LIM ADVISORS TEST REPORT

By Samuel Wu

I. FUND ANALYSIS

- ***Fund Introduction***

  UPAMC All Weather Fund A (ISIN: TW000T0902Y4) established since February 18th, 1994, aiming to pursuit long term appreciation and stable income by investing primarily in equities listed on the Taiwan Stock Exchange (TSE)[1].

  It is managed by Wen-Yan Zhu, President Investment Trust. She invests primarily in equities listed on the Taiwan Stock Exchange and the OTC market. Wen-Yan made the jump from senior analyst to fund manager in 2007. She has also worked as a manager at E SUN Securities.

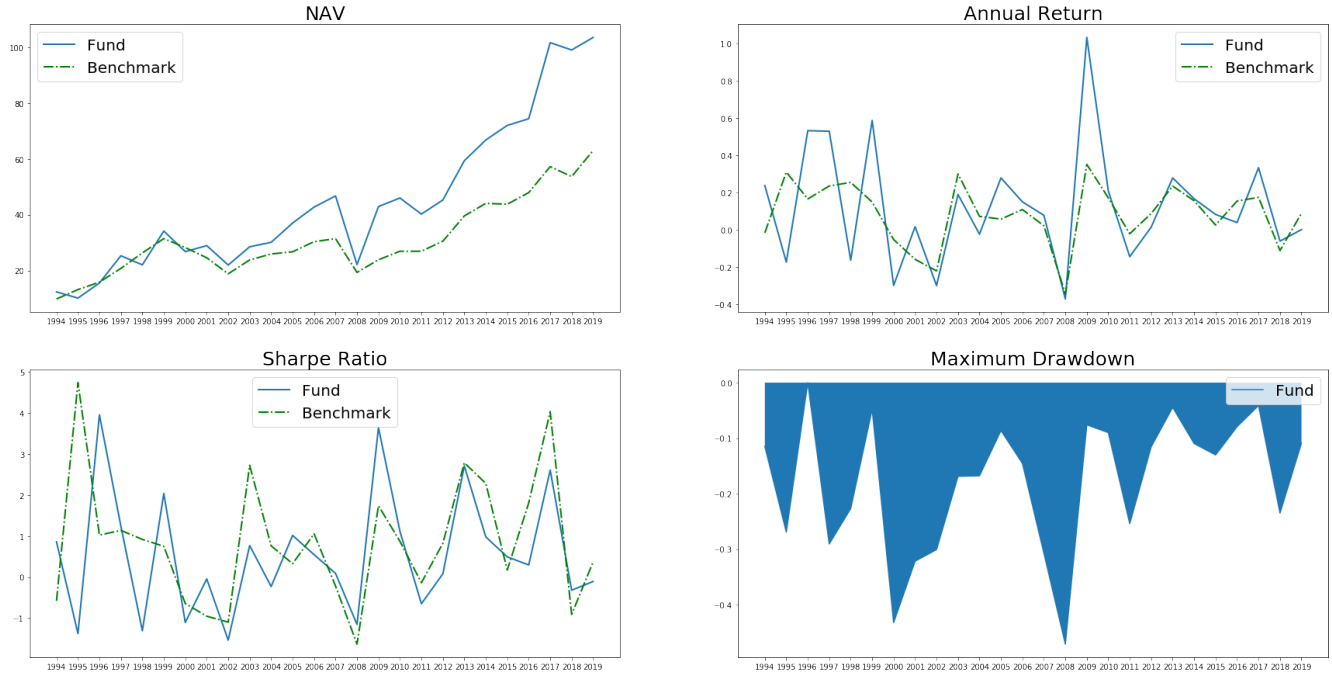
- ***Performance Analysis***

  From February 18th, 1994, to June 30th , 2019, the fund has annualized return of 9.65%, Sharpe ratio of 0.2989, maximum drawdown of 68.03%, beta of 0.759 using S&P500 as a benchmark.

  1) Basic Statistic[2]

	Annualized Return	Annualized Volatility	Sharpe Ratio	Max Drawdown	Corr	Beta
Since Inception	9.65%	0.2435	0.2989	-0.6803	0.4531	0.759

  2) Annual Detail Graph



[1] *Information Source: Citywise Selector*

[2] *Data Source: Yahoo Finance*

II. BETA HEDGING WITH PUT OPTION

- ***Algorithm***

The procedure and algorithm of implementation of a long put option on the fund are as follow.

1) Calculate monthly beta based on the previous two-year data. The first two-year betas are set to 0, which means no options transaction in this period. Monthly beta will be used as a rolling hedge ratio.
2) Generate the option price and its execution profit with Black Scholes model using S&P500 (^GSPC) spot to calculate spot price and strike price, VIX (^VIX) to calculate volatility, and 13-week US Treasury Bill rate (^IRX) to get the risk-free rate.

$$P(S,t) = Ke^{-rT}N(-d_2) - SN(-d_1)$$

3) Rolling the option contract based on 50% beta hedging.

$$NAV_{Hedged} = NAV_{Unheged} + \frac{1}{2}\sum(Beta_i \times OptionNetProfit_i)$$

4) Compare the beta of hedged portfolio and unhedged portfolio with different OTM ratio, expiry month parameters.

- ***Outcome***

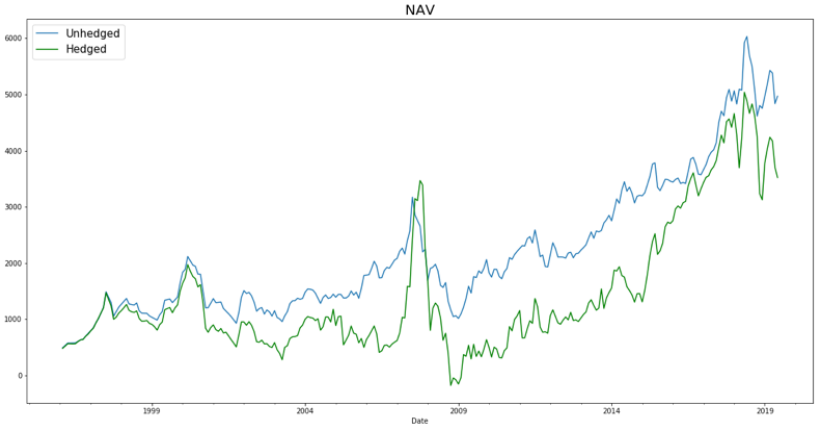
1) Hedged beta and unhedged beta of different parameters.

OTM Ratio	Expiry Month	Hedged Beta	Unhedged Beta
98%	1	0.12	0.75
98%	3	3.29	
95%	1	0.52	
95%	3	28.50	
90%	1	1.07	
90%	3	-3.31	

2) Hedged portfolio PnL.

	Annualized Return	Annualized Volatility	Sharpe Ratio	Max Drawdown	Corr	Beta
Since Inception	8.17%	2.2207	0.0261	-1.0515	0.0341	0.5214

3) NAV graph of put option strategy with 95% OTM ratio and 1 expiry month.



III. MARKET RISK FACTORS BETA

- ***Betas to single individual factors – simple linear regression***

$$R_{fund} = \beta R_{riskfactor} + \alpha + \epsilon$$

Market Factor	GLD	USO	DBC	VNQ	SPY	VEU	EEM	VIX	TNX	UUP
Beta	0.12	0.22	0.43	0.31	0.76	0.70	0.58	-0.10	0.16	-0.85

- ***Betas on multiple factors – multiple linear regression***

1) Original factors have high correlations with each other. The correlation matrix is as follows.

	GLD	USO	DBC	VNQ	SPY	VEU	EEM	VIX	TNX	UUP
GLD	1	0.166944	0.408786	0.0831466	0.0316376	0.19102	0.2739	-0.0161724	-0.313358	-0.436943
USO	0.166944	1	0.869088	0.214136	0.485043	0.530318	0.516317	-0.277927	0.357814	-0.449364
DBC	0.408786	0.869088	1	0.306787	0.527151	0.621439	0.622843	-0.335227	0.259885	-0.616343
VNQ	0.0831466	0.214136	0.306787	1	0.715863	0.682339	0.616979	-0.458855	-0.0456455	-0.380819
SPY	0.0316376	0.485043	0.527151	0.715863	1	0.887979	0.803413	-0.699906	0.288168	-0.480333
VEU	0.19102	0.530318	0.621439	0.682339	0.887979	1	0.942679	-0.656121	0.193899	-0.704048
EEM	0.2739	0.516317	0.622843	0.616979	0.803413	0.942679	1	-0.585506	0.159668	-0.670795
VIX	-0.0161724	-0.277927	-0.335227	-0.458855	-0.699906	-0.656121	-0.585506	1	-0.137552	0.322063
TNX	-0.313358	0.357814	0.259885	-0.0456455	0.288168	0.193899	0.159668	-0.137552	1	0.000788952
UUP	-0.436943	-0.449364	-0.616343	-0.380819	-0.480333	-0.704048	-0.670795	0.322063	0.000788952	1

2) Gram-Schmidt orthogonalization to reduce correlation.

GS Algorithm: regress two non-orthogonal variables and produce orthogonal vectors consecutively, aim at getting an orthogonal variable dataset. Correlation matrix after orthogonalization is as follows.

	GLD	USO	DBC	VNQ	SPY	VEU	EEM	VIX	TNX	UUP
GLD	1	0.00928673	0.00217211	-0.0136245	-0.0290978	0.0209306	-0.00418204	-0.0331214	0.00340918	-0.00783624
USO	0.00928673	1	-0.00142502	0.00893843	0.0190897	-0.0137316	0.00274365	0.0217294	-0.00223661	0.005141
DBC	0.00217211	-0.00142502	1	0.00209065	0.00446498	-0.00321173	0.000641722	0.00508238	-0.000523129	0.00120245
VNQ	-0.0136245	0.00893843	0.00209065	1	-0.0280065	0.0201456	-0.0040252	-0.0318792	0.00328132	-0.00754234
SPY	-0.0290978	0.0190897	0.00446498	-0.0280065	1	0.0430247	-0.00859658	-0.0680841	0.00700789	-0.0161081
VEU	0.0209306	-0.0137316	-0.00321173	0.0201456	0.0430247	1	0.00618367	0.0489741	-0.0050409	0.0115868
EEM	-0.00418204	0.00274365	0.000641722	-0.0040252	-0.00859658	0.00618367	1	-0.0097853	0.0010072	-0.00231512
VIX	-0.0331214	0.0217294	0.00508238	-0.0318792	-0.0680841	0.0489741	-0.0097853	1	0.00797693	-0.0183355
TNX	0.00340918	-0.00223661	-0.000523129	0.00328132	0.00700789	-0.0050409	0.0010072	0.00797693	1	0.00188727
UUP	-0.00783624	0.005141	0.00120245	-0.00754234	-0.0161081	0.0115868	-0.00231512	-0.0183355	0.00188727	1

3) Calculate fund beta on factors.

$$R_{fund} = \beta_1 R_{riskfactor1} + \beta_2 R_{riskfactor2} + \cdots + \beta_i R_{riskfactori} + \alpha + \epsilon$$

Market Factor	GLD	USO	DBC	VNQ	SPY	VEU	EEM	VIX	TNX	UUP
Beta	0.05	0.26	0.15	0.19	0.25	0.20	0.14	0.08	-0.03	0.11

IV. CONCLUSION AND COMMENTS

- ***Fund Analysis***

  1) From the result of Part I, we can see that the UPAMC All Weather Fund A is a fund with a long history and its annualized returns beat the market most of the time. However, its volatilities and drawdowns are also at a high level, which leads to its Sharpe ratio less prominent.

  2) One thing we can improve is using a more appropriate benchmark to evaluate the beta factor. Also, due to the limitation of Yahoo Finance, it doesn't provide the Taiwan government bond yield rate, so I use US 13-week treasury bill rate instead, which corresponds to the S&P 500 index. Since the UPAMC All Weather Fund A is a Taiwan market fund and it focuses on the stocks of Taiwan stock market, we can use the TSEC weighted index (^TWII) as the selection of benchmark and Taiwan 10-year government bond yield rate as the selection of risk-free rate.

- ***Beta Hedging with Put Option***

  1) The protective put option strategy reduces the beta of fund to some extent, yet, at a cost of return and Sharpe ratio. We can draw a conclusion that with higher OTM ratios, the hedged effect is more obvious in a short-term period.

  2) For OTM ratio of 90% put option strategy, since the S&P 500 spot rate rarely decreases 10% in one month, this strategy has the opposite effect on the beta hedging. When we extend the expiry month to backtest, the hedged effect starts to emerge.

  3) Using VIX as the volatility of option pricing in the Black-Scholes model is reasonable in short-term option, but doesn't apply to long-term option. VIX is the expected annualized change in the S&P 500 index over the following 30 days. When we use it to determine the price of 3-months expiry option, the option price itself has a deviation from its true price, causing the backtesting effect unsatisfactory.

  4) From the risk management perspective, we should take exchange risk into consideration in the model. Since the fund is traded at TWD when S&P 500 index USD, the exchange risk can have an impact on the overall profit of the portfolio.

- ***Market Risk Factors Beta***

  1) In the individual beta factor stage, we see that SPY (US equities) weighted most in affecting the performance of the fund. In the multiple beta factor stage, the explanation of SPY decrease and rank second among the market factors. USO (oil) becomes the most weighted factor.

  2) The reason why orthogonalization needs to be done is that factors may or may not have a high correlation with each other, if they are directly used in a multiple regression model, it will affect the coefficient of the factors and result in large regression errors.