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# Price risk reduction for wool growers using the new wool futures contract

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*In this paper the potential benefits to wool growers of using the deliverable wool futures contract (introduced in March 1995 by the Sydney Futures Exchange) to hedge against price risk are discussed. The paper contains quantitative analysis which provides an indication of the type and quantity of wool which might be hedged effectively.*

*Wool growers who produce wool with characteristics the same as those specified in the wool futures contract are most likely to be able to cost effectively reduce price risk by using the futures market. Growers who produce wool with different characteristics may need to use ratio hedging.*

ABARE project 1090

# 1 Introduction

Australian wool producers face two primary sources of income risk: uncertainty about future production (levels and quality) and uncertainty about future prices. The focus of the analysis presented in this paper is the uncertainty of income caused by price risk and possible benefits to wool growers of using wool futures in the management of price risk. Price risk is analysed taking into consideration the risks associated with selling wool at the auction markets and the basis risk (the variation of the difference between futures price and spot price) faced by a wool grower who chooses to hedge using the wool futures contract.

In a move towards improving the liquidity of the wool futures market, the Sydney Futures Exchange (SFE) on 13 March 1995 launched a revised wool futures contract which can be settled by physical delivery. Specifications of this deliverable contract include objective and subjective measurements of wool characteristics such as fibre diameter, vegetable matter content, staple strength, staple length, colour and style.

This paper assesses the use and effectiveness of wool futures as part of price risk management strategies. The sources of data for the study are:

- the Australian Wool Exchange (AWEX) auction data for the three selling seasons 1991-92, 1992-93 and 1993-94. These data have objective and subjective measurements of wool characteristics for each wool lot sold on the auction market;
- weekly wool price indicators from Wool International (WI) for a variety of micron grades for the period 1985 to June 1994 and;
- ABARE's farm survey data for the years 1992-93 and 1993-94 linked with the AWEX auction data for a similar period. It was not possible to link data for the financial year 1991-92 because the variable (brand name) which links the two data sets was then not collected by ABARE. Detailed description of the linked data set is contained in Lubulwa et al (1994). The linked data set has on farm variables (including: farm financial performance, management practices and location), characteristics of the wool produced on the farm, and the price for each wool lot sold from a particular farm.

The rest of the paper is structured in the following way. Section 2 contains a brief background of the wool futures marketing system. Hedging price risk using futures contracts, the mechanics of hedging and the description of the new futures contract are discussed in section 3. Section 4 contains the development of a model to assist in the analysis of basis risk and the type of wool which can be hedged effectively using the proposed wool futures contract. Concluding remarks are made in section 5.

# 2 Background

The volatility of wool prices in the 1950s led to the introduction in 1960 of a greasy wool futures contract traded on an open market. The wool futures contract enabled both producers and buyers of wool to hedge against price risk, and was also used by speculators who were involved in the market without trading in the physical commodity. By 1964 the Sydney Greasy Wool Futures Exchange (now the Sydney Futures Exchange) was the largest wool futures market in the world, with a total of 130 703 contracts traded that year (see Hosking 1993). However, the introduction of the Reserve Price Scheme (RPS) in the early 1970s, led to a decline in trading in wool futures, except for a brief period in the early 1980s.

## 2.1 Description of the new wool futures contract

From 1960 to 1986 the wool futures contract was a physical delivery contract. In 1986 the contract was changed to a cash settlement contract because of uncertainty which surrounded the future of the reserve price scheme and the low volumes of wool available for delivery.

The deliverable futures contract was re-introduced in March 1995 mainly because the uncertainty of the reserve price scheme was no longer an issue and the cash settlement contract failed to attract sustainable trading volumes. The wool futures contract can now be settled via physical delivery. Specifications of the contract now include measurements of wool attributes such as fibre diameter, staple strength, staple length, vegetable matter content, yield, colour and style. Since specifications include objective staple measurements, wool lots with these objective measurements will be the only ones accepted for delivery. Other contract specification are contained in table 1.

Table 1: Wool futures contract specifications (as of 13 March 995)

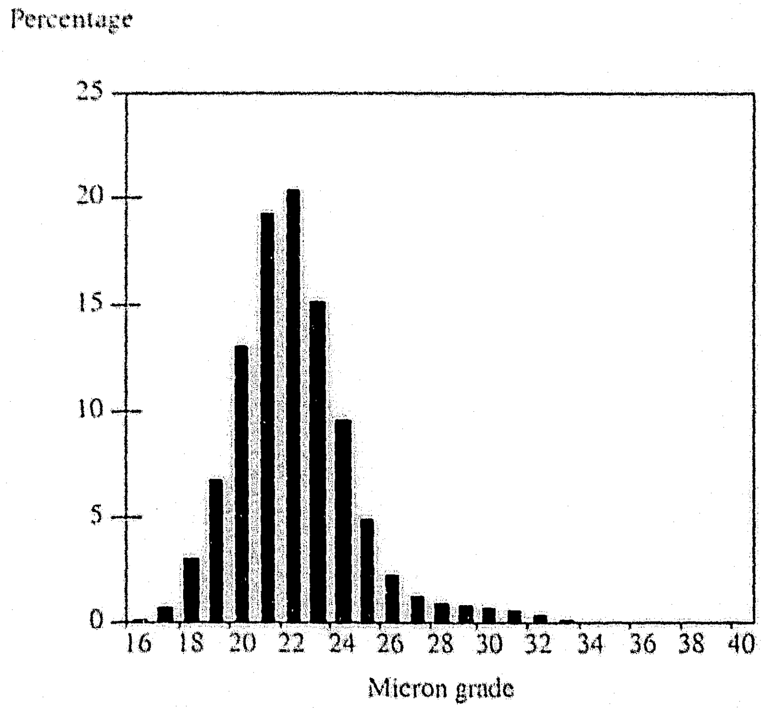
| | |
|---|---|
| Weight | The greasy equivalent of 2,500 kilograms clean weight of merino combing fleece ( approximately 25 farm bales) Clean weight determined using Schlumberger dry yield and must be greater than 62 per cent A deliverable parcel should be composed of lots with no less than 4 farm bales. A lot with less than 4 farm bales may be included only if it helps to top up the parcel to meet weight specifications |
| Standard Delivery | Good topmaking merino fleece with average fibre diameter of 21.0 microns with measured mean strength of 35 N/ktex, mean staple length of 90 mm of good colour, good topmaking style, with less than 1% vegetable matter. |
| Deliverable tolerances | Parcels of clean weight between 2,400 kg and 2,600 kg are acceptable. Wool of good top making style or better, good colour, with average micron between 19.6 to 22.5 micron and length between 80 mm and 100 mm is acceptable. Other acceptable requirements include measured staple strength greater than 30 newtons per kilotex (N/ktex), wool of less than 35 N/ktex must also have greater than 65% of position of break at the tip or base. Vegetable matter content of up to 2.0% is allowed but, with no more than 1.0% seed and shive. |
| Premiums and discounts | Invoices will be adjusted for weight. Premiums/discounts will be applied for each point of a micron below/above 21 microns within the specified micron range (19.6 to 22.5 micron). Discounts will be applied to staple strength between 30 and 35 N/ktex, but no premiums for staple strength greater than 35N/ktex. Discounts and premiums for all deliverable wools above and below the standard are fixed on the Friday prior to the last day of trading. |
| Quotations | Prices are quoted in cents per kilogram clean weight. (The minimum fluctuation of 1 cent per kilogram is equal to A$25.00 per contract.) |
| Contract months | February/April/June/August/October and December up to 18 months ahead. |
| Termination of trading | The last day of trading shall be the third Thursday of the contract month. Trading ceases at 12.00 noon. |
| Delivery Centres | To be determined by SFE but initially the approved centres are Sydney, Melbourne, Brisbane, Fremantle and Adelaide. |

*Source SFE(1995)*

## 2.2 Distribution of micron grade

The micron grade distribution of the auction sale data for the 1993-94 selling season indicate that over 50 per cent of the Australian clip falls in the deliverable specifications for micron grade (19.6-22.6 microns) figure 1. This percentage would be lower if other wool attributes specified in the contract were taken into consideration.

Figure 1: Distribution of fibre diameter for wool sold at auction 1993-94




Source: Australian Wool Sales Statistics 1993-94 season.

# 3. Hedging price risk using futures contracts

A key function of a futures market is to facilitate hedging. Hedging is the buying or selling of a futures contract to protect against adverse price movements in the physical market. The hedger seeks to fix now the return from a forthcoming sale of wool or the cost of purchasing wool at prices that are close to prices at the time the hedge is made.

## 3.1 Mechanics of hedging

Hedging price risk using wool futures involves signing a contract promising to either deliver or accept delivery of a certain quantity and quality of wool at a specified time. The seller of a wool futures contract has the option of delivering the commodity or buying back the futures contract prior to contract maturity. Likewise the buyer of a wool futures contract has the option of receiving the commodity at the time the contract matures or of selling the futures contract prior to the maturity date.

Trading in futures contracts requires the payment of a brokerage fee for executing orders and an initial margin. Initial margin deposits are required to meet potential liabilities of contract holders. The size of the initial margin is determined by SFE and depends on the volatility of futures prices. Transactions and orders are carried out by brokers who are required to be either associate members or floor members of the SFE. These are the only traders eligible to accept and transact client orders (Newman 1993).

The initial margin is usually a small proportion of the value of the contract to be traded. The ability to trade with a small down payment provides the trader with an option to manage price risk with a small capital outlay. Currently the initial margin for each contract is $1000 and each contract is for 2500 kg of clean wool. If for example the futures price for wool is 500c/kg then the initial margin is 8 per cent of the nominal value of the contract. Other costs might include margin calls which are made when the amount on the margin account falls below the initial margin.

A study by Gruen (1960) indicates that the basic purpose of trading in wool futures by wool growers is to limit their price exposure, between the time of shearing and the sale of the clip. This means that wool growers can lock in a price at the time of shearing if the price is desirable. In this case it does not matter whether prices rise or fall during the time of the hedge the grower will be assured of receiving a price close to the futures price at shearing time.

The time frame between the start of shearing and the sale of the clip is estimated at between 3 weeks and 3 months (personal correspondence with Wool International and a number of wool brokers). The time frame will be influenced by a range of factors such as the time of shearing and the time of auction sales, whether the farmer requires cash flow just after shearing or whether the farmer expects the market price to rise or fall.

### 3.2 Basis risk

At any point in time, there may be a difference between the spot market price of wool to be hedged and the nearby futures market price. This price differential is called the contract basis. The magnitude of the contract basis can depend on the quality of the wool being hedged, the specifications of the contract, the location of delivery, and time of settlement of the contract.

The effectiveness of a hedge is essentially governed by the movement in the basis during the hedging period. The net price received is equal to the futures price to which the contract was locked in plus the basis at the time when the contract expires or is closed out. A study over time of price relationships between the type of wool to be hedged and the price of wool meeting contract specifications can give an indication of the basis risk. If the expected basis risk is high then it is advisable not to hedge.

To make an effective hedge for wool with qualities different from those specified by the futures contract it is essential that the discounts and premiums between wool being hedged and wool meeting contract specifications are stable over time. Premiums or discounts must be predictable and the relationship between the two prices must be stable over the contract period (Cunningham 1995). Any instability in these premiums and discounts will create additional risk (basis risk), reducing the effectiveness of the hedge.

# 4. Modelling basis risk

To analyse the reduction in price risk that might be achieved by growers producing wool with different characteristics from the futures contract, a hedging process was simulated based on 1991-92, 1992-93 and 1993-94 AWEX auction sale data. These data were used to determine the risk associated with hedging wool of particular characteristics. A perfect hedge for wool with contract specifications was assumed.

## 4.1 Model development

The woolgrower who decides to hedge, takes out a contract which is to be delivered some months ahead. In doing this he or she assumes a basis risk in exchange for price risk. The ratio of basis risk to price risk can give an indication of the reduction in risk if the futures contract is used to hedge wool prices. This ratio can be estimated using equation 1.

The numerator in equation 1 is the price risk faced by a producer who has hedged using the futures contract, and the denominator is the price risk faced by a producer who has not hedged using the futures contract. The ratio ($\mu$) provides an indication of the reduction in price risk. This reduction in price risk is presented as 'percentage reduction in price risk' $=(1-\mu)*100$.

$$\frac{Var\{[\hat{p}_{t+h}(\bar{x}_l) - \hat{p}_t(\bar{x}_l)] - \alpha_t\,[\hat{p}_{t+h}(\bar{x}^*) - \hat{p}_t(\bar{x}^*)]\}}{Var[\hat{p}_{t+h}(\bar{x}_l) - \hat{p}_t(\bar{x}_l)]} = \mu \qquad (1)$$

The different terms in equation 1 represent the following:

$\bar{x}^*$ is a vector of wool characteristics satisfying the SFE contract specifications.

$\bar{x}_l$ is a vector of average characteristics for wool from farm $l$

$\alpha_t$ is the hedging ratio.

$[p_{t+h}(\bar{x}_l)]$ is the price of the type of wool being hedged h weeks out; and

$[p_t(\bar{x}^*)]$ is the price of wool satisfying contract specifications at time t (lack of futures prices data has compelled us to use this price as a proxy for the futures price a grower locks in).

$[p_{t+h}(\bar{x}^*)]$ is the price of wool satisfying contract specifications h weeks out (it is assumed that this is the futures settlement price).

The size of the 'percentage reduction in price risk' for a set of wool characteristics gives an indication of the extent to which that wool could be hedged effectively. If the price risk after hedging is low relative to the price risk without hedging, then use of the futures contract will allow a more substantial reduction in the overall price risk facing a grower. Values of the 'percentage reduction in price risk' close to 100 indicate that the type of wool being analysed can be hedged effectively. That is the hedge would offer a reduction in price risk. On the other hand, when the 'percentage reduction in price risk' is close to zero, the futures contract offers insignificant reduction in price risk and indeed the woolgrower may be exposed to greater price risk in using the wool futures market.

The 'percentage reduction in price risk' does not account for other risks associated with using wool futures such as production risk. That is the risk associated with being unable to meet delivery commitments entered into under a futures contract because of short falls in production or unexpected shifts in the quality of wool produced.

The 'percentage reduction in price risk' for a set of wool characteristics gives an indication of the quality basis risk associated with hedging wool of particular attributes. For any given set of wool characteristics, the 'percentage reduction in price risk' can be calculated for different hedging periods. The results reported in this paper are based on a two month hedge. Other hedging periods were also analysed and the results were very similar to those of a two months hedge. In the modelling process it was assumed that the spot and futures price for wools meeting the contract specification converge at delivery time.

### 4.2 Data and analysis

Analysis was carried out using auction sale data because of low traded futures contract volumes. Auction prices for wool meeting contract specifications were used as proxies for futures prices. For example a nearby futures price at time t was assumed to be the auction price for wool meeting contract specifications at time t. It was also assumed that at the time hedging commitments are made, the woolgrower would use the price of wool meeting contract specifications and the price of wool with average attributes he or she produces on the farm to estimate a hedging ratio. In the analysis this was taken to be the ratio of the two prices.

For each wool lot sold at the auction market, the Australian Wool Exchange (AWEX) keeps a record of the graded characteristics such as micron grade, staple length, staple strength, colour of the wool lot, style, the time of sale, the selling centre, weight and the brand name which identifies the woolgrower. ABARE used the three years' AWEX auction sale data for the selling seasons 1991-92, 1992-93 and 1993-94 to create a longitudinal data set composed of wool characteristics for all lots sold in the three year period.

The extent to which the prices vary with graded characteristics can be determined statistically using a regression model (Gleeson et al 1993). The AWEX auction sale data for the three selling seasons were grouped into weeks when the wool was sold. These weekly data were then used to estimate weekly equations which were used to predict the average weekly price of wool for any given set of wool attributes.

The hedonic price model was used to estimate weekly parameters for the function which relates the price of a wool lot to its various characteristics. The data set was composed of 126 weeks. A number of functional forms were analysed for each week and the function which fitted best to the data overall was:

$$(2) \qquad price_{it} = const_t + \beta_{1t}micr_{it} + \beta_{2t}veg_{it} + \beta_{3t}yld_{it} + \beta_{4t}lgth_{it} + \beta_{5t}str_{it} + \beta_{6t}strq_{it} + err_{it}\,.$$

where in week t,

| | | |
|---|---|---|
| $price_{it}$ | = | the clean price per kg for lot i |
| $const_t$ | = | the constant term |
| $micr_{it}$ | = | micron grade for lot i (microns) |
| $veg_{it}$ | = | percentage of vegetable matter content in lot i |
| $yld_{it}$ | = | expected percentage yield (Schlumberger dry yield) of lot i |
| $lgth_{it}$ | = | average length of staples in lot i (mm) |
| $str_{it}$ | = | average strength of staples in lot i (N/ktex) |
| $strq_{it}$ | = | is the square of the staple strength of staples in lot i |
| $err_{it}$ | = | is the error term |

Analysis was restricted to merino combing fleece of the following styles: good, best top making and spinners (the styles specified in the contract). The data was further restricted to wool lots with staple measurements. The model in equation 4 was fitted to data for each week in the longitudinal data set and a total of 126 equations were estimated.

Equation 1 and the estimated parameters from equation 2 for the 126 weeks were used to generate 'the percentage reduction in price risk' values for a given type of wool. In addition the 'percentage reduction in price risk' was calculated for 641 farms in ABARE's Australian Agricultural Industries Survey (AAGIS). The average wool characteristics for the 641 farms were obtained by identifying the wool lots which were sold by these farms at the auction market. This was done by linking the AWEX auction sale data for the 1993-94 selling season and AAGIS data.

The extent each wool characteristic specified in the wool futures contract affects a hedge was also investigated. The model for calculating the 'percentage reduction in price risk' was used to quantify the reduction in price risk when a particular wool attribute does not meet the contract specifications. For example in estimating the price risk associated with varying strength, all other wool characteristics were kept at the contract specification values. The calculated values of the 'percentage reduction in price risk' gave an indication of how different strength measurements affect a hedge.

### 4.3 Results

The plot of fibre diameter against 'percentage reduction in price risk' when other characteristics are kept at contract specification values (figure 2) indicates that fibre diameter is an important attribute in the assessment of price risk. Strength (figure 4) and other wool attributes such as vegetable matter content, yield and length also contribute to the price risk but these attributes are not as important as fibre diameter. According to (IWS/WI 1995) fibre diameter accounts for about 63 per cent of the total variation in clean price of merino fleece wool, staple strength accounts for 11 per cent. Although the variation in price associated with characteristics such as strength, length and vegetable matter content is relatively small compared with that of fibre diameter, the combined contribution of these attributes to the variation in price premiums /discounts should not be ignored.

Figure 2: **Reduction in price risk from hedging with wool futures for various fibre diameter when other wool attributes are kept at contract specification values**

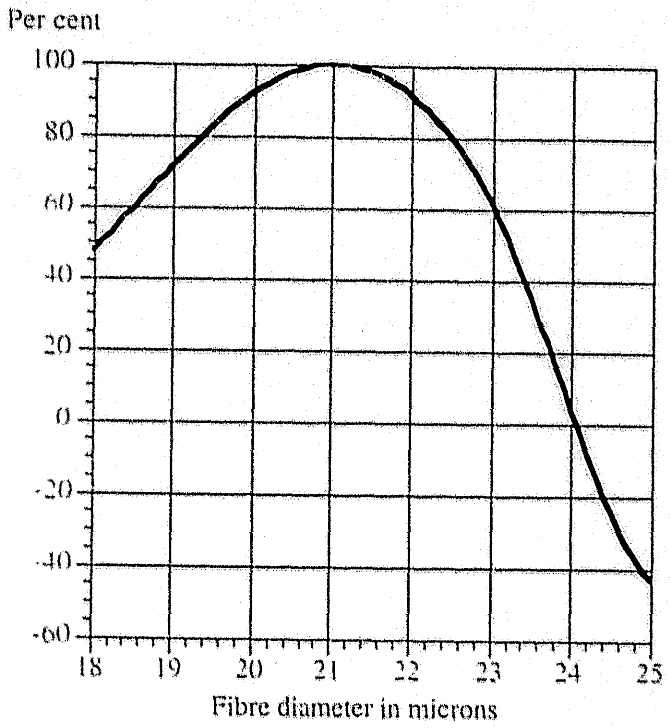
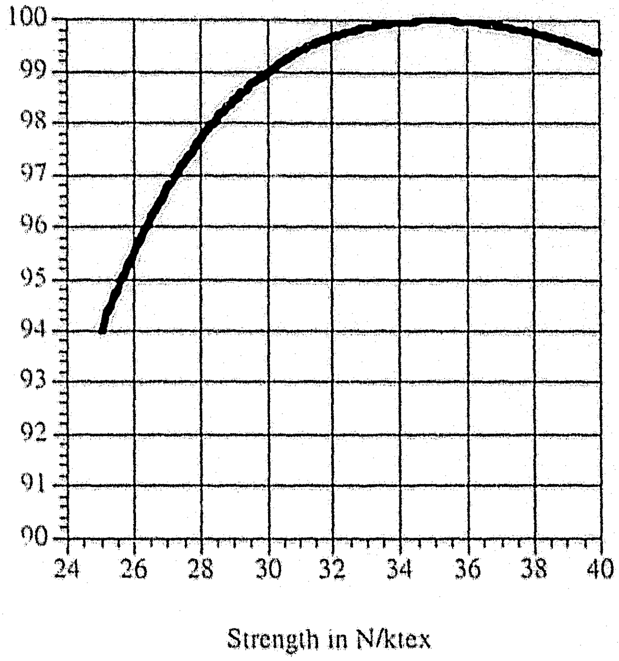


Figure 3: Reduction in price risk from hedging with wool futures for various staple strength measurements when other wool attributes are kept at contract specification values

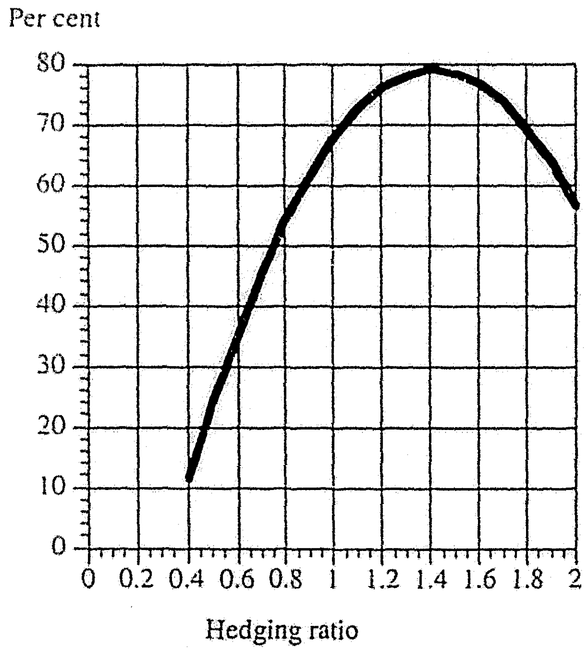



## 4.4 Optimal hedging ratio for different micron grades

The amount of price risk reduction depends on the proportion of the wool which is hedged. There are ways of estimating optimal hedging ratios. One method which is relevant to the wool contract is contained in Myers & Thompson (1989). Their method is based on an economic optimisation problem for the producer facing only price risk. If a producer faces both production and price risk then a model developed by Lapan and Moschini (1994) can be adapted to estimate the optimal hedging ratio. In this paper we used the ratio of futures price and auction price at the time hedging commitments are made.

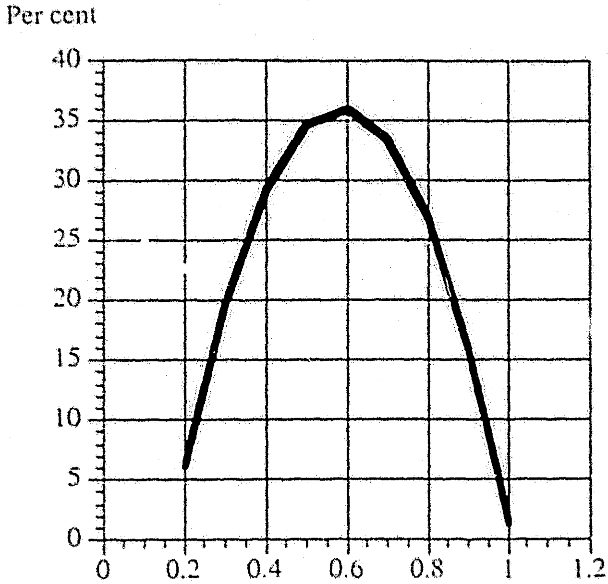
The model to estimate 'percentage reduction in price risk' was used to estimate hedging ratios for different micron grades. For example for the 19 micron grade (figure 4), when all other wool characteristics were fixed at the contract specification values, the highest 'percentage reduction in price risk' was observed when the hedging ratio was 1.4. This means that for a grower who produces wool of 19 micron grade and all other characteristics similar to the contract specifications, a standard futures contract of 2 500 kg would provide the maximum risk reduction on about 1785 kg ((1/1.4)*2500) of wool. Similarly for a woolgrower with wool lots averaging 23 micron (figure 5) and all other characteristics similar to the contract specifications, a standard futures contract of 2 500 kg would provide the maximum risk reduction on about 4167 kg ((1/0.6)*2500) of wool. Figures 6 and 7 show the hedging ratios for 20 and 22 micron grades respectively. The analysis as mentioned earlier, is based on the three year's (1991-92, 1992-93 and 1993-94) auction data. The hedging ratios are likely to be different for another set of data. However, if calculations for optimal hedging ratios are made over a period of time, likely optimal hedging ratios can be established. Note that the above method is ad hoc. Probably better results can be achieved by using the methods contained in Myers and Thompson (1989).

Figure 4: **Percentage reduction in price risk against hedging ratio 19 micron grade**



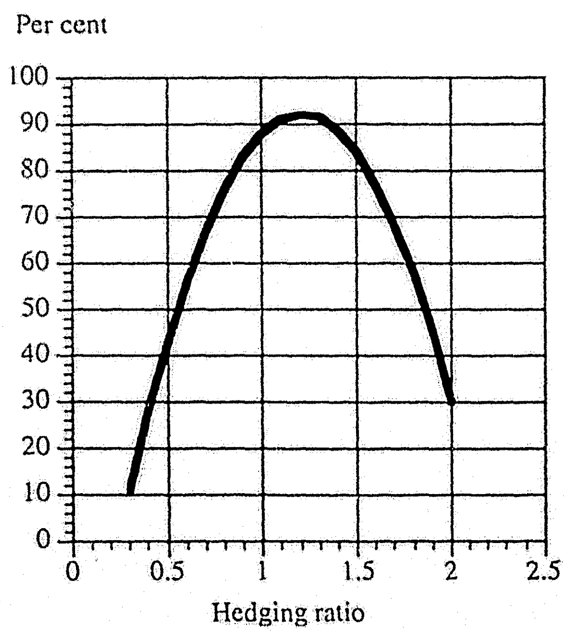

*Note*: Other wool attributes are fixed at the contract specification values

Figure 5: Percentage reduction in price risk against hedging ratio
23 micron grade.



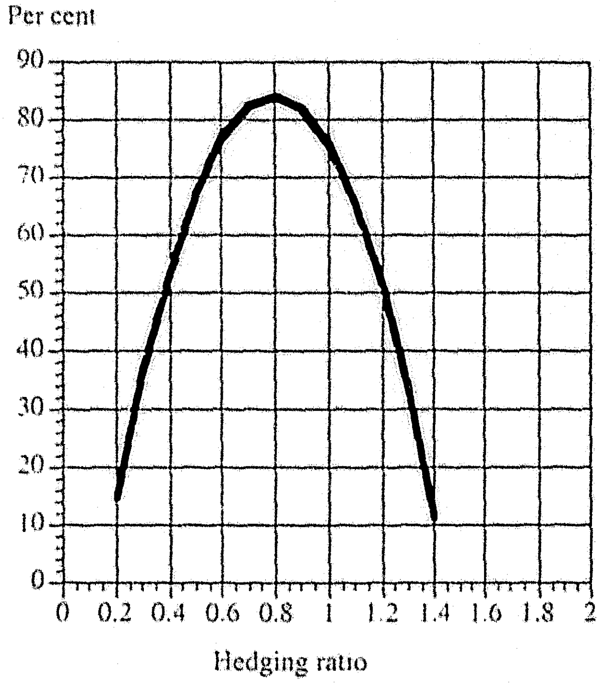

*Note: Other wool attributes are fixed at the contract specification values*

Figure 6: Percentage reduction in price risk against hedging ratio
20 micron grade.




*Note*: Other wool attributes are fixed at the contract specification values

Figure 7: Percentage reduction in price risk against hedging ratio 22 micron grade.



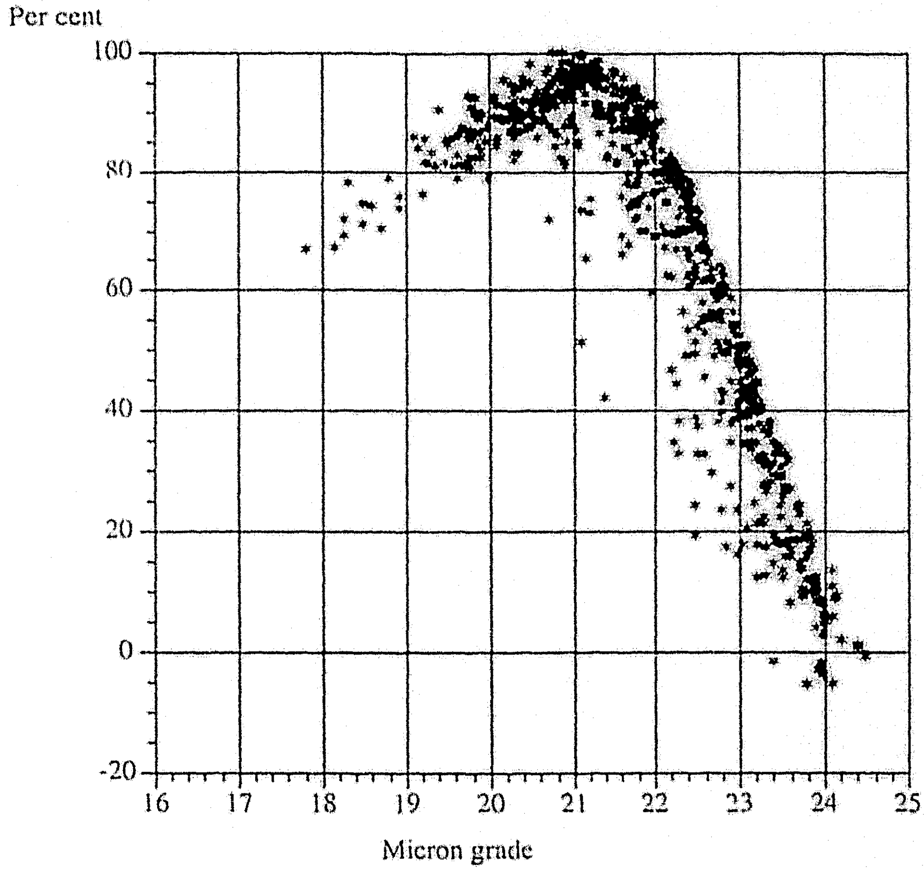

*Note*. Other wool attributes are fixed at the contract specification values

## 4.6 Distribution of risk cover among wool growers.

ABARE's 1993-94 Australian Agricultural Grazing Industry Survey (AAGIS) data contained 641 wool growing farms which could be linked to AWEX auction sale data. The linked data set contained information on the quality of wool sold from each of these farms. The average wool characteristics for each of these farms were used to simulate a ratio hedge and to calculate the corresponding 'percentage reduction in price risk' had the growers hedged using the new futures contract.

Figure 8 contains a plot of the calculated percentage reduction in price risk plotted against average micron grade for the 641 farms. The plot indicates that growers producing wool with micron grades close to the contract specifications (21 micron) can reduce price risk by using the wool futures contract to hedge. The plot also shows that the price risk increases as average micron grade moves away from the contract grade.

Figure 8: Reduction in price risk against micron grade for 641 farms in AAGIS




Risk factor is the ratio of basis risk to price risk

# 5 Concluding remarks

In the past wool few growers have traded in wool futures contracts. This might change if the specifications and operation of the new contract better meet their requirements. The extent to which this revised contract will be used by wool growers will largely depend on whether the contract can be used effectively to minimise price risk and whether there is adequate understanding of the contract including the way premiums and discounts are calculated for wools not meeting contract specifications.

The effectiveness of the wool futures contact as an instrument to reduce price risk will largely depend on the variation in basis of the type of wool to be hedged. The extent of basis risk likely to face a grower will depend on the characteristics of wool produced. Therefore, the benefits from using futures are likely to differ substantially from region to region and from grower to grower. Growers who intend to use the futures contract will need to study the movements of the basis over time.

Growers need to take into consideration all the costs associated with hedging wool when making marketing plans and may need to consult service brokers. A big question is whether the fixed premiums and discounts for wools falling in the micron range 19.6 to 22.5 will work. Once the volume of wool futures contracts improves there might be a need for another contract to increase the coverage of the Australian wool clip. Within the contract specifications for micron there is a loss of cover of up to 20 per cent (figure 8). Based on the 1993-94 clip 30 per cent of the clip is in the 22.6-25.5 micron range. For this micron range, the percentage reduction in price risk decreases as the micron grade increases from the 21 micron grade. The industry might need to consider designing a contract to cover this micron range. Statistical analysis carried out in this study indicates that growers who produce wool in this micron range may not reduce their price risk by using the current futures contract.

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