Managing the relationship between production and price risk in canola

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Abstract

This paper will report on RiskWatch Canola a computer based Decision Support System (DSS) that has been built to explore the risks and rewards of forward contracting canola in the Australian market given a climate outlook. Past experience has shown that there is inherent risk in forward selling given the variability of the Australian climate. The purpose of the DSS is to monitor risk exposure by monitoring growing season rainfall and Southern Oscillation Index (SOI) based rainfall indicators. These are then used to calculate a range of canola yield probabilities through regression approximation. The DSS then calculates the distribution of probable gross margins given the historical distribution of prices at harvest time plus aggregate contracted tonnage and price. Results are used for the comparison of financial risk of a contracted position against an un-contracted position and for estimation of the cost of a worst case scenario.

Keywords: SOI, canola yield forecast, forward contracts

Introduction

Pre-harvest contracting of canola in the pre and post sowing period has been used to varying degrees by farmers to lock in an economically viable price for their crop throughout the growing season (Lubulwa et al. 1997). In recent times however the use of forward contracts has declined with anecdotal evidence suggesting that many farmers have been financially ‘burnt’ by the forward selling decision. This has resulted primarily through drought conditions leading to crop failure and an inability to fill legally contracted positions that were entered into early in the growing season. For reasons of certainty of income forward contracts still have a role to play. Certainty of income provides assurance for financiers and farm operators that adequate cash flow will occur to cover costs of production at the end of the season.

Whether you are a grower or a trader forward selling or being short in the market is considered a high-risk strategy (Bittman 2001). Selling short is selling something that you don’t have based on the view that you will be able to supply it at a later date. Understanding the downside risk of a short trade is important for financial management. One measure of downside risk of a trading position is known as Value at Risk (VaR) (Best 1998) and is the measure used to establish whether or not a business has adequate capital to cover a worst case scenario (Johansson 1999). With forward sales the risk of not filling a contract is attributed to what is known as the washout cost. This is the difference between the cash price of canola at harvest time and the price agreed to in a contract, plus an administration fee (Cottle 2002). To address this issue a computer based decision support system has been developed to explore the role of Southern Oscillation Index (SOI) based climate forecasts (Stone et al. 1996) to approximate the probability of achieving a range of canola yields and gross margins returns for the canola enterprise. The question to be answered is what is the probability and value of a worst case scenario given forward prices, known rain, probable rain and probable harvest time cash prices at each stage of the growing season. The following paper introduces the main components of a DSS designed to address these questions for a canola enterprise.

Approximating canola yield

The variability of canola yield in the main growing areas of NSW is shown to be highly correlated to rainfall through the growing season of April to October inclusive (Figure 4, Figure 5, Figure 6 and Figure 7).

Consistent with the risk response approach developed by Dillon and Anderson (1990) the yield calculation method used in the Decision Support System is based on regression approximation as opposed to the water use efficiency (WUE) constants used in such programs as PYCal (Tennant and Tennant 1996) and CropRisk (van Rees et al. 2000). While the WUE equation is a simple tool for back of the envelope approximation the development and access to computer systems that are user friendly makes the use of more sophisticated methods of approximation much more accessible than in the past. These regression approximations also have the advantage of fitting the curve of yield...
response to inputs in a much more realistic representation of crop response to rainfall where rain is not the limiting factor (Cornish and Murray 1989) than does the linear and ‘arbitrary envelope’ (French and Shultz 1984) approach of the WUE vector.

In developing these regression curves time period for selection of data for modelling is based on agronomic improvements to canola crop performance. Prior to 1987 yield of Brassica napus varieties were highly restricted by disease such as blackleg.

Since the introduction of blackleg resistant varieties (Salisbury and Wratten 1999) yield response to rainfall has improved and as Figure 4, Figure 5 and Figure 6 show a high level of correlation exists between growing season rainfall (GSR) and yield response in the predominant canola regions of NSW. Figure 7 shows that further north and west the correlation of response to rainfall in the growing season is not as high as the south with a relative error for the region of 0.48 tonne around the regression trend line. Similar results can be found for further north of the state and in the south-west and western regions.
The regression modelling used in RiskWatch Canola is not limited to regional data. A farm based record system for rainfall and canola yield can be used for developing farm level approximations. This facility enables crop response curves to be generated for each farm being analysed so that the analysis has a greater likelihood of representing crop response to GSR on the farm in question than would a regional response curve.

The variability of rainfall and improvements in the forecasting of climate in Australia based on the SOI is well documented (see White et al. 1999 for a comprehensive bibliography) so an opportunity to use these developments in managing the risk in forward selling canola is addressed by using the regression approximation for estimating the probability of yield for the unfolding season. Given the high correlation of yield with growing season rainfall and improvements in the accuracy of climate forecasts in recent decades (Nichols 1997) the approximation of probable yield distributions at harvest is shown here in Figure 8.

To calculate potential yield RiskWatch Canola uses a record of rainfall received and an SOI Phase based chance of rainfall distribution for the remainder of the season. These forecasts are derived from the rainfall forecasting program Rainman© (Clewett et al. 1999) in an integrated and automated process. In RiskWatch Canola it is possible to use the probable distribution of yield given climatological (100 year) distributions of growing season rainfall or to approximate the chance of yield given a Southern Oscillation Phase indicator. In Figure 8 the rain from the period April to June in the Central West of NSW around Forbes was 51 mm. A Rainman derived forecast for the rest of the growing season was found to range from 66 mm with an 88% chance of occurring to 320 mm with only a 4% chance of occurring. The sum of rain received plus probable rain is used to calculate the probable yield given an SOI indicator. In the example given, at the beginning of August 2003 there was a 66% chance of receiving median rainfall and 1.04 tonne per hectare given rain received through the first half of the season. The standard error in this example is 0.38 tonne per hectare.

In August 2003 the even odds (50:50) chance indicates a potential Canola yield in the central-west of NSW at around 1.20 tonne per hectare plus or minus the error factor and this can be attributed to the poor soil moisture conditions resulting from below average rainfall in the autumn and early winter periods.

![Figure 8: Calculation of Probable Yield in RiskWatch using an SOI Phase indicator](image)
Calculating probability of gross margins

Although it is well known that dry times lead to low yields and higher prices the level of correlation is clouded by other factors such as global supply and demand for oilseed, meal and vegetable oil in the total oilseed complex (Verheijen and Jimmink 1995) and the basis variation in the Australian domestic market (Cottle 2002). In calculating the probability of a gross margin it is assumed then that price and yield are independent of each other (Miranda 1999) so probability of price is multiplied by probability of yield to identify the probability of gross returns. Gross margins are calculated by subtracting the variable enterprise costs from the probable gross returns.

Figure 43 and Table 24 show a comparison of probable gross margins for canola where median production potential is 100 tonnes from 100 hectares in the central-west NSW.

As a general rule it is assumed here that forward sales are restricted to median expected yields given an SOI forecast rather than expected yield based on long-term production averages. The no contract position assumes no forward sales while the contracted position assumes that 50% of median expected yield has been forward sold at $400 per tonne. In practice Riskwatch Canola can be used to monitor any type of forward sales strategy including the buying and selling of oilseed throughout the season as part of a hedging and speculation strategy.

One aspect of this potential yield calculator is that the SOI indicator changes the probability of yield potential. With this function the calculated risks and rewards for the canola enterprise changes with the statistical expectation of rainfall for the rest of the growing season. There is no other analysis tool in the world at this stage that performs this function. In managing the risk of the forward sale a farmer or consultant can continually update and put numbers to there subjective expectations (Anderson et al. 1977) for potential yield and use this information for regulating the amount of crop forward sold. The tool also enables what if analysis, what if we forward sell the even odds amount in August 2003. What is the chance and cost of a washout if the season turns against the decision?

Of interest to financiers and business managers here is that the worst case scenario or ‘Value at Risk’ at the 5% interval for the uncontracted position is 279% greater than that calculated for the contracted position. This tells the decision maker what the chance and size of loss might be given the rain received, SOI indicator and no forward sold position compared to the forward position. The graph and chart also highlight another factor. With a price locked in for a proportion of crop the upside potential for profit is reduced due to the amount of oilseed available for sale at harvest time.

Conclusion

RiskWatch Canola has been developed to approximate the canola response to rainfall given an SOI indicator and probable rain for regional and or farm level analysis across the whole of the cropping regions of NSW. The aim of this canola DSS is to monitor rainfall and market prices then to use SOI rainfall probabilities and long term harvest time prices in order to calculate the risk reward profiles for a canola enterprise. This includes putting numbers to the chance of not being able to fill a contracted position. The decision maker’s role in this situation is to evaluate whether or not the gamble of forward selling is worth the downside risk of not being able to fill a contract. Or conversely if yields look promising to consider the reward potential of
fixing a relatively high price on the chance that price will decline towards harvest. This model is a first step in trying to capture the systemic nature of the production and pricing nexus. Opportunities for further development of bio-economic models in canola production and price risk include the costs and benefits of fertiliser rates to maximise response to optimal season ahead climate forecasts and the role of financial instruments such as futures and options in hedging the forward physical position entered into throughout the growing season.

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