 (1.01)	0.10 (1.01)	-0.11 (0.92)	0.05 (0.95)	0.20 (1.18)	0.28 (1.07)	0.17 (1.19)	136.19 (63.66)	0.11 (1.04)	0.03 (1.02)
	51-75%	0.06 (1.03)	-0.07 (0.65)	-0.24 (0.76)	-0.20 (0.70)	-0.23 (0.52)	-0.13 (0.87)	-0.05 (0.78)	103.17 (49.90)	-0.44 (0.81)	-0.32 (1.00)
	Over 75%	0.01 (1.07)	0.01 (0.95)	0.17 (0.95)	144.00 (70.21)	-0.05 (0.92)	-0.14 (1.06)	-0.21 (0.79)	144.00 (70.21)	0.15 (1.08)	0.29 (1.20)
	F-test	0.12	0.14	0.72	1.39	1.31	2.62	1.15	0.97	0.19	2.11
Group 3 wheat %											
	Under 25%	-0.03 (0.99)	0.06 (0.95)	-0.06 (0.91)	-0.03 (0.96)	0.05 (0.96)	0.01 (0.97)	-0.01 (0.91)	-0.04 (0.94)	-0.01 (1.00)	-0.02 (0.98)
	26-50%	0.22 (0.96)	0.08 (0.94)	0.08 (1.05)	-0.03 (0.91)	0.08 (1.08)	0.08 (0.96)	-0.06 (1.02)	-0.04 (1.03)	0.11 (1.01)	0.02 (0.98)
	51-75%	0.12 (0.86)	0.16 (0.84)	-0.05 (0.89)	0.40 (1.10)	-0.21 (0.94)	0.00 (1.02)	0.17 (1.06)	0.21 (1.08)	-0.07 (0.91)	0.05 (0.98)
	Over 75%	0.05 (1.10)	0.06 (1.10)	0.06 (0.99)	-0.04 (0.96)	-0.22 (0.98)	-0.28 (0.98)	-0.05 (1.16)	-0.03 (0.98)	0.05 (1.03)	-0.01 (1.07)
	F-test	1.74	0.11	0.64	2.17	1.99	1.91	0.55	0.78	1.08	0.19
Group 4 wheat %											
	Under 25%	0.02 (1.06)	0.06 (0.98)	-0.05 (0.91)	0.07 (0.98)	-0.02 (1.01)	-0.04 (1.04)	-0.01 (1.06)	-0.02 (1.05)	-0.03 (1.04)	-0.03 (1.07)
	26-50%	0.06 (0.92)	0.11 (1.00)	0.04 (1.01)	-0.07 (0.98)	-0.03 (1.05)	-0.04 (0.93)	-0.19 (0.82)	0.03 (0.86)	0.05 (0.96)	0.00 (0.91)
	51-75%	0.21 (0.92)	0.11 (0.86)	-0.02 (0.98)	-0.14 (0.83)	0.24 (1.09)	0.13 (0.89)	0.19 (1.09)	-0.19 (0.82)	0.22 (1.02)	0.04 (0.93)
	Over 75%	0.00 (0.98)	0.06 (0.94)	0.02 (0.94)	0.01 (0.99)	-0.05 (0.86)	0.01 (0.93)	0.05 (0.88)	0.02 (1.00)	0.02 (0.93)	0.04 (0.95)
	F-test	0.63	0.10	0.23	0.92	1.17	0.51	2.11	0.72	0.55	0.08
% income from wheat											
	Under 25%	0.14 (0.99)	0.14 (0.85)	-0.18 (1.02)	-0.20 (0.79)	-0.01 (1.02)	-0.05 (1.02)	-0.12 (0.94)	-0.16 (0.81)	-0.03 (1.10)	-0.10 (1.01)
	26-50%	0.05 (0.99)	0.01 (0.96)	-0.03 (0.93)	-0.01 (0.93)	-0.01 (0.95)	-0.02 (0.99)	-0.05 (0.89)	-0.01 (0.96)	-0.03 (0.94)	-0.06 (0.97)
	51-75%	-0.05 (1.01)	0.19 (1.06)	0.15 (0.91)	0.09 (1.05)	-0.02 (1.00)	-0.03 (0.92)	0.09 (1.09)	0.03 (1.01)	0.12 (1.01)	0.15 (1.02)
	Over 75%	0.00 (1.24)	-0.04 (0.83)	0.16 (0.93)	0.68 (1.24)	0.06 (1.15)	0.31 (1.08)	0.31 (1.41)	0.41 (1.67)	0.19 (0.95)	0.22 (1.00)
	F-test	0.62	1.08	2.32 c	**3.83 ****	0.03	0.56	1.51	1.64	0.98	2.07

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

The number of years in business showed a significant result for Att factors of 'Financial/budgeting strategy' (p<0.001) and 'Risk/fear' (p<0.001) and 'Income securement' (p<0.05). The greater the years in business the lower the importance of the financial strategy and income securement scores but also the lower the 'Risk/fear' scores. These results suggest that the older farmers use their experience to budget and maintain an acceptable income more than less experienced farmers. Their reduced 'Risk/fear' scores could be due to the quantity of capital generated over their lives, so they are less worried about the risks of making a wheat-trading mistake. Also the SN factors of 'Non-farming advice (p<0.05), 'Independent advisor advice' (p<0.001) and 'Merchant advice' (p<0.05) were significant suggesting that the older farmers use their experience rather than taking advice compared to less experienced farmers. It is interesting to note that 'Peers advice' was not significant. The PBC factor of 'Verbal help' (p<0.001) was also significant suggesting that the younger farmers prefer to have verbal information than more experienced farmers. It is interesting to note that written information was not significant.

'Level of education' showed a significant result for Att factors of 'Financial/budgeting strategy' (p<0.001), 'Trading strategy' (p<0.05) and 'Income securement' (p<0.05). These results suggest that the more educated farmers are the greater the importance of budgeting and trading strategy to achieve an acceptable income compared to less educated farmers. Significant results for SN factor of 'Independent advisor advice' (p<0.05) suggest that the more educated farmers use independent advisors.

Percentage of Group1 wheat grown showed a significant result for only the SN factor of 'Independent advisor advice' (p<0.001). This result indicates that as the wheat area grown that is allocated to growing Group 1 varieties increases (Group 1 wheat is the highest quality wheat grown, generally yield are less than other types of wheat, is required to meet higher specifications when sold and is more complicated and costly to grow). Due to these agronomic characteristics of Group 1 wheat, they require greater care and costs during the growing season and have potentially greater quality and quantity risk once harvested and sold. So an independent advisor is regarded as an important factor in ensuring the Group 1 crop is grown correctly and meets quality and quantity specifications, to reduce the risk of a low or negative margin.

Farm type showed a significant result for only Att factors of ‘Financial/budgeting strategy’ (p<0.05) and ‘Trading strategy’ (p<0.05). Arable farms had higher budgeting and a trading strategy scores than mixed farms. These results suggest that arable farms place greater the importance on budgeting and trading strategy than mixed farms. This is probably due the arable farmer’s greater reliance on wheat for their income than mixed farms.

The ‘size of the farm’ factors of; cropped area; wheat area grown; tonnes of wheat produced; and wheat income as a percentage of total income showed a significant result for Att factors of ‘Financial/budgeting strategy’ (p<0.001), ‘Risk/fear’ (p<0.001) and ‘Income securement’ (p<0.05). The greater the size of the farm the greater the importance of a ‘Financial/budgeting strategy’ and ‘Income securement’ but the lower the ‘Risk/fear’ scores. These results suggest that the bigger the farm’s cropped area the greater the importance of budgeting and an acceptable income level but that these farmers have less fear, risk or worry concerning wheat price movements.

From these results it can be seen that there are eighteen Att scores that are significant, seven for SN and six for PBC. This implies that the Att construct is the major driving force behind the adoption of FPRM tools for wheat growers in England. Attitude is then enhanced with both SN and PBC constructs. Age, years in business and education are significant across

8.6.3 Building a model using new FA factors

As detailed previously, the factors derived were used together with the IFFs and two CBVs to create a model using GLM to predict intent to use FPRMs. The results from this model can be seen below in Table 8.50. The associated parameter estimates are shown below in Table 8.51.

Table 8.50 Tests of between-subject effects for the significant FA factors, IFFs and CBVs.

Construct	Factor/variable	df	F	**Sig**
	Intercept	1	47.588	**0.017***
Attitude	Financial strategy	1	32.115	**0.000*****
	Trading strategy	1	13.471	**0.000*****
	Risk/fear	1	35.530	**0.000*****
SN	Non-farming advice	1	6.875	**0.009****
	Independent advisor advice	1	20.063	**0.000*****
PBC	Written help	1	8.873	**0.003****
IFF	Futures/Options via Merchant	1	11.960	**0.001****
	Having children or not	1	12.621	**0.000*****
	Farm type	1	6.670	**0.010***

p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

Table 8.51 Parameter estimates, for the significant FA factors, IFFs and CBVs.

Construct	Parameter	Marginal means	B	Std. Error	t	**Sig**
	Intercept		3.895	.224	15.752	**.000*****
Attitude	Financial strategy		.516	.091	5.667	**.000*****
	Trading strategy		.315	.086	3.670	**.000*****
	Risk/fear		-.416	.070	-5.961	**.000*****
SN	Non-farming advice		-.190	.072	-2.622	**.009****
	Independent advisor advice		.351	.078	4.479	**.000*****
PBC	Written help		.239	.080	2.979	**.003****
IFF	FPRM tool via merchant trade = no	2.912	-.487	.141	-3.458	**.001****
	FPRM tool use merchant trade = yes	3.399	0^a	.	.	.
	Children = no	2.806	-.699	.197	-3.553	**.000*****
	Children = yes	3.505	0^a	.	.	.
	Farm type - Mixed	2.976	-.360	.139	2.583	**.010***
	Farm type - Arable	3.335	0^a	.	.	.

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

a. This parameter is set to zero because it is redundant.

ANOVA analysis of the derived factors of FA showed the significant influences on the intention to use FPRM tools in the next year were financial/budgeting strategy, trading strategy, the risk/fear of FPRM use, independent advisor advice and having children or not (p<0.001). Influence of non-farming advice, farm type and written help sources were also significant (p<0.05). All factors had a positive parameter value except risk/fear of using FPRM tools and advice from non-farming influences. Membership of Agricole was not significant but FPRM use via merchant was. These results suggest that farmers who budget, have a trading strategy, use independent advisors and read literature concerning FPRM tools are more likely to use FPRM tools. In addition, the less they fear or see a risk from using FPRM tools and the less they take advice from non-farming sources the more likely they are to use FPRM tools.

8.7 Cluster Analysis

8.7.1 Introduction

It has been discussed earlier how FA and PCA are a data reduction technique that reduces a number of original variables into a smaller set of combined factors. Cluster analysis (CA) (Tryon, 1939) is an exploratory data analysis tool using a number of algorithms and methods for grouping objects of a similar kind into respective categories (Mooi and Sarstedt, 2011; Statsoft.com, 2013). FA gives a better understanding of relationships (differences and similarities) between variables, whereas CA there is a better understanding of the relationships among the observations. CA allows the researcher to reduce the number of observations but not reducing the number of variables considered, by grouping them into homogeneous clusters, which is particularly useful with a large number of observations. This allows further analyses to be performed on the clusters as groups. It is a technique that has been widely used in many behavioural studies in the agricultural sector concerning farm segmentation modeling (Garforth and Rehman, 2006; Chouinard et al., 2008; DEFRA, 2008; WIDCORP, 2009; Barnes, 2010; Kings and Ilbery, 2010; Pike, 2011; Wilson et al., 2011; Wilson et al., 2013). Both FA and CA are based on classification, which in turn is based on homogeneity. FA looks for the homogeneity of variables resulting from the similarity of values given to variables by the respondents, the columns of a matrix and are classified into factors. With CA individuals or groups of individuals are classified into clusters with respect to their similarity on variables, the rows of a matrix. FA and CA reveal different information about the data. FA tries to establish a theoretical based causal relationship between indicators (items) and a latent variable (the factor). CA aims to find an empirical classification or cluster structure (Krebs et al., 2000).

CA is a technique of dividing data into separate sub-sets that are homogenous within themselves, but relatively different between each other, with respect to a given set of characteristics (Mazzocchi, 2008). The procedure maximises the homogeneity, and so minimises the variance, within clusters and maximises the heterogeneity, maximises the variance, between clusters (Shrestha and Kazama, 2007; Mazzocchi, 2008). Firstly the variables on which to form the groups are chosen. The variables are then standardised in a way that they can all contribute equally to the distance or similarity between cases. Finally the clustering procedure is chosen, based on the case numbers and types of variables wanted to form the clusters (Norusis, 2008). With a mixture of continuous and categorical variables, as is the case here, it is recommended to use the two-step method of CA (Norusis, 2008).

The two-step procedure (Zhang et al., 1996; Chiu et al., 2001) has the advantage over other clustering methods (Relocation method: K-means and Hierarchical: Euclidean) in that it can accommodate mixtures of continuous and categorical variables equivalent to the decrease in log-likelihood resulting from merging two clusters (Banfield and Raftery, 1993) and a varying number of clusters. It also only requires one data pass to produce the results. If the number of clusters is unknown, the two-step method in SPSS 20 will cluster automatically. From these initial results the researcher can re-run the analysis specifying different number of clusters to determine the optimal solution to their needs (SPSS.com, 2012).

In the first stage of the two-step method the data is compressed into dense regions to form sub-clusters. The second stage is to find the optimal number of clusters by applying a cluster method to the sub-clusters. None of the methods directly solve the number of clusters quandary as it is difficult and treated as a separate issue (SPSS.com, 2012).

8.7.2 Analysis and results

A two-step CA was run using SPSS 20 on the derived factors for Att, SN and PBC, as detailed earlier in FA (section 8.6). The analysis resulted in only two clusters showing very negative and very positive attitudes towards FPRM adoption which, following inspection of the results, were labelled ‘Insular’ and ‘Strategists’ (to be described later in this section).

However, these two clusters did not highlight any middle ground between the two clusters, which from this research's in-depth interviews and focus groups was expected. The analysis was re-run, forcing 3 and 4 clusters. However, the results whilst producing more meaningful clusters did not produce satisfactory statistical evidence via the silhouette measure of cohesion and separation (Mooi and Sarstedt, 2011).

It was decided to go back to the two-cluster solution and try 'nested' clustering. A nested cluster means a cluster that is composed of several sub-clusters (Li et al., 2010). The two clusters of Strategists and Insular were analysed independently. CA was re-run on both of these clusters. The analysis resulted in two sub-clusters for each of the two main clusters, which also satisfied the statistical criteria of the silhouette measure of cohesion and separation (= 0.3) as detailed in Figure 8.4.

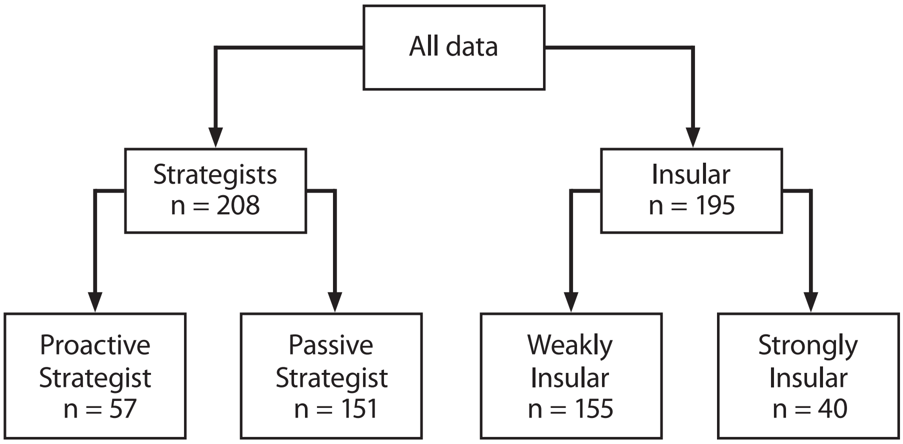


Figure 8.4 Diagram showing nested clustering process.

To describe the two main clusters of Strategists and Insular, Table 8.52 shows the relative importance of each of the factors and the mean factor scores for each cluster. The mean scores are the scores derived from the FA. In all cases the overall mean for every factor will be zero and a score of +/-1 represents a departure from the mean of one Standard Deviation. The mean scores show that the clusters are virtual opposites with the Strategists scoring positively on each factor compared to negative scores for the Insular cluster. The exception is 'Risk/fear', which is not an important defining characteristic of either cluster. The most important factor in differentiating the two clusters is 'Independent advice', suggesting that Strategists are much more likely to place importance on this source of advice. The

Strategists cluster can be defined by the importance of having a trading and financial management strategy, income securement as well as both written and verbal help. The Insular cluster appears to rely on its own judgement and does not place as much emphasis on strategic planning.

Table 8.52 Factor importance and Mean score for Strategists and Insular clusters.

Factor	Importance	Strategist mean score	Insular mean score
Independent advice	1.00	0.52	-0.53
Trading strategy	0.85	0.54	-0.42
Written help	0.81	0.46	-0.48
Income securement	0.76	0.47	-0.47
Verbal help	0.74	0.47	-0.40
Financial/budgeting strategy	0.69	0.47	-0.41
Merchant advice	0.61	0.33	-0.46
Peer advice	0.52	0.35	-0.42
Non-farming advice	0.51	0.41	-0.40
Risk/fear	0.02	-0.06	0.05

Table 8.53 shows the relative importance of each of the factors and the mean factor scores for each of the two Strategist clusters. Considering the important differentiating factors the results show that the proactive cluster scores are considerably higher than those of the passive cluster. The most important differences are ‘Verbal help’ and ‘Written help’ as well as ‘Independent advice’. This shows that the farmers in the proactive cluster are actively seeking information on FPRM tools, hence the choice of cluster name. Other important factors are a ‘Financial/budgeting strategy’ and ‘Trading strategy’.

Table 8.53 Factor importance and mean score for proactive and passive Strategist clusters.

Factor	Importance	Proactive Strategist mean score	Passive Strategist mean score
Verbal help	1.00	1.28	0.24
Written help	0.67	1.18	0.19
Independent advice	0.58	1.15	0.28
Financial/budgeting strategy	0.48	1.05	0.25
Trading strategy	0.48	1.09	0.33
Non-farming advice	0.41	1.03	0.17
Peer advice	0.20	0.79	0.18
Risk/fear	0.07	0.13	-0.13
Income securement	0.07	0.07	0.38
Merchant advice	0.02	0.42	0.30

Table 8.54 shows the relative importance of each of the factors and the mean scores for each one of the two Insular clusters. The results show a very similar pattern to the previous table as the mean factor scores for each of the important factors decreases from the weakly to strongly Insular clusters. The most important differentiating factor is that of 'Financial/budgeting strategy'. This does not imply, however, that the weakly Insular cluster places as much importance on this factor as the Strategists clusters, rather that have some financial plan in comparison to the strongly Insular cluster. The lack of importance associated with income securement suggests that this financial plan may be as simple as achieving the highest price possible without price risk management.

Table 8.54 Factor importance and mean score for weakly and strongly Insular clusters.

Factor	Importance	Weakly Insular mean score	Strongly Insular mean score
Financial/budgeting strategy	1.00	-0.17	-1.35
Independent advice	0.69	-0.34	-1.23
Written help	0.61	-0.32	-1.13
Non-farming advice	0.52	-0.22	-1.08
Trading strategy	0.43	-0.27	-1.03
Peer advice	0.28	-0.32	-0.80
Merchant advice	0.21	-0.38	-0.80
Verbal help	0.20	-0.28	-0.86
Income securement	0.19	-0.39	-0.80
Risk/fear	0.12	-0.05	0.45

Cluster versus two CBVs and IFFs

The clusters were examined for differences between the levels of the two CBVs concerning the past use of FPRM tools as well as the IFFs. Chi-squared tests were used as these are non-parametric and provide a robust statistical test of the differences (Howell, 2007; Field, 2009). In some instances the IFFs were recategorised to allow for at least five cases (Field, 2009) in each cell although in a few instances cells contain less than five because combining categories would lose too much information. The results for only the statistically significant findings are summarised in Tables 8.55 to 8.60.

The results from Table 8.55 and Table 8.56 clearly show that respondents who have previously used FPRM tools via a FSA broker or their merchant are more likely to be in the positive Strategists cluster and less likely to be in the strongly Insular cluster than those respondent who have not previously used FPRM tools. This shows that the proactive Strategists are more open to using these tools compared to other clusters. However, there appears to be no difference in past use between the passive Strategists and the weakly Insular clusters. This perhaps shows that although the passive Strategists have higher scores regarding strategy and information than the weakly Insular cluster, they have not yet reached the ‘tipping point’ in deciding to use FPRM tools. This may be because information regarding FPRM tool use is not freely accessible to them in a clear ‘farmer-friendly’ form. The passive Strategists group is nearly twice that of the proactive Strategist group (35.6% versus 20.0% when using a FSA broker respectively and 38.7% versus 17.8% when using a merchant respectively) and is therefore a group to focus efforts on to encourage use FPRM tools in the future.

Table 8.55 Past percentage use of FPRMs tools via FSA broker by cluster.

Past use of FPRM tools via FSA broker	Proactive Strategist	Passive Strategist	Weakly Insular	Strongly Insular
Yes	20.0%	35.6%	40.0%	4.4%
No	11.2%	38.4%	37.7%	12.7%

Pearson Chi-Squared = 11.419 (3 df), $p = 0.010$

Table 8.56 Past percentage use of FPRMs tools via merchant by cluster.

Past use of FPRM tools via merchant	Proactive Strategist	Passive Strategist	Weakly Insular	Strongly Insular
Yes	17.8%	38.7%	38.2%	5.2%
No	10.8%	36.3%	38.7%	14.2%

Pearson Chi-Squared = 11.638 (3 df), $p = 0.09$

Younger farmers and farmers with fewer years in business are more likely to be in the proactive and passive Strategists cluster whilst older farmers are more likely to be strongly Insular, as reported in Tables 8.57 and 8.58. This suggests that older farmers are less likely to change their farming practices and rely on their experience of the wheat market than adopt FPRM tools. An interesting observation is the increased percentage of 31 to 40 year olds in the proactive Strategists cluster (22.9%) compared with under 30 year olds (17.4%). This could be that even though the younger age group may be very interested and open to the use of FPRM tools, because they may not be the main decision-maker they are less able to be proactive than the slightly older group that are more likely to be running the farming enterprise.

Table 8.57 Age category percentage by cluster.

Age category	Proactive Strategist	Passive Strategist	Weakly Insular	Strongly Insular
Under 30	17.4%	47.8%	30.4%	4.3%
31 - 40	22.9%	42.6%	31.1%	3.3%
41 - 50	16.7%	32.7%	42.7%	8.0%
51 - 60	9.8%	41.5%	37.4%	11.4%
Over 60	4.9%	34.1%	41.5%	19.5%

Pearson Chi-Squared = 21.333(12 df), $p = 0.046$

Table 8.58 Years in business category percentage by cluster.

Years in business	Proactive Strategist	Passive Strategist	Weakly Insular	Strongly Insular
Under 10	21.4%	50.0%	30.2%	0.0%
11 - 20	14.8%	31.1%	49.8%	4.9%
21 - 30	14.7%	14.2%	36.3%	8.8%
31 - 40	12.7%	34.9%	41.3%	11.1%
Over 40	9.4%	35.9%	34.4%	20.3%

Pearson Chi-Squared = 23.457 (12 df), $p = 0.024$

From the results in Table 8.59, it is clear that respondents with a degree and post-graduate qualifications are more likely to be in the positive Strategists cluster and less likely to be in the strongly Insular cluster than those with only secondary education. However, there is a larger than expected percentage of secondary educated respondents in the passive Strategist cluster. Further analysis of the data did not reveal any other IFFs that could explain this observation except for a large group of respondents in the passive Strategist cluster who were secondary educated and in the older age categories. Possibly these farmers would have received further education had they been in a younger generation and thus represent a proportion of older farmers who are more strategic in their thinking. Further research is needed to answer this question.

Table 8.59 Highest level of education category percentage by cluster.

Highest level of education category	Proactive Strategist	Passive Strategist	Weakly Insular	Strongly Insular
Secondary	7.8%	42.9%	29.8%	19.5%
Degree	15.9%	37.0%	39.4%	7.6%
Post-grad	15.2%	24.2%	51.5%	9.1%

Pearson Chi-Squared = 16.56 (6 df), $p = 0.011$

Table 8.60 presents results that show that respondents with larger cropped areas are more likely to be in the Strategists clusters than those with smaller cropped area. This trend is only clearly shown for proactive Strategists cropped areas over 800 hectares.

Table 8.60 Cropped area category percentage by cluster

Cropped area category	Proactive Strategist	Passive Strategist	Weakly Insular	Strongly Insular
Under 200 ha	19.2%	26.9%	42.3%	11.9%
201 - 400	10.8%	37.5%	52.0%	9.7%
401 - 800	15.2%	36.4%	34.8%	13.6%
801 - 1200	10.0%	42.5%	42.5%	5.0%
Over 1200	32.1%	46.4%	21.4%	0.0%

Pearson Chi-Squared = 19.61 (12 df), $p = 0.075$

8.7.2.1 Cluster versus behavioural intent

ANOVA analysis was carried out on the intention to use FPRM tools in the next marketing season against the new four variables created by the CA. As the intention question was a continuous variable the parametric ANOVA test is appropriate, with all the associated normality assumptions. The results are detailed in Table 8.61 and Table 8.62. From the results there was a highly significant effect of the four CA groups on intention to use FPRM tools in the next marketing season ($F(3,396) = 44.89$, $p<0.001$).

The results clearly show an increasing BI to use FPRM tools as the clusters change from strongly Insular to proactive Strategist. The clarity of these results are in contrast to those of the earlier GLM models and provide a parsimonious method that utilises all aspects of the data to predict a farmer’s intention to adopt FPRM tools.

Table 8.61 ANOVA descriptives for intention to use FPRM tools in the next marketing season.

Cluster Analysis Group	N	Mean	Std. Deviation	Std. Error
Proactive Strategist	55	4.67	1.667	.225
Passive Strategist	150	3.30	1.654	.135
Weakly Insular	155	2.39	1.457	.117
Strongly Insular	40	1.48	1.132	.179
Total	400	2.95	1.771	.089

Table 8.62 ANOVA summary table – I intend to use FPRM tools to market my wheat next year.

	Sum of Squares	df	Mean Square	*F*	Sig.
Between Groups	317.739	3	105.913	44.888	.000***
Within Groups	934.358	396	2.359		
Total	1252.097	399			

* p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001

8.8 Summary

This chapter has presented the data analyses from the national questionnaire. The approach was to use the extended TPB model presented in Chapter 6 in order to understand and predict BI. The key findings showed that all the constructs and sub-constructs for Att, SN and PBC were significantly related to BI. The results also showed how these constructs were influenced by external factors such as age and years in business. However, whilst these results provide validity for the proposed model there were several shortcomings when an overall model was developed to predict BI.

The primary concern is the high correlation between the various constructs and sub-constructs of the TPB. Therefore, in using an approach such as GLM much information is lost as only a subset of the constructs is retained in the model. To retain as much information as possible without compromising the statistical validity of the results, an alternative method was sought. Factor analysis is one such technique and provided a unique set of factors that more accurately represented the underlying structure of attitudes, controls and norms. This demonstrates the difficulty in *a priori* determining the underlying constructs of a model. From the literature review in Chapter 4 it is clear that every study using TPB is different and that it is not possible to say that a set of constructs from one study will be appropriate for another. Attitudes and beliefs are more complex than this and should be considered in context. Therefore, this departure from the original model is justified and provides a better insight into how farmers perceive FPRMs.

Finally, cluster analysis was also used as a method for providing insight. In this instance, rather than providing an equation that can be used to predict BI, the factors from the factor analysis were used to allocate farmers into unique clusters. The derived clusters provided the simplest but most effective and parsimonious means of determining intent. They also retained as much of the information as possible. The clusters bear resemblance to the Diffusion of Innovation model as the cluster sizes and predicted intent broadly mirror the categories suggested by Rogers (1995). The four clusters in this model appear very similar to and support the Rogers' 'bell-shaped' graph of adopter categorisation and associated percentage of the individuals included in each category, see Figure 4.7. Rogers' 'Normal' and 'S' shaped adoption curves. Rogers' innovators and early adopters (16%) are similar to the results from this research for proactive Strategists (14.1%). Early majority (34%) are similar to the passive Strategists (37.5%), the late majority (34%) are similar to the weakly Insulars (38.5%) and the laggards (16%) are similar to the strongly Insulars (9.9%). However, there is no direct one-to-one correspondence, as the clusters presented here are measuring intent whereas Rogers (1995) is measuring actual adoption.

9 Discussion and conclusion

9.1 Introduction

The research for this thesis is summarised in this chapter. A review of the wheat market in England was undertaken detailing England's position in the world market. Factors affecting the wheat market price, volatility and risk were investigated. External risk factors and internal factors that mitigate the effects of price volatility and risk were highlighted. Farmers' attitude to risk, their goals, values, risk management strategies and attitudes towards new 'technology' adoption were discussed. Wheat marketing contracts and marketing methods in England were detailed. A behavioural model was developed following a literature review of three theoretical models, and incorporated salient aspects from the literature and qualitative research. The latter involved eighteen in-depth interviews with farmers, seven in-depth interviews with members of the English grain trade and land agents and three focus groups with wheat producers. Hypotheses were constructed derived from these findings and tested via a national survey with 802 returned questionnaires resulting in 673 usable responses. The data collected from the questionnaires was analysed using SPSS 20 and Excel. A GLM approach was undertaken but was found to be inadequate to explain the data fully, so additional Factor and Cluster analyses were carried out. The final chapter summarises the study, its contribution to the literature and the English grain trade. The limitations of the research are examined and future studies proposed.

9.2 Summary of Research

This research used a three-phased mixed-method approach, using qualitative and quantitative methods to establish the behavioural determinants of the adoption of FPRM tools by wheat growing farmers in England. Phase one used qualitative data collection methods of twenty-five in-depth interviews and three focus groups to elicit actual opinions, beliefs and behaviours of current wheat producing farmers in England. The questions used were based on the literature review and the author's own industry experience. The resultant information was combined with the behavioural and adoption of innovation theories (TRA, TPB, DTPB and Diffusion of Innovations) to produce a behavioural model. Using a model such as the TPB provides a structured, replicable and objective framework for such research; social psychology models may provide very useful explanations of behaviour where more traditional, neo-classical economic models maybe less satisfactory (Beedell and

Rehman, 2000). This new model was then used to investigate 13 hypotheses to test the intention of wheat producers in England to adopt FPRM tools to help market their wheat.

Phase two of the process was the quantitative phase, which involved the development of a national questionnaire survey to test the hypotheses in the behavioural model. The questionnaire was pre-piloted twice to six wheat-producing farmers, and then piloted to 30 different farmers before being nationally distributed to 2273 farmers with a resultant 673 clean responses.

Phase three involved the analysis of the resulting data from the farmer survey using Excel and SPSS 20 and a GLM approach. However, the results of this analysis did not provide a satisfactory model to explain BI. Additional analysis using Factor and Cluster analyses was required to explain the complexities of the intention to adopt FPRM tool behaviour.

9.3 Contributions

This study makes a contribution to both the academic literature concerning the adoption behaviour of wheat-producing farmers towards FPRM tools and concerning English agri-business in general.

9.3.1 To the literature

This study has shown the statistical significance of the three major constructs (Att, SN and PBC) of the TPB. The significance of the PBC shows that the TPB is more appropriate than the TRA. This concurs with much agricultural based literature, post the introduction of the TPB in the 1990s (Gorddard, 1991; East, 1993; Gorddard, 1993; Lynne et al., 1995; Bergevoet et al., 2004). However, the findings of this study contrast with those of a study of adoption practices in the Australian wool industry, which concluded that PBC itself was not a significant factor in the farmers' intention to use forward contracts to sell their wool (Jackson, 2008). This shows the importance of considering each study individually and that, despite the two areas of research appearing similar, their findings are very different in terms of farmers' attitudes and beliefs.

The study has also contributed to the literature by confirming the importance of the sub-constructs of Att, SN and PBC, as per DTPB (Taylor and Todd, 1995a). From these results, it can be seen that there are twenty-two Att scores that are significant, eight for SN and ten for PBC. This implies that the Att construct is the major driving force behind the adoption of FPRM tools for wheat growers in England. This Att is then enhanced with both SN and PBC constructs.

In particular, the division of the PBC into training, information and support, rather than the use of 'self-efficacy' is seen as more relevant due to the need for training, information and support when adopting the use of FPRM tools. This supported previous US literature Makus et al. (1990) that found that those farmers that were members of a grain-marketing club and had undergone training in the use of hedging tools were more likely to understand them and ultimately use them as part of their grain-marketing regime. Furthermore, the addition of Trust to the SN component had nine statistically significant results which showed in general that younger farmers and those producing a greater percentage of their wheat output as Group 1 milling wheat (generally a higher priced crop and more technically complicated to grow than feed wheat) were most likely to use an independent advisor or extension contact, this concurred with Fliegel (1993). This study has also confirmed that additional internal farm factors such as age, years in business and children do influence adoption and are added to the traditional TPB model.

The main contribution of this study to the literature is perhaps the *post-hoc* analysis of the data and its approach to predicting BI. The study showed several deficiencies when using approaches such as GLM to predicting BI. First, the various sub-components of the TPB were highly correlated so using them as independent variables presented problems for GLM as important information was lost. Although the sub-components can be added together to create the overall Att score for instance, this assumes that Att is actually represented by this formulation and not by a more sophisticated model. Further, although it is possible to use GLM to fit interactions which would provide a more detailed model that does not make the assumption that all effects from the predictor variables are independent, it very often results in a complex model that is difficult to interpret. Therefore an alternative model using FA and CA was created. The research demonstrated that FA could be used to better represent the subtleties of the different components. In particular the evidence from this and other studies clearly demonstrate differences in attitudes even when there is a high degree of similarity between the behaviours being studied. Therefore, rather than presuming the sub-components of Att, SN and PBC *a priori*, it may be more beneficial to create these *post-hoc*.

The use of CA to form groups of similar farmers was a useful contribution. This approach acknowledges that farmers are different and that the effects of the various Att, SN and PBC components in BI are also different. The analysis clearly identified four distinct clusters, each one of which exhibited different characteristics and different levels of intent. However, unlike other farmer segmentation studies (Garforth and Rehman (2006); DEFRA (2008); Pike (2011); Wilson et al. (2013)) which used surveys specifically designed to elicit clusters, the clusters in this research were formed *post-hoc* from using only the TPB data, that is, the survey was not designed with cluster analysis as its objective. As such, the clusters were directly related to the constructs of TPB and provided segmentations that clearly differentiated between levels of BI. This makes it difficult to provide comparisons of clusters in this study with others identified in the literature as these clusters are related to a very specific behaviour. For instance (Garforth and Rehman, 2006) using ADAS Farmers Voice Survey found five clusters: flexible strategist; dedicated producer; environmentalist; and, survivor. Clearly there is no one to one or simple correspondence with the clusters in this survey. Similarly in the same study, using a dedicated survey to elicit clusters, the following five clusters were identified: family orientation; business entrepreneur; enthusiast; lifestyler; and, independent small farmer. In this case it could be argued that the business entrepreneur might match the proactive Strategist, but even this is vague. The clusters derived from Garforth and Rehman (2006) were constructed using questions relating to many aspects of farming and not one specific behavioural issue which is very clear from the types of clusters obtained. Therefore, unless the two studies can be conducted using the same farmers there is little to gain from comparison. Rather, this shows the potential for all TPB and TRA studies to use such an approach in identifying groups of farmers with similar behaviour patterns, although the clusters will more than likely be independent of more general clustering studies. However, given the remarkable correspondence of the clusters to the Diffusion of Innovations adoption curve (Rogers, 1995) it would be interesting to see if other TRA and TPB studies provide similar clusters. This result suggests that FPRM tool usage, like any other product or service innovation, has to be presented in an appropriate format (show a relative advantage, compatibility, lack of complexity, ease of use and low risk of use) to the appropriately targeted customer, if the innovation is to achieve widespread adoption.

It is clear from this research that the use of FPRM tools by wheat farmers in England is seen as a new and complicated concept in general and confirms Rogers (1995) findings that increasing complication of an innovation reduced adoption. Farmers in England have had little or no past experience of using such tools supported US research Wilkening (1950a) that indicated the importance of communication to adoption. The responses indicate that those farmers adopting FPRM tools, have the highest PBC or 'self efficacy', are younger (so less actual time in the farm business and more likely to have no children or a named successor) are the primary decision maker and more educated. This group are willing to investigate and importantly have the inclination to investigate FPRM tools and concurs with the research by (Bandura and Adams, 1977; Bergevoet et al., 2004).

Those that indicated they had used FPRM tools before, via a merchant, was 41.2%, this is much higher than the figures previously suggested foe the UK by (DEFRA and HGCA, 2009) and the US (Carter and Mohapatra, 2008) at 5-10%. This may be a genuine result or a misinterpretation of the question but further research is required.

FPRM tools in this research have been confined to a basic future and options discussion. However, further discussion and development of different types or forms of FPRM tools is needed. This should include futures, the use of futures over differing time periods, options and the various option variants. Further, the practical use of FPRM tools and how they should be viewed in terms of their cost per tonne averaged over the whole crop, or as a percentage of the crop, as with other farm input costs. Finally, broadening the scope of FPRM tools (from purely a price risk management tool) to be used as a substitute for grain storage. That is, a mechanism for capturing a price rise and limiting the financial consequences of a substantial price fall during the grain marketing period post-harvest period. For example, when grain has been previously sold and moved for financial or storage reasons at harvest but would otherwise have been stored as a price rise is anticipated instead of having the physical crop in the farmer or third party's store.

9.3.2 Agribusiness in England

This study confirms Gilbert and Morgan (2010) findings that farmers perceive that the wheat price is getting more volatile and that farmers are worried about the volatility. The qualitative analysis showed that farmers are looking for a method that reduces the wheat price risk but that there is a perceived lack of knowledge and risk/fear of using FPRM tools which agrees with Drynan (1981) that farmers operate on a scale of risk averse to risk taking. If a farmer believes the current price is similar to the futures price then, unless they are highly risk averse the gain in 'utility' (financial or personal) from the use of FPRM tools is likely to be very small. If the farmer also has to incur learning costs/time too due to inexperience with these tools or is anxious about hedging the risk-reduction benefits of hedging may well be insufficient to justify the effort (Pannell et al., 2008) compared to the use of more traditional selling methods of spot, forward and pool contracts.

At present the wheat farmer in England receives a SFP of approximately £240 per hectare regardless of production as part of the latest CAP reforms. It is perhaps because of this SFP acting as a source of guaranteed revenue to the farming enterprise that farmers in England are less worried about the wheat price and its volatility in practice. This would perhaps help to explain the difference in importance of the interviewees' view that volatility of the wheat price and its effect on farm incomes needs to be addressed, and, what was indicated from this research's questionnaire responses to FPRM tool usage.

From the qualitative responses of this study the English 'grain trade' as a whole is seen as a negative influence and therefore a barrier to adoption of FPRM tools. First, the merchant trade use and value FPRM tools as an essential part of their business to price, purchase, sell and price-hedge their wheat contracts but these advantages of using FPRM tools are not clearly transmitted to their farmer clients. However, this research has shown that to increase the use of FPRM tools some entity in English grain trade, if not the grain merchant themselves, needs to engage more with farmers on the subject. The grain trade does not do this at present for their own commercial reasons, such as promoting their own in-house marketing products, time and personnel constraints as well as FSA legislation worries. Secondly, land agents have some FPRM knowledge but do not fully understand how these tools function (and/or may not have even practically used them) especially their nuances and so they don't directly offer FPRM tools to their clients.

Individual training and group seminars detailing what FPRM tools are, how they are set up, administered and closed out at expiry are seen from this study as ways to increase adoption potential and concurs with the findings from Welch et al. (2013). Similarly, on-going monitoring of the FPRM tools over the life of the contract is seen as a way to increase adoption potential. Further, the qualitative component of this study showed that information is seen as a way to increase adoption potential. Of particular importance are the effects of age and education in adoption of FPRM tools, which agrees with Fliegel (1993) that suggests the industry has to specifically direct FPRM tool training, advice and information accordingly to effectively diffuse FPRM knowledge and to increase the rate of adoption of FPRM tools. Further evidence from this study shows that effort should be concentrated on farms that have wheat as their main income earning enterprise. This concurs with Jackson (2008) and Deane and Malcolm (2006) who suggest that the rational decision maker will focus risk management on the enterprise(s) that contribute most to income.

From the qualitative research it is clear that the needs of the farmers regarding FPRM tools are not being met; not enough information, conflicting information, bias information, how to set FPRM tools up, monitor them and conclude them at the appropriate time. To improve the utility from the use of FPRM tools by the prospective and participating farmers some simple 'rules' or scenarios appear to be needed to encourage initial use before more complex scenarios are undertaken. These would likely to be different between farmer types depending on the degree of their risk averseness.

Several points were found that have potential relevance to the agri-business in this country and may also be applicable worldwide:

- The identification of the four farmer types means there can be a more targeted approach to FPRM tool information dissemination. However, it may not be easy to identify these farmer types from present industry data formats. A single blanket approach is not appropriate and is not working within the industry at present as the different farming groups will respond in different ways.
- Policy makers need to engage more fully with farmers, the grain trade and wider advisory services with respect to explaining all aspects of FPRM tools. At present, there is no lead from policy makers to achieve this and consequently the grain trade work independently and often in competition with little complimentary or synergistic relationships. This could be achieved using a trusted industry leader/organisation to disseminate FPRM information and training.
- There is a need for policy makers to develop and engage with local and national agricultural networks to disseminate information about FPRM tools. This should include farmers, advisors and the merchant trade groups/organisations. Collective action theory (Van Zomeren et al., 2008) suggests a stronger motivation to engage in a collective activity results from a stronger sense of social identity.
- As well as providing information it is necessary for government and trade organisations to monitor and evaluate the use of FPRM tools, especially over a longer timeframe to evaluate whether there have been any changes in attitudes towards and adoption of FPRM tools. This would be of particular interest following policy changes, such as the reduction or removal of the SFP system.
- Incentives to adopt FPRM tools are needed towards training, set-up costs/premiums provided by government. The qualitative research suggests many farmers feel FPRM tools are too expensive to try/use. This should not be in the form of a subsidy but could perhaps be included as part of the IACS payment.
- It may be difficult to ever communicate effectively with the Insular group due to isolation and pessimism, so it may be very difficult to influence this group. However, this group, like the 'challenged enterprises' group, identified in the DEFRA research is small (DEFRA, 2005; 2008).
- The remaining three groups, positive Strategist and passive Strategists and the weakly Insular, which represent the majority of the respondents (81.1%) can more

easily have policies directed towards them. For example, policies encouraging greater written and verbal help, budgeting skills and trading strategies.

- It may be useful to initially have a pilot scheme when instigating these initiatives and resource allocation (Wilson et al., 2011), perhaps via the HGCA.
- Individual behaviours are complex and influence intention differently but a common framework is useful in understanding this. Behavioural differences should not be perceived as an obstacle to adoption but need to match needs with ‘triggers’, to improve effectiveness of FPRM tool understanding.
- Lifestyle and family objectives (longer term goals) are sometimes more important drivers than pure profit-maximisation economics (short term goals).

9.4 Research limitations

Similar to the conclusions from Jackson (2008) a limitation of this study is that the approach did not consider the whole farm system but just the wheat crop. Therefore, any interactions between the wheat crop and other agricultural, as well as non-farm and off-farm, enterprises have been ignored. In particular, this study has only considered predominantly arable farms where wheat is sold off the farm. For instance, if mixed farms had been included (where wheat is consumed by stock on the same farm) then the attitude towards FPRM tools may have been different as the two sides of the business could be acting as a ‘natural hedge’ thus making FPRM tools less relevant. Similarly farms with a high percentage of income from non-farm and off-farm sources may place less importance on the price of wheat and so the need for FPRM tool use. Also, given the SFP available in England, perhaps farmers are less risk averse than they would be as the SFP is a guaranteed added income enhancement, lessening downside price risk and lessening the benefit from the use of FPRM tools.

A major acknowledged limitation of this and other TPB studies is the complexity and length of the questionnaire (East, 1993; Beedell and Rehman, 2000). The questions used in a TPB study can be prohibitively long and highly detailed. This study in particular experienced this phenomenon when piloting the national questionnaire. The questionnaire took up to 30 minutes to complete and there were in excess of 149 questions to be scrutinized by the survey participants. The length of a TPB questionnaire is compounded by the requirement to ask both the belief and the importance of a given Att, SN or PBC question. Therefore, researchers must be selective in which questions to include and the number of questions per construct. Therefore the response rate from this research was very encouraging.

Other limitations of this research;

- The data is from only one time period, so perhaps this study should have been constructed over multi-periods of time to see if attitudes change (Beedell and Rehman, 2000).
- Categorisation may change depending on external and internal factors, such as major CAP reform and true decoupling with no SFP; and,
- Only the views of the key decision-maker were sought. Views of other members of the family and/or business unit could possibly be sought as they may be different from the respondents in this research.

9.5 Future research

As with every study, there is scope for further research to confirm, enhance and build upon its findings and methodology. This study has highlighted several areas for further research:

- Identify means to educate the supply-chain in being more positive/proactive about farmers using FPRM tools. This could involve conducting a larger survey from the grain trade in England towards FPRM tools;
- Aim talks, seminars and information (verbal and written) at the four different farmer clusters identified in this research and assess their responses. This can be achieved by devising a short questionnaire using a small selection of key questions from the original survey to identify which cluster a farmer belongs to;
- Use farmers that have used FPRM tools before to explain why they did use them, what the results were and their opinions. Care must be taken to rigorously select the best ‘teachers’;
- Consider farm types other than mainly arable farmers and other potential farm and farmer attributes that could impact on FPRM adoption;

- Conduct a cluster analysis using data on both TRA/TPB data with a more general cluster analysis to provide inference on the links between general farmer clusters such as business entrepreneurs and the behavioural specific clusters. Further work on the clustering approach could try to strengthen the intuitive link between the theory of adoption and the clusters identified using TRA/TPB;
- Clearly define what is wanted by the farmer with respect to PRM;
- Introduce a continual monitoring and data recording system once a FPRM tool has been set up. This would allow a farmer to understand and assess the impact of these tools and realise the benefits;
- Conduct a follow up study to see if and how attitudes to FPRM tools have changed over time and potentially assess the impact of any training, information on behaviour;
- Combining the approaches in this study to clustering with those recommended by Wilson (2013) by using a semi-structured approach and appropriate segmentation, being driven post data collection; and,
- Evaluate the potential effect of an economic incentive, such as an extension service to encourage and support the use FPRM tools. This may change usage but may not change attitude towards FPRM tools. This could be a short-term policy but could lead to a longer-term better understanding of the usefulness of FPRM tools and greater usage.

9.6 Summary

This chapter has summarised the study and presented its contributions, limitations and scope for possible future research. It has highlighted the success of using a mixed-method approach directing the research effort from developing the quantitative analysis from the qualitative methods. The major contribution is the development of a parsimonious model to predict BI through the *post-hoc* use of FA and CA. This demonstrates that it is difficult to presume the sub-components of the TPB model and that Att, SN and PBCs are often more complex and unique to any given behaviour. Further, it has provided a framework from which effective targeting of resources and policy development can be achieved to encourage farmers to adopt FPRMs tools via the resultant four farmer type categorisation. However, it is acknowledged that this research has its limitations in the narrow range of farm types considered and the required format of the TPB questionnaire, which limits the information that can be collected. Finally, suggestions for future research have been presented.

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11 Appendices

11.1 Appendix 1. The four largest grain trading businesses in England

Cargill is an international producer and marketer of food, agricultural, financial and industrial products and services, founded in 1865, is a privately owned US company, based in Minneapolis, employing 131,00 people in 66 countries. In 2010 it had sales and other revenues of $107 billion dollars and net earnings of $2.6 billion. http://www.cargill.com/company/glance/index.jsp. (Retrieved 23/10/10).

Glencore "is a privately owned company, founded in 1974, owned by its management and employees, headquartered in Baar, Switzerland. It employs 2000 people worldwide with 50 offices in 40 countries. In 2010 it had a turnover of $70 billion and net income of $1.5 billion". http://www.glencore.com. (Retrieved 23/10/10). In May 2011 it was floated on the UK Stock Exchange and became a FTSE 100 company.

Gleadell was founded in 1880 in the UK. In 1991 AC Toepfer International and InVivo became stakeholders. AC Toepfer is Hamburg based and employs 2,000 people around the world, with equity of over 400 million Euro. http://www.acti.de/en. (Retrieved 23/10/10). AC Toepfer has ADM and InTrade as shareholders. ADM (Archers Daniel Midland) is US based multinational company similar to Cargill. http://www.adm.com. (Retrieved 23/10/10). InTrade is a holding company for a number of significant agricultural cooperatives in the EU and USA, Invivo is the largest French co-op employing 6000 people. http://invivo-group.com. (Retrieved 23/10/10).

These three companies have vast resources and financial influence but importantly, in these uncertain times, a perceived financial robustness. From this research, this is a major factor when the English farmer contracts wheat sales, especially into the future, a year or two ahead.

The fourth 'major', Openfield, is UK based and has evolved from the Southern Counties Agricultural trading Society, SCATS, which began trading in 1907 in Wiltshire. After building and developing grain storage in Hampshire, Wiltshire and Kent it acquired regional grain merchanting businesses in 1999 (Continental Grain UK and BDR). Countryside Farmers's grain business followed in 2000, then Sherriff Grain in 2001. SCATS became Grainfarmers Group Ltd in 2003, after acquiring the once nation merchant Dalgety Arable Ltd and the Scottish merchants, Aberdeen Grain and Union Grain. In 2008 it merged with Centaur Grain, to form Openfield. http://www.openfield.co.uk (Openfield, 2013a; 2013b) (Retrieved 23/10/10). Centaur Grain was a Lincolnshire grain cooperative that had itself grown by marketing agreements and mergers with other smaller regional grain marketing co-operatives until it went into spectacular receivership. Openfield has a turnover of £557 million and an operating profit of £7.2 million. Its membership over 2700 and trades with 7000 UK farmers. Shareholders' funds are just under £22 million. http://www.openfield.co.uk/news.php?id=52&section=Openfield. (Retrieved 23/10/10).

11.2 Appendix 2. In-depth Interview Questionnaire

Facilitator: Jeremy Cole
Scribe: Another
Participants: 1 farmer – The decision maker
Equipment: Dictaphones x2. Writing pad. *Italics = my prompts*

Introduction

Welcome everyone and explain the purpose and procedure.

Purpose: To gather information and attitudes of farmers to certain subjects that will form part of my PhD on the determinants of behaviour towards Price Risk Management in UK combinable crops.

No correct/incorrect answers
Jump in and comment at anytime
Honesty
1-1/2hrs max, followed by refreshments

1 General, getting started question

What are your views of the state of UK arable agriculture at present?

With reference to your business, what are goals and needs of you farming?

Max profit, acceptable profit, ROI, pay off debts, expansion, business development, happiness, fulfilment, protect environment.

How do you achieve these?

How important is the family in these decisions?

Have you ever changed your business plan/investment program because of a neighbour's /friend's/your 'communities' action/views?

Maslow's Theory of hierarchy.

How does past experience influence your decision now?

What methods do you use to reduce the overall risk of financial failure of the whole farm enterprise?

How did you learn these methods?

Which are the most profitable crops to grow at present?

Price x quantity, government policy/subsidy, special/ niche market

2 Wheat based questions

How has the wheat market changed over the last few years?

What is the perceived view of wheat prices over the last 10 or so years?

What is the effect of these changes on:

Farm business?

Farmers' attitude to selling wheat?

Ways of selling wheat?

How important is the profitability of the wheat crop to your business?

Do wheat prices currently give an acceptable return on investment?

If not, what would they have to be?

What does the farm business do if the wheat price it deemed too low and a negative margin likely to be obtained?

Before drilling?

Post drilling?

Post harvest?

How do you think that negative margin could be avoided / reduced?

How can the (net) margin from a wheat crop be increased?

Lowering input costs/lowering overheads/ expansion/specialisation/contracts/higher yield/higher prices/all of these?

3 Marketing questions

Which marketing channels do you use to sell to wheat?

Merchant/pools/shipper/end user/public

What % to each outlet?

What triggers you to sell?

4 Word association: *Write down individually, then put on flip chart?*

Wheat prices

Road miles

Futures

Organic

Currency

Wheat marketing

SFP

Merchants

Hedging

Options

Buy back contracts

5 PRM questions

What do you understand PRM to mean?

What methods <u>could</u> be used to reduce price risk in the wheat crop?

Pros and Cons

How do <u>you</u> reduce the effect of adverse wheat price changes on your crop/income?

Who of the panel uses / have used futures and options for PRM?

Futures %, Options %

Why used? Why not used? Why stopped using?

Who has an a/c with a FSA regulated broker?

Why/why not?

What was the perceived need for the business to use formal financial PRM tools such as futures and options?

(Stabilise prices, reduce business risk, reduce worry, make more money, base price, achieve a SOLL?)

How successful (did they serve the purpose they were employed for)?

Will the panel be using them again?

Why?

Have the panel been to any 'formal' training to use financial PRM – futures & options?

Who was the facilitating organisation?

Was the course charged for?

How long was its duration?

How good were they at 'getting the message' over?

Following from the training, how confident were you to use the methods?

Was this the impetus needed to use PRM tools?

If not, why?

What extra help / information is needed for complete understanding.

How was the process/experience of actually 'obtaining' a future or option?

What is your view on the advice given by the outlet you used?

How could the information be made better / more 'user' friendly?

6 Picture: Farmer and another farmer leaning on a fence looking at a growing wheat crop.

What are they saying?

What if now a farmer & grain rep/advisor talking

Advisor is giving advice such as forward selling of crop 18 months and then see what they reckon the farmer might say.
Even if £150/t (*These few questions were added for the interviews 11 onwards)*
Why and what would you do regarding wheat marketing? *Any mention of PRM?*
£200/t?
Why and what would you do regarding wheat marketing?
£500/t?
Why and what would you do regarding wheat marketing?

7 Harvest 10 prices

When did harvest 10 Futures begin trading? (Correct answer July 08)
What was the opening price? (Correct answer £147 futures)
What has been the range of prices seen since then and today? (Correct answer £102-147 futures)
What has been the range since the crop was drilled last autumn? (Correct answer £102-128 futures)
When was last time the current price was seen? (Correct answer June 2008).

- End of questionnaire -

11.3 Appendix 3. Word association responses for in-depth interviews - farmers

Wheat prices:
Higher, variable, volatile, volatile, low, £100, volatile, imp, going up, up, happy, volatility, volatile, profit, money, volatile, volatility, volatile.

Road miles:
Higher, important, fresh, cul de sac, buses, tarmac, Prince Charles, boring, cost, down, bad, do for me, random, not important, environment, cost, irrelevant, diesel.

Futures:
More, scary, hedge, hedging, don't understand, hassle, understanding, tools, would do, worrying, boring, call options, good mechanism, traders/stocks, risk mgt, sceptical, confusing/risky.

Organic:
Same, starve the world, health, not for me, waste of time, Prince Charles, scary, unnecessary, no, waste of space, terrible, niche, tiny market, Govt funding, anathema, done that, waste of time.

Currency:
Stronger £, v.imp, fluctuations, volatile, euro, interesting, dealers, volatile, interested, volatile, not interested, important, big influence on wht market, global mkts, factor, relevant, not a massive player.

Wheat marketing:
Aim to get better, difficult, weather, most important, dangerous, interesting, not as easy as appears, complex, cautious, important and relevant, worry, dull, tricky, No1 issue in wht price, when?, complicated, interesting, selling/simple.

SFP:

Volatile, reliant, reform, hindrance, shambles, sigh!, scrap it, pays mortgage, declining, integral to farm business, needed, thankful but wish wasn't there, useful, thankful for it, how long?, reducing, how long will it last?, hope it lasts.

Merchants:

Too many penalties, evil necessity, shipping, dishonest, rogues, 'love 'em, hate 'em', good and bad, tricky, necessary evil, trustworthiness and reputation, crooks, good/bad, mixed, part of supply chain, who?, don't trust, no problem, take markets down.

Hedging:

Good, worthwhile/scary, futures, important, 'not my scene', complex, need to understand, useful, most important, yes, worry, don't understand, dull, useful, useful tool, How much? vital, doubtful, increase risk/ complex.

Options:

May use again, marketing tool, risk mgt, expensive, don't understand, ought to do, cost, flexible, important, insurance, sort of, worry, God send, insurance, useful tool, which one?, insurance, doubtful, simple.

Buy back contracts:

Don't do, stability, secure, good, not normally a good idea, don't like, lift your leg, solid, useful, definitely, caution, no interest, possibility, useful tool, no answer, insurance, ignorance, not interested.

11.4 Appendix 4. Word association responses for in-depth interviews - grain trade

Wheat prices:
Volatile, volatility, money, variable/fluctuations.

Road miles:
Boring, 40, important, green, fuel use, tarmac, decreasing.

Futures:
Fun, options, essential, misunderstood, complicated, marketing, not understand enough.

Organic:
Desperately dull, miniscule, difficult, niche, yield drop, don't like it, Past it/forgotten mkt in recessionary times.

Farmers:
Conservative, variable, our business, wealthy, customers, genuine, mote business like/hungry/optimistic.

Currency:
Weak, sterling, relevant, anathema, Euros, Government, Euro crisis.

Wheat marketing:
Interesting, crazy, increasingly important, needs improving, season long, strategy, not understood enough.

SFP:
Horrendous, scandalous, interesting, unnecessary, December, Euro, decreasing/not to be relied upon in future.

Merchants:
Variable, honest, too few, ill thought of, deals, tricky, uncertain.

Hedging:

Interesting, options, essential, rare, don't understand, uncertain, useful tool but not understood.

Options:
Scary, premium, relevant, misunderstood/confused, don't use them, gives you options, not understood.

Buy back contracts:
Variable, useful, useful, safety, merchants, useful, not so popular.

11.5 Appendix 5. Focus Group Questionnaire responses

Focus Group Questionnaire amalgamated responses

	FG 1	% 1	FG 2	% 2	FG 3	% 3	FGA 3	Total FG 1-3	% total
Age									
20's	0	0.0%	1	11%	0	0%	0	1	4%
30's	2	20.0%	1	11%	1	13%	2	4	15%
40's	4	40.0%	1	11%	2	25%	1	7	26%
50's	4	40.0%	2	22%	1	13%	3	7	26%
60+	0	0.0%	4	44%	4	50%	1	8	30%
Total	10	100.0%	9	100%	8	100%	7	27	100%
No. of children									
0	0		0	0%	1	13%	1	1	4%
1	1	10.0%	0	0%	2	25%	1	3	12%
2	6	60.0%	3	43%	2	25%	4	11	44%
3	1	10.0%	4	57%	2	25%	0	7	28%
4	1	10.0%	0	0%	1	13%	1	2	8%
5+	1	10.0%	0	0%	0	0%	0	1	4%
Total	10	100.0%	7	100%	8	100%	7	25	100%
Business type									
Sole Trader	1	7.7%	1	11%	2	25%	1	4	13%
Partnership	8	61.5%	4	44%	3	38%	4	15	50%
Company	3	23.1%	3	33%	3	38%	1	9	30%
LLP	0	0.0%	1	11%	0	0%	0	1	3%
PLC	0	0.0%	0	0%	0	0%	0	0	0%
Other	1	7.7%	0	0%	0	0%	0	1	3%
Total	13	100.0%	9	100%	8	100%	6	30	100%
Family cycle									
Primary decision maker	7	70.0%	3	33%	5	63%	2	15	56%
Secondary D/M	0	0.0%	1	11%	0	0%	0	1	4%
Joint D/M	3	30.0%	4	44%	3	38%	1	10	37%
Hired/ farm manager	0	0.0%	1	11%	0	0%	0	1	4%
Total	10	100.0%	9	100%	8	100%	3	27	100%
Years in bussiness									
0-10	1	8.3%	1	13%	1	13%	0	3	11%
11-20	5	41.7%	2	25%	2	25%	1	9	32%
21-30	5	41.7%	2	25%	1	13%	0	8	29%
31-40	1	8.3%	1	13%	1	13%	2	3	11%
41-50	0	0.0%	1	13%	3	38%	0	4	14%
50+	0	0.0%	1	13%	0	0%	0	1	4%
Total	12	100.0%	8	100%	8	100%	3	28	100%

Education									
Secondary school	3	27.3%	0	0%	2	25%	0	5	19%
Degree or diploma	7	63.6%	7	100%	5	63%	1	19	73%
Post-graduate	1	9.1%	0	0%	1	13%	0	2	8%
Total	11	100.0%	7		8	100%	1	26	100%
Acres									
0-250	1	9.1%	0	0%	0	0%	0	1	4%
250-500	3	27.3%	0	0%	1	14%	0	4	16%
500-1000	2	18.2%	4	57%	2	29%	0	8	32%
1000+	5	45.5%	3	43%	4	57%	2	12	48%
Total	11	100.0%	7	100%	7	100%	2	25	100%
Arable acres									
0-250	1	9.1%	0	0%	0	0%	0	1	4%
250-500	3	27.3%	1	14%	1	14%	0	5	20%
500-1000	2	18.2%	4	57%	2	29%	0	8	32%
1000+	5	45.5%	2	29%	4	57%	1	11	44%
Total	11	100.0%	7	100%	7	100%	1	25	100%
Livestock									
0-250	1	50.0%	4	67%	7	100%	0	12	80%
250-500	0	0.0%	2	33%	0	0%	1	2	13%
500-1000	0	0.0%	0	0%	0	0%	0	0	0%
1000+	1	50.0%	0	0%	0	0%	0	1	7%
Total	2	100.0%	6	100%	7	100%	1	15	100%
Best describes farm business									
Arable	11	100.0%	5	71%	6	86%	1	22	88%
Mixed	0	0.0%	2	29%	1	14%	0	3	12%
Livestock	0	0.0%	0	0%	0	0%	0	0	0%
Total	11	100.0%	7	100%	7	100%	1	25	100%
Crops grown (% of total)									
Wheat									
0-25%	1	8.3%	0	0%	0	0%	0	1	4%
26-50%	5	41.7%	5	71%	1	14%	1	11	42%
51-75%	5	41.7%	1	14%	4	57%	1	10	38%
76-100%	1	8.3%	1	14%	2	29%	0	4	15%
Total	12	100.0%	7	100%	7	100%	2	26	100%
Barley									
0-25%	2	66.7%	4	100%	1	100%	1	7	88%
26-50%	0	0.0%	0	0%	0	0%	0	0	0%
51-75%	1	33.3%	0	0%	0	0%	0	1	13%
76-100%	0	0.0%	0	0%	0	0%	0	0	0%
Total	3	100.0%	4	100%	1	100%	1	8	100%
OSR									
0-25%	9	81.8%	3	60%	4	67%	1	16	73%
26-50%	2	18.2%	2	40%	2	33%	1	6	27%
51-75%	0	0.0%	0	0%	0	0%	0	0	0%
76-100%	0	0.0%	0	0%	0	0%	0	0	0%

Total	11	100.0%	5	100%	6	100%	2	22	100%
Peas/beans									
0-25%	7	100.0%	4	100%	4	80%	1	15	94%
26-50%	0	0.0%	0	0%	1	20%	0	1	6%
51-75%	0	0.0%	0	0%	0	0%	0	0	0%
76-100%	0	0.0%	0	0%	0	0%	0	0	0%
Total	7	100.0%	4	100%	5	1	1	16	100%
Other									
0-25%	4	100.0%	6	100%	1	100%	1	11	100%
26-50%	0	0.0%	0	0%	0	0%	0	0	0%
51-75%	0	0.0%	0	0%	0	0%	0	0	0%
76-100%	0	0.0%	0	0%	0	0%	0	0	0%
Total	4	100.0%	6	100%	1	1	1	11	100%
Annual income from wheat sales									
0-25%	0	0.0%	0	0%	1	14%	0	1	5%
26-50%	6	75.0%	5	83%	3	43%	0	14	67%
51-75%	1	12.5%	1	17%	2	29%	0	4	19%
76-100%	1	12.5%	0	0%	1	14%	0	2	10%
Total	8	100.0%	6	100%	7		0	21	100%
Farming discussion/Advisory group?									
Yes	3	27.3%	5	63%	7	100%	2	15	58%
No	8	72.7%	3	38%	0	0%	0	11	42%
Total	11	100.0%	8	100%	7	100%	2	26	100%
Do you have Internet access?									
Yes	12	100.0%	9	100%	8	100%	1	29	100%
No	0	0.0%	0	0%	0	0%	0	0	0%
Total	12	100.0%	9	100%	8	100%	1	29	100%
Do you use 'Futures'?									
Yes	5	45.5%	2	22%	2	25%	1	9	32%
No	6	54.5%	7	78%	6	75%	0	19	68%
Total	11	100.0%	9	100%	8	100%	1	28	100%
Do you use 'Options'?									
Yes	5	45.5%	1	11%	2	29%	1	8	30%
No	6	54.5%	8	89%	5	71%	0	19	70%
Total	11	100.0%	9	100%	7	100%	1	27	100%
FSA broker a/c									
Yes	0	0.0%	0	0%	0	0%	0	0	0%
No	10	100.0%	7	100%	7	100%	0	24	100%
Total	10	100.0%	7	100%	7	100%	0	24	100%

Notes

Some totals and numbers were affected due to partcipants not answering all questions and using more than one option.

FG = Focus Group number

FGA = Focus Group afternoon session

11.6 Appendix 6. Word association responses for - Focus Groups

	Wheat prices	Road Miles	Futures	Organic	Currency	Wheat marketing	SFP	Merchants	Hedging	Options	Buy back contacts
Focus Group 1											
1	Always wrong	Lorries	Need to deal	The good life	Euro	Essential	Goody	Making money	Difficult	Traders always win	
2	Good	High	Expensive	Old	Money	Sales	Farm	Grain	Sloe	Grain	Trade
3	Variable	Food	Wheat	Bread	Dollar	Selling	No idea	Frontier			
4	Volatile	Lots	Change	Small market	Out of my control	Biggest Challenge	Reducing	Have no agenda	No experience	Useful risk mgmt..	How
5	Volatile	Supermarkets	Traders	Never land	Euros	Tricky	How much longer	Pound of flesh	Every 3 years	Should	Tied In
6	Taxing	Too much	Changing	No		Difficult	Need more				No thank you
7	Volatile	Important	Dangerous	Unfeasible		Hindsight		Information	Yes	Yes	
8	Volatile	Experience	Useful	Rubbish	Nightmare	Psychology	Future	Who knows	Wheat		
9											
10	Bumper	Government	Past	Bad	Strong	Crucial	Going down	Necessary	Form of insurance		Expensive seed
11	£150	Costs	Complicated	Not interested	Sterling value v Euro	Little bit and offer	Expect loss		Can be expensive.	More certainty	
12	Money	Fuel	Sell	Muck	Pounds	Sales	Income	Traders			
Focus Group 2											
1	Difficult	Minimal	Variable Success	Not interested	Variable	Very important	Essential timing	Necessary Evil	Interested	Interested	no
2	Volatile										
3	Yo-yo	Local	Known	Niche	V. Important	Gamble	Essential	Correct Advice	Unknown	Lottery	Safety
4	Volatile	New Buzz Words	Complicated, useful	Unsustainable	Influential	Interesting	Necessary	OK			Useful
5	Good at the moment	Keep 'em low	Risky	Niche	Fluctuations	Guess work	Will it last	Some and some	Mystery	About the same	Possiblitly
6	Volatility	Travel	Insurance	Waste of time	Pounds	Luck	Subsidy	Leeches	McConnel	Choices	Safety
7	Volatile		Oh dear	Interesting	Volatile	Challenging	Useful	Careful	Problem	Wish to learn more	?
8	Pounds	Not many		Pounds	Pound	Profit & loss	Timing	Con men	End few	Many	Useful
9	Important	Becoming significant	For someone else	Theoretical	Significant	Difficult but important	Essential	Necessary	For someone else	Not for me	For niche crops
Focus Group 3											
1	Sales	Expensive	Good	No	Important	Myself	Payment	Local grain	Necessary	To consider	Don't
2	Volatile	Costs money	Useful	Niche market	Further complications	Difficult to get right	Going down	A condueit	Useful to have	Useful - but costs	Feel as though over a barrel
3	Hugh	Distance	Expensive	Con	Sterling not euro	Important	Com-plicated	Deviants	Tricky	2nd chance	Interesting
4	How much	Busy roads	Price	Rubbish	Money	Selling at right time	Control by government	Seed	Cutting	Do not know	
5	Good	Traffic jams	Future prices	Weeds	Euro	Good prices	Bonus	Price offers	Hedge cutting		Ensuring you have a reasonable price
6	Volatile	To many	Useful	Con	Declining	Haphazard	To go	Too powerful	Good	Good	Not sure
7	Travel opportunity	Too many	Guessing	No	Kopeks	Fun	Should end		Prefer stock market	Prefer stock market	Prefer stock market
8	Sustainable	Expensive	Cash flow	Starvation	Complicated	lottery	Vital		Risk		

11.7 Appendix 7. Focus Group discussion write up

- Numbers in parenthesis = Focus Group participant number in each group
- Group A = Suffolk
- Group B = Hants
- Group C = Kent

1. **<u>What are your views of the state of UK arable agriculture at present?</u>**

Group A
- Wheat profitable, but lot of red tape, gives good life style (1)
- Cheap money available for borrowing (2)
- Critical point for communication (4)
- Volatile (11)
- Supermarkets in control and not listening (12)
- Very controlled and tightening (7)
- Vulnerable to being taken advantage off (5)
- Supermarkets are knowledgeable and use that to control (7)

Group B
- Optimistic, but downside is the state of dairy farming (1)
- Volatile and expecting rent increases (6)
- Input costs of fuel, & fertilisers will increase, no control over this and it is short termism. (8)
- Large speculators influence, DEFRA is understanding the markets and influencing (3)
- Arable farming is good, but not necessary all agriculture, government pressure for single payment (4)
- Short term is good but no certainty for the future (3)
- Horn vs. Corn balance long way out.

Group C
- Enormous peak at present, future will be tough. Possible cash flows in 2013. Markets are now driven globally (3).
- Surprised by success of 2011, but expects input costs to catch up and therefore will return to previous revenue (margins) (5)
- World events having huge influence (6)
- No losses, No huge profits. There is a grain shortage globally so prices not expected to plummet. (9).

- Grain prices are damaging livestock market (8)
- Oil prices and inflation due to market uncertainty (9)

2. <u>With reference to your business, what are goals and needs of your farming?</u>

Group A

- Make a living, profit, and give a bigger return to the stakeholders (2)
- Pride in job and appearances (1&3)
- Enjoyment of job
- Pay off debt
- Aim to expand (12)
- Meet target of ROI of 15% (10)

Group B

- Decent income 7-8% ROI
- Adequate to reinvest and sustain income
- Maintain standard of living
- Happiness and job satisfaction
- Business development and diversification

Group C

- How little can I do? Semi-retired (7)
- Maximise yield to reduce costs (4)
- Maximise utilisation/production of acres (3)
- Simplification of activities, presentation, maximise output, work to the best of my ability (10)
- Enjoyment (6)
- Cover costs (4)
- Aim to get work/life balance right (5)

3. <u>How important is the family in these decisions?</u>

Group A

- Very, preservation for future generations.(1&3)
- Family is a driver but not always decision maker (1&3)
- Not wanting to let family down (1&3)
- No history but same pressures as above (1)
- Risk averse not wanting to jeopardise family (6)
- Company disperse risk (11)
- All – family not decision makers

Group B

- Family are partners in business (9) so important
- Give the long term view (10)
- Preservation of the future both environment and financial (11)
- Owners so very important (12)
- 75% of group consult with their family for key decisions

Group C
- 87.5% consult with family for key decisions.

4. <u>Which are the most profitable crops to grow at present?</u>

Group A
- Oil seed rape
- Price of OSR (2)
- First wheat
- All 3 crops, sold badly got about the same.

Group B
- Wheat 100%
- Rape second

Group C
- Wheat
- Oil Seed Rape
- Field beans.

5. <u>Do you use the internet for business needs?</u>

Group A
- Weather (1)
- Euro and Dollar exchange rates (2)
- Research (7)
- Equipment purchases (11)
- General information (12)
- Market comments (7)
- Purchasing (5)
- All emails and VAT

Group B
- Banking
- Price checks grain and machinery
- Parts purchasing

- 90% use internet daily

Group C

- Farmers Weekly
- Selling on line
- Banking
- Equipment pricing/sourcing
- Information transfer, contracts, grain prices, NFU newsletter, spray recommendations, Agri money, pricing etc.
- Weather
- General increase in use

6. <u>What are the changes you have seen in the wheat market over the last 5 Years?</u>

Group A

- More volatile
- Increased influence form global markets
- Longer term view
- Speculators entering the market

Group B

- More volatile – trend to continue
- Less reliable information in (8)
    - Trade information
    - Magazines
    - Government publications
- Information often contradicts (6)
- More Global influence (1) increased influence of speculators and the commodities market
- Fewer outlets
    - Shippers
    - End users
- Global diet influence increasing into market

Group C

- More volatile (5)
- Can always sell, but not always profitable (3)
- Reduction in number of outlets (9)
- Not good to grow Feed wheat as there is less livestock (5)
- More feed + add costs driving changes to buying
- No fixed prices
- Increasing difficult to budget

- No budgeting once in ground

7. Price change on the last 10 years

Group A
- Trend flat to volatile
- Disappointing
- 2000-20005 flat low prices
- Pricing not reflecting input costs

Group B
- More free market
- More volatile
- Less stability in world
- More government intervention
- Credit crunch driving increased interest by bankers in agriculture
- Effect on farm
    - Harder to make a profit
    - Harder to invest no guarantee of profit
    - Harder to budget
- Changes to crops driven by input costs (8)
- More frequent budgeting forecasts (6)
- Climate having effect

Group C
- Poor (10)
- Same as 1950 (5)
- Output not buying the same (3)
- Less volatile more predictable 10 years ago (6)
- 10 years ago sold as single units with guaranteed prices - subsidised(5)

8. What has been the effect of the changes in the market on the farm?

Group A
- Need to review and remove costs
- Increased diversification
- Increased profitability
- Look to reduce risk
- Improved investment opportunities as more information (7)
- Invest more time into attention to risk detail

Group B
- Harder to make a profit

- Harder to invest as no guarantee of revenue
- Harder to budget
- Changes to crops driven by input costs (8)
- More frequent budget forecasts (6)
- Climate driven changes

Group C
- Cash flow receiving closer attention
- Future selling
- Difficult to maintain steady cash flow
    - Driving selling in smaller units
- If cash rich can choose time of selling (9)
- More cautious
- Increased feeling of missing the highs (5 +6) need to look for average
- Large sums of money involved
- This year 'pools' not good
- Paying the taxman "profit shares"

9. <u>What has been the effect of changes to attitude to selling?</u>

Group A
- Need to know cost and sell above
- Spread selling
- Managing risk more (4)
- Yield having effect 20-30%
- Looking to manage variables
- More sold forward into profit
- Selling above average of previous year

Group B
- No change continue to sell in bits (4)
- More cautious (5)
- Can be disappointed if prices rise (6)
- More influence by cash flow (9)
    - Timing
    - Moved from selling driven by prices
- No independent assessment of quality – (*is this relevant?)*
- More thought looking at forwards, spot and call selling. (3)
- Removing risk by selling smaller quantities (6)

Group C

- Like to see minimum price form merchant (5)
- Increased influence from stakeholders in selling decisions (5)
- Increased worry (5)
- Still selling in small quantities (4)
- No change (3)
- Sell quicker (6) increased spot selling reduces worry
- Remained with same spot seller but concerned about financial state of buyer (7)
- More cautious (7)
- Attitude appears to vary with age
- No change - remained in the same selling process (9)
- Increased number of buyers and looking to get more information before selling

10. <u>What has been the effect of changes over the last 10 years to how wheat is sold?</u>

Group A

- More sold forward
- Pool selling considered the benchmark (4)
- Increased communication with end user
- Less/more pool selling…(mixed response from group)
- F P R M – using
- Thinks long term – everyone achieves average

Group B

- Question not asked

Group C

- Pool Manager – the perception is that he is not more informed so has moved away from pool selling (5)
- More spot selling
    - Forward 6/8
    - Spot 8/8
    - Pool selling 2/8
    - Min and Max 1/8
    - Trackers 1/8

11. <u>What is the importance of the wheat crop to your farmers/business?</u>

Group A
- CRUCIAL

Group B
- >50% of crops grown. 6/11
- Less as farm diversifies more than 5 years ago (7)
- If no diversity wheat very important

Group C
Question not asked

12. <u>What is the effect of wheat price changes?</u>

Group A
- Bigger effect than costs (11)
- Yield also has a large influence

Group B
- +10% a tonne. £100 per hectare

Group C
- Effect is delayed by a year

Driven by wheat markets, can be a 'bear'

13. <u>How do you look to increase margin?</u>

Group A
- Increase yield
- Look for higher prices
- Lowering fixed and variable costs
- Add value to crop
- New markets

Group B
- Lower input costs
- Look for better prices
- Lower overheads
- Add 'value' to crop

Group C
- Changes to input costs have a lot lower influence on margin than price

Above varies by ~4x

14. How can –ve margin be avoided?

Group A

- Lowering costs
- Sell to profit
- Planning
- Best job – harder work, more luck

Group B

- Forward planning
- Fixed price
    - Forward selling
- If –ve value when drilling, commitment to a cooperative
- If –ve value Post harvest
    - Sell as a whole crop
    - Sell look at options
    - Use for cows

Group C

No comment

15. What are your market channels?

Group A

- Merchant and Ship 100% (3) (5&2) 95%
- End users 2/11 20%
- Small amount chicken feed

Group B

- Merchants 100% 11/11
- Niche market <1%

Group C

- Merchants/shippers 100% 8/8

Livestock very small amount 4/8

16. What are your selling triggers?

Group A

- Cash flow
- Storage
- Price
- Fear of fall
- Target price

- Merchant price
- Merchant approach
- Stakeholder prompts
- Neighbours/peers (6)
- Agent will prompt (2)

Group B

- Gut feeling
- Cash flow
- Greed
- Fear
- Proximity to office
- Raining
- Trade less an influence than before
- Others too busy to get a better price
- Feeling optimistic/depressed
- Family
- Bank manger
- Pre-set targets
- owner

Group C

- Gut instinct
- Cash flow
- Target prices
- Manager calls/initiations
- Tax bill
- Discussions with peer and family
- Rent
- Domestic demands i.e. holiday
- Weather i.e. in office
- Family or farm manger

Newspapers/internet/telegraph/world news

17. <u>What do you do in the way of Price Risk Management?</u>

Group A

- Not sell all in one day (11)
- Could sell all in one day (2)
- Spread use of merchant (3)

- Use only large merchants (4)
- Not all collected in one month (11)
- Different marketing methods

Group B

- Look to cover back
- Forward selling
- Achieve budget
- Options
- Min price contracts
- Spreading time of selling

Group C

- Split selling over period of time
- Forward selling – at pre planting
- Selling at a price per acre
- Split across selling channels
- Selling when ‘thinking’ time is right
- Not being greedy (10)
- Selling at guaranteed price (8)
- Call options and sell (4)
- Do not sell purchase ‘put’ options

18. <u>What marketing methods to reduce risk?</u>

Group A

If you sell 100%?

- For
    - Lock in profit
    - Removes risk
    - Less man time
    - Could re-invest money
    - No merchants pestering
    - Less time on marketing
- Against
    - Price goes up…missed profit
    - Yield might have a shortfall

Min/Max Contracts?

- For

    - Second change
    - Set boundaries
- Against
    - Never hit top price
    - Min below current price
    - Need volatile market with up lift

Group B

- Buy back contracts 6/11
- Options 3/11
- Pooling 7/11
- Min/max (6)
- Niche markets (2)
- Own consumption (2)
- Base price plus premium (4)
- Link to future
- Store until price right

Group C

- Spot selling 8/8
- Forward selling 5/8
- Pools 3/8
- Futures and options 1/8 no longer doing it
- Min and Max 1/8
- Futures 3/8 uses them

19. <u>What is your view of futures and options?</u>

Group A

- For
    - Keeps you in market
    - Guaranteed minimum
    - Cash up front
    - No storage costs
    - No storage risks i.e. bugs
- Against
    - Cost of premium
    - Influence of volatility on premium
    - One chance of selling
    - Selling un-priced to merchant, exposure to change in price

Group B

- Complex

- Lack of information of how they work
- Risky
- Unclear explanations
- Hard work very intensive
- 2nd guess market
- Expensive
- Do not understand them
- Variable success
- Do not know when to use them
- Not 'our' business, not enough knowledge to do well
- Lifestyle change…relationship with trader, none with PRM tool

Group C

- Expensive
- Useful profit generating
- Reducing expense
- 2nd bit of cherry
- Gamble – prefer stock market
- Unproven advantage
- Lack of understanding
- Trust needed
- Another cost to the business
- Like to use if possible – could be useful (4)
- None user- as it is an added stress (7)
- Time consuming (6)

20. <u>What are the family/other stakeholder perceptions of futures and options?</u>

Group A

- Not asked

Group B

- Can be isolating
- Out of their depth
- Fingers previously burnt
- Use would affect responsibility to family

Group C

- Anti – because of accepting price on day (5)
- No experience of them (6)
- Lack understanding (10) Age related division

- Ignorance is fear (8)
-

21. What are your peers' views of options and futures

Group A
- Fashionable
- Complicated
- Increase understanding needed
- Expensive
- Business tool

Group B
- View- performing related
- Influence varies down to source
- Look for more than one source
- Lack of independent grain trader

Group C
- See responses to Q19
- 6/8 peers would influence them

22. What is your perception of futures and options?

Group A
- Driven by big merchants – do not like
- Consultants are
  - promoting them
  - No advice (7)
  - Fear of Fraud
  - Fear of advice
  - Lack of knowledge
- Not keen on them

Group B
- Lack of independence between grain trader and information

Group C
- See responses to Q19

23. What are merchants' views of futures and options?

Group A
- Question not asked

Group B

- Not enough information
- Farmers think Merchants engage in dark arts/ smoke and mirrors to sell futures and options
- Merchants like to keep F&O for themselves. They know about them.
- Not offered as not their market

Group C

- Merchant traders do not want farmers to use them, because they are using them
- Merchants are not making money out of them – so are not selling them (4)

24. <u>What are the advantages of using futures and options?</u>

Group A

- Buying time
- Gives a second chance
- Guarantees income
- Reduces exposure to market volatility

Group B

- Long term insurance
- Expensive
- Decreases exposure to volatility
- Help to budget
- Second chance of up size
- Second bite of cherry
- Insurance policy
- Peace of mind
- Manages volatility in price

Group C

- Increases profitability
- Insuring against a loss
- Increase knowledge in field
- Increases efficiency
- Predicts cash flow and timing
- Logistics advantage

25. <u>Compatibility of buying futures and options.</u>

Group A

- Not a natural thing to do
- More compatible when the market is poor
- Futures – cash flow not compatible
- Not farming it is a commodity trader (5)
- Lack of understanding (3)

Group B

- Not farming
- Not natural thing to do
- Could end up with less money
- Lack of knowledge/familiarity makes it incompatible

Group C

- Is compatible 2/8
- Small change 0/8
- Does not fit 1/8
- No opinion 5/8

26. <u>What is the risk associated with futures and options?</u>

Group A

- Known risk – amount of premium
- Reduces risk of volatility
- Up risk if futures contract granter goes bust (7)
- Merchant benefits

Group B

- Not asked

Group C

- Not asked

27. <u>How complex are buying futures and options?</u>

Group A

- Not asked

Group B

- Perception is that it is very complex due to
    - Rules
    - Costs
    - Accounts
    - Process
    - Increases risks

    - Timing
    - Time to monitor
    - Lack of knowledge

Group C

- Very – lack of knowledge and familiarity
- Do not understand

28. <u>What would help you to use futures and options?</u>

Group A

- Not asked

Group B

- Help
- Education
- Independent advice
- Training
- Information
- Items that prevent you using futures and options
    - Lack of understanding
    - Inertia
    - No historic reason to do so
    - lifestyle

Group C

- Not asked

29. <u>What is the business need to use futures and options?</u>

Group A

- Profit maximisation
- Even out volatility
- Avoid bottom of market
- Avoid average drive up profit
- Spread risk (11)
- Reduce worry (7)
- Feel in control (4)
- Generate cash flow (2)
- Need to manage different stakeholders views (7)

Group B

- Not asked

Group C

- Not asked

30. <u>Have you attended formal PRM training and how successful was it?</u>

Group A

- 3/11 attended training
- ODA 3 day course one person (2) attended. Very good
- HGCA morning course 2 people (7 & 10) attended. Ok but staid, just background.
- Very good, reduced stakeholders tension, successful (7)

Group B

- 5/10 attended morning meeting
- Small fee
- ~ 5 years ago
- Level of confidence went down
- 4/5 no confidence
- 1/5 confident

Group C

- Not asked

31. <u>Is there any impetus to do PRM?</u>

Group A

- No
- Already doing it (2)
- Already doing it so no need to change (7)
- Grey marketing so do not use (10)

Group B

- Why not done?
  - External driver not there
  - Not enough return
  - Confidence low
  - Market expectations
  - Need to concentrate on info
  - No confidence transfer from informed owners

Group C

- There is risk associated with it
- Loss of premium, can be reduce by not insuring all crop
- Loss of control of marketing dates

- There is more risk if you do nothing (4)

32. How important was the facilitator and content of the training?

Group A

- Could not remember him (10)
- Impartial – good
- Learnt about BASIS and Arbitration
- No change - reinforced view not to trade futures

Group B

- 2/5 used
- Exciting experience
- Information not at right level
- Uncertainty
- Gamble not enough information

Group C - Not asked

33. What was the quality of the advice given?

Group A

- None given just price
- Useless
- Gave more confidence

Group B

- xx

Group C

- xx

34. Why are futures and options not used?

Group A

- Lack of knowledge (3)
- Happy with the existing system (10)
- Introduction of something seen to be complex by the stakeholders
- Why stop?
    - Cost
    - Complacency with the market
    - Buoyancy of the market
    - Complexity un necessary (11)

Group B

- xx

Group C

- xx
-

35. <u>If you were offered £150 per tonne for 18 months ahead, what would you do?</u>

* Numbers in parenthesis are the number of participants agreeing with the question, out of the total number in the Focus Group)

Group A

- Ignore advice (3)
- Sell some (2)
- Sell nothing (6/11)
- Sell 30% (1/11)
- Sell 20% (1/11)
- See < 10% (3/11)

Group B

- Sell 100% (0/10)
- Sell 50% (4/10)
- Sell 20-30% (6/10)
- Sell 0 % (0/10)

Group C

- Sell 100% (0/7)
- Sell 75% (0/7)
- Sell 50% (2/7)
- Sell 25 % (2/7)
- Sell 0% (3/7)

36. <u>If you were offered £200 per tonne for 18 months ahead, what would you do?</u>

Group A

- Sell nothing (1/11)
- Sell up to 10% (1/11)
- Sell up to 25% (6/11)
- Sell 25-50% (3/11)
- Sell flat straight to seller

Group B

- Sell 100% (1/10) – with option
- Sell 75% (4/10) – protect against yield drop
- Sell 30% (5/10) – 1 with option

Group C

- Sell 100% (1/7) - risk not having it

- Sell 75% (1/7)
- Sell 50% (5/7)
- Sell 25% (0/7)
- Sell 0% (0/7)

37 If you were offered £500 per tonne for 18 months ahead, what would you do?

Group A

- Sell nothing (1/11)
- Sell up to 10% (0/11)
- Sell 10- 25% (1/11)
- Sell 25-50% (6/11)
- Sell > 50% (3/11)

Group B

- Sell 100% (1/10)
- Sell 75% (7/10)
- 2 not sell still might go up

Group C

- Sell + 100% (1/7)
- Sell 100% (2/7)
- Sell 75% (4/7)

11.8 Appendix 8. Example of the National Questionnaire; the Covering Letter and Information Sheet; and the Reminder Letter

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Survey into the use of Hedging tools, futures and options by arable farmers in England

Section A. Factors regarding the selling or marketing of wheat.

1. Which of these members of the 'grain trade' do you use to sell your wheat? (Tick as many as appropriate)

Farm advisor/consultant		Whole farm management (Land-agent)	
Merchant		Agronomist	
Wheat broker		Other (specify):	
Wheat Pool manager			

2. The following are questions about your attitudes to the advice you receive and how you feel about the wheat industry. Tick the most appropriate response, where 1 indicates strongly disagree and 7 indicates strongly agree.							
	1	2	3	4	5	6	7
I am actively encouraged to sell my wheat by various methods							
It is important to have an on-going relationship with the organisation that gives me selling advice							
I try to use independent advisory services to market my wheat							
Spot, Forward and Pools are the only ways I can market my wheat							
With large wheat price volatility I am looking for a method of marketing wheat which reduces the risks of a 'bad' sale							
I would like a way of marketing wheat that can adapt to global factors that affect my wheat price, both positively and negatively							
I tend to trade with those I have a strong personal bond / had a previous trading experience							

3. Have you ever used Hedging tools, i.e. formal exchange traded futures and options via a FSA regulated broker, when you have sold the following crops? (Please circle)

Wheat	Yes	No	Oil Seed Rape	Yes	No

4. Have you ever used Hedging tools, 'futures' and 'options' type contracts via the merchant trade, when you have sold the following crops? (Please circle)

Wheat	Yes	No	Oil Seed Rape	Yes	No

5. Which of the following statements best describes your **experience** of using Hedging tools of any sort? (Tick as many as appropriate).

Easy to use		Too much risk associated with them	
A good idea		Not enough information available	
Too much paperwork		I have not used Hedging tools	

6. How do you set a price for your wheat to achieve an acceptable return? (Tick as many as appropriate)

Take advice from someone in my business		Work out what I need to cover my costs of production	
Take advice from an advisor or wheat broker		Work out what I need to cover my costs of production plus a margin	
Use the current wheat price		Take what the market gives me	
Use the current wheat price plus a margin		Other (please specify)	

7. **The following are methods of marketing wheat. Please tick how many times, *per year*, you used each method in selling your wheat in the past 5 years.**	Never	1-5	6-10	11-15	16-20	Over 20
Spot sales via the merchant trade						
Forward sales via the merchant trade						
Committed tonnage via a merchant pool						
Buy-back contract with merchant trade/end-user						
Futures contract via the merchant trade / regulated broker						
Option contract via the merchant trade / regulated broker						
Direct sale to the mill (spot/forward or pool)						
Direct sale to the public						
Processing of wheat for sale to public via third party						
Selling via the internet to the merchant trade/end-user						

8. Indicate the importance of wheat production to your farm business by specifying the most appropriate response. Please tick the most appropriate response, where 1 indicates low importance and 7 indicates high importance.

	1	2	3	4	5	6	7
My farm's long term sustainability relies on the income from the wheat crop							
I am committed to my wheat producing enterprise							

9. Indicate your *attitudes* to marketing your wheat by specifying the most appropriate response. Tick the most appropriate response, where 1 indicates strongly disagree and 7 indicates strongly agree.

	1	2	3	4	5	6	7
I take a strategic wheat market view when choosing how to sell							
I know the quality of my wheat crop from one season to the next							
I know the quantity of my wheat crop from one season to the next							
I consider my tax and/or financial situation when selling my wheat							
I know what revenues my wheat crop will produce in 2012							
It would have been advantageous to have used a Hedging tool this year							

Section B. Factors relating to the use of Hedging tools when selling wheat

10(a). The following statements concern the use of Hedging tools when marketing your wheat crop. Indicate the extent to which you strongly disagree (1) or strongly agree (7). Please tick.							
	1	2	3	4	5	6	7
Helps with annual budgeting and making a profit							
Enables the setting of the MINIMUM market price							
Reduces adverse effects on income of volatile wheat price movements							
Enables me to have a second chance at marketing my crop							
Removes the chance of a price reduction, due to quality and quantity issues, after the contract is agreed							
Will achieve better price than other farmers not using Hedging tools							

10(b). Indicate the extent of importance to you of the following statements where (1) indicates not important at all and (7) indicates very important. Please tick.							
	1	2	3	4	5	6	7
How important is annual budgeting to your business?							
How important is it to set a minimum price for your wheat crop?							
Is it important to reduce adverse income effects in your business?							
How important is it to have a second chance when marketing?							
Removing the chance of a price movement, due to quality and quantity issues is important to me							
Achieving a better price than other farmers I know is important							

11(a). The following are some statements regarding how compatible Hedging tools are with your way of life and the way you work. Indicate the extent to which you strongly disagree (1) or strongly agree (7) with the following statements. Please tick.							
	1	2	3	4	5	6	7
Fits in well with my business cash flow requirements							
Are an alternative to ‘traditional’ selling methods							
Are a complement to ‘traditional’ selling methods							
Use my existing wheat trade contacts to set up Hedging tools							
Overall, adopting the use of Hedging tools to market my wheat would be good and fit well with my overall farm business							

11(b). Indicate the extent of importance to you of the following statements where (1) indicates not important at all and (7) indicates very important. Please tick							
	1	2	3	4	5	6	7
How important is business cash flow to you?							
How important are ‘traditional’ selling methods to your business?							
How important is it to have other methods to sell your wheat?							
How important are your existing grain trade contacts to you?							
How important is a new selling method fitting well with your existing business?							

12. The following are some statements regarding the level of complexity you might associate with using Hedging tools to market some, or all, of your wheat crop. Indicate the extent to which you strongly disagree (1) or strongly agree (7) with the following statements. Please tick.							
	1	2	3	4	5	6	7
Requires experience and confidence							
Are easy to use							
More jargon and contract terms to learn than ‘traditional’ selling methods							
Experience and confidence is important when using a new marketing method							
A new marketing method that was easy to use would encourage me to use it							
A new marketing method with many contract terms & jargon would deter me							

13. The following are some statements regarding the Hedging tools to sell/market some, or all, of your wheat crop. Indicate the extent to which you strongly disagree (1) or strongly agree (7) with the following statements. Please tick.							
	1	2	3	4	5	6	7
I am worried that using Hedging tools will give me less money or even lose my business money than using ‘traditional’ selling methods							
I am worried about not meeting contract quality and quantity specifications, which could result in a financial penalty when using Hedging tools							
Using Hedging tools are a good risk management strategy, being a trade off between risk management and maximising revenue							
A risk of making less money than ‘traditional’ selling methods is a concern							
The risk of a financial penalty from not meeting contract quality or quantity terms is a concern							
Having a good risk management strategy (risk v reward) is important to me							

Section C. Factors relating to social influences on your use of Hedging tools when selling wheat

14. The following questions relate to the advice and influence of various groups and how strongly you think these groups would recommend the use of Hedging tools, how much you trust the information on wheat and Hedging tools and how strongly motivated you feel to follow their advice.
Indicate the extent to which you strongly disagree (1) or strongly agree (7) with the following statements
Please tick.

		1	2	3	4	5	6	7
Merchants	Would recommend use of Hedging tools							
	Trust advice on wheat							
	Trust advice on Hedging tools							
	Motivated to comply with advice							
Independent advisors	Would recommend use of Hedging tools							
	Trust advice on wheat							
	Trust advice on Hedging tools							
	Motivated to comply with advice							
Farmer peers	Would recommend use of Hedging tools							
	Trust advice on wheat							
	Trust advice on Hedging tools							
	Motivated to comply with advice							
Farming press	Would recommend use of Hedging tools							
	Trust advice on wheat							
	Trust advice on Hedging tools							
	Motivated to comply with advice							
Academia	Would recommend use of Hedging tools							
	Trust advice on wheat							
	Trust advice on Hedging tools							
	Motivated to comply with advice							

Section D. Questions relating to training, support and information on your use of Hedging tools when selling wheat

15. The following are some statements regarding training, support and information and how they might encourage you to adopt Hedging tools. Indicate the extent to which you strongly disagree (1) or strongly agree (7) with the following statements. Please tick.							
	1	2	3	4	5	6	7
Technical seminars would encourage me to use Hedging tools							
One-to-one training would encourage me to use Hedging tools							
Training from technical seminars is important to me							
Training on a one-to-one basis is important to me							
On-line information would encourage me to use Hedging tools							
Good information from the farming press would encourage me to use Hedging tools							
On-line information is important to me							
Information in the farming press is important to me							
Having good practical help with setting up Hedging tools would encourage me to use them							
Monitoring and reviewing Hedging tools over their 'life time' would encourage me to use them							
Practical help is important to me							
A monitoring and reviewing process is important to me							

Section E. Questions relating to behavioural intention on your use of Hedging tools when selling wheat

16. The following are some statements regarding your intention to use Hedging tools to sell/market some, or all, of your wheat crop. Indicate the extent to which you strongly disagree (1) or strongly agree (7) with the following. Please tick.							
	1	2	3	4	5	6	7
Overall, adopting the use of Hedging tools to market my wheat would be good and fit well with my overall farm business							
I intend on making Hedging tools my main way in which I market my wheat over the next year							
I intend to use Hedging tools, in the next year, to market my wheat							
I intend to use Hedging tools if I believe the price will rise over 20% in the next 6 months							
I intend to use Hedging tools if I believe the price will fall over 20% in the next 6 months							

Section F. Questions relating to you and your farm business

17. Gender: | Male / Female | 18. What is your age? [ ]

19. In which county is your farm business principally located? [ ]

20. Which age group best describes the children in your family? (Tick as many as applicable)

No children [ ]   Children 18-30 years old [ ]
Children under 18 years old [ ]   Children over 30 years old [ ]

21. Have you identified a successor for your business? | Yes / No |

22. If this is your family farm business, what best describes your position? Please tick.

Primary decision maker [ ]   Secondary decision maker [ ]   Joint decision maker [ ]

23. How many years have you been actively involved in this farm business? [ ]

24. What is your HIGHEST level of education? Please tick.

Secondary school [ ]   Degree or diploma [ ]   Post-graduate qualification [ ]

25. What is the size of your cropped arable area? [Hectares]

26. Is your farm business?

Livestock & arable crops mixed [ ]   Arable combinable crops mainly [ ]   Livestock mainly [ ]

27. What is the area of WHEAT you currently grow? [Hectares]

28. Approximately how many tonnes of wheat did you produce this season? [Tonnes]

29. What was the % of each wheat category grown this year on your farm?

Group 1 [%]   Group 3 [%]
Group 2 [%]   Group 4 [%]

30. What proportion of your recent annual farm income came from the sale of wheat? [%]

Thank you for completing the questionnaire. Please return it in the reply-paid envelope provided.

If you would like to see a summary report of my findings, please provide your name and email address and a copy will be sent to you:

Name: ____

Email address (in CAPITALS):______________________________

School of Agriculture, Policy and Development
University of Reading
Earley Gate, PO Box 237
Reading RG6 6AR

Phone: **07860 904045**
Email: ***fb027200@reading.ac.uk***

September 2012

Dear Sir/Madam

Survey into the use of Hedging tools, futures and options by arable farmers in England

Recently there has been much discussion about the use of Hedging tools by farmers in the increasingly volatile wheat market as a way to increase margins and reduce the effects of market volatility. At present, I am engaged in a study of the factors that affect the use of Hedging tools by arable farmers in England.

I am writing to invite you to take part in this important project. I am a self-funded mature student of the School of Agriculture, Policy and Development at the University of Reading. Whilst I am making use of past studies, and carrying out in-depth farmer interviews, I need further information from a national spread of farm businesses. Thus, I am seeking the help of farmers and landowners in England like yourself, <u>in total confidence</u>.

The questionnaire, which I would like you to complete, has been designed to take no longer than 15 minutes. The search for a way to address the effects of the recent high wheat price volatility and its direct effect on the margins of arable farmers in England is crucially important. I believe that by filling in the questionnaire you will be making a direct contribution to the provision of effective advice and information in the future. I would like to thank you in advance for your time in making a valuable contribution to this research. A summary report of the findings will be available.

The questionnaire is in three parts:

Factors regarding the selling or marketing of wheat;
Factors relating to the use of Hedging tools when selling or marketing of wheat; and
Questions about you and your farm business

I hope you will be able to find time to answer the questions and return the completed form in the reply-paid envelope provided. As already stated, your answers will, of course, be treated in <u>the strictest of confidence</u>. Please do not hesitate to contact me if you require any further information.

Yours faithfully

Jeremy Cole
PhD Research student

Information sheet for Anonymous Data Collection

A survey about how you market your wheat crop

I am asking farmers in England for help to find out about the way wheat is marketed in the arable sector, with particular reference to the use of Hedging tools. The information provided in this questionnaire will make a direct contribution to the future of this sector of the agricultural industry.

The purpose of the research is to ascertain the perceptions and attitudes of farmers towards the use of Hedging tools in marketing their combinable crops, especially wheat. This research is part of a study towards a research PhD degree at the University of Reading.

All material collected will remain confidential. Jeremy Cole and his two Supervisors will be the only persons having access to the material. Information will be stored on Jeremy Cole's computer only and he is the only person with access to that computer. A back up will be made and kept on the University of Reading's main server.

All participants will be offered a summary report of the findings, if requested.

All participants may withdraw from the survey at any stage, with no reasons needing to be given by contacting Jeremy Cole and quoting the unique reference number at the top of the questionnaire.

The research results will be published in the final thesis towards a PhD. All participants' anonymity will be preserved when the results are reported.

By answering the interview questions/completing the questionnaire, you are acknowledging that you understand the terms of participation and that you consent to these terms. This project has been subjected to ethical review, according to the procedures specified by the University Research Ethics Committee, and has been allowed to proceed.

Data Protection Act: We respect your privacy and will always comply with data protection legislation currently in force in the UK.

Many thanks for your help and co-operation, it is very much appreciated. If you have any further comments on this subject, please do not hesitate to contact us.

Contact details:
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Supervisors:
Prof. R. M. Bennett: r.m.bennett@reading.ac.uk
Mr. R. B. Tranter: r.b.tranter@reading.ac.uk

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Phone: **07860 904045**
Email: ***fb027200@reading.ac.uk***

8 November 2012

Dear Sir/Madam

Survey into the use of Hedging tools, futures and options, by arable farmers in England

Five weeks ago I wrote to ask if you would take part in the above survey as part of my PhD research programme. However, if my records are correct, you have not yet had the opportunity to complete and return the questionnaire.

Recently there has been much discussion about the use of Hedging tools by farmers in the increasingly volatile wheat market as a way to increase margins and reduce the effects of market change. At present, I am engaged in a study of the factors that affect the use of Hedging tools by arable farmers in England.

It would be good not to leave out those who, so far, have not had time to take part. I would also like to include as wide a spectrum of farmers as possible, from all parts of the country and all sizes of farm. I would, therefore, still really appreciate it if you could help me with this important research by completing the questionnaire. Of course, your reply will be treated in the strictest confidence.

In case the original questionnaire has been mislaid, I enclose a further copy and another pre-paid envelope. I know your time is valuable so I hope this request will not be too much of a nuisance. If your reply has crossed in the post, please ignore this request and accept our thanks for helping in this important survey.

Yours faithfully

Jeremy Cole

Supervisors: Prof R. Bennett, r.m.bennett@reading.ac.uk
Mr. R.Tranter, r.b.tranter@reading.ac.uk

11.9 Appendix 9. The individual components of Att, SN and PBC

Table 11.1 Individual component descriptive statistics scores of Attitude

Attitude and their sub-components	N	Min	Max	Mean	S.D.
FPRM tools help with the budget and making a profit	578	1	7	3.91	1.669
How imp is annual budgeting?	655	1	7	5.33	1.688
Importance of budgeting	574	1	49	21.58	12.247
FPRM tools enables the setting of the minimum market price	577	1	7	4.57	1.779
How imp is having a min price?	652	1	7	4.69	1.532
Importance of a min price	573	1	49	22.19	11.615
FPRM tools reduce adverse effects of the market on income	579	1	7	4.49	1.597
How imp is not having adverse effects?	642	1	7	5.42	1.323
Importance of negative effects of marketing	570	1	49	24.85	11.452
FPRM tools give a second chance to marketing the crop	568	1	7	4.14	1.735
How imp is having a second chance to sell?	635	1	7	4.12	1.552
Importance of second chance of marketing	558	0	49	18.21	11.276
FPRM tools remove chance of price reduction for quality and quantity	571	1	7	3.02	1.657
How imp is known income?	635	1	7	4.42	1.562
Importance of known income	564	1	49	13.91	9.750
It would have been advantageous to use FPRM this year	571	1	7	3.03	1.470
Achieving a better price than other farmers is imp to me	641	1	7	3.73	1.943
Importance of having a better price than other farmers	566	1	49	11.66	8.923
FPRM tools fits well with business cash flow	580	1	7	3.31	1.605
How important is business cash flow?	658	1	7	5.80	1.387
Importance of cash flow	578	1	49	19.39	11.187
FPRM tools are an alternative to ‘trad’ methods	579	1	7	4.03	1.702
How important is using 'trad' selling methods?	649	1	7	5.16	1.476
Importance of 'trad' selling methods	574	1	49	20.39	10.593
FPRM tools are a compliment to ‘trad’ methods	579	1	7	4.31	1.714
How important is it to have other methods to sell wheat?	640	1	7	4.71	1.504
Importance of other selling methods	570	1	49	21.55	11.837
I use existing grain trade to set up FPRM tools	569	1	7	3.71	1.705
How important are existing trade relationships?	653	1	7	5.77	1.247
Importance of existing trading relationships	566	1	49	21.32	11.241
Using FPRM tools would be good and fit with my	575	1	7	3.67	1.719

business					
How imp is a good fit to business of a new selling method?	635	1	7	4.57	1.554
Importance of a good business fit of new selling method	569	1	49	18.12	11.548
FPRM tools require experience & confidence	623	1	7	5.45	1.455
How imp is experience & confidence to you when marketing grain?	614	1	7	5.55	1.364
Importance of experience & confidence	612	1	49	31.47	12.605
FPRM tools have more jargon than trad methods	619	1	7	5.07	1.620
A new marketing method with too many terms would deter me	618	1	7	5.02	1.876
Importance of lack of complexity of new method	615	1	49	26.58	14.002
FPRM tools are easy to use	612	1	7	3.72	1.665
An easy to use new marketing method would encourage me to use	618	1	7	5.34	1.491
Importance of ease of use of new method	609	1	49	19.89	10.675
FPRM tools may give me less/lose money than trad methods	630	1	7	4.45	1.690
The risk of achieving less/losing money than using 'trad' methods is a concern	627	1	7	4.82	1.594
Importance of not having less money than using trad methods	626	1	49	23.11	13.493
FPRM tools may give me quality or quantity penalties once harvested	629	1	7	4.59	1.790
The risk of a financial penalty from not meeting contract quality and quantity terms is a concern to me	626	1	7	4.93	1.731
Importance of not having quality and quantity penalties	626	1	49	24.94	14.772
FPRM tools may give me a good risk management strategy (risk versus reward)	624	1	7	4.42	1.487
Having a good risk management strategy (risk v reward) is important to me	623	1	7	5.09	1.401
Importance of a good risk management strategy	619	1	49	23.17	11.221

Table 11.2 Individual component scores of SN

SN Variables and their components	N	Min	Max	Mean	S.D.
Merchants - Would recommend use of FPRM tools	594	1	7	3.49	1.543
Merchants - Trust advice on FPRM tools	581	1	7	3.62	1.355
Merchant - Motivated to comply with advice	574	1	7	3.58	1.391
Ind Advisor- Would recommend use of FPRM tools	556	1	7	4.58	1.589
Ind Advisor - Trust advice on FPRM tools	553	1	7	4.17	1.472
Ind Advisor - Motivated to comply with advice	544	1	7	3.96	1.471
Peers - Would recommend use of FPRM tools	559	1	7	3.08	1.482
Peers - Trust advice on FPRM tools	559	1	7	3.08	1.403
Peers - Motivated to comply with advice	557	1	7	3.03	1.378
Farming Press - Would recommend use of FPRM tools	560	1	7	3.82	1.599
Farming Press - Trust advice on FPRM tools	558	1	7	3.30	1.383
Farming Press - Motivated to comply with advice	552	1	7	3.03	1.388
Academia - Would recommend use of FPRM tools	543	1	7	4.35	1.824
Academia - Trust advice on FPRM tools	547	1	7	3.65	1.581
Academia - Motivated to comply with advice	545	1	7	3.34	1.571

Table 11.3 Individual component scores of PBC

PBC Variables and their components	N	Min	Max	Mean	S.D.
Technical seminars would encourage me to use of FPRM tools	626	1	7	4.28	1.680
Advice from technical seminars is important to me	621	1	7	4.37	1.643
Importance of technical seminars in use of FPRM tools	619	1	49	20.59	12.761
One to one seminars would encourage me to use of FPRM tools	625	1	7	4.68	1.724
Advice from one to one seminars is important to me	623	1	7	4.56	1.695
Importance of one to one seminars in use of FPRM tools	620	1	49	23.57	13.988
On-line information would encourage me to use FPRM tools	624	1	7	3.65	1.743
On-line information is important to me	620	1	7	4.26	1.718
Importance of on-line information in use of FPRM tools	619	1	49	17.53	12.563
Good Press information would encourage me to use FPRM tools	624	1	7	3.76	1.566
Good Press info is important to me	617	1	7	4.23	1.465
Importance of good press information in use of FPRM tools	614	1	49	17.21	10.740
Having good practical help with setting up FPRM tools would encourage me to use	620	1	7	4.81	1.645
Practical help is important to me	623	1	7	5.14	1.475
Importance of practical help in use of FPRM tools	617	1	49	26.38	13.226
Monitoring and reviewing FPRM tool over their 'lifetime' would encourage me to use them	623	1	7	4.71	1.641
A monitoring and reviewing process is important to me	624	1	7	5.00	1.495
Importance of monitoring & reviewing when using of FPRM tools	622	1	49	25.33	13.128

11.10. Appendix 10. In-depth responses from farmers, grain trade and land agents.

On a CD.