

School of Economic Sciences

Cross Hedging Alfalfa to CME Corn Futures Contracts

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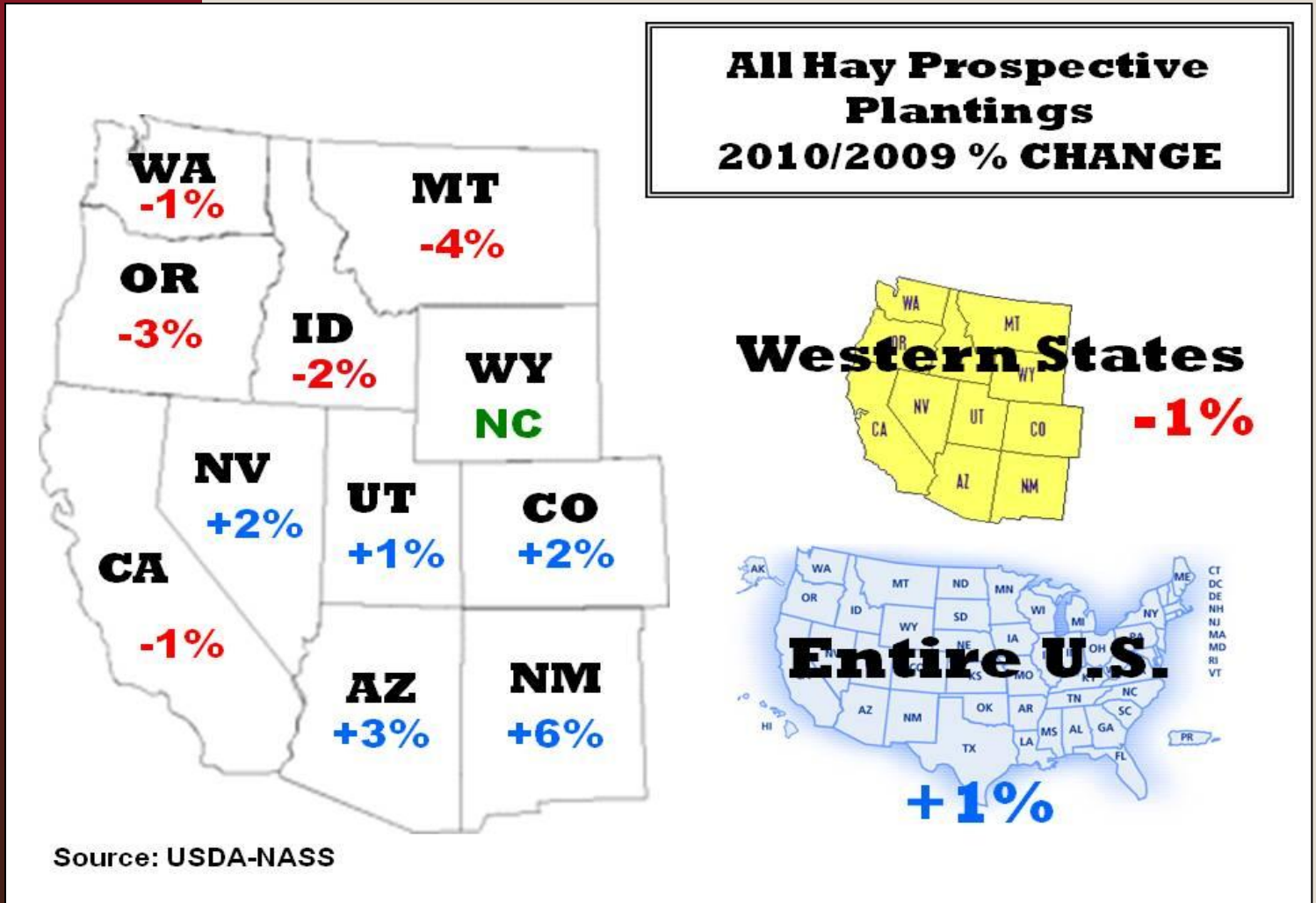
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Presentation Outline

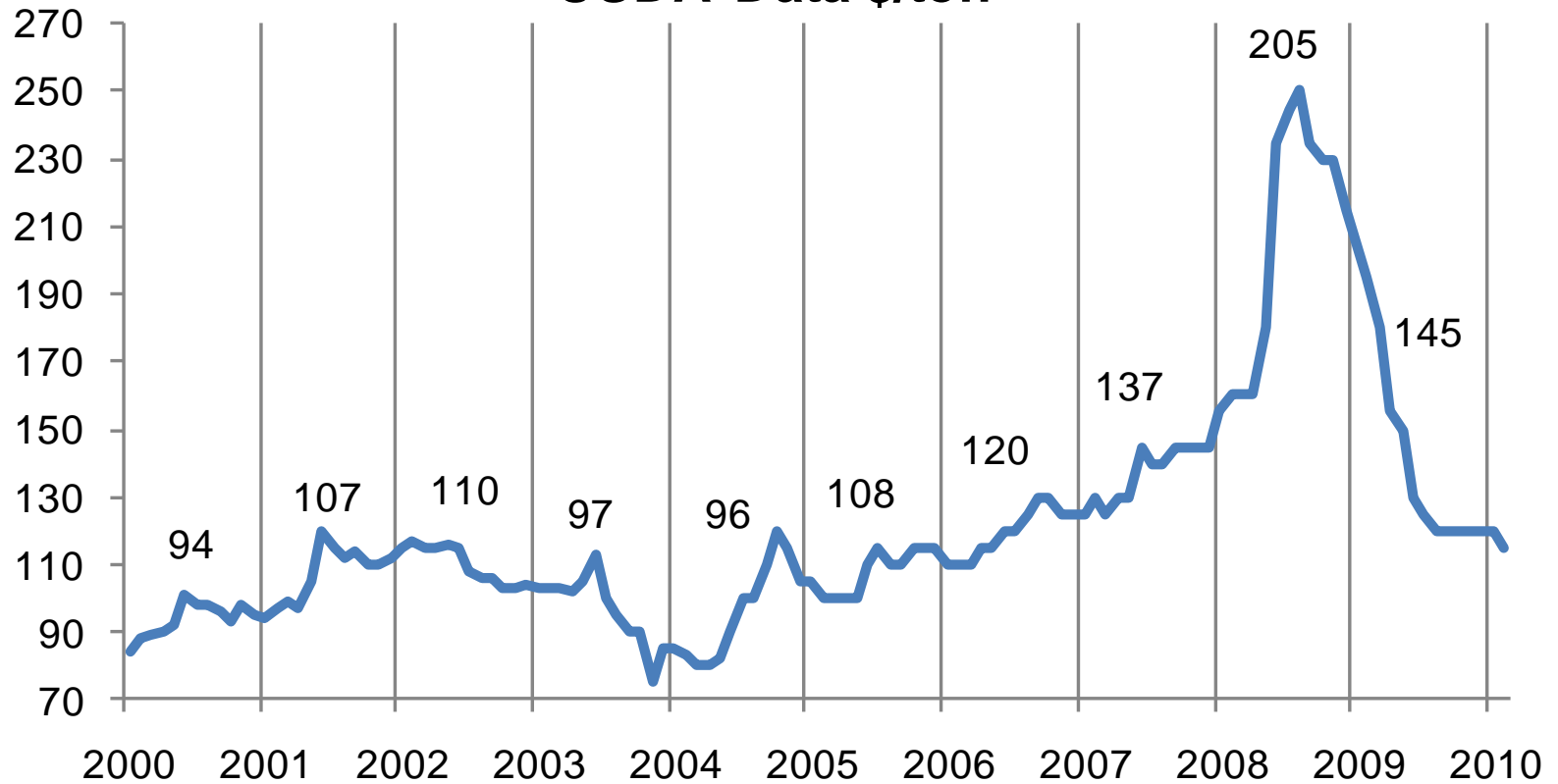
1. Briefly review the Northwest hay market to develop the primary economic risk incentives leading to this investigation.
2. Provide an overview of the methodology to analyze cross hedging commodities.
3. Present the analysis of Washington alfalfa – corn cross hedge.

Hay is a transportable commodity



Washington Alfalfa Hay Price Trend

Washington Monthly Alfalfa Hay Price
USDA Data \$/ton



Hay Price is a Derived Demand



- **Livestock industries**
 - Dairy, Cattle and Horses feed input
 - Price discovery
 - Point in time – typically June
 - Point of sale private contract
 - Contract for annual amount?
- **Export Market**
 - Small number of exporting firms
 - Price margin business
 - Price discovery
 - Purchase contracts set in March
 - Are open on export sale price
 - Price leaders

Forage Export Products

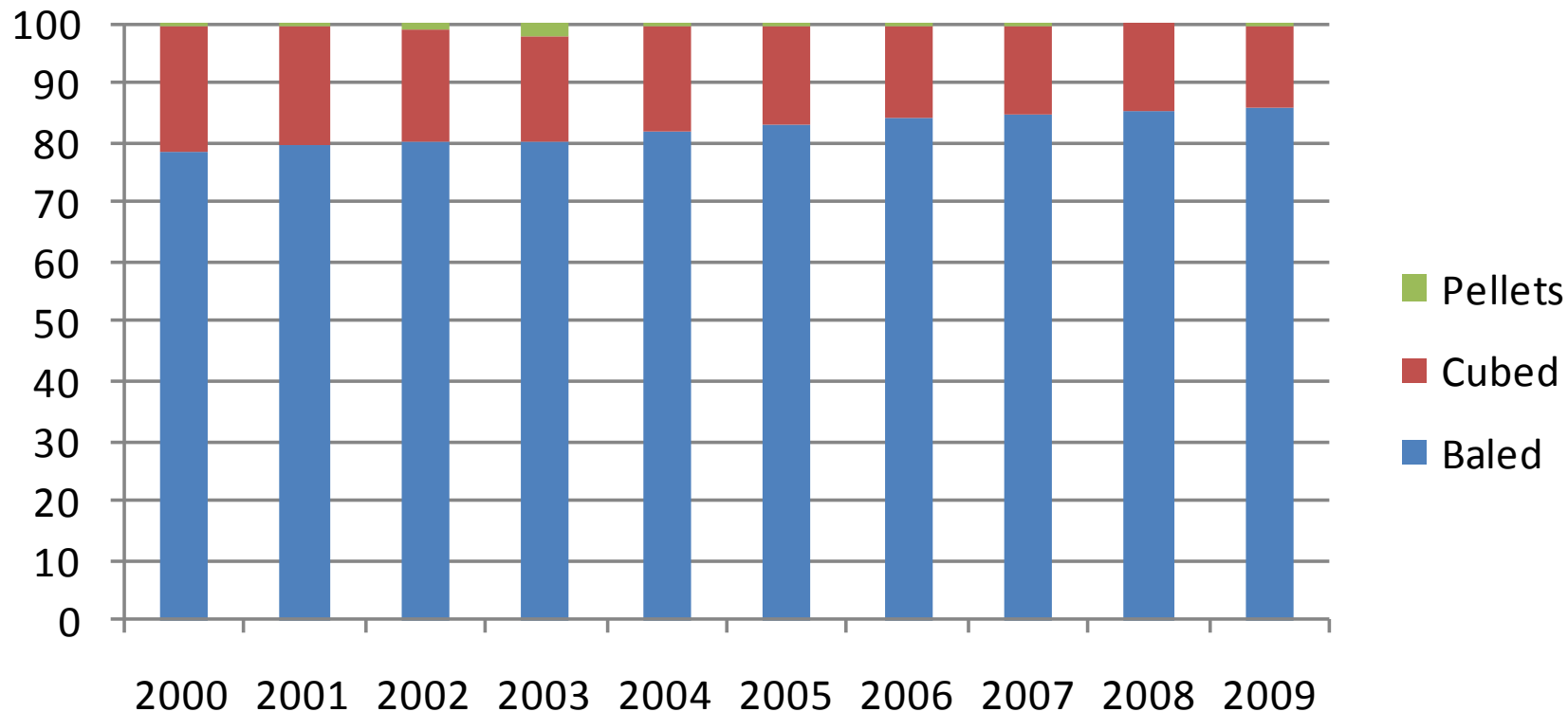


- Twice compressed baled hay
- Cubes
- Pellets



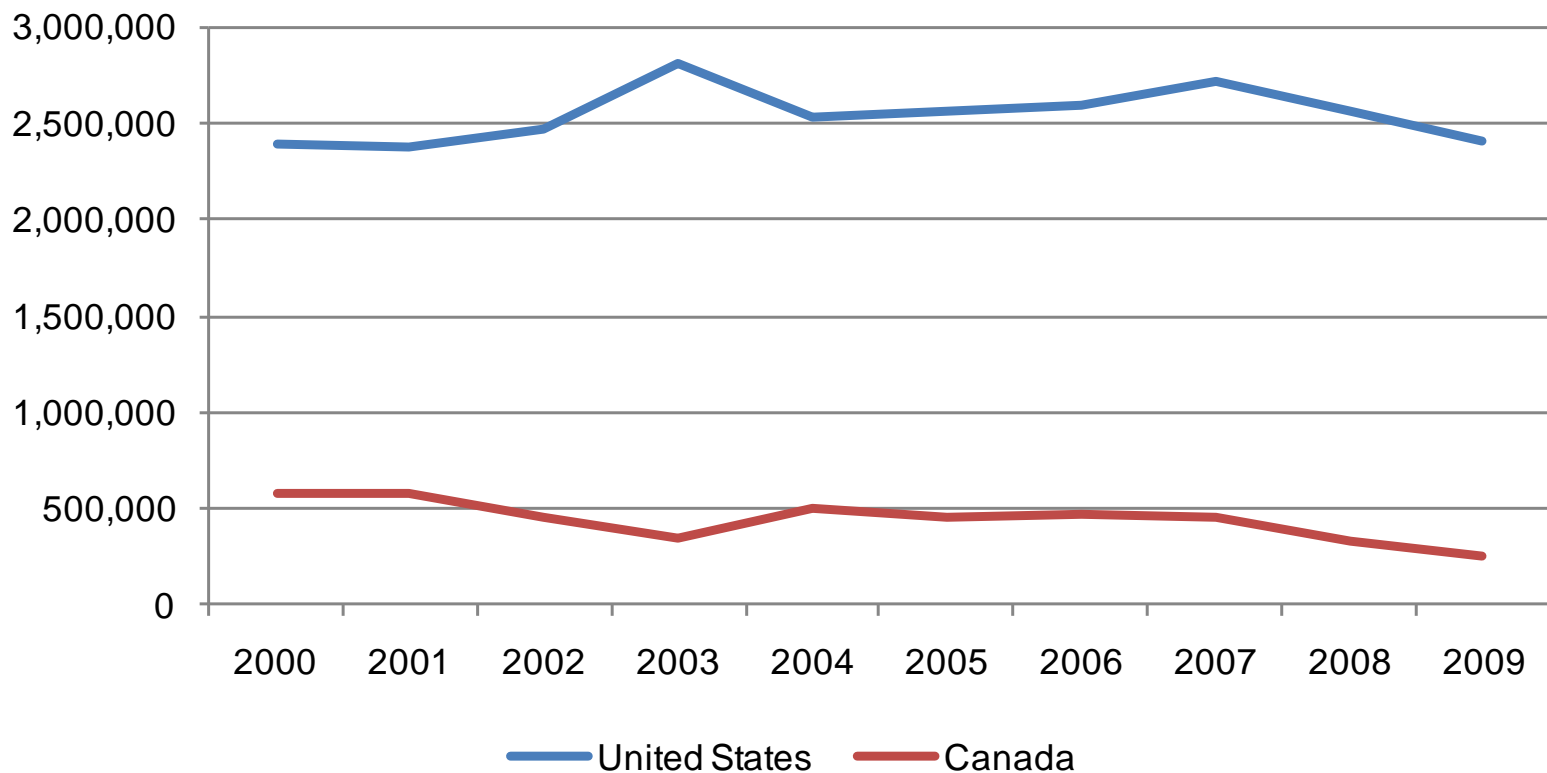
Forage Export Type

U.S. Forage Export Type Percent of Export Volume



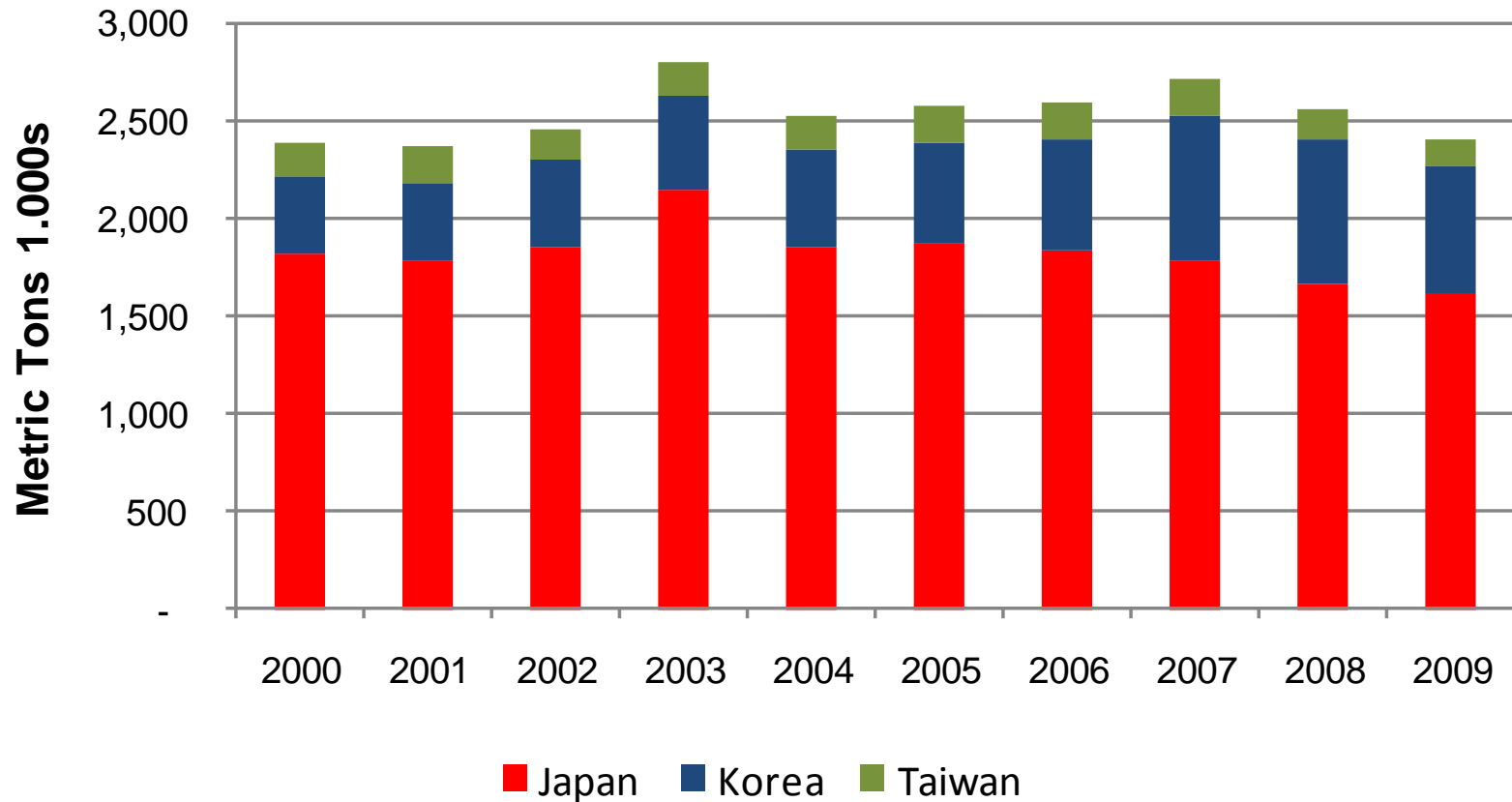
U.S. Versus Canada Pacific Rim Market Share

**Combined Forage Exports to Pacific Rim
(metric tons)**



Japan is the primary export market

Pacific Rim Total Forage Imports From the U.S.



Export Volume and Market Share

West Coast Forage Exports

Ports of Export	Volume (short tons)		
	2007	2008	2009
California	1,035,642	1,178,690	1,573,897
PNW	1,697,053	1,895,516	2,226,135

Percent Change in Volume Exported

Ports of Export	2007	2008	2009
California	na	14%	34%
PNW	na	12%	17%

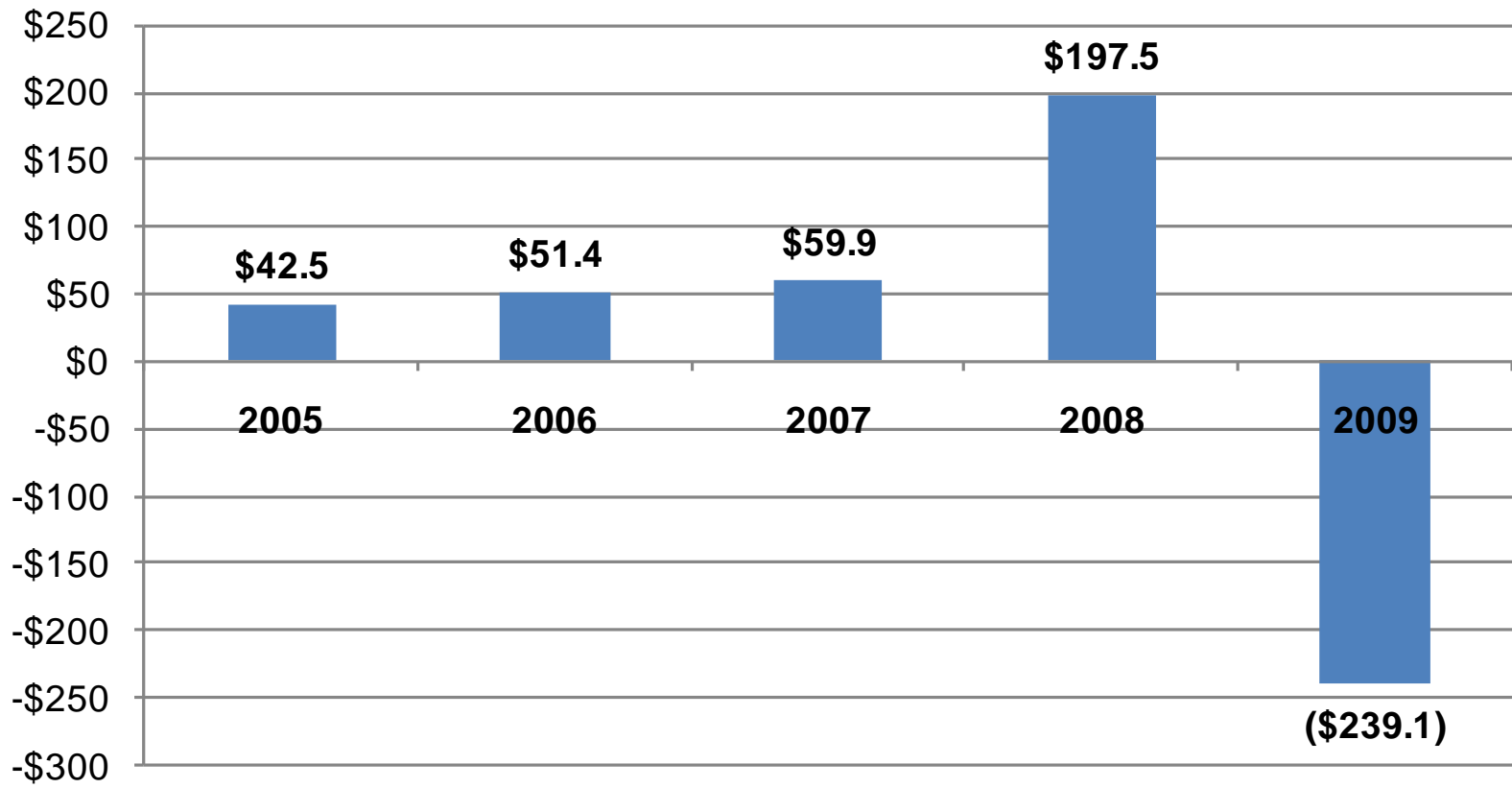
Market Share

Ports of Export	2007	2008	2009
California	38%	38%	41%
PNW	62%	62%	59%

U.S. Department of Commerce Forage Export Data

Value at Risk Estimate

Hay Exporters Estimated Value at Risk
(millions of dollars WA alfalfa hay value)



Examine potential to cross hedge hay

- Cross Hedging
 - Widely applied application
 - Blake and Catlett (1984)
 - 1955 to 1981 hay-corn price series
 - Select appropriate commodity
 1. Evaluate correlation between cash and futures commodities
 2. Determine optimal hedge ratio
 3. Evaluate the cross hedge risk

Modeling Issues

- Underlying market fundamentals of the commodities
- Price reporting frequency
 - Alfalfa is monthly
 - Corn futures are daily
- Futures contract delivery month
- Whether or not to first difference the price series.

Model Specification

Mean-Variance utility maximization specification:

$$\text{Max } E(U) = X_c E(R_c) + X_f E(R_f) - \lambda/2(X_c \sigma_c^2 + X_f \sigma_f^2 + 2 X_c X_f \sigma_{cf})$$

Where:

$E(U)$ = Expected Utility

X_c = amount of cash position

$E(R_c)$ = expected return on cash position

X_f = amount of futures position

$E(R_f)$ = expected return on futures position

λ = risk aversion coefficient

σ_c^2 = variance of cash price change

σ_f^2 = variance of futures price change

σ_{cf} = the covariance between the change in cash and futures prices

Reduced Model Form

a) first difference

$$(\text{Cash}_t - \text{Cash}_{t-k}) = \beta_0 + \beta_1(\text{Futures}_t - \text{Futures}_{t-k}) + \varepsilon_t$$

b) actual levels

$$E(\text{Cash}_t) = \beta_0 + \beta_1(\text{Futures}_t) + \varepsilon_t$$

Where:

β_0 = intercept or expected basis

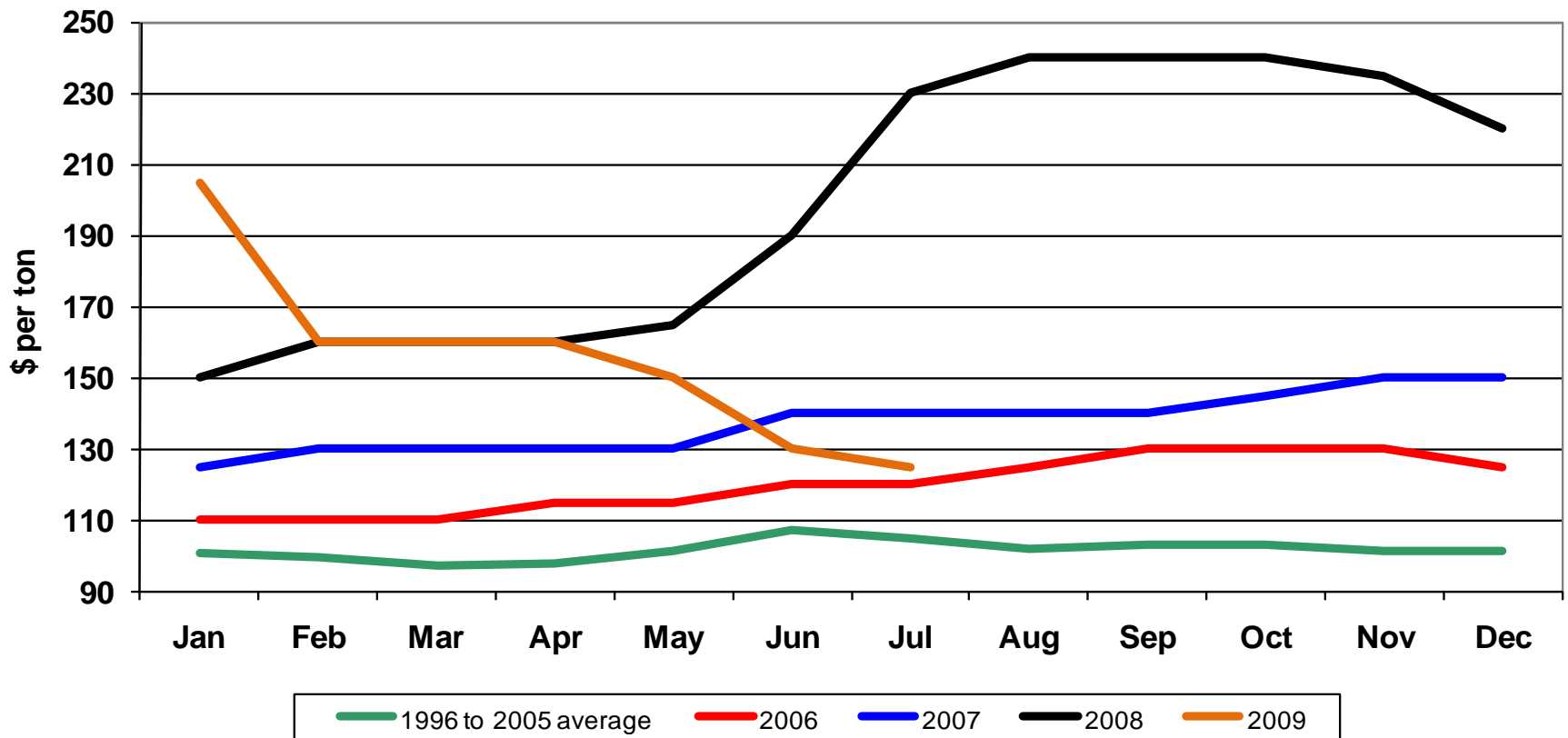
β_1 = the optimal hedge ratio

c) amount of commodity hedged

$$\text{cash quantity hedged} = \frac{\text{futures contract quantity}}{\beta_1}$$

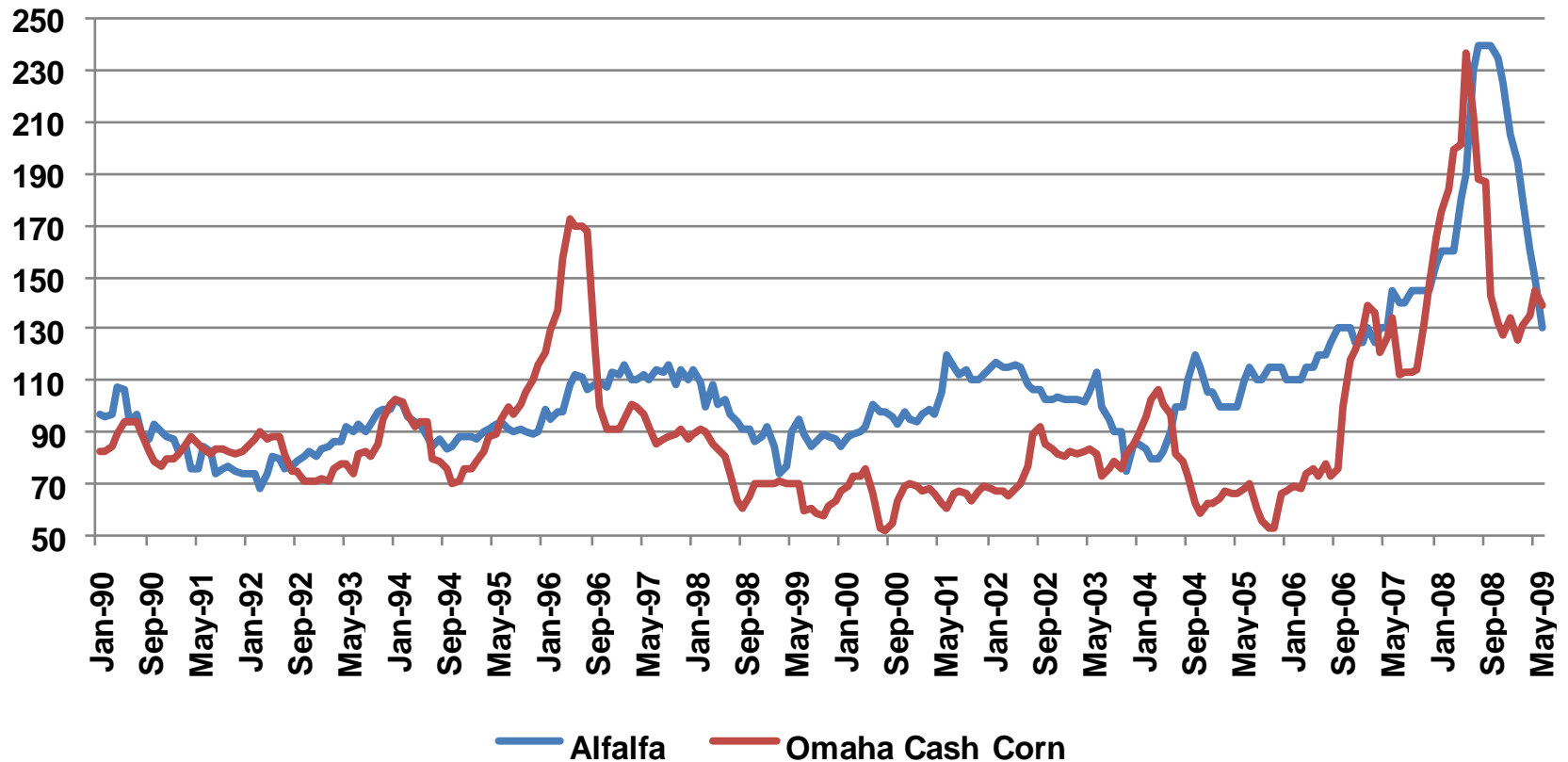
Washington Alfalfa Price

Washington Alfalfa Monthly Price Seasonality Trends



Alfalfa and Cash Corn Price Relationship

WA Alfalfa and Omaha Corn Monthly Cash Price (\$ per ton)



Correlation Results

Table 1. Correlation Coefficients Between Washington Monthly Alfalfa Prices and Corn Futures Prices for All Delivery Months, January 1990 to June 2009

Monthly Alfalfa Price	Corn Futures Delivery Months								
	March	May	July	Sept	Dec	Next March	Next May	Next July	Next Sept
January	0.683	0.692	0.711	0.767	0.804				
February	0.644	0.650	0.663	0.723	0.757				
March	0.709	0.652	0.668	0.718	0.750				
April		0.640	0.661	0.720	0.756	0.645			
May		0.798	0.756	0.819	0.854	0.627			
June			0.762	0.804	0.825	0.616	0.621		
July			0.856	0.881	0.914	0.616	0.622		
August				0.851	0.895	0.681	0.687	0.694	
September				0.887	0.877	0.667	0.673	0.683	
October					0.760	0.646	0.664	0.681	0.505
November					0.652	0.620	0.634	0.656	0.476
December					0.685	0.569	0.583	0.605	0.686

All correlations are significant at the 0.01 level (2 tailed) test.

Table 2. Linear Regression Model Results Alfalfa Price and Corn Futures

Hedge Ratio

	Washington Alfalfa Price 1990 to June 2009 Regression Coefficient			
	Intercept		Hedge Ratio (DECEMBER)	R ²
Jan =	14.05 (0.81)	+	32.67 (5.89)	.64
Feb =	23.58 (1.31)	+	28.56 (6.01)	.57
Mar =	31.18 (1.93)	+	24.67 (4.66)	.56
Apr =	43.54 (3.36)	+	20.37 (4.84)	.58
May =	42.31 (4.27)	+	21.87 (6.81)	.73
Jun =	57.6 (6.27)	+	17.70 (6.12)	.69
Jul =	29.24 (3.12)	+	29.09 (9.11)	.84
Aug =	4.61 (0.34)	+	38.63 (8.07)	.80
Sep =	6.42 (0.43)	+	39.92 (7.26)	.77
Oct =	-7.97 (-0.31)	+	45.99 (4.65)	.57
Nov =	11.05 (0.37)	+	37.89 (3.39)	.42
Dec =	13.11 (0.50)	+	35.48 (3.71)	.46

Number in () are t-values

Coverage Ratio

Table 3. Hay to Corn Cross Hedge Coverage Ratio

Month	Futures Contract Month	Coverage Ratio (Tons of Hay per 5,000 Bushel Corn Contract) ¹
January	December	153
February	December	175
March	December	203
April	December	245
May	December	229
June	December	282
July	December	172
August	December	129
September	December	128
October	December	108
November	December	132
December	December	141

¹ Coverage ratio is calculated by $(5,000 / \text{hedge ratio})$

Simulation

Table 4. Alfalfa Corn Cross Hedge Simulation Results

	Mar	Mar	Aug		Futures	
	Predicted	Actual	Actual	Hay	Contract	Cross
	Hay Price	Hay Price	Price	Gain / (Loss)	Gain / (Loss)	Hedge
Year	\$/ton	\$/ton	\$/ton	Per Contract	Per Contract	Gain / (Loss)
1990	94	97	89	(1,035)	(474)	(1,510)
1991	96	84	74	(4,429)	(387)	(4,816)
1992	97	68	77	(4,128)	(2,354)	(6,482)
1993	91	86	90	(209)	62	(147)
1994	97	96	87	(2,021)	(2,224)	(4,245)
1995	95	90	90	(1,068)	1,098	30
1996	109	98	106	(701)	954	253
1997	103	110	113	2,096	(1,193)	903
1998	101	100	94	(1,342)	(3,207)	(4,549)
1999	91	74	84	(1,501)	(897)	(2,397)
2000	94	89	98	788	(3,232)	(2,444)
2001	91	99	112	4,295	(840)	3,454
2002	87	115	106	3,765	2,087	5,852
2003	90	103	95	1,106	(448)	658
2004	105	80	100	(1,024)	(3,239)	(4,263)
2005	90	100	110	4,008	(466)	3,542
2006	95	110	125	6,135	(548)	5,587
2007	131	125	140	1,736	(2,915)	(1,179)
2008	171	160	240	14,045	196	14,241
2009	114	180	120	1,299	3,864	5,162
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			Total	21,815	(14,163)	7,652
			W/o 2008	7,770	(14,360)	(6,590)

Conclusions

- WA alfalfa price and corn are not highly correlated enough to be an effective simple cross hedge in the desired time frame
- DDG futures market trading to begin April, 26 2010
- Develop a econometric hay price forecasting model

Questions

