Cotton Futures Hedging during the 1990-91 Season

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1. Introduction

The 1990-91 season was a difficult time for those pool managers in the Australian cotton industry who routinely use futures as a means of reducing price risk. The movement of New York cotton futures relative to the spot price of Australian cotton created a basis problem which had not been seen for many years. Instead of offering a stabilization in prices for a small reduction in expected revenue, a standard hedge in 1991 cost some producers dearly. In this paper the preliminary results are reported of an on-going project aimed at discovering the response of pool managers to losses made in 1991.

The purpose of this paper is first to identify the basis risks associated with hedging Australian cotton exposures with the New York Cotton Exchange's No. 2 contract as illustrated through the computation of a hedge ratio applied to the 1990-91 season; second, to identify those organisations in the Australian cotton industry which should research and apply hedge ratio computation to their risk management strategies of managing basis risk; and last, offer a methodology which can be applied by cotton producers, but more especially by pool managers.

First, the operation of the use of futures for hedging purposes is outlined. This is followed by a review of the 1990-91 season using optimal hedge ratios. The structure of cotton processing and marketing is then considered in order to identify the traders who use futures for hedging. Finally, preliminary results and extensions to the study are discussed.

2. A Standard Futures Hedge

A theoretical hedge is described in this section. Without the use of hedging, a pool manager accepts the spot price for the commodity p_{t+1}. This price is uncertain until the commodity is actually sold. Hence, during the growing season there is some variability associated with the eventual price p_{t+1}. (For example, one way to express this variability is in terms of the range in possible prices, say from 40¢/lb to 80¢/lb.)

For a commodity with a recognised futures market, a futures hedge could be set up. The hedger sells a futures contract during the growing season at a price of f_t. At the end of the season he sells the commodity for p_{t+1} and buys back the futures contract at f_{t+1}. The effective price is then $f_t + (p_{t+1} - f_{t+1})$.

Because f_t is fixed as soon as the futures is sold (usually early in the growing season), the only variability remaining is that which is associated with the basis (p_{t+1} - f_{t+1}). Ideally in a futures hedge arrangement the commodity the hedger is selling and the commodity specified in the futures contract are similar so that there is strong price correlation between them. If this condition holds then, if arbitrage is possible, the terminating futures price (f_{t+1}) will approximate the spot price (p_{t+1}), and the size of the basis will be small. Thus, the idea of a futures hedge is to swap the risk associated with the spot price for the risk in the basis. (In fact it was the lack of arbitrage that was behind the basis problem of the 1990-91 cotton season.)

There are some costs of achieving such an insurance policy. These are brokerage fees, deposits and margin calls. While all but the first are refundable once the futures contract is closed out, there are opportunity costs of tying up funds, and a line of credit may need to be established to finance deposits and margin calls.

3. Optimal Hedge Ratios During 1990 and 1991

Following the methods presented by Sarassoro and Leuthold (1991) optimal hedge ratios were calculated for risk averse pool managers in the cotton industry. For expository purposes a simplified version of the method is presented here while the full hedge ratio formulae are included in Appendix A.

The hedge ratio shows the proportion of a producer's expected crop that is hedged on the futures market, or for a marketing organisation the proportion of their expected throughput of the commodity that is hedged. The optimal hedge ratio is that level of the ratio which maximises the decision maker's expected utility. The standard approach in the optimal hedging literature is to define expected utility in terms of mean and variance of returns as in equation 1.

(1) $$EU = ER - \frac{1}{2}\phi \mathrm{Var}\, R,$$

where EU is expected utility, ER is expected return, Var R is the variance of returns and ϕ is a risk aversion coefficient.

The idea of futures hedging is to reduce the variance of the effective price of the commodity in return for accepting a slightly lower mean. The variance is reduced because the variability in the spot price of the commodity is traded for the generally smaller variability in the basis. The expected return from hedging is lower because of the transactions costs involved, the opportunity cost of margin calls and deposits and because on the other side of the market, speculators would on average be expected to make profits. For crops that are partly hedged, the overall expected price is a weighted average of spot and futures prices, and the overall variability is a combination of basis risk and spot price risk.

Theoretically, the optimal movement is from unhedged to fully hedged if the E-σ indifference surface is as in Figure 1(a). Conversely, the indifference surface of Figure 1(b) leads to a partially hedged optimum.

At this level of abstraction and assuming that the current futures price is an unbiased predictor of next period's futures price, Thompson and Bond (1987, p48) showed that the hedge ratio (R) is

$$(1) \qquad R = \frac{V_t(p) - Cov_t(p,B)}{V_t(p) - 2Cov_t(p,B) + V_tB},$$

where V and Cov are variance and covariance operators, respectively; p is the spot price and B is the basis risk. From equation 1 it is clear that the optimal level of hedging depends on (a) the relative variability of the spot price and the basis, and (b) the correlation between them. By manipulation of Figures 1(a) and 1(b) and from equation 1, it is observed that an increase in the basis risk reduces the hedge ratio.

To define the optimal hedge ratio analytically involves expanding equation 1 to include, in addition to spot and futures prices, components for the interest rate, and, because cotton is hedged in US dollars in New York, the forward and spot exchange rates (see Appendix A).

Figure 2 shows the optimal hedge ratio month–by–month during 1990-91. At the start of the season, the relationship between the price of Australian cotton (as reflected in the A-Index) and the New York futures price was within the normal trading range and so therefore was the basis at around 10¢/lb. As a consequence, the optimal hedge ratios in October and November, 1990 were 0.62 and 0.61, respectively. (In fact, the basis is probably more precisely defined as the relationship between the New York futures price and the price received on Australian cotton sales to the Far East. However, because of unavailability of this data the A-Index is used as an approximation.)

As the season progressed the low stock situation especially in the United States continued. Despite economic uncertainty, textile demand stayed buoyant longer than many analysts expected, and United States cotton prices were pushed higher and higher.

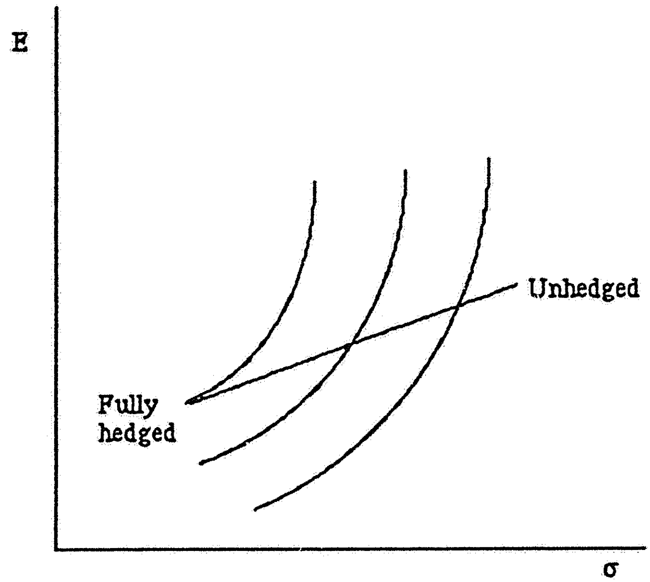

Figure 1(a): A fully hedged optimum

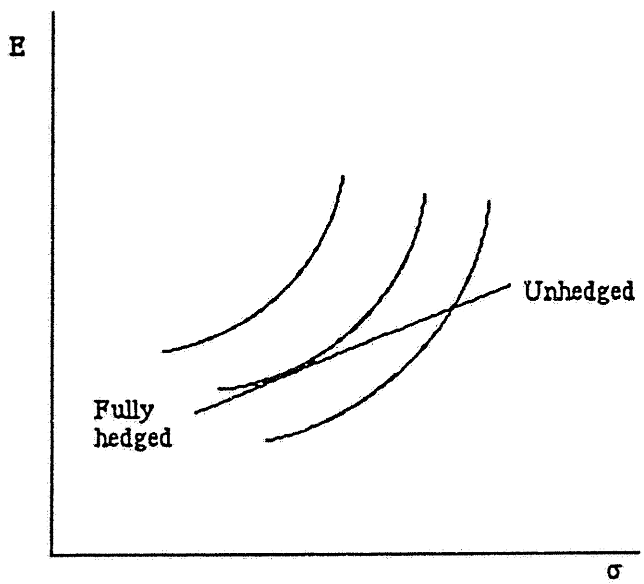

Figure 1(b): A partially hedged optimum

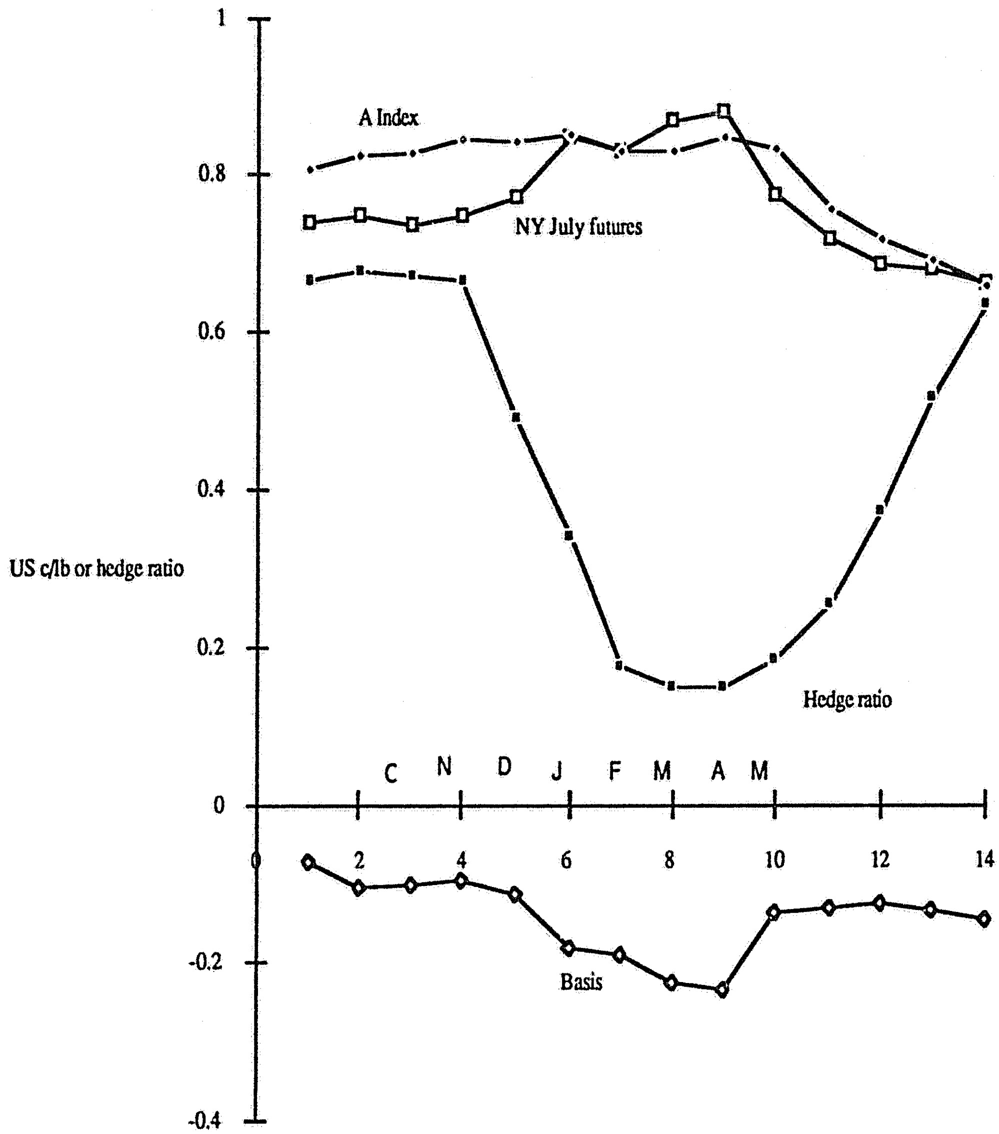

Figure 2: Optimal hedge ratios and basis for 1990-91

Elsewhere in the world, demand was not so buoyant. Business was at average levels in Europe, and while Korean mills were active spinning cotton yarn Japanese textile production has slowed.

The overall result was that New York futures broke the highest ground for forward delivery since the early 1980s. Meanwhile the A-Index was just about stationary so that the A-Index basis fell dramatically during the period from December, 1990 to April, 1991.

The outcome for the optimal hedge ratio was that it declined continuously during the 1991 season, reaching 0.13 in April and 0.16 in May. In other words an optimal hedge of roughly 62 per cent of expected output at the start of the season had fallen to between 13 and 16 per cent by harvest. A rational cotton pool manager who had hedged 62 per cent of the crop in September–October, 1990 would have wanted the quantity hedged to be much lower by the end of the season and, transaction costs permitting, would progressively have closed off the position as the season proceeded. Table 1 shows a comparison between the average effective price for 1991 associated with an unhedged position, a fixed hedging strategy and a hedging strategy that updates the hedge ratio monthly. Relative to the unhedged position a fixed hedge suffered a price reduction of about 12.2 per cent while updating the hedge ratio monthly produced a reduction of about 8.1 per cent. For comparison, the Namoi Cotton Cooperative is reported to have lost 10 per cent of its annual revenue in futures trading in 1990-91 (Primary Industry Newsletter, 9 December, 1991).

Before leaving optimal hedge ratios, it is worth noting that the A-Index basis had reached more normal levels by the start of the 1992 season, and there is a consequent increase in the optimal hedge ratio. However, it seems probable that an individual pool manager or producer who had hedged on the New York futures during 1990-91 would react to the experience by revising his risk attitude towards the appropriate hedge ratio.

At this point it should be noted that minimising basis risk is not everyone's objective. The merchants (or traders) whether they be Dunavant, Volkart, CTC or Conticotton or even the organisations who run trade books in addition to pools, such as the Namoi Cotton Cooperative, Colly Farms and Queensland Cotton, trade basis risk and thus want some volatility in Australian cotton hedge ratios. Thus the hedge ratio doesn't necessarily apply universally.

Table 1

A Comparison between Hedging Strategies for 1991[a]

Strategy	Effective price (US ¢/lb)
Unhedged	84.95
Fixed hedge ratio (0.62)[b]	74.60
Adjustment to optimal hedge ratio each month [c]	78.07

a using A-Index cotton quotes delivered N. Europe.

b includes transaction costs of 1.5 ¢/lb.

c includes transaction costs of 3.77 ¢/lb.

4. Structure of Cotton Processing and Marketing in Australia

Having developed the optimal hedge ratios, one way to extend the analysis would have been to simulate the operation of cotton futures over a number of hypothetical seasons, and thereby to compare different hedging strategies (see Mues 1990). Instead our focus turned to consider the cotton processing and marketing system so as to assess who might use the optimal hedge ratio information to minimise basis risk.

The three main marketing methods open to the cotton grower are a seasonal pool, a call pool and cash offer contracts (Mues 1990, p.1). The first two of these involve futures trading and are given some attention below. Cash offers involve a forward contract under which "merchants, and more recently processors, offer a daily cash price for cotton delivered to the gin yard, usually payable within two weeks of ginning. Some processors require that intentions to use the cash offer method be stated at the start of the season. The offer price is usually determined by the prevailing New York futures quote and a quoted basis. When a cash offer is accepted by a grower, the merchant or processor usually negotiates a 'back-to-back' contract in the world market to cover the offer price to the grower" (Mues 1990, p.4). Thus in this case there is no directly linked futures trading.

The major processors have established seasonal pools, and the pool managers would regularly utilise futures. "A grower may pledge all or part of the expected crop to the seasonal pool by a date set by the processor (usually in October after planting). The processor markets the cotton by various means, starting well before harvest, and subsequently gives the growers an equalised return (adjusted for quality premiums and discounts), thus relieving them of time-consuming market analysis" (Mues 1990, p.1). Of relevance to our research is how closely pool managers follow the spot, futures and foreign exchange markets during a growing season. It would be easy to envisage the optimal hedging approach of section 3 being introduced as a relevant part of the analytical work they would complete to assess their risk position.

Under the call-pool method of marketing, growers "assign a specified quantity of the crop to the call pool, instructing that it be hedged by selling futures contracts if and when a specified New York cotton future (typically July) reaches the specified price." (Mues 1990, p.3). If such a hedge is established, then at the end of the season the grower delivers the contract quantity of cotton to the processor, who sells it on the spot market and closes out the futures position. The effective price to the producer is then as in the standard hedge discussed in section 2 (including costs of brokerage, deposits and margin calls which are allocated to the producer). In terms of the strategies discussed in section 3, this approach is closest to a fixed proportional hedge.

Having established the various types of marketing methods, the next step is to identify those firms which are involved in each. Relevant to this is the market share of each firm and the quantity of cotton that each has in the respective pools.

Ten years ago the Namoi Cotton Cooperative and Auscott were the only competitors in the processing sector. There are now nine major firms in cotton processing and marketing. These are the Namoi Cotton Cooperative, Auscott, Queensland Cotton, Colly Farms, Dunavant, Twynam, North West Ginning, Darling River, and Tandou (see Appendix B). Their market shares are shown in Figure 3.

A review of the structure of the cotton processing and marketing sector, shown in Appendix B, shows that optimal hedge ratio information should be useful to the futures activities of four firms - Namoi Cotton Cooperative, Auscott, the Queensland Cotton Marketing Board and Colly Farms. From our research, it is evident that the 1990-91 season was an optimum time to apply this methodology. As the ratio (i.e. the basis) fluctuates from season to season, it is advisable to keep historical records for both from this historical data, a typical pre-season ratio can be received based on a five or ten-year moving average. As the hedging of a particular crop gets underway, the ratio could be updated weekly based on a weekly or monthly moving average.

Thus the pool manager can scientifically enforce what he subjectively perceives. As before, his strategy to sell a portion of his production on fixed price contract and a portion on basis can be calculated on a percentage derived from historical study. Even if the system doesn't catch the sudden shift in prices and basis, it will capture the majority of any move. This is always the objective of any risk management practice, not to achieve 100 per cent but certainly more than 75 per cent.

5. Concluding Remarks

By applying optimal hedge ratios to the 1990-91 cotton season it was shown that basis risk increased as the season proceeded and this implied that the level of futures hedging should have been progressively reduced. It was revealed that there are four cotton marketing firms that could profitably employ the hedge ratio analysis. Given the level of so-called futures losses during the 1990-91 season, and given our observation of these cotton marketing enterprises, it would appear that less successful methods of

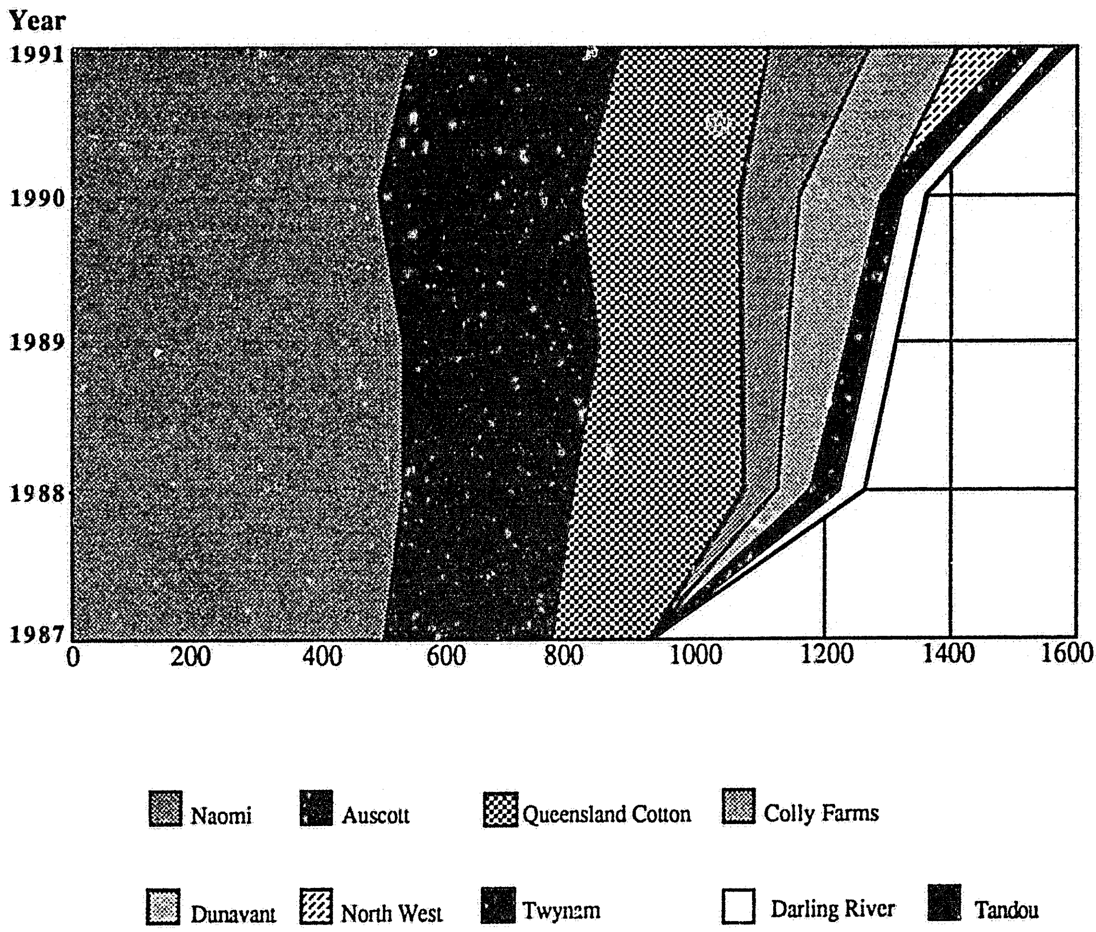

Figure 3: Market Share of Australian Cotton Processors

determining hedging levels are being employed. This suggest that these firms should at the least make some investment in investigating risk management strategies incorporating optimal hedge ratios. In addition to this, alternatives to continuously adjusting futures positions, such as the use of options, should be considered.

6. References

Mues, C. (1990), 'An analysis of marketing options for cotton in Australia', paper presented to the Australian Agricultural Economics Society Conference, Brisbane, February.

Sarassoro, G.F. and Leuthold, R.M. (1991), 'Managing multiple international risks simultaneously with an optimal hedging model', Agricultural Economics 6(1), 37-47.

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Appendix A

Optimal Hedge Ratios

Following Sarassoro and Leuthold (1991) the optimal hedge ratio is given by:

$$H = \frac{E(R_f)}{2\phi V(R_f)} - \frac{Cov(R_f,R_c)}{V(f)} - e\frac{Cov(R_f,R_e)}{V(R_f)} - i\frac{Cov(R_f,R_i)}{V(R_f)},$$

where H is the optimal hedge ratio; R_f, R_c, R_e and R_i are returns from cotton futures activities, from the spot market, from exchange rates futures activities and from interest rate futures activites; e and i are the levels of currency and interest rate hedges; E, V and Cov are the expectations, variance and covariance operators; and ϕ is a risk aversion coefficient.

As shown by Sarassoro and Leuthold (1991, p. 39), a time-series method can be applied to estimate the expectations in the hedge ratio formula. Given the paucity of data available to us, we were forced to assume that the best forecast of future returns is an average of past returns. Hence, the parameters of the hedge ratio are estimated by regressing on past returns.

Appendix B

Structure of the Cotton Processing Industry

The Namoi Cotton Cooperative has been the largest processor of the Australian crop since its inception, reaching a production peak of 661 500 bales in 1985. As seen in Figure 3, Namoi has the largest market share. The Cooperative operates 10 gins in the Namoi, Gwydir and Macintyre valleys. An eleventh gin at Mungindi is expected to be operational for the 1992 ginning season.

Auscott, owned by the Boswell Company, has the second largest market share in the processing industry. This also is shown in Figure 3. Three gins are operated in the Gwydir, Namoi, and Macquarie valleys, with an approximate total throughput capacity of 300 000 bales.

Queensland Cotton, owned by shareholders is the next largest competitor. Currently four gins are operated in Biloela, Emerald, Cecil Plains, and St George. Currently, Queensland Cotton's market share and total capacity is
250 000 bales. A fifth gin is to be strategically located at Dalby, and is expected to be operational for the 1992 ginning season. This is expected allow for a 100-day production time, boosting the total capacity to 400 000 bales.

Dunavant is a wholly owned subsidiary of Dunavant Enterprises Incorporated. Two gins are operational, one in the Gwdir Valley and the other in Emerald. For the 1990-91 ginning season, Dunavants processed 170 000 bales of cotton, giving it the fourth largest market share.

Colly Farms is owned by a superannuation fund investment trust called the Commonwealth Funds Management Limited. Currently, Colly operates one gin in the Gwydir which has a throughput capacity of approximately 150 000 bales. This places Colly Farms as the holder of the fifth largest market share as seen in Figure 3. A second gin is, once again planned for Mungindi, and should be operational for the 1992 ginning season.

North West Ginning is the first privately owned gin and was opened early in 1991. This gin is situated in the Gwydir Valley, and for its first year of processing, gained a throughput of 130 000 bales.

Finally, there are three smaller companies. Twynam, a subsidiary of Twynam Pastoral Company, operates one gin in the Macquarie Valley. Even though it has been established longer than North West Ginning, it has a smaller market share with a throughput of 60 000 bales. Darling River is a subsidiary of Clyde Agriculture, part of the Swire Group of Companies. One gin operates at Bourke with a processing capacity of 48 000 bales. Its market share is only narrowly less than that of Twynam. Tandou operates one gin at Broken Hill which has only recently come into operation. Its market share is minute in comparison to all other competitors.

Many of the cotton processing firms are vertically integrated, being producers in their own right as well offering processing and marketing services. The least integrated are North West Ginning, Twynam and Tandou which, although growing their own cotton, offer only a processing service. So growers processing through them must market their cotton elsewhere.

In complete contrast to this, the Namoi Cotton Cooperative has a different philosophy in regard to growers who must become members to use the services of the cooperative. However, membership gives them the advantage of a large range of processing and marketing services. There is a current policy of gentle ginning to retain the highest possible spinning quality of the cotton, while flexible marketing allows alternatives of seasonal pools, call pools and cash sales. This vertical integration is supplemented with the provision of up-to-date price, option and currency information.

Queensland Cotton, similar to the Namoi Cotton Cooperative, is grower controlled with shareholdings spread over long-standing industry participants. Processing and marketing services are offered, showing a degree of vertical integration. The range of marketing alternatives are wider, however, than the Namoi Cotton Cooperative. To provide a superior service for growers, Queensland Cotton has included an additional service of Cottco depots. These, strategically placed subsidiaries, supply fertiliser, chemicals and crop credit for approved growers.

The remaining firms are between these two groups in that they are not cooperatives but attempt to offer a package of processing and marketing services.

Auscott, grows its own cotton, provides custom ginning, processing, and marketing services. The initial reasoning behind its vertical integration was the lack of competitors in all these areas. Auscott was able to monopolise these activities. There is now more emphasis on the needs of the grower and the philosophy of providing a total service. Current strategies undertaken by Auscott are to provide the best service and quality product, and to supply to buyers on a timely basis.

Colly Farms, although smaller than Auscott, also grows its own cotton, provides custom ginning, processing and marketing facilities. It also boasts a wider range of marketing alternatives and more up to date and modern technology than Auscott. An example of this is modern classing facilities including a Spinlab HVI line. Colly Farms is service orientated in order to increase market share with strict quality control, good access for outside growers, warehousing facilities, and stringent ginning machinery maintenance.

Dunavant and Darling River provides the same services as Auscott and Colly Farms through vertical integration. While Dunavant is actively expanding custom ginning and marketing services, Darling River is very small in comparison, providing services to local growers, and increased market share is not actively sought.