BEHAVIOURAL FACTORS AFFECTING THE ADOPTION OF FORWARD CONTRACTS BY AUSTRALIAN WOOL PRODUCERS

Elizabeth Jackson and Mohammad Quaddus*
Graduate School of Business
Curtin University of Technology, Perth, WA 6000
Email: elizabeth.jackson@postgrad.curtin.edu.au

Nazrul Islam and John Stanton
Department of Agriculture Western Australia
South Perth, WA 6151

Abstract

A behavioural theory, based on the Theory of Planned Behaviour and Diffusion of Innovations, was previously developed to understand wool producers' intentions to adopt the use of forward contracts. The purpose of this research is to test the reliability and validity of our model using structural equation modelling. Empirical results indicate that the most significant variables in the model related to the nature of the Australian wool industry and a range of variables internal to the farm business. Relative advantage, compatibility and risk were also highly significant variables. The single message from this research is that there are a number of behavioural characteristics accounting for the slow adoption of price risk management strategies that are available to stabilise income. These findings will be useful to those wool traders and researchers looking to strengthen the international wool supply chain by using forward contracts to improve knowledge of wool qualities and quantities.

Keywords: Structural equation modelling, PLS, wool, relative advantage, compatibility, risk.

Introduction

Australian wool traders and researchers have little knowledge of why producers have been slow to adopt those price risk management strategies which are available to stabilise their income. Auction is by far the most popular method of selling raw wool with an adoption rate of about 85% (Bolt 2004). However, this system exposes users to highly volatile prices and non-specific knowledge of supply and demand. The New Zealand wool industry has been highly successful over the past ten years in introducing knowledge and structure to its supply chain (The Merino Company 2006, Cuming 2006, The Woolmark company 2005, Champion 2004, Brakenridge 2004). Diminishing the importance of the auction system and increasing the use of forward contracts in New Zealand have provided producers with stabilised incomes, traders with improved knowledge of qualities and quantities available and processors with better operating plans (Cuming 2006, Brakenridge 2004). Australia has made an effort to create similar efficiencies but has not been quite as successful (The Merino Company 2006). While changes designed to restructure the industry and move away from the auction system were publicly rejected by producers (Sharman 2006a, The Merino Company 2006), there is evidence to suggest that key wool buyers and traders are quietly establishing the supply chain efficiencies observed in New Zealand. Examples of such moves include the alliance made between Roberts (Tasmanian agribusiness) and Lempriere (wool merchant, exporter and processor) as well as the alliance made between the Australian Wool Network and clothing manufacturer Rammite International.

Roberts is offering forward contracts to encourage farmers to continue to produce wool and develop a brand associated with Tasmanian wool – a brand that shows high quality, reliable supply and accurate information (Harris 2006). In Western Australia, the Australian Wool Network and Rammite

International have made a similar alliance (Sharman 2006b). From this partnership, Western Australian wool producers are contracted to provide 18 micron wool for manufacture into military and extreme sport garments. In both of these examples, producers have a known income from their wool and the processors have a known quality and quantity of wool with which to work.

Examples such as these give our research two purposes. We first aim to test the reliability and validity of a behavioural model of wool producers' intentions to adopt the use of forward contract. This model was developed using a combination of constructs from the Theory of Planned Behaviour and Diffusion of Innovations; a unique element of the model was added by the inclusion of several constructs gathered from four focus groups with local wool producers. These constructs were designed to capture all dimensions of farm-level decision-making. In testing the model's reliability and validity, we can ascertain how successful we were with our theory building. We can also know how well the model fits with our data. Our second aim is to identify significant behaviours that are limiting the adoption of forward contracts for selling wool.

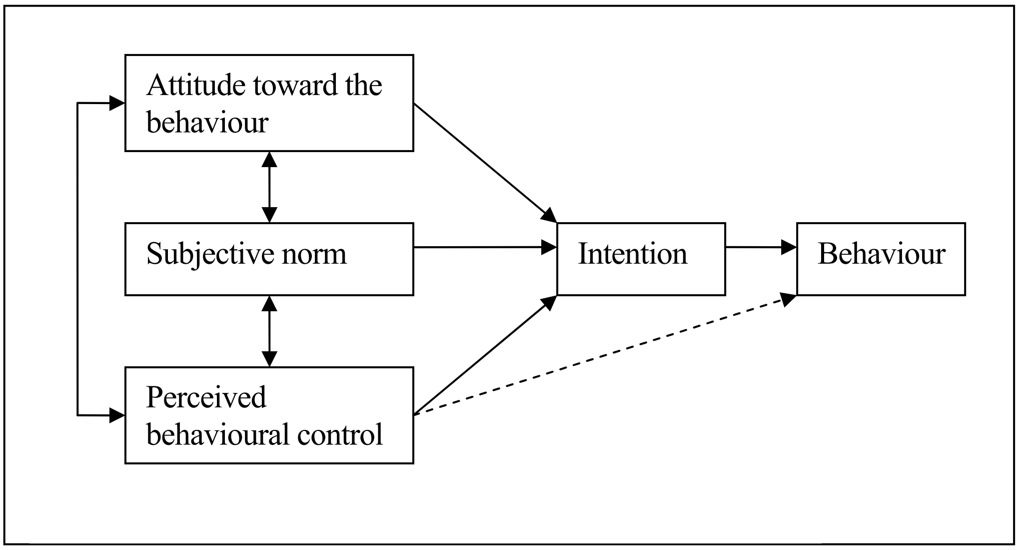
In addressing these aims, we first demonstrate that the theoretical bases of this research are suitable for use in the agribusiness and farm management research domains. We then go on to describe our methods of data collection and analysis. A detailed discussion of results is then provided, followed by some concluding remarks about our findings.

Theoretical background & frameworks

Theory of Planned Behaviour

Ajzen's Theory of Planned Behaviour (1991) is a firmly-established behavioural model that has been extensively used in research disciplines such as consumer behaviour (Dierks & Hanf 2006, Mazzocchi, Lobb & Traill 2006, McEachern & Warnaby 2005), social work (Christian & Armitage 2002, Marcil, Bergeron & Audet 2001), environmental studies (Corral 2002), finance (Tan & Teo 2000, East 1993) and health science (Gantt 2001) to explain behaviour. Figure 1 shows the constructs and relationships of the Theory of Planned Behaviour (TPB). In essence, the model uses the knowledge of attitudes, subjective norms and perceived behavioural control to understand beliefs and thus predict behaviour. The most important aspect to note is that the TPB uses perceived behavioural control to predict behaviour in two ways. Firstly, through motivational factors and the intention to perform the behaviour (via the 'Intention' construct) and, secondly, through actual control via the direct link between the 'Perceived behavioural control' and 'Behaviour' constructs, which is not necessarily mediated by intention (Madden, Ellen & Ajzen 1992).

Figure 1: Path model for the Theory of Planned Behaviour



Since the TPB was first published, research has been conducted to show that, not only is there significant relationships between the theory's constructs, but that it is possible to include other factors in the theory. Ajzen (1991) had the foresight to predict that this would be the case and, more than ten years later, Burton (2004) cites studies that have successfully integrated additional factors to the TPB on an "as needed" basis. Factors such as habit, moral obligation and self-identity were listed, although it was only the construct of identity that Burton (2004) nominates worth using in farming-based social psychology research. As previously explained, "past behaviour" is a construct worth consideration.

Limited use of the TPB has been attributed to its complexity in terms of its questionnaire development and its analytical requirements (Beedell & Rehman 2000, East 1993). Despite these criticisms, studies in the agribusiness research domain have proved the TPB to be a suitable tool for measuring farmer behaviour in two ways: to find out if all farmers behave in the same way and if not, are the differences in their beliefs explained by difference in their behaviours (for examples see Beedell & Rehman 1999 & 2000, Gorddard 1991 & 1993, Lynne *et al* 1993, Bergevoet *et al* 2004).

Diffusion of Innovations

Diffusion is defined by Rogers (1995, p. 5) as "the process by which an innovation is communicated through certain channels over time among members of a social system." and has successfully been applied in rural contexts since the 1940s (Fliegel 1993) with the focus being on the adoption of agricultural ideas such as herbicides, hybrid seed and fertilisers (Rogers 1995). Fisher, Norvell, Sonka and Nelson (2000) explain that diffusion is different from adoption in that it is the process by which new technologies are spread among users, whereas adoption is said to be an individual, internal decision.
Rogers (1958 & 1995) and Fliegel (1993) often refer to the seminal research by Ryan and Gross (1943) who studied the diffusion of hybrid corn through communities of Iowa, USA. It was this study that provided the early fundamental characteristics of the theory: the classic "diffusion of innovations" paradigm. This study promoted the significance of communication as a construct in the diffusion model and provided us with the generic bell-shaped (Figure 2) and sigmoid (Figure 3) curves of adoption on which a plethora of research on rural sociology has been based.
One of the recurring themes in Rogers' (1995) description of each category of adopter was that of communication. Among other characteristics, members of each category were always described in terms of their communication activities with other members of their social system and how far they reached outside the boundaries of their system in order to access information on a new idea. Communication is so

important to the diffusion of innovations process, as identified by Ryan and Gross (1943), that Rogers (1995) provides a definition immediately after his definition of diffusion: “Communication is a process in which participants create and share information with one another in order to reach a mutual understanding.” (p. 5-6).

Communication has been discussed in terms of social networks however, there is a great deal of literature on the importance of information networks that aid the diffusion of innovations. Research published as early as 1950 (Wilkening) reports the importance of agricultural agencies and mass media as conduits for information diffusion; research has since continued to find support for these methods (see Longo 1990, Saltiel, Bauder & Palakovich 1994). However, the most important means of information transfer has been found to be the importance of peer relationships (Longo 1990, Saltiel, Bauder & Palakovich 1994, Copp, Sill & Brown 1958, Wilkening 1950), with social class and size of land holding found to be factors which influence information up-take (Feder & Slade 1984, Wilkening 1950).

Figure 2: Technology adoption cycle (bell-shaped curve showing categories of individual innovativeness and percentages within each category)

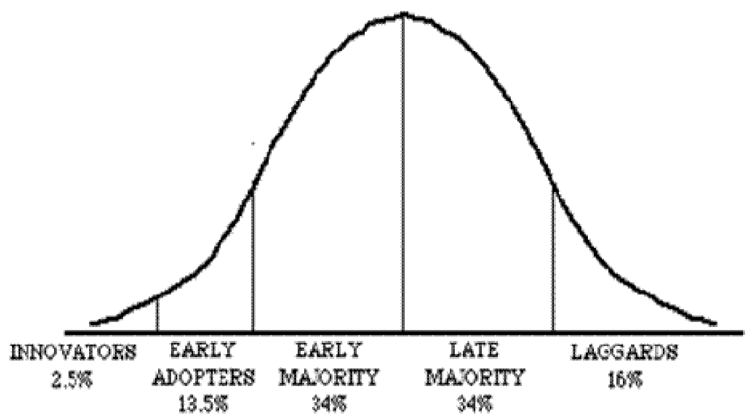
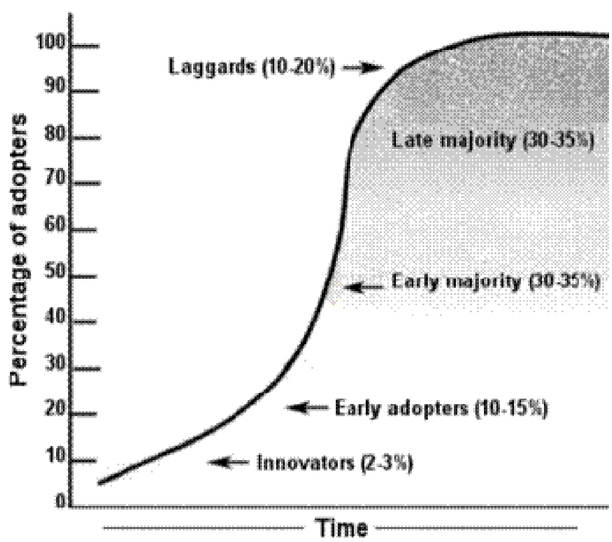
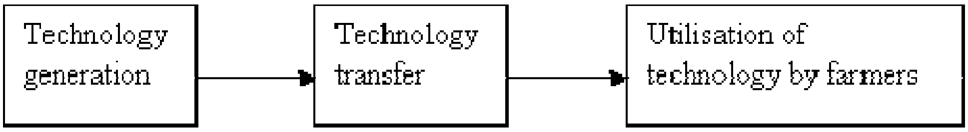


Figure 3: The S-shaped cumulative diffusion curve and adopter categories



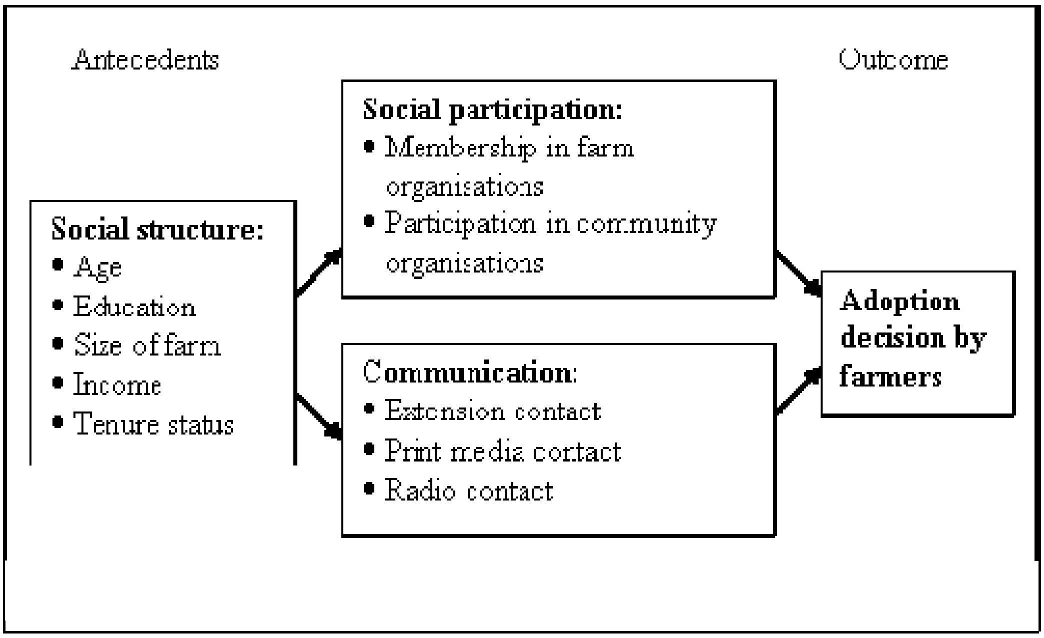
Now that the components of the Diffusion phenomenon have been described, its process can be detailed. Many authors who have studied the empirical nature of diffusion (such as Ajzen & Fishbein 1980, Quaddus & Xu 2005, Ryan & Gross 1943) take a classic, linear view of the process, in that external factors contribute to perceptions which, in turn, give rise to diffusion. Rogers (1995) presents a version of this linear model of the diffusion process within agriculture (Figure 4):

Figure 4: Diffusion as a linear phenomenon



However, Fliegel (1993), with support from Feder and Umali (1993), illustrates an approach more tailored to the adoption of agricultural innovations. Fliegel argues that the linear approach tends to restrict the process of diffusion to being a rational, planned process that relies on the developments of institutions such as government departments, rather than viewing the farmer as a passive individual who responds to more random forces related to social participation and communication (Figure 5):

Figure 5: Fliegel's approach to the adoption of agricultural innovations



In terms of diffusions of innovations in agriculture and rural sociology, a survey of the literature was conducted by Rogers (1995) who reviewed 3,890 publications and found rural sociology to have contributed the greatest percentage of research to the broader field of diffusion. Some 845 rural sociology publications were identified, with the next greatest contribution coming from the area of marketing and management (585 publications); thus proving the importance and dominance of agriculture to this research tradition.

A combined approach

So far, the strengths and weaknesses of the aforementioned behavioural theories have been discussed herein. From here, this investigation turns to finding if the strengths of these theories can be combined to provide theoretical frameworks that are equal to, or better, than their "parents". The approach of combining various behavioural theories has successfully been applied on numerous occasions in business and technology research (Intrapairot 2000, Xu 2003 and Hofmeyer 2005) but seldom in the agribusiness domain.

Tutkun and Lehmann (2006) and Tutkun, Lehmann and Schmidt (2006) combined the TPB and Diffusion of Innovations to explain farmer behaviour is two Swiss studies. Their explanation for taking this approach was that the weaknesses of TPB can be discarded and the traditional model enhanced by including diffusion constructs. Results of these studies were extremely encouraging in that most of the relationships tested in this combined model resulted in a $p < 0.001$ level of significance with the all-important communication construct from the Diffusion of Innovations explaining an astounding 76% and 67% variation in adoption behaviour, respectively.

While there are few agribusiness-related studies that have taken a combined approach to behavioural research, this research aims to add to this body of knowledge by contributing another such model. In this research, the model developed uses the philosophies of Xu and Quaddus (2005) whereby only select constructs of the theoretical frameworks have been used and reorganised to suitably capture the all dimensions of farm-level decision-making. Our combined behavioural model is presented in Figure 6.

Methods

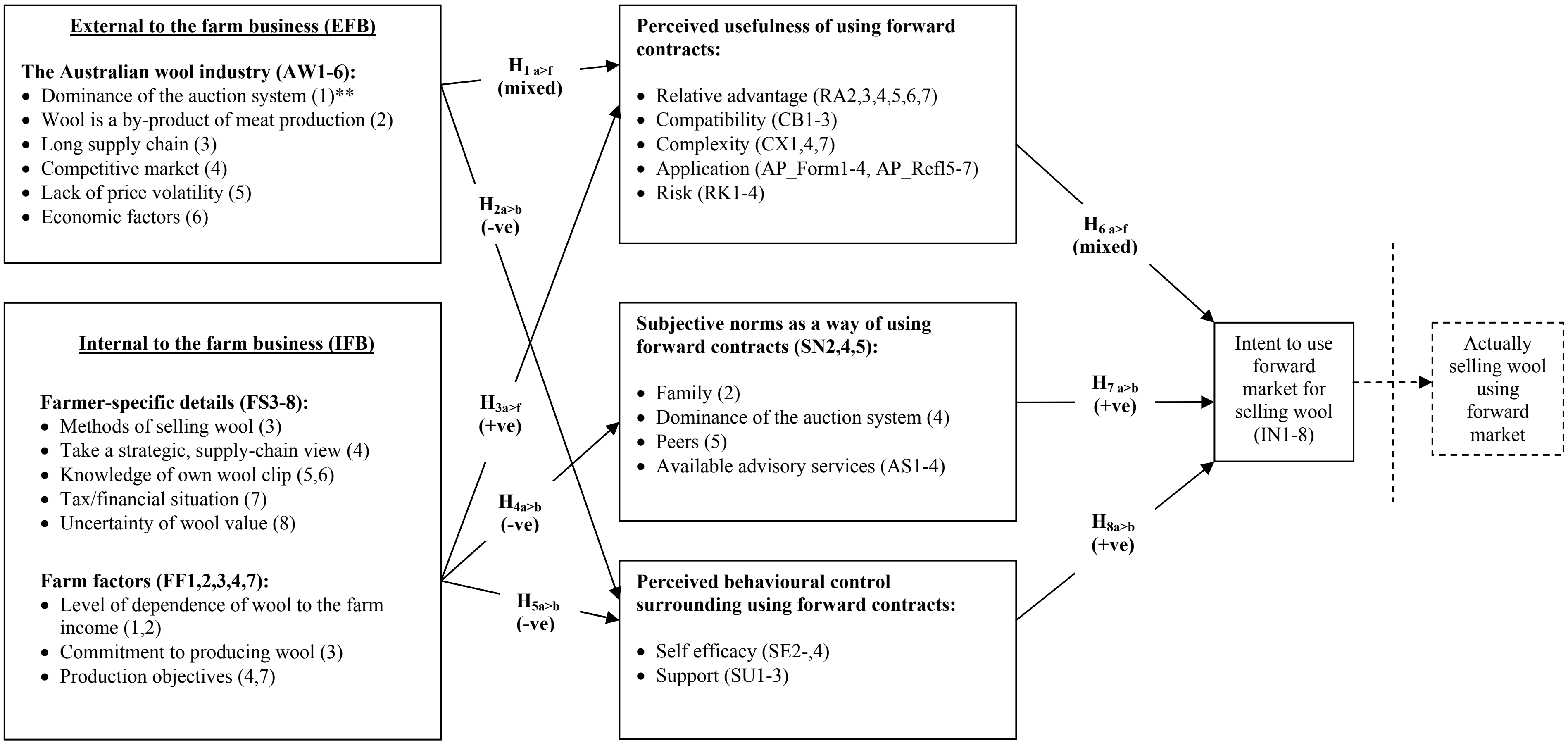
Data collection

A behavioural model was developed from the results of four focus groups conducted in regional Western Australia (Northampton, Merredin, Kojonup and Esperance)[1] and an extensive review of the literature on TPB, Diffusion of Innovations and a combined approach to these frameworks. From this model, a questionnaire was constructed to ascertain farmers' thoughts and perceptions of selling raw wool by forward contract; all questions (except those measuring demographics) used a 7-point Likert scale. The data from the questionnaire was analysed to test the reliability and validity of the behavioural model. Several drafts of the questionnaire were scrutinised by the four researchers, before its release, to ensure validity of content.

A professional marketing company was employed to administer a telephone survey of randomly-selected Western Australian wool producers in May 2006. A pilot survey was conducted on 113 wool producers in order to ensure the validity of the survey; the final survey yielded 305 valid responses. The only criterion of respondents was that, at the time of the survey, they were primary producers, had a flock of at least 700 adult sheep and were commercial wool producers.

[1] For a detailed description of this study, see the authors' paper in *Journal of Farm Management*, 2007, vol. 12, no. 11.

Figure 6: The combined behavioural model of wool producers' intentions to adopt the use of forward contracts



Data analysis

Structural equation modelling (SEM), the statistical tool chosen for data analysis of this research is a second-generation multivariate data analysis technique. It allows the simultaneous assessment of reliability and validity whilst also estimating the relationships among the constructs. Barclay, Higgins and Thompson (1995, p. 288) outline the three main advantages of SEM:

1. It permits the assessment of measurement properties of constructs within different theoretical contexts in which they are embedded.
2. It deals explicitly with measurement error.
3. It provides other benefits to researchers that are not available with first-generation techniques, such as multiple regressions, principle components analysis and cluster analysis.

This method of analysis was chosen for its ability to estimate multiple and interrelated dependence relationships and its function of representing unobserved concepts of such relationships (Hair et al. 1992). This method of analysing data is also finding a place in agricultural-based studies (for examples see Tutkun & Lehmann 2006, Tutkun, Lehmann & Schmidt 2006, McEachern & Warnaby 2005, Pennings & Leuthold 2001).

Discussion of results

The results that follow were calculated using SPSS 13 and the partial least squares (PLS) approach to structural equation modelling. The sample population was 88% male who had an average of 31 years working with the farm business; exactly half of the respondents were the farm's primary decision maker. About 66% of respondents had used forward contracts as a selling method but only 24% had used forward contracts to sell wool. About 34% of respondents had no experience using forward contracts.

Analysis of correlations is a good method of testing the strength of association between two variables. Table 1 is the correlation matrix for the variables tested in our behavioural model; it also shows the abbreviations of variable items used herein. The highest correlation coefficient is between relative advantage and intention to adopt forward contracts (r = 0.602). Relationships to 'intention' feature with the highest correlation coefficients in the model, therefore indicating that as factors such as compatibility, support and subjective norms increases, then producers are more likely to take out forward contracts. The only exception to this finding is with the risk variable. Most correlation coefficients associated with risk are negative which shows that, as perceived risks increase, the likelihood of producers taking out forward contracts to sell wool diminishes. This makes intuitive sense. However, from the results in Table 2, strictly speaking this is only relevant when risk influences intention ($H6_F$), in other cases ($H1_F$ and $H3_F$), the impact of risk is not significant.

The problem with using correlations for data analysis is that they only compare the statistical relationship between two variables. Structural equation modelling allows researchers to discover the casual relationships between variables by taking into account all other variables within a model (Barclay, Higgins & Thompson 1995). To attain a richer understanding of the data, we now explore it further by using this highly sophisticated form of multiple regression and path analysis.

In accordance with the hypotheses in our behavioural model, we tested pairs of variables for the significance of their relationships; the results of this analysis are shown in Table 2. It is clear that most relationships within the model are statistically significant, seventeen of which are significant to the 0.5% level; only two relationships were significant at the 5% level (factors internal to the farm business with the complexity of using a forward contract and factors internal to the farm business with formative items that measure the application of forward contracts to the farm business). Surprisingly, nine relationships were found not to be significant indicating, that they have no impact on producers' intentions to take out a forward contract to sell their wool.

Table 1: Pearson correlation matrix for behavioural model constructs

r	Factors external to the farm business (EFB)#	Factors internal to the farm business (IFB)#	Relative advantage (RA)	Compatibility (CB)	Complexity (CX)	Application_ Form (AP_Form)#	Application_ Refl (AP_Refl)	Risk (RK)	Self-efficacy (SE)	Support (SU)	Subjective norms (SN)	Advisory services (AS)#	Intention (IN)
EFB#	1.00												
IFB#	0.241	1.00											
RA	0.413	0.387	1.00										
CB	0.331	0.280	0.533	1.00									
CX	0.296	0.225	0.599	0.448	1.00								
AP_Form#	0.414	0.235	0.480	0.366	0.504	1.00							
AP_Refl	0.301	0.078	0.390	0.451	0.373	0.355	1.00						
RK	0.091	-0.081	-0.109	-0.040	-0.076	0.211	0.138	1.00					
SE	0.287	0.310	0.471	0.371	0.459	0.494	0.300	0.157	1.00				
SU	0.360	0.311	0.498	0.363	0.390	0.375	0.240	-0.002	0.485	1.00			
SN	0.398	0.314	0.398	0.379	0.363	0.472	0.438	0.144	0.517	0.372	1.00		
AS#	0.178	0.364	0.311	0.253	0.186	0.205	0.144	-0.057	0.278	0.244	0.204	1.00	
IN	0.362	0.426	0.602	0.531	0.416	0.373	0.316	-0.223	0.360	0.421	0.431	0.318	1.00

= formative indicators

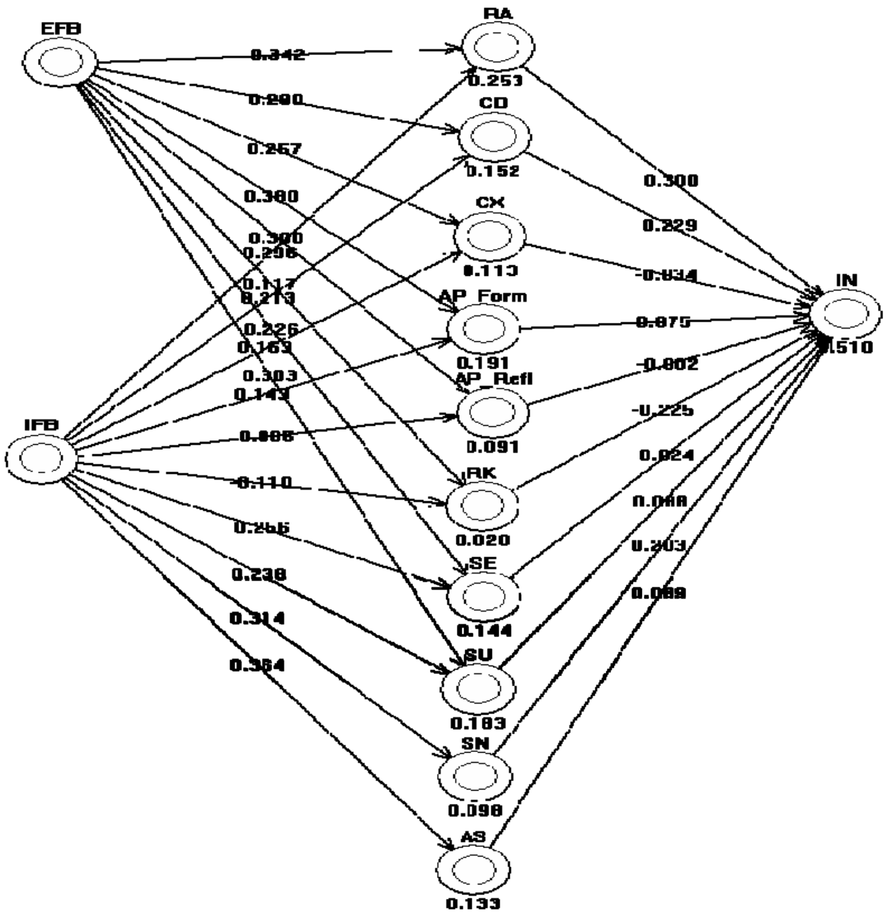
Table 2: Significance of hypothesised relationships

Hypothesis	Relationship	Standardised path co-efficient	t-value	Levels of significance
$H1_A$	EFB[1] → RA	0.342	5.371	***
$H1_B$	EFB → CB	0.280	4.962	***
$H1_C$	EFB → CX	0.257	3.763	***
$H1_D$	EFB → AP_Form	0.380	6.560	***
$H1_E$	EFB → AP_Refl	0.300	5.956	***
$H1_F$	EFB → RK	0.117	1.070	Not significant
$H2_A$	EFB → SE	0.226	3.452	***
$H2_B$	EFB → SU	0.303	4.372	***
$H3_A$	IFB[2] → RA	0.296	4.900	***
$H3_B$	IFB → CB	0.213	2.741	***
$H3_C$	IFB → CX	0.163	2.259	*
$H3_D$	IFB → AP_Form	0.143	2.114	*
$H3_E$	IFB → AP_Refl	0.005	0.067	Not significant
$H3_F$	IFB → RK	-0.110	1.029	Not significant
$H4_A$	IFB → SE	0.256	3.462	***
$H4_B$	IFB → SU	0.238	3.363	***
$H5_A$	IFB → SN	0.314	4.611	***
$H5_B$	IFB → AS	0.364	5.771	***
$H6_A$	RA → IN	0.300	5.098	***
$H6_B$	CB → IN	0.229	4.070	***
$H6_C$	CX → IN	-0.034	0.699	Not significant
$H6_D$	AP_Form → IN	0.075	1.233	Not significant
$H6_E$	AP_Refl → IN	-0.002	0.039	Not significant
$H6_F$	RK → IN	-0.225	3.698	***
$H7_A$	SE → IN	-0.024	0.447	Not significant
$H7_B$	SU → IN	0.088	1.720	Not significant
$H8_A$	SN → IN	0.203	3.589	***
$H8_B$	AS → IN	0.089	1.522	Not significant

[1] = Factors external to the farm business (ie Australian wool industry)
[2] = Factors internal to the farm business
** = $p < 0.05$, *** = $p < 0.005$*

Figure 7 shows output from the PLSgraph. In this figure, all the relationships that have been reported are illustrated. The only relationship that has not yet been discussed is how well the model fits to the data; this is shown at the far right of the diagram. The R^2 of the model is 0.510; this indicates that the model has an extremely good fit to the data and, more importantly, that the model has a strong explanatory power of adoption behaviours. The basis for our comparison is from a study by Santosa, Wei and Chan (2005) who cite literature recommending that R^2 should be greater than 0.1 in behavioural science studies to be considered adequate. Other values of interest are those which do not meet this criterion: Application_Refl (R^2 = 0.091), Risk (R^2 = 0.020) and Subjective Norm (R^2 = 0.098). These low R^2 values indicate that these three variables do not explain wool producers' adoption of forward contracts as a selling method. Structural equation modelling also allows us to conclude that the model's exogenous variables do not strongly contribute to the validity of the three aforementioned dependent variables.

Figure 7: Model of factors affecting the adoption of forward contracts by Australian wool producers (n = 307)



To summarise our discussion of results, it can be said that the analysis of results shows that our model is an adequate reflection of the sample that represents the population. Also, our results have revealed some behavioural factors that can explain the slow adoption of forward contracts by Australian wool producers.

Conclusions

This research aimed to address the lack of information available to wool traders and researchers on the slow adoption of price risk management strategies by Australia wool producers. In order to fill this gap, we set out to test the reliability and validity of a previously developed model that aimed to understand wool producers' intentions to adopt the use of forward contracts. Our findings have led to two main conclusions. First, that the model is a good fit to the data, thus indicating that our combination of constructs from the TPB and Diffusion of Innovations was successful and that the model is an adequate reflection of the data that represents the population. Second, there are a number of factors that have proved to be useful for understanding the slow adoption of forward contracts to sell raw wool. These factors were found to be: the current nature of the Australian wool industry, farmers' past experiences, farmers' current operating procedures, the relative advantage of taking out a forward contract, the compatibility of forward contracts with farm business requirements and the perceived risk associated with using forward contracts. The single message from these findings is that these behavioural factors can be used by wool traders and researchers to understand the slow adoption of price risk management strategies. These findings are important because, as wool supply chains become more sophisticated in their structure, traders and processors will be calling for better knowledge of qualities and quantities available. The adoption of forward contracts by producers will not only provide them with a stabilised income but will assist members of the supply chain who operate beyond the farm gate with advanced knowledge of supply and demand.

Acknowledgements
This research is part of the project “Behavioural Determinants of the Adoption of Forward Market by Australian Wool Producers”, jointly supported by the Department of Agriculture and Food Western Australia and the Australian Research Council. The views expressed in the paper are not necessarily the views of the supporting organisations. The authors would like to thank the farmers and industry stakeholders who participated and helped organise the focus group sessions. Support from Zohurul Hoque with the mobile technical equipments has been excellent.

References

Ajzen, I. 1991, 'The Theory of Planned Behaviour', *Organizational Behavior and Human Decision Processes,* vol. 50, no. 2, pp. 179-211.

Ajzen, I. & Fishbein, M. 1980, *Understanding Attitudes and Predicting Social Behavior*, Prentice-Hall, New Jersey.

Barclay, D., Higgins, C. & Thompson, R. 1995, 'The partial least squares (PLS) approach to causal modelling: Personal computer adoption and use as an illustration', *Technology Studies,* vol. 2, no. 2, pp. 285-324.

Beedell, J. & Rehman, T. 1999, 'Explaining farmers' conservation behaviour: Why do farmers behave the way they do?' *Journal of Environmental Management,* vol. 57, no. 3, pp. 165-176.

Beedell, J. & Rehman, T. 2000, 'Using social-psychology models to understand farmers' conservation behaviour', *Journal of Rural Studies,* vol. 16, no. 1, pp. 117-127.

Bergevoet, R. H. M., Ondersteijn, C. J. M., Saatkamp, H. W., van Woerkum, C. M. J. & Huirne, R. B. M. 2004, 'Entrepreneurial behaviour of Dutch dairy farmers under a milk quote system: Goals, objectives and attitudes', *Agricultural Systems,* vol. 80, no. 1, pp. 1-21.

Bolt, C. 2004, 'Plan for rival wool sales', *The West Australian,* 6 April, p. 45.

Brakenridge, J. 2004, *Contracts gain traction*, The New Zealand Merino Company, Retrieved: October 13 2004, from http://www.nzmerino.co.nz/news/merinonews.asp?id=230.

Burton, R. J. F. 2004, 'Reconceptualising the 'behavioural approach' in agricultural studies: a socio-psychological perspective', *Journal of Rural Studies,* vol. 20, no. 3, pp. 359-371.

Champion, S.C. 2004, 'Customising to the needs of the customer - insights from the New Zealand Merino experience', in *Proceedings of Agribusiness Sheep Updates*, Perth, Australia, pp. 18-19.

Christian, J. & Armitage, C. J. 2002, 'Attitudes and intentions of homeless people towards service provision in South Wales', *The British Journal of Social Psychology,* vol. 41, no. 2, pp. 219-231.

Copp, J. H., Sill, M. L. & Brown, E. J. 1958, 'The function of information sources in the farm practice adoption process', *Rural Sociology,* vol. 23, no. 2, pp. 146-157.

Corral, C. M. 2002, 'Structure: A behavioural model for environmental and technology policy analysis', in *Environmental Policy and Technological Innovation: Why do firms adopt or reject new technologies?*, Edward Elgar, Cheltenham, UK, pp. 36-59.

Cuming, M. 2006, 'Links in wool sector prove effective', *Farm Weekly*, 27 April, p. 31.

Dierks, L. & Hanf, C. H. 2006, 'Trust as a determinant of consumer behaviour in food safety crises', *26th International Association of Agricultural Economists Conference*, Gold Coast, 12-18 August.

East, R. 1993, 'Investment decisions and the theory of planned behaviour', *Journal of Economic Psychology,* vol. 14, no. 2, pp. 337-375.

Feder, G. & Slade, R. 1984, 'The acquisition of information and the adoption of new technology', *American Journal of Agricultural Economics,* vol. 66, no. 3, pp. 312-320.

Feder, G. & Umali, D. L. 1993, 'The adoption of agricultural innovation: A review', *Technological Forecasting and Social Change,* vol. 43, pp. 215-239.

Fisher, D. K., Norvell, J., Sonka, S. & Nelson, M. J. 2000, 'Understanding technology adoption through system dynamics modelling: implication for agribusiness management', *International Food and Agribusiness Management Review,* vol. 3, no. 3, pp. 281-296.

Fliegel, F. C. 1993, *Diffusion Research in Rural Sociology*, Greenwood, Westport, USA.

Gantt, C. J. 2001, 'The theory of planned behaviour and postpartum smoking relapse', *Journal of Nursing Scholarship,* vol. 33, no. 4, pp. 337-341.

Gorddard, B. J. 1991, *The adoption of minimum tillage in the Western Australian wheatbelt*, University of Western Australia, Agricultural economics discussion paper no. 3/91.

Gorddard, B. J. 1993, *Beliefs, attitudes and conservation behaviour*, Retrieved: 16 March 2006, from http://auth.lis.curtin.edu.au/cgi-bin/auth-ng/eres_display.cgi?url=DC60003447.pdf&copyright=1.

Hair, J. F., Anderson, R. E., Tatham, R. L. & Black, W. C. 1992, 'What is structural equation modeling?' in *Multivariate data analysis - with readings*, Macmillan Publishing Company, Canada, pp. 432-452.

Harris, M. 2006, *Roberts launches new wool marketing initiative*, media release, Roberts Pty Ltd, Retrieved 2 May 2006 from http://www.robertsltd.com.au/upload/Roberts%20Wool%20Link%202%20May%202006.pdf

Hofmeyer, G. 2005, *An Investigation of the Factors that Influence the Intention to Adopt Business to Business (B2B) Trading Exchanges in Small Business in Western Australia*, DBA thesis, Curtin University of Technology.

Intrapairot, A. (2000) A study on the adoption and diffusion of information and communication technologies in the banking industry in Thailand using multiple-criteria decision making and system dynamics approaches, PhD thesis, Curtin University of Technology.

Longo, R. M. J. 1990, 'Information transfer and the adoption of agricultural innovations', *Journal of the American Society for Information Science,* vol. 41, no. 1, pp. 1-9.

Lynne, G. D., Casey, C. F., Hodges, A. & Rahmani, M. 1995, 'Conservation technology adoption decisions and the theory of planned behavior', *Journal of Economic Psychology,* vol. 16, no. 4, pp. 581-598.

Madden, T. J., Scholder Ellen, P. & Ajzen, I. 1992, 'A comparison of the Theory of Planned Behavior and the Theory of Reasoned Action', *Personality and Social Psychology Bulletin,* vol. 18, no. 1, pp. 3-9.

Marcil, I., Bergeron, J. & Audet, T. 2001, 'Motivational factors underlying the intention to drink and drive in young male drivers', *Journal of Safety Research,* vol. 32, no. 4, pp. 363-376.

Mazzocchi, M., Lobb, A. E. & Traill, W. B. 2006, 'Food scares and consumer behaviour: A European perspective', *26th International Association of Agricultural Economists Conference*, Gold Coast, 12-18 August.

McEachern, M. G. & Warnaby, G. 2005, 'Improving customer orientation within the fresh meat supply chain: A focus on assurance schemes', *Journal of Marketing Management,* vol. 21, no. 1/2, pp. 89-115.

Pennings, J. M. E. & Leuthold, R. M. 2001, 'A behavioural approach towards futures contract usage', *Australian Economic Papers,* vol. 40, no. 4, pp. 461-478.

Quaddus, M. & Xu, J. 2005, 'Adoption and diffusion of knowledge management systems: Field studies of factors and variables', *Knowledge-Based Systems,* vol. 18, no. 2-3, pp. 107-115.

Rogers, E. M. 1958, 'Categorizing the adopters of agricultural practices', *Rural Sociology,* vol. 23, no. 4, pp. 345-354.

Rogers, E. M. 1995, *Diffusion of Innovations,* 4th edn, The Free Press, New York.

Ryan, B. & Gross, N. C. 1943, 'The diffusion of hybrid seed corn in two Iowa communities', *Rural Sociology,* vol. 8, no. 1, pp. 15-24.

Saltiel, J., Bauder, J. W. & Palakovich, S. 1994, 'Adoption of sustainable agricultural practices: Diffusion, farm structure and profitability', *Rural Sociology,* vol. 59, no. 2, pp. 333-349.

Santosa, P. I., Wei, K. K. & Chan, H. C. 2005, 'User involvement and user satisfaction with information-seeking activity', *European Journal of Information Systems,* vol. 14, no. 4, pp. 361-370.

Sharman, L. 2006a, 'NZ chain model doubts', *Countryman*, 13 April, p. 9.

Sharman, L. 2006b, ‘Wool deal WA winner’, *Countryman*, 23 November, p. 6.

Tan, M. & Teo, T. S. H. 2000, 'Factors influencing the adoption of internet banking', *Journal of the Association for Information Systems,* vol. 1, no. 5, pp. 1-42.

The Merino Company Pty Ltd 2006, *New Zealand Merino supply chain business model for Australia*, Australian Wool Innovation Limited, EC709, Retrieved 21 April 2006, from http://www.wool.com.au/attachments/Publications/Trade_development/Final_Report_NZ_Merino.pdf

The Woolmark Company 2005, *New Zealand Wool Exports (media release)*. Retrieved: 14 October 2005, from http://www.wool.com.au/LivePage.aspxId=2239
Tutkun, A. & Lehmann, B. 2006, 'Explaining the conversion to particularly animal-friendly stabling system of farmers of the Obwalden Canton, Switzerland - Extension of the Theory of Planned Behavior within a Structural Equation Modeling Approach', paper presented to the *80th Agricultural Economics Society conference*, Paris, 30-31 March.

Tutkun, A., Lehmann, B. & Schmidt, P. 2006, 'Explaining the conversion to organic farming of farmers of the Obwaldon Canton, Switzerland - Extension of the Theory of Planned Behaviour within a structural equation modeling approach', *26th International Association of Agricultural Economists Conference*, Gold Coast, 12-18 August.

Wilkening, E. A. 1950, 'Sources of information for improved farm practices', *Rural Sociology,* vol. 15, no. 1, pp. 19-30.

Xu, J. 2003, *A study of the factors influencing knowledge management systems diffusion in Australia*, PhD thesis, Curtin University of Technology.

Xu, J. & Quaddus, M. 2005, 'Adoption and diffusion of knowledge management systems: An Australian survey', *The Journal of Management Development,* vol. 24, no. 4, pp. 335-361.