Compatibility of Government Guarantees with Flexibility in Canadian Wheat Price Pooling

by

James Unterschultz and Frank Novak

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Abstract

Financial option theory is used to evaluate Canadian Wheat Board (CWB) price pooling and associated government guarantees. Price guarantees and final payments on the pool can be viewed as special financial derivative products. Financial models are used to evaluate pricing flexibility alternatives within the constraints of the CWB price pooling system and at the same time to provide a measure of the CWB dollars at risk associated with offering these contracts. Flexible pricing alternatives may not be compatible with a government price guarantee. The CWB dollar risk of flexible pricing could be substantial.

Introduction

The Canadian Wheat Board (CWB), first established in 1935, is responsible for marketing all barley and wheat produced on the prairies and destined for export. Western Canadian farm managers are interested in more pricing flexibility within the current CWB pooling system (Western Grain Marketing Panel 1996, CWB). Their interests stem from a desire to improve cash flow management and control revenue uncertainty. Uncertainty exists at the time of grain delivery as to the farm gate final realized wheat price. Also the farm cash inflow from wheat sales is potentially spread out over one and one half years from the time of delivery. The Western Grain Marketing Panel (1996) concluded from their study of the Western Canadian grain marketing system that any system needs to provide good price signals and allow farm managers ways to manage risk and cash flows.

The provision of more flexible pricing is under consideration by the CWB (CWB) and changes to the CWB legislation have been contemplated. Offering more price flexibility in the pooling system may range from offering forward contracts on the CWB pool value at seeding to providing early pay outs on the expected remaining value of the pool on grain already delivered to the CWB. One key constraint imposed by the CWB on these considerations is that any form of price flexibility must not have any impact on the actual grain pool value. That is, any price flexibility alternative offered by the CWB must be self-financing and kept independent of the pool value.

This paper has three main objectives related to price pooling and price flexibility. These are:

Show that government price guarantees and final payments on the pool can be viewed as special financial derivative products.

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2. Value pricing flexibility alternatives within the constraints of the CWB price pooling system using financial derivative methods and at the same time provide a measure of the CWB dollars at risk associated with offering these contracts.
3. Evaluate the compatibility of flexible pricing alternatives with a Federal price guarantee.

These are extremely timely issues considering the ongoing debate about the future role of the CWB and wheat marketing in Western Canada.

The paper begins with a review of selected background information on CWB pooling for wheat. This focuses on the nature of the current pooling system, the role of the government price guarantee and their relationships to financial models. A conceptual model is provided that shows how the guarantee can be considered a specialized type of put option. Further details on flexible pricing alternatives are then provided. Financial models (i.e. average value option pricing models) are used to value flexibility pricing alternatives and examine diverging values on the expected pool value between the CWB and farmers due to the federal government price guarantee.

Conceptual Financial Models in Pooling

The CWB's mandate is to serve farm managers in Western Canada by marketing their crops around the world for the best possible price. Deliveries of grain to the CWB are grouped into pools based on the type of grain. The grain from each pool is sold with the CWB acting as the marketing agent for the farm manager. The total revenue (less marketing costs) is returned to the farm based on the total tonnes delivered by each manager into a specific pool. The revenue returned to the farm consists of an initial payment upon delivery of the grain, upward adjustments to the initial payment as pool revenues become less uncertain and a final payment when all sales from the pooled grain have been finalized. The actual pooling mechanism is described next along with the role of the Federal government guarantee. Option theory is then used to place pooling within a financial model framework.

Deliveries of grain are placed into specific pricing pools. For example all wheat, including Canada Western Red Spring (CWRS) grades excluding durum are placed into a single pool (CWB) as the grain is sold. As the different classes/grades/protein levels of wheat are sold, these dollars are deposited into a single pool. A series of quality grade/protein level price differentials are tracked over the course of the year and used to calculate the final selling price within each pool for each grade/protein level (CWB). These differentials appear to be a simple average over time. The pool is finalized when all grain delivered during the crop year is sold. This final pool value determines the total pay out to the farm.

Closely tied to pooling is the federal government's price guarantee. Farmers delivering wheat are paid an initial payment of so many dollars per tonne. The federal government guarantees this initial payment. If subsequent total pool returns are not sufficient to cover the initial payment, the federal government pays the difference on the pool and the farmer does not have to return any money to the CWB. The CWB with approval of the federal government does adjust the initial payment upward throughout the course of the crop year if markets and prices indicate a higher pool return than that covered by the initial payment.

A clear conceptual foundation is required to evaluate this federal guarantee. The guarantee is a floor price or minimum price guarantee where the money is paid up front to the farmer. This guarantee is equivalent in principle to a put option with a strike price equal to the initial payment (Merton 1977). The put is provided by the federal government. The value of a put or call option (i.e. the option premium) is the risk adjusted present value of the potential pay off from this financial asset. It is a European type option since there is no early exercise in the formal sense.

A put gives the holder the right but not the obligation to exercise (sell) the underlying contract at the strike price. For the moment, ignore the pooling aspects of the CWB and the timing of the payment and examine the guarantee. Let the initial price be designated as "I". Let the final realized price (at the end of the crop year) on the grain be $\overline{S}_T$. Then the terminal put payoff using standard notation for options is $putpayoff = Max[I-\overline{S}_T,0]$. This put payoff corresponds to the final pool value. If the final pool value does not cover the initial payments made, the farm does not have to pay back the difference and gets to keep this difference of $I-\overline{S}_T$ If the final pool value is greater than the initial payment then, the put value has a final pay out of 0. Prior to delivery of grain to the CWB the farmer views the potential terminal payoff as being the greater of the initial payment or the final realized price $\overline{S}_T$. This then is a potential terminal payoff prior to grain delivery of $Farmgrainvalue = Max[I-\overline{S}_T,0]+\overline{S}_T$. If the final price is above the initial payment, "I" the farm gets $\overline{S}_T$, since the $Max[I-\overline{S}_T,0]=0$. If the final price is below the initial then the farm gets $I-\overline{S}_T+\overline{S}_T=I$, which is simply the initial payment. So prior to delivery at time t, the value of the grain in the bin is equal to $P[I,\overline{S}_t]+E_t(\overline{S}_T)$ where $P[I,\overline{S}_t]$ is the put premium with strike price I and some expected price $\overline{S}_t$ and E_t is the expectations operator.

Puts have value and there is a recognized literature for valuing put options (Merton, 1990; Ingersoll 1987; Hull 1993). This interpretation of the price guarantee as a type of put option is supported by the literature. Bardsley and Cashin (1990) apply the option model from Black and Scholes (1973) to value government price guarantees to the Australian Wheat Board. Conceptually Bardsley and Cashin correctly identify the government guarantee as a type of put option however the Black Scholes option pricing model will overprice the option when price averaging is part of the model. Clark and Fleming (1990) analyze price distortions in CWB initial payment policy using a Tobit procedure that specifically recognizes the truncation introduced in prices with the initial price guarantee. Kang and Brorsen (1995) value support programs using average value option models. Turvey (1992) evaluates agricultural price insurance programs using the Black option pricing model.

There are several wrinkles on this simple put option definition when Western Canadian institutional details are examined. The CWB initial payment is paid upon delivery of the grain and this occurs before expiry of the guarantee (option expiry). Upon delivery the farm receives a risk free bond in the form of the initial payment "I" and is issued a call which gives the holder the right to any future value above the initial value. That is, upon delivery, the farm exchanges the expected value discussed above ($P[I,\bar{S}_t] + E_t(\bar{S}_T)$) for the new (and equal value) of $C[I,\bar{S}_t] + I$ where $C[I,\bar{S}_t]$ is the call premium for an option with a strike price "I" and an underlying asset value of $\bar{S}_t$. The call option's terminal payoff (final payment) is $Max[\bar{S}_T - I, 0]$. C[I, $\bar{S}_t$] represents the risk adjusted present value of the future final payment for the grain that has been delivered. The farmer simply lets the call option expire if the final pool value is below the initial payment. However, if the final pool value is above the initial payment, the farmer will exercise the option and receive the final payment. The exercise is automatic similar to commercial exchanges such as the Chicago Board of Trade (CBOT). Most years this call expires in the money (i.e. with value).

Valuing any of the derivatives discussed above, the farm value of the final payment, would be relatively straight forward using financial models if it were not for the quantity weighted price averaging in $\bar{S}_t$. This makes the options a specialized derivative using an average price. These are sometimes referred to as Asian options (Hull, 1993). Further complicating the issue is that no single cash price or futures price exactly matches the price for wheat found in the pool. This makes valuation more difficult to achieve. Canadian wheat is sold in many different markets around the world and some of the prices may not closely correlate with existing futures markets. Option models can be used to evaluate different flexible pricing alternatives that might be considered for the CWB price pooling system.

Flexible Pricing Alternatives

Two types of flexible pricing alternatives are examined here. These are:

1. Fixed Price Contracts (FPC)
2. Early Pool Cash Out (EPCO)

FPC are equivalent to forward contracts offered on the price pool. The EPCO has features similar to a specialized call and it is a pay out of the remaining price pool value. Each of these products, depending on the time of year, will allow the manager to fix a price and manage their cash flow.

Fixed Price Contracts (FPC) might be offered in the months of February, March, April, May and possibly June prior to the beginning of the crop year. Contracts would lock in a fixed cash price for delivery. The grain covered under a fixed price contract would not participate in any further pool accounts from the viewpoint of the farm manager. The physical grain would still be a part of the CWB pool from the CWB's viewpoint and it would be included in the calculations of the pool pay outs.

The FPC contracts would be entered into prior to or during seeding. FPCs are forward contracts and would have the properties associated with forward contracts. Delivery on these contracts would occur earlier in the crop year rather than later. However, there are no conceptual reasons why forwards could not be offered that specified delivery later in the crop year.

The presence or the absence of a guarantee on the initial payment has implications for valuing the FPC. Under most circumstances the initial payment would be determined after the period for FPC was closed but from prior history farm managers will have expectations regarding the size of initial payment that will be offered. Recently from 1993 to 1997, the CWB has set initial payments ranging from 73% to 80% of their projected pool return for CWRS wheat. The CWB must recognize that guarantees (put option value) have value and it is provided for free to the farm manager. Managers using FPC give up the guarantee. The guarantee limits the downside price risk on the pool and leaves open the upside on pooled price potential. If the guarantee has little value, an historical and empirical question, then this will have little impact on the FPC. Once the initial payment is announced, a FPC will be compared to the benefits of retaining a cash position (unpriced) combined with the guarantee (put). We expand on this comparison later. The early pool cash out is discussed next.

Early pay out of final payments (EPCO) is the second flexible pricing alternative. The crop year ends on July 31. The CWB is essentially purchasing back the farm's call option on the remaining pool value. The value of the call depends on the priced grain in the pool, the expected price and all initial and interim payments up to that point in time. The financial models presented next demonstrate how to value these contracts and evaluate the dollar (i.e. forecast) risk the CWB accepts by offering these contracts.

Finance Models Description and Estimation

Financial economics specializes in measuring risk, pricing risk and valuing assets. Using the pooling definitions, finance models are built here to evaluate flexible pricing. The general numerical methods underlying the financial models specific to CWB flexible pricing are presented first. Monte Carlo simulations using these financial models evaluate the CWB's dollar (i.e. forecast) risk and illustrate an alternative flexible pricing valuation method.

Monte Carlo is the general method used for valuing average-value (Asian) financial instruments (Kang and Brorsen 1995). With Monte Carlo, essentially all possible wheat price paths through time are sampled. Information on the price distribution and its parameters are required. For example, given a current market price today of $130/tonne (U.S. dollars), the model uses the price distribution to simulate the possible price path of this wheat price on a weekly or even daily basis for up to 20 months into the future. Prices for one week in the future, two weeks in the future and so on generated. At the same time another price such as the Canada-U.S. spot exchange rate is simulated on a week by week or day by day basis. All simulated U.S. wheat prices are converted into Canadian dollars. Wheat prices for the pool sales period are averaged over a prespecified time period to estimate the final pool value. U.S. wheat prices are used since most CWB sales are denominated in U.S. dollars and the public risk markets for milling wheat are based in the U.S. Since the Monte Carlo has a random component, many different price paths through time are possible. The complete price path needs to be simulated many thousands of times to arrive at the most likely asset value. Once the final value of the model is determined, it is discounted to the present time period to arrive at the asset's value. (Hull 1993; Kemna and Vorst 1990).

The remainder of this section develops and presents financial models that demonstrate how to value flexible pricing. The discussion begins with the base assumptions incorporated into the Monte Carlo financial models. Applications to FPC and EPCO are then presented.

A Monte Carlo financial model was built that incorporated three wheat prices and one exchange rate. Wheat futures prices in February 1996 for December 97 futures from CBOT, Kansas Board of Trade (KBOT) and Minneapolis Grain Exchange (MGE) are included to simulate the multiple prices entering the wheat pricing pool. The model could be expanded to include other futures prices or different maturity contracts. These prices allow the evaluation of flexible pricing prior to the beginning of the crop year and also demonstrate how to value these financial products at different times during the crop year. The prevailing exchange rate is also included to convert U.S. wheat prices into Canadian prices. All prices are assumed to be log normal, a standard assumption in many financial pricing models. Distribution analysis of the prices (not reported) provides some justification for using the log normal distribution especially for the wheat price variables. Risk neutralized drift rates of 0 are used for all futures wheat prices. The difference between U.S. and Canadian two year bond interest rates are the risk neutral drift rates used for the exchange rate. Details on the reasons for using risk neutral drift rates in the valuation are omitted here due to the level of technical complexity associated with these financial models. Interested readers are referred to references previously mentioned, in particular Hull (1993).

Financial models require inputs on current prices, volatilities, correlations and other data. Tables 1 and 2 contain data on returns correlations and volatility (standard deviation of returns) for the KBOT and CBOT September and December 1997 wheat futures. Recent historical data suggests the volatility on the wheat futures returns ranges from 14% to 16.5% (Table 1). There are indications for the prior year that MGE had volatilities ranging to 28%. Implied wheat volatilities on the CBOT (i.e. the volatilities implied by current option values) are higher than the estimated historical volatilities with values in the 21% range (Table 2). The implied exchange rate volatility for a similar date is 3.8%. The returns correlation between wheat on the CBOT and KBOT is 0.65. The correlation between returns on the exchange rate and wheat values is very close to 0. These data are used to guide inputs into the Monte Carlo. The futures prices (average market futures price of $179.09/tonne Canadian) and parameters used in the base simulations are presented in Table 3. Several different scenarios are analyzed.

Two main Monte Carlo models were simulated to evaluate FPC and EPCO.

1. Fixed Price Contract

a) Assuming Initial Payment is Known at the Time the FPC is Valued:

i) The principal objectives of this model are to value the FPC, to estimate the forecast risk (standard deviation of the final pool) and value the government guarantee assuming the government guarantee is known

ii) Twenty months to final pool sale is modelled. (i.e. offering a FPC starting in March prior to the beginning of the crop year). This estimates the pool value when 20 months remain until the CWB makes the last sale out of the pool and no wheat sales have yet occurred in the pool. A separate model is run assuming the start time is 19 months to the final sales (i.e. equivalent to offering a FPC in April). This estimates the pool value assuming only 19 months remain until the final pool sale. Separate models are run for 20, 19, 18, 17 and 16 months prior to last pool sale. This demonstrates how the value of the financial instruments and the forecast risk change with time while other relevant parameters are held constant.

iii) None of the wheat in the pool is priced at the time of valuation. CWB pool wheat pricing (i.e. sales to wheat customers) are assumed to begin 15 months prior to the final sale in the pool (assuming 16 time periods that sales occur in).
iv) Initial price is varied for different model runs.
v) Wheat prices in Table 3 are always used as the current market price for models estimated for different times to maturity.
b) Assuming that initial payment is not known at the time the FPC is valued but the initial payment is some proportion of the expected final pool price:
i) The objective is to value the government guarantee under a FPC type scenario using a different set of assumptions about the initial payment.
ii) The initial price is announced in July just prior to the beginning of the new crop year.

2. Early Pool Cash Out
a) The second model, simulated within the crop year, is similar to model one but it incorporates the sales already made in the pool and continues to vary the time remaining to the final pool sale by the CWB. Model 2 demonstrates how the valuation changes as more and more of the pool sales are completed. The objectives of this model are to value the call option implicit in the future "final payment", estimate the forecast risk as less of the pool remains to be priced and estimate the present value (discounted value) of the final pool price. Specific inputs related to this model and Table 3 are as follows.
b) Different time periods from 14 months to 1 month prior to the last CWB pool sale with varying levels of priced grain are run as separate models. The model is first run with 14 months remaining to the final sale. Then a separate model is run again with less time remaining to final sale. At the same time the percentage of grain already priced in the pool is increased. Separate models with 14, 10, 6, 4, and 1 month to final pool sale are shown here to demonstrate time and sales impact on the pool.
c) The average value of all CWB pool sales prior to the current date are \$170/tonne and it is assumed that the CWB prices about 6.25% of the pool each month. For example, a model run with 10 months remaining until the final pool sale assumes that 37.5% of the total pool has been priced and the average price of these sales was \$170/tonne.
d) Initial price is varied for different model runs.
e) Current market futures prices are always the Table 3 prices which average to \$179.09/tonne.
These two basic models are used to evaluate CWB dollar risk exposure, value FPC and value EPCO. Results from these models are presented next.

Analysis of CWB Dollar risk exposure

The analysis on the different models first focuses on the forecast error, the per tonne dollar risk measures associate with offering FPC or EPCO. Both models estimate the range of possible final pool values and provide a measure of the dollars the CWB may have at risk by offering such contracts. This is very relevant when the CWB is required to insulate the general pool from any activities associated with offering FPCs and EPCOs. Figure 1 presents the pooled standard deviations based on Table 3 inputs. Twenty months prior to the final sale (i.e. February or March before the beginning of the crop year) the standard deviation of the forecast is just under \$35/tonne.

Using a standard normal assumption about the confidence interval surrounding the forecast, 32% of the time the final pool price is expected to be greater than $35 dollars from the forecast pool price. Potentially the CWB has a 16% chance of losses over $35/tonne of grain contracted under FPC during this time period. The standard deviation decreases to just under $10 per tonne two months prior to the last sale. At twenty months none of the pool has been priced. At two months remaining in the pool it is assumed that 87.5% of the pool is priced with an average price of $170/tonne. The CWB is accepting significant dollar risks by offering FPC. This forecast performance is sensitive to current price levels and to the volatility estimates used.

Evaluating Fixed Price Contracts

Valuing the government guarantee is a component of FPC and has implications for farm participation in flexible pricing. The put premium is the farm value of the government guarantee. Figure 2 presents the average value put premiums implied by the government guarantee. The government guarantee has value even when initial prices are low relative to current market prices. When initial prices are set at $140/tonne, which is $39/tonne below the prevailing average futures market model price, the guarantee still has a value of $1.62/tonne at twenty months prior to last sale. When the initial price is set at $190/tonne and the prevailing futures market price is $179.09, the possibility of the federal government having to pay out on the guarantee is high and this is reflected in the put value of $20.63/tonne. The put values decrease as time to maturity decrease and increase with higher price guarantees.

Alternatively, initial payments in recent years appear to be set as a fixed proportion (i.e. 73% to 80%) of the expected pool return. Farms are interested in receiving a higher initial payment relative to the expected pool return. This implies a greater implied option value associated with the government guarantee. Even before initial prices are announced, farmers have expectations as to the approximate initial payment relative to the expected pool price. Raising the expected initial raises the value of the expected guarantee. Figure 3 illustrates this point. Whereas Figure 2 assumes the initial price is known at the time the FPC is valued, Figure 3 assumes that the initial will be set as a percentage of the prevailing expected pool price. If at seeding time, the farm expects initials announced in July to be 70% of the pool outlook the approximated value of that future put option is only $0.15/tonne[2]. If initials were expected to be at 80% or 90% of the expected pool return then the approximate value of the put option is $0.56 or $3.19/tonne respectively.

Farm manager participation in the FPC will be affected by the pattern of values in Figures 2 or 3. If initial prices are set relatively close to the prevailing market price (i.e. $10 to 30 below prevailing market prices) the government guarantee has value. In Figure 2, with 20 months to maturity and an initial guarantee of $160/tonne, the average value put premium is $5.98/tonne. Neither the CWB nor the federal government has received any compensating premium for the price guarantee yet this $5.98/tonne has real value to the farm manager. The $5.98/tonne value is all derived from the guarantee. There is a possibility that the pool price will end up below the

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[2] Assuming the CWB has 14 million tonnes of sales, this represents an approximate dollar value of $2.1 million.

initial price and this value is reflected in the calculated put premium. Rational farm managers should expect to be compensated for this guarantee in the FPC. Since the CWB does not receive any premium for the guarantee, the CWB is not in any financial position to compensate the farm for the value of the guarantee. Thus, the CWB's perceived pool value and the farm manager's perceived pool value diverge due to the guarantee.

Valuing Early Pool Cash outs

When the grain is delivered the farm manager exchanges the expected pool value plus the put value for a risk free bond equal to the initial payment and an average value call option with a strike price equal to the initial payment. The average value call option represents the present value of the final payment. The EPCO, an early pay out of the final payment, can be valued based on this average call. Managers taking an EPCO are giving up the benefit of the price guarantee. Figure 4 illustrates the average-value call option premiums under differing assumptions on initial price and time to final pool sale using financial model 2. All other input values such as average futures price, \$179.09/tonne, are as given in Table 3. The values in Figure 4 are the risk adjusted present value of the expected final payment. The value of the final payment decreases as the crop year progresses and decreases with higher initial payments.

Figure 4 demonstrates the value of the guarantee to the farm manager who has delivered wheat, received an initial payment and is now considering an EPCO. The call option has value to the farm manager even when the initial payment is quite high relative to current market conditions. For example, if the current market price is \$179.09/tonne, the average value of wheat sold in the pool is \$170/tonne, the initial is \$190/tonne, and there is 14 months to the final pool sale, the call still has a value of \$3.22/tonne. This \$3.22 value exists because there is a possibility that market prices may rise and the pool value may exceed the initial payment.

Comparing the initial payment plus the call value to the present value of the pool without a price guarantee results in Figure 5. The present value of the pool (the bars on the figure) represents the CWB's value on the pool and the total value the CWB is willing to remit to a farm at delivery under an EPCO. The lines represent the value farm managers place on the initial plus the final payment when the federal guarantee is included. The different lines are for different initial payments. In all cases the farm value is above the CWB value. Even when the initial is \$140/tonne with market prices at \$179.09/tonne and the averaged sales value of the grain already sold is \$170/tonne, the farm manager places a slighter higher value on wheat than does the CWB. Where the initial price is below the final pool price, the CWB value and the farm value converge as the final pool sales period approaches. Unless the CWB is compensated in some way for the farm manager's free guarantee, it cannot afford to pay for the guarantee that is built into the expected final payment. When the guarantee has little value then the farm and CWB values converge and the EPCO is viable from the CWB's viewpoint.

Conclusion

The Western Canadian wheat industry is evaluating ways to provide more flexibility within the existing price pooling system. Proposed financial instruments based on the Canadian Wheat Board's pooling system include fixed price contracts offered at seeding time and early cash outs of the final payment after grain delivery. A conceptual framework and financial models were developed to evaluate and value these financial products.

The conceptual framework explained how price guarantees and final payments on the pool can be viewed as special financial derivative products. The price guarantee is similar to a specialized average value put option. The final payment is similar to an average value call option on the final value of the price pool.

The conceptual models were used to build average value option pricing models to evaluate alternative financial derivatives on the CWB price pool for wheat . These same models demonstrated the significant dollar risk the CWB assumed if it offered such contracts.

The federal price guarantee, valued using these financial models, provides a financial benefit to farms similar to an average value put option. This value must be considered in the design of flexible pricing alternatives. If the government guarantee has value, the farm view of the pool value diverges from the CWB view of the pool value. This may limit participation in the flexible pricing program. The government guarantee will be a critical issue in determining the success of flexible pricing since a valuable guarantee will reduce a farm manager's incentives to participate in any FPC or EPCO.

Table 1: Relationship Between Two Wheat Futures Contracts (August 1996 to January 1997 Daily Data)

	Kansas Sept. 97 Wheat Futures[1]	CBOT Sept. 97 Wheat Futures	Kansas Dec. 97 Wheat Futures	CBOT Dec. 97 Wheat Futures
Returns Correlation Between Markets	0.65	-------------	0.65	----------
Annualized Standard Deviation of Returns (Volatility)	14.5%	16.5%	13.9%	16.0%

Source of Data Used For Calculations: CWB. Analysis of the MGE September and December 1996 futures showed an historical returns standard deviation of 28% over a 350 trading days or 22% over the last 100 days of trading data.

Table 2: Implied Wheat Futures Volatilities on CBOT Wheat June 97 Options (Using the Black Option Pricing Model)

	Put Implied Volatility Range	Call Implied Volatility Range
At-The-Money Options	20.5-20.8%	20.4-20.7%
Out-Of-The-Money Options	20.3-20.5%	21.2-22.6%

Table 3. Financial Model Monte Carlo Base Case Input Variables

Variable description	Variable Value
Canadian risk free interest rate (2 year bond rate)	4.17%
U.S. risk free interest rate (2 year bond rate)	5.87%
CBOT Dec 97 wheat futures converted to U.S.$/tonne	$130.83/t (177.30 in Can. $)
KBOT Dec 97 wheat futures converted to U.S. $/tonne	$132.66/t (179.70 in Can. $)
MGE Dec 97 wheat futures converted to U.S. $/tonne	$133.03/t (180.28 in Can. $)
U.S. Canada exchange rate	.7379 $ U.S. to buy 1 Can $
Time to final sale in the wheat pool	varies: 20 months to 1 month
Initial price or current initial plus interim	varies
Current value of any wheat already sold in the wheat price pool	$170/t (Can.) or varies depending on the simulation and the time remaining to final sale
Proportion of pool already price	varies from 0 to 100% depending on the time remaining to final sale
CBOT wheat returns volatility	21%
KBOT wheat returns volatility	20%
MGE wheat returns volatility	28%
Exchange rate returns volatility	.038
Returns correlation CBOT and KBOT	.65
Returns correlation between CBOT and MGE	.65
Returns correlation between KBOT and MGE	.65
Returns correlation between exchange rate and all wheat contracts	0.0
Portion of sales at CBOT simulated price	.33 (assuming equal sales each period when sales ongoing)
Portion of sales at KBOT simulated price	.33 (assuming equal sales each period when sales ongoing)
Portion of sales at MGE simulated price	.34 (assuming equal sales each period when sales ongoing)
Number of price paths simulated[1]	10,000 to 100,000

Some simulations used fewer numbers of price paths due to the extensive computer time required to run the different scenarios.

Figure 1: Financial Model Simulation: Forecast Risk (Standard Deviation) of Possible Pool Price Outcomes For Different Times to Maturity

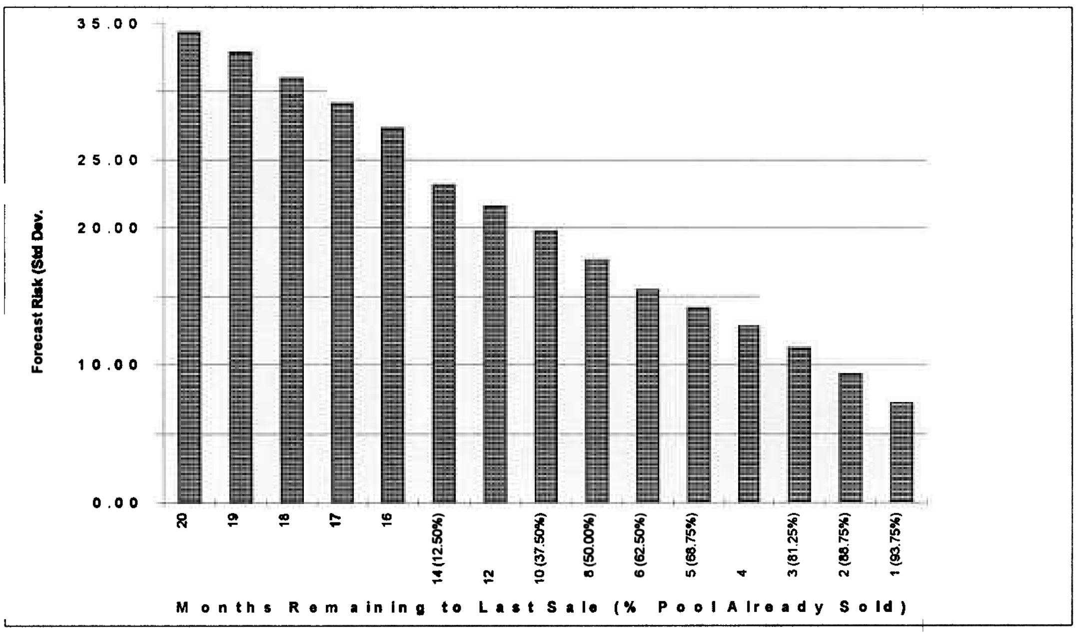


Figure 2: FPC Financial Model Simulation: Government Guarantee Value (Average Value Put Option Premium) Assuming Initial Price Is Known

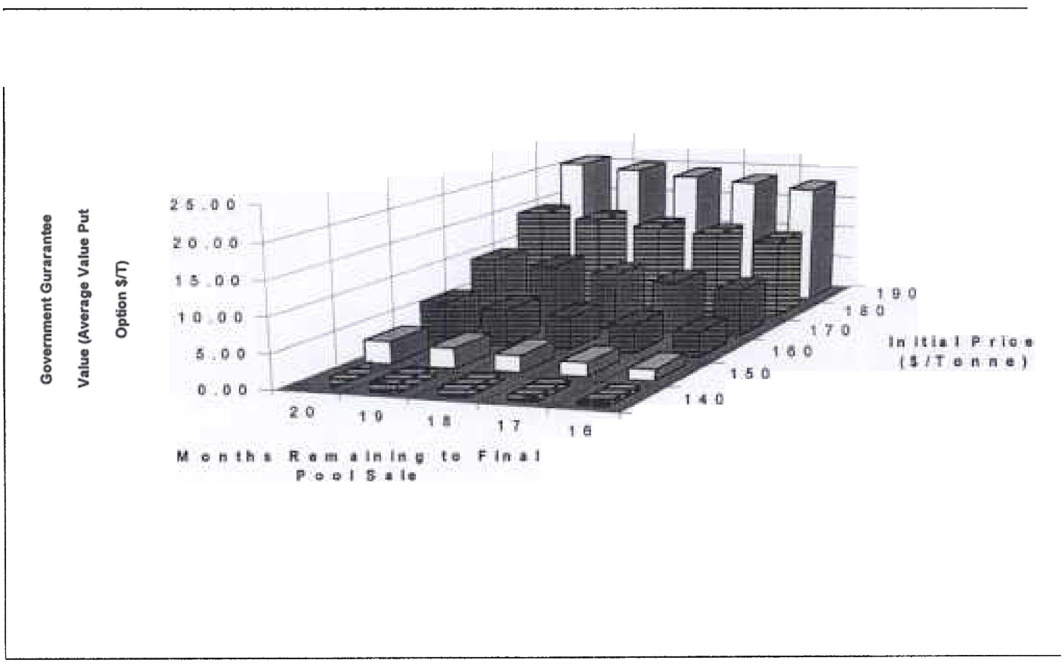


Figure 3: FPC Financial Model Simulation: Government Guarantee Value (Average Value Put Option Premium) Assuming Initial Price Is Set As A Fixed Percentage of the Expected Price In Month 15

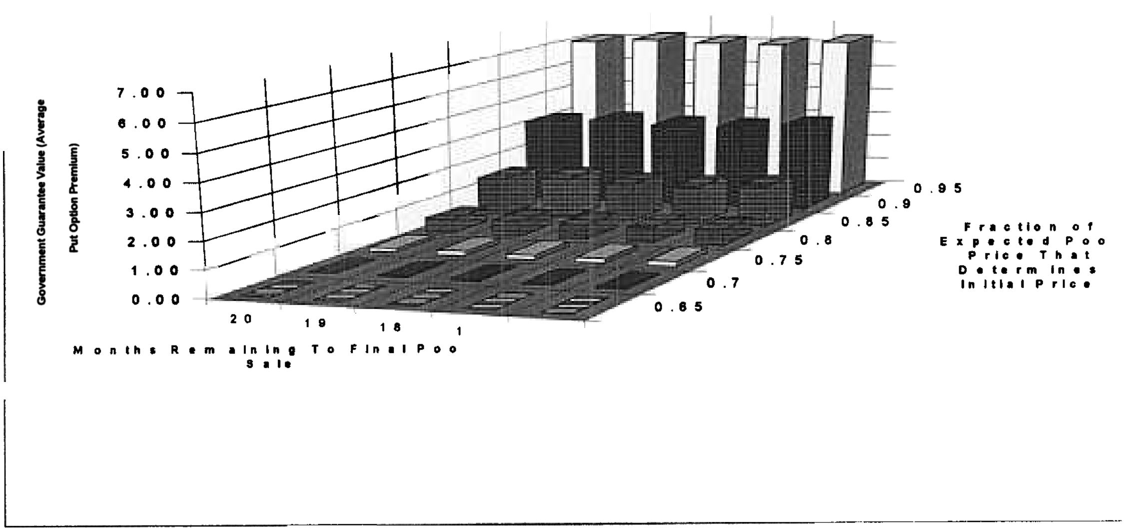


Figure 4: EPCO Financial Model Simulation: Value of the Final Payment (Call Option Premium)

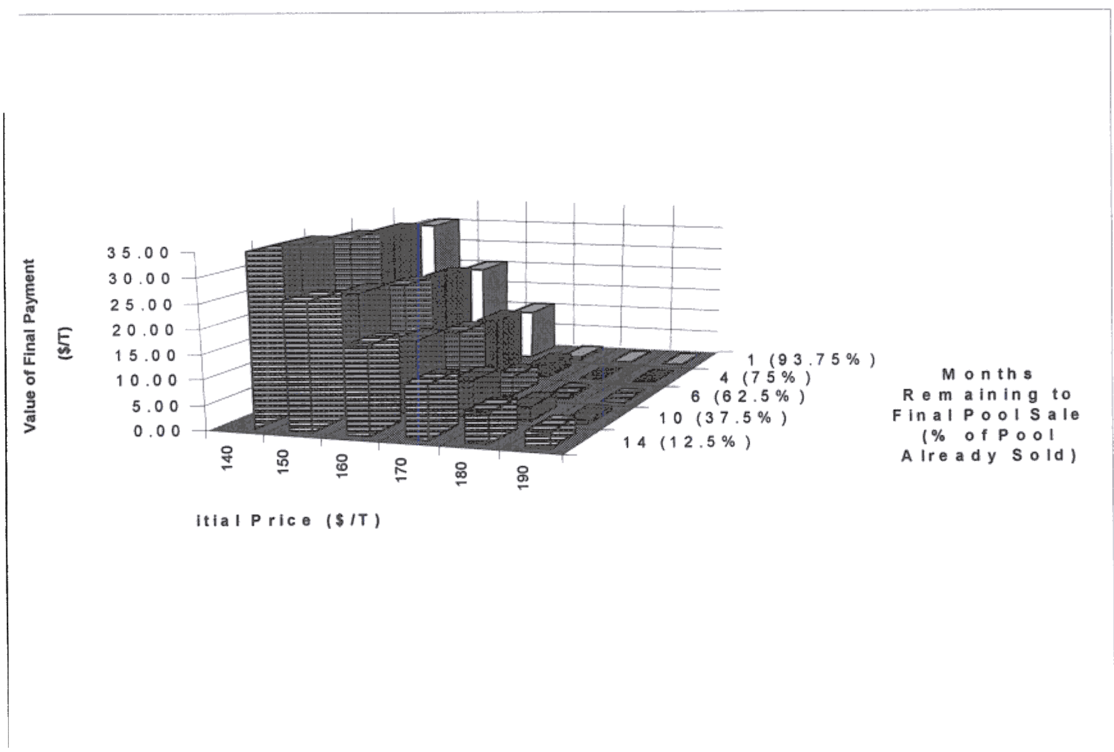
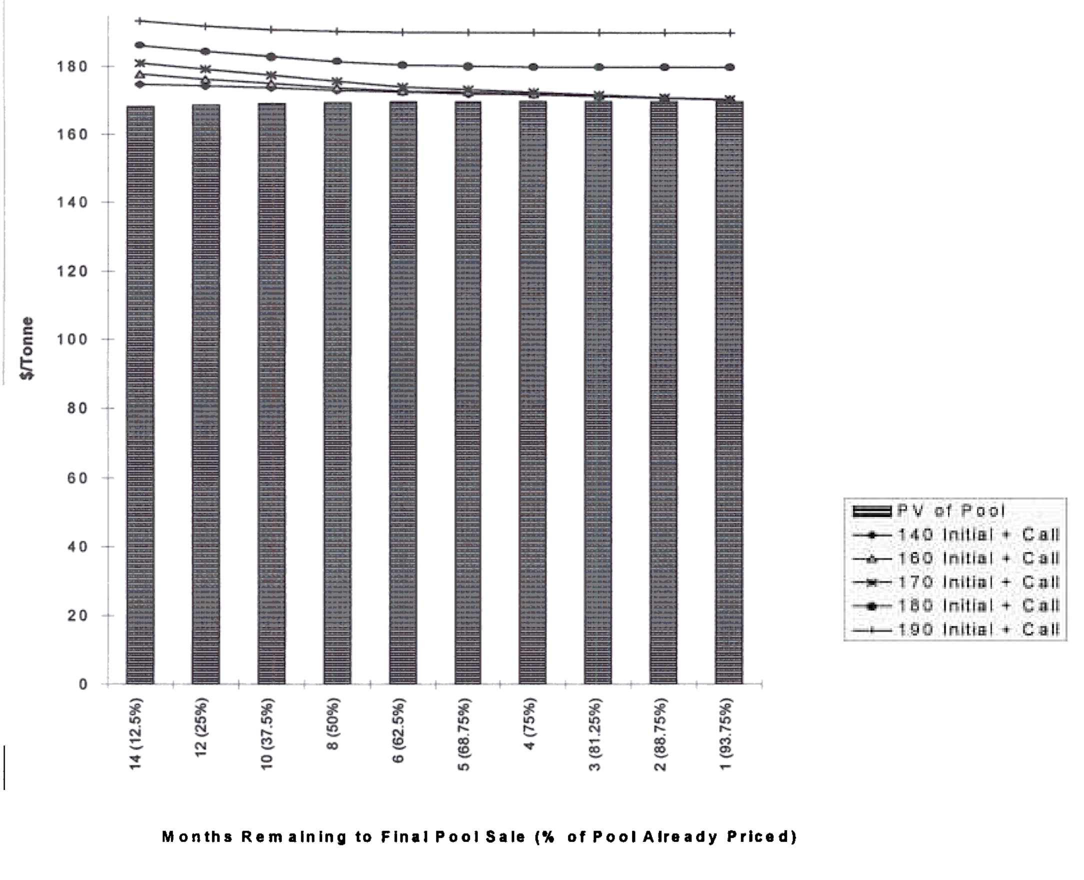


Figure 5: EPCO Financial Model Simulation: Comparing Initial Price Plus the Average Value Call Option (Expected Final Payment With Government Guarantee) to the Expected Present Value of the Pool.



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