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A mixed-method approach for determining the risk and complexity farmers associate with using forward contracts

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Abstract

This paper reports on a model that was developed to understand the behavioural determinants surrounding farmers' adoption of forward contracts for agricultural commodities. Based on the Theory of Planned Behaviour and Diffusion of Innovations, 28 hypotheses within the model were written and then tested via a telephone survey that gathered 305 responses from Western Australian wool producers. The data from the telephone survey were analysed using SPSS 14 and the Partial Least Squares approach to Structural Equation Modelling. Most relationships within the model could be explained after rigorous quantitative analysis, however, further explanation was required to understand two final aspects of adoption behaviour: firstly, the sources of risk wool producers perceive about using forward contracts and, secondly, why 'complexity', which is normally a limiting factor to adoption, was not significant in the context of using forward contracts to sell wool. Qualitative case studies of four Western Australian wool producers were conducted to fill these gaps. Key findings from the case studies were that profit-raising, the whole farm system as basis for decision making, the mass media and social pressures are important behavioural factors that are limiting the adoption of forward contracts by Australian wool producers.

Background

The Wool Industry Review Committee (1993, p. 76) defines a forward contract as "A binding contract specifying the price (or price formula), quality and quantity of a product to be delivered at some specified date. The quantity may be expressed in units of output or as the production from a specified area. The contract usually specifies penalties to be exacted from each party for particular kinds of non-fulfilment." Further to this, Barnard and Nix (1979) provide a British agribusiness definition of forward contracts and aptly describe them as a tool of turning price uncertainty into price certainty. What can be gleaned from these definitions is that no matter how one looks a forward contract, such a selling mechanism is characterised by a set price and set delivery date for a specified commodity.

The principal benefits of forward contracts to farmers discussed in the literature are based on the concepts of the uncertainty associated with price risk management and income stabilisation (Barnard & Nix 1979; Miller 1986; Musser, Patrick & Eckman 1996; Fraser 1997; McLeay & Zwart 1998; Coad 2000; Kingwell 2000; Champion & Fearne 2001; Bolt 2004; Brakenridge 2004; Cuming 2004, Liddle 2004). Many authors discuss the risk-averse nature of farmers (Bond & Wonder 1980; Pluske & Fraser 1995; Coad 2000, Pannell, Malcolm & Kingwell 2000) and comment on the benefit of forward contracts in terms of income stabilisation. With this knowledge, it is difficult to understand why Australia's highly volatile spot market (primarily the auction system) accounts for 85% of wool sales (Bolt 2004).

In order to gain insight into this situation, consideration was given to prominent adoption theories: Diffusion of Innovations (Rogers 1995), the Theory of Reasoned Action (Ajzen & Fishbein 1980) and Theory of Planned Behaviour (Ajzen 1991). While a plethora of literature exists on the application of Diffusion of Innovations in the agriculture and agribusiness research domains, there are fewer applications of the Theories of Reasoned Action and Planned Behaviour in such fields of study. In so saying, however, scholars such as Beedell and Rehman (1999 & 2000), Bergevoet et al. (2004), Lynne et al. (1995), Tutkun and Lehmann (2006) and Gorddard (1991 & 1993) have found the Theory of Planned Behaviour to be most appropriate for their agribusiness-based research questions.

With evidence that these theoretical frameworks are appropriate to use for understanding adoption behaviours in the field of agribusiness, the researchers built a behavioural model to explore the reasons that are limiting the adoption of forward contracts for managing price risk in Western Australia. Prior to the development of the model, four focus groups were conducted with Western Australian wool producers to ensure that the model was tailored to the research environment being studied. The combination of results of the focus groups and the literature on farmers' adoption behaviours produced the behavioural model that is the focus of the present paper. Further exploration of the findings of the behavioural model is conducted via qualitative case studies.

Method

The integration of quantitative and qualitative findings is termed the concurrent triangulation strategy by Creswell (2003); the purpose of which is said "to strengthen the knowledge claims of the [whole] study or explain any lack of convergence that may result" (p. 217). By employing the concurrent triangulation strategy, richer information about producers' wool selling behaviours will be gained.

The behavioural model for this study, illustrated in Appendix 1, was developed using a three-step qualitative/quantitative/qualitative research process; of which the latter two phases are discussed herein. The data from the focus groups conducted in regional Western Australia was combined with concepts drawn from the Theory of Planned Behaviour and Diffusion of Innovations to build a behavioural model. The focus group data, not discussed herein[1], showed that factors internal and external to the farm business were likely to have significant influences on their adoption of forward contracts. These factors were included in the model and their impact on producers' adoption behaviour was tested.

Examples of internal factors included the producer's commitment to producing wool and secondly, the producer's dependence on wool to earn a living. Factors external to the farm business mainly considered the current selling and marketing structures of Australia's wool industry. The dominance of the auction system was hypothesized to be the main factor suppressing adoption behaviour.

Other factors tested in the model included:

(i) the perceived usefulness of forward contracts from Roger's (1995) Diffusion of Innovations (including relative advantage, compatibility, complexity, application to the farm business and risk),

(ii) the subjective norms (from the Theory of Planned Behaviour) associated with using forward contracts to sell raw wool (including family opinions, dominance of the auction system, opinions of peers and the influence of advisory services) and

(iii) the perceived behavioural control (from the Theory of Planned Behaviour) surrounding the use of forward contracts (including the support from advisory services).

This model was then tested using data gathered from a telephone survey of 305 Western Australian wool producers. Structural equation modelling, a combination of regression analysis and path analysis, was used to estimate the fit of the model to the data set (Barclay, Higgins & Thompson 1995; Chin, Marcolin & Newsted 1996; Gefen, Straub & Boudreau 2000). While most of the relationships with the model could be explained we were curious about the findings related to the factors of risk and complexity.

To further explain relationships within the behavioural model, case studies were chosen as the primary vehicle for gathering more data. "Case studies are rich, empirical descriptions of particular instances of a phenomenon that are typically based on a variety of data sources" (Eisenhardt & Graebner 2007, p. 25). They are useful for comparing the behaviours of multiple types of people and they provide a rich insight into complex patterns of causality that are sometimes lost in positivist research (Hamel 1991). Berg (2001) and Stake (2000) describe a number of approaches to case study research, of these approaches, the instrumental, explanatory approach was chosen for this research. This was principally because the intention of this study was to use a qualitative methodology to further explore and explain the findings of the previous quantitative study (Bailey et al. 2006; Howden & Vanclay 2000). With this knowledge, case studies of four Western Australian wool producers were carried out.

[1] This study is detailed in Jackson, E.L., Quaddus, M., Islam, N. and Stanton, J. 2007, 'Evaluating producers' perspectives on selling raw wool: A field study of behavioural factors and variables', *Journal of Farm Management*, vol. 12, no 11, pp. 679-707.

Results

Quantitative phase

Results of the behavioural model are presented in Appendix 2 and show that there is a significant relationship between most of the behavioural factors tested within the model (with the exception of H1e, H3dii and H3e). Like the work of Beedell and Rehman (1999 & 2000), Bergevoet et al. (2004), Lynne et al. (1995), Tutkun and Lehmann (2006) and Gorddard (1991 & 1993), this result indicates that most of the behavioural factors tested in the model are accounted for by the attitudinal factors. This finding also shows that the theoretical frameworks used for this study suit the research context. The results that are relevant to the present paper (Table 1, Figure 1) however, are associated with complexity (H1c, H3c and H6c) and risk (H1e, H3e and H6e).

Table 1: Structural equation modelling results of risk and complexity

Hypothesis	Path	γ	t-value
H1c	Factors external to the farm business → Complexity	0.257	3.763***
H1e	Factors external to the farm business → Risk	0.117	1.070
H3c	Factors internal to the farm business → Complexity	0.163	2.259*
H3e	Factors internal to the farm business → Risk	-0.110	1.029
H6c	Complexity → Intention to sell wool by forward contract	-0.034	0.699
H6e	Risk → Intention to sell wool by forward contract	-0.225	3.698***

γ = Standardised path co-efficient
* indicates significance at t 0.05 > 1.645
*** indicates significance at t 0.005 > 2.576

Table 1 shows the hypothesis relevant to the present paper. The first four hypotheses test the sources of risk and complexity. Hypothesis 1c and 1e relate to factors external to the farm business, that is the Australian wool selling environment, and how such factors influence the complexity and risk farmers associate with using forward contracts. Hypotheses 3c and 3e relate to factors internal to the farm business, such as details of the farmer and the farm business, and the impact these have on the complexity and risk farmers associate with using forward contracts. Finally, hypotheses 6c and 6e test if these sentiments actually impact on farmers' intentions to use forward contracts.

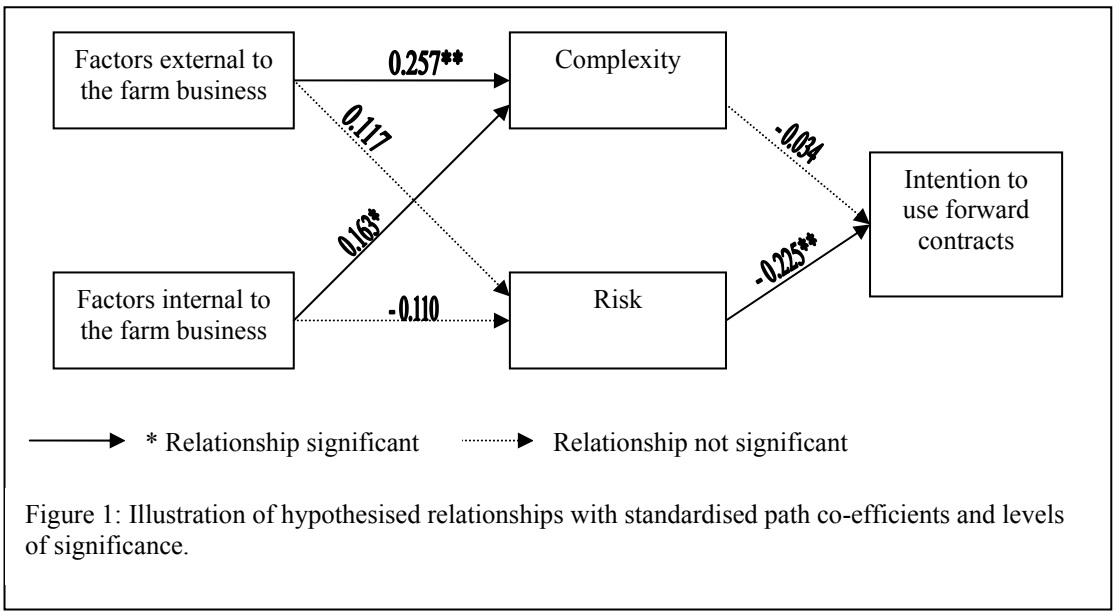

Figure 1: Illustration of hypothesised relationships with standardised path co-efficients and levels of significance.

Results show support for the work of Abadi Ghadim, Pannell and Burton (2005) and Batz, Peters and Janssen (1999) who found that risk has a highly significant, negative influence over intention to adopt the use of forward contracts (H6e). However, neither attitudinal variables (factors external [H1e] nor internal to the farm business [H3e]) can account for this notion. Conversely, the complexity associated with using forward contracts is positively influenced by factors internal and external (H1c and H3c) to the farm business but, contrary to the findings of Fliegel and Kivlin (1962) and Rogers (1995), does not significantly impact on farmers' intentions to use forward contracts (H6c).

These results have shown that the attitudinal factors tested in this behavioural model have accounted for the root causes of why farmers perceive the use of forward contracts to be complex however the same cannot be said for the root causes of risk. It is well documented that farmers' perceptions related to risk and uncertainty (Abadi Ghadim, Pannell & Burton 2005), and their perceptions and attitudes (Pannell et al. 2006) are key influencing factors on adoption decisions. Further explanation is therefore required regarding the sources of these risks and subsequent adoption, or non-adoption, of forward contracts. Therefore, to further develop knowledge on the adoption of forward contracts an interview guide was developed to address the question:

1. Why do perceptions of risk exist in association with using forward contracts?
2. Why is complexity not an issue when intending to use forward contracts?

Qualitative case studies

To further explore the aforementioned research questions, four case studies were conducted, via interview, on Western Australian wool producers.

In all cases, wool provided the main source of income however earnings were also derived from some form of grain or fodder crops. Further to this, some other information about the sample is useful for developing a picture of the individual cases (Table 2). The interview candidates for each case were all male, third or fourth generation farmers and had been involved with the farm business for a range of 26 – 45 years. Farm sizes ranged from 900 – 2,950 hectares. In terms of farm production, the three interview candidates who are currently farming each have flocks of 14,000 sheep whereas the case of the interview candidate who has exited the industry had a flock of 5,500 sheep at his last shearing. The largest wool producer was not the candidate with the largest farm; overall, wool production ranged from 140 – 400 bales per annum. Simple arithmetic after the interviews (*) showed that the cases which use forward contracts produce more wool per hectare. The immediately obvious implication of this is that those who use forward contracts may be more profitable than those who do not. The less obvious implication is that using forward contracts may allow producers to more finely determine their on-farm enterprise mix therefore being able to better optimise their land resource.

Table 2: Descriptive information of interview candidates (#1 = Never used forward contracts to sell wool, #2 = Consistently used forward contracts to sell wool, #3 = Had exited the wool industry, #4 = Used futures for selling wool; not forward contracts)

	Cases			
	#1	#2	#3	#4
Length of family involvement with the farm (years)	100	99	75	84
Length of individual's involvement with the farm (years)	45	31	29	26
Size of farm (hectares)	2,630	2,950	900	2,200
Sheep at last shearing (head)	14,000	14,000	5,500	14,000
Wool production at last shearing (bales)	286	330	140	400
Wool production (bales) per hectare*	0.109	0.112	0.155	0.182

The following description and discussion of results is broken down into four subsections in order to answer our research questions. This section starts with identifying the perceptions of risks associated with using forward contracts to sell wool. This is followed by an analysis of sources of perceived risks and then we discuss knowledge gained about complexity.

Perceptions of risk

Abadi Ghadim, Pannell and Burton (2005) showed that the perceived risk associated with new farm processes will strongly influence adoption. The foregoing quantitative results concurred with this finding although further clarification was needed on the actual factors that contribute to the risk perceived about the use of forward contracts to sell wool. The case studies conducted for this paper shed some light on this problem.

Three key perceptions of risk expressed in the focus groups about using forward contracts to sell wool. There was the concern that the price differential between the spot market and the forward market was too great to warrant using forward contracts, there was the fear of not being paid for the wool after the forward contract had closed and there was the concern of not meeting the obligations of the forward contract. Case study research showed that only one of the these factors is critical for using forward contracts.

Price differential

The case studies showed an alternative point of view to the researcher's previous studies: the aspect of the price differential between the spot and forward market. The wool producers interviewed described the forward market as being unattractive at the time of gathering information to make a selling decision because it offered a lower price than the spot market. Evidence of this sentiment is demonstrated from comments from the wool producer who exclusively used the auction system, the wool producer who usually uses forward contracts and the wool producer who usually uses futures, respectively: "The forward market is roughly a dollar under the physical." and

> *…/In the last year we didn't sell forward, we sold at auction. When the market was drifting along and trending down, the discounts for selling forward were not an incentive to do so, so we shore the wool and sold it in auction probably over a small number of sales, say two or three sales…/We haven't forward marketed too far out and that's only in recent history simply because wool prices have been bloody ordinary and you haven't got to be a rocket scientist to know that there's no premiums in the forward market based on the current physical market prices…/*

These results are not surprising given the statement made by Pannell et al. (2006) that one of the factors that contributes to the perceived relative advantage is the "cost or

profitability that the innovation will replace" (p. 1414). These authors use the adoption of herbicides in the United States as an example. It is said that farmers could no longer afford not to use herbicides because the price of fuel and labour were increasingly disproportionately to farm income. The reverse appears to be the case with wool price discovery. In direct agreement with the findings of Tiller (2000), the above statements show that the price differential between the spot and forward markets means that forward contracts are not attractive enough to be adopted. This is particularly evident in the quote made by the wool producer who traditionally uses forward contracts but did not do so last year because the price differential was too great.

In addition to price differential being recognised as a factor limiting the adoption of forward contracts among wool producers, the author's previous research showed there to be two other limiting factors: the fear of not being able to meet contractual obligations and farmers not being paid for delivering wool to a forward contract. All four cases in this paper showed these latter two factors to be myth rather than fact.

The fear of not being able to meet contractual obligations was also explored in this research. Similarly, the issue of not being paid for delivering wool to a forward contract was also explored and rejected in all cases. It was initially thought that wool producers feared that wool buyers would not honour forward contracts by taking wool but not paying. The interview candidates discussed that the wool supply chain is too long and complex for any single party to not honour an agreement to take and subsequently pay for a delivery of wool (*…/ because it is going through second hands …/ I have never actually heard of that happening with the wool industry. I think that the wool industry is that ingrained …/).*

Sources of risk

Another objective of conducting the case studies was to determine the sources of risk about using forward contracts to sell wool. Previous analysis of the behavioural model showed that risk (alternatively known as uncertainty) was the only negative, significant factor impacting on the intention to adopt forward contracts as a way of selling wool. The model also showed that neither factors internal nor external to the farm business were the source of this perception. The cases used to further explore this issue exposed some highly specific factors that may demonstrate the source of the perceived risk of using forward contracts. The main factors that emerged were the importance of farm profits when making selling decisions, media publications and social pressure the whole farm system.

Farm profits

In the present research, it appeared that the farm's profit, or revenue earning potential, was pivotal in the decision-making process examined in each case; a factor also identified by Abadi Ghadim, Pannell and Burton (2005). Evidence of this inference is provided in the following five statements:

> *…/I suppose within myself it is that we have operated profitably, that we have [earned] more than our cost of production. I think if we can make a profit each year we will be around next year to have another go. So as long as I can operate at a profit I am happy …/For our enterprise we just aim to make a profit, that's what we do is try to make a profit and we do benchmarking and all these things, but I don't necessarily see that we have to be at the top of the benchmark …/ Effectively I knew what I needed per kilo to break even or get in front and I got into a position where I was selling about a third of my clip on forward selling which I tried to set up to cover my costs, so the other two-thirds of the clip would be the marginal profit …/That covered my costs. I would ring them up and say what are you offering? They would give me a price and then I would basically go back and say, what's it going to cost to shear, da da da da. OK. That's my costs in the bag …/We just*

> *work on a price that we know that we can earn a comfortable living from and we will stitch up a futures contract relative to that …/*

In this evidence, profit and price discovery were discussed in terms of the decisions made on which selling methods to choose. The above statements show that, in each case, the ability of the farm business to earn a profit dictates the wool producer's attitude towards pricing, which in turn, dictates the method ultimately chosen to sell wool. This concurs with the findings of Deane and Malcolm (2006) that the rational risk manager will concentrate risk management efforts on the enterprise that contributes the most to cash flow and expenditure. Another insight can be provided by re-examining the survey data. It was found that 78.4% of survey respondents mainly operate mixed livestock-cropping farms, the majority of responses would have been from a combined livestock-cropping perspective. This may account for the lack of evidence about the source of risk because survey respondents were not asked about their point of reference when concentrating on risk management initiatives.

The whole farm system

Closely linked to the concept of profit-making, was the importance of considering the whole farm system when making selling decisions about wool. The systems approach to analysing farm businesses is a widely accepted research paradigm (Dent & Anderson 1971; Pannell et al. 2006; Dent, Edwards-Jones & McGregor 1995). It is possible that such an approach to the research problem would have been more appropriate for addressing the larger research problem. This notion came from arguments made by Deane and Malcolm (2006) who warned that research on farmers' decisions about forward marketing should be considered from the perspective of the whole farm and it is naïve to look at individual enterprises in isolation.

In the case of wool producer who had never used forward contracts to sell wool it was said:

> *…/You can still make money at both those prices but you use completely different management skills. Those management skills in a lot of cases have got dollars attached to them by using one method you can scrape through on the smell of an oily rag. It is like you do not give the extra drench when you should, you can actually put it off because the price is not going to have a big bearing, but at a higher priced wool you can even double that price to $10 a kilo. You would make certain that your sheep are fed properly, that their health status is number one, in other words you can afford to increase your management skills by a dollar a head and still have a margin to work on. If, all of a sudden, you are using everything properly at $10 and all of a sudden the price of wool drops to bloody $5 dollars, all of a sudden you might find that you are not breaking even and the cost of production has gone up. Other things are: yes I can afford to run more sheep, if I run more sheep it means I have to conserve more fodder so that if anything goes wrong I can get through. Or you can take the simplistic approach as saying if I drop my stocking rate by 1 DSE there is still a very healthy margin in it, it means I do not have to conserve as much fodder…/*

The importance of this statements lies in the description of the wool producer not only managing his on-farm resources in order to make a profit from wool but also the knowledge that an entirely different approach to sheep production may be required if profits are going to be made.

Further evidence of the importance of considering the whole farm system came from the wool producer who consistently used forward contracts to sell wool and grain. This case study showed that the use of forward contracts is a philosophical strategy in that, no matter if the farmer is forward contracting wool, meat, or grain, the main intention is to "try and sell forward a certain portion to lock in our income". Even

when discussing production risks, forward contracts were discussed in the context of the whole farm system:

> *…/I think probably production risks would be the biggest thing. With wool for us it is not so great. With selling grain forward the production risk is probably our number one risk. For our wool production enterprise, regardless of the season, we are going to grow roughly the same amount of wool because we are geared up for summer drought…/*

The attention that must be paid to the whole farm system is emphasised by Wood and Ashton (2007) who advocate that a systems approach to decision making is most important in the context of mixed livestock-crop farms. Given that 78.4% of survey respondents operate mixed livestock-crop farms, it is reasonable to conclude that studying the entire farm business system, instead of one only one aspect, is an important point of reference for determining an appropriate research paradigm.

Media publications

These case studies showed that the media is an important influencing factor on farmers' adoption decisions of forward contracts to sell wool. Rehman et al. (2007) showed that farming press, among other factors, would support a decision to change farming systems and practice. Similar conclusions were reached by Longo (1990) and Wilkening (1950). The impact of communications and the influence of advisory services were included in the behavioural model after reading Fliegel (1993) and Rogers (1995) however, in the situation of this research, the influence of the media, alone, was only exposed in the later part of this study. Both Fliegel (1993) and Rogers (1995) advocate that the mass media is an important element of the Diffusion of Innovations theory; a phenomenon supported by this research.

Weekly publication, in popular Western Australian farming magazines (the *Farm Weekly* and the *Countryman*), of business names that earned the highest wool prices at auction was regarded as a major impediment to the adoption of selling systems alternative to auction. To verify this finding, the wool producer who consistently sold his wool using futures said:

> *…/I have never been able to understand why rows and rows and rows of people's names are listed for what they got for bales of wool. You have no idea what it is like, why is it published. It has got no relevance to me. I will look through clients and see if they have done alright because I know some clients who love the auction system and love getting their name in the Farm Weekly, so I will sift through it. But it has got me buggered why it is published in the Farm Weekly and the Countryman every week…/*

The wool producer who has exited the industry gave further support to this statement by saying:

> *…/ We are not competitors, but it is almost a competitive thing. Everyone runs around crapping on about figures. When wool was doing well I would read the Farm Weekly and I would see this article and the guy would go: "Oh yeah, we averaged 6 kilos a head over 10,000 sheep." – 6 kilos of fleece wool is a big fleece… It is a lot of bull. The next week you read an article and this bloke would be raving on about his weathers cutting 8 kilos and you would be thinking "5000 wethers cut 8 kilos". But they couldn't get their sums right because I worked it out, yeah, 200 kilos a bale wool is 40 bales or whatever and they go yeah, we got 25 bales of wool, well you wouldn't have got 25 bales off so many wethers if you'd cut 8 kilos, you'd get double. It is just bloody weird…/*

The lesson learned from these two cases is that the print media evidently plays a large role in bolstering the significance of selling systems in wool producers' minds. The behavioural model showed that subjective norms are significant contributors to wool producers' adoption behaviours but what has been identified here is that media publications are evidently a source for competitiveness amongst producers. It was also shown that the mass media is perpetuating the notion that a high wool price is the

only price that is acceptable, rather than a pre-determined, secure wool price that earns a profit for the farm business.

Social pressures

These case studies identified the media as a possible explanation of the source of concern about using forward contracts by wool producers. Another issue that was raised, closely related to that of subjective norms, was the influence of peers and brokers in the decision to use forward contracts to sell wool. All the cases provided evidence that people of significant importance to the decision-maker doubted or criticised decisions to use a method other than auction to sell wool.

There was doubt from wool brokers: "The brokers were adamant that this was it. … They were really concerned that I was going to come back to them in two years time and go, 'You bastards, why didn't you talk me out of it'." Similarly, "I said, yes, I will take that contract for this many bales. They asked me if I was sure. They rang me back three times to confirm it." Following this, the wool producer who consistently sold wool by forward contract inadvertently offered an explanation for brokers' reticence:

> *…/ Well, a while ago when we first started [using forward contracts], they were all averse to it, but I think that's from the services they have got to offer though. There is a conflict of interest there in that if a service provider is offering something, they are going to want people to use that service they are being offered and not want to use another service, which means they have got to stop doing something and develop something else, which requires money and effort. So it is easier to keep the status quo …/*

There was also doubt from peers:

> *…/ One year I managed to sell a line of wool for three years running at about 1100c clean and, that must have been 2002 when the Chinese came and blew the market apart, and it went through the roof. Everyone said to me you are mad signing up for another three years of 1100c …/Probably two or three years ago I reckon 90% of my peers would have criticised me for selling anything forward …/*

While there is evidence to suggest that significant others made derogatory comments about the use of forward contracts, it appears that the individuals interviewed for this research have some particular strategies that separate them from the norm.

> *…/ There is that relating [price] back to the spot market, so we don't do that …/[Farm business success] is not relative to what other people are doing …/Whether it is more or less than what our neighbours got or the group we benchmark with doesn't really interest me a lot because I don't compete. To me it is a meaningless exercise, but unfortunately it is used as a benchmark for some reason …/That is one thing you never try and do is pick the top and the bottom of the market, you just go at a price you are happy with that you know you can educate the kids, you can have a holiday and plan for retirement …/*

This evidence suggests that people who have adopted the use of forward contracts, and are satisfied with this as a method of selling wool, possess clear knowledge about their costs of production and can thus make an informed decision about wool pricing. These people's decision making is not influenced by the general community (which includes comments from significant others, the mass media or the price of wool at auction). So while the behavioural model showed that subjective norms have a positive relationship to the intention to adopt forward contracts, it must be taken into account that 75.1% of survey respondents always used auction to sell their wool. The combined implication of these findings is that auction users are influenced by pressures of the wider community whereas adopters of forward contracts have the ability to reject social pressures and adopt rational behaviours for managing risk.

An explanation of complexity

Despite the common finding that complexity will have a negative influence on the decision to adopt an innovation (Rogers 1995; Fliegel & Kivlin 1962; Tiller 2000; Batz, Peters & Janssen 1999), the empirical conclusions of the research showed there to be no significance in this relationship. It was anticipated that an explanation for this lack of significance between 'complexity' and the intention to adopt would be explained in the case studies, although this did not eventuate.

In all cases, including the wool producer who consistently used auction, complexity associated with using forward contracts was found not to be an issue. The perception of forward contracts is that they are simple to use and that the wool supply chain is too long and well-established for any contracts not to be honoured by buyers or processors; as perceived by so many participants in the focus groups.

Given the inconclusive nature of this finding, it is pertinent to revisit the survey data. There were three items used to measure 'complexity' in the behavioural model:

CX1: Using forward contracts requires experience with your wool clip.

CX4: Using forward contracts is an easy way of selling wool.

CX7: When using forward contracts, there is no guess work involved with pricing.

These items had respective means of 5.2, 3.89 and 4.62 from the 7-point Likert scale. In order to understand the significance of these results, these means were subjected to one-sample t-tests using a target value at the mid-point of the Likert scale used in the survey. Items CX1 and CX7 both proved to be highly significant ($t = 13.027$ and 8.188, respectively [$p < 0.05$]) which indicates that experience with one's wool clip is required for selling wool by forward contract but also that, once a forward contract is taken out, any complexity associated with guessing future prices is annulled. In contrast to CX1 and CX7 being highly significant, CX4 was not significant ($t = -1.192$) thereby indicating that the ease of use is not a deciding factor associated with forward contracts.

This finding is similar to that of Tan and Teo (2000). In their investigation of the adoption of internet banking services in Singapore, these authors found a lack of support for 'complexity' as a construct in their behavioural model. The conclusion from this finding was that, because internet banking in Singapore was quite new at the time of the study, an insufficient amount of people within the sample population had had the opportunity to trial the innovation. Given that 80% of survey respondents have never used forward contracts to sell wool, the lack of support for the hypothesis related to complexity appears to be due to the lack of familiarity survey respondents had to actually using this selling method.

Conclusions

The purpose of the research conducted for this paper was to explore the unexplained elements of a behavioural model developed to understand the adoption, or indeed non-adoption, of forward contracts. Quantitative analysis using the partial least squares approach to structural equation modelling showed that farmers associate complexity with the use of forward contracts as a result of factors internal and external to the farm business. Surprisingly, despite popular consensus in the literature, this association does not significantly influence the intention to sell wool via forward contract. In contrast, neither factors external nor internal to the farm business significantly account for the strong sense of risk associated with intention to sell wool by forward

contract. To address these findings, case studies were chosen as the research strategy because they are an effective way of gathering a range of view points on a particular subject. Four wool producers with varying levels of commitment to using forward contracts were interviewed as case studies for the research. Cross-case analysis helped answer the proposed research questions. These questions primarily addressed the perceptions of risks and complexity associated with the use of forward contracts in the Western Australian wool industry.

It was found that the price differential between the spot market and the forward market was the main source of risk perception related to using forward contracts. In all cases, the spot market was said to offer better prices for wool than the forward market. Evidence was provided to demonstrate that the sources of risks were identified as being the need to maximise farm profits, the influence of the whole farm system in decision making about selling methods and the influence of the mass media and social norms on perceptions of using forward contracts. The most important of these findings from an industry perspective was that wool producers are highly responsive to the influence of the mass media and social norms. In addition, those who have already adopted the use of forward contracts are part of a small group who are not responsive to the pressures of the general community.

While a small number of cases have been studied herein, the findings of this study have shed some light on the unanswered aspects of the behavioural model. Implications are that wool buyers can use the mass media as a means of increasing the adoption of forward contracts to improve knowledge of wool stocks to processors. Such efforts will need to be well thought out as current norms dictate that forward contracts are not a preferred method of selling wool.

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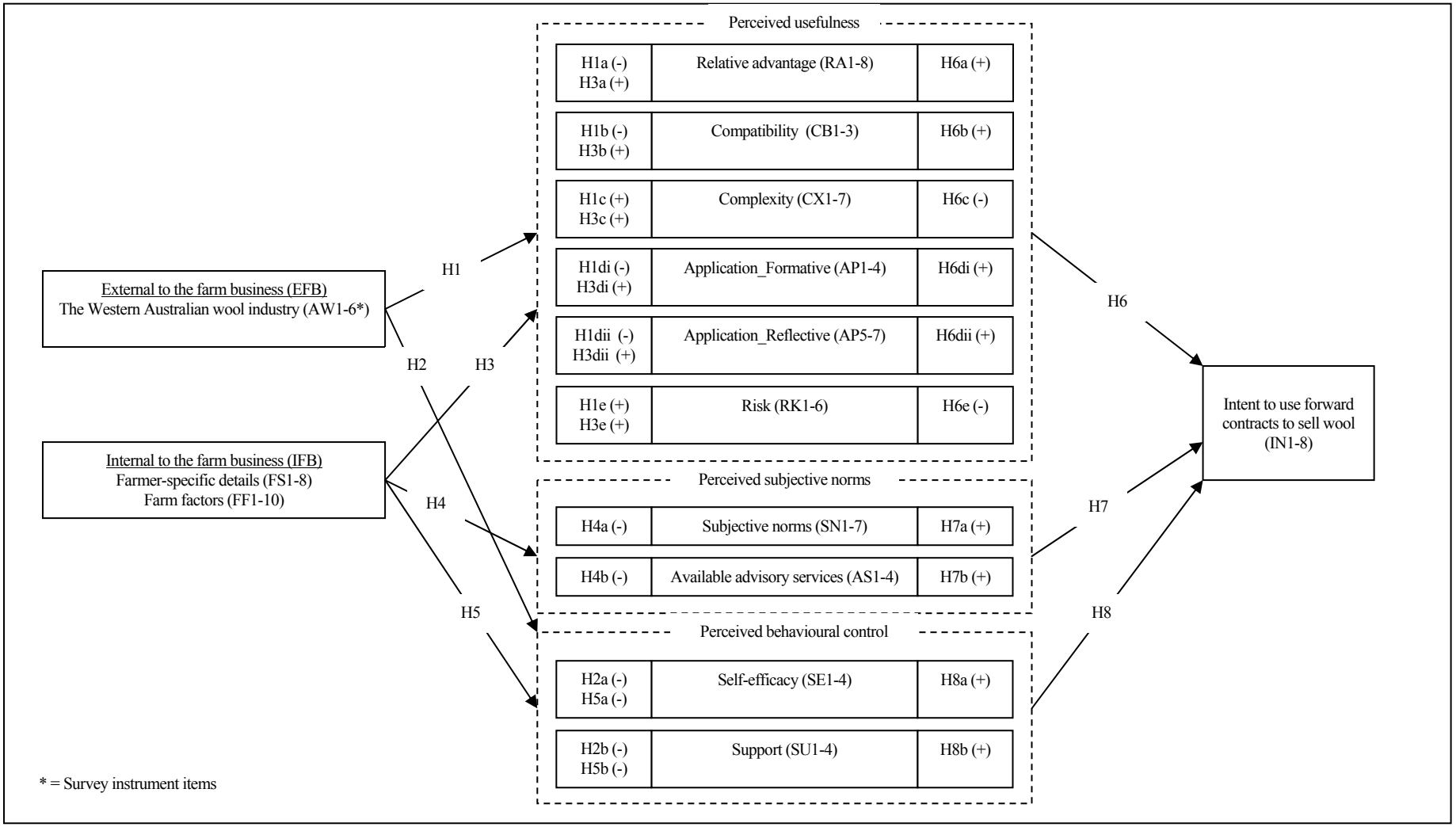
Appendix 1 – Illustration of hypothesised relationships



Appendix 2 – Summary results of hypothesis testing

	Hypothesis	Path	γ	t-value
Attitudinal factors	H1a	Factors external to the farm business → Relative advantage	0.342	5.371**
	H1b	Factors external to the farm business → Compatibility	0.280	4.962**
	H1c	Factors external to the farm business → Complexity	0.257	3.763**
	H1di	Factors external to the farm business → Application (Formative)	0.380	6.560**
	H1dii	Factors external to the farm business → Application (Reflective)	0.300	5.956**
	H1e	Factors external to the farm business → Risk	0.117	1.070
	H2a	Factors external to the farm business → Self-efficacy	0.226	3.452**
	H2b	Factors external to the farm business → Support	0.303	4.372**
	H3a	Factors internal to the farm business → Relative advantage	0.296	4.900**
	H3b	Factors internal to the farm business → Compatibility	0.213	2.741**
	H3c	Factors internal to the farm business → Complexity	0.163	2.259*
	H3di	Factors internal to the farm business → Application (Formative)	0.143	2.114*
	H3dii	Factors internal to the farm business → Application (Reflective)	0.005	0.067
	H3e	Factors internal to the farm business → Risk	-0.110	1.029
	H4a	Factors internal to the farm business → Subjective Norms	0.314	4.611**
	H4b	Factors internal to the farm business → Advisory services	0.364	5.771**
	H5a	Factors internal to the farm business → Self-efficacy	0.256	3.462**
	H5b	Factors internal to the farm business → Support	0.238	3.363**
Behavioural factors	H6a	Relative advantage → Intention to sell wool by forward contract	0.300	5.098**
	H6b	Compatibility → Intention to sell wool by forward contract	0.229	4.070**
	H6c	Complexity → Intention to sell wool by forward contract	-0.034	0.699
	H6di	Application (Formative) → Intention to sell wool by forward contract	0.075	1.233
	H6dii	Application (Reflective) → Intention to sell wool by forward contract	-0.002	0.039
	H6e	Risk → Intention to sell wool by forward contract	-0.225	3.698**
	H7a	Subjective Norms → Intention to sell wool by forward contract	0.203	3.589**
	H7b	Advisory services → Intention to sell wool by forward contract	0.089	1.522
	H8a	Self-efficacy → Intention to sell wool by forward contract	-0.024	0.447
	H8b	Support → Intention to sell wool by forward contract	0.088	1.620

γ = Standardised path co-efficient

* indicates significance at $t_{0.05} > 1.645$

** indicates significance at $t_{0.005} > 2.576$