AGBE 321

Problem Set 6—Solutions

1. In your own words (i.e., in a manner that you would explain it to someone who has not taken this course) explain how local price risk can be hedged using futures markets?

   Farmers typically are not interested in speculating on price changes in the futures market. They are more concerned with reducing/removing uncertainty in prices that occur in the local market, where they sell their commodities. They can use the fact that local and futures prices move in the same direction to hedge any adverse price movements in the local market. That is, if they lose money in the local market, they offset this loss by gaining money in the futures market.

2. Suppose that you are a Montana farmer growing winter wheat. You intend to sell the wheat to local elevators after it's harvested, but you don't know the price you will be quoted by the elevator at the time of sale (many things can change in the span of several months). It costs you \$6.00/bu to produce the wheat and you are only interested in earning a profit on your product (that is, you're not interested in using the futures market to speculate on prices). Respond to the following:

   (a) What position would you take in the futures market to offset local price variability risk? Why?

   You are naturally long in the local market, because if local prices go up, you win. Therefore, you need to take a short position in the futures market to offset price drops.

   (b) What is the lowest futures contract price you would need to observe in order to guarantee a per bushel profit?

   Because your costs are \$6.00/bu to produce the wheat, you need futures prices to be at least \$6.01/bu to lock in a profit.

   (c) Suppose that in May you take a position on a July futures contract that is priced at \$7.50/bu. Explain what you would do in July just before the contract expires.

   In order to offset your obligations in the futures market, you must take an opposite position on a July contract in July. Therefore, you will have to go long on July futures contract in July. Then, you will be able to sell the wheat to local elevators.

(d) Assume that futures and local prices converge (are exactly the same in July). Given that you took a May-July futures contract priced at \$7.50, calculate your per bushel profits *in the local* and *in the futures* markets if the price in July was one of the following (construct a table to summarize your results):

i. \$5.50/bu
ii. \$6.75/bu
iii. \$7.50/bu
iv. \$9.25/bu

Price in July	\$5.50/bu	\$6.75/bu	\$7.50/bu	\$9.25/bu
Local Equity $(P - Cost)$	(\$5.50 - \$6.00) –\$0.50	(\$6.75 - \$6.00) \$0.75	(\$7.50 - \$6.00) \$1.50	(\$9.25 - \$6.00) \$3.25
Short Futures Position $(F_{July}^{May} - F_{July}^{July})$	(\$7.50 - \$5.50) \$2.00	(\$7.50 - \$6.75) \$0.75	(\$7.50 - \$7.50) \$0	(\$7.50 - \$9.25) –\$1.75
Total per Unit	\$1.50	\$1.50	\$1.50	\$1.50

3. Consider the scenario in problem (2). In addition to the given information, you know that you operate a 2,500 acre farm that, on average, yields 45 bushels per acre. However, there is also yield risk, and you know that you typically observe production on 2,200 of the 2,500 acres. You are risk averse and wish to hedge as much risk as possible. Additionally, you wish to sell your wheat in August, rather than July. Respond to the following:

(a) How much wheat (in bushels) do you expect to produce?
2,200 acres × 45 bu/acre = 99,000 bushels

(b) How much wheat can you hedge using futures markets? Is there any wheat that will not be hedged?
You can only hedge 95,000 bushels because futures contracts are in 5,000 bushel increments. Therefore, 4,000 bushels will be unhedged.

(c) How many futures contracts will you need to establish?
To hedge 95,000 bushels, you will need $(95,000/5,000) = 19$ *contracts.*

(d) What position would you take in the futures market to offset local price variability risk? Why?
You are naturally long in the local market, because if prices go up, then you benefit. Therefore, you'd take a short position in the futures market to hedge adverse cash price movements.

(e) Given that you want to sell the wheat in a local market in August, which futures contract month will you choose? Why?

You would choose the nearby contract that has not yet expired. Therefore, you would choose the September futures contract.

(f) Explain what you would do just before the contract expires in order to offset your futures contract obligations.

To offset your obligations, you would take a long position on a September futures contract. Then, sell your wheat in the local market.

(g) Assume that you have enough liquid assets to cover any margin calls. Given that you took a May-September futures contract priced at \$7.50, calculate your per bushel profits *in the local* and *in the futures* markets if the price in August was one of the following *and* construct a table to summarize your *total* returns in the local market, the futures market, and overall:

i. Local: \$5.50/bu; Futures: \$6.25/bu
ii. Local: \$6.75/bu; Futures: \$7.20/bu
iii. Local: \$9.15/bu; Futures: \$9.50/bu
iv. Local: \$9.75/bu; Futures: \$10.25/bu

Prices in Sept.	L: \$5.50/bu F: \$6.25/bu	L: \$6.75/bu F: \$7.20/bu	L: \$9.15/bu F: \$9.50/bu	L: \$9.75/bu F: \$10.25/bu
Local Equity $(P - Cost)$	(\$5.50 - \$6.00) –\$0.50	(\$6.75 - \$6.00) \$0.75	(\$9.15 - \$6.00) \$3.15	(\$9.75 - \$6.00) \$3.75
Short Futures Position $(F_{Sept}^{May} - F_{Sept}^{Sept})$	(\$7.50 - \$6.25) \$1.25	(\$7.50 - \$7.20) \$0.30	(\$7.50 - \$9.50) –\$2.00	(\$7.50 - \$10.25) –\$2.75
Total Local:[a] Total Futures:[b]	–\$49,500 \$118,750	\$74,250 \$28,500	\$311,850 –\$190,000	\$371,250 –\$261,250
Total:	\$69,250	\$102,750	\$121,850	\$110,000

[a] Local revenues are calculated as the product of the price per bushel received in the local market and 99,000 bushels sold in the local market.
[b] Futures revenues are calculated as the product of the price per bushel from the futures contract and 95,000 bushels that were contracted.

4. You are a feedlot operator that purchases feeder cattle. You will purchase 2,000 head of feeders in August, and each feeder is on average 700 lbs. You will raise these cattle to a weight of 1,200 lbs. and the variable feed costs are \$0.70 per pound of weight gain. Feed acquisition has been forward contracted and, therefore, feed price will not change. It will take four months to raise the cattle to weight and you will sell them in December. Assume that all of the cattle will be raised to weight.

   You wish to hedge both the input (feeder cattle) price and the output (fed cattle) price. The current feeder cattle futures contract is trading at \$1.45/lb. and the fed cattle futures contract is trading at \$1.30/lb. You will purchase feeder cattle at a stockyard for the established price and you will sell the fed cattle to a local processing plant at the going local market price. Respond to the following:

   (a) What are the contract specifications for feeder and for fed cattle? That is, how many pounds are contracted using a futures contract?

   Feeder cattle contracts are 50,000 lbs. per contract. Fed (live) cattle contracts are 40,000 lbs. per contract.

   (b) How many pounds of fed cattle do you expect to produce with the acquired feeder cattle? What is the expected net revenue (profit) if current conditions do not change?

   You expect to produce $2,000 \times 1,200 = 2.4$ *million lbs.. The production will gross you* $2.4 \times \$1.30 = \$3.12$ *million. Your cost of acquiring feeders is* $2,000$ head $\times$ 700 lbs./head $\times$ \$1.45/lb. $= \$2.03$ *million. Lastly, your cost of feed is* $2,000$ head $\times$ 500 lbs. gain/head $\times$ \$0.70/lb. $= \$700,000$.

   Therefore, your profit is: $3.12 - (2.03 + 0.56) = \$0.70$ million $= \$390,000$.

   (c) How much (in pounds) of the feeder cattle can you hedge? How many contracts will be required?

   You will purchase 1.4 million pounds of feeders. Therefore, you can contract all of the feeders. You will need 28 futures contracts.

   (d) How much (in pounds) of the fed cattle can you hedge? How many contracts will be required?

   You will sell 2.4 million pounds of fed cattle. Therefore, you can contract all of the fed cattle. You will need 60 futures contracts.

   (e) What positions would you take in the futures market to offset local price variability risk for feeder cattle and for fed cattle? Why?

   In the feeder cattle market, you are naturally short, because if prices go up, you are adversely affected (have to pay more to acquire feeders). Therefore, you'd take a long position in the futures market for feeder cattle to hedge adverse cash price movements.

   In the fed cattle market, you are naturally long, because if prices go up, you benefit (receive more money to sell feeders). Therefore, you'd take a short position in the futures market for fed cattle to hedge adverse cash price movements.

(f) Explain what you would do in just before the contracts expire in order to offset your futures contract obligations.

You would offset your long feeders contracts by going short. You would offset your short fed cattle contracts by going long.

(g) Calculate your net profits *in the local* and equity *in the futures* markets for the following price scenarios:

i. Local feeders: \$1.00/lb; Futures feeders: \$1.05/lb Local fed: \$0.95/lb; Futures fed: \$0.90/lb.

ii. Local feeders: \$1.15/lb; Futures feeders: \$1.20/lb Local fed: \$1.10/lb; Futures fed: \$1.05/lb.

iii. Local feeders: \$1.45/lb; Futures feeders: \$1.55/lb Local fed: \$1.30/lb; Futures fed: \$1.30/lb.

iv. Local feeders: \$1.55/lb; Futures feeders: \$1.60/lb Local fed: \$1.40/lb; Futures fed: \$1.25/lb.

See table below on next page.

5. In your own words (i.e., in a manner that you would explain it to someone who has not taken this course) explain the intuition behind basis. Why does a basis occur? (Provide some specific factors in answering the latter question.)

Basis occurs because there are differences (mostly geographical/distance related) between the futures market and local markets. We typically think of basis as the transaction costs that are required to transfer a commodity from a local market to the location of the futures market.

	L fdrs: $1.00/lb L fd: $0.95/lb F fdrs: $1.05/lb F fd: $0.90/lb	L fdrs: $1.15/lb L fd: $1.10/lb F fdrs: $1.20/lb F fd: $1.05/lb	L fdrs: $1.45/lb L fd: $1.30/lb F fdrs: $1.55/lb F fd: $1.30/lb	L fdrs: $1.55/lb L fd: $1.40/lb F fdrs: $1.60/lb F fd: $1.25/lb
Costs				
Local Feeder Costs	($1.00× 2,000× 700)	($1.15× 2,000× 700)	($1.45× 2,000× 700)	($1.55× 2,000× 700)
Futures Feeder Costs	($1.45 - $1.05)× 28 × 50,000	($1.45 - $1.20)× 28 × 50,000	($1.45 - $1.55)× 28 × 50,000	($1.45 - $1.60)× 28 × 50,000
Feed Costs	$0.70 × 500 × 2,000	$0.70 × 500 × 2,000	$0.70 × 500 × 2,000	$0.70 × 500 × 2,000
Total Costs	$2.66 mil.	$2.66 mil.	$2.59 mil.	$2.66 mil.
Revenues				
Local Fed Revenues	($0.95× 2,000× 1,200)	($1.10× 2,000× 1,200)	($1.30× 2,000× 1,200)	($1.40× 2,000× 1,200)
Futures Fed Revenues	($1.30 - $0.90)× 60 × 40,000	($1.30 - $1.05)× 60 × 40,000	($1.30 - $1.30)× 60 × 40,000	($1.30 - $1.25)× 60 × 40,000
Total Revenues	$3.24 mil.	$3.24 mil.	$3.12 mil.	$3.48 mil.
Profits:	$0.58 mil.	$0.58 mil.	$0.53 mil.	$0.82 mil.

6. Using the table below, calculate the basis for the first week of April in the Great Falls, MT region for ordinary winter hard red wheat (HRW). Then, using these calculations, predict the local prices in the Great Falls region in 2015, 2016, and 2017 based on the known April futures contract prices.

Market	Month	Year	July KCBT Contract	Local HRW $	Basis
Great Falls	April	2003	3.11	2.90	–$0.21
Great Falls	April	2004	2.83	2.96	$0.13
Great Falls	April	2005	4.12	4.06	–$0.06
Great Falls	April	2006	4.09	3.74	–$0.35
Great Falls	April	2007	3.39	3.11	–$0.28
Great Falls	April	2008	3.63	3.05	–$0.58
Great Falls	April	2009	5.24	4.67	–$0.57
Great Falls	April	2010	9.18	8.95	–$0.23
Great Falls	April	2011	5.18	4.01	–$1.17
Great Falls	April	2012	5.65	4.20	–$1.45
Great Falls	April	2013	7.30	4.95	–$2.35
Great Falls	April	2014	7.14	5.65	–$1.49
Great Falls	April	2015	7.28	5.52*	
Great Falls	April	2016	7.89	6.13*	
Great Falls	April	2017	6.19	4.43*	

[a] Calculated using the average basis from the most recent three years, 2012 – 2014.

You are a Montana winter wheat farmer who will seek to sell the wheat in September 2015 at the local cash price. You know that the historical September basis for your region is –\$0.30/bu. In April, the July 2015 futures contract price is \$7.55/bu. Your total production costs are \$5.25/bu.

Complete the following:

7. Calculate the price at which you expect to sell in your local market.

   You can use the following relationship to solve for the expected local price: $E[Cash] = Futures + E[Basis]$. *Therefore,* $E[Cash] = \$7.55 - \$0.30 = \$7.25/bu$.

8. Suppose that you don't hedge. That is, you fully take on price risk. Assuming that the historical basis holds, calculate your profits if the price of a September, 2015 futures contract at expiration when prices are:

   (a) \$4.25

   (b) \$8.75

   (c) \$10.50

Prices in Sept	\$4.25/bu	\$8.75/bu	\$10.50/bu
Local Equity $[(F + B) - Cost]$	[(\$4.25 - \$0.30) - \$5.25]	[(\$8.75 - \$0.30) - \$5.25]	[(\$10.50 - \$0.30) - \$5.25]
Total per bushel	–\$1.30	\$3.20	\$4.95

9. Now, suppose that you do hedge, and therefore exchange price risk for basis risk. That is, you establish a futures hedge in April using the July 2015 contract. In September 2014, calculate your local market profit, futures equity, and total profit under the following scenarios (there are 9 total scenarios – 3 basis scenarios associated with a particular futures price):

(a) Futures: \$4.25; Actual basis: -\$0.15, -\$0.25, -\$0.30

Actual basis	-\$0.15/bu	-\$0.25/bu	-\$0.30/bu
Local Equity $[(F+B)-Cost]$	[(\$4.25 – \$0.15) – \$5.25] –\$1.15	[(\$4.25 – \$0.25) – \$5.25] –\$1.25	[(\$4.25 – \$0.30) – \$5.25] –\$1.30
Short Futures Position	(\$7.55 - \$4.25) \$3.30	(\$7.55 - \$4.25) \$3.30	(\$7.55 - \$4.25) \$3.30
Total per bushel	\$2.15	\$2.05	\$2.00

(b) Futures: \$8.75; Actual basis: -\$0.18, -\$0.22, -\$0.28

Actual basis	-\$0.18/bu	-\$0.22/bu	-\$0.28/bu
Local Equity $[(F+B)-Cost]$	[(\$8.75 – \$0.18) – \$5.25] \$3.32	[(\$8.75 – \$0.22) – \$5.25] \$3.28	[(\$8.75 – \$0.28) – \$5.25] \$3.22
Short Futures Position	(\$7.55 - \$8.75) –\$1.20	(\$7.55 - \$8.75) –\$1.20	(\$7.55 - \$8.75) –\$1.20
Total per bushel	\$2.12	\$2.08	\$2.02

(c) Futures: \$10.50; Actual basis: -\$0.20, -\$0.30, -\$0.40

Actual basis	-\$0.20/bu	-\$0.30/bu	-\$0.40/bu
Local Equity $[(F+B)-Cost]$	[(\$10.50 – \$0.20) – \$5.25] \$5.05	[(\$10.50 – \$0.30) – \$5.25] \$4.95	[(\$10.50 – \$0.40) – \$5.25] \$4.85
Short Futures Position	(\$7.55 - \$10.50) –\$2.95	(\$7.55 - \$10.50) –\$2.95	(\$7.55 - \$10.50) –\$2.95
Total per bushel	\$2.10	\$2.00	\$1.90

10. Is basis risk *less* or *more* risky than price risk?

    Basis risk is always less risky than pure price risk, because basis risk occurs after you have hedged most of the price risk away by taking opposite positions in the local and futures markets. Any variation in basis that occurs is substantially smaller than variation in prices.

11. Determine your expected profit in May. That is, the profit that you would expect to obtain (given the current market information) after you sell the fed cattle to processing plant, purchase feeder cattle and feed to replenish the feedlot, and pay for the labor.

    First, a three-year average historical basis must be calculated in order to determine and expected price for May.

	Corn	Feeder Cattle	Fed Cattle
2012 Basis	$-\$0.10/bu$	$\$0.10/lb$	$-\$0.05/lb$
2013 Basis	$\$0.55/bu$	$\$0.05/lb$	$-\$0.15/lb$
2014 Basis	$\$0.25/bu$	$\$0.05/lb$	$-\$0.15/lb$
Three year avg:	$\$0.23/bu$	$\$0.07/lb$	$-\$0.12/lb$
$\mathrm{E}[P]$	$(4.75+0.23)/bu$ \$4.98/bu	$(1.60+0.07)/lb$ \$1.67/lb	(1.22 + (-0.12))/lb \$1.10/lb

Then the expected profit may be determined:

$$\begin{aligned}
\mathrm{E}[R] &= 200 \cdot 1200 \cancel{lbs} \left(\frac{\$1.60}{\cancel{lb}} \right) \\
&= \$384,000
\end{aligned}$$

$$\begin{aligned}
\mathrm{E}[C]_{\text{feeders}} &= 200 \cdot 750 \cdot \$1.67 = \$250,500 \\
\mathrm{E}[C]_{\text{corn}} &= (2750 \cdot 200)/55 \cdot \$4.98 = \$49,800 \\
\mathrm{E}[C]_{\text{labor}} &= \$160 \cdot 200 = \$32,000 \\
\mathrm{E}[C] &= \$250,500 + 49,800 + 32,000 = \$332,300
\end{aligned}$$

$$\mathrm{E}[\Pi] = 384,000 - 332,300 = \boxed{\$51,700}$$

12. Explain how you will use the futures market to hedge the price risks. Be specific in discussing which commodities you will want to hedge and what costs you would need to incur in order to be able to use futures markets for hedging price risk.

    See table below.

	Futures Position	Margin Requirement
Corn	Long	$10,000 \cancel{bu} (\$4.75/\cancel{bu})\ (0.08)$ $= \$3800$
Feeder	Long	$150,000 \cancel{lbs} \left(\$1.60/\cancel{lb}\right)\ (0.08)$ $= \$19{,}200$

13. Determine what your actual May 2014 profits (or losses) if the following scenario occurs:

    - Actual feeder cattle basis in May is: $B_{may}^{feeder} = 0.02/lb.$
    - Actual corn basis in May is: $B_{may}^{corn} = 0.30/bu.$
    - Actual fed cattle basis in May is: $B_{may}^{fed} = -0.15/lb.$
    - The May price of a May feeder cattle futures contract is: $F_{may}^{feeder} = \$1.50/lb.$
    - The May price of a May corn futures contract is: $F_{may}^{corn} = \$4.20/bu.$

    See solution below.

Local Prices

$$P_{may}^{feeder} = (1.50 + 0.02)/lb = 1.52/lb$$
$$P_{may}^{corn} = (4.20 + 0.30)/lb = 4.50/lb$$

Local Profit

$$C = \left[50\cancel{bu}\left(\frac{\$4.50}{\cancel{bu}}\right) + \$160 + \frac{\$1.52}{\cancel{lb}}(750\cancel{lbs})\right] \cdot (200)$$
$$= \$305,000$$
$$R = 200 \cdot 1200\cancel{lbs}\left(\frac{\$1.60}{\cancel{lb}}\right)$$
$$= \$384,000$$
$$\Pi^{local} = \$384,000 - \$305,000 = \boxed{\$79,000}$$

Future Market Equity

$$Eq^{feeder} = [(\$1.50 - \$1.60)/\cancel{lb}] \cdot 150,000\cancel{lbs}$$
$$= -\$15,000$$
$$Eq^{corn} = [(\$4.20 - \$4.75)/\cancel{bu}] \cdot 10,000\cancel{bu}$$
$$= -\$5,500$$

Total Profit

$$\Pi^{total} = \$79,000 - \$15,000 - \$5,500 = \boxed{\$58,500}$$