



Financial Modeling Course: Portfolio Management Report

Conclusion

Based on the short-term 11-week's performance, the managed portfolio is approaching our design goals that (1) it exceeded DJIA index by 0.3682% per week (2) the volatility is much lower with the portfolio beta about 0.59 and (3) portfolio alpha is 0.07 (all results are after-cost basis). However, the performance data featured only represents the short-term, which is no guarantee of future results.

Results:

- Financial market environment research work has found that long technology/health/utilities short energy sectors will outperformance the market with relatively high probability.
- Leverage effect has a significant impact for portfolio performance. Comparing with 100/0 strategy (long only), 130/30 strategy is actually effective to decrease 12.72% of portfolio beta and increase 48.23% of portfolio alpha.
- Through Fama-French 5-factor model, we identified key variables (CMA factor=1.15, Beta=0.74, HML factor=-0.82 and alpha=0.05, assuming SP500 market Beta is 1) to influence the portfolio performance.
- The portfolio performance is continuing to outperformance the market. The weekly excess return over DJIA is 0.3682% and Sharpe ratio is 0.59 (as of 2016/4/15). Additionally, the average return of long position stocks is 11.52% in less than 4 months (as of 2016/5/4).
- Our portfolio is good choice under current financial market. The most challenge/risk factor is that current tight monetary policy (Raising interest rate) will shift to the easing monetary policy (QE or cut off interest rate).

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Portfolio Management Ground Rules

Current, our group is required to do the fund management job. A notional \$1 million is provided for our investment.

Project Rules:

Rule 1: Trading is restricted to the 30 stocks in the DJIA and the 1-month T-bill. Short sale and margin trading are both allowed. Assume a one-way transaction cost of 20 basis points for trading stocks.

Rule 2: Securities are bought/sold once a week (every Friday) for 15 weeks (1/22-4/29). Each purchase/sale should be justified on the basis of current market conditions and finance principles. Our report explained the rationale of our trading, report the weekly profit and loss of our portfolio and provides key summary statistics of the portfolio performance over the trading period.

Rule 3: In particular, the summary statistics also include the following: portfolio mean return, standard deviation, t-ratio of mean return (and statistical significance), excess return over the T-bill (and statistical significance), excess return over the DJIA return (and statistical significance), Sharpe ratio, market beta, market alpha (and statistical significance), Fama-French betas, Fama-French alpha (and statistical significance), Treynor measure, M2 measure (portfolio outperformance relative to the market), appraisal ratio, best weekly return, worst weekly return, number of winning weeks, number of losing weeks, and maximum consecutive losing weeks. We do the analysis on a before-cost basis and on an after-cost basis.

Scope of investment :

30 large stocks listed in the course's syllabus, including MMM, AXP, T, BA, CAT, CVX, CSCO, KO, DD, XOM, GE, FS, IBM, INTC, JNJ, JPM, MCD, MRK, MSFT, NKE, PFE, PG, HD, TRV, UTX, UNH, VZ, V, WMT, DIS.

Investment Objectives:

- (1) Achieve long term returns that exceed DJIA /SP500 by 1% per year.
- (2) The volatility of return is less than DJIA/SP500.

Roles and Responsibility:

The investment managers will implement professional financial knowledge to purchase, sell, or hold the specific securities that will be used to meet the long term portfolio's investment objectives.

Financial Market Environment Research

In general, financial market environment that federal reserve raises interest rate is dominantly important for portfolio management because analysis of similar historical finance background will help us raise the probability of gaining the profit. All aspects for background analysis includes: (1) statistics of the past mutual funds' historical data to find the suitable fund style, asset allocation and long-short proposition that outperformed the market in such financial market environment. (2) Sector allocation analysis (3) Individual stock weights analysis.

The past experience state that when the risk free rate is increasing, the stock market will be corrected for the relatively high price based on the discounted cash flow (DCF) valuation model. For example, the dot.com bubble is crashed on 2000 shortly after FED raising fund rate. Thus, the raising fund rate cycle will frequently accompany market volatility or correction.

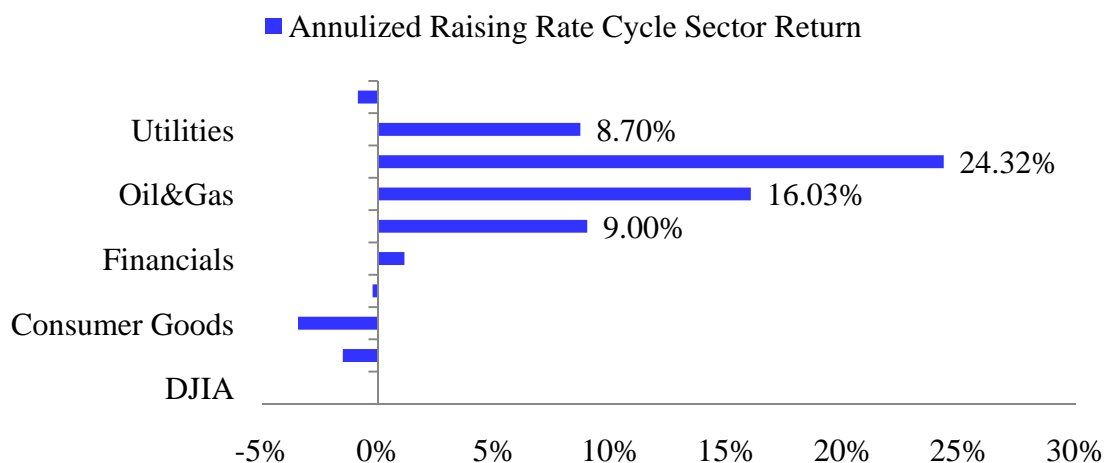
Current, we are entering the raising fund rate cycle. It happened three times in the last twenty years. Therefore, the aim of research is to find the outperformance sectors/portfolios/individual stocks for the raising fund rate cycle. For example, it is very meaningful to download the portfolio performance data sets from Morningstar company website (<http://www.morningstar.com/>) during these periods and analysis the suitable strategies for outperformance.

To simply the problem, we initially focus on sector analysis. Based on the statistics result of past sector performance, we found that the technology, oil&gas (its fundamental is completely different form past due to shale gas revolution), health and utilities sectors will outperformance with relatively high probability in FED raising fund rate cycles. Thus, **we long technology, health and utilities sectors** and pick up the mainly individual stocks from these sectors.

Last three FED
Raising Rate Cycles:
(1)2004/6/29-
2006/6/30 (2 years)
(2)1999/6/29-
2000/5/17 (0.89 year)
(3)1994/2/3-1995/2/2
(1 year)

Long
technology,
health and
utilities sectors'
stocks

Figure 1:Statistics Result of Sector Performance in FED Raising Rate Cycles



Data source: Bloomberg, Rutgers 2017MQF Team 4

Current Sector Fundamental Statistics

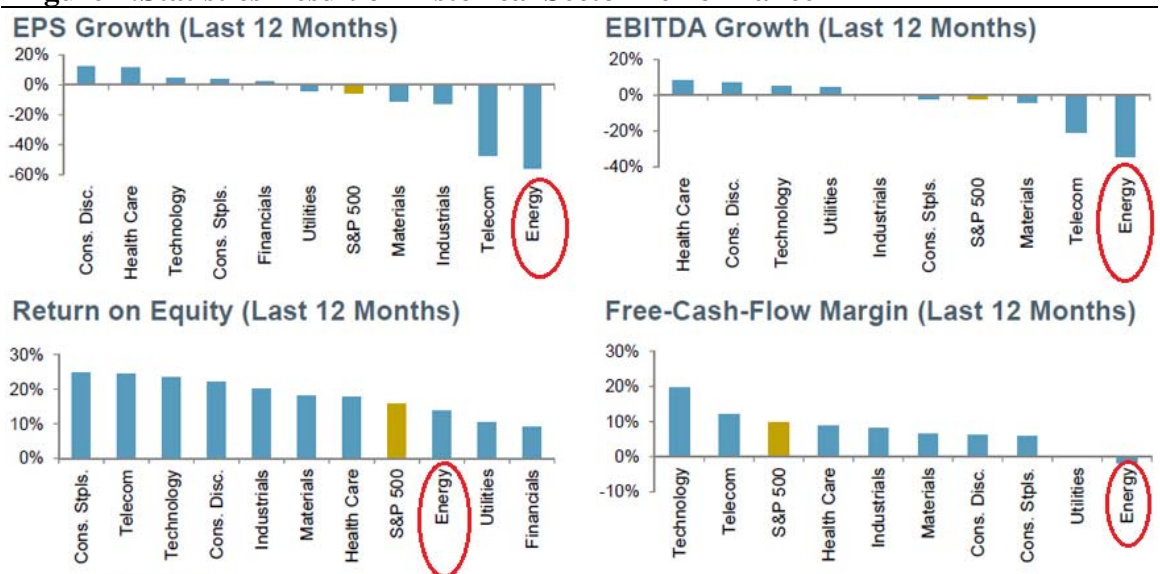
In general, the outperformance is consistent with above-average fundamental. Thus, we checked the sector fundamental with four key factors: EPS growth, EBITDA growth, ROE and free-cash-flow margin. The results illustrate it seems be consistent with technology, health and utilities sectors. However, energy sector is the only exception that represented very bearish fundamental expectation. So, **we short the individual stock from oil&gas sector.**

(1)Energy EPS growth and EBITDA growth rate is about -40%, which reflected the strong bearish opinion about company earning ability. And free cash flow margin is -5%, which is a most important indicator of company financial health.

(2)In news event, two of big three credit rating agencies, Moody and S&P had decided to a wholesale downgrade of the US big energy companies on Feb, 2016. Absolutely, the analysts of Wall Street financial company will cut off the long-term stock pricing following the steps of credit rating agencies.

(3)Three scenarios worth monitoring in the future: Iran is likely to boost production once sanctions are lifted, Saudi Arabia may seek to grow its market share and OPEC increases crude-oil production capacity. If the global economy were to decline due to further weakness in emerging markets or some unexpected event, then demand growth for oil (currently about 1.8 million barrels per day) would likely slow sharply. Such an event would lead to even lower oil prices, and put further pressure on energy companies currently fighting to survive.

Figure 2:Statistics Result of Historical Sector Performance



Source: FactSet, Fidelity

Data source: FactSet, Fidelity, Rutgers 2017MQF Team 4

Long/Short 130/30 Strategy

After sector allocation, leverage effect is the next important point for portfolio management. The 130/30 strategy is to purchase the high expected returns shares with 130% long position and to short the poor performing stocks with 30% short position. Gordon B. and Fowler, Jr in the Glenmede Trust Company (Understanding 130/30 Equity Strategies, 2007 <http://www.cfapubs.org/doi/pdf/10.2469/cp.v24.n3.4848>) have found that 130/30 strategy has the maximize information ratio (IR=0.541) while the 100/0 long only portfolio's IR is 0.486. So 130/30 strategy is a typical hedge fund strategy and strongly recommended by the CFA institute.

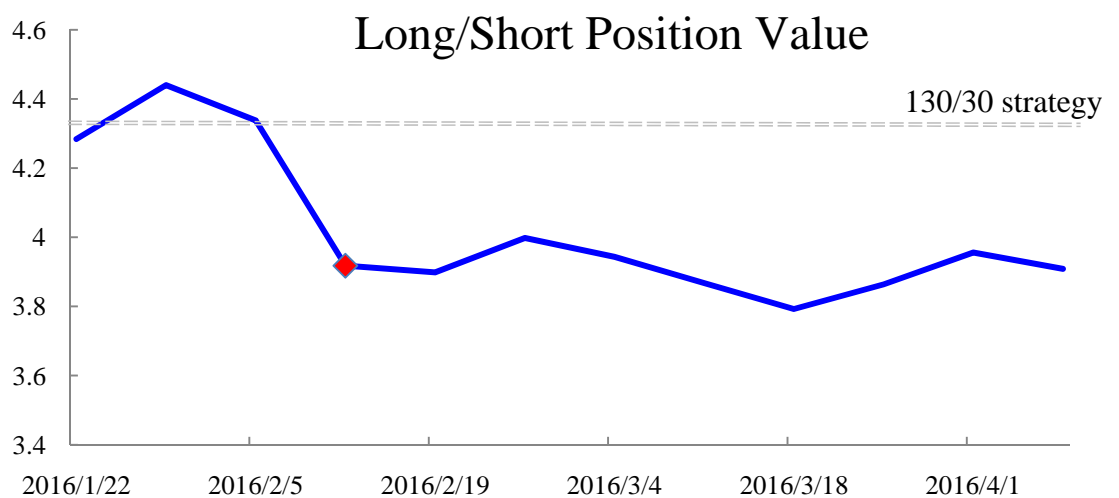
In order to verify the effective of 130/30 strategy, we have checked the effect of portfolio leverage between the 100/0 long only optimization portfolio and 130/30 strategy optimization portfolio using Fama-French 5-factor model (see Appendix 5).

- (1) The 130/30 strategy optimization portfolio has decreased 12.72% of portfolio beta to 0.7411 (normalized SP500 beta=1).
- (2) The 130/30 strategy optimization portfolio has increased 48.23% of portfolio alpha (excess return) to 0.0544(normalized SP500 beta=1).
- (3) The 130/30 strategy optimization portfolio has a relative low R square 63% (100/0 long only = 87%), which means the portfolio return cannot be fully explained by Fama-French 5-factor model.

Hence, **the 130/30 strategy is actually effective to decrease our portfolio beta and increase portfolio alpha.**

Figure 3:Portfolio's Long/Short Position Value

Our portfolio is using the 130/30 strategy and make a slightly position change on Feb 12, 2016.



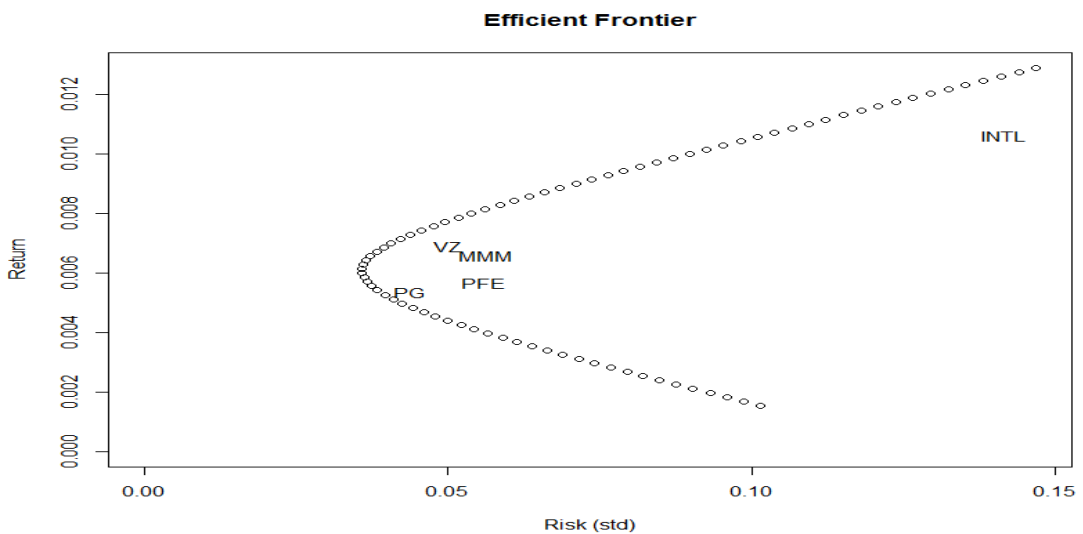
Data source: Rutgers 2017MQF Team 4

Individual Stocks Weights Calculation

As stated on page 3, we select the individual stocks from technology, health and utilities sectors and initially optimized portfolio by efficient frontier method.

The efficient frontier method is to find a series of optimal portfolios that offers the highest expected return for a given risk or the lowest risk for a given expected return. In order to reduce portfolio risk, we have made the efficient frontier for 5 stocks, MMM, VZ PFE, PG and INTL. We can see in the Figure 4 that the risk of the portfolio is greatly reduced, which means the objective to minimize the portfolio risk has been achieved.

Figure 4: Individual Stocks Weights Based On Covariance Results



Data source: Rutgers 2017MQF Team 4

Using efficient frontier method, we can get another important result about individual stock weights. In our initially optimized portfolio, PFE 17%, MMM 54%, INTL 0.3%, VZ 24% and PG 3.7%. It is not cogent reason that single stock weight is over 20% for portfolio diversity, so we set 25% of the weight limit for the single stock.

Figure 5: Individual Stocks Weights Based On Covariance Results

Variance - Covariance Matrix							
		Pfizer	Exxon Mobil	3M	Intel	Verizon	rocter and Gamble
	Pfizer	4.13339E-05	-2.34752E-05	-6.8987E-06	1.58551E-05	-8.87702E-06	-6.67545E-06
	Exxon Mobil	-2.34752E-05	5.63382E-05	3.51308E-05	2.38459E-05	1.80262E-05	2.60032E-05
	3M	-6.8987E-06	3.51308E-05	3.22121E-05	2.33348E-05	1.30361E-05	1.77752E-05
	Intel	1.58551E-05	2.38459E-05	2.33348E-05	5.59055E-05	-2.30073E-06	1.29823E-05
	Verizon	-8.87702E-06	1.80262E-05	1.30361E-05	-2.30073E-06	2.48309E-05	1.43321E-05
	Procter and Gambl	-6.67545E-06	2.60032E-05	1.77752E-05	1.29823E-05	1.43321E-05	2.44714E-05

Data source: Rutgers 2017MQF Team 4

Portfolio Optimization: Lower Beta and Higher Alpha

After 3-week portfolio management, we are lower return expectation based on the world financial market performance.

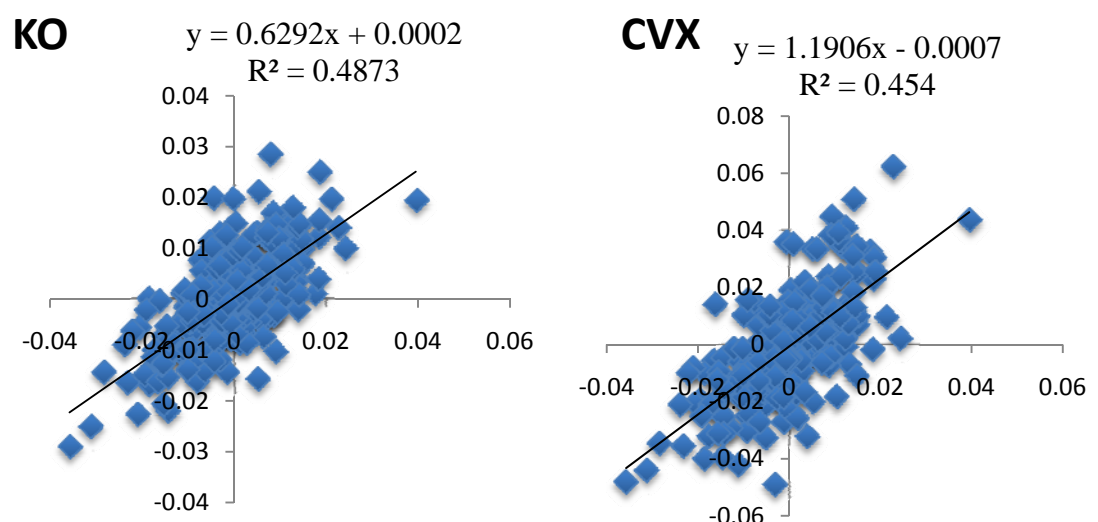
(1) China GDP growth rate has hit 25-year slowest record and many economic indicators traced the deepening slowdown on Jan 19, 2016. Wall Street is worried about the spillover effect of Chinese economy slowdown to the world.

(2) US oil prices crashed below \$27 dollars a barrel on Jan 20, 2016. Wall Street fears both external and internal shocks for US financial market. The typical external shocks includes: (1) Oil-led country default, such as Venezuela Kazakhstan, Nigeria and Azerbaijan (2) Oil-led currency devalue, such as Russia. For the internal shocks, it seems to be close to US energy companies. Moody and S&P had decided to a wholesale downgrade of the US big energy companies on Feb, 2016.

(3) The U.S. economy slows to 0.7 percent in the 4th quarter of 2015 reported on Jan 29, which is an indication of how tepid global growth is exposing seriously weaknesses in US's long-term sluggish recovery.

So **it is necessary to lower our portfolio beta to hedge the market volatility.** Here, we use one variable linear regression method to lower portfolio beta. Since our portfolio beta is 0.614 (long position beta 0.855), we will buy stock if stock beta is much lower than 0.855, and short stock if stock beta is much higher than 0.855. For example, stock KO's beta is 0.629 (<0.855), and we buy it. Stock CVX's beta is 1.191 (>0.855), and we short it. However, this method has an obvious weakness that stock return cannot be fully explained by model ($R^2 < 0.5$). Thus, we want to implement Fama-French 5-factor model to improve it.

Figure 6: One Variable Regression Method For Portfolio Optimization



Data source: Bloomberg, Rutgers 2017MQF Team 4

Portfolio Optimization: Lower Beta and Higher Alpha

In 1990s, Professor Fama and French developed the Fama-French three-factor (beta, size and value) model to replace the single-factor capital asset pricing model (CAPM) and became the standard model for portfolio return/risk analysis in finance industry. In 2015, they provided the up-to-date Fama-French 5-factor model to include the additional factors (profitability and investment) that have significant impact for portfolio performance.

So, we use the Fama-French 5-factors model to get a whole return/risk picture and thus to maximize our portfolio long-term performance.

(1) The 130/30 strategy optimization portfolio return can be nicely explained by Fama-French 5-factors model about 63.3%.

(2) The 130/30 strategy optimization portfolio can get 0.05% alpha (normalized SP500 market premium=1), which means 0.05% per year excess return if SP500 annual return is 1%.

(3) The 130/30 strategy optimization portfolio return has three positive factors: CMA, MKT and RMW. It means portfolio gains positive return by investing conservative and high profitability companies.

(4) The 130/30 strategy optimization portfolio return has one significant negative factor HML. Comparing with the value of long only position, we can conclude that the short position (energy companies) has high value. However, we are not worried about it because there is no obvious rally for energy company fundamental. Low oil prices are likely to stay as the expansion of shale oil revolution.

Thus, it is clear **130/30 strategy optimization portfolio advantages are: (1) conservative investment style is suitable for market volatility (2) portfolio beta is lower (3) portfolio has an obvious risk-adjusted excess return (alpha). The weakness of portfolio is also clear that it will be sluggish if market has an obvious upside trend.**

Figure 7: Fama-French 5-Factor Model Results

Alpha: excess return of portfolio

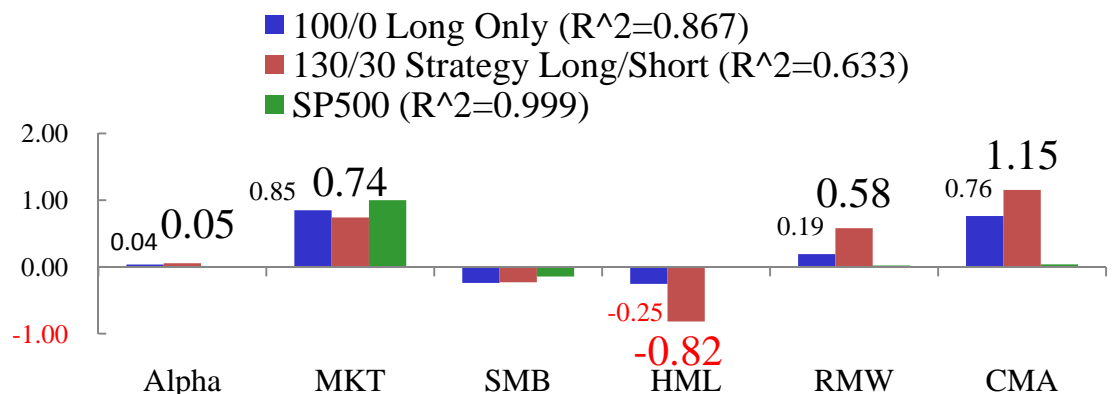
MKT: market premium

SMB: small minus big

HML: high value minus low value

RMW: high operating profit minus low operating profit

CMA: Conservative minus Aggressive



Data source: Kenneth R. French, Rutgers 2017MQF Team 4

Back Testing for 130/30 Optimization Portfolio

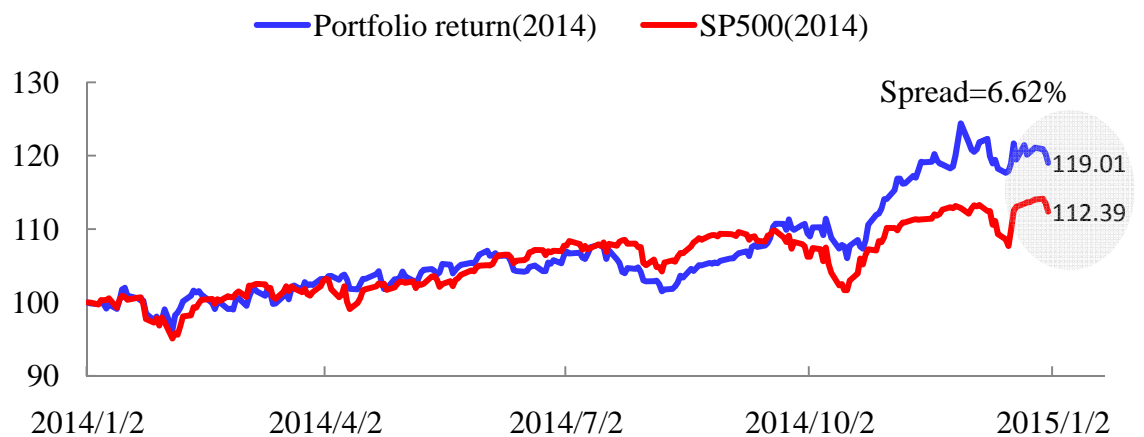
As we known, short-term performance cannot guarantee anything of future results. To verify the effect of portfolio optimization, it should be back testing to observe the long-term performance. The back testing results are below:

(1) The 130/30 strategy optimization portfolio has outperformance the market by 6.62% on 2014. However, it is obvious that portfolio is lagged behind the SP500 index when the market has the upside trend.

(2) The 130/30 strategy optimization portfolio has outperformance the market by 13.17%. This is a huge, unbelievable excess return.

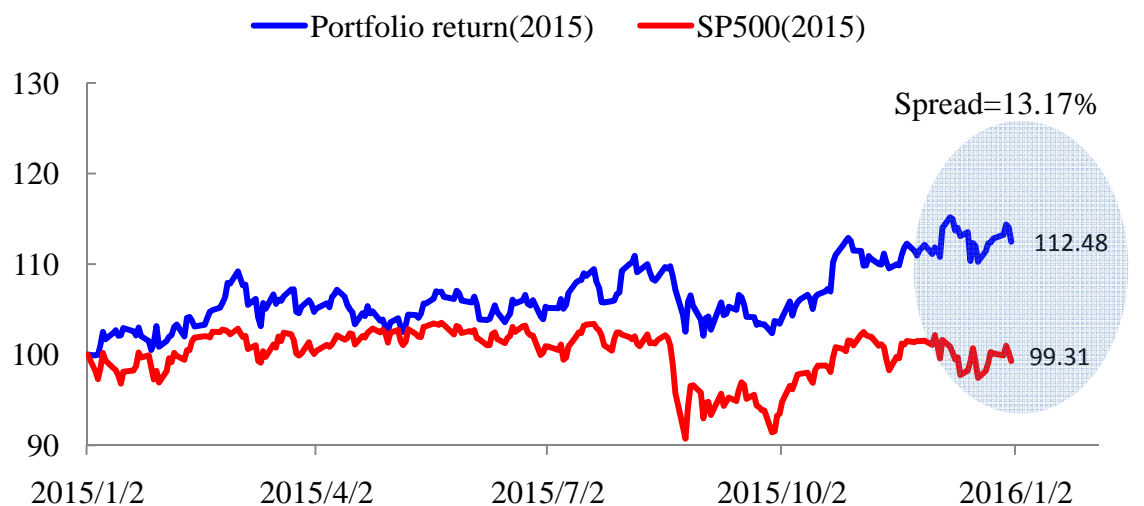
Through long term back testing, we confirm the points that **130/30 strategy optimization portfolio is suitable for current volatility financial market while it has innate defect for upside trend financial market.**

Figure 8: Back Testing of 130/30 Strategy Optimization Portfolio on 2014



Data source: Bloomberg, Rutgers 2017MQF Team 4

Figure 9: Back Testing of 130/30 Strategy Optimization Portfolio on 2015



Data source: Bloomberg, Rutgers 2017MQF Team 4

Portfolio Management Conclusion(1)

Figure 10: Statistics Results of Before-Cost Basis

	Value	T-ratio	Result
Portfolio return	1.1936%	1.98019494	do not reject
Excess return over T-bill	1.1332%	1.87846055	do not reject
Excess return over DJIA	0.3764%	0.67180805	do not reject
Market alpha	0.006855418	1.18689327	do not reject
Market beta	0.591528843	1.7901596	do not reject

Data source: Rutgers 2017MQF Team 4

Figure 11: Statistics Results of After-Cost Basis

	Value	T-ratio	Result
Portfolio return	1.1854%	1.97511265	do not reject
Excess return over T-bill	1.1250%	1.87295456	do not reject
Excess return over DJIA	0.3682%	0.66048017	do not reject
Market alpha	0.006773861	1.17963485	do not reject
Market beta	0.591494326	1.80052848	do not reject

Data source: Rutgers 2017MQF Team 4

Figure 12: Statistics of Portfolio Performance

	Before Cost	After cost
Portfolio mean return	1.1936%	1.1854%
Standard deviation	0.019061335	0.018979387
Best weekly return	6.3493%	6.3193%
Worst weekly return	-0.5538%	-0.5538%
Number of winning week	9	9
Number of losing week	2	2
Maximum consecutive losing week	1	1
Market alpha	0.006855418	0.006773861
Market beta	0.591528843	0.591494326
Sharpe Ratio	0.594505845	0.592761867
Treynor measure	0.019157265	0.019020058
M-square	0.01810	0.01802
Appraisal ratio	0.396999181	0.394571341

Data source: Rutgers 2017MQF Team 4

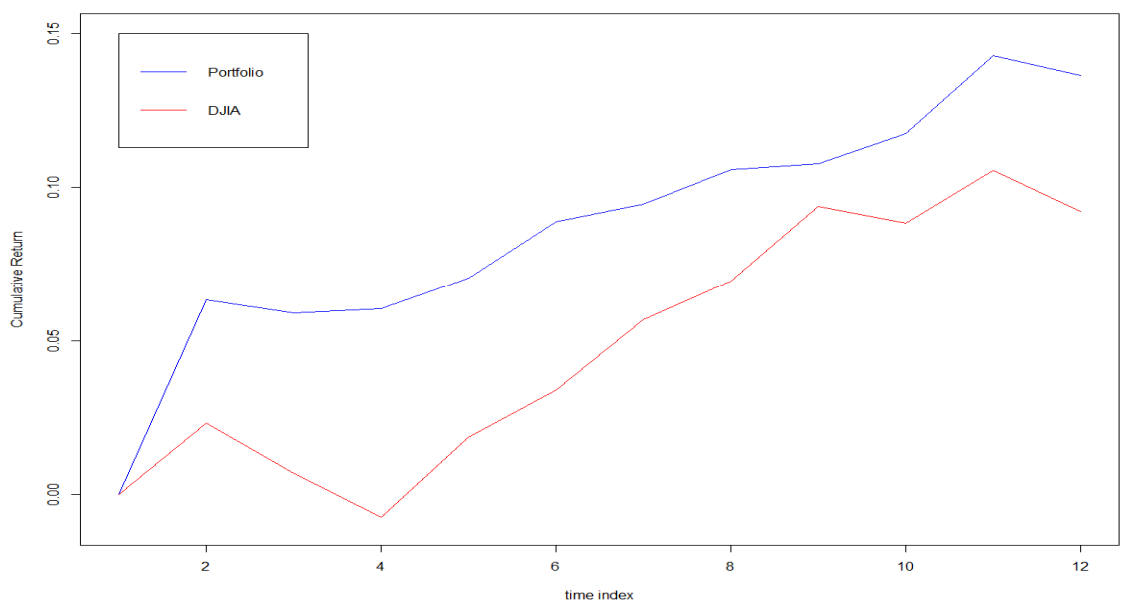
Portfolio Management Conclusion(2)

Based on the performance results, we can conclude that:

- The positive sharp ratio means that under same risk level, the return of our portfolio is bigger than the risk-free portfolio.
- Market beta is closed to 0.6, means that when market portfolio's return increases by 1 unit, our portfolio increases by around 0.6 unit.
- Positive market alpha means that our portfolio is a good choice to invest.
- Treynor measure means that we can get 0.01916 unit risk premium every unit of risk.
- M-square measure means that 1.80 percent return of the portfolio, adjusted for the risk of the portfolio relative to that of market portfolio.
- Appraisal ratio means that we can get about 0.397 unit risk-adjusted return.
- Average return of Long Position Stock is 11.52% in less than 4 months (See Appendix 1).

From the statistics result and cumulative return above, we can conclude that **our portfolio is good choice under current financial market.** If there is a clear signal to end the tight monetary policy (Raising interest rate) and shift to the easing monetary policy (QE or cut off interest rate), our portfolio should be adjusted sharply to meet the different financial environment.

Figure 13:Weekly Portfolio Performance



Data source: Rutgers 2017MQF Team 4

Appendix 1: 130/30 Strategy Optimization Portfolio

130/30 Strategy Optimization Portfolio means long PFE/INTC/VZ/PG/MMM/MCD/KO/T and short XOM/CVX.

100/0 Strategy Optimization Portfolio means long PFE/INTC/VZ/PG/MMM/MCD/KO/T.

The aim of comparing these two strategies is to understand the leverage effect of portfolio management.

Below is our portfolio performance, every long stock has gained the positive return and the average return is 11.52% in less than 4 months.

Figure 14: Long Position of 130/30 Strategy Optimization Portfolio (As of May 4)

SYMBOL	DESCRIPTION	QTY	PURCHASE PRICE	CURRENT PRICE	TOTAL VALUE	TOTAL GAIN/LOSS
PFE	PFIZER INC	2800	\$30.98	\$33.52	\$93,842.00	\$7,098.00(8.18 %)
INTC	INTEL CORP	100	\$29.74	\$29.89	\$2,988.50	\$14.50(0.49 %)
VZ	VERIZON COMMUNICATIONS INC	2500	\$46.84	\$50.81	\$127,025.00	\$9,925.00(8.48 %)
PG	PROCTER & GAMBLE CO	300	\$77.41	\$81.72	\$24,516.00	\$1,293.00(5.57 %)
MMM	3M CO	1400	\$139.51	\$167.23	\$234,122.00	\$38,802.00(19.87 %)
JNJ	Johnson & Johnson	900	\$100.19	\$112.43	\$101,187.00	\$11,016.00(12.22 %)
MCD	MCDONALD's CORP	900	\$115.17	\$129.53	\$116,577.00	\$12,924.00(12.47 %)
KO	COCA_COLA CO	2000	\$43.06	\$45.07	\$90,130.00	\$4,010.00(4.66 %)
T	AT & T INC	2200	\$36.40	\$38.87	\$85,503.00	\$5,423.00(6.77 %)
					\$875,890.50	\$90,505.50 (11.52 %)

Data source: Rutgers 2017MQF Team 4

Figure 15: Short Position of 130/30 Strategy Optimization Portfolio(As of May 4)

SYMBOL	DESCRIPTION	QTY	PURCHASE PRICE	CURRENT PRICE	TOTAL VALUE	TOTAL GAIN/LOSS
XOM	EXXON MOBIL CORPORATION	1300	\$75.82	\$87.89	\$114,257.00	- \$15,691.00(- 15.92 %)
CVX	CHEVRON CORP	1200	\$85.38	\$100.65	\$120,780.00	- \$18,324.00(- 17.88 %)
					\$235,037.00	- \$34,015.00 (- 16.92 %)

Data source: Rutgers 2017MQF Team 4

Appendix 2: Portfolio Trading History

Total commission fees: \$ 1972.81

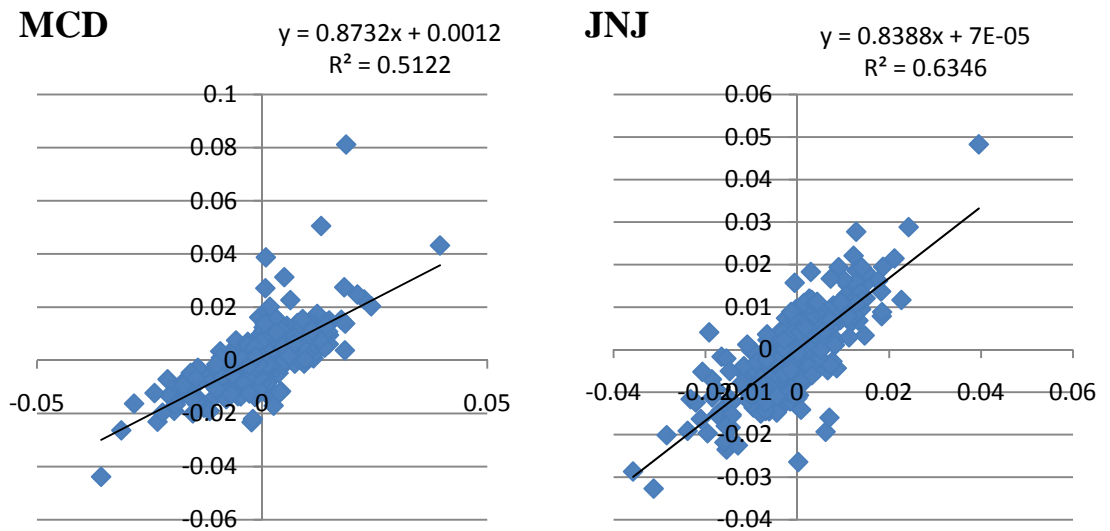
Figure 16:Portfolio Trading History

Date	Trade Type	Symbol	Quantity	Target Price	Price	Total Cash Value	Account Value
1/22/2016 2:46 PM	Buy	MMM	400	\$139.79	\$139.65	\$55,860	\$1,000,694
1/22/2016 2:30 PM	Buy	MMM	1000	\$139.56	\$139.46	\$139,460	\$1,000,286
1/22/2016 2:02 PM	Short	XOM	1300	\$75.81	\$75.82	\$98,566	\$1,000,004
1/22/2016 2:01 PM	Buy	PG	300	\$77.42	\$77.41	\$23,223	\$1,000,004
1/22/2016 2:00 PM	Buy	VZ	2500	\$46.89	\$46.84	\$117,100	\$1,000,004
1/22/2016 1:46 PM	Buy	INTC	100	\$29.75	\$29.74	\$2,974	\$1,000,014
1/22/2016 1:40 PM	Buy	PFE	2800	\$30.99	\$30.98	\$86,744	\$1,000,000
2/5/2016 4:05 PM	Buy	JNJ	900	\$100.40	\$100.19	\$90,171	\$1,019,001
2/5/2016 4:06 PM	Buy	MCD	900	\$115.55	\$115.17	\$103,653	\$1,019,001
2/12/2016 2:48 PM	Buy	KO	2000	\$43.08	\$43.06	\$86,120	\$1,021,269
2/12/2016 2:48 PM	Buy	T	2200	\$36.42	\$36.40	\$80,080	\$1,021,269
2/12/2016 3:13 PM	Short	CVX	1200	\$85.15	\$85.38	\$102,456	\$1,021,478

Data source: Rutgers 2017MQF Team 4

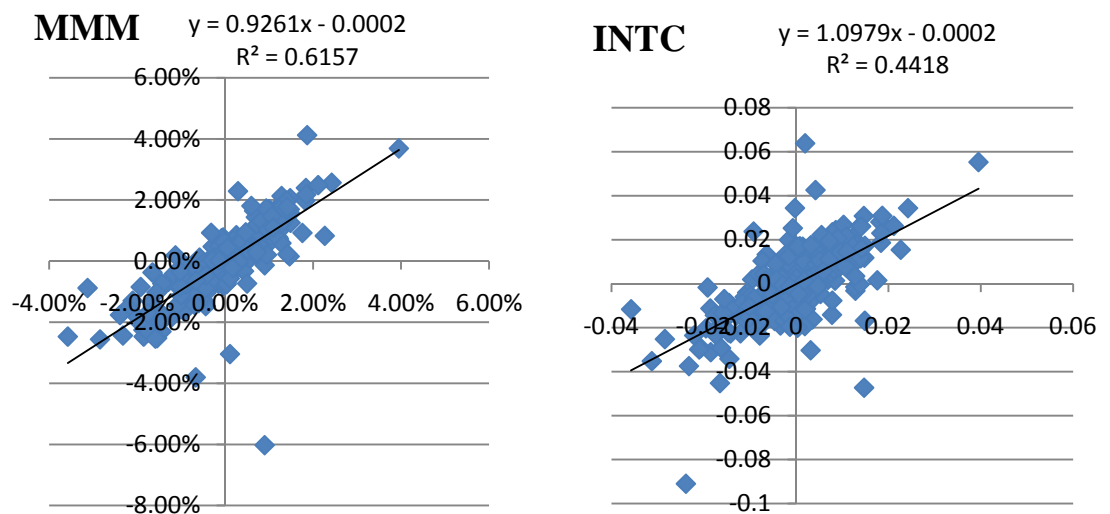
Appendix 3: Regression For Portfolio Optimization

Figure 17: One Variable Regression Model For Stock MCD/JNJ Beta and Alpha



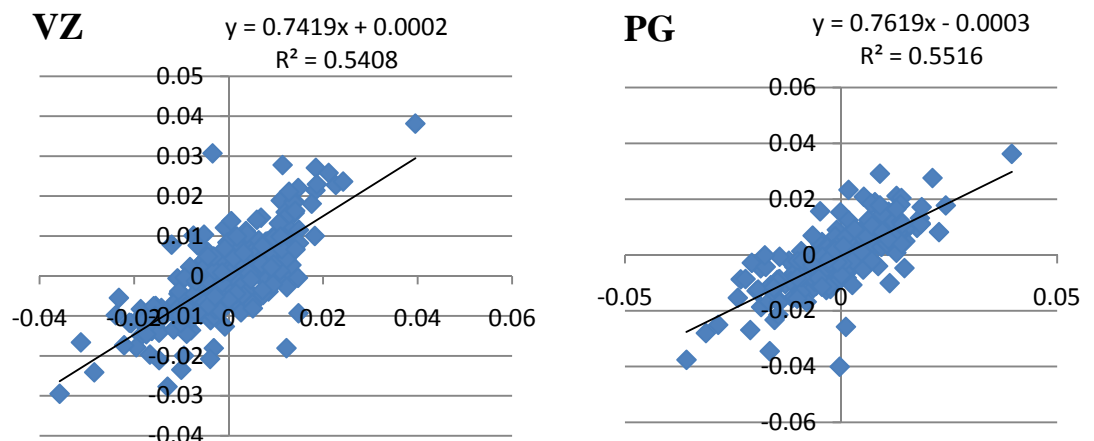
Data source: Rutgers 2017MQF Team 4

Figure 18: One Variable Regression Model For Stock MMM/INTC Beta and Alpha



Data source: Rutgers 2017MQF Team 4

Figure 19: One Variable Regression Model For Stock MMM/INTC Beta and Alpha



Data source: Rutgers 2017MQF Team 4

Appendix 4: Fama-French 3-Factor Model Results

Figure 20:130/30 Strategy Optimization Portfolio Result (1)

Regression Statistics	
Multiple R	0.730489
R Square	0.533614
Adjusted R Square	0.528354
Standard Error	0.006691
Observations	270

Data source: Rutgers 2017MQF Team 4

Figure 21: 130/30 Strategy Optimization Portfolio Result (2)

ANOVA	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	3	0.013625	0.004542	101.4475215	8.39E-44
Residual	266	0.011908	4.48E-05		
Total	269	0.025533			

Data source: Rutgers 2017MQF Team 4

Figure 22: 130/30 Strategy Optimization Portfolio Result (3)

		<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
	Intercept	0.000538	0.000409	1.316384	0.189178415	-0.00027	0.001343	-0.00027	0.001343
MKT	-0.11	0.006456	0.000401	16.08953	3.82801E-41	0.005666	0.007246	0.005666	0.007246
SMB	-0.59	-0.0031	0.000846	-3.6594	0.000304812	-0.00476	-0.00143	-0.00476	-0.00143
HML	0.17	-0.00348	0.000775	-4.48799	1.07143E-05	-0.005	-0.00195	-0.005	-0.00195

Data source: Rutgers 2017MQF Team 4

Figure 23:SP500 Index Result (1)

Regression Statistics	
Multiple R	0.999236
R Square	0.998473
Adjusted R Square	0.998455
Standard Error	0.000402
Observations	270

Data source: Rutgers 2017MQF Team 4

Figure 24: SP500 Index Result (2)

ANOVA	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	3	0.028161	0.009387	57960.78	0
Residual	266	4.31E-05	1.62E-07		
Total	269	0.028204			

Data source: Rutgers 2017MQF Team 4

Figure 25: SP500 Index Result (3)

		<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
	Intercept	-4.7E-05	2.46E-05	-1.89819	0.058753	-9.5E-05	1.74E-06	-9.5E-05	1.74E-06
MKT	-0.11	0.009973	2.41E-05	413.2443	0	0.009926	0.010021	0.009926	0.010021
SMB	-0.59	-0.00149	5.09E-05	-29.2023	5.94E-85	-0.00159	-0.00139	-0.00159	-0.00139
HML	0.17	-2.7E-05	4.66E-05	-0.57573	0.565285	-0.00012	6.49E-05	-0.00012	6.49E-05

Data source: Rutgers 2017MQF Team 4

Appendix 5: Fama-French 5-Factor Model Results (1)

Figure 20:130/30 Strategy Optimization Portfolio Result (1)

Regression Statistics	
Multiple R	0.799604
R Square	0.639367
Adjusted R Square	0.632536
Standard Error	0.005906
Observations	270

Data source: Rutgers 2017MQF Team 4

Figure 21: 130/30 Strategy Optimization Portfolio Result (2)

ANOVA	df	SS	MS	F	Significance F
Regression	5	0.016325	0.003265	93.60903	2.03E-56
Residual	264	0.009208	3.49E-05		
Total	269	0.025533			

Data source: Rutgers 2017MQF Team 4

Figure 22: 130/30 Strategy Optimization Portfolio Result (3)

		Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
	Intercept	0.000545	0.000362	1.50263	0.13413	-0.00017	0.001258	-0.00017	0.001258
MKT	-0.11	0.007424	0.000373	19.91506	1.66E-54	0.00669	0.008158	0.00669	0.008158
SMB	-0.57	-0.0023	0.000801	-2.87196	0.00441	-0.00388	-0.00072	-0.00388	-0.00072
HML	0.17	-0.0082	0.000957	-8.56972	8.83E-16	-0.01008	-0.00632	-0.01008	-0.00632
RMW	-0.32	0.005818	0.001401	4.152536	4.44E-05	0.00306	0.008577	0.00306	0.008577
CMA	0.1	0.011556	0.001689	6.841903	5.43E-11	0.00823	0.014881	0.00823	0.014881

Data source: Rutgers 2017MQF Team 4

Figure 23:SP500 Index Result (1)

Regression Statistics	
Multiple R	0.9993
R Square	0.998601
Adjusted R Square	0.998575
Standard Error	0.000387
Observations	270

Data source: Rutgers 2017MQF Team 4

Figure 24: SP500 Index Result (2)

ANOVA	df	SS	MS	F	Significance F
Regression	5	0.028165	0.005633	37692.77	0
Residual	264	3.95E-05	1.49E-07		
Total	269	0.028204			

Data source: Rutgers 2017MQF Team 4

Figure 25: SP500 Index Result (3)

		Coefficient	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
	Intercept	-5.1E-05	2.37E-05	-2.14108	0.033183	-9.7E-05	-4.1E-06	-9.7E-05	-4.1E-06
MKT	-0.11	0.010017	2.44E-05	410.5248	0	0.009969	0.010065	0.009969	0.010065
SMB	-0.57	-0.00145	5.24E-05	-27.5893	9.58E-80	-0.00155	-0.00134	-0.00155	-0.00134
HML	0.17	-8.2E-05	6.26E-05	-1.31474	0.189739	-0.00021	4.1E-05	-0.00021	4.1E-05
RMW	-0.32	0.000204	9.17E-05	2.221016	0.027199	2.31E-05	0.000384	2.31E-05	0.000384
CMA	0.1	0.000382	0.000111	3.459791	0.00063	0.000165	0.0006	0.000165	0.0006

Data source: Rutgers 2017MQF Team 4

Note: Normalization means set SP500 MKT=1 (the original value is 0.010017). So, the 130/30 strategy optimization portfolio's normalized beta is $0.007424/0.010017=0.7411$

Appendix 5: Fama-French 5-Factor Model Results (2)

Figure 26: 100/0 Strategy Optimization Portfolio Result (1)

Regression Statistics	
Multiple R	0.932048
R Square	0.868714
Adjusted R Square	0.866228
Standard Error	0.003294
Observations	270

Data source: Rutgers 2017MQF Team 4

Figure 27: 100/0 Strategy Optimization Portfolio Result (2)

ANOVA	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	5	0.01895	0.00379	349.3766	3.8E-114
Residual	264	0.002864	1.08E-05		
Total	269	0.021814			

Data source: Rutgers 2017MQF Team 4

Figure 28: 100/0 Strategy Optimization Portfolio Result (3)

		<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
	Intercept	0.000545	0.000362	1.50263	0.13413	-0.00017	0.001258	-0.00017	0.001258
MKT	-0.11	0.007424	0.000373	19.91506	1.66E-54	0.00669	0.008158	0.00669	0.008158
SMB	-0.57	-0.0023	0.000801	-2.87196	0.00441	-0.00388	-0.00072	-0.00388	-0.00072
HML	0.17	-0.0082	0.000957	-8.56972	8.83E-16	-0.01008	-0.00632	-0.01008	-0.00632
RMW	-0.32	0.005818	0.001401	4.152536	4.44E-05	0.00306	0.008577	0.00306	0.008577
CMA	0.1	0.011556	0.001689	6.841903	5.43E-11	0.00823	0.014881	0.00823	0.014881

Data source: Rutgers 2017MQF Team 4