Evaluation of Business Risk Management Strategies for Hog Production in Alberta (2008-2012)

Alberta Government

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Alberta Agriculture and Rural Development
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Executive summary

This paper assesses the magnitude of margin losses by Alberta hog producers in 2008-2012 that could have been reduced or avoided had they used certain business risk management strategies. Three price risk management strategies are analysed and compared to selling hogs in the cash market: routine hedging, selective hedging, and forward contracting. In addition, the Hog Price Insurance Program (HPIP) offered by Agriculture Financial Services Corporation (AFSC) is evaluated for the September 2012 hog contract settlement.

To simulate cash flows of a hog enterprise, a model of a typical (representative) hog farm in Alberta is developed. The model is designed to incorporate impacts of selected price risk management strategies on the bottom-line of a typical hog farm in Alberta.

Analysis conducted shows that routine hedging and forward contracts (with up to 75% or 100% of contract volume) produced the highest average mean margin per head given specific market conditions (i.e. mostly negative margins in cash market in 2008 to 2012). Essentially using any form of price risk management was better than selling hogs in a cash market in 2008-2012.

Participating in HPIP mitigates some price risk. Depending on the timing of purchasing HPIP coverage, and had the insured price been chosen at the 140 $/ckg level, the hog producers would have mitigated around $9-$14 of losses per head in September 2012. In general, producers would have mitigated around $0-$20 of losses per head at the different levels of insured prices.

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1. Background

The pork industry plays an important role in Alberta's agricultural industry and economy. Alberta has a positive net trade balance in pork as its exports exceed imports. In 2011, Alberta exported $417 million worth of pork, a 6.5% increase from 2010. Alberta imported slightly over $15 million in pork products in 2011. Alberta is estimated to have 11% of the nation's total pig herd and sow base, fourth largest in the country after Quebec, Ontario, and Manitoba. However, the number of pigs in the breeding herd has declined over the years, along with the number of producers. The 2011 Census of Agriculture reports the number of hog farms declined approximately 70% since 2001. A combination of farm consolidation, voluntary liquidation programs, and producers exiting the industry, contributed to this decline. The reasons some producers exited the industry are rising feed costs, depressed market prices, export barriers and appreciation of Canadian dollar among others (ARD, 2012).

From 2008-2012 hog margins in Alberta were positive only in the second half of 2010 and in 2011. By the summer of 2012 the situation in the hog cash market was once again very favorable until hog margins dropped substantially and reached $40 to $50 loss per marketed hog. Had hog producers used one or a combination of business risk management strategies, could these high margin losses have been reduced or avoided?

This paper looks specifically at hog price risk management as opposed to hog production and/or production input price risk management. Price risk management is a tool that helps improve profitability and, therefore, competitiveness of Alberta pork producers in domestic and international markets. Successful hog price risk management requires some knowledge of futures markets and how they work. This research assumes hog producers in Alberta are familiar with futures markets and price risk management strategies. The following questions are addressed in this paper:

- By how much will the use of price risk management strategies improve per head margins?
- Which price risk management strategies would have been the best for the market conditions experienced between 2008-2012?

Three price risk management strategies are analysed and discussed in this paper: routine hedging, selective hedging, and forward contracting. These strategies are compared to selling hogs on the cash market. In addition, the Hog Price Insurance Program (HPIP) offered by Agriculture Financial Services Corporation (AFSC) is evaluated for September 2012 hog contract settlement.

2. Hog farm model

To simulate cash flows of a hog enterprise, a model of a typical (representative) hog farm in Alberta is developed. The model is designed to incorporate impacts of various price risk management strategies on the bottom-line of a typical hog farm. A number of assumptions and guidelines are used as referred to below.

2.1 Hog numbers in production

The typical hog farm is assumed to operate in the Southern region of Alberta during 2008 to 2012. It is assumed to be a farrow to finish operation with 450 sows. Detailed hog farm characteristics and productivity assumptions are provided in appendices A and B. Based on the initial assumptions of numbers of piglets born alive per litter, litters per sow per year, and number of sows, the average number of piglets born alive per week is calculated. Pigs born during the same week are assumed to stay in the same pen throughout the production phases and eventually to be sold altogether, once reaching a determined sale weight. The final number of head sold in each pen depends on the variation in mortality rates of pigs at different stages of feeding, as well as piglets born alive per litter and number of litters/sow/year.

2.2 Revenue from selling hogs on a cash market

Weekly index 100 hog prices are obtained from the Statistics and Data Development Branch (SADD) of Alberta Agriculture and Rural Development (ARD). These prices are multiplied by a total dressed weight of a finished pen of hogs, and by an average price index of 1.1. Cash revenue is reported in $/head sold.

2.3 Cost of hog production

Cost of production per pig sold is provided in Appendix C. Ration cost per pig sold is calculated for every week of the period 2008 to 2012 based on the weekly prices for the ration components.

The remainder of the cost items are assumed constant from week to week, but change annually. Some of the cost items are assumed fixed throughout the period of production from 2008 to 2012 (see Appendix C).

2.4 Cash flows

Revenue minus total cost of production per pig sold constitutes a net cash flow or margin. Net cash flow is calculated for every week from 2008 to 2012 and adjusted for inflation with Consumer Price Index (CPI). This net cash flow is what a hog producer receives for the pigs sold on a cash market. All other scenarios with introduced hog price risk management strategies are compared to this net cash flow on a cash market.

2.5 Introducing production uncertainty

There are many productivity elements in hog production that are not known beforehand and, therefore, uncertain. Even though the average productivity coefficients are assumed in the model, in real life they will not be the same from year to year, and even month to month. In the model, three productivity elements are chosen to be uncertain:

- Piglets per litter born alive;
- Litters per sow per year;
- Pre-wean mortality of piglets.

Mortality at the post weaning stage is assumed to be constant (certain) to simplify analysis.

The triangular probability distribution for each of the uncertain productivity elements is chosen. Triangular probability distributions require specifying the minimum possible, most frequent and the maximum possible value of the uncertain productivity element. The most frequent number of piglets per litter born alive is 11, whereas the minimum of 11 and the maximum of 14.12 piglets are chosen. The minimum, most frequent and maximum number of litters per sow is set at 2.11, 2.42, and 2.56 respectively. Pre-wean mortality percentage minimum, most frequent, and maximum is 1.1%, 13.1% and 13.1%. These choices are based on the summary of Alberta Pork cost of production (COP) data 2011 (Ron Gietz, personal communication).

2.6 Monte Carlo simulation

Monte Carlo simulation using Excel add-in software @Risk© is used for the analysis. In a Monte Carlo simulation the software draws samples from specified distributions of the uncertain variables (in our case the variables discussed in the section above), and then recalculates the formulas of the model based on these draws. Monte Carlo simulation is based on random sampling and the results of the model are subject to sampling error. This error can be minimized by increasing the number of iterations. The number of iterations for the analysis is set at 5,000. It is the largest number of iterations that allows for high precision results without consuming too much computing power.

An output of the Monte Carlo simulation is a distribution of outcomes of all iterations for the real[1] net cash flow each week. An example of such a distribution of outcomes is provided in Figure 1. These results are reported in section 4.

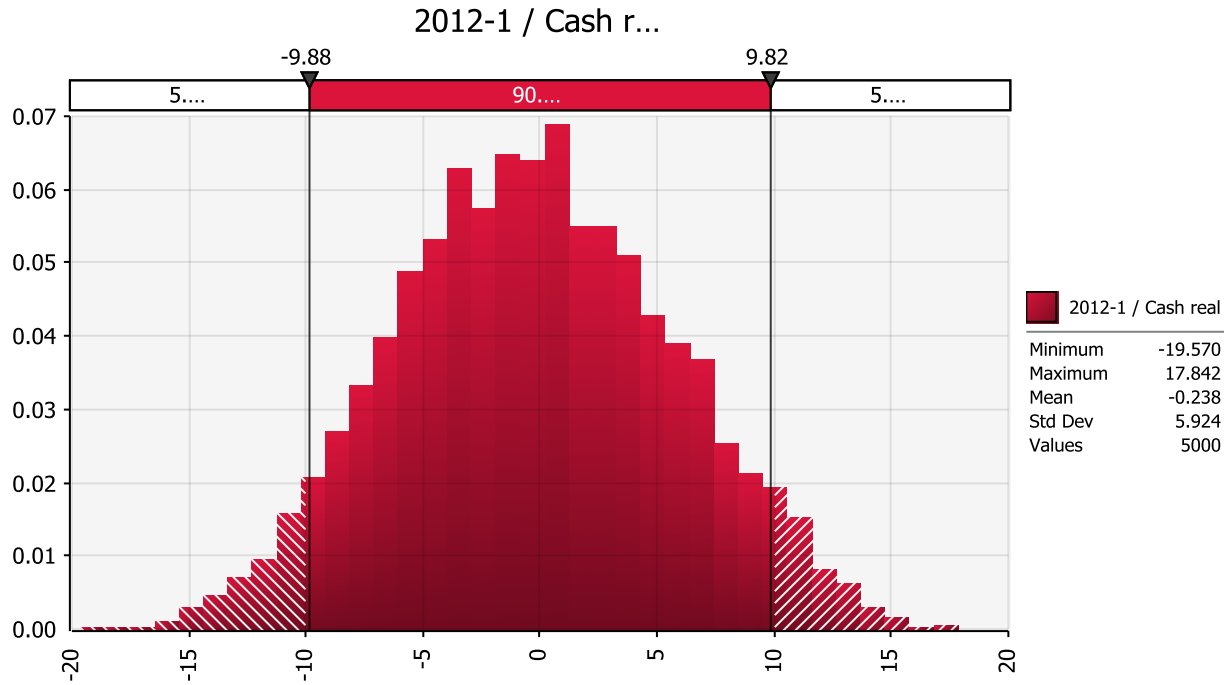

Figure 1. Net cash flow distribution in week 1 of 2012, $/pig sold

[1] Nominal values of net cash flows are adjusted for inflation using Consumer Price Index (CPI), in constant 2012 dollars.

3. Business risk management (BRM) strategies

3.1 Routine hedging

Hedging is performed using futures contracts. A futures contract is an agreement between a seller and a buyer to exchange a product or an asset of a specific quantity and quality at a specific date and location in the future for a pre-determined price. From a hog producer's point of view, hedging is essentially selling futures contracts to be able to offset decreasing prices on the cash market with the corresponding gains on the futures market. The gain or loss from trading a futures contract is the difference between the selling and buying price of the contract multiplied by the quantity of a product traded.

Routine hedging involves selling a Chicago Mercantile Exchange (CME) live hog futures contract each week when a pen of piglets is born. Routine hedging makes the sales price of hogs to be somewhat predetermined, while remaining exposed to basis risk[2] and exchange rate risk. It is assumed that the total quantity of the piglets in a pen corresponds to the quantity required for one CME live hog contract. This contract is held until a pen of pigs is sold, at which time the futures position will be offset. It is also assumed that no brokerage fees, initial margins, and margin calls[3] are paid by the hog producer. The formula used to calculate weekly net cash flows (margins) per head sold when using routine hedging is provided in Appendix D.2.

3.2 Selective hedging

Selective hedging is similar to routine hedging. The difference is that selective hedging involves hedging each pen of hogs, not when they are born, but at any point of production/feeding phase, and only if it is profitable to do so. When hedging selectively, a hog producer will not place a hedge if the futures market prices are not favorable, or if the futures prices are expected to increase. The decision to place a hedge is made when both of the following two conditions are met:

[2] Basis is a difference between a spot (cash) price and futures price of the contract at the time of futures contract closure. Basis risk is the chance that the basis will have strengthened (gained in value) or weakened (lost in value) from the time the hedge is implemented to the time the hedge is removed.

[3] An initial margin is usually required before a broker will agree to purchase or sell futures contracts for a hedger. They ensure there is enough money to cover potential losses of a broker in the futures market. Margin calls are requests to provide additional money when margin account falls below the minimum level.

1) Forecasted net cash flow (margin) offered by futures markets is equal or exceeds the target amount of a hog producer;
2) Declining 10-week moving average of hog futures prices is greater than the 4-week moving average of hog futures prices[4].

Once the hedge is placed, it is held until the pen of pigs is sold. The decision to hedge could be made any time from when the pen of pigs is farrowed until a four-week timeframe prior to the pen of pigs being sold. Hedging closer than four weeks before selling is usually not performed as it is less likely that a hedger can benefit from the difference between cash market and futures market prices. Formulas for weekly forecasted net cash flows (margins) per head sold when using selective hedging are provided in Appendix D.3. The target forecasted margin is set at 0, 5, and 10 $CAD/head sold. Therefore, three sets of results for selective hedging are presented in section 4.

3.3 Forward contracts

Forward contracts involve selling each pen of hogs at the time of farrowing for the forward price that week. Routing forward contracting is assumed to be performed for each pen of hogs, but for 50% of contract volume[5] according to Western Hog Exchange (WHE) rules. The remaining 50% of contract volume is sold at regular delivery contract prices (i.e. essentially cash prices). Unlike the case of hedging, forward contracts lock in basis at the time of farrowing. The buyer of hogs assumes basis risk, but receives a guaranteed supply of hogs. Forward contracts are signed directly with hog buyers. The formula used to calculate weekly net cash flows (margins) per head sold when using forward contracts is provided in Appendix D.4. The outcome of selling hogs using forward contracts for 100% of the volume is modelled for comparison purposes.

[4] This condition (of longer moving average of futures prices crossing shorter moving average) is often used on financial markets to forecast a peak of the markets and a forthcoming decline. This is the best time from the point of view of hog producers to place a hedge to be able to lock in a higher hog price using a futures contract.
[5] Western Hog Exchange (WHE) offers forward contract pricing for hog producers, who have a valid signed and up to date WHE Master Agreement and current OlyWest delivery contract. Up to 50% of the OlyWest delivery contract volume can be sold at forward prices.

4. Comparing BRMs and cash marketing

A summary of the outcomes of the simulated cash flows for a typical Alberta hog farm from 2008-2012 is presented in Table 1. Each row contains a separate price risk management strategy used.

Table 1. Outcomes of employing various price risk management strategies

Price risk management strategy	$/ head sold			
	Mean	Standard deviation	Minimum	Maximum
Cash marketing	-5.24	6.01	-24.12	12.21
Hedging (routine)	2.06	6.01	-16.81	19.52
Selective hedging ($0 target margin)	0.08	6.88	-19.76	20.96
Selective hedging ($5 target margin)	-0.16	6.78	-19.90	20.75
Selective hedging ($10 target margin)	-0.25	6.69	-20.38	18.97
Forward contracts (50%)	-0.47	5.60	-17.92	16.25
Forward contracts (75%)	1.43	5.58	-15.74	18.03
Forward contracts (100%)	3.54	5.61	-13.59	20.01

A modelled hog producer lost $5.24/head on average during 2008-2012 when selling hogs in the cash market. The producer's average minimum and maximum margins for the same time were $ -24.12/head and $12.21/head respectively. Standard deviation represents the level of variability of the average margin. Essentially this reflects riskiness of each option: the higher the standard deviation, the higher the risk.

Routine hedging produced the highest positive average margin of $2.06/head, reduced maximum loss and increased maximum gain relative to cash marketing. When hedging selectively, the average margin decreased when hedging decision was made by increasing the target margin from $0 to $10. This is a result of negative margins in the cash market for most of 2008-2012. Selective hedging exposed hog producers to prolonged periods of negative cash market margins when they set the target margin too high (e.g. $10/head). Selective hedging is still a better alternative to cash marketing, as it decreases loss. Under different circumstances, for example, when hog margins stay positive for a prolonged period of time, selective hedging may become superior to using routine hedging. However, according to the current market "mood", routine hedging provides better protection against margin losses.

Routinely applied forward contracts (for 50% of contract volume) produced an average margin of $ -0.47/head for the period 2008-2012, but had the lowest risk associated with it (standard deviation of $5.60). If 75% of contract volume was subject to forward pricing, as it is right now at WHE, then the average margin per head would be $1.43 for 2008-2012. However, the current version of WHE forward contracting program was launched in 2012. Therefore, this scenario is hypothetical in regard to WHE clients for 2008-20012. Routine forward contracts (hypothetically applied to 100% of contract volume) produced the highest positive average margin of $3.52/head, which is higher than for routine hedging. This strategy is less likely to be applied in real life, as hog producers have to commit to physical delivery of 100% of hogs at the time of contract closure. However, Maple Leaf offers this possibility of forward pricing up to 100% of contract volume to their clients.

The strategy of forward contracts protects hog producers from basis fluctuations by fixing the sales price. However, this works only when the sales price in the contract is higher than breakeven price of hogs at the time of sale. This requires precise forecasting of breakeven prices.

5. Hog Price Insurance Program (HPIP)

This section evaluates the merit of using the HPIP offered by Agriculture Financial Services Corporation. The analysis is conducted for the hogs that were sold in September 2012. The assumptions of the planned September 2012 sale are outlined in Table 2.

Table 2. Assumptions of the hog producer

Expected number of hogs to sell in September 2012	500 head
Expected sales (dressed) weight per hog	97 kg
Weight to insure (=500x97÷100)	485 ckg
Insured price	140 $/ckg
Settlement price for September 2012 (not known before September 2012)	122.72 $/ckg

A range of insured prices is available for each specific day of the week. For each specific day the premiums for the highest, the lowest and $140 price of this range are reported in the scenario tables for comparison purposes. For example, when the policy is purchased on November 1, 2011, the available insured price range is from $126 to $152 (see Scenario 1). Total net gain is calculated as total indemnity payment minus total premium payment.

Net gain/head is calculated as total net gain divided by the number of hogs (which is 500 in this case). Net gain/head, highlighted in yellow color, is the gain that would be incurred by hog producers if they insured their hogs at $140 insured price. Depending on the day and the month when the policy was purchased, this net gain/head would change. Net gain/head, highlighted in red color, is a loss. Net gain/head, highlighted in green color, is the highest possible gain for that specific scenario.

Scenario 1. Hog price insurance was purchased in November 2011 – 10 months in advance (the earliest possible insurance policy for September 2012 settlement)

Date	**Insured prices at a specific date $/ckg**		**Premium $/ckg**	**Total net gain $**	**Net gain/head $**
1-Nov-11 (Tu)	Lowest	126	4.50	-591.70	-1.18
		140	8.03	4486.25	8.97
	Highest	152	13.60	7604.80	15.21
8-Nov-11 (Tu)	Lowest	124	3.88	-1261.00	-2.52
		140	7.75	4622.05	9.24
	Highest	150	12.48	7178.00	14.36
15-Nov-11 (Tu)	Lowest	128	4.01	615.95	1.23
		140	6.83	5068.25	10.14
	Highest	154	12.86	8933.70	17.87
22-Nov-11 (Tu)	Lowest	130	3.57	1799.35	3.60
		140	5.77	5582.35	11.16
	Highest	156	12.29	10180.15	20.36
29-Nov-11 (Tu)	Lowest	128	2.99	1110.65	2.22
		140	5.49	5718.15	11.44
	Highest	154	11.19	9743.65	19.49

Note: The premiums are obtained from AFSC for each Tuesday of the week only.

Scenario 1 is chosen because November 2011 was the earliest possible time to insure hogs for the September 2012 sale. In general, the premiums are fairly high at this time, since the sale date is far in the future, and that means more uncertainty around future prices. The table (Scenario 1) shows that had the policy been purchased in November 2011 for the insured price of $140 to market the hogs in September 2012, the net gain per head would have been around $9 to $11. At the lowest possible coverage purchased (insured price of $124 or $126), the producers would lose their premium. This would translate to $1 to $3 loss per head. The highest possible net gain

would have been $20.36/head had the policy been purchased for the highest insured price of $156 available on November 22, 2011.

Scenario 2 is chosen because July 2012 was the latest possible time to insure hogs for the September 2012 sale. The premiums for the same levels of insured price are lower in this scenario compared to Scenario 1. In July 2012, the Alberta index 100 hog price was high and just started falling from its peak at the end of June 2012 (around $1.8 to $1.7/kg dressed). Generally, high cash prices observed in the market (coupled with strong prices in futures market) mean that the prices can be insured at relatively cheap premiums at that specific time.

Scenario 2. Hog price insurance was purchased in July 2012 – 2 months in advance (the latest possible insurance policy for September 2012 settlement)

Date	**Insured prices at a specific date $/ckg**		**Premium $/ckg**	**Net gain $**	**Net gain/head $**
3-Jul-12 (Tu)	Lowest	120	0.56	-271.60	-0.54
		140	3.29	6785.15	13.57
	Highest	146	5.46	8642.70	17.29
10-Jul-12 (Tu)	Lowest	124	0.53	363.75	0.73
		140	2.47	7182.85	14.37
	Highest	148	5.13	9772.75	19.55
17-Jul-12 (Tu)	Lowest	116	0.56	-271.60	-0.54
	Highest	138	4.96	5005.20	10.01
24-Jul-12 (Tu)	Lowest	120	0.50	-242.50	-0.49
	Highest	138	3.83	5553.25	11.11
31-Jul-12 (Tu)	Lowest	128	0.64	2250.40	4.50
	Highest	140	3.14	6857.90	13.72

Note: The premiums are obtained from AFSC for each Tuesday of the week only.

The table (Scenario 2) shows that had the policy been purchased in July for the insured price of $140 to market the hogs in September 2012, the net gain per head would have been around $13 to $14. At the lowest possible coverage purchased (insured price of $116 or $120), the producers would lose their premium. This would translate in $0.5 to $0.6 loss per head. The highest possible net gain would have been $19.55/head had the policy been purchased for the highest insured price of $148 available on July 10, 2012.

Scenario 3 is chosen because the lowest Alberta Index 100 hog prices of the January-July 2012 period were observed in April and May 2012. The premiums for the same levels of the insured prices are relatively lower in this scenario compared to Scenario 1, but relatively higher compared to Scenario 2. Generally, low cash prices observed in the market (coupled with weak prices in futures market) mean that the prices can be insured at relatively expensive premiums at that specific time.

The table (Scenario 3) shows that had the policy been purchased in April for the insured price of $140 to market the hogs in September 2012, the net gain per head would have been around $10 to $13. At the lowest possible coverage purchased (insured price of $118), the producers would lose their premium. This would translate in approximately $0.8 to $1.0 loss per head. The highest possible net gain would have been $20.05/head had the policy been purchased for the highest insured price of $150 available on April 10, 2012.

Scenario 3. Hog price insurance was purchased in April 2012 (low cash prices in 2012)

Date	**Insured prices at a specific date $/ckg**		**Premium $/ckg**	**Net gain $**	**Net gain/head $**
3-Apr-12 (Tu)	Lowest	118	0.98	-475.30	-0.95
		140	5.28	5820.00	11.64
	Highest	144	7.04	6906.40	13.81
10-Apr-12 (Tu)	Lowest	124	0.90	184.30	0.37
		140	3.00	6925.80	13.85
	Highest	150	6.61	10024.95	20.05
17-Apr-12 (Tu)	Lowest	118	0.92	-446.20	-0.89
		140	5.38	5771.50	11.54
	Highest	142	6.23	6329.25	12.66
24-Apr-12 (Tu)	Lowest	118	0.86	-417.10	-0.83
	Highest	140	6.63	5165.25	10.33

Note: The premiums are obtained from AFSC for each Tuesday of the week only.

6. Conclusions

Analysis of various price risk management strategies presented in this paper shows that routine hedging and forward contracts (with up to 75% or 100% of contract volume) produced the highest average mean margin per head given specific market conditions (i.e. mostly negative

margins in cash market in 2008 to 2012). Essentially using any form of price risk management was better than selling hogs in a cash market in 2008-2012.

Participating in HPIP mitigates some price risk. When the settlement price turns out to be higher than the insured price, the producers lose only their premium. Premium loss may not be a very big issue when the margins per head are positive. However, every cent counts when the margins are at the $-40 to $-50 per head as it was in September 2012. Depending on the timing of purchasing HPIP coverage, and had the insured price been chosen at the 140 $/ckg level, the hog producers would have mitigated around $9-$14 of losses per head in September 2012. In general, producers would have mitigated around $0-$20 of losses per head at the different levels of insured prices. Therefore, when the margins reach large negative values (as it was observed in September 2012), HPIP may provide only partial protection against price risk. Had the coverage been purchased for the lowest insured price of the available range, there would have been a chance to lose their premiums. The earlier the policy coverage is purchased the higher the premiums tend to be. It is advisable to purchase insurance coverage at the times when the observed cash market prices are relatively high. This requires close monitoring of the market on a weekly or even daily basis.

7. Acknowledgements

Ron Gietz and Chris Panter from Alberta Agriculture and Rural Development and Bill Mullen from Western Hog Exchange are gratefully acknowledged for providing advice and data for this study.

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APPENDIX A. Hog farm model assumptions and data sources

Table A.1 Productivity assumptions

Variable	Productivity
Piglets / litter (alive)	12.10*
Litters / sow / year	2.39*
Weaned piglets / year (alive)	26.30
Weaning age, days	21
Pre-weaning mortality, %	9*
Post-weaning mortality (nursery), %	2
Starter mortality, %	1
Grower mortality, %	1
Finisher mortality, %	1
% sows culled (incl. dead), %	50
*- These numbers are initial averages only. They are going to be different in the process of modeling (see section 2.5).	

Source: Alberta Pork summary of COP (2011),
Manitoba Agriculture, Food and Rural Initiatives (MAFRI) (2013)

Table A.2 Herd movement

Variable	Total / year	/week	/sow	/litter
Sows	450			
Litters	1076	20.68	2.39	
Pigs born alive	13014	250.26	28.92	12.10
Pigs died, pre-weaning (before 6 kg)	1171	22.52	2.60	1.09
Pigs weaned	11842	227.74	26.32	11.01
Pigs died, post-weaning (before 26 kg)	237	4.55	0.53	0.22
Nursery pigs transferred	11605	223.18	25.79	10.79
Starters died	116	2.23	0.26	0.11
Starters transferred	11489	220.95	25.53	10.68
Growers died	115	2.21	0.26	0.11
Growers transferred	11375	218.74	25.28	10.58
Finishers died	114	2.19	0.25	0.11
Finishers sold	11261	216.55	25.02	10.47

Source: Own calculations based on productivity assumptions

APPENDIX B. Feeding

Table B.1 Feed requirements for farrow-nursery feeding stage

Feeding stage	Feed Requirements
Nursing (lactating) sow, kg/day	6.8
Dry (gestation) sow, kg/day	2.5
Pre-starter ration 1, kg	0.5
Pre-starter ration 2, kg	2.1
Starter ration 1, kg	9.4
Starter ration 2, kg	19.3

Source: MAFRI (2013)

Table B.2 Indicators of productivity for weaner pigs

Variable	Pre-starter 1	Pre-starter 2	Starter 1	Starter 2
Days post-weaning (nursery)	3.0	7.0	18.0	22.0
Target starting weight, kg	6.0	6.5	8.3	15.0
Target ending weight, kg	6.5	8.3	15.0	26.0
Feed conversion ratio	1.00	1.20	1.40	1.75

Source: MAFRI (2013) and own calculations

Table B.3 Feed requirements for starter-finisher feeding stage

Feeding stage	Feed requirements
Starter, kg/pig	27.3
Grower, kg/pig	165
Finisher, kg/pig	84

Source: MAFRI (2013) and own calculations

Table B.4 Indicators of productivity for starter-finisher pigs

Variable	Starter	Grower	Finisher
Target starting weight, kg	26	40	95
Target ending weight, kg	40	95	119*
Feed conversion ratio	1.95	3.00	3.50
* Average dressed weight of a finished pig is assumed to be 97 kg (i.e. dressing percentage is 81%)			

Source: MAFRI (2013) and own calculations

Table B.5 Ration formulas

Feed	Gestation sow	Lactation sow	Pre-starter 1	Pre-starter 2	Starter 1	Starter 2	Starter	Grower	Finisher
	%								
Wheat		30.00	10.60	13.45	40.50	40.40	47.50	20.00	
Barley	87.70	46.40				6.50	21.50	59.70	83.40
Corn					24.90	25.00			
Soybean meal		19.70	12.00	13.00	20.00	22.70	17.50	7.50	
Canola meal	8.70							10.00	8.00
Peas							10.00		7.00
Sow micro premix	0.50	0.50	0.50	0.50	0.50	0.50			
Grower micro premix							0.30	0.30	0.30
Canola oil			2.70	1.90	1.10		1.00	0.80	
Whey powder			12.10	12.50	7.00				
Fish meal			6.10	7.50	4.00	2.50			
Plasma			5.90						
Limestone	1.60	1.65	1.25	1.25	0.70	1.10	1.20	1.00	0.80
Dical (16% Ca-21% P)	1.10	1.10	1.00	1.00	0.80	0.80	0.50	0.20	0.10
Salt - 96%	0.35	0.50	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Phytase	0.05	0.05			0.05	0.05	0.05	0.05	0.05
L-Lysine HCL		0.10	0.05	0.05	0.10	0.10	0.10	0.10	
L-Threonine		0							
D L-Methionine		0							
Oats - groats		0	47.45	48.50					

Source: MAFRI (2013)

Table B.5 Sample calculation of the cost of feed by rations for a pig sold in week 1 of 2008

Lactation sow		21	days average weaning age
	x	2.39	litters/sow/year
	=	50.19	days lactation
	x	6.8	kg ration/day
	x	$270	/tonne lactation sow ration
	÷	1000	kg/tonne
	÷	25.04	pigs sold/sow/year
	=	**$3.68**	**/pig sold in 2008 week 1**
Gestation sow		365	days/year
	-	50.19	days lactation
	=	314.81	days gestation
	x	2.5	kg ration/day
	x	$233.57	/tonne gestation sow ration
	÷	1000	kg/tonne
	÷	25.04	pigs sold/sow/year
	=	**7.34**	**/pig sold in 2008 week 1**
Pre-starter 1		6.5	kg target sale weight
	-	6	kg target weaning weight
	=	0.5	kg weight gain
	x	1.00	feed conversion ratio
	=	0.5	kg ration/pig
	x	$743.38	/tonne pre-starter 1 ration
	÷	1000	kg/tonne
	x	28.92	pigs born alive/sow/year
	÷	25.04	pigs sold/sow/year
	=	**0.43**	**/pig sold in 2008 week 1**
Pre-starter 2		8.25	kg target sale weight
	-	6.5	kg target weaning weight
	=	1.75	kg weight gain
	x	1.20	feed conversion ratio
	=	2.1	kg ration/pig
	x	$427.37	/tonne pre-starter 2 ration
	÷	1000	kg/tonne
	x	25.79	weaners transferred/sow/year
	÷	25.04	pigs sold/sow/year
	=	**0.92**	**/pig sold in 2008 week 1**

Table B.5 (continued)

Starter 1		15	kg target sale weight
	-	8.3	kg target weaning weight
	=	6.7	kg weight gain
	x	1.40	feed conversion ratio
	=	9.4	kg ration/pig
	x	$371.26	/tonne starter 1 ration
	÷	1000	kg/tonne
	x	25.79	weaners transferred/sow/year
	÷	25.60	pigs sold/sow/year
	=	**3.52**	**/pig sold in 2008 week 1**
Starter 2		26	kg target sale weight
	-	15	kg target weaning weight
	=	11	kg weight gain
	x	1.75	feed conversion ratio
	=	19.25	kg ration/pig
	x	$294.74	/tonne starter 2 ration
	÷	1000	kg/tonne
	x	25.79	weaners transferred/sow/year
	÷	21.03	pigs sold/sow/year
	=	**6.96**	**/pig sold in 2008 week 1**
Starter		14	kg weight gain/pig
	x	1.95	feed conversion ratio
	=	27.3	kg ration/pig
	x	$266.12	/tonne starter ration
	÷	1000	kg/tonne
	x	25.53	starters transferred/sow/year
	÷	23.69	pigs sold/sow/year
	=	**7.83**	**/pig sold in 2008 week 1**
Grower		55	kg weight gain/pig
	x	3.00	feed conversion ratio
	=	165	kg ration/pig
	x	$247.26	/tonne grower ration
	÷	1000	kg/tonne
	x	25.28	grower transferred/sow/year
	÷	23.69	pigs sold/sow/year
	=	**43.54**	**/pig sold in 2008 week 1**

Table B.5 (continued)

Finisher		24	kg weight gain/pig
	x	3.50	feed conversion ratio
	=	84	kg ration/pig
	x	$219.25	/tonne ration
	÷	1000	kg/tonne
	=	**$18.42**	**/pig sold in 2008 week 1**

Source: MAFRI (2013) and own calculations

APPENDIX C. Cost of production

Table C.1 Cost of pig production by year

Cost items, $/pig sold	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Feed	97.46	113.24	106.29	96.90	95.09	104.36
Depreciation, investment, taxes	18.00	18.00	18.00	18.00	18.00	18.00
Veterinary and medicine	2.28	2.47	2.78	2.76	3.23	3.19
Utilities (hydro, propane, electricity)	4.89	5.42	4.57	3.87	5.20	6.59
Repair and maintenance	1.11	1.18	1.20	1.23	1.27	1.30
Insurance	2.36	2.36	2.36	2.36	2.36	2.36
Breeding costs (A.I.)	1.40	1.51	1.70	1.69	1.98	1.96
Custom charges (manure, dead pig disposal)	2.57	2.74	2.77	2.84	2.94	3.01
Office and business costs	0.76	0.78	0.78	0.80	0.82	0.83
Freight and transportation	3.35	3.35	3.35	3.35	3.35	3.35
Herd replacement (cull 50% sows/year)	3.67	3.67	3.67	3.67	3.67	3.67
Straw and bedding	0.06	0.06	0.06	0.06	0.06	0.06
Tractor and equipment operation (fuel)	0.22	0.28	0.18	0.21	0.27	0.28
Labor	14.07	14.98	15.13	15.53	16.07	16.45
Total cost of production	**152.19**	**170.05**	**162.84**	**153.26**	**154.31**	**165.42**

Note: Cost of production is calculated for 2011 based on summary of Alberta Pork COP data 2011 (Ron Gietz, personal communication). The cost items of other years (except feed costs) are indexed from 2011 using Farm Input Price Index (FIPI) or assumed fixed for the period 2007 to 2012. Feed costs are calculated weekly. Prices of ration components are obtained from a database of Statistics and Data Development Branch (SADD), ARD.

Sources: MAFRI (2013), Alberta Pork COP (2011), SADD

APPENDIX D. Formulas of net cash flows (margins) per head sold using price risk management tools

Formula D.1 Cash marketing

$$CMargin_{t+j} = \left(97 \times P_{t+j} \times 1.1\right) - TC_{t+j}$$

CMargin - weekly margin per head sold when selling on the cash market;

97 - dressed weight of finished hog in kilograms;

P - hog index 100 price at week *t+j* (finish) in $CAD/kg dressed;

1.1 - hog price index;

TC - total cost of hog production per head at week *t+j* (finish);

t - week of farrowing;

j - is equal to 26 weeks or 175 days (from the time hogs are born until they are marketed).

Formula D.2 Routine hedging

$$HMargin_{t+j} = CMargin_{t+j} + \left(\frac{HF_{t,t+j} - HF_{t+j}}{100 \times \$CAD_{t+j}}\right) \times 0.925 \times 2.204 \times 119$$

HMargin - weekly margin per head sold when using routine hedging;

CMargin - weekly margin per head sold when selling on the cash market;

$HF_{t,t+j}$ - futures price at week t (farrowing) of hog futures contract expiring closest but not prior to week *t+j* (finish) in $US cents per pound liveweight;

HF_{t+j} - futures price at week *t+j* (finish) in $US cents per pound liveweight;

$CAD - spot exchange rate ($US dollars to buy one $CAD);

0.925 - conversion of US liveweight to Canadian dressed weight ($0.925 = \frac{0.74}{0.80}$ where 0.74 is a dressing percentage in the US and 0.80 is a dressing percentage in Canada);

2.204 - conversion from pounds to kilograms;

119 - liveweight of finishied hog in kilograms.

Formula D.3 Selective hedging

$$SHMargin_{t:t+(j-k),t+j} = \left(PHP_{t:t+(j-k),t+j} \times 97 \times 1.1\right) - PTC_{t,t+j}$$

SHMargin - weekly forecasted margin per head sold when using selective hedging. This is forecasted to be the margin at week *t+j* (finish), and calculated every week starting from week *t* (farrow) till week *t+(j-k)* (*k*=4 weeks prior to finish);

PHP - predicted hog price at week *t+j* (finish) in $CAD/kg dressed. This is calculated every week starting from week *t* (farrow) till week *t+(j-k)* (*k*=4 weeks prior to finish); the formula provided below;

97 - dressed weight of finished hog in kilograms;

1.1 - hog price index;

PTC - predicted (at week *t* (farrow)) total cost per head at week *t+j* (finish). In this report for the sake of simplification this predicted total cost is equal to the actual total cost (*TC*) per head at week *t+j* (finish).

$$PHP_{t:t+(j-k),t+j} = \left(\frac{0.952 \times 2.204 \times HF_{t:t+(j-k),t+j}}{100 \times PX_{t:t+(j-k),t+j}}\right) - PB_{t,t+j}$$

PHP - predicted hog price at week *t+j* (finish) in $CAD/kg dressed. This is calculated every week starting from week *t* (farrow) till week *t+(j-k)* (*k*=4 weeks prior to finish);

0.925 - conversion of US liveweight to Canadian dressed weight ($0.925 = \frac{0.74}{0.80}$ where 0.74 is a dressing percentage in the US and 0.80 is a dressing percentage in Canada);

2.204 - conversion from pounds to kilograms;

HF - futures price during production/feeding period for hog futures contract expiring closest but not prior to week *t+j* (finish) in $US cents per pound liveweight. This is tracked every week starting from week *t* (farrow) till week *t+(j-k)* (*k*=4 weeks prior to finish);

PX - forecast during production period of exchange rate at week *t+j* (finish) in $US dollars to buy one $CAD. The forecasted exchange rate is assumed to be a spot exchange rate at week t (farrow);

PB - forecast of hog basis in $CAD/kg dressed at week *t+j* (finish). This is calculated as a 5-year average of hog basis at week *t+j* (finish).

Formula D.4 Forward contracts

$$FMargin100_{t+j} = 97 \times FP_{t,t+j} - TC_{t+j}$$

$$FMargin50_{t+j} = 97 \times \frac{1}{2}(P \times 1.1 + FP_{t,t+j}) - TC_{t+j}$$

FMargin - weekly margin per head sold when using forward contracts (assuming 100% or 50% of contract volume is sold on a forward contract basis);

97 - dressed weight of finished hog in kilograms;

FP - forecasted (at week *t* (farrow)) hog price at week *t+j* (finish) in $CAD/kg dressed; the formula provided below;

TC - total cost of hog production per head at week *t+j* (finish);

P - hog index 100 price at week *t+j* (finish) in $CAD/kg dressed;

1.1 - hog price index.

$$FP_{t,t+j} = \left(\frac{HF_{t,t+j}}{100 \times X_{t,t+j}}\right) \times 2.204 \times 0.925 \times 1.1 + PB_{t,t+j} - 0.02 - 0.003$$

FP - forecasted (at week *t* (farrow)) hog price at week *t+j* (finish) in $CAD/kg dressed;

HF - futures price at week t (farrowing) of hog futures contract expiring closest but not prior to week *t+j* (finish) in $U.S. cents per pound liveweight;

X spot exchange rate at time of forecast in $US dollars to buy one $CAD;

2.204 - conversion from pounds to kilograms;

0.925 - conversion of US liveweight to Canadian dressed weight ($0.925 = \frac{0.74}{0.80}$ where 0.74 is a dressing percentage in the US and 0.80 is a dressing percentage in Canada);

1.1 - hog price index;

PB - forecast of hog basis in $CAD/kg dressed at week *t+j* (finish). This is calculated as a 5-year average of hog basis at week *t+j* (finish);

0.02 - assumed risk factor fee in $CAD/kg dressed (charged by Western Hog Exchange);

0.003 - assumed administration fee in $CAD/kg dressed (charged by Western Hog Exchange).