 USING COMMODITIES AS A STRATEGY OF DIVERSIFICATION – A HISTORICAL ANALYSIS

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Abstract

Commodities are relatively new asset class that offer high returns in 2008. Nevertheless, it is a new asset class that has to be discussed critically. The risk/return relation and possibility to diversify a portfolio by the usage of commodities shall be analyzed. This article applies the model of Markowitz onto historical data of several asset classes in order to offer first hints to diversify a portfolio with commodities.

Key words: commodities, diversification, efficiency, historical analysis

1 INTRODUCTION

Commodities reach record prices in 2008. The return seems to be good, but the asset class commodities have to be analyzed critical according to its risk/return profile. Further, its diversification abilities have to be analyzed. The simplest but most accepted approach is the correlation model, so it will be applied on historical data in this article.

The structure is as follows. Section 2 defines the theoretical basics of the portfolio theory. Section 3 describes the status quo of the investment possibilities in the commodity market. Section 4 analyses several assets according to their risk/return profile. After that the diversification effects are quantified. Section 5 sums up the main aspects and gives an outlook to the future.
2 MARKOWITZ’ PORTFOLIO THEORY

2.3 Theoretical Aspects

The origin of the Portfolio Theory can be found in 1952. Harry M. Markowitz published his theory by an article in the “Journal of Finance” titled “Portfolio Selection”. Markowitz demonstrates how an investor can reduce the risk respectively the standard deviation of the portfolio returns by choosing stocks that do not move exactly together.\(^2\)

The portfolio theory analyses the situation of investment decisions considering risk by using the principle of \(\mu\sigma\): The volatility can be seen as a degree of risk if all shares can be described by the expected returns (\(\mu\)) and the volatility (\(\sigma\)) of returns.\(^3\) The theory assumes that rational investors only invest in efficient portfolios. A portfolio is consequently efficient if there is no alternative to get:

- less \(\sigma\) for the same \(\mu\),
- more \(\mu\) for the same \(\sigma\),
- both more \(\mu\) and less \(\sigma\).\(^4\)

The expected rate of return resulting from diversification corresponds to the sum of returns of particular shares weighted by their proportion within the portfolio. Therefore, the expected rate of return of a portfolio \(\mu_p\) consisting of \(n\) shares \(i\) with expected returns \(\mu_i\) is:

Expected rate of return of a portfolio\(^5\)

\[
\mu_p = \sum_{i=1}^{n} a_i \mu_i \quad \text{with} \quad \sum_{i=1}^{n} a_i = 1
\]

with:

- \(\sigma_p\) = volatility of portfolio
- \(\sigma_i\) = volatility of share \(i\)
- \(n\) = number of available shares
- \(a_i\) = proportion of share \(i\) within the portfolio

The standard deviation of the portfolio diversification is not equivalent to the weighted sum of every single variance. Additionally, the stochastically dependence of particular shares measured by the covariance \(\text{cov}_{ij}\) has to be taken into account. The term for the variance of diversification could be found in following equation:

Variance of diversification\(^6\)

\[
\sigma_p^2 = \sum_{i=1}^{n} a_i^2 \sigma_i^2 + \sum_{i=1}^{n} \sum_{j \neq i}^{n} a_i a_j \text{cov}_{ij} = \sum_{i=1}^{n} \sum_{j=1}^{n} a_i a_j \text{cov}_{ij}
\]

\(^1\) Markowitz (1952), pp. 77.
An example should demonstrate the meaning of these facts: given are two shares, the Sunshine Corp. (share A with \( \mu_1 \), standard deviation \( \sigma_1 \) and a quota of \( a \)) produces sun cream whereas the Rainbow Corp. (share B with a return of \( \mu_2 \), a standard deviation \( \sigma_2 \) and a quota of \( 1-a \)) produces umbrellas. So the share price fairly depends on the weather. If the sun is shining all the year the Sunshine Corp. will increase its sales in sun cream as well as increase in value, whereas the Rainbow Corp. will decrease in value, and vice versa. Granted that investors have only one of these shares in their portfolio it gets – depending on the share – highly revalued or devalued. If investors hold shares from both companies they spread their risk and it will balance at a certain point. Sunshine and Rainbow Corp. behave in such a counteractive manner that the value of the whole portfolio will not change. So diversification means nothing else than minimizing the risk by splitting stocks, which does not move exactly together. The efficient diversification of A and B shares can be calculated by the so-called correlation coefficient. Correlation is a term from mathematical statistics expressing the degree of common variation of to sets of numbers. The coefficient of correlation can vary from a maximum of 1.0 (perfect agreement) via the value 0 (no relationship) to a minimum of –1.0 (perfect disagreement). The correlation coefficient is defined by following equation:

Correlation coefficient of two shares

\[
c_{12} = \frac{\text{cov}_{12}}{\sigma_1 \sigma_2}
\]

Possible diversifications of a two-share portfolio are defined as:

Correlation coefficient of two shares

\[
\mu_p = a\mu_1 + (1-a)\mu_2
\]

\[
\sigma_p = \sqrt{a^2\sigma_1^2 + (1-a)^2\sigma_2^2 + 2c_{12}a(1-a)\sigma_1\sigma_2}
\]
2.4 Visualizing at an Example

In order to visualize these effects, the following figure shows possible correlations:

![Figure 1: Return of share portfolio (2 shares, correlation -1,0,1)](image)

For the example, following data is assumed:

<table>
<thead>
<tr>
<th>Table 1: Assumptions for Sunshine / Rainbow shares example</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Return p.a.</td>
</tr>
<tr>
<td>Volatility p.a.</td>
</tr>
</tbody>
</table>


The line “correlation 1” of figure 2 determines possible diversifications of shares A and B. In case of uncorrelated returns (correlation 0) a diversification of A and B shares can result in increasing returns at decreasing standard deviations to a certain point (62,5% for share A and 37,5% for share B).

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3 INVESTMENT POSSIBILITIES IN COMMODITIES

3.3 Analyzing the Actual Bull Market

But the actual bull market in commodities is a bit different than all others in the past. Historical booms were caused by limited supply but the current boom is powered by huge demand especially from emerging market countries e.g. China.

Now it can be said that the commodity bull market began and probably will be also continue. The main reasons for this suggestion can be summed up as follows.\(^{12}\)

- The 1980’s and 1990’s was a period of a declining commodities market. The commodities were very cheaper to compare with consumer price index or price of stocks or bonds. This long term declining commodity market caused fast reduction of capacity and thus imbalance between demand and supply. Now demand is rising but the supply is extremely low and it will take several years that they will be aligned. If Asia economy will continue in growth, the world demand about commodity will grow as well. Especially China transforms from the main exporter to the main importer because of its consumptions of iron ore, copper, oil, soya etc.
- According to historical data the price of commodities are negatively correlated to the price of stocks, bonds or other financial assets. If stocks reach they top the commodities are in they bottom and vice versa. It means that only with some commodity investment a good portfolio diversification can be achieved.
- Commodities as a property asset have no credit risk.
- Commodities can rise although the economy has opposite trends.

3.4 Relevant Data

First, the relevant markets have to be defined. Therefore, the following figure shows the used indices to do a historical analysis. A 10-year history from 03.1998 – 03.2008 is chosen in order to generate stable correlations. Therefore the indices stated in table 2 are used. Normally, monthly yields in percent will be used. Just Private Equity and Real Estate assets are calculated with yearly yields as monthly yields are not available. The results will be presented in the following section.

<table>
<thead>
<tr>
<th>Asset Class</th>
<th>Used Benchmark for the Asset Class(^ {14})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro-shares</td>
<td>Euro Stoxx</td>
</tr>
<tr>
<td>UK-shares</td>
<td>FTSE 100 (Performance)</td>
</tr>
<tr>
<td>US-shares</td>
<td>S&amp;P 500 (Performance)</td>
</tr>
<tr>
<td>Japan-shares</td>
<td>Nikkei</td>
</tr>
<tr>
<td>German Bonds</td>
<td>Rex (German Bond Index)</td>
</tr>
<tr>
<td>US Bonds</td>
<td>10 years Treasuries</td>
</tr>
<tr>
<td>Real Estate</td>
<td>DIX (German Real Estate Index)</td>
</tr>
<tr>
<td>Emerging market debt</td>
<td>EMBIG (Emerging Markets Bond Index)</td>
</tr>
<tr>
<td>Private Equity</td>
<td>Euro Private Equity Index</td>
</tr>
<tr>
<td>Hedge Funds</td>
<td>Credit Suisse/Tremont Hedge Fund Index</td>
</tr>
<tr>
<td>Commodities</td>
<td>Dow Jones AIG Commodity Index</td>
</tr>
<tr>
<td>High Yields</td>
<td>Merrill Lynch High Yield Master Index II</td>
</tr>
</tbody>
</table>


\(^{13}\) Own figure.

\(^{14}\) Performance in local currency.
3.5 Risk/Return Analysis

On the basis of these data, historical standard deviations and returns are calculated. Normally, higher risk leads to a higher expected return. On the basis of the related data, the figure 2 can be modeled.

The result is very interesting. Several assets exist that are not efficient just looking at an historical risk/return relation. The best example is the Japanese share market. Its performance is negative but the risk is relatively high. The Dow Jones commodity index shows a good risk/return relation. It has only a little bit more risky than US or UK shares, but the expected yield is higher. Euro-shares show a worse relation. Only emerging markets show better results. This leads to the conclusion, that US, UK and Euro shares could be diversified with commodities as the efficiency of this asset class is high.

![Risk/return diagram of the relevant assets](image)

**Figure 2: Risk/return diagram of the relevant assets**

3.6 Diversification Effects

Therefore the correlation effects between commodities and these assets are analyzed. The result is visualized by the figure 3:

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15 Own figure. The monthly volatilities is converted into yearly volatilities by using the formula: 

\[ \sigma_{\text{yearly}} = \sqrt{12} \times \sigma_{\text{monthly}} \]
For very portfolio, the diversification effect is very high. Even the maximal value of 0.28 is relatively low. So the theory that commodities are a good possibility to diversify a portfolio can be stated as true. The following figure shows the possible two stock portfolios resulting from the above mentioned data:

The figure shows possible mixtures of 10% steps into a two stock portfolio. So for every two-stock-portfolio, 11 mixtures are possible. The result is interesting. Even a small part of commodities in the portfolio leads to higher returns and/or a lower risk. Especially in the asset classes Private Equity, Euro shares and Jap-shares, the diversification effect is very high. Jap-shares have a negative return while Private Equity has the highest return of the assets. So the central conclusion is that investing just a small part of the portfolio into commodities will lead to a good diversification. Depending on the asset class, up to 60% of commodities will lead to risk minimized portfolio.

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16 Own figure.
17 Own figure.
Nevertheless the suggestion of the authors is not to invest more than 10 – 20% in a first step as the results depend on a very short historical database and might change during time.

4 CONCLUSION

Finally, it has to be stated that commodities show a good risk/return profile – if historical data are used. Surely, the future cannot be estimated by the history, but the commodities help to diversify each portfolio combination analyzed in this article. The main conclusion and hint is to mix commodities to every portfolio in order to generate the lower risk defined by Markowitz. Private equity, Jap-shares and European shares are the portfolios that can be diversified best. But even all other assets show low correlations so that the diversification effect takes place. But it has to be kept in mind that the results rely on historical data. If the assets will perform different from the past, the results will not be the same.

REFERENCES