

The Hershey Company



Cocoa and Sugar Risk Management

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Background



The Company



The Hershey Company is the leading candy and confectionary manufacturer with well known brands such as Hershey's, Reese's, Almond Joy and Hershey's Kisses. Traded publicly under NYSE ticker symbol HSY, the firm operates with revenues of over \$4 billion and 13,000 employees



Source: www.thehersheycompany.com

Cocoa



Cocoa



- Discovered by the Aztec, also known as Theobroma Cacao and “Food for the Gods”
- The development of steam engines propelled the transition of Chocolate from luxury goods to a commodity
- Developed countries with the highest income are major processor and consumer of chocolate with Netherland as the top processing country closely followed by the US
- Cocoa’s term of delivery: 22,046 lbs (10 metric tons)
As of March 30,2006, future price per metric ton was \$1,983, approximately \$0.90 per lbs.



Source: www.nybot.com

Cocoa Futures Prices

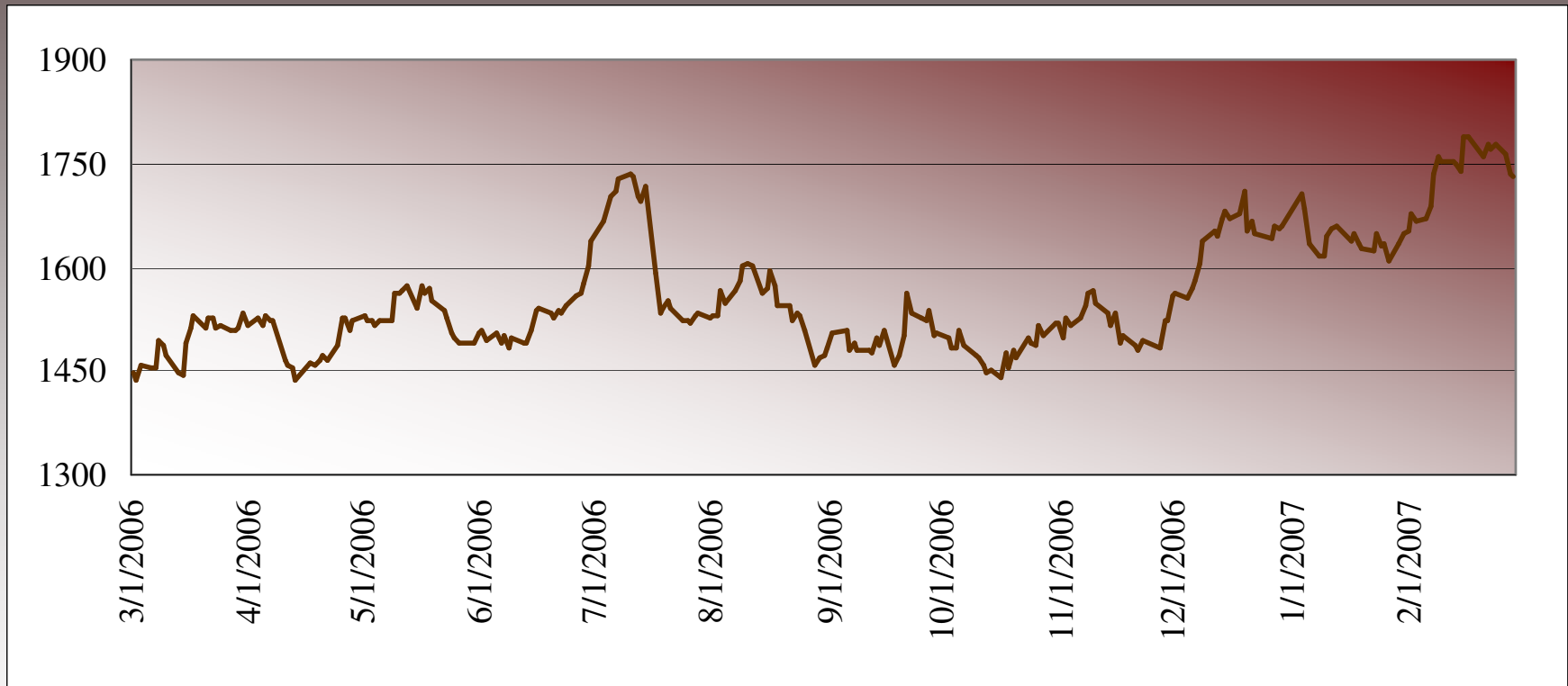
NYBOT Cocoa (CC) Prices as of Friday, March 30th 2007

Contract	High	Low	Settle	Change
May 2007	1969	1920	1953	12
July 2007	1995	1947	1983	15
Sep 2007	2003	1995	2006	16
Dec 2007	2035	2010	2027	18
Mar 2008	2035	2035	2042	15
May 2008	2047	2047	2060	15



Source: www.nybot.com

Cocoa Futures History

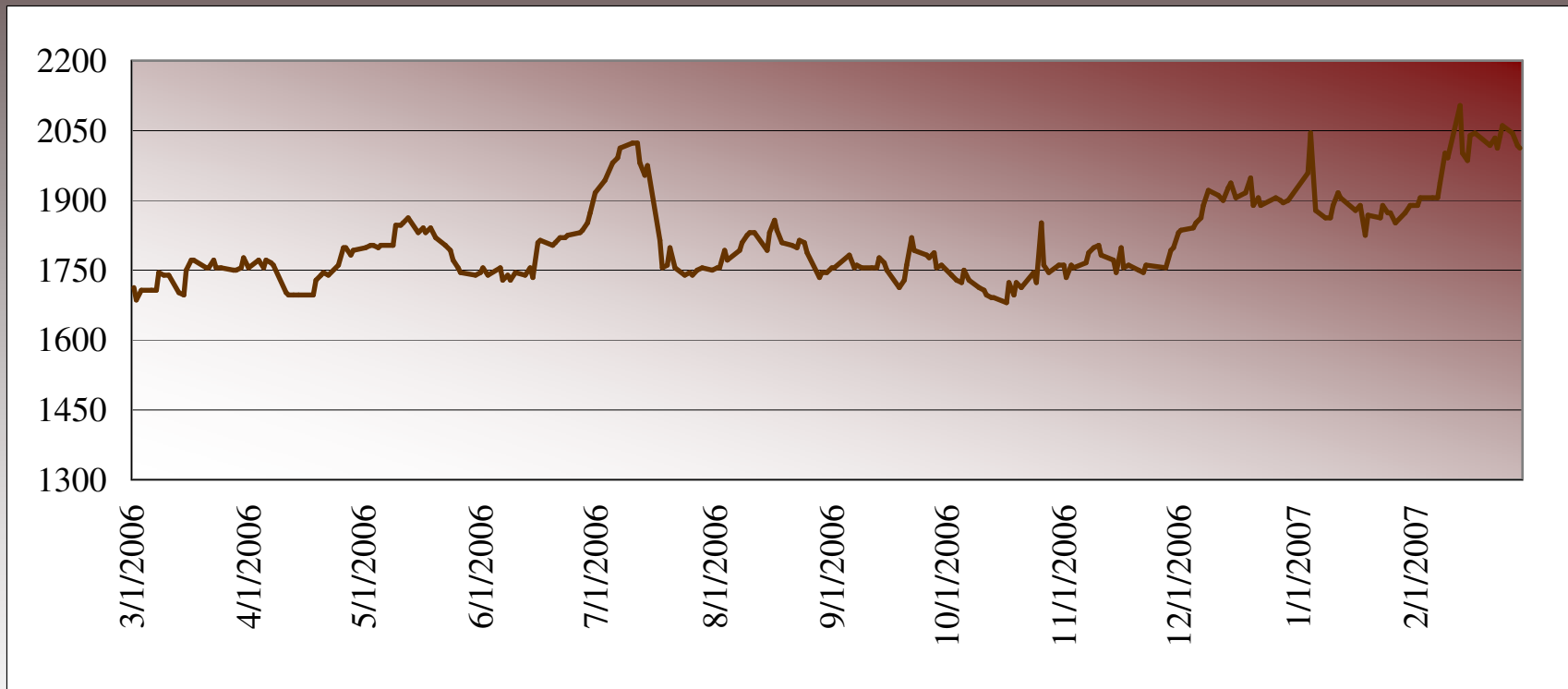


Annual Volatility (282 days in a year): 22.64%



Source: www.nybot.com, prices are in \$ per metric ton

Cocoa Spot History



Annual Volatility (282 days in a year): 27.46%



Source: www.nybot.com, prices are in \$ per metric ton

Cocoa Exposure



- Currently, Hershey's annual cocoa expenditure is \$139,720,000 (based on 40% of total raw materials purchases assumptions)
- Given the future price of \$0.90 per pound, the annual exposure is of 154.8 mm lbs, and 7,024 futures contracts
- The quarterly exposure is 38.7 mm lbs, and 1,756 futures contracts



Hedging Calc.

Based Hershey's prior year purchase and past data, we've determined that :

- The # of contract exposure is 1,756
- Management's loss limit for Cocoa is 3% as that would translate to a one basis point change in Hershey's margin
- σ is 22.64%
- Cocoa spot at March 30, 2007 of \$1,983/contract, deliverable on June 2, 2007 ($t = 93$ days)
- Interest rate is 5% and no risk premium



Hedging Calc.



Underlying	t	${}_0F_t$	${}_0R_t$	${}_0R_{pt}$	St market	δ	Short Crit Price
Cocoa	0.2548	1983	5%	0	1983	22.64%	2,380.85

Underlying	Loss @ Lower Crit	Target Loss	Cut risk by	# Exposure	Hedge
Cocoa	20.06%	3.00%	85.05%	1756	1,493



Current Position

Short cocoa (-F):

L or S (Long/Short)

F, C, or P (Forward, Call, Put)

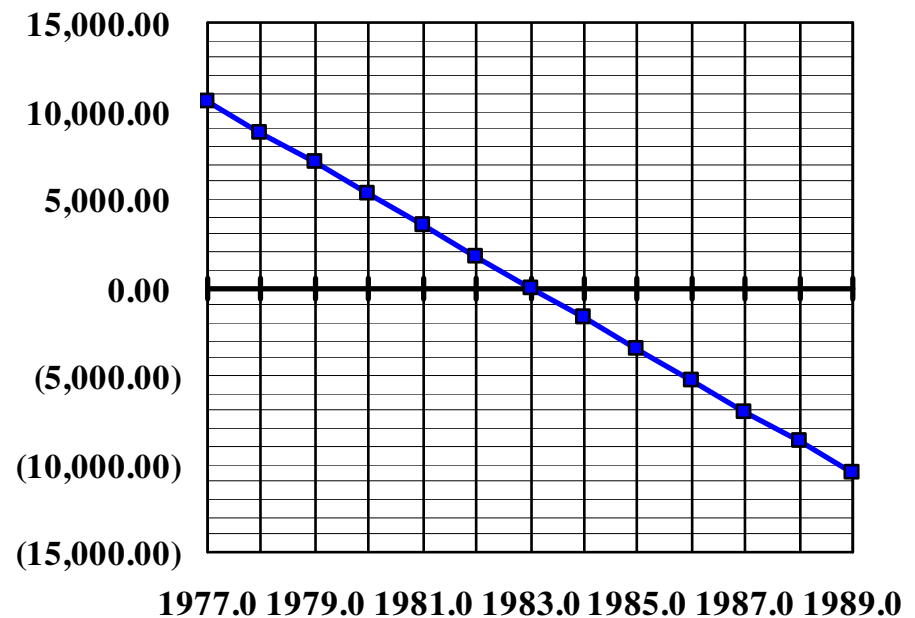
Forward/Strike Price

Price (C or P), 0.0 (F) - FV

Number of Contracts

s
f
1983.0
0.00
1756

Short Forward Position



Price at Contract Maturity



Cocoa Direction



- The eight primary cocoa producing countries are Ivory Coast (more than 40%), Ghana, Indonesia, Nigeria, Brazil, Cameroon, Ecuador, and Malaysia¹
- Conflict in the Ivory Coast region has hindered cocoa production and added considerable volatility to the cocoa futures markets²
- Ghana and Ivory Coast are struggling to contain the spread of a disease hitting their cocoa crops³
- Ivory Coast has recently experienced a drought (from the end 2006 to March 2007) that farmers have described as the worst in decades³



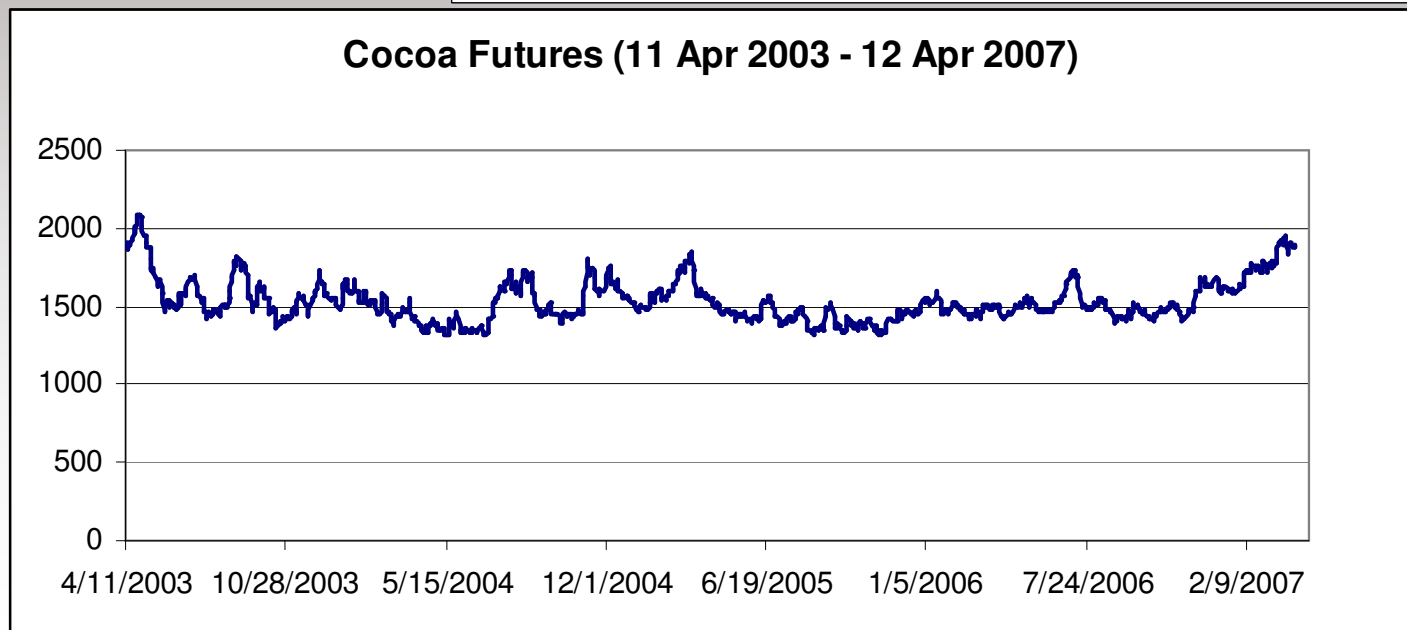
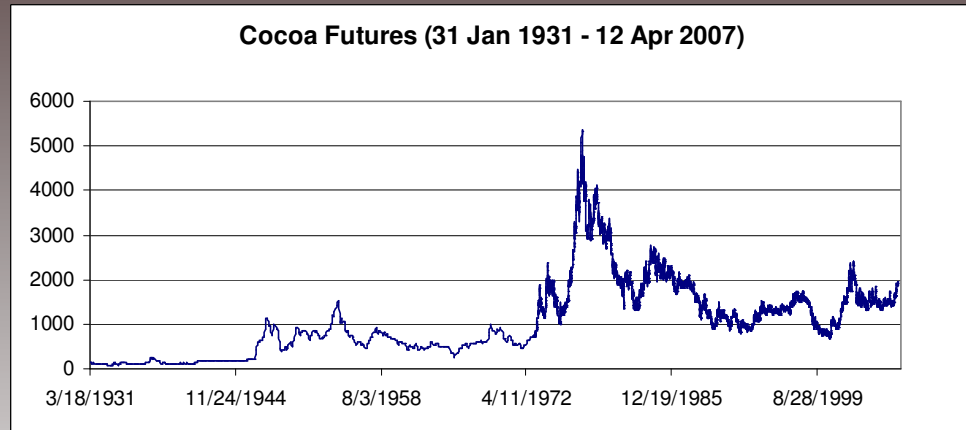
¹ www.nybot.com/education/brochuresPublications/files/cocoafinal.pdf

² <http://www.tkfutures.com/cocoa.htm>

³ <http://www.dailyfutures.com/softs>

Cocoa Direction

- Accordingly, Cocoa Futures have experienced a recent rally to near four-year highs



Source:
Global Financial
Database



Our View



Recent events have changed Cocoa's direction:

- Scattered showers have recently fallen over West Africa, helping ease stress on the cocoa midcrop. These positive conditions are expected to continue in the short-term¹
- On March 4, 2007, the Ivory Coast government and rebel forces agreed to form a new government and hope to have national elections in the next year. This political stability is expected to have significantly positive impact on the cocoa industry²
- Concerns remain, however, that the upcoming midcrop will be lower because of earlier dry weather¹



¹http://futures.fxstreet.com/Futures/news/afx/singleNew.asp?menu=latestnews&pv_noticia=i4758187477692973120

² <http://news.bbc.co.uk/2/hi/africa/3567349.stm>

Our View



Direction: DOWN (not significantly)
Certainty: UNSURE

of contracts to hedge: 1,493



Map of Alternatives

	Level of Confidence		
	Uncertain	= market	Certain
Directions vs. Market View	Volatility up (option prices cheap)	Volatility stable (option prices fair)	Volatility down (option prices rich)
Up			
Stable	* Alternative II (Long Stradle)	* Alternative III (Forward Hedge)	
Down	Recommended Position (Bear Spread)	* Alternative I (Bear Spread)	



Source: NYBOT, as of March 30, 2007 (for all alternatives)

Recommendation

Syn. Bear Spread

$$= -F + C - P_{OTM}$$

We assume prices will not go down significantly, and therefore choose to limit the downside to ~7%, \$1,850

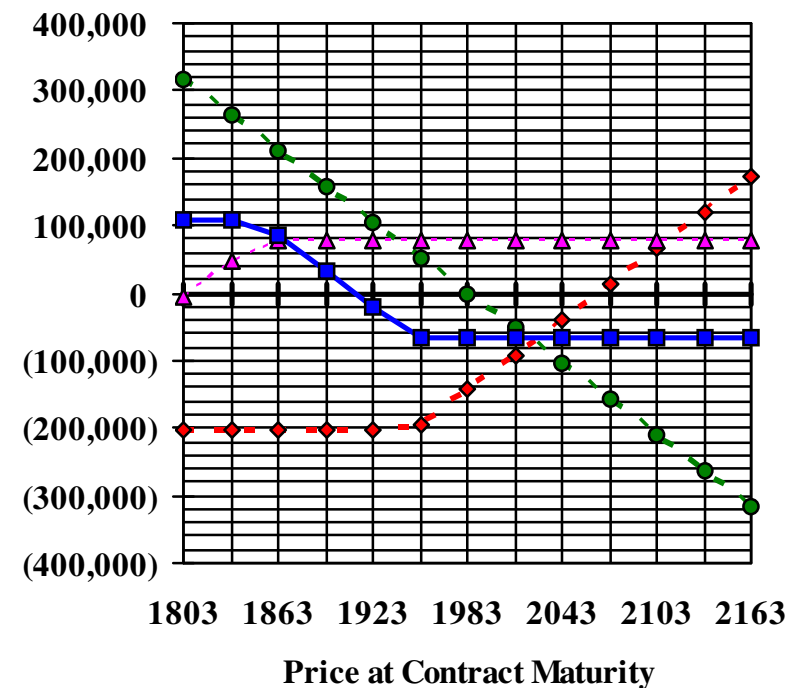
View: Prices down, no more than 7%

S	L	S
F	C	P
1983.0	1950.0	1850.0
0.00	115.00	44.00
1756	1756	1756

	-1756F	+1756C	-1756P	Sum
1803.0	316,080	(201,940)	(5,268)	108,872
1833.0	263,400	(201,940)	47,412	108,872
1863.0	210,720	(201,940)	77,264	86,044
1893.0	158,040	(201,940)	77,264	33,364
1923.0	105,360	(201,940)	77,264	(19,316)
1953.0	52,680	(196,672)	77,264	(66,728)
1983.0	0	(143,992)	77,264	(66,728)
2013.0	(52,680)	(91,312)	77,264	(66,728)
2043.0	(105,360)	(38,632)	77,264	(66,728)
2073.0	(158,040)	14,048	77,264	(66,728)
2103.0	(210,720)	66,728	77,264	(66,728)
2133.0	(263,400)	119,408	77,264	(66,728)
2163.0	(316,080)	172,088	77,264	(66,728)



Combined Sum Position



● -1756F
 ◆ +1756C
 ▲ -1756P
 ■ Sum

Alternative I

Syn. Bear Spread

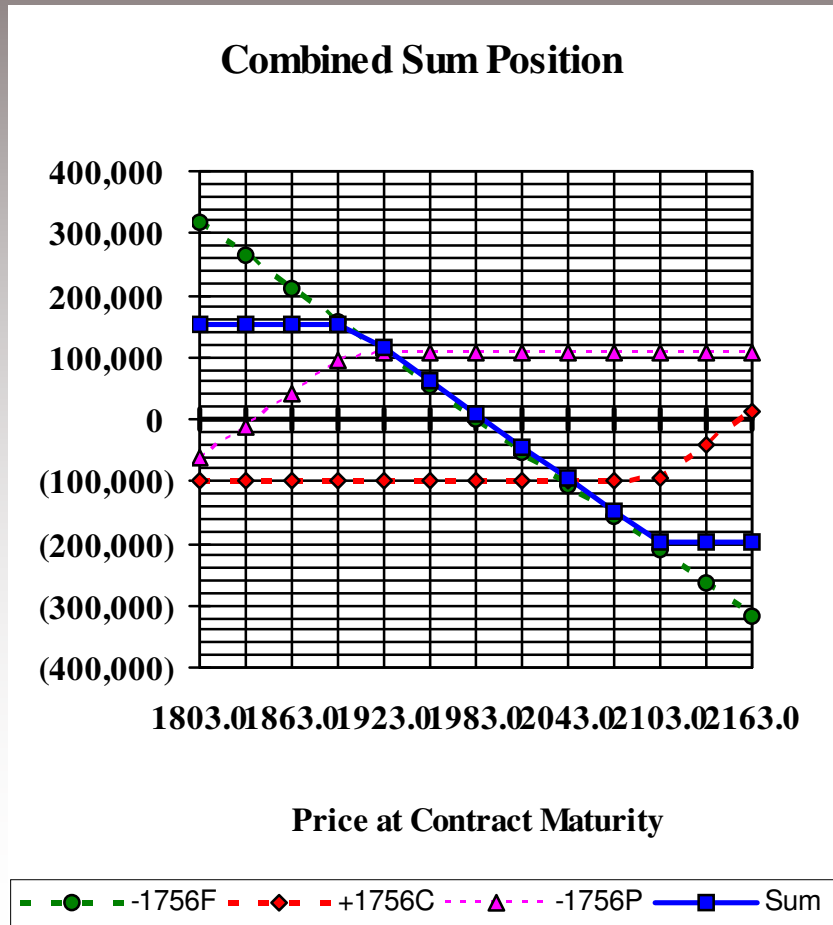
$$= -F + C_{OTM} - P_{OTM}$$

OTM strike prices are designed to accommodate 4-6% price changes

View: Prices down, less volatility

S	L	S
F	C	P
1983.0	2100.0	1900.0
0.00	56.00	61.00
1756	1756	1756

	-1756F	+1756C	-1756P	Sum
1803.0	316,080	(98,336)	(63,216)	154,528
1833.0	263,400	(98,336)	(10,536)	154,528
1863.0	210,720	(98,336)	42,144	154,528
1893.0	158,040	(98,336)	94,824	154,528
1923.0	105,360	(98,336)	107,116	114,140
1953.0	52,680	(98,336)	107,116	61,460
1983.0	0	(98,336)	107,116	8,780
2013.0	(52,680)	(98,336)	107,116	(43,900)
2043.0	(105,360)	(98,336)	107,116	(96,580)
2073.0	(158,040)	(98,336)	107,116	(149,260)
2103.0	(210,720)	(93,068)	107,116	(196,672)
2133.0	(263,400)	(40,388)	107,116	(196,672)
2163.0	(316,080)	12,292	107,116	(196,672)



Alternative II

Syn. Long Stradle

$$= -F + 2C_{ATM}$$

The C_{ATM} strike prices is designed to reflect the higher probability of prices going down, within the expected high volatility

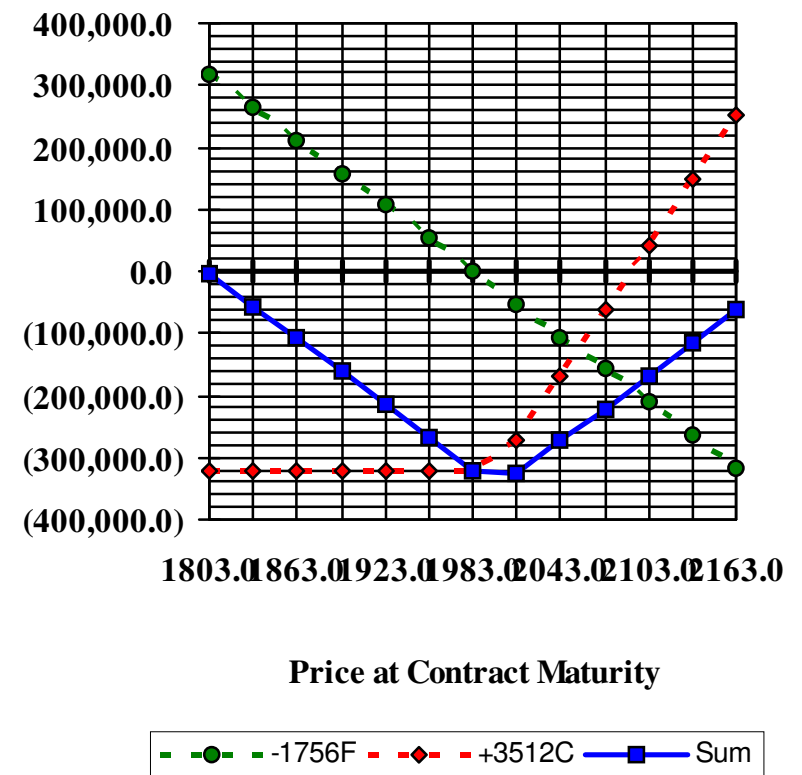
View: High volatility

S	L
F	C
1983.0	2000.0
0.00	91.00
1756	3512



	-1756F	+3512C	Sum
1803.0	316,080	(319,592)	(3,512)
1833.0	263,400	(319,592)	(56,192)
1863.0	210,720	(319,592)	(108,872)
1893.0	158,040	(319,592)	(161,552)
1923.0	105,360	(319,592)	(214,232)
1953.0	52,680	(319,592)	(266,912)
1983.0	0	(319,592)	(319,592)
2013.0	(52,680)	(273,936)	(326,616)
2043.0	(105,360)	(168,576)	(273,936)
2073.0	(158,040)	(63,216)	(221,256)
2103.0	(210,720)	42,144	(168,576)
2133.0	(263,400)	147,504	(115,896)
2163.0	(316,080)	252,864	(63,216)

Combined Sum Position



Alternative III

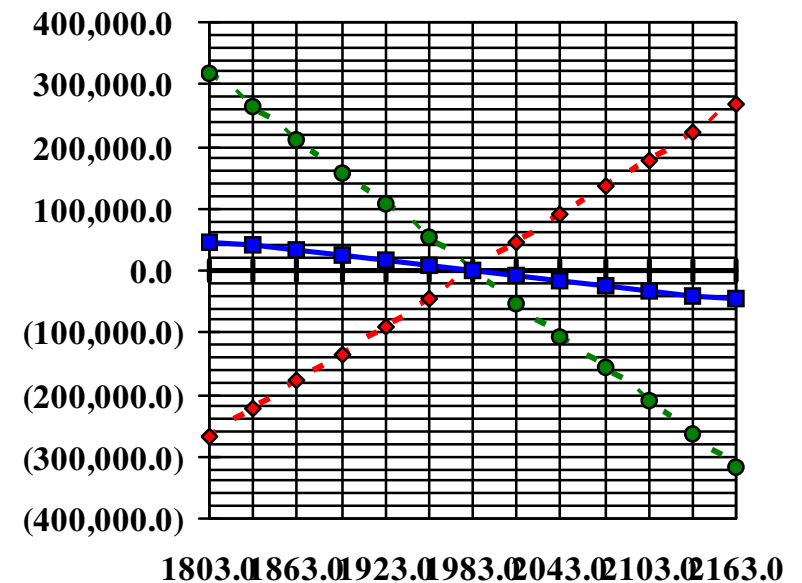
Forward Hedge:
= $-F+F$:

View: Price stable, low volatility

S	L
F	F
1983.0	1983.0
0.00	0.00
1756	1493



Combined $-1756F+1493F+?$ Position



Price at Contract Maturity



Sugar



Sugar

- Produced in over 120 countries
- Two types of futures traded:
 - Sugar no. 11
 - Sugar no. 14
- Sugar no. 11 Options were the first options on commodities offered by NYBOT
- There is a higher correlation between sugar prices and the value of US dollars than in many other commodities
- Sugar no. 11 delivery: 112,000 lbs (50 metric tons)
As of March 30, 2006, future price per 112,000 lbs was \$1,002, approximately \$0.009 per lbs.



Source: www.nybot.com

Sugar Futures Prices

NYBOT Sugar No. 11 (SB) Prices as of Friday, March 30th 2007

Contract	High	Low	Settle	Change
May 2007	990	979	988	3
Jul 2007	1002	990	1000	4
Oct 2007	1037	1027	1036	1
Mar 2008	1101	1091	1101	4
May 2008	1110	1100	1106	3



Source: www.nybot.com

Sugar Futures History

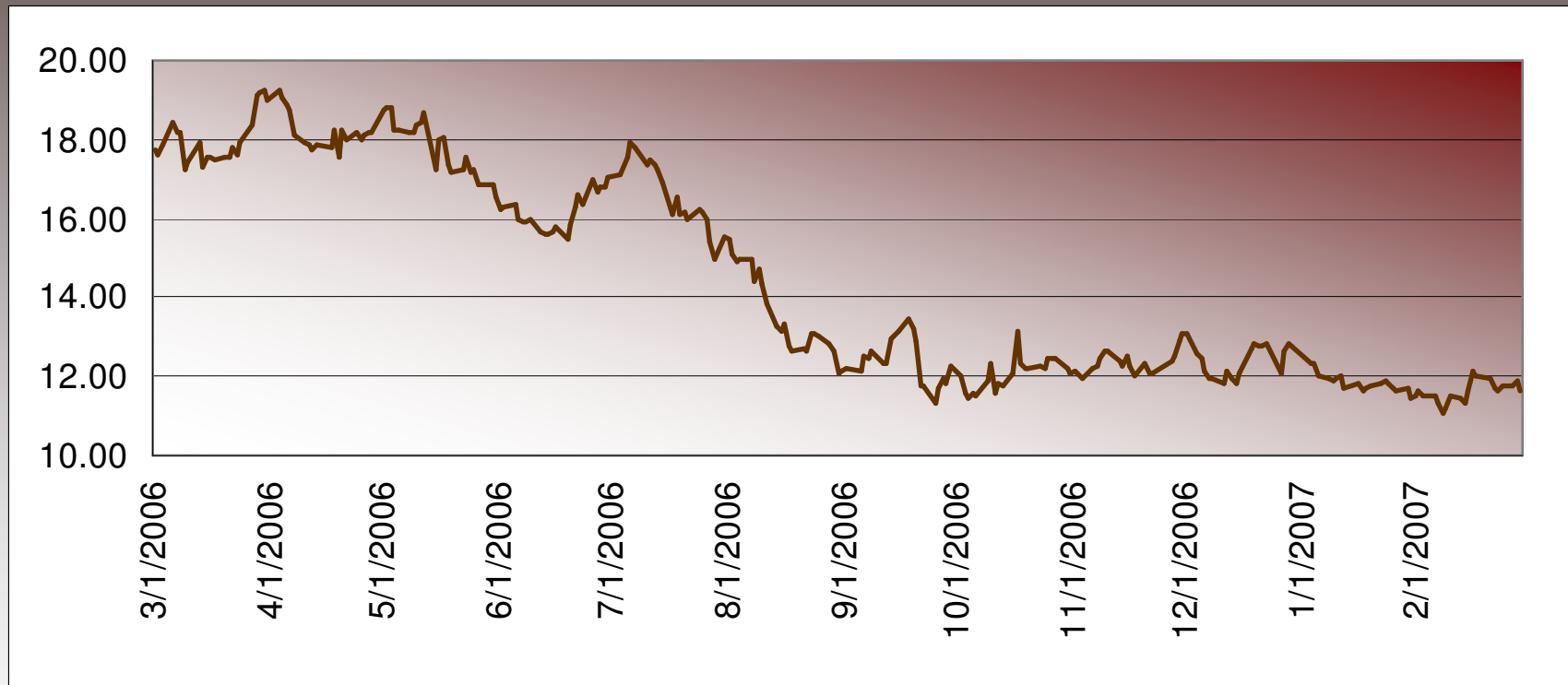


Annual Volatility (282 days in a year): 33.05%



Source: www.nybot.com, prices are in cents per pound

Sugar Spot History



Annual Volatility (282 days in a year): 37.14%



Source: www.nybot.com, prices are in cents per pound

Sugar Exposure

- Currently, Hershey's annual sugar expenditure is \$34,817,500 (based on 10% of total raw materials purchases assumptions)
- Given the future price of \$0.10 per pound, the annual exposure is of 347.5 mm lbs, and 3,103 futures contracts
- The quarterly exposure is 86.9 mm lbs, and 776 futures contracts



Hedging Calc.

Based Hershey's prior year purchase and past data, we've determined that :

- The # of contract exposure is 776
- Management's loss limit for Cocoa is 5% as that would translate to a one basis point change in Hershey's margins
- σ is 33.05%
- Sugar spot at March 30, 2007 of \$1,000/contract, deliverable on June 2, 2007 ($t = 93$ days)
- Interest rate is 5% and no risk premium



Hedging Calc.

Underlying	t	${}_0F_t$	${}_0R_t$	${}_0R_{pt}$	St market	δ	Short Crit Price
Sugar	0.2548	1000	5%	0	1000	33.05%	1,305.94

Underlying	Loss @ Lower Crit	Target Loss	Cut risk by	# Exposure	Hedge
Sugar	30.59%	5.00%	83.66%	776	649



Current Position

Short sugar (-F):

L or S (Long/Short)

F, C, or P (Forward, Call, Put)

Forward/Strike Price

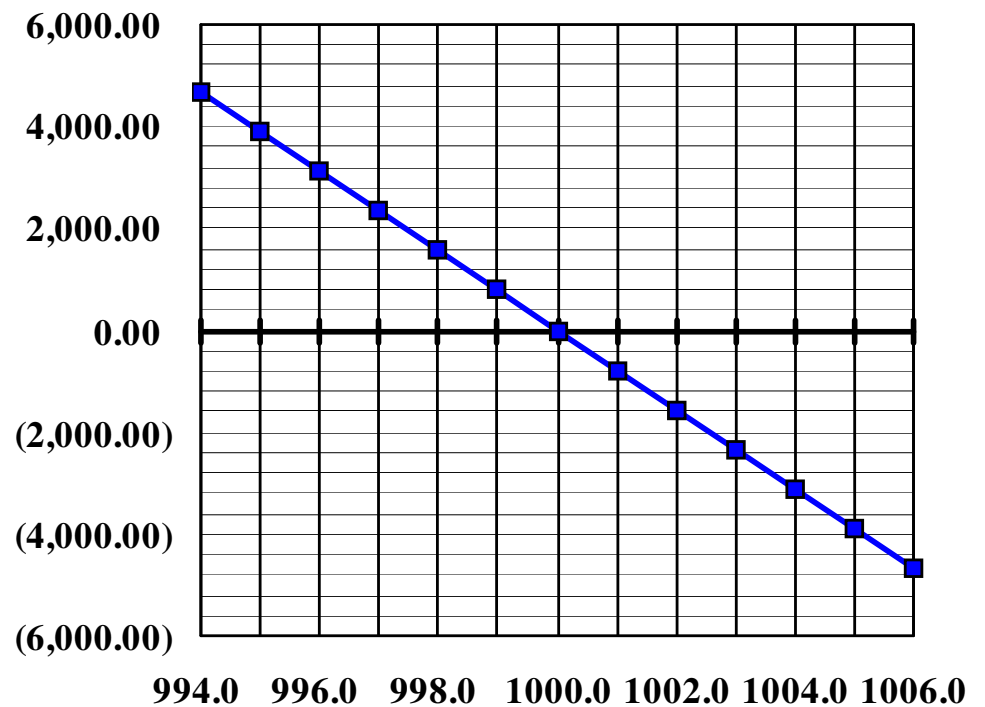
Price (C or P), 0.0 (F) - FV

Number of Contracts

S
F
1000.0
0.00
776



Short Forward Position



Price at Contract Maturity

Sugar Direction

- Brazil, Australia, Thailand, the European Union, and Cuba account for more than 72% of the total world free market exports¹
- Since 1994, Brazilian sugars have accounted for nearly 80% of the total tonnage delivered against the NYBOT's Sugar futures contract¹
- Healthy production trends in most sugar-growing countries²
- The bumper supplies are seen coming from Brazil, as well as India (the world's biggest consumer of sugar)³

¹ www.nybot.com/education/brochuresPublications/files/sugarfinal.pdf

² www.agriculture.com/ag/futuresource/FutureSourceStoryIndex.jhtml?storyType=food&storyId=88401023

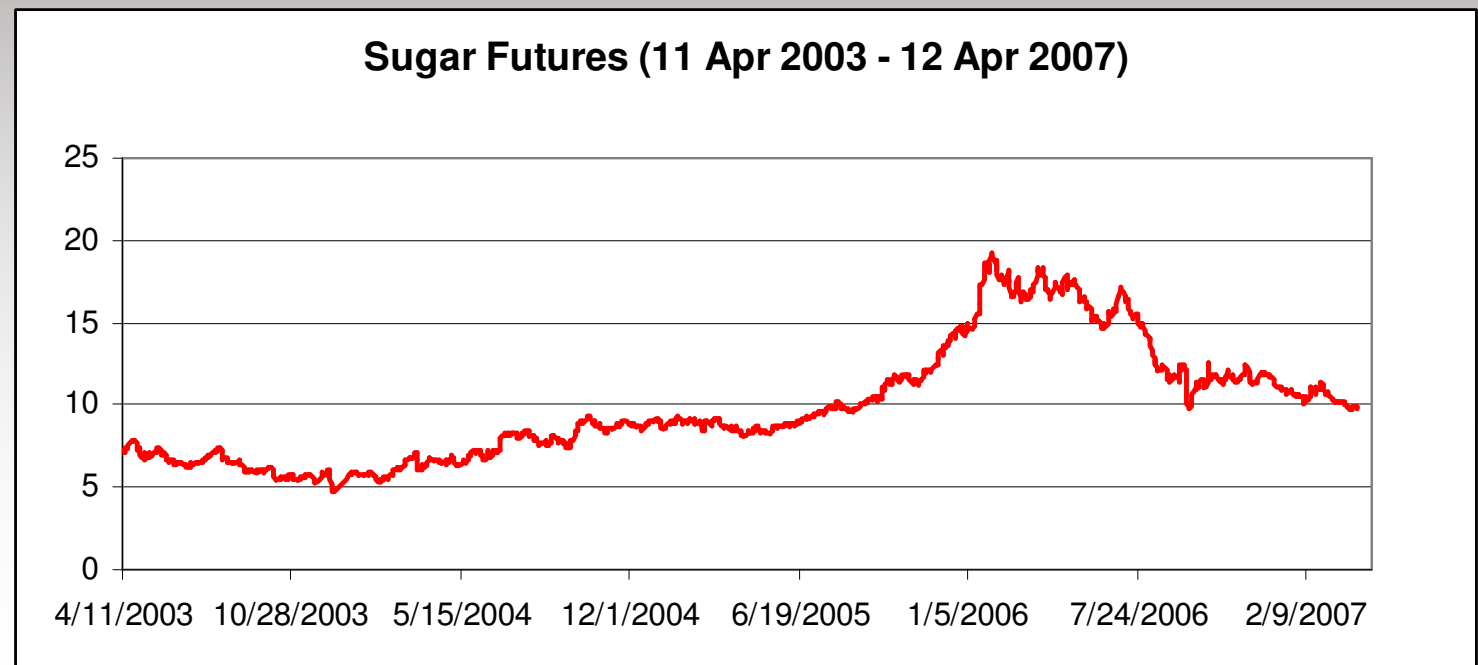
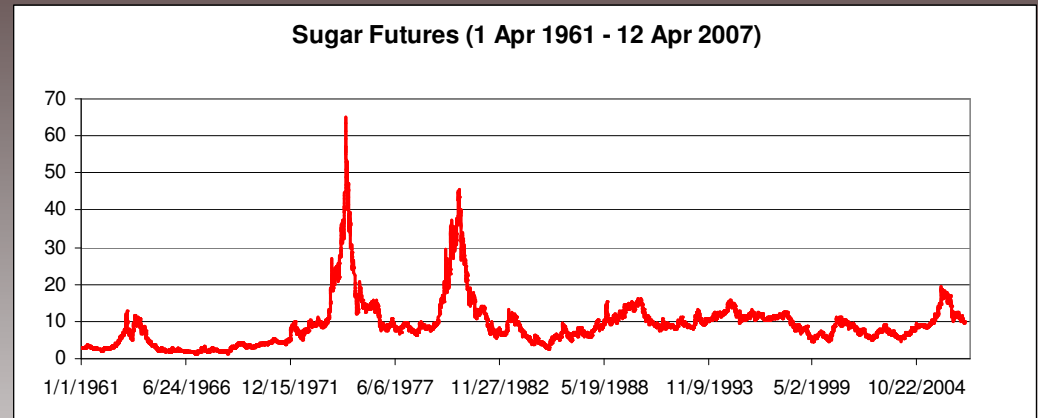
³ NY sugar finishes firm on specs, switch trade, 11 April 2007, 11:30 Reuters News English (c) 2007 Reuters Limited



Sugar Direction

- The revised forecast surplus adds to the largely bearish backdrop for the market

Source: Global Financial Database



Our View

Given the recent trends, Sugar's direction is not expected to change:

- The consensus is that there is large amounts of sugar will hang heavily over the market¹
- Traders have recently said that attempts by investors to drive sugar prices higher have been short-circuited by the abundant supplies in the market¹
- The International Sugar Organization (ISO) Chief (Mr. Peter Baron) has recently stated that world sugar prices were likely to fall further this year²

¹ NY sugar finishes firm on specs, switch trade, 11 April 2007, 11:30 Reuters News English (c) 2007 Reuters Limited

² UPDATE 2-London sugar ends near 5-1/2-wk high before expiry 12 April 2007, 13:13. Reuters News English (c) 2007 Reuters Limited



Our View



Direction: DOWN
Certainty: UNSURE

of contracts to hedge: 649



Map of Alternatives

	Level of Confidence		
	Uncertain	= market	Certain
Directions vs. Market View	Volatility up (option prices cheap)	Volatility stable (option prices fair)	Volatility down (option prices rich)
Up			
Stable	* Alternative II (Long Stradle)	* Alternative III (Forward Hedge)	
Down	Recommended Position (Long Put)	* Alternative I (Bear Spread)	



Source: NYBOT, as of March 30, 2007 (for all alternatives)

Recommendation

Syn. Long Put = $-F+C$:

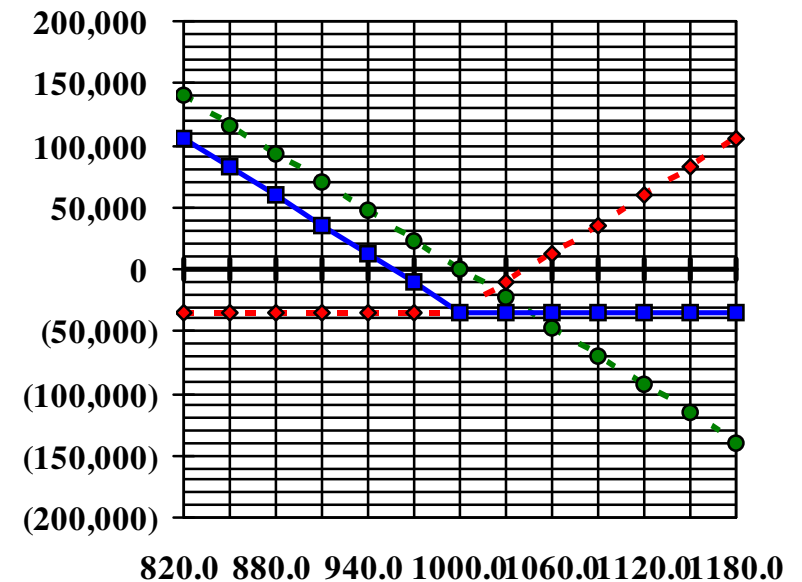
View: prices will go down, but volatility is high.

S	L
F	C
1000.0	1000.0
0.00	44.00
776	776

	-776F	+776C	Sum
820.0	139,680	(34,144)	105,536
850.0	116,400	(34,144)	82,256
880.0	93,120	(34,144)	58,976
910.0	69,840	(34,144)	35,696
940.0	46,560	(34,144)	12,416
970.0	23,280	(34,144)	(10,864)
1000.0	0	(34,144)	(34,144)
1030.0	(23,280)	(10,864)	(34,144)
1060.0	(46,560)	12,416	(34,144)
1090.0	(69,840)	35,696	(34,144)
1120.0	(93,120)	58,976	(34,144)
1150.0	(116,400)	82,256	(34,144)
1180.0	(139,680)	105,536	(34,144)



Combined Sum Position



Price at Contract Maturity



Alternative I

Syn. Bear Spread = $-F + C_{OTM} - P_{OTM}$:

OTM strike prices are designed to accommodate a 10% range of expected volatility

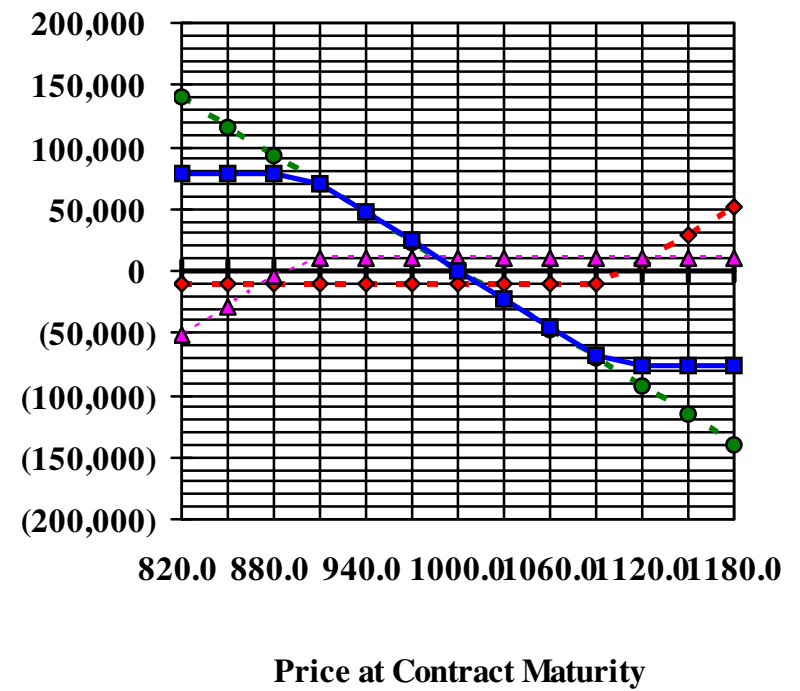
View: Prices down, less volatility

S	L	S
F	C	P
1000.0	1100.0	900.0
0.00	13.00	14.00
776	776	776

	-776F	+776C	-776P	Sum
820.0	139,680	(10,088)	(51,216)	78,376
850.0	116,400	(10,088)	(27,936)	78,376
880.0	93,120	(10,088)	(4,656)	78,376
910.0	69,840	(10,088)	10,864	70,616
940.0	46,560	(10,088)	10,864	47,336
970.0	23,280	(10,088)	10,864	24,056
1000.0	0	(10,088)	10,864	776
1030.0	(23,280)	(10,088)	10,864	(22,504)
1060.0	(46,560)	(10,088)	10,864	(45,784)
1090.0	(69,840)	(10,088)	10,864	(69,064)
1120.0	(93,120)	5,432	10,864	(76,824)
1150.0	(116,400)	28,712	10,864	(76,824)
1180.0	(139,680)	51,992	10,864	(76,824)



Combined Sum Position



—●— -776F
 —◆— +776C
 —▲— -776P
 —■— Sum

Alternative II

Syn. Short Stradle

$$= -F + 2C_{OTM}$$

The C_{OTM} strike prices is designed to reflect the higher probability of prices going down, within the expected high volatility

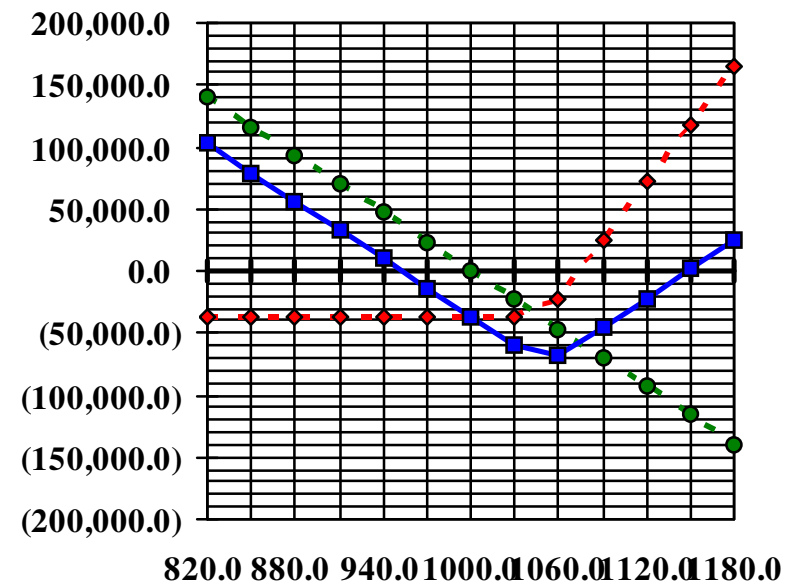
View: High volatility

S	L
F	C
1000.0	1050.0
0.00	24.00
776	1552

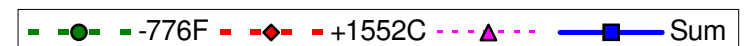


	-776F	+1552C	Sum
820.0	139,680	(37,248)	102,432
850.0	116,400	(37,248)	79,152
880.0	93,120	(37,248)	55,872
910.0	69,840	(37,248)	32,592
940.0	46,560	(37,248)	9,312
970.0	23,280	(37,248)	(13,968)
1000.0	0	(37,248)	(37,248)
1030.0	(23,280)	(37,248)	(60,528)
1060.0	(46,560)	(21,728)	(68,288)
1090.0	(69,840)	24,832	(45,008)
1120.0	(93,120)	71,392	(21,728)
1150.0	(116,400)	117,952	1,552
1180.0	(139,680)	164,512	24,832

Combined Sum Position



Price at Contract Maturity



Alternative III

Forward Hedge:

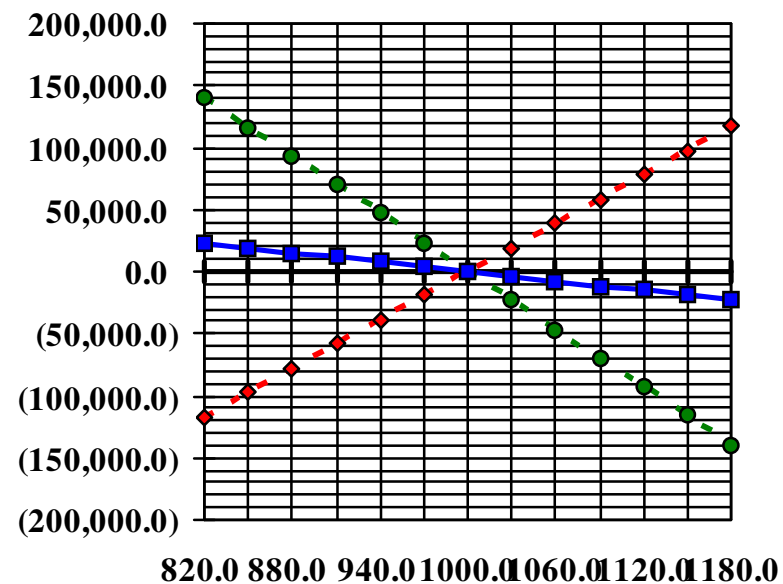
$$= -F + F:$$

View: Price stable, low volatility

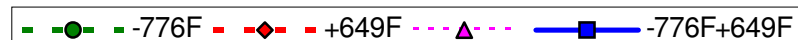
S	L
F	F
1000.0	1000.0
0.00	0.00
776	649



Combined -776F+649F Position



Price at Contract Maturity



Correlation



Introduction

- To further analyze Hershey's risk management challenges, we performed basic correlation analysis
- By using a “portfolio approach”, instead of separate analysis for each risk factor (each commodity), Hershey's could potentially decrease the need for hedging
- The correlation analysis is based on cocoa and sugar prices from the past 12 months.



Correlation Analysis

Correlation Sugar-Cocoa
P-Value = 0.014

0.1563

STATISTICALLY SIGNIFICANT AT 98.5% CONFIDENCE

	Daily	Annual
Average Return Sugar	-0.16%	-40%
Average Return Cocoa	0.08%	20%
St. Dev Sugar	1.97%	31%
St. Dev Cocoa	1.35%	21%
Variance Sugar	0.000387	0.0965
Variance Cocoa	0.000182	0.0452

Covariance Sugar-Cocoa

0.000041289



Correlation Analysis



	Portfolio
Weight Sugar	20%
Weight Cocoa	80%

	Daily	Annual
Return Portfolio	0.03%	8.31%
Variance Portfolio	0.000145	0.0361
St. Dev Portfolio	1.20%	19.0%
VALUE AT RISK (Portfolio)		
95% Confidence	-1.947%	-22.941%
99% Confidence	-2.772%	-35.956%



Conclusions

- Sugar and Cocoa are statistically correlated (significant correlation, p-value = 0.014). However, their correlation is low (just 0.1563), which allows us to reduce dramatically the risk of our overall position through diversification by combining both underlying assets in our hedging position
- Thus, if we only had Sugar, the annual 95% VaR = -90.8%, and if only Cocoa, the annual 95% Var = -14.7%
- Therefore, Sugar is extremely riskier. But when combining both of them (20% Sugar, 80% Cocoa), the overall annual 95% Var is just -22.9%



Portfolio Hedging

Base on the correlation analysis, we can calculated hedging for the portfolio of both sugar and cocoa:

Underlying	t	${}_0F_t$	${}_0R_t$	${}_0R_{pt}$	St market	δ	Short Crit Price
Portfolio	0.2548	1786.4	5%	0	1786.4	19.00%	2,082.67

Underlying	Loss @ Lower Crit	Target Loss	Cut risk by	# Exposure	Hedge
Portfolio	16.59%	5.00%	69.85%	1560	1,090

The portfolio approach resulted in lower hedging level, reducing the need risk cut of 85% and 84% for cocoa and sugar respectively, down to 70% for the combined portfolio

