Earning embedded fee dynamically

OTC dealer

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Earning embedded fee dynamically

- Context:
  - Many OTC derivatives embedded fees that are not transparent.
    - Often referred to as “costless” contracts.
- Purpose:
  - Identify embedded fee.
  - Show how embedded fee is earned.

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Using options to collar stock price

- Ted Turner's "costless" collar:
  - *WSJ* (9/17/97) described 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

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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.

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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.

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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.

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Estimating embedded fee

- On 5/12/97, need values for:
  - Interest rate
  - Present value of expected dividends
  - Volatility

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Estimating embedded fee

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

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

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Estimating embedded fee

- Predict futures dividends based on history.

Ex-dividend date	*Quarterly dividend*	*Ex-dividend date*	*Quarterly dividend*	*Ex-dividend date*	*Quarterly dividend*
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

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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.

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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,…,33).

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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,…,45, you can project the quarterly dividends over next 3 years.

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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.

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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.

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Estimating embedded fee

- Estimate volatility.

Description	*Daily*	*Weekly*	*Monthly*
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%

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Estimating embedded fee

- Supporting file: Turner collar valuation.xlsx

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

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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.

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Earning embedded fee

- To simplify matters, assume 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%.

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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**

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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.

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Earning embedded fee

- Sample simulation run.

Simulation run

Period	Random draw, z	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	-0.9446	40.586	0.9167	-0.1356	0.2390	0.3746	749,146	-124,965	124,965	-5,071,822	-5,309,691
2	-0.4149	38.914	0.8333	-0.1565	0.1870	0.3434	686,846	-62,300	62,300	-2,424,347	-2,527,495
3	-1.9096	31.396	0.7500	-0.3399	0.0561	0.3960	792,024	105,178	-105,178	3,302,177	3,428,360
4	0.5062	33.481	0.6667	-0.2738	0.0642	0.3379	675,819	-116,204	116,204	-3,890,623	-4,022,497
5	-0.2421	32.748	0.5833	-0.2963	0.0415	0.3378	675,526	-294	294	-9,613	-9,898
6	0.9109	36.593	0.5000	-0.1756	0.0645	0.2401	480,131	-195,395	195,395	-7,150,157	-7,331,164
7	0.6197	39.538	0.4167	-0.1005	0.0799	0.1804	360,758	-119,374	119,374	-4,719,798	-4,819,159
8	0.2846	41.098	0.3333	-0.0605	0.0734	0.1339	267,831	-92,927	92,927	-3,819,119	-3,883,304
9	-0.2758	40.043	0.2500	-0.0541	0.0315	0.0856	171,178	-96,653	96,653	-3,870,240	-3,918,921
10	-2.0127	31.925	0.1667	-0.3038	0.0001	0.3039	607,822	436,643	-436,643	13,939,687	14,056,337
11	0.9842	35.976	0.0833	-0.0478	0.0000	0.0478	95,529	-512,293	512,293	-18,430,291	-18,507,245
12	-1.0238	**32.152**	0.0000	0.0000	0.0000	0.0000	0	-95,529	95,529	-3,071,432	-3,071,432
							Totals		**0**		**5,435,623**

EMBEDDED FEE SIMULATION
This sheet demonstrates how an OTC dealer can dynamically hedge to lock in the fee that was embedded in an OTC costless collar at contract inception. The demonstration is carried out using Monte Carlo simulation to generate random price paths over the one-year holding period.

	Shares outstanding	Terminal share price	Terminal value
Terminal value of cash account			5,435,623
Cover remaining shares outstanding	0	32.152	0
Bank exercises call option			0
Customer exercises put option			0
Net proceeds from selling collar			5,435,623

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Earning embedded fee

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

Summary of shares traded by frequency of rebalancing

	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

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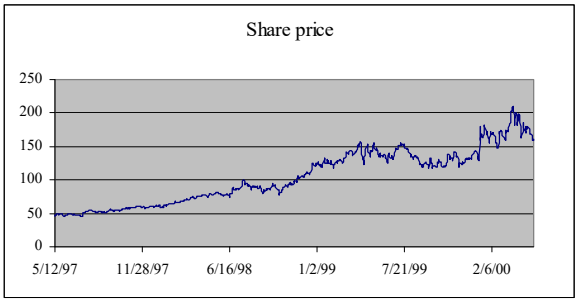
Turner's lament

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



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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

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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

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Lesson summary

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

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