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Midterm

Question 1.

Synthetic storage is used to imitate the cashflows of holding actual barrels of oil using financial instruments. This strategy is used to hedge the firm’s net worth against spot price risk. “A firm utilizing a synthetic storage strategy is able to pay the marginal cost of storage net of the convenience yield for the marginal physical storer, while actual physical storage must pay marginal cost of storage and receives its own marginal convenience yield.” MGRM likely used this hedging strategy due to the belief its own marginal cost of storage to be higher than the marginal cost using futures. MGRM used this synthetic storage or carrying-charge hedge to profit from the basis while remaining neutral to market spot prices.

A risk minimizing hedge is used to reduce the variance of a firm’s cash flows, which in-term reduces the firm’s reliance on capital markets for financing. One of the major differences between the two is that synthetic storage can be used to maximize value where risk minimizing is generally only used to minimize risk. These strategies also have differing optimal hedge ratios, a synthetic storage has an optimal hedge ratio of one-to-one while a minimum variance hedge ratio is optimal for reducing risk. Another major difference is between the intended use of these ratios, rather than simply reducing risk a synthetic storage or carrying-charge strategy is intended to capitalize on arbitrage opportunities by trading the basis of price relation changes between spot and future prices.

Question 2.

One of the major reasons outlined by Culp and Miller for using the stack-and-roll strategy is the higher cost they would incur due to the size of their operations. Longer-dated futures contracts have lower volume and open interest, meaning for MGRM to buy enough of these contracts to cover their whole operation they would have to face major transaction costs. This lower liquidity would also have made it difficult for MGRM to switch their hedge between heating oil, gasoline, and crude oil depending on seasonal conditions.

Culp and Miller also point out that a longer-dated hedge strategy would have exposed MGRM to greater basis risk due to the fact that they provided customers sell-back options. These options would allow customers to sell contracts for a discount “because the long-dated futures prices are imperfectly correlated with front-month prices.” MGRM also benefited from the stack-and-roll because it better protects against the risk of rising spot prices and has a lower cost of carry. MGRM may also have believed that the forward curve would flatten, which would not be beneficial if they had already purchased the longer-dated contracts. Overall, the stack-and-roll was the better option given their strategy of trading the basis and marketing and storing oil products, and not trying to predict spot price directional movements.

Question 3.

MGRM was able to create a market for their customers by offering fixed long-term prices, which they then hedged with short-dated futures. Because MGRM believed they had an informational advantage in price relations they were able to offer value to their customers in the form of fixed prices, while also capitalizing on delivering and hedging the oil products they marketed and stored. In the case that current demand for oil is high relative to current oil supply, spot prices will rise above futures prices, which is known as backwardation. MGRM’s use of a stack-and-roll strategy helped hedge against this backwardation and provided an arbitrage opportunity.

MGRM believed they were in a position to recognize and time their hedge positions such that they could capitalize on arbitrage opportunities when backwardation happened. Looking at recent historic data of heating oil futures MGRM noticed frequent backwardation, which likely led to the assumption that backwardation would continue and MGRM would earn a positive return on their strategy. Had backwardation continued the way historic data predicted MGRM would have been able to successfully arbitrage these situations while creating a mutually beneficial market for their customers.

Question 4.

If I were a Senior Quantitative Analyst at MGRM, I would put into place a strategy to forecast future oil prices using a similar Monte Carlo economic model like that of Bollen and Whaley. Using this data, I would be able to test all hedge ratios and create a distribution of returns for each. I would not focus on a model similar to Pirrong because it was tested in-sample only and does not account for future possibilities.

In determining the appropriate hedging strategy, I would look for a ratio that maximizes profit while being able to adequately cover likely cash deficits. As shown in table C. of Bollen and Whaley’s “Simulating Supply,” the greatest mean payout comes from the one-to-one hedge ratio that MGRM had in place, but it also has the highest standard deviation and highest possibility for a cash deficit above $1 billion (33.36%). Table C also shows that there was aa 99.92% chance of a positive terminal value. With this is mind I would have done my best to move forward with the one-to-one ratio, dependent on the firm’s ability to cover likely liquidity restraints.

One option would be to use puts, but because there was likely not a large enough market for puts to cover all MGRM’s operations, synthetic put strategies would also be implemented. As the Senior Quantitative Analyst at MGRM, I would make it a point to clearly present the results of the stress-testing and price forecasting to senior management and creditors. This would allow greater access to credit and would reduce the likelihood of management pulling the program was things got rough. The use of puts, synthetic puts, and additional credit would allow the program to continue through times of cash deficits, leading to the strategy lasting long-term and providing the largest possible profit.

If these strategies were not enough to cover the risk of the one-to-one hedge ratio, I would choose a ratio with the best Sharpe ratio. The table below is a replica of table C from “simulating supply,” with an additional column for the Sharpe ratio. This table shows that the tailed option offers the greatest projected return per unit of risk. If I could not properly cover the risk of the one-to-one, I would choose the tailed as the next best option.

|  |  |  |  |
| --- | --- | --- | --- |
| Ratio | Mean | Std dev | Sharpe |
| 0.70 | 3207 | 830 | 3.864 |
| 0.75 | 3340 | 888 | 3.761 |
| 0.80 | 3473 | 947 | 3.667 |
| 0.85 | 3605 | 1006 | 3.583 |
| 0.90 | 3738 | 1066 | 3.507 |
| 0.95 | 3871 | 1126 | 3.438 |
| 1.00 | 4004 | 1186 | 3.376 |
| Tailed | 3303 | 807 | 4.093 |

Question 5.

Pirrong’s backwardation-adjusted GARCH model seems to be more complex than the models used by Bollen and Whaley and seems to have a better grasp on theory. Pirrong creates a convincing case that MGRM did not successfully stress-test their model and were thus engaging in speculation. His model also creates a strong case that MGRM chose the wrong hedge ratio by empirically showing the losses they would face. Although Pirrong has a well-developed model, he did not test the model outside of the sample which would have shown the hedge ratio would have been positive if it had continued to operate.

Bollen and Whaley on the other hand focus less on creating a complex model to pinpoint a hedge ratio and focus more on testing historical data. Bollen and Whaley were able to show that that all hedge ratios had an extremely high probability of being profitable. They also show that the one-to-one hedge ratio chosen by MGRM would have been the most profitable hedge ratio had it not been cancelled. Bollen and Whaley are the most persuasive because they had a better approach and application to empirical work.

Question 6.

A market in backwardation is very important for MGRM’s strategy because in backwardation MGRM would be able to roll forward futures in the spot market for more than the cost of purchasing new futures, meaning they would have a negative rollover cost. A market in contango would force MGRM to buy contracts at a price higher than they could sell their contracts and resulting in a positive rollover cost. A market in contango is not ideal for MGRM because it would cause a cash drain, but MGRM would have been able to get through it and generate positive returns had the program continued.

Question 7.

Pirrong’s statement seems to be a way to support a model that was built based on his predetermined view that MGRM had the wrong hedging strategy. Terence Speed makes the argument that we do not need to be Bayesian because we can be approximately Bayesian with the use of simulation based statistical analysis. This is something that Pirrong failed to do, and if he had he likely would have found that his empirical work would have hurt the theme of his paper rather than support it. Due to Pirrong’s lack of testing on simulated data, I do not find his argument to be convincing.

Bollen and Whaley do a better job of being “approximately Bayesian” with their empirical work because they use simulated future results. Bollen and Whaley use Monte Carlo simulations to create predictive distributions that allowed testing for all hedging ratios. I believe their model to be more Bayesian and less biased than that of Pirrong.