Global Investment Strategy Leveraging US Interest Hike Cycle

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Abstract
As we are at the beginning of an interest rate hike cycle, it is necessary for us to rethink the investment strategy under this new environment to develop a portfolio to take advantage of impending changes. In this report, we study the historical period from 2004 to 2006 that has a similar macroeconomic and policy environment. We analyze the effect of an interest hike on five different markets: the US equities, emerging markets, commodity, foreign exchange and fixed income. For each specific market, we construct different portfolios based on their characteristics. Finally, we conduct a scenario test on our portfolios using Monte Carlo simulation and provide our investment suggestions under different potential future environments.

Keywords
Federal Funds Rates — Momentum Strategy — Mean-Variance Portfolio Optimization — Monte Carlo Simulation

Contents

1. Introduction

The US Federal Reserve raised interest rates from 0.5% to 0.75% on December 14th, 2016 for the first time since December 2015. The effective federal funds rate has been kept near zero since the financial crisis of 2008; making it near zero for the past eight years. The good statistics of the unemployment rate and economic growth since December 2016 boosts the confidence of Federal Reserve to post another interest rate hike within a short time. Waiting too long to raise interest rates would be "unwise" as economic growth continues and inflation rises, Janet Yellen told Congress on February 14th. Standing at the beginning of the new hike, it's necessary for market participants to think about this new macroeconomic environment and seek opportunities to take advantage of it.

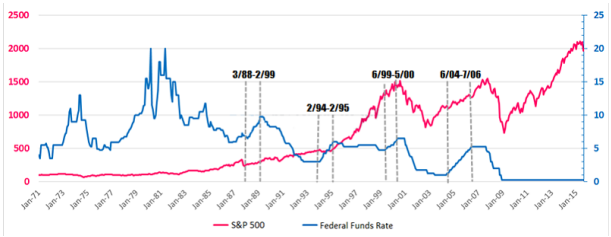
How will different markets respond in this rate hike cycle? What will be the magnitude and frequency of the interest rate hike? What kind of strategies will have an impressive performance during the new interest rate hike cycle? We will answer these questions in our report.

1.1 Market Influence

From a theoretical perspective, equity markets have an inverse relationship with the interest rate. An interest rate hike will push forward a strong dollar which will trigger capital inflow and stimulate the US equity market's short-term growth. However, in the long term, the monetary policy will push investors to bond markets. Looking back on the four hike cycles respectively in March 1988, February 1994, May 1999 and June 2004, we found that the US equity market still kept its strong tendency at least for a year no matter before or after those cycles. Figure 1 shows the performance of S&P 500 in respective periods. What is worth noticing is that the US equity benefits from the interest rate hike. Particularly, cyclical industries performs much better than other sectors. Thus, sector selection will be key, given that we are in a new rate hike cycle.

For emerging markets, their performance is strongly influ-

Figure 1. The Changes of S&P 500 and Federal Funds Rate



enced by currency value and commodity price, we will discuss emerging markets, foreign exchange markets, and commodity markets together. On the one hand, higher US interest rates reduce the relative value of foreign currencies, which have lower real interest rate, with respect to the US dollar. It will cause capital outflow from these markets to the US market. Furthermore, the strong dollar basis will tend to abate the price of raw materials, as the majority of commodity contracts are quoted in US dollar. Both of these impacts will pose downside stress on emerging markets in a short time. On the other hand, through the process of globalization, the revival of the US economy will create opportunities for export, which will benefit developing countries, especially for those that rely on the raw material export. Consequently, this revival will drive up these markets' investment return and currency value. Besides, the growth of the US economy will lead to higher demand for raw materials, which will then trigger a new bullish cycle in commodity markets. All these will support the growth of emerging markets under the intermediate and long investment window.

Traditional financial theories suggest that rising federal funds rate usually makes investments in fixed income markets more competitive. However, rates are rising from extraordinarily low levels and fixed income investors will not have the buffer of juicy yields that they enjoyed in past cycles to offset capital depreciation, as rising rates lead to falling bond prices.[1] If we have to invest in fixed income, the only candidate for us will be high yield. However, investing in high yield bond requires high trading skills as well as acuity, which an average investor may not have.

1.2 Prediction

After the first hike decision comes out, market participants believe that the rate increases during this cycle are more likely to be moderate due to fundamental and technical factors that have kept rates relatively low and may mitigate future rate increase. We fit Bloomberg's WIRP (World Interest Rate Probability) January prediction using the Poisson process N(t). N(t) is a counting process that indicates the number of rate hikes before time t. We estimate the parameter λ in the Poisson process[2] using the Maximum Likelihood Estimation, which turns out to be 0.2. Based on this result, we simulate this process 10,000 times by the following steps:

1. Generate random number u_i from $Unif[0,1]$, i=1,2,...,8 and t_i indicates the time of the ith meeting.
2. $t_i = F^{-1}(u_i) = -\frac{log(1-u_i)}{\lambda}$
3. if $t_i <= 1$, $N(t_i) = N(t_{i-1}) + 1$, which means this meeting will increase federal funds rates. i=1,2,...8,and $N(t_0) = 0$
4. else $N(t_i) = N(t_{i-1})$

We also fit the trend of federal funds rate between each hike using the ARIMA(1,1) model:

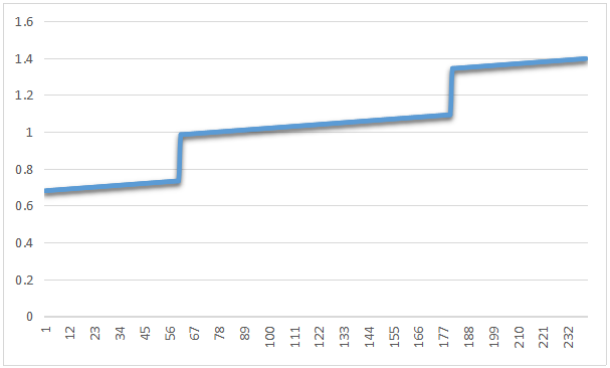
$$r_t = c + \varepsilon_t + ar_{t-1} + b\varepsilon_{t-1}$$

Hence the total path will follow this formula:

$$r_t = c + \varepsilon_t + ar_{t-1} + b\varepsilon_{t-1} + 0.25N(t)$$

According to the simulation result, we observe that the average rate at time t_8 is about 1.2%, the average number of rate hike is about 1.5 and the probability of interest rate hike at each meeting is about 18%. A sample path is shown in Figure 2.

Figure 2. Simulated Path of Federal Funds Rate



Our model gives us a good sense of the market prediction of the magnitude and frequency of the hike in January. However, many Federal Reserve officials expressed support for raising interest rates fairly soon after the most recent federal reserve interest rate meeting, which indicates that this prediction may be too conservative. Hence, it is more reasonable to expect that there will be 3 to 5 interest hikes this year, which should be very similar to the first year of the last hike cycle (2004).

1.3 Data

As it is very beginning of this interest hike cycle, the data after the December hike is not sufficient to conduct a reliable research, as such, we decide to use historical data. The task here lies in which historical period we should choose. It's obvious that previous hike cycles will be our optimal choices. Among the four hike cycles in the last 30 years, the recent one (2004-2006) is the most analogous to the current situation, based on following observations:

(1) In 2004, the federal funds rate experienced five 25-basis hikes. The frequency and magnitude of interest rate hike matches our prediction in the previous part.

(2) Comparing the potential fiscal policies of President Donald Trump with those of former President George W. Bush, we observe that the main parts are similar. Firstly, tax-cut policies play a crucial role in both of their stimulative economic programs. Secondly, just as what Bush did in his presidency, President Trump also proposes to create new employment opportunities by increasing the public expenditure in his first ruling period. Finally, President Trump plans to abolish the Dodd-Frank Act, which releases a strong signal of financial deregulation.

(3) The Federal Reserve in January 2004 amended the FOMC meeting statement and then the market began to have a clear rate hike expectation, the dollar index continued to appreciate nearly 8% during the following 5 months. However, from June 2004 when the interest rates started to increase, the US dollar index experienced slight appreciation at first, but substantial depreciation of more than 10%, until the end of 2005, the highest point of the year was only slightly higher than the index prior to the first rate hike in June 2004. We experienced a similar trend before the December hike. It indicates that the market has already priced the expectation of the interest hike before it actually happened in both of these two hike cycles. This will influence the market response when the 2017 hike comes true.

Figure 3. USD Index Value from Jan 2004 to Dec 2005

Therefore, it is well-grounded for us to carry out our analysis on this period.

2. Portfolio

In this part, we apply quantitative portfolio construction strategies to seek opportunities in the new hike cycle by using the data we chose in last part. There are several remarks we need to clarify before we present our results in each market:
(1) The characteristics of these four markets are quite different. For example, there is a very obvious seasonal pattern in exchange markets and commodity markets. However, this pattern does not exist in other markets. Thus, it is impossible for us to use one single model in all markets. Despite using the same strategy, the optimal parameter will vary in each case.

(2) There are several different measures we can use to judge the performance of portfolios. As the macroeconomic environment is still uncertain, we can not only use expected return here. The combination of Sharpe ratio and Maximum Drawdown is more appropriate, since it keeps a balance between the profitability and risk hedging.

(3) As the backtesting is conducted on historical data, our results will have high variance. A scenario test will be useful for us to test the statistical performance of our optimal portfolios.

2.1 US Equity

In this part, we want to analyze the relation between federal funds rate and different sectors of US equities, and then select the ones we want to invest in. Here we choose the S&P 500 sectors to study and use two models to achieve our goal.

2.1.1 Regression model

First, we used a regression model [3] to analyze:

$$Y_{t+1} = \alpha Y_t + \sum_{i=0}^{n} \beta_i X_{t-i} + \gamma Z_t + \varepsilon_t \tag{1}$$

Y_t is the first difference of the logarithm of an industry sector index, X_t is the first difference of the logarithm of federal funds rate, and Z_t is the first difference of the logarithm of S&P 500 index. If we use daily data, we choose n = 5. If we use weekly data, we choose n = 4.

When doing a t-test, we choose the Halbert White estimator[4] to calculate the covariance matrix.

2.1.2 Granger test

$$Y_{t+1} = \sum_{i=1}^{L} \alpha_i Y_{t-i} + \sum_{i=1}^{L} \beta_i X_{t-i} + \varepsilon_t \tag{2}$$

The X and Y are same with the Eqution (1). Granger test[5] is used to test causality of X and Y, so the null hypothesis is: $H_0 : \beta_1 = \beta_2 = ... = \beta_L = 0$. We apply F-test to this hypothesis.

2.1.3 Results of model

First, we use daily data to do the linear regression and Granger test. For Granger test, we choose L from 1 to 10. Setting the significance level to 0.1, we find that only energy and real estate sectors, are significant in these two experiments.

Table 1. Results of Regression of Energy and Real Estate

	E β	E p	RE β	RE p
β_0	0.0163	0.3664	0.0197	0.1178
β_1	0.0326	0.0522	0.0212	0.2112
β_2	-0.0098	0.5767	-0.0119	0.4888
β_3	0.0024	0.8915	0.0240	0.1356
β_4	0.0299	0.0795	-0.0290	0.0444
β_5	0.0002	0.9918	0.0032	0.8080

Table 2. Results of Granger test of Energy and Real Estate

	E p	RE p		E p	RE p
$L=1$	0.0779	0.1031	L=6	0.3553	0.0520
$L=2$	0.1256	0.1710	L=7	0.3403	0.1122
$L=3$	0.2453	0.0590	L=8	0.3950	0.1855
$L=4$	0.2411	0.0253	L=9	0.3744	0.2217
$L=5$	0.3677	0.0513	L=10	0.4708	0.1934

Then, we switch to weekly data, and observe that only consumer staples sector has small p-value in regression model and Granger test.

Table 3. Results of Regression of Consumer Staples

	CS β	CS p
β_0	-0.0203	0.4746
β_1	0.0152	0.3532
β_2	-0.0179	0.3004
β_3	-0.0625	0.0021
β_4	-0.03229	0.2193

Table 4. Results of Granger test of Consumer Staples

	CS p		CS p
$L=1$	0.2234	L=6	0.1380
$L=2$	0.4106	L=7	0.1902
$L=3$	0.0930	L=8	0.1469
$L=4$	0.1124	L=9	0.3521
$L=5$	0.1129	L=10	0.7044

2.1.4 Strategy

Based on the results we obtained, we choose energy, real estate and consumer staples as our candidates for our US equity portfolio. From the historical view, we find that these candidates have good performance in last hike cycle. However, the volatility of them are too high to guarantee the stability of our portfolio. The performance of these three sectors is listed in the table 5.

Table 5. Single Asset Performance

	Consumer Staple	Real Estate	Energy
Maximum Return	0.0822	0.5170	0.7397
Annulized Return	0.0531	0.3467	0.5121
Sharpe Ratio	0.0657	1.1416	1.3082
Volatility	0.0939	0.1699	0.2212

The market has an explicit trend in the last hike cycle which indicates that we can potentially take advantage of such trend. Thus, momentum strategy[6] becomes the most appropriate choice due to its property of following the market trend. Besides, we can also reduce the beta of our portfolio by shorting the market index in such strategy. The scheme is described below:

1. At the beginning of each holding period T, find the candidate with the largest Sharpe Ratio in the last observation period [T-L,T] and select it as our long position asset in this holding period [T,T+H].

2. Construct the portfolio by longing R $\times$ 100% long position asset and shorting (1 - R) $\times$ 100% market index.

3. Repeat step (1) and (2) at the end of each holding period.

For this scheme, we need to select optimal parameters to get our optimal portfolios:

1. In our analysis, we choose L = 20 and H = 5, since a fixed five-day holding period has a significant correlation with the past twenty-day data.

2. The coefficient R reflects the risk appetite. The value of R can be chosen from 0.5 to 1, which is respectively from risk aversion to risk seeking. The optimal $R = 0.73$ on this backtesting set.

3. For the hedging position, we can choose S&P 500 or equal weighted average of these three sectors. Here, we choose the latter one.

We compare the performance of this strategy with the single sector investment in figure 4

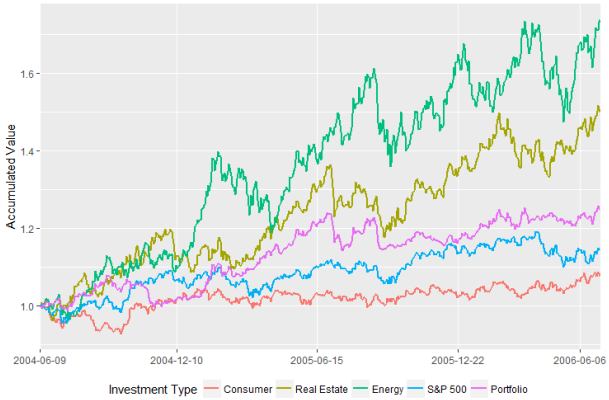


Figure 4. US Equity Portfolio Performance

Our portfolio gets an overall return of 25.78% in previous hike cycle(2004 - 2006), with Sharpe Ratio 0.9463, volatility 0.0989. The Shape Ratio is slightly less than the Real Estate and Energy sector, but it substantially reduces the portfolio volatility. Therefore, it is included in our portfolio candidate in this new hike cycle.

2.2 Emerging Markets

2.2.1 Asset Selection

MSCI indexes are used in this part to reflect the behavior of emerging markets. We use same method as US Equity part to test the relationship between MSCI indexes of countries belong to emerging markets and the U.S federal funds rates. It is evident that MSCI indexes in China, Russia and India have a significant correlation with the U.S federal funds rate. Since MSCI ETFs track MSCI indexes and are common trade assets, we select MSCI ETFs of these three countries as our underlying assets.

2.2.2 Strategy

Now that we have three candidates that performed well during last hike cycle, but the volatility is too high for us to invest in them individually. The charateristics of them are listed in Table 6:

Table 6. Emerging Market Indexes Performance

	Rusia	China	India
Maximum Return	0.1142	0.04800	0.0708
Annualized Return	0.4371	0.2418	0.3506
Sharpe Ratio	1.24	1.11	1.42
Volatility	0.3274	0.1911	0.2254

Just like the US equity, we also find an explicit trend to follow in emerging markets, which helps us decide to use the same strategy. For observation period L and holding period H, we set L = 40 and H =10 by running the same optimization program. We choose S&P 500 as our hedge objective and use R = 0.65. Results are shown in the table 7:

Table 7. Emerging Momentum Portfolio Performance

Vol	Return	Sharpe ratio	Annual return	Max drawdown
0.1571	0.1430	0.72	0.2891	0.1386

The performance of our portfolio during last hike cycle is shown in Figure 5, As we can see from the table, although the annual return of our portfolio is in the intermediate level of the three indexes, it has very low volatility and max drawdown. Meanwhile, the Sharpe Ratio is still in an acceptable range. Overall, we can invest in this portfolio in the emerging markets to keep a balance between risk and profit in the coming future.

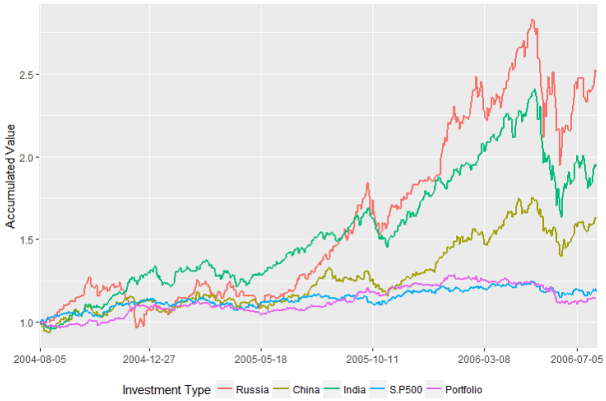


Figure 5. Emerging Market Portfolio Performance

2.3 Commodity and Exchange Market

2.3.1 Correlation Analysis and Individual Performance

Table 8 presents the correlation matrix of five major currencies as well as Gold and Crude Oil commodity with federal funds rate during the last rate hike cycle. The exchange rates are quoted as FX per USD. It shows that on a daily basis, the value of HKD, MXN, KRW and the two commodity contracts have a strong positive correlation with the fed funds rate, and the JPY has a strong negative correlation. For Euro, the correlation is not as strong as the others.

Table 8. Correlation Matrix between FFR and Exchange Commodity

	EUR	JPY	FED	HKD	MXN	KRW	GC1	CO1
EUR	1.00	0.75	0.21	-0.42	-0.48	0.13	0.05	0.18
JPY	075	1.00	0.70	-0.71	-0.54	-0.35	0.60	0.62
FED	0.21	0.70	1.00	-0.81	-0.61	-0.89	0.87	0.94
HKD	-0.42	-0.71	-0.81	1.00	0.65	0.61	-0.71	-0.74
MXN	-0.48	-0.54	-0.61	0.65	1.00	0.56	-0.30	-0.55
KRW	0.13	-0.35	-0.89	0.61	0.56	1.00	-0.77	-0.82
GC1	0.05	0.60	0.87	-0.71	-0.30	-0.77	1.00	0.83
CO1	0.18	0.62	0.94	-0.74	-0.55	-0.82	0.83	1.00

Hence, we can build single asset investments in these contracts by taking long positions in the ones with positive correlations and short positions in those with negative correlations. Table

9 shows the performance of these single investments. Based on the Sharpe Ratio, the two commodities generate the highest risk premium, but a very significant max drawdown, which is very undesirable from the view of risk management.

Table 9. Single Asset Performance

	JPY	EURO	HKD	MXN	KRW	GC1	CO1
Return	0.019	0.022	0.002	0.007	0.102	0.224	0.341
Standard Deviation	0.092	0.093	0.004	0.064	0.071	0.177	0.326
Sharpe Ratio	-0.129	-0.097	-7.628	-0.381	0.987	1.087	0.949
Maximum Drawdown	10.47%	15.9%	0.4%	10.1%	6.9%	39.9%	39.5%

2.3.2 Strategy

The Mean-Variance type portfolio construction technique[7] should be a better choice for us to apply here in order to keep a balance between profitability and risk-control. Besides,we apply a rotating dynamic scheme rebalancing the weight of our portfolio, to work with the seasonal pattern in the commodity markets. The scheme is as below:

1. Set the holding period for each of our portfolio choice to τ months, and re-balance the portfolio at the end of each holding period.

2. For each re-balancing date t_i, calculate the covariance matrix and the expected return vector of the candidate assets using the daily data in previous holding period$[t_i - \frac{\tau}{12}, t_i]$. Modify the weight of the portfolio using the Mean-Variance Optimization Algorithm below.

By running experiments choosing different τ, we choose τ as four months, since the strategy performance is the best by using this value. The Mean-Variance Optimization Algorithm can be expressed as a constrained quadratic programming problem:

$$\begin{aligned} &\min_{w} \ \frac{1}{2} w^T \sum w - \lambda w^T \mu \\ &\text{subject to} \ \sum_{i=1}^{n} w_i = 1, \\ &\quad w_i \geqslant -1 \quad \forall \ w_i \end{aligned}$$

In this case, we allow short position but restrict the proportion of it. Now the task changes to choose an appropriate risk aversion parameter λ representing the market expectation under the interest hike environment. Hence, we test the λ from 0 to 1 with increment 0.01 and search for the choice with the best back-testing Sharpe Ratio. Figure 6 and table 10 compare the performance of the commodity contracts and the portfolio using the optimal λ, which is 0.02. It shows that our portfolio creates a slight lower annualized return, but a much lower volatility as well as a lower max drawdown. From the safety viewpoint, this scheme will be a better choice to consider under the interest hike assumption.

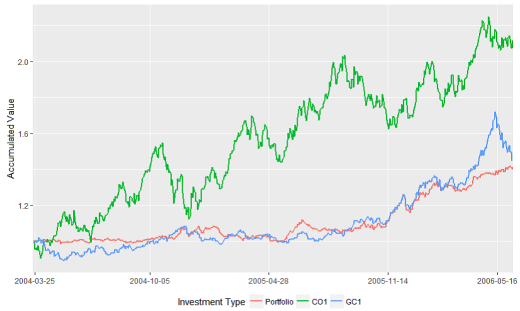


Figure 6. Commodity and FX Portfolio Performance

Table 10. Single Asset and Portfolio Comparison

	Portfolio	GC1	CO1
Return Rate	0.149	0.224	0.341
Standard Deviation	0.122	0.177	0.326
Sharpe Ratio	0.97	1.087	0.949
Maximum Drawdown	8.5%	39.9%	39.5%

2.4 Fixed Income

2.4.1 Asset Selection

The Table 11 below gives the characteristics of popular investment tools among fixed income asset classes. Investments in fixed income asset classes involve active management and diverse asset allocation. In order to achieve potential profits as well as manage risk effectively, we position tools for fixed income investment based on following principles[8]:

1. Select assets that can diversify risks. Undoubtedly, the fixed-income products can usually be regarded as a popular investment tool largely because they are less risky than other investment tools. For example, the broad bond market index consists of investment grade bonds from three asset classes: government, corporate and securitized, which can not only diversity risks but also achieve more return than Treasuries. Hence, it is reasonable to invest in it.

2. Select assets with shorter duration. Generally, the asset with shorter duration usually experiences less price decline because of their less-interest-sensitivity. Hence assets like short-term corporate bonds and fixed-rate loans can be good candidates.

3. Select asset that can enjoy the change of tighten yield curve.

From data of the last hike cycle, we can observe that the intermediate-term bonds, such as preferred securities and high yield products outperformed the short-term corporates. This is because their higher income offsets price decline and their intermediate maturity lessens the impact of a flattening yield curve. Accordingly, we can adjust the portfolio's yield curve by investing in the higher yield products such as preferred securities and high yield corporates.

In conclusion, we choose broad bond market index, short-term corporates, preferred securities, and high yield corporates as our candidates for fixed income portfolio construction.

Table 11. Characteristics of Fixed Income Assets

	Effective Duration	Average Yield Spread	Yield to Worst
Preferred Securities	5.61	47	5.86
Treasuries	8.12	0	4.17
Broad Bond Market	5.14	39	4.51
Investment Grade Credit	5.60	91	5.07
Short Term Corporates	1.79	56	4.43
Municipal Bonds	6.64	88	5.61
High Yield Corporates	4.5	341	7.89
Mortgage Backed Securities	3.34	44	5.13
Fixed Rate Loans	2.09	101	4.88

2.4.2 Strategy

In this part, we use the same portfolio construction scheme as the commodity and foreign exchange part. Since the risk in the fixed income market is much less than that in commodity markets, instead of trying to find the best risk parameter selection for the whole backtesting data set, we use the optimal weight on the efficient frontier[9] in each holding period here. Besides, we set the holding period to 3 months, so that the portfolio will generate the highest Sharpe Ratio on the backtesting data set in every individual holding period.

The table 12 and Figure 7 compares the performance of individual fixed income assets and the mean-variance portfolio. We can find that the portfolio achieves a better return than other four assets except for high yield corporates. However, the Sharpe Ratio of the portfolio is only 0.2, which can hardly be regarded as a robust strategy in reality. Therefore, we do not suggest investing in fixed income market in the coming hike cycle.

Table 12. Individual Asset and Portfolio Comparison

	Volatility	Annulized Return	Sharpe Ratio	Maxmium drawdown
Broad Bond Market	0.03	-1.39%	-0.43	2.65%
Fixed Rate Loans	0.01	-0.10%	-0.07	1.21%
Short Term Corporates	0.01	-1.20%	-1.16%	1.13%
Prefered Securities	0.02	-0.60%	-0.33 %	5.27%
High Yield Corporates	0.02	2.70%	1.14 %	5.27%
Portfolio	0.01	0.20%	0.2 %	1.25%

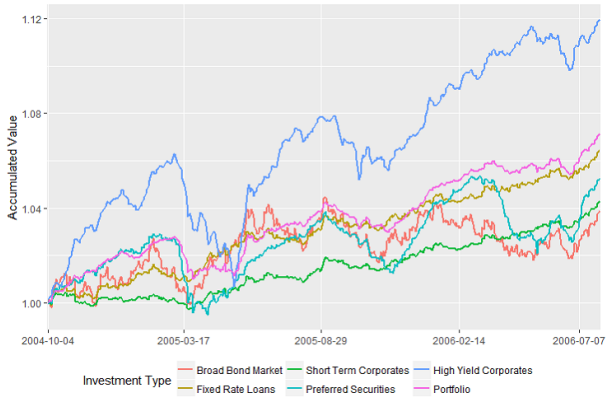


Figure 7. Fixed Income Portfolio Performance

3. Scenario Test

In this part, we test the performance of our portfolios under different volatility scenarios, and give our suggestions based on the results. Here, we use 252 trading days as our investment window here.

3.1 Methodology

We build the basic scenario under the Black-Scholes Geometric Brownian Motion Assumption and assume the market is consistent with the condition of last hike cycle. The assets price system can be expressed as bellow:

$$\frac{dS_{i,t}}{S_{i,t}} = \mu_i dt + \sigma_i dW_{i,t}, i = 1,2,...,n \tag{3}$$

We use maximum likelihood estimation to estimate the covariance matrix as well as the expected return vector. The data set includes the historical data in the last hike cycle as well as that in the recent two months, after Federal Reserve made the first hike decision. The MLE parameter is regarded as our basic scenario, and other ones are built on it. To achieve our goal, we construct three scenarios by applying appropriate multipliers to the base scenario parameters:
(1) Baseline(Base)
(2) High Volatility(HV)
(3) Low Volatility (LV)

Under each scenario, we conduct Monte Carlo Simulation, and choose sample size n = 10,000.

3.2 Result

For the US equity market, we test the Sharpe Ratio based momentum strategy which we build in the previous section. Its annualized return distribution under each scenario are shown in the figure below:

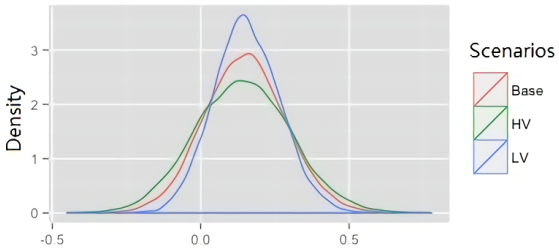


Figure 8. Scenario Test Result of US Equity Strategy

The portfolio performance is summarized in the Table 13:

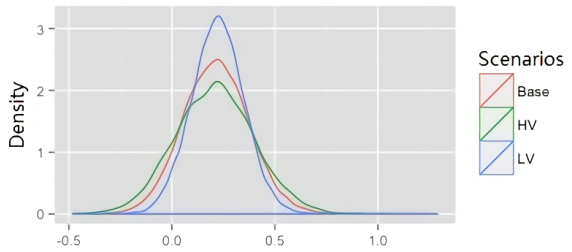


Figure 9. Scenario Test Result of Emerging Markets Strategy

Table 13. Scenario Test Result of US Equity Portfolio

	Base	HV	LV
Expected Return	14.89%	14.18%	15.51%
Standard Deviation	0.1397	0.1663	0.1133
Sharpe Ratio	0.96	0.76	1.24
Prob. Of Positive	86.23%	80.89%	91.83%
Prob. Of better than S&P 500	72.36%	68.56%	78.81%

We have several observations:

1. The strategy works well in all the three scenarios, as the probability that it is better than the S&P 500 is always above 0.5.

2. The performance of this strategy is influenced by the market volatility. High market volatility will drive up the portfolio volatility as well, but the change in the expected return is not very obvious.

3. The distribution graph shows us, the higher the market volatility is, the fatter tail the return distribution will have. In other words, we will have a higher value at risk as well as a higher potential extreme profit in the high volatility case. However, it will not influence our investment decision, as the probability of each case is extremely small. For the emerging market, we apply the same momentum strategy by using different parameters. The distribution graph and performance measures are summarized below.

Table 14. Scenario Test Result of Emerging Markets Strategy

	Base	HV	LV
Expected Return	21.37%	20.77%	22.23%
Standard Deviation	0.1596	0.1919	0.1271
Sharpe Ratio	1.26	1.01	1.64
Prob. Of Positive	91.16%	85.85%	95.94%
Prob. Of better than S&P 500	77.20%	72.14%	83.70%

From Central Limit Theorem, we can understand the similarity in the shape of the two density graphs. Compared with our US Equity portfolio, our emerging market portfolio generates a higher expected return with a slight higher volatility under all these scenarios. Hence, the Sharpe Ratio is always higher than that of the US Equity one. Besides, the winning probability of the strategy is higher than that in the US Equity one, which indicates that it is also safer to invest in this emerging market portfolio if we only want to lock the S&P 500 return. Hence, under the consistent market assumption, our suggestion will be the momentum strategy in emerging markets under all the three scenarios.

The case of Foreign Exchange and Commodity Market are very different from the former two ones. The seasonal pattern and frequently changed correlation will make our MLE estimator work poorly. Hence, instead of using the Monte Carlo Simulation[10], we analyzed the performance of this portfolio in a much longer historical period from 2004 to 2016, which contains diversified market conditions. Figure 10 shows the accumulated value of this portfolio.

Figure 10. Performance of FX & Commodity Markets Portfolio

It indicates that the strategy works well, with an annualized Shape Ratio equal to 0.78, during the period from 2004 to 2012, even if the market fluctuates severely between 2005 and 2010. However, it did not capture the market movement precisely during 2013 to 2014, which results in a large drawback and more fluctuated pattern of the portfolio in this period. It seems that the strategy could seek for opportunities automatically when unexpected market movements happens, and take advantage of the short positions to make profit. However, the optimal holding period and risk aversion parameter we obtained from the backtesting data may not be the optimal one when the market moves. The other two strategies also face the same problem in practice. Hence, we should do the model validation continuously, in order to adapt our model to the change of market environment.

4. Summary

After analyzing the effects of rising interest rate, we provide different investment strategies on US equity market, emerging markets, currency and commodity markets. Our main assumption is that the current market environment will be consistent with that of historical hike cycle to a large extent based on our observations in macroeconomic environment. Since we do not have enough data at the beginning of this hike cycle,

we borrow historical wisdom from the last one. However, nimbleness is the key point here and we encourage investors to validate the model continuously and adapt the model to the current market by running the optimization scheme iteratively. When the current data shows consistency with historical hike cycle, we should invest in the emerging market using the momentum strategy, which works best under all the volatility levels. If some black swan events happen and the consistency assumption does not hold any more, we suggest investors withdraw from the market and wait for recovery. For the extreme risk seeking speculators, we will recommend commodity and foreign exchange strategy in this case, based on its backtesting result in the last 10 years. Finally, we encourage investors to add a stop-loss line to reduce the potential loss.

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