



# Derivatives Group Project: Ford Motor Company Hedging Yen Foreign Exchange Exposure



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# Ford Motor Company Background

- The world's second largest motor vehicle manufacturer.
- Produces cars and trucks, and many of the vehicles' plastic, glass and electronic components, and replacement parts.
- Owns a 33% stake in Mazda Motor Corp. Financial services include Ford Motor Credit (automotive financing and insurance) and American Road Insurance Co.

Source: S&P Analyst Reports





# Project Definition



- Ford's treasury department would like to reduce Mazda's potential profit deterioration from exchange rate translation.
- Treasury management estimates a 7% profit margin on a 267B Yen (~\$2.29B @ \$0.008574/Yen) receivable (profit from 7% of \$2.29B = \$160.3M) from Mazda Motor Corporation sales.
- Risk guidelines stipulate that exchange rate related-profit erosion should be limited to 25% of the profit margin or \$40.07M (= 25% of 7% of \$2.29B).
- Treasury would like to reduce exchange rate risk through entering into yen futures contracts.



# Market Trend

## Economy

- The Japanese economy is steady and strong so the Bank of Japan will increase the interest rate earlier than expected (Jun-Jul)
- There is uncertainty about the US's economy due to sub prime mortgage woes and the rising current account deficit. (US Economic growth slowed to its weakest pace in four years during the first three months of 2007)

## Recent signs of Dollar weakness

- Euro near record highs
- British Pound broke through \$2 barrier
- Fed reluctant to raise rates despite mild inflationary fears



# Japanese Yen Currency Market

## Our View:

- JPY will appreciate slightly
- Volatility will be lower than the market implies
  - We prefer to short options
- Expected exchange rate range:  
\$0.0086-0.0089/Yen
- JPY exchange rate as of 2 Apr 2007 was  
\$0.00842



# Market Data

- Chicago Mercantile Exchange Option Premiums

Strike Price (\$/Yen)	Premium (\$)	
	Call	Put
0.00800	0.000000	0.000004
0.00805	0.000000	0.000006
0.00810	0.000000	0.000008
0.00815	0.000000	0.000012
0.00820	0.000000	0.000017
0.00825	0.000242	0.000025
0.00830	0.000204	0.000036
0.00835	0.000169	0.000051
0.00840	0.000138	0.000070
0.00845	0.000113	0.000094
0.00850	0.000091	0.000122

Strike Price (\$/Yen)	Premium (\$)	
	Call	Put
0.00855	0.000073	0.000153
0.00860	0.000059	0.000189
0.00865	0.000049	0.000229
0.00870	0.000040	0.000269
0.00875	0.000033	0.000312
0.00880	0.000028	0.000357
0.00885	0.000025	0.000403
0.00890	0.000022	0.000450
0.00895	0.000019	0.000000
0.00900	0.000017	0.000000

- Futures price: \$0.008574/Yen
- All data is as of 2 Apr 2007



# Value at Risk

- Our underlying exposure is a \$2.29B receivable
  - Equal to 21360 futures contracts
- Our allowable loss limit is \$40.07M
- We only want a 5% chance of exceeding our loss limit
- Expected future price is \$0.008574/Yen
  - Upper critical price = \$0.00922/Yen
  - Lower critical price = \$0.00797/Yen
- Risk Calculation Results
  - We must hedge 16055 contracts
  - We may leave 5305 contracts exposed

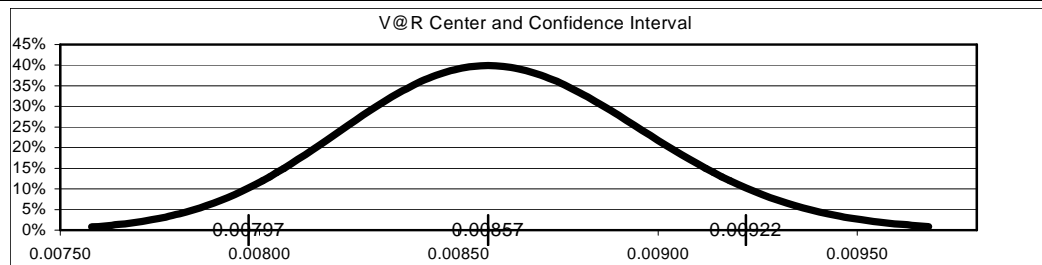


# Value at Risk Calculations

(all \$ in millions)

Price Value at Risk (V@R)		Underlying <b>JPY</b>	
Today <b>4/2/2007</b>	Futures price	<b>0.008574</b>	Monthly price volatility (stan. dev.) <b>2.7161</b>
Risk Limit	<b>-40.07</b>	# of contract underlying	<b>12.5</b>
# s.d. V@R (e.g. 1.00)	<b>1.65</b>	Exposure (+/-Contracts)	<b>21360</b>
Exposure (maturity) Date	<b>6/20/2007</b>	\$ underlying	\$2,289
For risk premium-adjusted V@R	<b>Adjustment (+/-Contracts)</b>		<b>-16055</b>
Funding Rate	<b>5.00%</b>	Monthly Estimates	T>30 days= <b>79</b>
Risk Premium Estimate	<b>0.00%</b>	Riskmetrics (optional)	Riskmetrics inferred (optional)
		weight last 150 obs. Own estimate	monthly vol*sqrt(79/30) Own estimate
Standard deviations (s.d. E.g. 1% as 1.0)		2.7161	2.7161
Long V@R @ price*exp(-#*sd)		0.0082	0.0082
\$ V@R		-25	-25
Long upside @ price*exp(+*sd)		0.0090	0.0090
\$ profit		26	26

For Volatility - standard deviation information,  
<http://riskmetrics.com/clients/data/cde/index.cgi>  
 user is guriskmetrics  
 password is riskmetrics



Probability of doing worse than -1.65 standard deviation (or 0.0080) is 4.95%

Note: Riskmetrics assumes a zero risk premium.

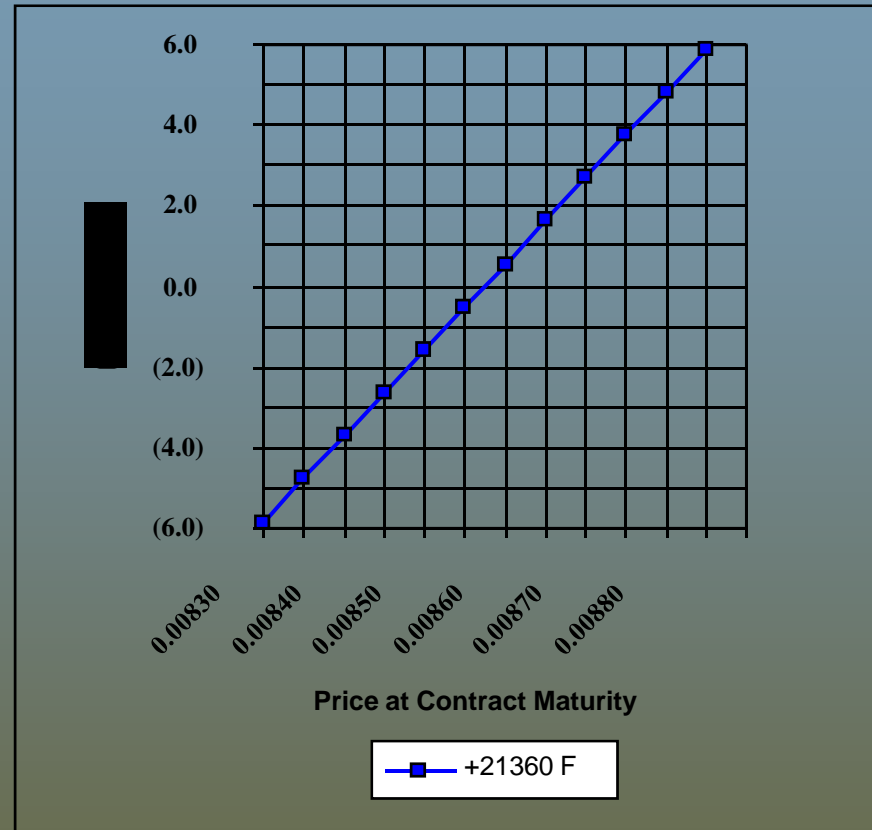
If the graph doesn't plot, click the X-axis and format axis "scale" to bracket price range.



# Original Position

Exposure: +21360 F contracts at  
0.008574 \$/¥

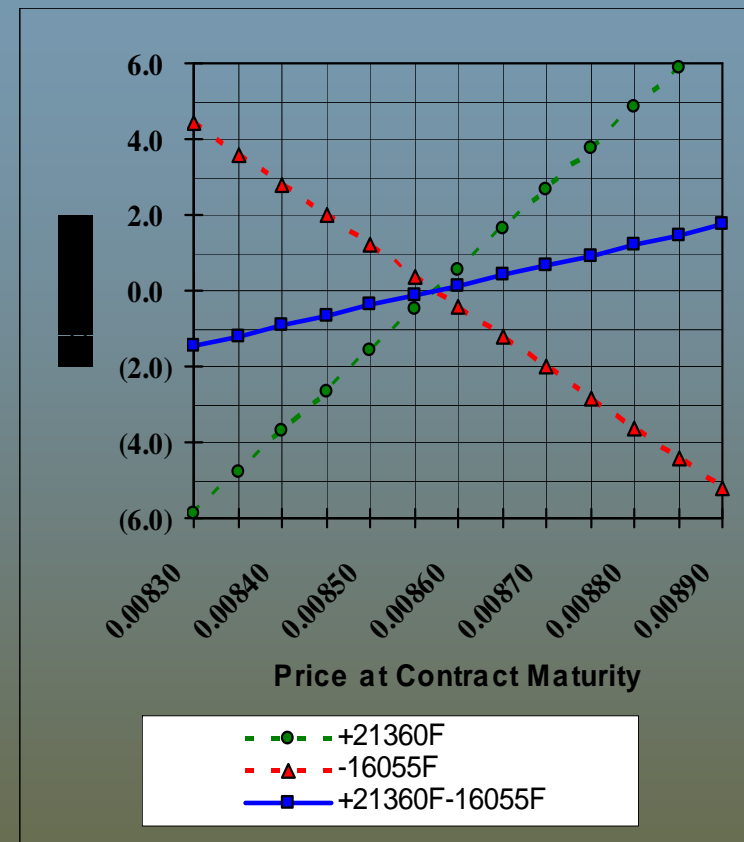
	+21360F	Profit (\$M)
0.00797	(12.9)	(\$161.27)
0.00830	(5.9)	(\$73.16)
0.00835	(4.8)	(\$59.81)
0.00840	(3.7)	(\$46.46)
0.00845	(2.6)	(\$33.11)
0.00850	(1.6)	(\$19.76)
0.00855	(0.5)	(\$6.41)
0.00860	0.6	\$6.94
0.00865	1.6	\$20.29
0.00870	2.7	\$33.64
0.00875	3.8	\$46.99
0.00880	4.8	\$60.34
0.00885	5.9	\$73.69
0.00890	7.0	\$87.04
0.00895	8.0	\$100.39
0.00900	9.1	\$113.74
0.00922	13.8	\$172.48



# Alternative A: Short Forward Hedge

- Original exposure: +21360 F contracts at 0.008574 \$/¥
- 75% hedged with a -16055 F short

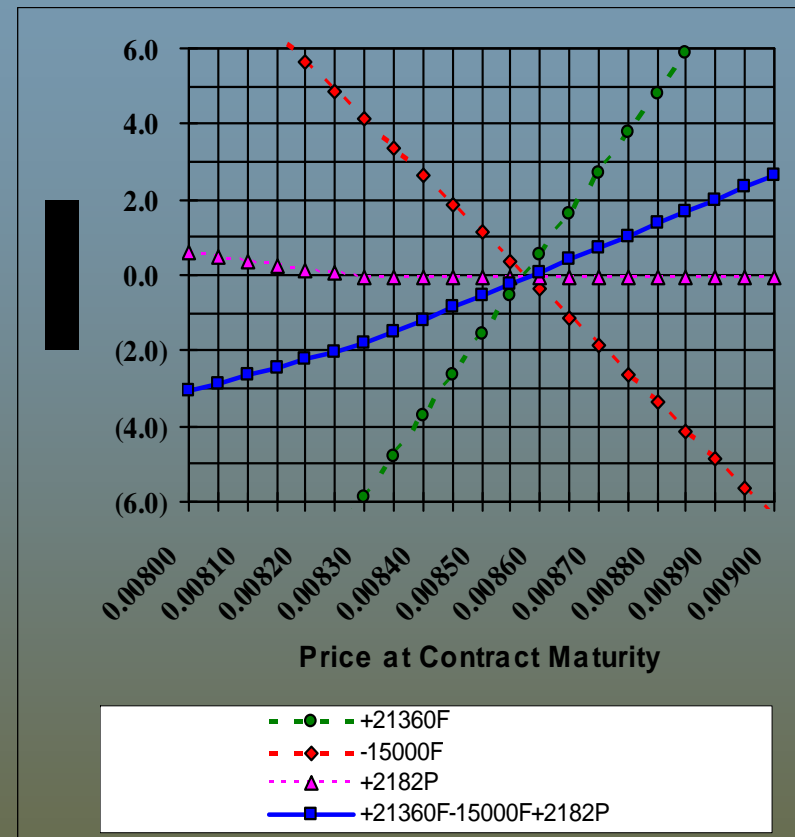
	+21360F	-16055F	Combined	Profit (\$M)
0.00797	(12.9)	9.7	(3.2)	(\$40.05)
0.00830	(5.9)	4.4	(1.5)	(\$18.17)
0.00835	(4.8)	3.6	(1.2)	(\$14.85)
0.00840	(3.7)	2.8	(0.9)	(\$11.54)
0.00845	(2.6)	2.0	(0.7)	(\$8.22)
0.00850	(1.6)	1.2	(0.4)	(\$4.91)
0.00855	(0.5)	0.4	(0.1)	(\$1.59)
0.00860	0.6	(0.4)	0.1	\$1.72
0.00865	1.6	(1.2)	0.4	\$5.04
0.00870	2.7	(2.0)	0.7	\$8.36
0.00875	3.8	(2.8)	0.9	\$11.67
0.00880	4.8	(3.6)	1.2	\$14.99
0.00885	5.9	(4.4)	1.5	\$18.30
0.00890	7.0	(5.2)	1.7	\$21.62
0.00895	8.0	(6.0)	2.0	\$24.93
0.00900	9.1	(6.8)	2.3	\$28.25
0.00922	13.8	(10.4)	3.4	\$42.84



# Alternative B: Partial Synthetic Call

- View: Up, insure against significant downside
- -F to meet risk guidelines
- +P<sub>otm</sub> at 0.00830 \$/¥

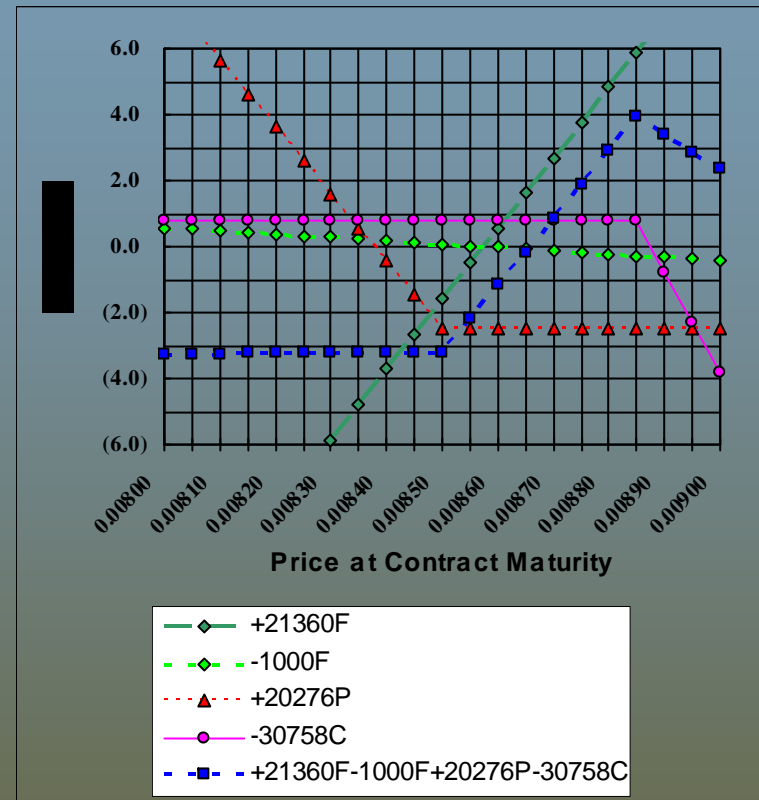
	+21360F	-15000F	+2182P	Combined	Profit (\$M)
0.00797	(12.9)	9.1	0.6	(3.2)	(\$40.00)
0.00840	(3.7)	2.6	(0.1)	(1.2)	(\$14.81)
0.00845	(2.6)	1.9	(0.1)	(0.9)	(\$10.84)
0.00850	(1.6)	1.1	(0.1)	(0.5)	(\$6.86)
0.00855	(0.5)	0.4	(0.1)	(0.2)	(\$2.89)
0.00860	0.6	(0.4)	(0.1)	0.1	\$1.09
0.00865	1.6	(1.1)	(0.1)	0.4	\$5.06
0.00870	2.7	(1.9)	(0.1)	0.7	\$9.04
0.00875	3.8	(2.6)	(0.1)	1.0	\$13.01
0.00880	4.8	(3.4)	(0.1)	1.4	\$16.99
0.00885	5.9	(4.1)	(0.1)	1.7	\$20.96
0.00890	7.0	(4.9)	(0.1)	2.0	\$24.94
0.00895	8.0	(5.6)	(0.1)	2.3	\$28.91
0.00900	9.1	(6.4)	(0.1)	2.6	\$32.89
0.00922	13.8	(9.7)	(0.1)	4.0	\$50.38



# Alternative C: Bull Spread

- View: Limited up, insure downside, sell upside to generate income
- $+P_{otm}$  at 0.00850  $\$/\yen$
- $-C_{otm}$  at 0.00885  $\$/\yen$

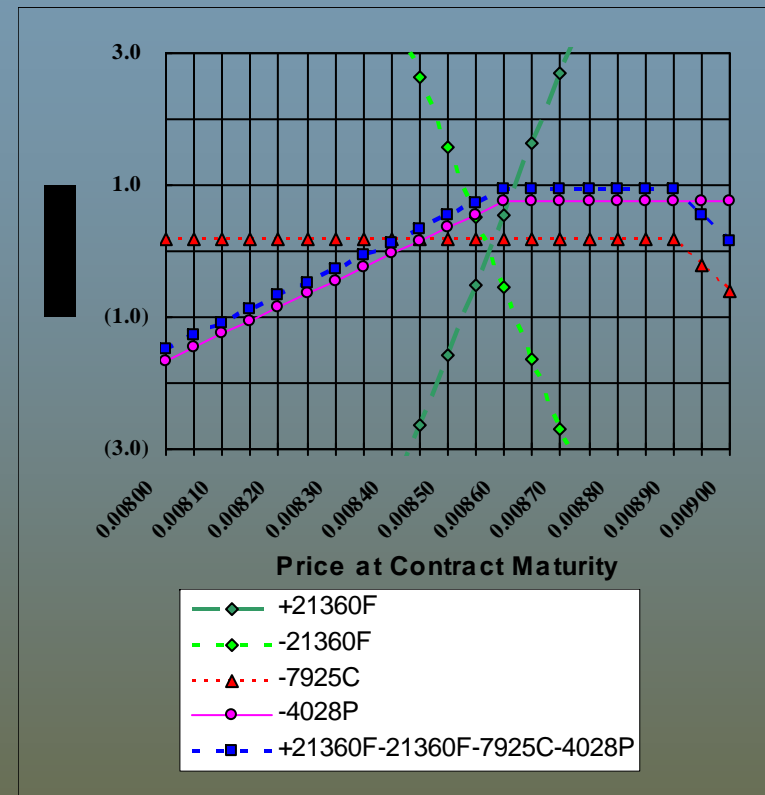
	+21360F	-2100F	+19000P	-29345C	Combined	Profit (\$M)
0.00797	(12.9)	1.3	7.8	0.7	(3.1)	(\$39.34)
0.00840	(3.7)	0.4	(0.4)	0.7	(3.0)	(\$37.95)
0.00845	(2.6)	0.3	(1.4)	0.7	(3.0)	(\$37.78)
0.00850	(1.6)	0.2	(2.3)	0.7	(3.0)	(\$37.62)
0.00855	(0.5)	0.1	(2.3)	0.7	(2.0)	(\$25.58)
0.00860	0.6	(0.1)	(2.3)	0.7	(1.1)	(\$13.55)
0.00865	1.6	(0.2)	(2.3)	0.7	(0.1)	(\$1.51)
0.00870	2.7	(0.3)	(2.3)	0.7	0.8	\$10.53
0.00875	3.8	(0.4)	(2.3)	0.7	1.8	\$22.57
0.00880	4.8	(0.5)	(2.3)	0.7	2.8	\$34.60
0.00885	5.9	(0.6)	(2.3)	0.7	3.7	\$46.64
0.00890	7.0	(0.7)	(2.3)	(0.7)	3.2	\$40.34
0.00895	8.0	(0.8)	(2.3)	(2.2)	2.7	\$34.04
0.00900	9.1	(0.9)	(2.3)	(3.7)	2.2	\$27.73
0.00905	10.2	(1.0)	(2.3)	(5.1)	1.7	\$21.43
0.00910	11.2	(1.1)	(2.3)	(6.6)	1.2	\$15.13
0.00915	12.3	(1.2)	(2.3)	(8.1)	0.7	\$8.82
0.00920	13.4	(1.3)	(2.3)	(9.5)	0.2	\$2.52
0.00922	13.8	(1.4)	(2.3)	(10.1)	(0.0)	(\$0.00)



# Alternative D: Short Strangle

- View: Neutral direction, trade volatility outside of 0.00860 - 0.00890 range
- Fully hedge +F with equal -F
- $-C_{otm}$  at 0.00890  $\$/\yen$
- $-P_{itm}$  at 0.00860  $\$/\yen$

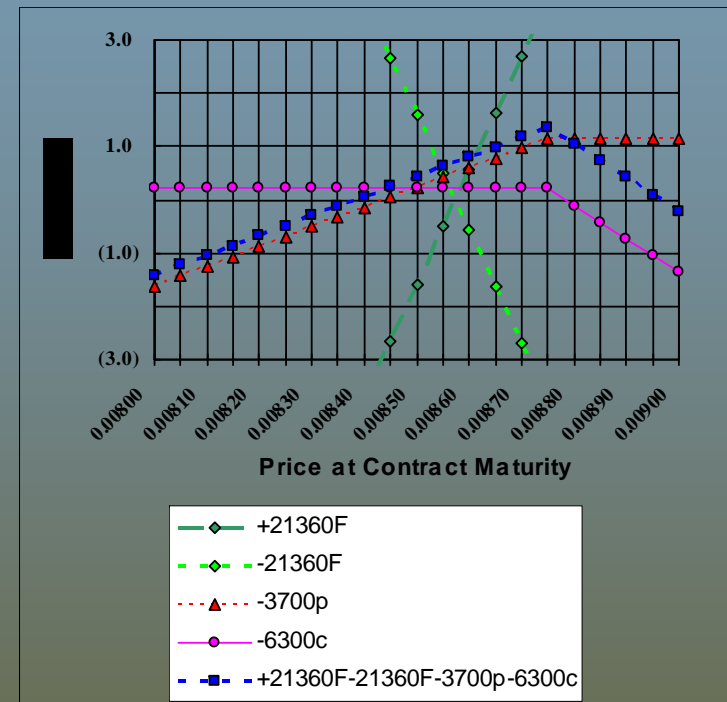
	+21360F	-21360F	-7925C	-4028P	Combined	Profit (\$M)
0.00797	(12.9)	12.9	0.2	(1.8)	(1.6)	(\$20.02)
0.00840	(3.7)	3.7	0.2	(0.0)	0.1	\$1.63
0.00845	(2.6)	2.6	0.2	0.2	0.3	\$4.14
0.00850	(1.6)	1.6	0.2	0.4	0.5	\$6.66
0.00855	(0.5)	0.5	0.2	0.6	0.7	\$9.18
0.00860	0.6	(0.6)	0.2	0.8	0.9	\$11.70
0.00865	1.6	(1.6)	0.2	0.8	0.9	\$11.70
0.00870	2.7	(2.7)	0.2	0.8	0.9	\$11.70
0.00875	3.8	(3.8)	0.2	0.8	0.9	\$11.70
0.00880	4.8	(4.8)	0.2	0.8	0.9	\$11.70
0.00885	5.9	(5.9)	0.2	0.8	0.9	\$11.70
0.00890	7.0	(7.0)	0.2	0.8	0.9	\$11.70
0.00895	8.0	(8.0)	(0.2)	0.8	0.5	\$6.74
0.00900	9.1	(9.1)	(0.6)	0.8	0.1	\$1.79
0.00905	10.2	(10.2)	(1.0)	0.8	(0.3)	(\$3.16)
0.00910	11.2	(11.2)	(1.4)	0.8	(0.6)	(\$8.12)
0.00915	12.3	(12.3)	(1.8)	0.8	(1.0)	(\$13.07)
0.00920	13.4	(13.4)	(2.2)	0.8	(1.4)	(\$18.02)
0.00922	13.8	(13.8)	(2.4)	0.8	(1.6)	(\$20.00)



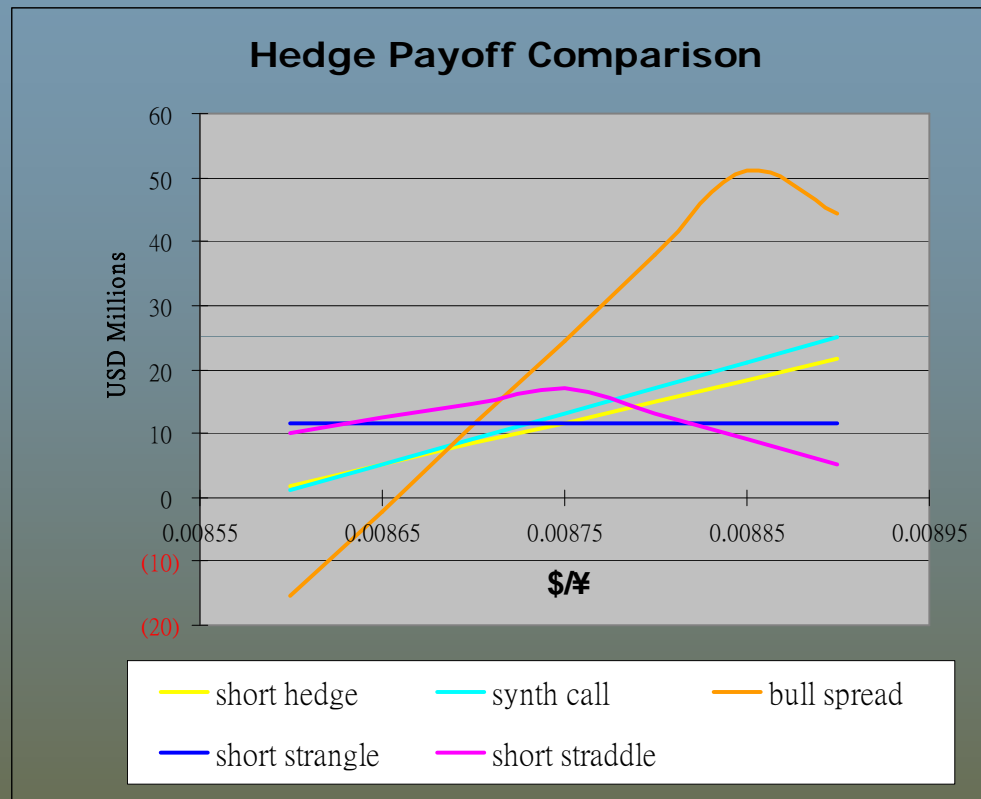
# Alternative E: Short Straddle

- View: Neutral direction, trade volatility
- Fully hedge +F with equal -F
- $-C_{otm}$  at 0.00875  $\$/\yen$
- $-P_{itm}$  at 0.00875  $\$/\yen$

	+21360F	-21360F	-3700P	-6300C	Combined	Profit (\$M)
0.00797	(12.9)	12.9	(1.7)	0.2	(1.5)	(\$19.05)
0.00840	(3.7)	3.7	(0.1)	0.2	0.1	\$0.84
0.00845	(2.6)	2.6	0.0	0.2	0.3	\$3.15
0.00850	(1.6)	1.6	0.2	0.2	0.4	\$5.47
0.00855	(0.5)	0.5	0.4	0.2	0.6	\$7.78
0.00860	0.6	(0.6)	0.6	0.2	0.8	\$10.09
0.00865	1.6	(1.6)	0.8	0.2	1.0	\$12.40
0.00870	2.7	(2.7)	1.0	0.2	1.2	\$14.72
0.00875	3.8	(3.8)	1.2	0.2	1.4	\$17.03
0.00880	4.8	(4.8)	1.2	(0.1)	1.0	\$13.09
0.00885	5.9	(5.9)	1.2	(0.4)	0.7	\$9.15
0.00890	7.0	(7.0)	1.2	(0.7)	0.4	\$5.22
0.00895	8.0	(8.0)	1.2	(1.1)	0.1	\$1.28
0.00900	9.1	(9.1)	1.2	(1.4)	(0.2)	(\$2.66)
0.00905	10.2	(10.2)	1.2	(1.7)	(0.5)	(\$6.60)
0.00910	11.2	(11.2)	1.2	(2.0)	(0.8)	(\$10.53)
0.00915	12.3	(12.3)	1.2	(2.3)	(1.2)	(\$14.47)
0.00920	13.4	(13.4)	1.2	(2.6)	(1.5)	(\$18.41)
0.00922	13.8	(13.8)	1.2	(2.8)	(1.6)	(\$19.98)



# Map of Alternatives



# Recommendation

Our recommendation is Alternative D: Short Strangle

- The position ensures we are profitable throughout our expected exchange rate range of 0.0086-0.0089 \$/¥.
- Our 5% loss limit of \$40.07M is satisfied.
- Position sacrifices benefits from potential upside, but maximizes profits throughout our expected range.
- Alternative E: Short Straddle, is also acceptable as it provides an average profit of ~\$12M over the expected range, same as the Short Strangle.
- However, we prefer the Short Strangle because we get a consistent payoff of ~\$12M at each strike price within our expected range.

