Commodity Mutual Funds: Do They Add Value?

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Abstract

The use of commodities to hedge inflation risk and diversify portfolios is generally considered to be an important consideration for portfolio management. Direct investment in commodities or commodity derivatives requires that investors have significant assets and/or expertise in these commodities or their respective derivatives markets. As an alternative to direct investment, investors in recent years have increasingly resorted to the use of commodity based mutual funds. At issue is the question of whether or not these funds are delivering the benefits investors expect. In this paper we evaluate the performance, persistence, market timing and selectivity of four categories of mutual funds whose returns are based on commodity prices over the time period from each fund's inception through December, 2012. Our results indicate that these funds have not been able to create positive alphas for their investors; have negative or insignificant performance persistence; and have no market timing ability. Some of the categories of funds, however do exhibit some selectivity. We did find that when these commodity based funds' performance was evaluated during specific time periods of market downturns (e.g., the 2000 stock market downturn and the 2007 financial crisis), their performance was significantly positive which indicates that these funds provide a good hedge during bear markets/financial crises.

JEL Classification: G12, G20, G23.

I. Introduction

Commodities or commodity based investments such as commodity mutual funds are often added to portfolios as an inflation hedge and to provide diversification benefits for standard stock and bond portfolios. The amount of assets in these mutual funds has grown rapidly in the last few years. As of December, 2012 the total assets under management (AUM) for these funds was approximately $129 Billion.

The use of commodity mutual funds provides investors a simple method to diversify their portfolios through indirect participation in the commodities market (it is much more difficult for many investors to invest directly in the futures market due to initial margin and daily settlement requirements). In this research we focus on the questions of whether commodity based mutual funds are able to add value to investors' portfolios and if there is any evidence of persistence and/or market timing and selectivity. We derive the risk-adjusted performance of these mutual funds during different market conditions to provide insight into the usefulness of these investments as instruments of portfolio diversification and hedges against down markets.[1]

The types of funds used in our study include Natural Resources, Precious Metals, and Equity Energy mutual funds which primarily invest in stocks issued by commodity based industries. We also study Commodity (Broad Basket) funds which, in contrast to the other funds, extensively use derivatives (See Appendix 1 for a brief explanation of these mutual funds).

Our results indicate that since the inception of each of the various funds they have been unable to provide positive alphas to their investors except during the bear market of early 2000

[1] The use of commodity based mutual funds as an inflation hedge was not investigated in this paper due to the relatively modest domestic inflation rates during the period of study. For example, the compound annual growth rate in the consumer price index from 1999 through 2012 was approximately 2.5%.

and the recent financial crisis. We find negative or insignificant performance persistence and no market timing ability for these funds, however Natural Resource, Precious Metals, and Equity Energy Funds do exhibit some selectivity.

II. Literature Review

Commodity mutual funds can help investors offset increases in their cost of living (especially from rising food and energy prices) and provide diversification benefits which, according to Zapata, et al., (2012), are due to a highly negative relationship that has existed between stocks and commodities over the last 140 years. Commodities and stocks have also alternated in price leadership over this time period (Zapata, et al., 2012). The stock-commodity correlation however, is much higher during economic downturns. This correlation is consistent with recession-increased risk aversion causing investors to treat all risky assets the same (Bhardwaj and Dunsby, 2012). The same pattern is observed in intra-commodity correlation. This stock-commodity correlation and business cycle correlation are also stronger for industrial commodities than for agricultural commodities.

Bleke, Bordon, and Volz (2013) note a long-term relation between global liquidity (as provided by central banks) and the food and commodity prices to explain the rapid increase in prices from 2000 to 2008 followed by a collapse in prices and subsequent rebound in 2009. They offer two explanations. The first is based on supply and demand factors. Prices increased due to rapid growth in emerging market economies until mid-2008 and then prices fell due to the global financial crisis when aggregate demand decreased. The second explanation pertains to the "financialization of commodities" which transformed the commodities market into an asset class which could be used to diversify traditional stock and bond portfolios.[2] The results of these studies provide the motivation to examine the performance of commodity based mutual funds during period of financial distress.

Previous literature on mutual fund performance is almost exclusively focused on conventional bond and stock funds and the results have been mixed. Jensen (1968) found that net performance of conventional mutual funds is inferior to a comparable passive benchmark. Ippolito (1989) finds that risk-adjusted returns of conventional mutual funds, net of fees and expenses, is comparable to the returns of index funds. Grinblatt & Titman (1992) look at mutual fund performance and find evidence that differences in performance between funds persist over time and this persistence is consistent with ability of fund managers to earn abnormal returns. Hendricks, Patel, and Zeckhauser (1993) and Goetzmann and Ibbotson (1994) find that past returns predict future returns. This result means that investors could earn higher risk-adjusted returns by buying recent winners. Elton, et al. (1996a) find that funds that did well in the past tend to do well in the future based on risk adjusted future performance. Gruber (1996) tries to answer the puzzle of why actively managed funds exist when their performance is inferior to that of index funds. He suggests that mutual funds are bought and sold at their NAV, and thus management ability may not be priced. Carhart (1997) looks at persistence in equity mutual funds and risk-adjusted returns. His results do not support the existence of skilled or informed mutual fund managers. Wermers (2000) examined mutual fund databases and finds evidence in support of active mutual fund management. Davis (2001) in his study of equity mutual fund performance and manager style finds that none of the investment styles earned positive abnormal returns during the 1965-1998 time period. Even

[2] See Jesse Columbo, “The Commodities Bubble,” www.thebubble.com/commodities-bubble/

the persistence among the best performing growth funds did not last beyond a year. Baras, et al. (2010) find most actively managed mutual funds have either positive or zero alpha net of expenses. The underperformance of actively managed funds is due to the long term survival of a small proportion of truly underperforming funds.

Budiono and Martens (2010) find that some fund characteristics significantly predict performance. By combining information on past performance, turnover ratio, and ability produces yearly excess net returns of 8%, while an investment strategy that just uses past performance generates 7.1% in excess returns over the1978-2006 period.

To our knowledge, our study is one of the first to look at the performance of commodity based mutual funds. We analyze four categories of funds including Commodity (Broad Based), Natural Resources, Precious Metals, and Energy Equity funds since their inception and then examine their performance during both bear markets to determine whether these funds provide investors with an effective hedge against declining markets. We also determine if commodity based mutual funds exhibit performance persistence, market timing and selectivity.

III. Data

We begin our data collection first by developing a comprehensive list of all Commodity, Natural Resource, Precious Metals, and Equity Energy mutual funds (surviving as well as dead) from the Morningstar Direct database from their inception through December 2012.[3] Table 1a indicates that at the end of December, 2012 there were 121 surviving funds and 28 dead funds (all the dead funds have been included in the analysis). The total assets under

[3] Elton, et al. (1996b) find that previous mutual fund studies suffered from survivorship bias as funds that merge or die have worse performance than funds that don't and failing to account for survivorship bias will lead to higher risk-adjusted returns for mutual funds. Brown et al. (1992) also finds that survivorship bias can give a false impression about persistence in mutual fund performance.

management (AUM) for all surviving mutual funds at the end the December, 2012 was $129.05 billion.

[Insert Table 1a]

Using the same data source we then obtain monthly returns, NAVs, and total assets for these mutual funds. Following Bauer, et al., (2005, 2006 & 2007), among the surviving funds we included all funds with at least 12 months of data in our analysis. Following Baks (2003) and Wermers, et al., (2012), funds with several share classes are combined and the asset-weighted returns were computed.

The monthly Fama-French three factors, the momentum factor (for Carhart analysis), and the monthly risk-free rate were all taken from the WRDS database. Information on expense ratios, 12b-1 fees, turnover, inception data (for calculating fund age), and load fees were obtained from Morningstar Direct. Table 1b shows the expense ratios, management fees, and turnover ratios for each category. The average expense ratios for the four categories of funds are 1.35% (Commodity), 1.63% (Natural Resource), 1.49% (Precious Metals) and 1.6% (Equity Energy).[4]

[Insert Table 1b]

IV. Methodology

Performance (α) for our four categories of mutual funds is computed using the following three models; the Capital Asset Pricing, the Fama – French Three Factor, and the Carhart Four-Factor models as discussed in the following sections.

Capital Asset Pricing Model

[4] These expense ratios are similar to other mutual funds categories. According to Morningstar Direct, the average expense ratios for Large Growth (1.43%), Large Value (1.43%), Mid Growth (1.55%), Mid Value (1.37%), Small Growth (1.61%), Small Value(1.43%), Long Term Bond (1.09%), and Multisector Bond (1.22%).

This model was developed by Sharpe (1964) and this model is used to address the problem of evaluating a portfolio manager's performance ability. A fund manager's skill is represented by α_i, which represents return after adjusting for systematic risk. The model is specified as:

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i (R_{m,t} - R_{f,t}) + \varepsilon_{i,t} \quad (1)$$

A positive intercept (α_i) would indicate that manager has outperformed the market through superior stock selection ability.

Fama French Three-factor Model

According to Elton, Gruber, & Blake (2011) the most frequently used multi-factor model for measuring portfolio performance is the three factor model developed by Fama and French (1993). The three-factor model is used in our study as it provides evidence that the three factors (excess market return, size factor, and value versus growth factor) explain about 90% of diversified portfolio returns (as they are associated with risk). According to Davis (2001), if the three factors do measure risk, then the fund manager should be able to earn returns to compensate for this risk. Also, the premiums associated with factors can be earned by a passive strategy of buying a diversified portfolio of stocks with sensitivity similar to the factors. Therefore, if active fund management has any economic value, it should be able to outperform these passive strategies.

For each fund, monthly returns are used to estimate the following regression:

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i (R_{m,t} - R_{f,t}) + \beta_s SMB_t + \beta_v HML_t + \varepsilon_{i,t} \quad (2)$$

where $R_{i,t}$= the percentage return to fund i in month t.

$R_{f,t}$= US T-bill rate for month t.
$R_{m,t}$= return on CRSP value-weighted index for month t.
SMB_t= realization on capitalization factor (small-cap return minus large-cap return) for month t.
HML_t = realization on value factor (value return minus growth return) for month t.
$\varepsilon_{i,t}$= an error term.

Small company stocks will have a positive loading on SMB (positive slope, β_S) whereas big-company stocks tend to have a negative loading. Similarly, a positive estimate on β_V indicates sensitivity to the value factor and a negative estimate indicates sensitivity to the growth factor.

A positive intercept (α) would indicate superior performance, whereas a negative intercept would indicate underperformance, compared to the three factor model.

Carhart Four-factor Model

Carhart's (1997) four-factor model is also used as a performance benchmark. The Carhart four factor model is similar to the Fama-French three-factor model, but it includes an additional factor for momentum (MOM), which is the return difference between a portfolio of past 12-month winners and a portfolio of past 12-month losers. The four-factor model is consistent with a model of market equilibrium with four risk factors.

The model is as follows:

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i (R_{m,t} - R_{f,t}) + \beta_S SMB_t + \beta_V HML_t + \beta_m MOM + \varepsilon_{i,t} \quad (3)$$

Here also, a positive alpha would indicate superior performance, whereas a negative alpha would indicate underperformance, compared to the four-factor model.

Since the observations for one specific fund for different years may not be independent (within correlation). Therefore, following Adams et al. (2009), Christoffersen and Sarkissian (2009), Cremers and Petajisto (2009), Aiken et al. (2011), Aragon and Strahan (2012) and Schaub and Schmid (2013), we use clustered-robust standard errors and treat each fund as a cluster. For comparative purposes, we also conduct our analysis with heteroscedasticity-robust standard errors. The significance levels increase substantially in size as compared to the results in this section. This, however, confirms that clustering at the fund level is an important concern in our sample and, therefore, we only report the more conservative estimates based on the cluster-robust standard errors.

VI. Results

In Tables 2a, b, and c we show the alphas computed from all three models for all funds from inception through December 2012. The results show that the Commodity funds have underperformed as seen by the significantly negative annualized alphas of over 4% (significant at 1%) for all three models. Natural Resource funds show insignificant annualized alphas of 0.60% and -0.91% respectively for the CAPM and Fama-French three-factor models. The Carhart four-factor model, however, indicates that Natural Resource funds have annualized alphas of -1.05% (significant at 10%).

[Insert Tables 2a, b, and c]

For Precious Metals funds, the CAPM and Fama-French models show significantly positive annualized alphas of 3.45% and 2.08% respectively (significant at 1% and 5%). When the momentum factor is included, however, the significance disappears (the Carhart four-factor model shows an insignificantly positive annualized alpha of 0.62%). For Equity Energy funds, only CAPM shows significantly positive annualized alphas of 1.89% (Fama-French and Carhart models show insignificantly positive annualized alphas of 0.68% and 0.007% respectively).

With the possible exception of Precious Metals funds, our results indicate that based on the significance of the net alphas using the three models, these funds have not created any value for their investors over the period since their inception through 2012.[5]

VII. Conditional Factor Models

All the models we used previously are unconditional factor models which are predicated on the assumption that investors and managers use no information about the state of the economy to form expectations. However, if managers trade on publicly available information and employ dynamic strategies, unconditional models may produce inferior results. To address these concerns, Chen and Knez (1996) and Ferson and Schadt (1996) advocate using conditional models. The basic models are adjusted by using time-varying conditional expected returns and betas instead of unconditional betas. The instruments used are commonly available and proven to be useful for determining stock returns. The instruments are: i) Three-month T-Bill rate (TB3M); ii) Dividend yield on CRSP value weighted index (DY); iii) Slope of the term structure (10 year Treasury Bond yield – three-month Treasury Bill yield) (TERM) ; iv) Quality spread in the corporate bond market (Moody's BAA rated corporate bond yield – Moody's AAA rated corporate bond yield) (QS). All of the instruments are lagged by one month. The resultant equations are shown as follows where $z_{j,t-1}$ is the demeaned value of the unconditional factors. In these models, we allow the market beta to be a linear function of these pre-determined instruments.[6]

Conditional CAPM

[5] Precious Metals funds have been in existence longer than the other categories with the inception of the first fund in 1956 (See Table 1a.)

[6] See also Yan (2006) and Yan (2008).

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i (R_{m,t} - R_{f,t}) + \delta\{z_{j,t-1} * (R_{m,t} - R_{f,t})\} + \varepsilon_{i,t} \quad (4)$$

Or this can be rewritten as

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i (R_{m,t} - R_{f,t}) + [\beta_1 * TB3M_{t-1} * (R_{m,t} - R_{f,t}) + \beta_2 * DY_{t-1} * (R_{m,t} - R_{f,t}) + \beta_3 * TERM_{t-1} * (R_{m,t} - R_{f,t}) + \beta_4 * QS_{t-1} * (R_{m,t} - R_{f,t})] + \varepsilon_{i,t} \quad (5)$$

Conditional Fama-French 3 factor model

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i (R_{m,t} - R_{f,t}) + \delta\{z_{j,t-1} * (R_{m,t} - R_{f,t})\} + \beta_S SMB_t + \beta_V HML_t + \varepsilon_{i,t} \quad (6)$$

Or this can be rewritten as

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i (R_{m,t} - R_{f,t}) + [\beta_1 * TB3M_{t-1} * (R_{m,t} - R_{f,t}) + \beta_2 * DY_{t-1} * (R_{m,t} - R_{f,t}) + \beta_3 * TERM_{t-1} * (R_{m,t} - R_{f,t}) + \beta_4 * QS_{t-1} * (R_{m,t} - R_{f,t})] + \beta_S SMB_t + \beta_V HML_t + \varepsilon_{i,t} \quad (7)$$

Conditional Carhart 4 factor model

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i (R_{m,t} - R_{f,t}) + \delta\{z_{j,t-1} * (R_{m,t} - R_{f,t})\} + \beta_S SMB_t + \beta_V HML_t + \beta_m MOM + \varepsilon_{i,t} \quad (8)$$

Or this can be rewritten as:

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i (R_{m,t} - R_{f,t}) + [\beta_1 * TB3M_{t-1} * (R_{m,t} - R_{f,t}) + \beta_2 * DY_{t-1} * (R_{m,t} - R_{f,t}) + \beta_3 * TERM_{t-1} * (R_{m,t} - R_{f,t}) + \beta_4 * QS_{t-1} * (R_{m,t} - R_{f,t})] + \beta_S SMB_t + \beta_V HML_t + \beta_m MOM + \varepsilon_{i,t} \quad (9)$$

The results shown in Tables 3a, b and c remain robust with conditional factor models as there are no major changes in sign or significance of alphas.

[Insert Tables 3a, b and c]

VIII. Gross Performance of funds

Until now only net performance of mutual funds has been considered which means that expenses have already been deducted from funds' returns. Previous literature (Jensen (1968), Malkiel (1995), Gruber (1996), & Detzler (1999)) indicates that mutual funds net of expenses have not been able to generate excess returns. When using gross returns, superior performance can be identified (Blake, Elton, & Gruber (1993) and Detzler (1999)), however alphas were not significantly different from zero. This finding is consistent with Grossman & Stiglitz's (1980) theory of informationally efficient markets, where after adjusting for risk, informed investors earn higher gross returns, but they also incur more expenses which in equilibrium net out any advantage.[7] To test this hypothesis, the funds' monthly gross returns are obtained from Morningstar Direct database and the alphas computed using the CAPM, Fama-French, and Carhart Models.

As can be seen in Tables 4a, b, and c, all three models again show that the Commodity mutual funds have annualized gross alphas of approximately -3% (significant at 1% and 5%) and, hence, the underperformance of Commodity mutual funds is not due to expenses.[8] However, Precious Metals, Natural Resources, and Equity Energy mutual funds have significantly positive gross alphas. These results indicate that the fund managers are successful in finding and taking advantage of new information, however this benefit is not enough to offset the fund expenses.

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[7] See, for example, Ippolito (1993).

[8] Recall that Commodity funds, according to Morningstar, invest "… in physical assets or commodity linked derivative instruments, such as commodity swap agreements." The increase in assets under management in these funds could result in an increase in long hedges which would shift the market from normal backwardation to contango. A futures contract in a contango market has a futures price high relative to the expected spot price which would result in a negative expected return. This phenomenon could explain the negative alphas on Commodity funds when using either conditional or unconditional models.

[Insert Tables 4a, b, and c]

IX Bear Market Analyses

Since commodities have had a high negative correlation with stocks over a long period of time, we hypothesize that commodity based funds would not outperform equities during major financial crises. To test this hypothesis, the performance of Commodity, Natural Resources, Precious Metals and Equity Energy funds is analyzed during the 2000 bear market and the 2007 financial crisis. We report results for Carhart four-factor model (1997). However, results remain same with other factor models.

Performance during the 2000 Bear Market

The 2000 bear market has been widely attributed to the bursting of the Dot-Com bubble. The period leading up to this crash (1992-2000) was very favorable for the stock market due to strong economic growth and low inflation. However, from 1999 to early 2000, the Federal Reserve increased interest rates over 6 times. These increases contributed to the slowing of the economy and the bubble bursting on March 10, 2000, when the technology heavy NASDAQ Composite index peaked before starting its decline. The NASDAQ Composite index lost 78% of its value between March 10, 2000 and October 9, 2002. Consequently, for purposes of our analysis we chose our relevant time period from March 2000 – September 2002.

Results shown in Tables 5 indicate that all categories, with the exception of Commodity funds, have significantly positive alphas during the 2000 stock market crash.[9] Precious Metal

[9] Note that there were only 2 Commodity funds during this time period. Most of the Commodity funds were created during 2004/2005 period (According to Morningstar, the first Commodity fund was created in 1997).

funds had the best performance with annualized alpha of over 20% (statistically significant at 1%).

[Insert Tables 5]

Performance during the 2007 financial crisis

According to the Wall Street Journal, the most recent bear market in US stocks (2007-2009) was declared in June 2008 after the DJIA had fallen 20% from its October 11, 2007 high. The bear market reversed course during March, 2009. Our analysis covers of this financial crisis period from October 2007 to March 2009.

As shown in Tables 6, results support our hypothesis as these funds performed very well and had significantly positive alphas during the 2007 financial crisis. The Carhart four-factor model indicates that Commodity funds have an annualized alpha of 10.25% (statistically significant at 1%). Precious Metals funds had the best performance with annualized alpha of over 44% (statistically significant at 1%).

[Insert Tables 6]

In summary, the results from both bear market time periods analyzed indicate that, in general, these funds are an effective hedge during major financial crises generating positive and significant alphas. The exception being the Commodity funds most of which were created just before the financial crisis of 2007-2009.[10]

X. Persistence

[10] No benefits of an inflation hedge are evident due to level or declining commodity prices during both periods. The IMF All Commodity Price Index for the period from March 2000 through September 2002 was basically flat representing no changes in commodity prices over this period. For the period from October 2007 until March 2009, commodity prices declined by approximately 34%.

Grinblatt and Titman (1992), Brown et al (1992), Hendricks et al (1993), Brown and Goetzmann (1994), Goetzmann and Ibbotson (1994), Kahn and Rudd (1995), Malkiel (1995), Elton et al (1996) and Carhart (1997) have tested the persistence of conventional mutual fund total returns in time. Grinblatt and Titman (1992) find evidence that differences in performances between funds persists over time and this persistence is consistent with the ability of fund managers to earn abnormal returns. Hendricks et al (1993) find that relative performance no-load growth funds persist in the near term, with the strongest evidence for a one-year horizon. Goetzmann and Ibbotson (1994) find strong evidence that past mutual fund performance predicts future mutual fund performance. Their data suggests that winner and losers are likely to repeat, even when performance is adjusted for relative risk. Kahn and Rudd (1995) investigate performance persistence for fixed income and equity mutual funds and found performance persistence only for fixed income funds. However, this persistence edge cannot overcome the average underperformance of fixed-income funds resulting from fees and expenses. Elton et al (1996) find that risk-adjusted performances of mutual funds persist, i.e. funds that did well in the past continue to do well in the future.

Survivorship bias plays a very important role in performance persistence. This impact is due to truncation of the data set due to disappearance of poorly performing funds from the sample. Studying only surviving funds will overstate performance. Brown et al. (1992) show that early studies exaggerate the extent of persistence by relying on survivorship- biased data sets. Since survivorship bias has been controlled for in our study, there will be no such problems.

Carhart (1997) finds that in his survivorship bias free sample of US equity funds, persistence disappears after accounting for momentum in stock returns. However, recent studies argue that after properly considering fund styles, there is persistence in U.S. equity funds (Ibbotson and Patel (2002); Wermers (2003)).

Following Kahn and Rudd (1995), the following model is used test whether commodity based mutual funds have any performance persistence.

Period 2 performance is regressed against Period 1 performance.

Performance (2) = a + b X Performance (1). (10)

where 'Performance' is annual returns. Positive estimates of coefficient b with significant t-statistics are evidence of persistence: Period 1 performance contains useful about information about Period 2 performance.

[Insert Table 7]

Results from Table 7 indicate that none of the categories of commodity based mutual funds display any performance persistence. Commodities, Natural Resources and Equity Energy funds have significantly negative persistence, whereas the results are insignificant for Precious Metals funds.

XI. Mutual fund market-timing & Selectivity

Previous literature (Treynor and Mazuy (1966), Kon and Jen (1979), Henriksson and Merton (1981), Lee and Rahman (1990)) studies conventional mutual fund market timing and selectivity. They find that mutual fund managers have limited success in market timing and selectivity.

We use two models to test for market timing and selectivity. The first model was developed by Treynor and Mazuy (1966). This model adds a quadratic term to CAPM or the market model to capture market timing and selectivity. The equation is as follows:

$$R_{i,t} - R_{f,t} = \alpha_S + \beta_1 (R_{m,t} - R_{f,t}) + \beta_2 (R_{m,t} - R_{f,t})^2 + e_{i,t} \qquad (11)$$

A positive and significant β_2 indicates superior market timing ability. However, a negative and significant β_2 indicates inferior market timing. If β_2 is not different than 0, then the manager has no market timing ability. Similarly, α_S measures selectivity.

The second model, which was developed by Henriksson and Merton (1981), replaces the quadratic term with a variable Max (0, R_m). The equation is as follows:

$$R_{i,t} - R_{f,t} = \alpha_S + \beta_1 (R_{m,t} - R_{f,t}) + \gamma[D_t(R_{m,t} - R_{f,t})] + e_{i,t} \qquad (12)$$

Where $D_t = 0$ if $R_{m,t} > R_{f,t}$ (-1 otherwise).

Here, γ measures market-timing ability whereas α_S measures selectivity.

[Insert Tables 8a, b, c and d]

As seen in Table 8a, the Treynor and Mazuy (1966) model indicates that Natural Resources, Precious Metals, and Equity Energy funds exhibit some selectivity, but no market-timing ability, whereas Commodity funds have neither selectivity nor market-timing ability.

The results of the Henriksson and Merton model are reported in Table 8b. The results for Commodity, Natural Resource, and Equity Energy funds show no market timing ability and no selectivity. Precious Metal funds do have selectivity and market timing ability.

Following Ferson and Schadt (1996), the conditional market timing and selectivity of these funds is given by-

Conditional Treynor and Mazuy:

$R_{i,t} – R_{f,t}= \alpha_s + \beta_1 (R_{m,t}- R_{f,t}) +\delta\{zt-1*(R_{m,t}- R_{f,t}) \}+ \beta_2 (R_{m,t}- R_{f,t})^2 + e_{i,t}$ (13)

Conditional Henriksson and Merton:

$R_{i,t} – R_{f,t}= \alpha_s + \beta_1 (R_{m,t}- R_{f,t}) +\delta\{zt-1*(R_{m,t}- R_{f,t}) \}+ \gamma[D_t(R_{m,t}- R_{f,t})] + e_{i,t}$ (14)

Where $D_t = 0$ if $R_{m,t}> R_{f,t}$ (-1 otherwise).

Conditional Treynor and Mazuy (1966) and Henriksson and Merton (1981) models show similar results in terms of market timing and selectivity as seen in Tables 8c and d.

XII. Index funds vs. Commodity based mutual funds

Would investors have been better off by investing in index mutual funds or commodity based funds? Index funds (tracking S&P 500) are passively managed and have lower expense ratios primarily due to lower management fees. The performance of all index funds tracking the S&P 500 (living as well as dead) from Inception (September 1976) – December 2012 is computed. There are a total of 61 index funds tracking S&P 500 during this period. Table 9a shows the differences in expense ratios and management fees between index funds and commodity based funds. Index funds have average expense ratio of only 0.65% compared to 1.35% for Commodity, 1.63% for Natural Resources funds, 1.49% for Precious Metals funds; and 1.60 for Equity Energy funds.

[Insert Tables 9a, b, c, and d]

The performance comparison is made using the Carhart four-factor model and is shown in Table 9b. For the period starting with the inception of these funds through December 2012, the S&P 500 Index funds had a net annualized alpha that was negative, but better than Natural Resources and Commodities which partially could be explained by the alternating price (performance) leadership (Zapata, et al., 2012) and/or the relatively low and stable commodity prices from 1980 through 2000.[11]

Results in Table 9c and d indicate that the performance of Commodity, Natural Resources, and Precious Metals and Equity Energy funds was much better than the performance of Index funds tracking S&P 500 both during the 2000 stock market crash and the 2007 financial crisis. Based on these results, we conclude that the Commodity (Broad Basket) funds appear to not provide value as measured by net annualized alpha over long periods of time, but all categories of commodity based funds provide value during bear markets.

XIII. Conclusions

Our main finding is that investors can benefit by increasing their holdings of these categories of funds during times of economic distress as evidenced by the 2000 bear market and the 2007 financial crisis. During these bear markets, the net alphas of these funds were significantly positive and much higher than Index funds tracking S&P 500.

In addition our results indicate that based on the three performance models used in our study, these categories of funds have not been able to consistently create positive net alphas for their investors over longer time periods as measured by the time period from their inception until December 2012. When looking at each category of fund, we find significantly positive gross alphas for Precious Metals, Natural Resources, and Equity Energy funds, while the gross alpha of Commodity funds is negative. The results indicate that the funds with positive gross alphas are successful in finding and implementing new information, however this activity is not enough to offset the fund expenses as seen by their net alphas. We also observe that Natural

[11] See Blake, Bordon and Volz (2013).

Resources, Precious Metals funds, and Equity Energy have some selectivity, but no market-timing ability whereas Commodity funds have neither market-timing nor selectivity.

Based on these results, it is our opinion that during bear markets, there are significant diversification benefits of these categories of funds relative to the S&P 500 confirming the rationale as to why investors should hold them in their portfolios as hedges against market downturns.

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Appendix 1- Definitions (Source - Morningstar)

Commodity Broad Basket - portfolios can invest in a diversified basket of commodity goods including but not limited to grains, minerals, metals, livestock, cotton, oils, sugar, coffee and cocoa. Investment can be made directly in physical assets or commodity linked derivative instruments, such as commodity swap agreements.

Natural Resources- Natural resources portfolios focus on commodity-based industries such as energy, chemicals, minerals, and forest products in the U.S. or outside of the U.S. Some portfolios invest across this spectrum to offer broad natural resources exposure. Others concentrate heavily or even exclusively in specific industries including energy or forest products.

Precious Metals- Precious metals portfolios focus on mining stocks, though some do own small amounts of gold bullion. Most portfolios concentrate on gold-mining stocks, but some have significant exposure to silver-, platinum-, and base-metal-mining stocks as well. Precious-metals companies are typically based in North America, Australia, or South Africa.

Equity Energy- Equity Energy portfolios invest primarily in equity securities of U.S. or non-U.S. companies who conduct business primarily in energy-related industries. This includes and is not limited to companies in alternative energy, coal, exploration, oil and gas services, pipelines, natural gas services and refineries.

Table 1a

Category	# of living funds (Dec 2012)	AUM (Dec 2012)	Dead Funds(Dec 2012)	Inception Date (1st fund)
Commodity	30	$50.40	2	Apr-97
Natural Resources	36	$27.90	16	Feb-69
Precious Metals	21	$23.90	9	Mar-56
Equity Energy	34	$26.85	1	Aug-81
Total	121	$129.05	28	

AUM- Assets under management.

All figures in billions of $ (Dec 2012).

The next to last column contains number of funds that died before Dec 2012.

Table 1b

Category		Mean	Standard Deviation	Median	Max	Min
	Management fee	0.81	0.24	0.85	1.29	0.30
Commodity	Annual Net Expense Ratio	1.35	0.50	1.26	2.75	0.07
	Turnover(%)	193.87	440.57	72.50	3455.00	0.00
	Management fee	0.85	0.21	0.81	1.35	0.11
Natural Resources	Annual Net Expense Ratio	1.63	0.62	1.56	3.84	0.14
	Turnover(%)	79.53	60.15	73.00	297.00	7.00
	Management fee	0.75	0.19	0.75	1.50	0.26
Precious Metals	Annual Net Expense Ratio	1.49	0.53	1.37	3.04	0.29
	Turnover(%)	65.25	191.39	22.00	1297.00	1.00
	Management fee	0.86	0.24	0.85	1.35	0.12
Equity Energy	Annual Net Expense Ratio	1.60	0.54	1.56	2.91	0.14
	Turnover(%)	62.66	68.47	43.32	288.00	3.00

<u>Table 2a, b, and c-</u> This table reports the net alphas from a pooled OLS regression (for CAPM, Fama-French three-factor model, and Carhart four-factor model) from Inception-Dec 2012. All alphas have been annualized. Standard errors are clustered at the fund level. T-stats are in brackets

CAPM	Annualized Net Alpha (× 100)	Net Alpha	K	R^2	#
Commodity	-4.26%	-0.0036245***	0.8304019 ***	0.3419	32
		[-3.85]	[7.63]		
Natural Resources	0.60%	0.0005061	1.008464***	0.4660	52
		[1.09]	[26.95]		
Precious Metals	3.45%	0.0028327 ***	0.5543144 ***	0.0677	30
		[4.19]	[23.08]		
Equity Energy	1.89%	0.0015631**	1.022136***	0.3899	35
		[2.43]	[21.58]		

Fama-French	Annualized Net Alpha (× 100)	Net Alpha	SMB	HML	K	R^2	#
Commodity	-4.14%	-0.0035238 ***	-0.2612455*	-0.1402309	0.9081646***	0.3512	32
		[-3.46]	[-1.90]	[-1.13]	[6.43]		
Natural Resources	-0.91%	-0.0007653	0.1327002***	0.3726523***	1.025322***	0.4922	52
		[-1.65]	[3.70]	[9.79]	[30.97]		
Precious Metals	2.08%	0.0017202 **	0.432783 ***	0.2488876 ***	0.525212***	0.0872	30
		[2.55]	[16.81]	[6.69]	[20.02]		
Equity Energy	0.68%	0.0005614	0.1188162**	0.3257313***	1.032103***	0.4062	35
		[0.95]	[2.65]	[5.87]	[26.66]		

Carhart	Annualized Net Alpha (× 100)	Net Alpha	SMB	HML	K	MOM	R^2	#
Commodity	-4.40%	-0.0037494***	-0.2750734**	-0.0741139	0.9647944 ***	0.1594232***	0.3633	32
		[-3.82]	[-2.08]	[-0.59]	[7.21]	[5.58]		
Natural Resources	-1.05%	-0.0008874*	0.1312797***	0.3794833***	1.031918***	0.0188053	0.4924	52
		[-1.97]	[3.68]	[10.26]	[33.44]	[1.05]		
Precious Metals	0.62%	0.000513	0.4257934 ***	0.2983 ***	0.563428****	0.1449903 ***	0.0918	30
		[0.80]	[16.79]	[8.51]	[21.11]	[9.16]		
Equity Energy	0.007%	6.12e-06	0.1093491	0.3541126***	1.064608 ***	0.0894793***	0.4095	35
		[0.01]	[2.46]	[6.66]	[25.25]	[4.89]		

***- Significant at 1%

** - Significant at 5%

* - Significant at 10%

Table 3a, b, and c This table shows the Conditional vs. Unconditional alpha for CAPM, Fama-French three-factor and Carhart four-factor models from a pooled OLS regression. All alphas have been annualized. Standard errors are clustered at the fund level. T-stats are in brackets.

CAPM	Annualized Alpha (× 100)	Unconditional net alpha	R^2	Annualized Alpha (× 100)	Conditional net Alpha	R^2
Commodity	-4.26%	-0.0036245***	0.3419	-4.54%	-0.0038682 ***	0.3592
		[-3.85]			[-4.00]	
Natural Resources	0.60%	0.0005061	0.4660	0.104%	0.0000873	0.4799
		[1.09]			[0.20]	
Precious Metals	3.45%	0.0028327 ***	0.0677	3.86%	0.0031636***	0.0725
		[4.19]			[4.94]	
Equity Energy	1.89%	0.0015631**	0.3899	2.44%	0.0020149***	0.4048
		[2.43]			[2.98]	

Fama-French	Annualized Alpha (× 100)	Unconditional net alpha	R^2	Annualized Alpha (× 100)	Conditional net Alpha	R^2
Commodity	-4.14%	-0.0035238 ***	0.3512	-4.48%	-0.0038181***	0.3763
		[-3.46]			[-3.53]	
Natural Resources	-0.91%	-0.0007653	0.4922	-1.21%	-0.0010146	0.4953
		[-1.65]			[-1.67]	
Precious Metals	2.08%	0.0017202 **	0.0872	2.25%	0.0018549***	0.0926
		[2.55]			[2.77]	
Equity Energy	0.68%	0.0005614	0.4062	1.17%	0.0009657	0.4166
		[0.95]			[1.63]	

Carhart	Annualized Alpha (× 100)	Unconditional net alpha	R^2	Annualized Alpha (× 100)	Conditional net Alpha	R^2
Commodity	-4.40%	-0.0037494***	0.3633	-4.99%	-0.0042597***	0.3929
		[-3.82]			[-3.91]	
Natural Resources	-1.05%	-0.0008874*	0.4924	-1.37%	-0.0011469 ***	0.4956
		[-1.97]			[-2.74]	
Precious Metals	0.62%	0.000513	0.0918	0.77%	0.0006434	0.0983
		[0.80]			[1.01]	
Equity Energy	0.007%	6.12e-06	0.4095	0.60%	0.000506	0.4198
		[0.01]			[0.89]	

***- Significant at 1%

** - Significant at 5%

* - Significant at 10%

Table 4a, b and c- This table reports the gross alphas from a pooled OLS regression (for CAPM, Fama-French three-factor model, and Carhart four-factor models) from Inception-Dec 2012. All alphas have been annualized. Standard errors are clustered at the fund level. T-stats are in brackets

CAPM	Annualized Gross Alpha (× 100)	Gross Alpha	K	R^2
Commodity	-3.04%	-0.002568 ***	0.8312145 ***	0.3419
		[-2.85]	[7.63]	
Natural Resources	1.97%	0.0016283 **	0.4209685***	0.1189
		[2.65]	[4.15]	
Precious Metals	5.06%	0.0041218 ***	0.5568964***	0.0680
		[5.76]	[25.77]	
Equity Energy	3.46%	0.0028399***	1.023539***	0.3900
		[4.39]	[21.56]	

Fama-French	Annualized Gross Alpha (× 100)	Gross Alpha	SMB	HML	K	R^2
Commodity	-2.92%	-0.0024673**	-0.2614783*	-0.1405568	0.9090726***	0.3511
		[-2.51]	[-1.90]	[-1.13]	[6.43]	
Natural Resources	1.40%	0.0011604 *	0.0210269	0.146045***	0.4333718 ***	0.1247
		[1.77]	[0.75]	[3.33]	[4.22]	
Precious Metals	3.67%	0.0030091***	0.4456573***	0.251161***	0.5278918***	0.0884
		[4.51]	[18.11]	[7.08]	[21.88]	
Equity Energy	2.23%	0.0018367 ***	0.1191829**	0.3261339***	1.033476***	0.4063
		[3.06]	[2.65]	[5.87]	[26.64]	

Carhart	Annualized Gross Alpha (× 100)	Gross Alpha	SMB	HML	K	MOM	R^2
Commodity	-3.18%	- 0.0026931***	-0.2753193**	-0.0743772	0.965756***	0.1595741***	0.3633
		[-2.87]	[-2.08]	[-0.59]	[7.21]	[5.56]	
Natural Resources	1.51%	0.0012502 *	0.0220716	0.1410192***	0.4285187***	-0.0138354	0.1249
		[1.89]	[0.78]	[3.29]	[4.11]	[-0.71]	
Precious Metals	2.11%	0.0017437**	0.438632 ***	0.3025232***	0.5664114***	0.1498341***	0.0933
		[2.80]	[17.93]	[9.09]	[23.65]	[10.39]	
Equity Energy	1.55%	0.0012799**	0.10969**	0.3545925***	1.06607***	0.089723***	0.4096
		[2.32]	[2.46]	[6.67]	[25.23]	[4.90]	

*** - Significant at 1%

**- Significant at 5%

* - Significant at 10%

Table 5 - This table reports the net alphas for a pooled OLS regression (for Carhart four-factor model) for the period march 2000-September 2002. All alphas have been annualized. Standard errors are clustered at the fund level. T-stats are in brackets.

Carhart (2000 stock market crash)	Annualized crisis Alpha (× 100)	Net Alpha	SMB	HML	K	MOM	R^2
Commodity	11.71%	0.0092691	-0.0354154	-0.0855625	0.1756941	0.1473223***	0.1890
		[0.98]	[-0.42]	[-0.52]	[1.43]	[3.83]	
Natural Resources	4.10%	0.0033569***	0.1069117***	0.6885104***	1.069403***	0.0333296	0.4829
		[2.62]	[3.31]	[16.49]	[22.60]	[1.40]	
Precious Metals	22.43%	0.0170043***	0.3615615***	0.4597126***	0.8436595***	0.2696969***	0.2117
		[11.09]	[13.98]	[13.62]	[20.88]	[23.36]	
Equity Energy	7.31%	0.0058962**	-0.0010949	0.5850291***	1.235959***	0.0908009***	0.4111
		[2.74]	[0.02]	[11.75]	[23.84]	[3.24]	

***- Significant at 1%

** - Significant at 5%

* - Significant at 10%

Table 6 - This table reports the net alphas for a pooled OLS regression (for Carhart four-factor models) for the period October 2007-March 2009. All alphas have been annualized. Standard errors are clustered at the fund level. T-stats are in brackets.

Carhart (2007 financial crisis)	Annualized crisis Alpha (× 100)	Net Alpha	SMB	HML	K	MOM	R^2
Commodity	10.25%	0.0081661***	-0.5423482***	-.3433572 **	1.507988***	0.7265912***	0.4692
		[3.04]	[-6.42]	[-2.73]	[7.12]	[8.80]	
Natural Resources	8.71%	0.0069825***	-.1794617	-0.7258371***	1.637325***	0.4524385***	0.6920
		[4.09]	[-1.68]	[-8.46]	[21.02]	[7.01]	
Precious Metals	39.91%	0.0283831 ***	-0.0809039	-1.466831***	1.456556***	0.0447969*	0.3120
		[18.06]	[-1.08]	[-21.11]	[19.38]	[1.83]	
Equity Energy	13.02%	0.0102541***	-0.5546169***	-0.8451713***	1.908469***	0.8264148***	0.7181
		[6.76]	[-6.01]	[-16.95]	[28.77]	[16.53]	

*** - Significant at 1%

** - Significant at 5%

* - Significant at 10%

Table 7- Reported are the results of Kahn and Rudd (1995) performance persistence model. Standard errors are clustered at the fund level. T-stats are in brackets. Period 2 performance is regressed against Period 1 performance.

Performance (2) = a + b X Performance (1).

where 'Performance' is annual returns. Positive estimates of coefficient b with significant t-statistics are evidence of persistence: Period 1 performance contains useful information about Period 2 performance.

Kahn and Rudd (1995)	a	b	R^2
Commodity	0.0527178**	-0.3692058***	0.1606
	[2.17]	[-10.54]	
Natural Resources	0.142861***	-0.2668571***	0.0757
	[17.53]	[-9.31]	
Precious Metals	0.1024856***	0.0369648	0.0014
	[7.93]	[1.51]	
Equity Energy	0.1546694***	-0.2370113***	0.0604
	[12.54]	[-6.78]	

***- Significant at 1%

** - Significant at 5%

* - Significant at 10%

Table 8a, b, c, and d- Reported are the results from Treynor and Mazuy (1966), Henriksson and Merton (1984) and conditional Treynor and Mazuy and Henriksson and Merton models. For the Treynor and Mazuy (1996) models, α_S measures selectivity whereas β_2 measures market-timing. Similarly, for the Henriksson and Merton (1984) models, α_S measures selectivity whereas γ measures market-timing. Standard errors are clustered at the fund level. T-stats are in brackets.

Treynor and Mazuy	α_s	β_2	R^2
Commodity	0.0011606	-1.947379 ***	0.3536
	[0.80]	[-4.54]	
Natural Resources	0.0021186***	-0.6827301***	0.4674
	[3.06]	[-3.89]	
Precious Metals	0.0092401***	-2.875043***	0.0807
	[9.83]	[-9.54]	
Equity Energy	0.0049938***	-1.501977***	0.3953
	[8.12]	[-8.40]	

Henriksson and Merton	α_s	γ	R^2
Commodity	-0.0072827***	-0.0085214*	0.3434
	[-3.99]	[-1.87]	
Natural Resources	-0.0005612	-0.00246	0.4661
	[-0.56]	[-1.44]	
Precious Metals	0.0050555 ***	0.0050565*	0.0679
	[3.77]	[2.01]	
Equity Energy	0.0023185	0.001746	0.3900
	[1.54]	[0.73]	

Conditional Treynor and Mazuy	α_s	β_2	R^2
Commodity	0.0021522	-2.860844***	0.3800
	[1.43]	[-6.80]	
Natural Resources	0.0023877***	-1.009675***	0.4830
	[3.41]	[-5.55]	
Precious Metals	0.0092401***	-2.875043***	0.0807
	[9.83]	[-9.54]	
Equity Energy	0.0055106***	-1.637158***	0.4107
	[8.90]	[-8.04]	

Conditional Henriksson and Merton	α_s	γ	R^2
Commodity	-0.0065639***	-0.0062493*	0.3600
	[-4.86]	[-2.01]	
Natural Resources	-0.0004482	-0.0012197	0.4800
	[-0.45]	[-0.71]	
Precious Metals	0.0050555 ***	0.0050565*	0.0679
	[3.77]	[2.01]	
Equity Energy	0.0035578**	0.0035154	0.4050
	[2.30]	[1.44]	

***- Significant at 1%

** - Significant at 5%

* - Significant at 10%

Table 9a- Expenses and turnover for index funds tracking S&P 500 and Commodity, Natural Resources, Precious Metals, and Equity Energy mutual funds.

Comparision	Number		Mean	Standard Deviation	Median
		Management fee	0.20	0.16	0.18
Index Mutual Funds	61	Annual Net Expense Ratio	0.65	0.47	0.57
		Turnover(%)	9.89	24.60	5.00
		Management fee	0.81	0.24	0.85
Commodity	32	Annual Net Expense Ratio	1.35	0.50	1.26
		Turnover(%)	193.87	440.57	72.50
		Management fee	1.35	0.21	0.81
Natural Resources	52	Annual Net Expense Ratio	1.63	0.62	1.56
		Turnover(%)	79.53	60.15	73.00
		Management fee	0.75	0.19	0.75
Precious Metals	30	Annual Net Expense Ratio	1.49	0.53	1.37
		Turnover(%)	65.25	191.39	22.00
		Management fee	0.86	0.24	0.85
Equity Energy	35	Annual Net Expense Ratio	1.60	0.54	1.56
		Turnover(%)	62.66	68.47	43.32

<u>Table 9b</u> show the difference in performance between passively managed index mutual funds tracking S&P 500 and Commodity, Natural Resources, Precious Metals, and Equity Energy mutual funds (using alpha from Carhart four-factor model) from inception-Dec 2012. All alphas have been annualized. Standard errors are clustered at the fund level. T-stats are in brackets.

Carhart (Inception-Dec 2012)	Annualized net Alpha (× 100)	Net Alpha	R^2
Index Funds (S&P 500)	-0.32%	-0.0002698 ***	0.9716
		[-4.02]	
Commodity	-4.40%	-0.0037494***	0.3633
		[-3.82]	
Natural Resources	-1.05%	-0.0008874*	0.4924
		[-1.97]	
Precious Metals	0.62%	0.000513	0.0918
		[0.80]	
Equity Energy	0.007%	6.12e-06	0.4095
		[0.01]	

***- Significant at 1%

** - Significant at 5%

* - Significant at 10%

Tables 9c and d show the difference in performance between passively managed index mutual funds tracking S&P 500 and Commodity, Natural Resources, Precious Metals and Equity Energy mutual funds (using alpha from Carhart four-factor model) during the 2000 stock market crash (March 2000 – September 2002) and the 2007 financial crisis (October 2007 – March 2009). All alphas have been annualized. Standard errors are clustered at the fund level. T-stats are in brackets.

Carhart (March 2000 - September 2002)	Annualized crisis Alpha (× 100)	Net Alpha (crisis)	R^2
Index Funds (S&P 500)	-0.45%	-0.0003755**	0.9437
		[-2.33]	
Commodity	11.71%	0.0092691	0.1890
		[0.98]	
Natural Resources	4.10%	0.0033569***	0.4829
		[2.62]	
Precious Metals	22.43%	0.0170043***	0.2117
		[11.09]	
Equity Energy	7.31%	0.0058962**	0.4111
		[2.74]	

Carhart (Oct 2007 - March 2009)	Annualized crisis Alpha (× 100)	Net Alpha (crisis)	R^2
Index Funds (S&P 500)	-1.243%	-0.0010419***	0.9979
		[-12.15]	
Commodity	10.25%	0.0081661***	0.4692
		[3.04]	
Natural Resources	8.71%	0.0069825***	0.6920
		[4.09]	
Precious Metals	39.91%	0.0283831 ***	0.3120
		[18.06]	
Equity Energy	13.02%	0.0102541***	0.7181
		[6.76]	

***- Significant at 1%

** - Significant at 5%

* - Significant at 10%