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Alpha Investing in Oil Firms: An Augmentation to Passive Investing

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Abstract

We used the Jensen (1967) alpha to identify five oil firms among the world's largest 59 producers of which 18 have trading in U.S.A. Using the Treynor-Black (1973) technique to establish an active portfolio that augments the passive SPY portfolio, our augmented oil portfolio yielded a Sharpe ratio that is 2.35 times that of the Sharpe ratio of the passive portfolio, and a rate of return that is 2.17 times that of the passive portfolio in forward testing.

Key Words: Jensen Alpha, Sharpe Ratio, Treynor-Black Model, Portfolio Management, Mutual funds

I. Introduction

The capital asset pricing model, CAPM, relates positively the expected or required return, $E(r_i)$, of an asset i to its relevant risk as measured by beta, β_i. Given an asset's beta, an investor can quickly estimate the required return given the risk-free rate, r_f, and the expected return of the market, $E(r_m)$. Graphically, the positive relation between beta and expected or required return of an asset i in the CAPM is a straight line that hinges at the vertical axis at the risk-free rate level, and the line has a slope of $E(r_m) - r_f$. That is, the CAPM in its algebraic form $E(r_i) = r_f + [E(r_m) - r_f]\beta_i$ parallels y = c + bx which is the planar equation of a straight line with vertical intercept at c, and slope of value b. For any known beta value, there is a corresponding value on the straight line. That value is the equilibrium, required or risk-adjusted return of the asset. The expectation sign reminds the readers that the CAPM is a one-period forward-looking model in which only the return of the risk-free rate is known *ex ante* while that of any risky asset i and the market's are not known *ex ante*.[1]

Where does alpha for asset i, α_i, come into the picture? Any realized return that deviates *temporarily* from the equilibrium, expected or required return as predicted by the CAPM is called its alpha. For example, given r_f at 0.5%, $E(r_m)$ at 10.5%, and a beta at 1.5, we'll estimate the expected return of asset i to be 15.5%. If the actual or realized return of asset i turns out to be 16%, then we say asset i has a positive alpha of .5%. If, however, the actual or realized return of asset i turns out to be 15%, then we say asset i has a negative alpha of –.5%. Positive alpha implies undervaluation of the asset with potential net buying pressure whereas negative alpha implies overvaluation with potential net selling pressure of the same asset. Of course, at any instant, each scenario is mutually exclusive. Thus, any savvy investor is expected to buy a positive-alpha asset while she is expected to sell or sell-short a negative-alpha asset assuming short-selling is not institutionally prohibited.

The keyword in the above paragraph is "*temporarily*." The temporary deviation between realized and required returns implies violation of the efficient market hypothesis. If the market is truly information-efficient, then any non-zero alpha will be wiped out so quickly that an average investor who has no prescience into the alpha's existence will have no opportunity to take

[1] Since r_f is known *ex ante*, there is no need to include an expectation sign for it, unlike what we do for the r_i and r_m.

advantage of it. The net buying of positive-alpha asset and the net selling of negative-alpha asset will be the economic equilibrium process that restores the required or expected return of any asset i back to the level dictated by the CAPM. In short, beta investing uses the beta in the CAPM which allows an investor to establish her required or expected return according to her risk tolerance whereas alpha investing uses the alpha which enables an investor to identify mispriced, albeit temporary, assets to either buy or sell them accordingly.

In this study, we identify a portfolio of five (5) oil-company stocks that each has the highest absolute information ratio, a measure of alpha per unit risk, among the world's largest oil companies. We designate this portfolio the active portfolio. We use the active portfolio's alpha to augment the return of a passive investor whom we assume to buy and hold the S&P's 500 exchange-traded fund, ticker symbol SPY. Our empirical results show that the Sharpe ratio, which measures excess return per unit risk, of the augmented portfolio is significantly higher than that of the SPY.

Section 2 discusses the methodology of active portfolio formation using the Treynor-Black (1973) technique. It also exposes the role of the active portfolio relative to other portfolios. Section 3 discusses the data sources, collection and management process. Section 4 discusses the results, and Section 5 concludes.

II. Methodology

From the CAPM equation $E(r_i) = r_f + [E(r_m) - r_f]\beta_i$, we rearrange it to become $E(r_i) - r_f = [E(r_m) - r_f]\beta_i$. If we now define $E(r_i) - r_f$ as the excess return which we denote with R_i, then $E(r_m) - r_f$ will also become R_m, the excess return for the market portfolio. For simplicity of exposition, let's drop the expectation sign, and we are left with to $R_i = \beta_i R_m$. When we regress R_i on R_m in an ordinary-least-squares, OLS, regression, our model is $R_i = \alpha_i + \beta_i R_m + \varepsilon_i$. The results of the OLS regression will be $\hat{R}_i = \hat{\alpha}_i + \hat{\beta}_i R_m$ and variance of the residuals will be the $\sigma^2_{\varepsilon i}$. In this manner, we estimate the alpha, the beta, and the idiosyncratic or unique risk of each asset i.

From the estimates of α_i, β_i and $\sigma^2_{\varepsilon i}$, we proceed to construct the active portfolio using the Treynor-Black technique in the following 7-step procedure following Bodie, et al. (2014, 2013)[2].

i. find w^0_i as $w_i^0 = \dfrac{\alpha_i}{\sigma^2_{\varepsilon i}}$

ii. find w_i as $w_i = \dfrac{w_i^0}{\sum_{i=1}^{n} \dfrac{\alpha_i}{\sigma^2_{\varepsilon i}}}$

iii. find active portfolio's alpha, α_A, as $\alpha_A = \sum_{i=1}^{n} w_i \alpha_i$

[2] Treynor-Black technique has been so well-accepted that it made its way into regular textbooks. Both undergraduate and graduate texts of Bodie et al. include Treynor-Black technique's discussions in their proper contents, not merely footnotes.

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iv. find active portfolio's beta, β_A, as $\beta_A = \sum_{i=1}^{n} w_i \beta_i$

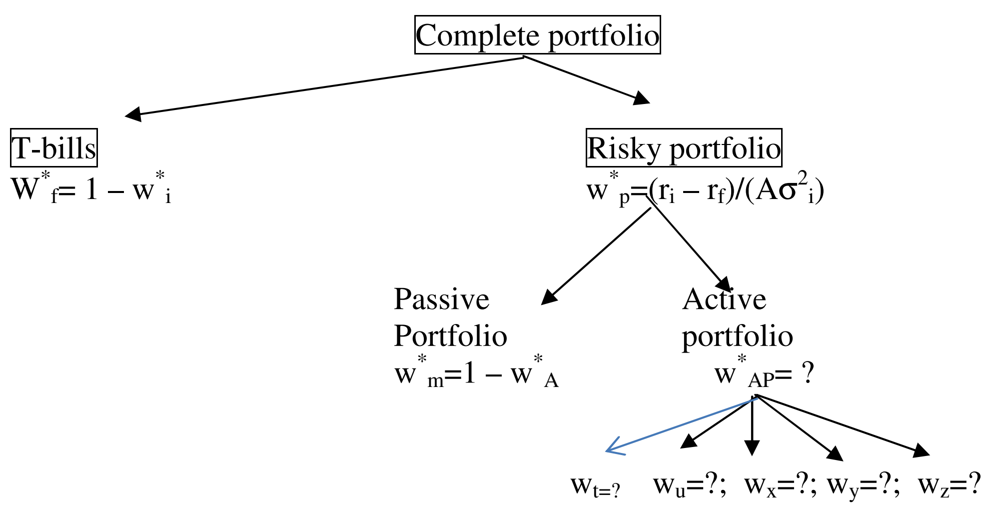
v. find active portfolio's unique risk, $\sigma^2_{\varepsilon A}$, as $\sigma^2_{\varepsilon A} = \sum_{i=1}^{n} w_i^2 \sigma^2_{\varepsilon i}$

vi. compute the initial position of the active portfolio, w^0_A, as $w^0_A = \dfrac{\left(\dfrac{\alpha_A}{\sigma^2_{\varepsilon A}}\right)}{\left(\dfrac{R_m}{\sigma^2_m}\right)}$

vii. adjust the initial position in the active portfolio, w^*_A, as $w^*_A = \dfrac{w^0_A}{1+(1-\beta_A)w^0_A}$

To illustrate, let's start with five high-alpha stocks (t, u, x, y, z) from which we use to construct the *active portfolio, A*. We then conjugate the *active portfolio* with the *passive/ market portfolio* to form the *risky portfolio, i*. To form the final *complete portfolio*, we combine the risky portfolio with some risk-free portfolio. The final step is dictated by the investor's risk-aversion index and utility function. Our analysis in this exercise stops at the construction of the *risky portfolio* with the estimate of its risk premium and variance of which we then use to estimate the new Sharpe ratio. All rational investors have the sole objective function of maximizing the Sharpe ratio which measures excess return per unit risk.

The various portfolios are best illustrated schematically as:



viii. After finding w^*_A in step vii above, we proceed to find w^*_m as $w^*_m = 1 - w^*_A$, and each of the weight of high-alpha stock as $w^*_i = w^*_A w_i$.

ix. Calculate the risk premium of the risky portfolio as $R_p = (w^*_m + w^*_A \beta_A)R_m + w^*_A \alpha_A$. Note that this equation parallels $R_i = \beta_i R_m + \alpha_i$ we discussed earlier. Since it is a now a portfolio, the beta is

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now a weighted-average beta as does the weight for alpha. Of course, we assume the index or market portfolio has a beta of unity per the assumption in the CAPM.

x. Compute the variance of the risky portfolio as $\sigma_p^2 = (w_m^* + w_A^* \beta_A)^2 \sigma_m^2 + (w_A^* \sigma_{\varepsilon A})^2$. Obviously, we assume no correlation between the passive portfolio's returns and the residuals of the active portfolio.

xi. Compute Sharpe ratio of the risky portfolio as $S_p = \dfrac{R_p}{\sigma_p}$.

xii. Compute Sharpe ratio of the index or market portfolio as $S_m = \dfrac{R_m}{\sigma_m}$.

For effective alpha investing, we expect S_p to be higher than S_m. More specifically, investment literature has S_p and S_m related as $S_p^2 = S_m^2 + \left(\dfrac{\alpha_A}{\sigma_{\varepsilon A}}\right)^2$. The ratio within the parentheses is known as the information ratio, IR. In order to maximize the Sharpe ratio, S_p, an investor need to maximize the information ratio.

III. Data

We identify the world's largest oil firms from the "*List of largest oil and gas companies by revenue*" in www.wikipedia.org, current as of August 2013. The list has 59 firms the smallest of whose revenue was \$25b. We then narrow down from the 59 firms to 18 firms all of whom have either their stocks or American Depository Receipts, ADR's, traded in the U.S. The identity of the 18 firms follows.

No.	Name	HQ'd in	Revenue, \$b	Ticker symbol
1	Royal Dutch Shell	Netherlands/UK	484	RDSA
2	Exxon Mobil	USA	438	XOM
3	British Petroleum	UK	386	BP
4	Sinopec	China	275	SNP
5	Chevron Corporation	USA	246	CVX
6	Conoco Philips	USA	237	COP
7	Total	France	232	TOT
8	Eni	Italy	154	E
9	Petrobras	Brazil	146	PBR
10	Valero Energy	USA	125	VLO
11	Statoil	Norway	120	STO
12	Enterprise Products	USA	44	EPD
13	Suncor Energy	Canada	40	SU
14	Hess	USA	38	HES
15	World Fuel Services	USA	35	INT
16	Plains All American Pipeline	USA	34	PAA
17	Murphy Oil	USA	31	MUR
18	Tesoro	USA	30	TSO

From these 18 firms, we ran OLS regressions to find out their respective alpha, beta and $\sigma^2_{\varepsilon i}$ using monthly data obtained from the University of Chicago's CRSP database for five years from January 2009 through December 2013. We use the monthly value-weighted market returns

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with dividends (**vwretd**) and the Fama risk-free rate (**ave_3**) which correspond to r_m and r_f in Section 2. In addition, we use SPY and treat it as our passive/market portfolio.[3] We use the variance of the residuals of the regressions as our $\sigma^2_{\varepsilon i}$. Our results follow.

No.	Name	Alpha, α_i	Beta, β_i	$\sigma^2_{\varepsilon i}$
1	Royal Dutch Shell	-.00430	1.0485	.001795
2	Exxon Mobil	-.00249	.616873	.001398
3	British Petroleum	-.01274	1.4845	.004263
4	Sinopec	.002753	.822869	.004333
5	Chevron Corporation	-.00013	.867649	.001318
6	Conoco Philips	-.00019	1.019189	.002300
7	Total	-.00772	1.113825	.002126
8	Eni	-.00913	1.16857	.002786
9	Petrobras	-.02099	1.354639	.009239
10	Valero Energy	.00298	1.415463	.009211
11	Statoil	-.00388	1.045876	.002219
12	Enterprise Products	.016183	.608119	.001545
13	Suncor Energy	-.00538	1.443583	.005968
14	Hess	-.00617	1.211428	.005007
15	World Fuel Services	.000980	1.110734	.003552
16	Plains All American Pipeline	.018083	.403071	.002322
17	Murphy Oil	-.003770	1.234657	.003847
18	Tesoro	.015478	1.279131	.014587

From the OLS regression results obtained in the above table, we will select the five oil firms to form the "*active portfolio*" in the Treynor-Black technique of alpha investing.

How are the five firms selected? Since positive and negative alpha measures degree of underpricing and overpricing respectively, a casual but logical thinking is to simply select the five firms with the highest absolute value of alpha. However, modern portfolio theory dictates that an investor should maximize her excess return per unit risk as measured by the Sharpe ratio, S. The exact relation follows

$S_p^2 = S_m^2 + \left(\frac{\alpha_i}{\sigma_{\varepsilon i}}\right)^2 = S_m^2 + (IR)^2$ where S_p is the Sharpe ratio of the risky portfolio, S_m is the Sharpe ratio of passive or market portfolio, the ratio ($\alpha_i/\sigma_{\varepsilon i}$) is known as the information ratio, IR. Thus, we base our selection of the five oil firms on the maximum value of their respective information ratio.

IV. Results

Sorting the contents of the last table based on the highest five information ratios, we identify the five oil firms to form our active portfolio as *Enterprise Products*, *Plains All American Pipelines*, *Petrobras*, *British Petroleum*, and *Eni*[4,5]. Their respective 2013 rankings in *Fortune Global 500*

[3] We choose SPY as our passive or market portfolio and not vwretd as there is no trading for vwretd.
[4] We take the absolute value of alpha to form the information ratio before we begin the sorting process. Else, negative alpha firms would have been sorted last, resulting in them been missed. Missing them is wrong since significantly-negative-alpha firm can be sold short since U.S. market permits short sale on most stocks.
[5] The correlation between information ratio and the t-statistics of alpha obtained in the regression is +1. Of the five firms, however, only the top two firms have statistically significant t-statistics at 5% significance level.

are: 246, 286, 25, 6 and 17 respectively. Each appears in cells A2 through A6 in its respective ticker symbol at the NYSE.

	A	B	C	D	E	F	G
1	Firm, i	α_i	β_i	$\sigma^2_{\varepsilon i}$	w^0_i	w_i	w_i^2
2	EPD	0.016183	0.608119	0.001545	10.47443366	1.077104645	1.160154
3	PAA	0.018083	0.403071	0.002322	7.787683032	0.800821299	0.641315
4	PBR	-0.02099	1.354639	0.009239	-2.271890897	-0.233622582	0.05458
5	BP	-0.01274	1.484486	0.004263	-2.988505747	-0.307313362	0.094442
6	E	-0.00913	1.16857	0.002786	-3.277099785	-0.33699	0.113562
7				$\Sigma=$	9.72462026	1	
8							
9	α_{AP}	0.043807665					
10	β_{AP}	-0.188677408					
11	σ^2_{AP}	0.00450482					
12	w^0_{AP}	1.438685984	Note: we get $E(R_{spy})$ and $\sigma^2(R_{spy})$ from main spreadsheet bottom of last column as .013877 and .002053 respectively				
13	w^*_{AP}	0.530854281					
14	w^*_m	0.469145719					
15	w^*_{EPD}	0.571785612					
16	w^*_{PAA}	0.425119415					
17	w^*_{PBR}	-0.124019548					
18	w^*_{BP}	-0.163138614					
19	w^*_E	-0.178892584					
20	Check…	0.530854281	Yes, the sum here verifies the answer in cell B13				
21	$(IR)^2$	0.426012906					
22	S^2_m	0.093799868					
23	S^2_{RP}	0.519812774	Note: $S^2_{RP} = S^2_m + (IR)^2$				
24	R_{RP}	0.028375898					
25	σ^2_{RP}	0.001549003					
26	S_{RP}	0.720980426	0.720980426				
27		Note: Cell B26 was obtained using last 2 equations in Section 2; cell C26 was obtained by sqrt(B23). They are the same as they should be.					
28		This proves that both last 2 equations are correct, as is $S^2_{RP} = S^2_m + (IR)^2$					

The numerical inputs for the implementation of the Treynor-Black technique are in cells B2 through D6. Calculations for step i (in Section 2) are presented in cells E2 through E6, while those for step ii are in F2 through F6. Here, we see that the two positive-alpha stocks are held long with positive weights whereas the three negative-alpha stocks are sold short with negative weights in cells F2 through F6. The five weights sum to one as they should.

The active portfolio's alpha, beta, residual variance, initial position and adjusted position as discussed in steps iii through vii (in Section 2) are calculated in cells B9 through B13 respectively. From cells B13 and B14, we are to allocate 53% of our investment budget to the

DOI: 10.0612/article-1

active portfolio and the remaining 47% to the market portfolio which in our case is the SPY exchange-traded fund. Of the 53% in the active portfolio, 57.2% is to go to *Enterprise Products*, 42.5% to go to *Plains All American Pipes*, -12.4%, -16.3%, and -17.9% to go to *Petrobras*, *British Petroleum* and *Eni* respectively, i.e., 57.2 + 42.5 – 12.4 – 16.3 – 17.9 = 53.1%. In cell B20, we conducted a simple check to ensure the five weights sum to 53.1%.

In cell B21, we estimated the information ratio squared, IR^2, i.e., $.043807665^2/.00450482$. Add this IR^2 to market portfolio's Sharpe ratio squared, S^2_m, in cell B22, we obtained the risky portfolio's Sharpe ratio squared, S^2_{RP} in cell B23. Taking the square root both Sharpe ratios squared, we see that the Sharpe ratio of the risky portfolio has increased by 135.4% (since $(\sqrt{.519812774})/(\sqrt{.093799868}) = 2.354$) relative to the Sharpe ratio of the market portfolio as represented by the SPY exchange-traded fund. The 135.4% increase in the Sharpe ratio was made possible all by the inclusion of the 5-stock active portfolio in which we longed two stocks and sold-short the remaining three stocks.

In cell B24 and B25, we estimated the excess return, R_{RP}, and the variance of excess returns, σ^2_{RP}, for the risky portfolio as we discussed in steps ix and x (in Section 2). From these two estimates, we proceeded to calculate the Sharpe ratio of the risky portfolio as $.028375898/\sqrt{.001549003}$ which turned out to be .720980426, exactly the same as the earlier estimate we obtained by using the information ratio squared model. This latter step reaffirmed the accuracy of our estimation on the Sharpe ratio's improvement by 135.4% over the Sharpe ratio obtained via the passive market portfolio alone.

To forward-test the effectiveness of our model, we used the weights in cells F2 through F6, and stock prices of SPY plus the five stocks selected based on their alphas for the active portfolio on December 31, 2013 and June 30, 2014. Our results follow.

Ticker symbol	Price on 12/31/13	Price on 6/30/14	Weight	Rate of return
SPY	$184.69	$195.97	1	6.11%
EPD	68.55	78.29	1.077	14.21
PAA	51.77	60.05	.801	15.99
PBR	13.78	14.60	-.234	5.95
BP	48.61	52.75	-.307	8.52
E	48.49	54.90	-.337	13.22

An investor who invested in SPY realized a return of 6.11% over the first-half of 2014. The same investor who adopted the weights as suggested by the alpha-investing technique proposed in this exercise earned a gross, i.e., before transaction costs, return of 19.65%. We obtained the latter number as 1.077(14.21) + .801(15.99) – .234(5.95) – .307 (8.52) –.337(13.22) = 19.65%. Since only 53% of the wealth was invested in the active portfolio while the remaining 47% was invested in the passive portfolio, our alpha-augmented portfolio return was indeed .53(19.65) + .47(6.11) = 13.29% which is 2.17 times that of 6.11% of the passive portfolio.

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V. Conclusion

An unsuspecting reader at this point may argue that the inclusion of the active portfolio might have increased risk and return at the same time. That argument is only seemingly true. However, a closer look at the definition of Sharpe ratio reminds us that it is a measure of excess return per standard deviation, i.e., $S = (r_p - r_f)/\sigma_p$. In the derivation of the Sharpe-Lintner-Mossin capital asset pricing model, one of the underlying assumptions was that the maximum Sharpe ratio attainable was that of the market portfolio since alpha was assumed to be zero under efficient diversification. In alpha investing, investors endeavor to search for statistically non-zero-alpha stocks and form them into an active portfolio which in turn augments Sharpe ratio attained under the CAPM. In this exercise, we identified five oil firms via their statistically significant alphas and then we formed an active portfolio from them to augment the S&P 500 exchange-traded fund, SPY. Our empirical result shows that the augmented Sharpe ratio increased by 135.4% relative to the Sharpe ratio of the passive market portfolio. . The forward-testing result showed that the augmented portfolio has a return 2.17 times of SPY's in the first-half of 2014.

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