

Earning embedded fee dynamically

OTC dealer



Earning embedded fee dynamically

- Purpose:
 - Show how OTC option dealer earns fee built into “costless” contract.



Using options to collar stock price

□ Ted Turner's collar:

- *WSJ* (9/17/97) described a stock price collar Ted Turner placed on 2,000,000 shares of Time Warner:
 - bought three-year put with \$39.63 exercise price
 - \$39.63 is guaranteed minimum sales price for shares
 - sold three-year call with \$60.90 exercise price
 - gives up price appreciation beyond \$60.90 to pay for put



Estimating embedded fee

- Deduce embedded fee on collar.
 - Assume:
 - No money changed hands at inception.
 - Both options are European-style.
 - Origination date was 5/12/97.



Estimating embedded fee

- To determine embedded fee, value put and call options.
 - With no fee, call value should equal put value.
 - With embedded fee, call value will exceed put value.



Estimating embedded fee

- On 5/12/97:
 - Stock price is 45.00.
 - Exercise prices are 39.63 and 60.90.
 - Time to expiration is 3 years.



Estimating embedded fee

- On 5/12/97, need values for:
 - interest rate
 - present value of expected dividends
 - volatility



Estimating embedded fee

- Interest rate based on 3-year strip T-bond price, 82.8125.

$$r = \frac{\ln(100 / 82.1825)}{3} = 6.29\%$$

Estimating embedded fee

- Predict futures dividends based on history.

<i>Ex-dividend date</i>	<i>Quarterly dividend</i>	<i>Ex-dividend date</i>	<i>Quarterly dividend</i>	<i>Ex-dividend date</i>	<i>Quarterly dividend</i>
2/21/89	0.0625	12/2/91	0.0625	8/26/94	0.09
5/22/89	0.0625	2/18/92	0.0625	11/28/94	0.09
8/22/89	0.0625	5/27/92	0.0625	2/23/95	0.09
11/20/89	0.0625	8/18/92	0.07	5/25/95	0.09
2/20/90	0.0625	11/25/92	0.07	8/30/95	0.09
5/21/90	0.0625	2/18/93	0.07	11/29/95	0.09
8/21/90	0.0625	5/26/93	0.08	2/28/96	0.09
11/19/90	0.0625	8/18/93	0.08	5/30/96	0.09
2/19/91	0.0625	11/24/93	0.08	8/29/96	0.09
5/21/91	0.0625	2/23/94	0.08	11/27/96	0.09
8/19/91	0.0625	5/25/94	0.09	2/27/97	0.09



Estimating embedded fee

- Patterns appear.
 - Time Warner stock goes ex-dividend near end of the month on quarterly expiration cycle Feb/May/Aug/Nov.
 - Once a quarterly cash dividend amount is set, it is generally held constant until it can be increased again.
 - Dividends are small relative to stock price.



Estimating embedded fee

- Run regression,

$$D_t = \alpha_0 + \alpha_1 t + \varepsilon_t$$

where D_t is quarterly dividend amount and t is trend variable (i.e., $t=1, \dots, 33$).



Estimating embedded fee

- Regression results:
 - Estimated intercept coefficient is 0.054749.
 - Estimated slope coefficient is 0.001209.
 - Using these coefficients and trend variables $t=34, \dots, 45$, you can project the quarterly dividends over next 3 years.



Estimating embedded fee

- Regression results:
 - Rounding each estimated dividend to nearest cent, projected quarterly dividends are:
 - 10 cents per share for each quarter 5/97 through 2/99
 - 11 cents a share from 5/99 through 2/00



Estimating embedded fee

- Regression results:
 - Assuming each dividend is paid at end of the month and using 6.29% interest rate, present value of quarterly cash dividends expected over life of the collar, *PVD*, is 1.13.

Estimating embedded fee

- Estimate volatility.

<i>Description</i>	<i>Daily</i>	<i>Weekly</i>	<i>Monthly</i>
Mean	0.037%	0.180%	0.857%
Volatility	1.684%	3.620%	7.534%
No. of observations	1,260	260	60
Annualization factor	252	52	12
Annualized volatility	26.74%	26.10%	26.10%

Estimating embedded fee

- Supporting file: Turner collar valuation.xlsx

COLLAR VALUATION	
<i>Stock</i>	
Price	45.00
Present value of dividends	1.13
Volatility	26.10%
Interest rate	6.29%
<i>Options</i>	
Put exercise price	39.63
Call exercise price	60.90
Years to expiration	3.00
<i>Collar valuation</i>	
Call value	5.542
Put value	2.662
Call less put	2.881
Number of shares	2,000,000
Embedded fee	5,761,050

Estimating embedded fee





Earning embedded fee

- How does OTC dealer earn fee?
 - By dynamically hedging position until options' expiration in three years.
 - PV of expected revenue is \$5.76 million.



Earning embedded fee

- For simplicity, assume Turner's costless collar has following parameters:
 - 2 million shares of Time Warner stock
 - Exercise price of put is \$30.
 - Exercise price of call is \$60.
 - Both options are European-style and have 1 year to expiration.
 - Stock:
 - Has \$45 share price.
 - Pays no dividends.
 - Has expected return of 15%.
 - Has volatility rate of 40%.
 - One-year risk-free interest rate is 5%.

Earning embedded fee

COLLAR VALUATION

Stock price	45.00
Put exercise price	30.00
Call exercise price	60.00
Time to expiration in years	1.00
Interest rate	5.00%
Expected stock return	15.00%
Volatility rate	40.00%
Call value	3.415
Put value	0.899
Call less put value	2.516
Number of shares	2,000,000
PV of embedded fee	5,032,042
FV of embedded fee	5,290,040



Earning embedded fee

- Use simulation to illustrate OTC dealer's hedging activity.
 - Assume:
 - Manage only stock price risk (i.e., delta-hedge).
 - Reset hedge at end of each month.
 - Supporting file: Earning embedded fee dynamically.xlsx

Earning embedded fee

□ Sample simulation run.

SIMULATION RUN											
Period	Random draw	Closing price	Years to expir.	Put delta	Call delta	Net delta	Aggregate delta	Change in delta	Shares sold	Cash paid/received	Terminal value of cash
0		45.000	1.0000	-0.0903	0.3467	0.4371	874,111		-874,111	39,334,984	41,351,734
1	0.6999	49.073	0.9167	-0.0552	0.4154	0.4706	941,179	67,068	-67,068	3,291,244	3,445,603
2	-0.8738	44.623	0.8333	-0.0832	0.3035	0.3867	773,441	-167,738	167,738	-7,484,906	-7,803,365
3	0.2071	45.970	0.7500	-0.0651	0.3130	0.3780	756,091	-17,351	17,351	-797,608	-828,086
4	-0.8238	42.043	0.6667	-0.0970	0.2051	0.3021	604,210	-151,880	151,880	-6,385,521	-6,601,959
5	0.6024	45.336	0.5833	-0.0548	0.2517	0.3065	613,076	8,865	-8,865	401,922	413,817
6	-1.3135	39.183	0.5000	-0.1202	0.1009	0.2211	442,124	-170,952	170,952	-6,698,495	-6,868,069
7	1.4243	46.458	0.4167	-0.0285	0.2174	0.2459	491,815	49,691	-49,691	2,308,564	2,357,164
8	0.8059	51.287	0.3333	-0.0060	0.3114	0.3175	634,954	143,139	-143,139	7,341,176	7,464,554
9	-0.7246	47.446	0.2500	-0.0071	0.1560	0.1630	326,023	-308,932	308,932	-14,657,705	-14,842,077
10	0.6269	51.307	0.1667	-0.0003	0.2045	0.2048	409,556	83,533	-83,533	4,285,847	4,321,712
11	0.6788	55.815	0.0833	0.0000	0.2972	0.2972	594,491	184,935	-184,935	10,322,130	10,365,229
12	-0.2566	54.502	0.0000	0.0000	0.0000	0.0000	0	-594,491	594,491	-32,401,122	-32,401,124
							Totals		0		375,133

	Shares outstanding	Terminal share price	Terminal value
Terminal value of cash account			375,133
Cover remaining shares outstanding	0	54.502	0
Bank exercises call option			0
Customer exercises put option			0
Net proceeds from selling collar			375,133

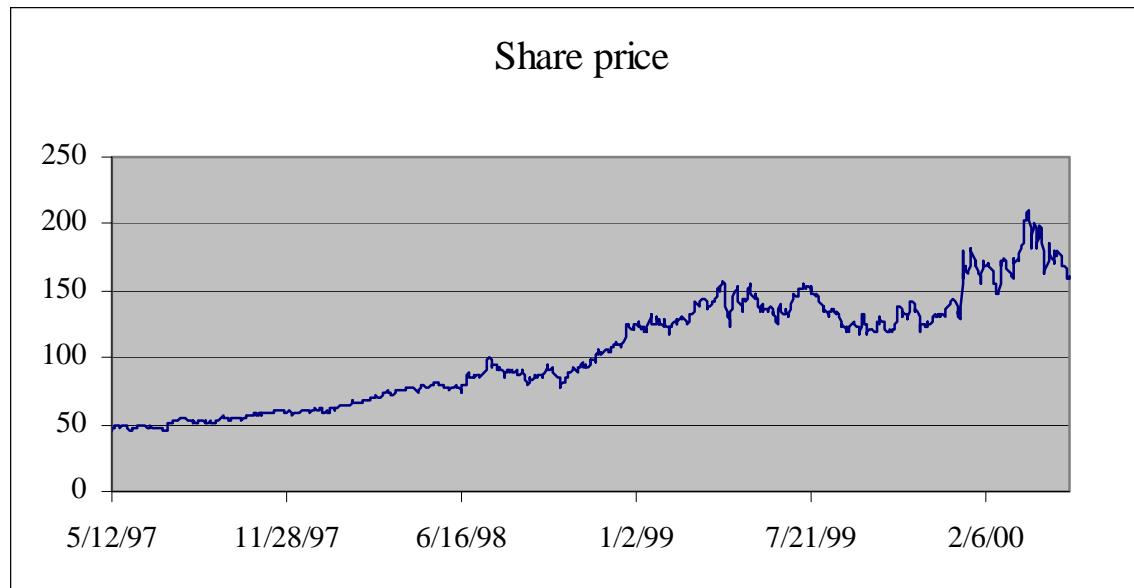
Earning embedded fee

- Results using different time increments.
 - Optimal rule in this application is 6 times per day.

	Mean	StDev	Minimum	Maximum	Average number of shares traded	After trading cost profit	Profit per unit of risk
Monthly	5,191,907	4,108,591	-10,008,845	26,521,463	3,135,707	4,878,336	1.187
Weekly	5,343,014	2,002,836	-631,657	13,943,237	5,192,995	4,823,714	2.408
Daily	5,285,976	786,634	2,174,783	8,786,527	12,085,420	4,077,434	5.183
Every 4 hours	5,290,299	301,906	4,316,409	6,852,635	27,957,722	2,494,527	8.263
Every 2 hours	5,296,894	214,420	4,418,705	6,416,575	38,567,903	1,440,104	6.716
Every hour	5,304,550	151,603	4,646,940	6,116,745	54,896,398	-185,089	-1.221

Turner's lament

- ❑ What did happen?
 - ❑ TWX tripled in price over next 3 years.





Turner's lament

- ❑ With no collar, Turner would have earned
 - ❑ $$(161.50 - 45.00)$ times 2 million shares
 - ❑ \$233,000,000!
- ❑ With collar in place, he earned only
 - ❑ $$(60.90 - 45.00)$ times 2 million shares
 - ❑ \$31,800,000



Turner's lament

- OTC dealer:
 - With no hedge, would have earned
 - \$233,000,000-31,800,000 or \$201,200,000
 - With hedge, should have earned
 - PV of \$5.76 million
 - FV of \$6.96 million



Lesson summary

- OTC contracts have embedded fees.
 - They are not generally transparent.
- Fees can be estimated by applying option valuation mechanics.
- To lock-in fee, OTC dealer must dynamically hedge over life of contract.