Stock derivatives

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Stock derivatives

- Context:
  - Have developed tools needed to understand derivatives valuation and risk measurement.
  - Apply tools in specific asset markets.
- Purpose:
  - Describe stock derivatives market development.
  - Value contracts.
  - Discuss popular “dividend capture” strategy.

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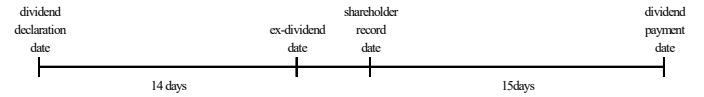
Stock derivatives

- Dividend-paying stocks:
  - If dividends are paid, adjustments need to be made.
    - Since cash dividends are predictable in amount and timing, adjustments are straightforward.

FIGURE 8-2: Median number of calendar days between quarterly dividend dates for NYSE/AMEX and NASDAQ stocks during the calendar years 1996 through 2000.



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Stock futures

- Stock futures began trading in US in November 2002.
  - Had been banned by Johnson-Shad Accord (1984).
  - Ban rescinded by Commodity Futures Modernization Act of December 2000.
  - Traded on OneChicago Exchange.
- Market closed in September 2020.

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Stock futures

- Contract specifications:
  - No. of shares: 100
  - Contract months: 2 quarterly; 2 nearest serial months
  - Prices quoted in cents per share
  - Settlement day: third Friday of contract month
  - Settlement method: physical delivery
  - Two contract styles:
    - Unprotected from dividend distributions
    - Protected from dividend distributions

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Stock futures valuation

- Cost of carry relation for unprotected futures contract is:

$$F = Se^{rT} - De^{r(T-t)}$$

- Cost of carry relation for protected futures contract is:

$$F = Se^{rT}$$

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US stock options

- Stock options traded in OTC market since late 1800s.
  - Called “privileges”
- CBOT formed CBOE in April 1973.
  - Calls on 16 large NYSE stocks
- Other US exchanges followed.
  - AMEX and PHLX in 1975; PSE in 1976
- Other markets worldwide followed.
  - Canada and Australia in 1975; UK in 1978

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US stock options

- Put options introduced in June 1977.
- Today, stock options trade on:
  - 16 exchanges in US.
  - More than 2,800 stock option classes are traded in US.
  - Over 50 exchanges in 38 different countries.

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US stock options

- Decision about whether to list options on stock rests only with exchange.

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US stock options

- Minimum requirements:
  - 7 million shares outstanding (excl. insiders).
  - 2,000 shareholders.
- Stock must have:
  - Traded at least 2.4 million shares in last 12 months.
  - Closed at market price of at least $7.50 for majority of business days in last 3 months.

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US stock options

- US stock options
  - Contract specifications:
    - Style: American-style
    - Denomination: 100 shares
    - Prices reported per share
    - Expire Saturday after third Friday
    - Unprotected for cash dividends; protected for splits

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Stock options

- Non-dividend-paying stocks:
  - If stock pays no dividends during option's life, no-arbitrage price relations and valuation equations are special cases of general principles derived earlier.

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Stock options

- Dividend-paying stocks:
  - Define stock price net of present value of escrowed dividend.

$$S^x = S - De^{-rt}$$

  - European-style put-call parity

$$c - p = S^x - Xe^{-rT}$$

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Stock options

- Dividend-paying stocks:
  - European-style call formula is:

$$c = S^x N(d_1) - Xe^{-rT} N(d_2)$$

where

$$d_1 = \frac{\ln\left(S^x / Xe^{-rT}\right) + .5\sigma^2 T}{\sigma\sqrt{T}},$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

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Stock options

- Dividend-paying stocks:
  - European-style put formula is:

$$p = Xe^{-rT}N(-d_2) - S^x N(-d_1)$$

where

$$d_1 = \frac{\ln\left(S^x / Xe^{-rT}\right) + .5\sigma^2 T}{\sigma\sqrt{T}},$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

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Stock options

- Dividend-paying stocks:
  - American-style option valuation
    - No formulas. Must use numerical approximation such as binomial method.

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Stock options

- Dividend-paying stocks:
  - American-style call option on dividend-paying stock will be exercised either
    - (a) just prior to ex-dividend, or
    - (b) at expiration.
  - Decision about whether to exercise early depends on call's exercise proceeds versus call value if left "alive."

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Dividend-paying stock options

- Illustration:
  - Suppose you own call and you are at close of trading on day prior to stock going ex-dividend.
  - Assume call has:
    - 50 exercise price
    - 30 days remaining to expiration

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Dividend-paying stock options

- Illustration:
  - Assume stock has:
    - Price of 57.
    - Volatility rate is 25%.
    - Cash dividend is 5.
  - Assume interest rate is 6%.
  - Should call be exercised early?
  - Supporting file: Early exercise of call.xlsx

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Dividend-paying stock options

- Illustration:
  - Compare call value if you exercise just prior to ex-dividend with call value just after dividend is paid.

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Dividend-paying stock options

- Illustration:
  - Call value just prior to dividend payment is 57-50=7.

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Dividend-paying stock options

- Illustration:
  - Ex-dividend call value is:

B17 =OV_OPTION_VALUE(B5,B12,B14,B9,0,B6,"C","E")

	A	B	C
1	EARLY EXERCISE OF CALL ON DIVIDEND-PAYING STOCK		
2	*Stock parameters*		
3	Cum-dividend price	57.00	
4	Cash dividend	5.00	
5	Ex-dividend price	52.00	
6	Volatility rate	25%	
7			
8	*Market parameters*		
9	Interest rate	6%	
10			
11	*Call option parameters*		
12	Exercise price	50.00	
13	Days to expiration	30	
14	Years to expiration	0.082192	
15			
16	Cum-dividend call value	7.000	
17	Ex-dividend call value	2.845	
18	Gain from early exercise	4.155	

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Dividend-paying stock options

- Illustration:
  - Anyone holding call should exercise just prior to ex-dividend instant.
    - Failure to do so results in an implied loss of 4.155.
  - In practice, not all option holders exercise when they should.

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Dividend-paying stock options

- Illustration:
  - Suppose only 50% of call buyers exercise when they should. Devise trading strategy that may profit from this oversight.
    - Called “dividend spread.”

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Dividend-paying stock options

- Illustration:
  - Sell (write) call just prior to ex-dividend and hedge by buying stock.
    - Cost is 57 – 7 = 50.

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Dividend-paying stock options

- Illustration:
  - If call holder exercises, deliver stock. You receive exercise price, $50, and break even.

$$(7-57)+50=0$$

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Dividend-paying stock options

- Illustration:
  - If call holder fails to exercise, buy call and sell stock on following morning.
    - Receive call premium less stock price.
    - Pay 2.845 for call.
    - Receive cash dividend of 5.
    - Receive 52 from sale of stock.
    - Net profit is 4.155.

$$(7-57)-2.845+5+52=4.155$$

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Dividend-paying stock options

- Krepley, Stoll and Whaley (*JFM* 2008)
  - Examine call options on dividend-paying stocks from Jan. 1996 through April 2006.
  - Find more than 50% of outstanding long positions remain unexercised.
  - Failure to exercise has caused call option holders to lose over $491 million over 10-year period.
  - Market makers capture lion's share of proceeds by using dividend spreads.

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Dividend-paying stock options

- Krepley, Stoll and Whaley (*JFM* 2008)

Options Volume Query Results for December 23, 2009

NOTE:

Each report is available in CSV format. This Volume Query provides data for up to two years. Archived volume data can be found in the **Historical Volume Query**. Batch processing information can be found **here**.

All values stated in this report represent contract sides (1 side long, 1 side short). Therefore to get a number that reflects the total number of contracts (both long and short combined as 1 contract), you must divide the total exchange volume shown by 2. *For example: ISE reports 1400 contract sides, the actual number of contracts would be 700. (1400 divided by 2 is 700).*

Percentages may not equal 100% due to rounding.

View Record Layout (PDF)

Return to Query Page

	Exchange Volume							Call/Put Volume		Transaction Type		
Opt. Symbol	AMEX	BOX	CBOE	ISE	NSDQ	PCX	PHLX	Calls	Puts	Cust	MM	Firm
MO	10,390	1,418	43,664	8,730	1,172	10,850	5,972	48,686	33,510	52,322	27,912	1,962
VPM	272	100	2,600	430	0	292	290	2,998	986	1,958	1,875	151
WRR	110	0	544	68	0	40	4	642	124	387	304	75
Totals	10,772	1,518	46,808	9,228	1,172	11,182	6,266	52,326	34,620	54,667	30,091	2,188
Percentage	12%	2%	54%	11%	1%	13%	7%	60%	40%	63%	35%	3%
								0.66 Puts to 1 Call				

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Dividend-paying stock options

- Krepley, Stoll and Whaley (*JFM* 2008)

Options Volume Query Results for December 24, 2009

NOTE:

Each report is available in CSV format. This Volume Query provides data for up to two years. Archived volume data can be found in the **Historical Volume Query**. Batch processing information can be found **here**.

All values stated in this report represent contract sides (1 side long, 1 side short). Therefore to get a number that reflects the total number of contracts (both long and short combined as 1 contract), you must divide the total exchange volume shown by 2. *For example: ISE reports 1400 contract sides, the actual number of contracts would be 700. (1400 divided by 2 is 700).*

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Return to Query Page

	Exchange Volume							Call/Put Volume		Transaction Type		
Opt. Symbol	AMEX	BOX	CBOE	ISE	NSDQ	PCX	PHLX	Calls	Puts	Cust	MM	Firm
MO	5,906	664	15,354	9,216	3,398	859,156	2,659,834	3,537,666	15,862	27,706	2,676,906	848,916
VPM	506	56	3,808	874	0	1,202	413,318	418,682	1,082	2,623	416,081	1,060
WRR	52	0	218	62	0	56	12,800	13,146	42	199	12,989	0
Totals	6,464	720	19,380	10,152	3,398	860,414	3,085,952	3,969,494	16,986	30,528	3,105,976	849,976
Percentage	0%	0%	0%	0%	0%	22%	77%	100%	0%	1%	78%	21%
								0.00 Puts to 1 Call				

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Flex options vs OTC options

- Flex(ible) option contract terms are available on exchanges.
  - Up to 15 years to expiration.
  - Put or call
  - American or European
  - Exercise price
  - Results in delivery.
- OTC stock options have wider flexibility.

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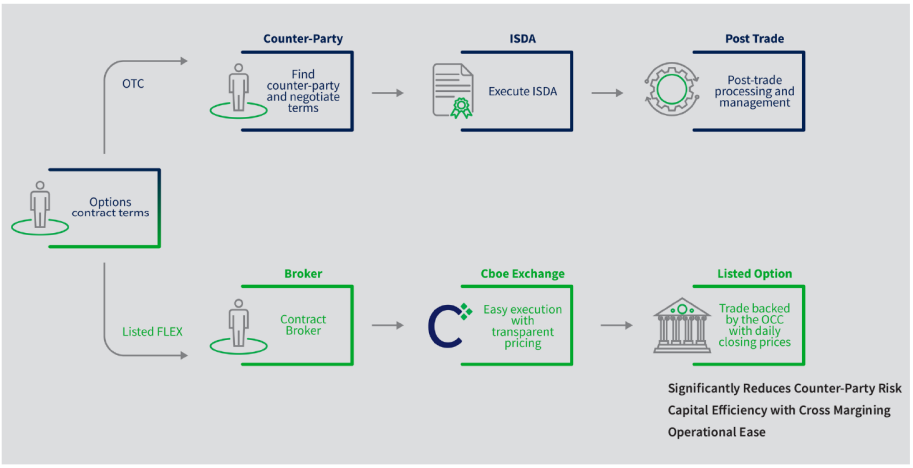
FLEX Options vs. OTC



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Lesson summary

- Stock futures trade in US and other countries but are not particularly active.
- Stock options have traded in US:
  - In OTC market since late 1800s.
    - Privileges
  - On exchanges since April 1973.

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Lesson summary

- No-arbitrage relations and valuation equations need to account for discrete cash dividends.
  - Presents no real challenge. Simply subtract present value of dividend.

$$S^x = S - De^{-rt}$$

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Lesson summary

- For retail customers, standardized options are available on 16 different U.S. stock option exchanges.
- For institutional customers, flexible contract terms are available on exchanges and in the OTC market.

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