United Grain Growers Limited - Case Summary

Group - Night’s Watch

Ming Lei
Lyuwen Lu
Yao Su
Ruijie Sun

Executive Summary

Standing at late 1998, United Grain Growers Limited (UGG), a Canadian grain distribution company is trying to quantify the risks it faces from the agriculture business for a better perspective.
This report mainly implements the Earning at Risk Model to evaluate yearly earning risk exposure for UGG and compares two hedging strategies for the $500mn crop portfolio. We conclude that the 1999 EaR risk exposure is $-17mn benchmarked at 1998 followed by a discussion about potential pitfalls and improvements of the model. We derive that the most efficient hedging strategy is to buy wheat and corn put options based on random walk simulation. What's more, the report analyzes the positive role of poison pills in corporate governance from the shareholders' aspect.

Poison Pill

In corporate governance, a poison pill is a defensive measure used by companies to defend against hostile takeover attempts by an acquirer. It is also known as a shareholder rights plan, as the board of directors gives shareholders the right to buy newly issued shares at a substantial discount, often 50 percent. As a result, this would have substantially diluted the share ownership of the non-complying bidder.
Poison pills are controversial devices. There is no common conclusion of how the market reacts to their adoption. From a shareholder perspective of UGG, we believe it is beneficial to them. Two of UGG's competitors initiated a joint hostile takeover in 1997 because of the industry-wide economic strains and the attraction of UGG's modernized grain. Obviously, UGG didn't want to be acquired. The "poison pill" made it difficult for other parties to obtain control over the firm, and the bidders of UGG withdrew their offer at the end. However, some see poison pills as a way to protect poorly performing management. In this case, we believe UGG's management has been doing a good job based on their shifting towards an environmental driven business and integration of technology strategies.

Wilis Report

Nature of Earnings at Risk Model

The EaR Model is used to generate 5000 risk scenarios that will be used to calculate 1-year EaR risk number at 99% confidence level against the corresponding benchmark (previous year grain handling operating income). When we trigger the EaR model, the Weather-To-Yield Model, and Yield-To-Earning Model will be used together as yield engine and Grain Handling Operating Income engine where the 4 weather factors are generated by correspondingly simulated factor distribution.
Considering Operating income of Crop Production Services, Livestock Services, Farm Business Communications and Corporate and Other are constant over years, the EaR model works reasonably well for 1-year earning risk. As a result, the EaR risk exposure is $-17mn for 1999. More model details are provided below.
Based on yields data, precipitation in June and July and the average temperature data in February and September from 1940 to 2000, we get Weather-to-Yield Model by using linear regression which explains 91% variation in yields (Appendix 2a.3(1)). Based on Grain Handling Operating Income and yields data from 1993 to 1998, we get the Yield-to-Earning Model (Appendix 2a.3(2)). We assumed a normal distribution of temperature and precipitation and used Monte Carlo Simulation to generate 5000 scenarios of those four weather factors in the Weather-to-Yield model based on the historical data. Then we estimated yields and grain handling earnings in the simulated scenarios using our Weather-to-Yield and Yield-to-Earning Model. We calculated the 99% EaR by taking 1% quantile of earnings after deducting the benchmark in 5000 scenarios (Appendix 2a.4).

It is important to appreciate and understand the assumptions of our EaR Model:

1. The model must work reasonably with only 40 years of historical weather-yield observed data.
2. The model must work reasonably with only 6 years of historical yield-income observed data.
3. The 5000 simulation scenarios should be implemented independently to guarantee the model correctness.
4. The model must work with the assumption that time-related factors, such as technological development, improved by constant every year which could be explained by the time-relative term in Weather-to-Yield Model.
5. The model must work with yearly data.
6. The model must work reasonably with the assumption that the sum of total yields in Alberta，Manitoba and Saskatchewan is very approximate to total yields in Canada.
7. The model must work reasonably with the assumption that the Operating income of Crop Production Services, Livestock Services, Farm Business Communications, and Corporate and Other are constant over years

Hedging Strategy

Based on UGG 's inventory turnover ratio, we decided to use a three-month hedging period for 300mn corn and 200mn wheat. We considered to either selling March 19 corn futures and wheat futures or buying put options on March 19 corn futures and wheat futures. In order to find the most efficient strategy to hedge the risk of holding this portfolio, we analyzed these two strategies by simulating 5000 times of corn and wheat price paths with random walk.

The first strategy is selling 15,707 corn futures at $3.82/bushel and 7,674 wheat futures at $5.21/ bushel on Dec 3rd, which guarantees that UGG will be able to sell those corn and wheat at $3.82/bushel and $5.21/bushel on March 19. UGG could lock in 300 mn profit in corn and 200 in profit in wheat. The hedging cost of this strategy is UGG would have been better off without the hedge if the price corn and wheat went up.

The second strategy we considered is buying 15,707 put options on March 19 corn futures and 7,674 put options on March 19 wheat futures, which will expire on February 22nd (contract size 5000 bushels). If the options expire without exercise, then selling corn or wheat futures on the option expiry date (Feb 22nd). We calculated lock-in profits of buying put options with a different strike price in our simulated 5000 scenarios. For corn, we analyzed 25 available put options with the strike price in the range $3.20/bushel to $4.40/bushel, the average lock-in profit of all of them are in range 299 mn to 344mn (Appendix 2b.1). We found that the expected gain is higher when buying deep in-the-money put but further analysis on the liquidity of these deep in-the-money options is needed. For wheat, we also analyzed 25 available put options with the strike price in the range $4.6/bushel to $5.8/bushel, the average profit of all of them are in the range from 205 mn to 250 mn (Appendix 2b.2). We found that the expected profit is higher when buying deep in-the-money puts but further analysis on the liquidity of these deep in-the-money options is needed. The hedging cost of this strategy is the premium paid for buying put options and losses from commodity futures if prices go up after February 22nd.

Based on our analysis, we decide to buy corn and wheat in-the-money put options to hedge 500 mn portfolio. Because in our 5000 simulated scenarios, buying wheat and corn put options at the market price on Dec 3rd gives a higher average profit than selling wheat and corn futures.

Yield-to-Earnings Model

94% Variability Explained

94% is the coefficient of determination, which is a key output of regression model analysis. It is interpreted as the proportion of the variance in the dependent variable (earning) that is explainable from the independent variable (yield). A high coefficient of determination displays a high correlation between the earning and yield, which means that it is reasonable to predict the earning based on the yield in the earning model. However, in our analysis, we fail to replicate the determination with our data, possibly due to different sources and scope of data.

Pitfalls and improvement of the model

Potential pitfalls of the yield model include:

1. Explaining earning only from the yield aspect attributes all the variability of earnings to the supply side without taking into account the demand side. Although it may be true for Board grains, the model may be inaccurate for non-Board grains whose prices are decided by the market. Under such conditions, demand is also a vital factor in deciding the market price.
2. Exhibit 7 concludes a positive correlation between the yield and precipitation without taking into account the negative effect of a flood (exceptionally high precipitation) on yield.
3. The detailed statistics of the Weather-to-Yield model is not provided. Based on our data, the precipitation plays a far more important role than temperature in predicting the crop yield. Adding more independent variables to the model will surely increase the coefficient of determination but does not necessarily improve the quality of the model.

Based on these pitfalls, the corresponding improvements include:

1. Keep the yield-to-earning model for Board grains while introducing a new model including the demand-reflecting factors for nonBoard grains.
2. Adopt a similar method in the Weather-to-Yield model by setting a twist level of precipitation. i.e We assume a positive correlation between yield and rain when the precipitation is under this specific level and a negative correlation above this level.
3. Develop a recapitulative weather index (for example, precipitation index and temperature index) and construct yield model over the index rather than weather conditions of specific months.

Conditions of Unlimited-protection Insurance

1. Develop a historical database of weather conditions and categorize farms by certain standards (productivity, variation of weather, etc) and set different insurance contracts for different standards.
2. Link sum insured to national average yield to relieve the impact of the shocks from the global economy as well as moral hazard.
3. Set compulsory clause in the contract to make sure that the insurance covers all the farms under UGG. This helps to diversify the weather risk faced by the insurance company and eliminate biased selection.

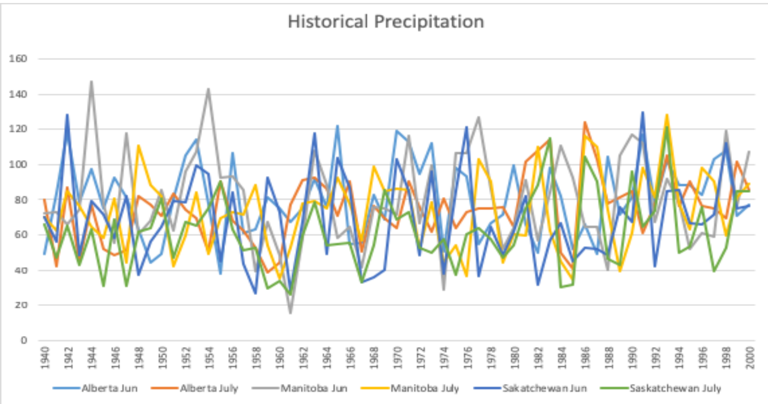
Data Sources

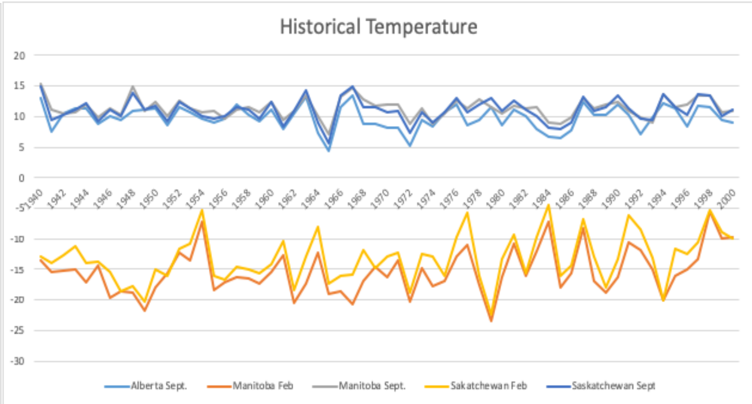
1. Government of Canada, Environment and natural resources - Monthly Climate Summaries - http://climate.weather.gc.ca/index_e.html
2. Agriculture and Agri-Food Canada, http://www.agr.gc.ca/eng/home/?id=1395690825741

Appendix

2a.1 Historical June and July Precipitation of Alberta, Manitoba, Saskatchewan (left)

2a.2 Historical February and September Temperature of Alberta, Manitoba, Saskatchewan (right)





2a.3 Summary tables of two regression models

1) Yield-to-Earning model

*Grain-handling-Earning = -55.42 + 0.033 * Yield*

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.516766582
R Square	0.2670477
Adjusted R Squa	0.083809625
Standard Error	7.550351535
Observations	6

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	83.08210011	83.0821	1.457381	0.293850791
Residual	4	228.0312332	57.00781		
Total	5	311.1133333			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-55.42066704	63.40557658	-0.87407	0.431421	-231.4627698	120.6214357	-231.4627698	120.6214357
Yield	0.032463082	0.026890767	1.20722	0.293851	-0.042197656	0.107123819	-0.042197656	0.107123819

2) Weather-to-Yield model

*Yield = 200.4 + 4.48 * Precipitation_Jun + 6.36 * Precipitation_Jul - 2.84 * Temperature_Feb + 10 * Temperature_Sep + 21.57 * Time*

SUMMARY OUTPUT

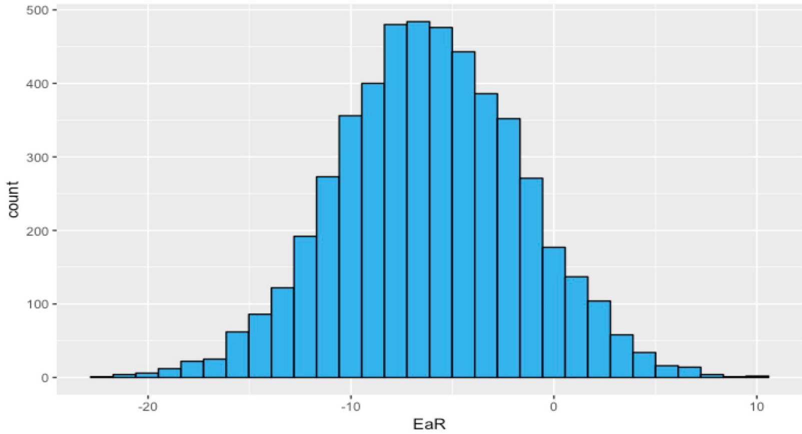
Regression Statistics	
Multiple R	0.9328313
R Square	0.87017423
Adjusted R Square	0.85837188
Standard Error	177.159473
Observations	61

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	11570090.19	2314018	73.72894	3.93115E-23
Residual	55	1726201.339	31385.48		
Total	60	13296291.53			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	200.421227	228.0758093	0.878748	0.383361	-256.6529093	657.495363	-256.652909	657.4953625
Precipitation - Jun	4.47982785	1.225864815	3.654422	0.000577	2.023139861	6.93651584	2.023139861	6.936515835
Precipitation - Jul	6.35793258	1.397169795	4.55058	3E-05	3.557941741	9.15792342	3.557941741	9.15792342
Temperature - Feb	-2.83566218	6.703378573	-0.42302	0.67393	-16.26953304	10.5982087	-16.269533	10.59820868
Temperature - Sep	9.99726945	13.68738467	0.7304	0.468245	-17.43286239	37.4274013	-17.4328624	37.42740129
Time	21.5692597	1.401035431	15.39523	1.36E-21	18.76152196	24.3769975	18.76152196	24.37699745

2a.4 Distribution of simulated Earning of 1999



2b.1 Average payoff of corn put options strategy(left)

2b.1 Average payoff of wheat put options strategy(right)

Corn put options strike	Corn put options price on Dec 3rd	# of times that payoff > 300mn in simula	Average payoff
320	0.125	2,487	300,004,809.81
325	0.25	2,485	300,002,846.45
330	0.25	2,485	300,002,846.45
335	0.375	2,485	300,000,883.10
340	0.5	2,482	299,998,919.75
345	0.75	2,478	299,994,993.05
350	1	2,473	299,991,066.35
355	1.5	2,467	299,983,212.95
360	2.25	2,455	299,971,432.84
365	3.375	2,434	299,953,762.68
370	5	2,405	299,928,239.12
375	7	2,366	299,896,899.87
380	9.375	2,320	299,992,990.52
385	12.25	5,000	302,211,736.49
390	15.5	5,000	306,039,338.38
395	19.125	5,000	309,909,031.41
400	23	5,000	313,774,869.11
405	27	5,000	317,638,743.46
410	31.25	5,000	321,498,691.10
415	35.5	5,000	325,358,638.74
420	40	5,000	329,214,659.69
425	44.625	5,000	333,068,717.28
430	49.25	5,000	336,922,774.87
435	54	5,000	340,774,869.11
440	58.875	5,000	344,625,000.00

Wheat put options strike	Wheat put options price on Dec 3rd	# of times that payoff > 200mn in simulations	Average payoff
460	1.25	2,656	204,876,493
465	1.75	2,716	205,577,893
470	2.375	2,792	206,363,280
475	3.125	2,906	207,237,385
480	4	3,004	208,204,276
485	5.125	3,153	209,269,144
490	6.5	3,330	210,426,782
495	8.125	3,543	211,688,147
500	9.875	3,780	213,061,147
505	12	4,019	214,549,770
510	14.375	4,290	216,159,288
515	16.875	4,597	217,898,005
520	19.625	4,918	219,768,241
525	22.625	5,000	221,744,454
530	25.75	5,000	223,829,221
535	29.125	5,000	226,028,408
540	32.625	5,000	228,338,917
545	36.25	5,000	230,756,623
550	40	5,000	233,286,946
555	43.875	5,000	235,931,852
560	47.875	5,000	238,686,151
565	51.875	5,000	241,547,249
570	56.125	5,000	244,506,778
575	60.375	5,000	247,557,114
580	64.625	5,000	250,690,848

2b.3 An example of 5000 scenarios of payoff with corn put options strike $3.20 (left)

2b.4 An example of 5000 scenarios of payoff with wheat options strike $4.60 (right)