Derivatives and Risk Management (BM40202)

Group Assignment-II

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Option Greeks Case

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Link to code:

https://colab.research.google.com/drive/1RypMlKab_VSnjR6LYVlVPQ_4e66Wo8nr?usp=sharing

Question 1. Estimate the Greeks (delta, gamma, vega, theta, and rho) for the call options that traded on Feb 13, based on the data given in the case. You should submit a code for estimating the Greeks. Get a divided yield by applying put-call parity.

Soln.

Greeks for all call options traded on February 13, 2013

For call option with strike price 60 and maturity date 16/02/2013:

Traded Volume: 8700
Call Price: 0.9224498500723541
Delta: 0.6207937746298733
Gamma: 0.23132435740625318
Vega: 2.086385589323157
Theta: -38.197393425358094
Rho: 0.30101225457158115
Dividend Yield: 0.0

For call option with strike price 60 and maturity date 16/03/2013:

Traded Volume: 30100
Call Price: 2.357897814884314
Delta: 0.5549030908258389
Gamma: 0.07473150479953472
Vega: 6.964939950327125
Theta: -12.403951369897046
Rho: 2.6500873278524244
Dividend Yield: -1.1748391794975203e-16

For call option with strike price 60 and maturity date 22/06/2013:

Traded Volume: 3900
Call Price: 4.558528635962876
Delta: 0.5558245629469238
Gamma: 0.0366225599238577
Vega: 14.203336092308037
Theta: -6.124050630761397
Rho: 10.26972213728124
Dividend Yield: 1.1748391794975203e-16

For call option with strike price 65 and maturity date 22/06/2013:

Traded Volume: 259300
Call Price: 2.5797507884429614
Delta: 0.37888595738464886
Gamma: 0.035267489191144814
Vega: 13.677798688981047
Theta: -5.872218631593636
Rho: 7.186986512135062
Dividend Yield: 5.874195897487602e-17

For call option with strike price 60 and maturity date 21/09/2013:

Traded Volume: 300
Call Price: 5.883867920840924
Delta: 0.5632467071303351
Gamma: 0.027964572702367723
Vega: 18.496213244236255
Theta: -4.696033153575011
Rho: 16.985984777557213
Dividend Yield: 0.0

For call option with strike price 65 and maturity date 21/09/2013:

Traded Volume: 8800
Call Price: 3.874858464503088
Delta: 0.42682659539808987
Gamma: 0.027843487973487718
Vega: 18.416125878345788
Theta: -4.6555047800986715
Rho: 13.22387694667985
Dividend Yield: -5.874195897487602e-17

For call option with strike price 60 and maturity date 18/01/2014:

Traded Volume: 0
Call Price: 7.250287474081972
Delta: 0.5724911885873644
Gamma: 0.02243746528339258
Vega: 22.867855927931817
Theta: -3.783594050282759
Rho: 25.424052296877093
Dividend Yield: 1.1748391794975203e-16

For call option with strike price 65 and maturity date 18/01/2014:

Traded Volume: 100
Call Price: 5.242027499464008
Delta: 0.4625023439069436
Gamma: 0.02271430882165139
Vega: 23.150009819537708
Theta: -3.8138383965852003
Rho: 21.110982833286222
Dividend Yield: -1.1748391794975203e-16

For call option with strike price 55 and maturity date 17/01/2015:

Traded Volume: 30400
Call Price: 12.68262695010262
Delta: 0.6742089924231645
Gamma: 0.014307606805518076

Vega: 30.239477083153186
Theta: -2.4477746192096363
Rho: 54.1089140736718
Dividend Yield: 5.874195897487602e-17

For call option with strike price 65 and maturity date 17/01/2016:

Traded Volume: 0
Call Price: 10.785274874880038
Delta: 0.5536746224855623
Gamma: 0.012737471012250189
Vega: 40.898409269994225
Theta: -2.171531079714792
Rho: 66.42364931773685
Dividend Yield: 0.0

Question 2. The case states: "To find an insider trader, she needed to think like one." Suggest various strategies that an informed insider *could* have implemented to take advantage of an impending price increase of Heinz.

Soln.

In the context of insider trading, an informed insider who knows about an impending price increase, such as the acquisition of Heinz by Berkshire Hathaway and 3G Capital, could employ several sophisticated trading strategies. These strategies aim to maximize profit while potentially minimizing the risk of detection. Here are various strategies that an insider might consider:

1. Buying Call Options: This is a straightforward strategy where the insider purchases call options on Heinz stock. Call options would increase in value significantly if the stock price increases, as expected from the acquisition. By buying calls, the insider leverages their capital since the cost (premium) of a call option is much less than the cost of the underlying stock.

2. Bull Call Spread: This involves buying call options at a lower strike price and selling an equal number of call options at a higher strike price. Both options would have the same expiration date. This strategy limits both the potential gain and the potential loss but requires less capital than buying calls outright and might be less conspicuous.

3. Protective Put and Buy Call (Risk Reversal): An insider might buy calls and simultaneously buy puts on a competitor or a related stock that might negatively react to the

acquisition news. This strategy hedges against market moves and might mask the intended speculative action on Heinz.

4. Straddles or Strangles: These are strategies that involve buying both a call and a put with the same expiration date but different strike prices (strangle) or the same strike price (straddle). If the insider expects significant volatility but believes there might be scrutiny on directional bets, such a strategy could be advantageous. However, for a straddle or strangle, the insider would benefit most from a significant price movement in either direction, which might not align perfectly with known positive news.

5. Writing Uncovered Put: If an insider is confident about a price increase, they might write put options, expecting them not to be exercised. This allows the insider to collect the premiums. It's a risky strategy because it can lead to substantial losses if the stock unexpectedly drops, but it might not be as directly linked to insider trading suspicions if used sparingly.

6. Leveraged Buyouts with Calls (Synthetic Long Stock): This involves buying call options and selling put options with the same strike price and expiration. The strategy simulates a long position in the stock and benefits from upward movements in the stock price, mirroring the gains of holding the actual stock but at a fraction of the price.

7. Volume-weighted Average Price (VWAP) Trading: To avoid detection, an insider might use a VWAP trading strategy, spreading their option purchases over the day or several days to blend in with average trading patterns. This method can mask the trade size and timing, reducing the likelihood of raising red flags.

8. Using Complex Derivatives: Engaging in swaps or other complex financial instruments could obscure the nature of the trades. These might include contracts whose payoffs are linked to Heinz's stock performance but are customized in a way that is not transparent to regulators or easily understood by market participants.

For an insider, the key is balancing the desire for profit with the risk of detection. The insider could have focused on call options with high delta and gamma values, such as the call options with strike prices of $60 and $65 and various maturity dates. These options would offer significant sensitivity to price movements, allowing the insider to maximize gains with limited capital. Sophisticated strategies that blend into regular trading activities or hedge market risks might help in avoiding immediate scrutiny but still carry ethical and legal risks that can lead to significant consequences if uncovered.

Question 3. Compare the profitability of strategies that use options, vis-a-vis strategies that use stocks only.

Soln.

Comparing the profitability of strategies using options versus those using stocks requires evaluating different aspects such as leverage, risk exposure, and capital requirements. Here's an analysis of how these strategies differ in terms of potential profitability and risk:

Strategies Using Stocks Only

1. **Direct Stock Purchase:** The most straightforward strategy involves buying the stock outright. This strategy benefits fully from any stock price increase but requires significant capital investment. The potential gain is linear; for every dollar the stock increases, the investment increases by an equal amount in dollar terms.

Pros:

- Simplicity and transparency.
- Full dividend rights and voting rights in the company.
- No expiration; can hold as long as desired.

Cons:

- Requires more capital upfront.
- Profit potential is limited to the rise in stock price (1:1 ratio).
- Full exposure to downside risk unless hedged.

2. **Short Selling:** This is the opposite strategy, relevant if expecting a price drop. It involves borrowing stock to sell at the current price and then buying it back later at a lower price.

Pros:

- Potential profit from stock price decreases.

Cons:

- Unlimited risk since the stock price can theoretically increase indefinitely.
- Requires margin and subject to margin calls.
- Costs associated with borrowing stock.

Strategies Using Options

1. **Buying Call Options**: This allows for significant leverage. A call option increases in value as the stock price goes above the strike price, offering potentially high returns relative to the initial investment.

Pros:

- Lower initial capital requirement than buying stock.

- Leverage: higher percentage returns relative to the movement in the stock price.
- Limited downside risk (limited to the option premium paid).

Cons:

- Premium cost, which is a total loss if the stock price does not exceed the strike price plus the premium by expiration.
- Expiration date limits the opportunity window.

2. Protective Puts: Involves buying stock and buying put options to hedge against potential losses. This strategy ensures profits are locked in or losses are limited without requiring the sale of the stock.

Pros:

- Provides downside protection.
- Allows continued participation in potential stock price increases.

Cons:

- Cost of the put premium reduces overall profitability.
- Still requires significant capital to hold the stock.

3. Writing Covered Calls: Involves holding the stock and selling call options. This generates income from the option premiums but caps the maximum possible gain.

Pros:

- Generates income, reducing the cost basis of the stock.
- Provides some protection against a decline in stock price.

Cons:

- Gains are capped at the strike price of the call options.
- If the stock surges above the strike price, you might have to sell it at the strike price, missing out on higher profits.

Profitability and Risk Assessment

- Potential for High Returns: Options can provide higher returns on a percentage basis due to leverage. For instance, if the stock price increases significantly, the return on a call option can exceed that of the stock due to the option's lower initial cost.

- Risk Exposure: Options can also limit risk better through strategies like protective puts or limit losses to the premium paid for buying options. However, they can also

expose traders to nearly total losses of the premiums if the market doesn't move as expected.

- Capital Efficiency: Options require less capital compared to purchasing stock outright, allowing for more diversified investment strategies or freeing up capital for other uses.

In conclusion, while options can offer greater leverage and potentially higher returns for less capital, they also come with risks of premium loss and the complexities of managing expirations and strikes. Stock strategies are more straightforward but require more capital and expose the investor to potentially unlimited losses in short-selling scenarios or less profit potential in bullish scenarios without the leverage provided by options

Question 4. Identify the trade that might have been executed by the insider. Give a rationale for your answer.

Soln.

Based on the information provided in the case, the trade that might have been executed by an insider is the purchase of call options on Heinz stock with a strike price of $65.00 and a maturity date of January 2014.

Rationale:

1. The case mention that some traders had spotted a put option on Heinz's stock with a strike price of $65.00 trading at an offer price of $5.50 in the over-the-counter (OTC) market, as opposed to its exchange-traded value shown in Exhibit 6. This suggests that there may have been mispricing or arbitrage opportunities in the options market surrounding the Heinz acquisition. The fact that the same put option was trading at a significantly different price ($5.50) in the OTC market compared to its exchange-traded value indicates there was a mispricing of the option. This could create an arbitrage opportunity for traders to exploit. If the put option was indeed mispriced in the OTC market compared to the exchange, traders could potentially execute an arbitrage trade to profit from the price discrepancy. This would involve buying the underpriced put option in the OTC market and selling the correctly priced put option on the exchange, locking in a risk-free profit. The existence of this mispriced put option in the OTC market could indicate that some traders had access to non-public information about the impending acquisition, allowing them to identify and trade on this arbitrage opportunity. The discovery of this mispriced put option is evidence that the options market surrounding Heinz was exhibiting unusual activity that warranted further investigation.
2. The case also indicate that informed traders would try to select options with high leverage, such as those with high delta and gamma values, to maximize gains with

limited capital. Call options with a strike price of $65.00 and a maturity date of January 2014 would likely exhibit these characteristics, as they would be highly sensitive to the expected increase in Heinz's stock price following the acquisition announcement. Options with high delta and gamma values are considered to have high leverage. Delta measures the rate of change of the option price concerning the underlying asset price, while gamma measures the rate of change of delta concerning the underlying asset price. Options with high delta and gamma values are more sensitive to price movements, offering traders the potential for amplified gains with relatively small price changes in the underlying asset. The case suggests that there were rumors circulating about Berkshire Hathaway's interest in acquiring Heinz, indicating an impending increase in Heinz's stock price following the acquisition announcement. In this context, call options with a strike price of $65.00 and a maturity date of January 2014 would be highly sensitive to this expected price increase. As the stock price rises, these call options would experience significant value appreciation due to their high delta and gamma values. By selecting options with high leverage, informed traders can maximize their gains while using limited capital. Options with high delta and gamma values allow traders to control a larger position with a smaller amount of capital, enabling them to potentially benefit more from the anticipated price increase in Heinz's stock following the acquisition announcement.

3. The case mention that informed traders would also need to consider the time decay of the options, as a position in an option that quickly depreciated would make for a very hastened unwinding. The January 2014 maturity date would provide the insider with more time to unwind their position compared to shorter-dated options, reducing the risk of raising suspicion. The key point here is that options experience time decay, where their value decreases as they approach their expiration date. This time decay can be a concern for informed traders who are trying to unwind their positions without raising suspicion. The case suggests that the January 2014 maturity date for the call options would provide the insider with more time to unwind their position compared to shorter-dated options. This longer time to maturity would mean the options would experience less time decay over the holding period, allowing the insider to gradually exit the position without the value depreciating rapidly. In contrast, shorter-dated options would experience faster time decay, meaning the insider would need to unwind the position more quickly before the options lost significant value. This hastened unwinding could potentially raise more suspicion and draw the attention of regulators like the SEC analyst, Ana Barre.

4. The case suggests that the SEC analyst, Ana Barre, was particularly interested in identifying trades that were "too large or too short-term-oriented to be coming from market considerations that were in the public domain." The purchase of call options with a January 2014 maturity date would be less likely to raise such suspicions compared to more aggressive, short-term-oriented trades. The January 2014

maturity date provides the trader with more time before the options expire. This means they could unwind the position gradually over a longer period, rather than having to exit the trade quickly. Short-term trades are more likely to raise suspicion as they may indicate the trader is trying to capitalize on very recent, non-public information. Longer-dated options, like the January 2014 calls, are generally less aggressive or leveraged compared to shorter-dated options. This means the trader is not trying to maximize their gains in an extremely short time frame, which could be a red flag for Barre. The case states the options had a strike price of $65.00, which was above the Heinz stock price of $60.48 on February 13. This suggests the trader was positioning for an increase in the stock price, which aligns with the public rumors about Berkshire Hathaway's interest in acquiring Heinz. Shorter-term, more aggressive trades may have seemed less connected to public information.

Therefore, based on the information provided, the trade that might have been executed by an insider is the purchase of call options on Heinz stock with a strike price of $65.00 and a maturity date of January 2014. The case provides evidence that Barre was investigating potential unusual trading activity, such as unusually large trades, transactions at non-standard prices, sudden spikes in options volume, and significant purchases of out-of-the-money options, in the period leading up to the Heinz acquisition announcement.