

The Black Swan Hedge:

How Fordham's Student Managed Investment Fund navigated through the 2020 market crash

A Case Study¹

On Wednesday, January 15th, Professor Jake Russell convened the first-class meeting of Fordham's Student Managed Fund for the spring semester.

All of the 28 students were in high spirits. After all, 2019 was the best year in the fund's 10 year history. The global balanced fund gained 19.68% and beat its benchmark by 49 bp. This performance reflected a strong US economy, record low unemployment, inflation and interest rates. The current environment could not be more positive...and that was the problem. What could go wrong?

The Fordham Student Managed Investment Fund (SMIF)

The Student Managed Investment Fund is an academic program consisting of 2 consecutive semester long finance elective courses. It is designed to instruct students in the practical applications of investment management theory through the active management of a global balanced portfolio of investments encompassing the 4 major asset classes (global bonds, global stocks, commodities and FX). The fund was established in 2010 as a part of the Fordham Endowment Fund and funded with \$1,000,000. By year end 2019, the assets had grown to \$1,734,000, with a 5.71% internal rate of return. The fund was profitable in 9 out of 10 years.

The program was designed and is supervised by Prof. Russell, who reports to Fordham's Chief Investment Officer, the manager of the endowment fund.

¹ This case was prepared by Prof. James R. Kelly of the Gabelli School of Business at Fordham University, and is for class discussion only. ©Copyright 2020, James R. Kelly.

Organization of the Students: The class is composed of Analysts (First Semester) and Portfolio Managers (Second Semester). The **Analyst** positions are as follows;

Macro Team (Asset Classes)

- Fixed Income & FX
- Commodities & Materials
- Emerging Markets
- Real Estate (REITs)

Equity Sector / Company Team

- Industrials
- Health Care
- Info Technology & Communication Services
- Energy
- Consumer Staples
- Consumer Discretionary
- Financials
- Utilities

The **Analysts** are responsible for monitoring all relevant macro and micro economic data relating to their area of responsibility. Each analyst works in a team with last semester's analyst (current Portfolio Manager and Mentor) in their respective sector or asset class

The **Portfolio Managers** have functional responsibilities as follows:

Executive Committee - Managing Directors (3) *

Economist

Macro Team Leader (2)

Equity Team Leader (2)

Risk Manager (2)

Options Strategist

Technician

Weekly Market Update Coordinator

Marketing & Monthly Reporter

* Including Chief Investment Officer

Each Portfolio Manager is a member of the fund's Investment Committee and has an equal vote in adding or deleting securities from the portfolio. A majority (8 of 14) with a quorum of at least 8 members is required to make an investment decision.

Market Environment at Year End 2019

Mr. Market was euphoric, buying up stocks with abandon, pushing the Shiller cyclically adjusted P/E ratio (CAPE) to 29.9x, the second highest level in its history. There was no "margin of safety", to quote Ben Graham, the founder of security analysis.

The consensus forecasts for 2020 by Wall Street analysts called for the S&P 500 Index to increase by 6.5% following a gain of 31.5% in 2019.²

As a wily Wall Street veteran of every bear market since the 1970's, Prof. Russell knew that the most dangerous periods followed years like 2019. To emphasize that point with the students, he logged on to Amazon and bought a fuzzy stuffed black swan to bring to class and share with them.

He explained to the students that the black swan symbolized the theory popularized by Nassim Taleb in his book, *The Black Swan*, published in 2007. "A black swan is an event, positive or negative, that is deemed improbable yet causes massive consequences". The name originates from the (Western) belief that all swans are white because these were the only ones accounted for. However, in 1697 the Dutch explorer Willem de Vlamingh discovered black swans in **Australia**. This was an unexpected event in (scientific) history and profoundly changed zoology.³

January 15 - First Class

In the first class of each semester, the student portfolio managers are expected to review the asset allocation of the fund and to make

² The RIC Report, January 2020, p. 13, BOA Global Reteach

³ wikipedia.org/wiki/Black_swan_theory

recommendations for any changes. The fund's allocation reflected the optimism of the market and was over weighted with equities:

Asset Class	Benchmark	Proposed Allocation	Difference Relative to Benchmark
Equities	50%	59.00%	9.00%
Fixed Income & FX	40%	31.00%	-9.00%
Commodities	6%	6.00%	0.00%
Real Estate	4%	4.00%	0.00%
Total:	100%	100.00%	

As the students began to review their asset allocation, Prof. Russell challenged them to think out of the box. What can go wrong? Are there any black swans out there?

Class discussion turned to recent news from China.

December 31 -The New York Times reported that on

Chinese authorities treated dozens of cases of pneumonia of unknown cause.

On Dec. 31, the government in Wuhan, China, confirmed that health authorities were treating dozens of cases. Days later, researchers in China identified a new virus that had infected dozens of people in Asia. At the time, there was no evidence that the virus was readily spread by humans. Health officials in China said they were monitoring it to prevent the outbreak from developing into something more severe.

January 11 - It further reported

China reported its first death.

Chinese state media reported the first known death from an illness caused by the virus, which had infected dozens of people. The 61-year-old man who died was a regular customer at the market in Wuhan. The report of his death came just before one of China's biggest holidays, when hundreds of millions of people travel across the country.

There were 5 Chinese students in the fund program. Russell encouraged them to share their knowledge of the situation with the class. One of them indicated that local people are concerned about the possibility of the virus spreading within China. Another mentioned that the government was not sharing enough information.

A consensus among the students formed that they should monitor this situation very carefully.

During the following week, the New York Times reported

Other countries, including the United States, confirmed cases.

The first confirmed cases outside mainland China occurred in Japan, South Korea and Thailand, according to the W.H.O.'s first situation report. The first confirmed case in the United States came the next day in Washington State, where a man in his 30s developed symptoms after returning from a trip to Wuhan.

Wuhan, a city of more than 11 million, was cut off by the Chinese authorities.

Chinese authorities suspended buses, subways and ferries within the city of Wuhan. The Chinese authorities closed off Wuhan by canceling planes and trains leaving the city, and suspending buses, subways and ferries within it. At this point, at least 17 people had died and more than 570 others had been infected, including in Taiwan, Japan, Thailand, South Korea and the United States.

January 22 -Second Class

The Wuhan virus became the #1 topic of discussion in class. Another Chinese student had just returned from China and reported to the class that many people on her plane were fearful about the spread of the virus.

Russell focused the discussion by asking "What are the economic implications for China if the virus continues to spread?" The students reasoned that the problem must be very serious for the Chinese government to have locked down a city of 11 million people. They concluded that China's domestic production and exports would be

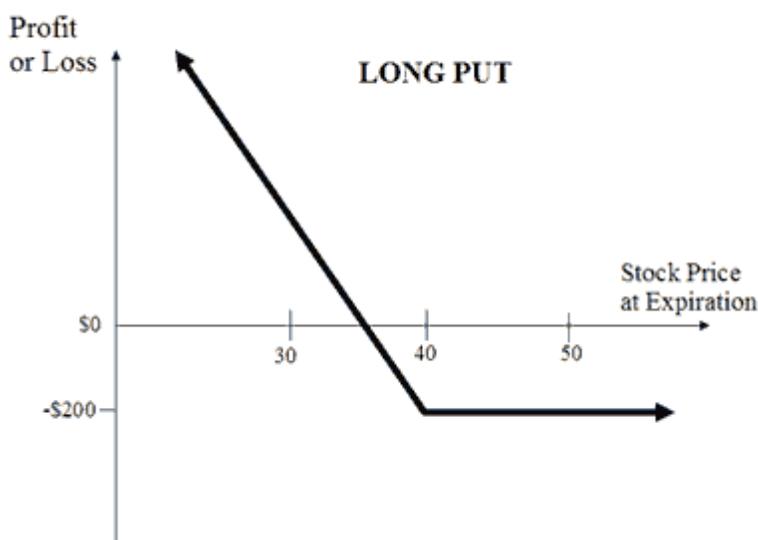
negatively impacted, with negative implications for world GDP growth if the virus spread to other countries.

“OK, then what can you do to protect the fund?”, he asked. The fund had recently renewed its option trading authority with its prime broker and custodian, Bank of America Merrill Lynch. Under guidelines approved by the administration, the fund could buy puts and calls and write covered calls, but were not permitted to short any options outright because of the potential unlimited loss.

The students were anxious to use this option trading authority to protect the fund from a market decline, especially in view of the fact that the fund was overweight equities and vulnerable to underperformance if the market declined.

Most of the students had no prior experience and limited knowledge about options. But several had taken the Options & Futures course and had the knowledge required to make intelligent decisions. In addition, Tom, the fund’s Chief Investment Officer, had completed an internship at a fund where he gained experience in options trading.

It was obvious to the students that the most straight forward simple hedge was to buy puts on SPY, the S&P500 Index ETF. That would provide broad based protection for the equity portion of the portfolio since the put rose in value when the equities declined. Here is the payoff diagram for a long-put option



The questions were how much to invest, for how long, what price per contract, and how many contracts

The answers to those question required an evaluation of the “Greeks”

The Greeks

Delta	<ul style="list-style-type: none">• Change in value on account of a unit change in the underlying
Gamma	<ul style="list-style-type: none">• Change in Delta on account of a unit change in the underlying
Vega	<ul style="list-style-type: none">• Change in value on account of change in volatility
Theta	<ul style="list-style-type: none">• Change in value on account of change in time
Rho	<ul style="list-style-type: none">• Change in value on account of change in interest rates



How Much? The equity portion of the portfolio was approximately \$1,000,000 (59% of \$1,700,000). The students discussed how much money they would be willing to lose assuming that the put option expired worthless. As a % of equity assets, 1%= \$10,000, 50bp = \$5,000, 10 bp = \$1,000

How Long (Theta)? That question was easy for them to agree upon. The semester ended in May 2020. They wanted to provide coverage for the whole semester given the uncertainty of the time line of the virus threat.

What Price per contract? This was derived through the Black Sholes model which requires five input variables: the strike price of an option, the current stock price, the time to expiration (theta), the risk-free rate (rho), and the volatility (vega).

How many contracts? This was a residual function of the answers to the other questions. The effectiveness of coverage depended on the delta of the option selected.

Resolving all of these variables and coming to an agreement on a specific put option to buy was a real challenge for the students. Russell emphasized that buying a put option was like buying an insurance policy. “It’s like buying automobile insurance. You hope that you never have to make a claim to cover the cost of an accident. If the SPY put expires worthless, then the equity portfolio almost certainly will appreciate a lot more than the cost of the put.”

The students viewed the new virus as a potential black swan, an unexpected event with potentially devastating consequences. Nevertheless, they were still reluctant to risk underperforming their benchmark by spending a lot on the hedge, especially in view of the its uncertain impact on equity prices.

Prof. Russell summarized the decision process in terms of the Greeks by explaining that the price of an option is a function of the time outstanding (the longer the expiration date, the higher the cost; strike price (the closer to the market price, the higher the price); implied volatility (the higher the vol, the higher the price).

Decision Time

“So”, he explained, “if you want to minimize the cost of hedging the equity portfolio for the semester, you need to choose between these 2 strategies.

- First, a small number of **near the money** put contracts (<5% below strike price) which would have a high delta and provide immediate protection on a portion of the portfolio
- Or, a large number of **deep out of the money** put contracts (> 15% below strike price) which would have a low delta and higher implied volatility but would protect most or all of the equity portfolio from a decline below the strike price.”

A spirited discussion of these parameters led to a vote by the portfolio managers at the end of class. They decided to invest only 15bp (\$1500) of the fund's equity capital in a deep out of the money put option expiring in May 2020. The specific option chosen was SPY 250 put expiring May 15, 2020. It was 25% out of the money compared to the market price of SPY at 331.

The price of the option was \$0.53 per contract. Russell placed an order to buy 29 contracts for a total investment of \$1,537 on January 23rd. This provided significant coverage of equity portfolio if SPY declined beyond 25% ($29 \times 100 \times 250 = \$725,000$), but very little coverage at the current price of 331 because of the very low delta associated with deep out of the money options. In fact, the delta of the put selected was only -0.13 at the current market price. It would increase geometrically if the SPY market price approached the strike price.

Over the next 4 weekly classes, the stock market, as represented by SPY, continued to rally to a peak of 338 on February 19th. The students wondered if they had wasted their money on the SPY puts.

The news about the virus during this period was another story altogether. The New York Times reported;

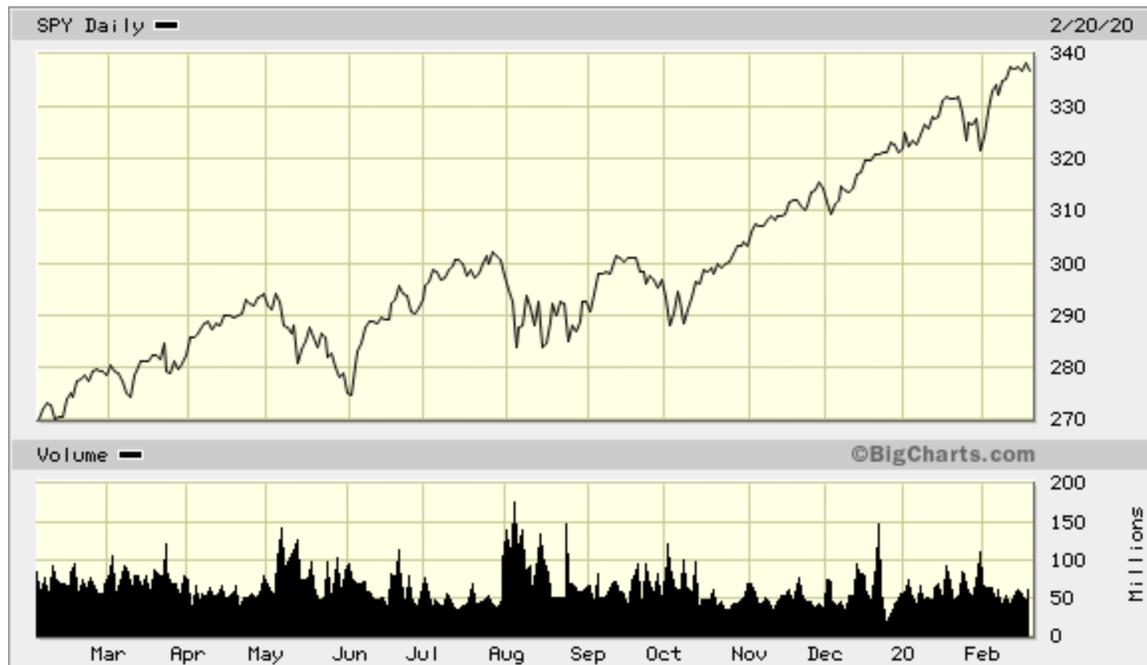
JAN. 30 -The W.H.O. declared a global health emergency.

Amid thousands of new cases in China, a “public health emergency of international concern” was officially declared by the W.H.O. China's Foreign Ministry spokeswoman said that it would continue to work with the W.H.O. and other countries to protect public health, and the U.S. State Department warned travelers to avoid China.

JAN. 31 -The Trump administration restricted travel from China

The Trump administration suspended entry into the United States by any foreign nationals who had traveled to China in the past 14 days, excluding the immediate family members of American citizens or permanent residents. By this date, 213 people had died and nearly 9,800 had been infected worldwide.

Feb. 19 - Sixth Class -- Stock market reverses course and begins an epic plunge.



FEB. 23 - Italy saw a major surge in cases.

Europe faced its first major outbreak as the number of reported cases in Italy grew from fewer than five to more than 150. In the Lombardy region, officials locked down 10 towns after a cluster of cases suddenly emerged in Codogno, southeast of Milan. Schools closed and sporting and cultural events were canceled.

March 11 – Ninth Class

Fordham closed because of pandemic– Class moved on-line.

The students scrambled to put together an emergency conference call and manage the fund remotely. The stock market was in free fall. SPY had declined from 338 to 274, a decline of 19%.

With the Spring Break starting on the next day, Russell appointed the 3 managing directors as an emergency executive committee to manage the fund until the next scheduled class on March 25.

More bad news...

MARCH 13 - President Trump declared a national emergency.

President Trump, who declared a national emergency, made millions of dollars in funds available to states. Mr. Trump officially declared a national emergency, and said he was making \$50 billion in federal funds available to states and territories to combat the coronavirus. He also said he would give hospitals and doctors more flexibility to respond to the virus, including making it easier to treat people remotely.

MARCH 15 - The C.D.C. recommended no gatherings of 50 or more people in the U.S.

The C.D.C. advised no gatherings of 50 or more people in the United States over the next eight weeks. The recommendation included weddings, festivals, parades, concerts, sporting events and conferences. The following day, Mr. Trump advised citizens to avoid groups of more than 10. New York City's public schools system, the nation's largest with 1.1 million students, announced that it would close.

MARCH 17 - The E.U. barred most travelers from outside the bloc

The European Union adopted a 30-day ban on non-essential travel to at least 26 European countries from the rest of the world. European leaders voted to close off at least 26 countries to nearly all visitors from the rest of the world for at least 30 days. The ban on nonessential travel from outside the bloc was the first coordinated response to the epidemic by the European Union.

Performance of SPY, VIX, and the Put option during the crash

SPY fell from 338 to 222, down 34%, in a month



VIX Volatility increased from 15 to 82 (highest ever recorded)



Performance of SPY Put Option (SPY Put 250 5/15/20)

From \$0.53 to \$36.00 per contract



The stock market was down 34%, but the SPY put option was up 68x to \$36 per contract. The initial investment of \$1,537 had increased to \$104,000. Even more importantly, with the strike price of 250, the option had gone from deep **out of the money** to **in the money** by 12% $((250-222)/250)$ covering a nominal amount of \$725,000 of equity exposure, more than equal to the reduced market value of the equity holdings.

The fund was more than fully hedged. It had been transformed from a long only balanced fund to a classic hedge fund with no net equity exposure.

March 18 – Conference Call – Prof. Russell with the Managing Directors

After congratulating the three managing directors on a great Black Swan hedge trade, Russell asked them “What are you going to do now?”

Dead silence on the phone as the 3 managing directors contemplated this enormous decision.

They knew from observing the VIX index that Mr. Market had swung from euphoria in January to panic and despair in March. Having studied behavioral finance, they realized that this was a great time to be a contrarian and take the profit.

On the other hand, they felt a strong responsibility to protect the portfolio from any further loss and were reluctant to sell.

Finally, Tom, the chief investment officer, responded “Let us think it trough and get back to you with our decision in an hour”

End

Addendum:

VIX Index Historical Volaitity (1990-2019)

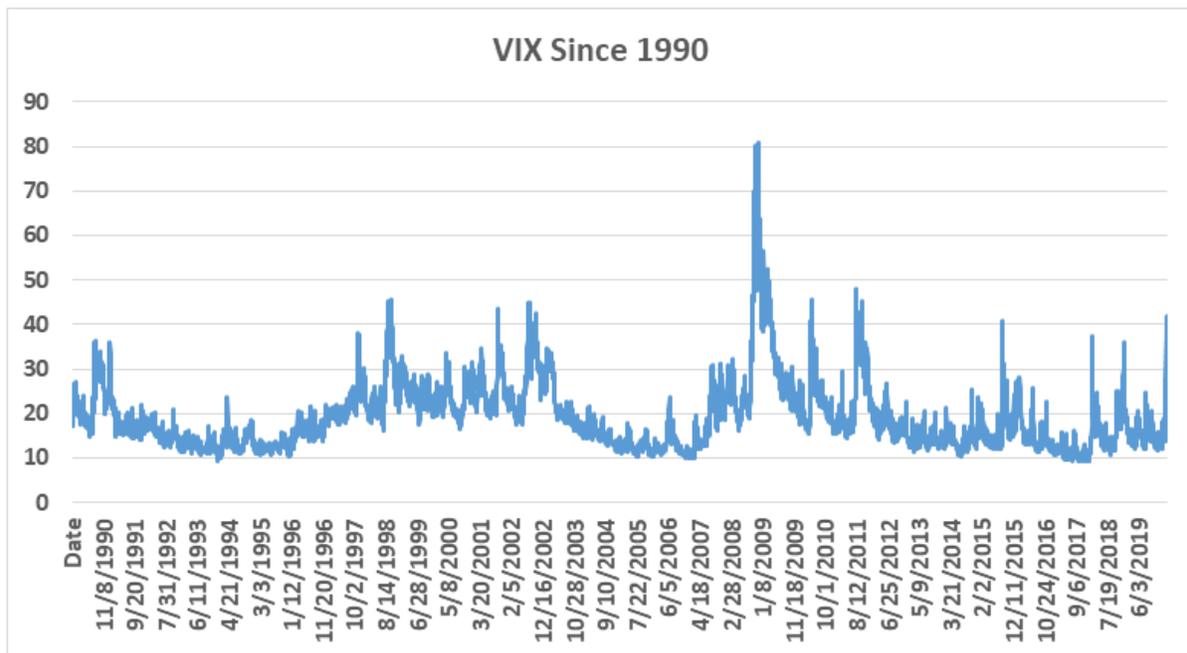


Chart 1. The VIX since 1990

Epilogue

The managing directors decided to sell 8 of 29 contracts. They were sold the same day for \$30.01, close to the all-time high price, locking in a profit of \$24,000. They held onto the balance of the contracts because they prudently did not want to expose the equity portfolio to additional losses if the market kept going down. In retrospect, this was a well-intentioned mistake. SPY rocketed up from 222 to 283 on April 14, a gain of 28% in response to the Federal Reserve's massive injection of liquidity into the financial markets. At the same time, the VIX Index fell 55% from 82 on March 16 to 37 on April 14. The value of the puts declined from \$104,000 to \$34,000 on April 14, when the students sold the balance.

Lessons learned:

- When Mr. Market swings from euphoria to panic, be a contrarian. Take advantage of his manic-depressive personality disorder and buy.
- Don't fight the Fed
- Beware of Black Swans



Teaching Points for Instructor

1) The radically different price performance characteristics of deep out of the money puts vs. in the money puts as reflected in the deltas and the gammas.

- See the chart showing the price movement of the SPY put as SPY went from 338 to 222 (p.14). It becomes parabolic as SPY approaches the strike price.

2) Implied volatility has a critically important influence on option pricing. In this case, vol (as measured by VIX) went from 15 to 82. The historical VIX chart in the addendum dramatically shows the sudden, short term spikes in the VIX over time. March 2020 was the all time high at 82 vs 78 in 2008. Both spikes lasted only one day - a very important consideration in managing the hedge (explained below)

3) Behavioral finance plays an important role in the decision making process. This is especially true in panic situations such as March 2020, when economic forecasts are completely unreliable.

4) The dynamic nature of hedging involved with at the money or in the money puts. If SPY continues to decline below the put strike price, the equity portfolio becomes over-hedged, or net short, as the delta of the put trends to -1.0. This requires selling some puts to maintain balance.

- Question for students. This case study implicitly assumes that the equity portfolio has the same beta as SPY (1.0). How would hedging strategy be impacted if the equity portfolio had a higher or lower beta than 1.0?