



PORTFOLIO DIVERSIFICATION AND EFFICIENT FRONTIER ON EQUITY MARKETS AND COMMODITY

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ABSTRACT

KEYWORDS:

Portfolio, Diversification, Commodities, Gold.

The theory of portfolio diversification has been around for many years. The concept of diversification plays a critical role in the international context. Investors have various options or more precisely asset class to choose on while investing in foreign markets. Inclusion of various asset classes does not ensure efficient portfolio diversification unless there exists negative correlations among the chosen asset class. In the present study, equity/market indices, real estate, and commodities have been chosen as various options for international portfolio diversification. It has been observed not all assets bring maximize returns for portfolio. Among all the commodities chosen gold has been found to contribute to optimal portfolio construction.

INTRODUCTION

Since the arithmetic average return of a portfolio is simply a linear function of the arithmetic average returns of the portfolio constituents, the benefits of diversification lie not in return enhancement, but in risk reduction. Thus, the true benefits of diversification are sensitive to the choice of risk measure.

One of the first definitions of a well-diversified portfolio is the market portfolio. Based on the Capital Asset Pricing Model (CAPM), there are a linear relationship between systematic risk and portfolio return. In this context, the market portfolio exists and consists of all risky assets traded in the market, where each asset is weighted by market value. The market portfolio is deemed as being completely diversified and its risk is non-diversifiable.

Another common way to think about a diversified portfolio is to analyze one that contains a large number of securities. The return variance of a portfolio of a group of securities is lower than the average variance of the individual securities, unless all of the securities are perfectly correlated.

As a risk on and off asset, the issue of using commodities as a diversifier within a portfolio because of their lower volatility has been questioned in recent years. Do commodities provide portfolio diversification? If it does, then how well commodities provide portfolio diversification and how to achieve a balanced portfolio.

LITERATURE REVIEW

Financial globalization has opened the doors of many potential for these days' investors. There are various assets classes namely equity, market indices, real estate,

antiques, commodities etc. Since the market is volatile and investors usually want to avoid risk and maximize their returns hence, so the concept of diversification is of utmost importance to the investors. Investors can reduce their risks and increase profits with the help of diversification. International diversification helps investors to reduce their risks substantially while investing in varying international asset class.

Not all assets bring positive returns for the investors. And also not all assets ensure effective diversification. In order to get the most out of diversification, investors should investment in negatively correlated assets. As the portfolio theory of Harry Markowitz states, investments get positive returns only when they combine negatively correlated assets. Several studies have been performed to see the pattern of returns as well as international portfolio diversification. The benefits of diversification are best achieved with a portfolio consisting of several asset classes that have negative or low correlation between them (Bodie and Rosansky, 1980).

According to the study conducted by Rezayat and Burhan (2006), even though there is inter-dependency among the world's markets, still international portfolio diversification can result in more positive returns. In this study, the focus is on the benefit that investors can reap investing in international markets.

One study has been conducted to see the patterns of gains from international diversification. The study conducted by Campa and Fernandes (2006), country level shocks are less relevant in explaining returns to investments

in emerging markets compared to developed ones. This study focuses mainly on the impact of country risk on stock returns as returns from investment also vary from country to country.

Since there are various asset classes to invest, hence there are varying returns for these varying asset class. Three broad categories of asset classes are equity/market indices, property and commodities. Different studies have been carried out from time to time to study about the returns from various asset classes.

Equity/market index is one of the most widely used asset class. There are many studies explaining the returns from equity/market index from the world markets. The stock markets around the world are not even. Some markets are really big while some are small. Hence, the returns from investing in these markets also vary. As per the study by Bahr and Maas (2014), international investing can play an important role in portfolio diversification and increasing returns in international markets. In their study, they have studied the international equity markets in comparison with US stock market. Also there is also another study by Meric, Gishlick, Taga and Meric (2011) explaining risk, return and diversification in selected bear and bull markets. They have concluded that Malaysia, Japan, U.S., and Switzerland country index funds had the best performance in both markets (bear and bull markets). But, positive returns are only possible only when the economic condition is positive. Investors in international settings usually consider market indices as one of the asset class in their portfolios. So under normal economic conditions, portfolio diversification normally yields positive returns for the investors while during bad economic conditions the returns are badly affected. During crisis period, portfolio benefits decreases and during post-crisis period, portfolio benefits increases (Patev, Kanaryan and Lyrouti, 2006).

The world's real estate market is booming quite surprisingly. And thus has become one of the lucrative options for investing. Returns from investing in real estate/property markets also vary from country to country. Although the world property markets are different, they are integrated globally. Investing in real estate assets, such as buildings, would keep their quality as goods and would also keep a value to better resist shocks and thus allowing an increase of the capital (Maria, 2013). Whatever may be the property type, investors usually focus on maximizing their returns. Investing in property or real estate is also backed up by same notion. Foreign investors dealing with real estate investments usually favor countries with higher property prices (Gholipour Fereidouni and AriffinMasron, 2013).

Commodities have long been used as one of the alternatives for investment. Investing in commodities is actually two-edged sword. Still investors typically include commodities in the portfolio. Investment in the commodity market improves the return of the portfolio and significantly reduces the risk when investing in assets that rise in price with inflation provides a natural hedge against losses in equity and debt holdings that tend to lose value during periods of unexpected inflation. The rise and fall of the commodity prices are due to strong growth and evidence of declining impact of oil on the economy (Blanchard and Galí, 2008; Gregorio, Landerretche and Neilson 2008) requires a greater increase in prices to reduce demand. The extreme increase in oil prices is result of the low sensitivity of the world economy to oil.

Economic growth was biased toward emerging Asia, which demand relatively more food, energy, and commodities in general with some constraints on the supply has changed the relative price. The impact on inflation depends on the degree for pass-through from international prices to domestic prices, and depends to a large extent on the degree of distortions in the price-setting mechanism.

The investment in commodities can be on physical commodities, commodity related stocks and commodity futures. The investment in physical commodities involved high storage costs, the perishable nature of commodities and the seasonal cycles for different commodities. Similarly investment in commodity related stocks, gives the investor an extra exposure to company specific risks such as competencies, trade uncertainties and labor issues. It is the most preferable to purchase and sell commodity futures and include them in the portfolio. Due to high inflation in 1970s the risk and return of a traditional portfolio composed of stocks and bonds had increased with the inclusion of commodities in asset allocation.

There are several studies explaining how inclusions of commodities impact the return from portfolio. The study conducted by Bansal, Kumar and Verma (2014) showed that by introduction of commodities in the portfolios, it can provide an increase in the returns without a corresponding rise in risk. It also proved that with the increase in risk aversion levels of the investor, allocation to commodity future tends to increase.

One study by Jensen, Johnson and Mercer (2002), the long run diversification benefits of commodity futures is a result of the infrequent outburst in the commodity market and these benefits are not conclusive in a bearish commodity environment.

But commodity market also experiences ups and downs. Commodity prices will fall because of relatively inelastic demand and because of the lack of differentiation among producers, which means that the markets are purely competitive. In manufacturing industry, prices can be influenced by producers, while labor costs depend on bargaining and union power, as well as on market conditions, has been repeatedly tested and found valid (Bloch, Sapsford, 2000).

RESEARCH METHODOLOGY

For this study, secondary data have been collected and analyzed representing the returns of ten asset classes. The assets are commodities, real estate, and equity markets from emerging market (KLCI), European market (DAX), developed Asia Pacific markets (NIKKEI) and the Index representing the most technologically advanced companies in the world (NASDAQ).

In constructing efficient portfolios and efficient frontier, Microsoft Solver Analysis has been utilized to find the Minimum Global Variance Portfolio, the Optimal Portfolio and various risk-return efficient portfolio combinations that lie on the efficient frontier.

The Index and Prices used in the under commodity classes are:

1. Industrial Metals : Copper, Aluminum, Iron Ore, Tin, Nickel, Zinc, Lead, and Uranium Price Indices
2. Energy: Crude Oil price
3. Precious Metal: Gold price
4. Agriculture: Crude Palm Oil price

The other six asset classes consist of five countries Stock Market Indexes and a Real Estate Index. These are:

5. Singapore FTSE Real Estate Index
6. Malaysian KLCI Index
7. Hong Kong Hang Seng Index
8. Japan Nikkei Index
9. American Nasdaq Index
10. German DAX Index

For the purpose of the study, the monthly closing price or the monthly closing index data for the last five years, starting from January 2010 and ending on 31st December 2014 have been gathered.

This study aims to answer to important questions. Hence, the research questions are-

- Do commodities provide effective portfolio diversification?
- If so, then how well commodities provide portfolio diversification and how to achieve a balanced portfolio.

RESULT

The Mean (expected) returns and Standard deviation from the mean returns of the ten asset classes are summarized in the table below:

ASSET CLASS	EXPECTED RETURNS	STD DEVIATION
METALS	-0.003192097	0.045979592
CRUDE OIL	-0.002357173	0.05773878
GOLD	0.003473395	0.055963018
CPO	-0.001371756	0.055551834
REAL ESTATE	0.003875165	0.043170381
KLCI	0.008019989	0.068062781
HANG SENG	0.004020518	0.050820598
NIKKEI	0.010536171	0.052685587
NASDAQ	0.014422793	0.043215852
DAX	0.012213795	0.047998096

Table 1: Asset Class Expected Returns and Standard Deviation

Correlation:

	METALS	CRUDE OIL	GOLD	CPO	REAL ESTATE	KLCI	HANG SENG	NIKKEI	NASDAQ	DAX
METALS	1									
CRUDE OIL	0.44996	1								
GOLD	0.23041	0.152045	1							
CPO	0.39038	0.344969	0.06754	1						
REAL ESTATE	0.21254	0.182322	0.203753	0.009388	1					
KLCI	-0.0682	-0.12691	-0.05993	-0.07938	0.15373	1				
HANG SENG	0.25865	0.134858	0.309188	0.059589	0.76632	0.130566	1			
NIKKEI	0.24342	0.08892	-0.16702	0.13912	0.46517	0.011937	0.4651745	1		
NASDAQ	0.20846	0.297312	0.197477	0.164111	0.59668	0.065839	0.6801556	0.600925	1	
DAX	-0.0925	-0.18159	-0.25413	-0.02194	0.08997	0.254021	0.0431412	0.014056	-0.04679	1

Table 2: Correlation between Asset Classes

It can be seen from the correlation table that there are possible diversification benefits that can be gained from combining commodities with stock market indices in a portfolio. For example there are negative correlations between

gold and Nikkei (-0.0167), gold and DAX (-0.254), crude oil and KLCI (-0.1269) and very low correlation between crude oil and Nikkei (0.08892) and CPO and Hang Seng (0.0595).

Table 3: Co-variance between Asset Classes

	METALS	CRUDE OIL	GOLD	CPO	REAL ESTATE	KLCI	HANG SENG	NIKKEI	NASDAQ	DAX
METALS	0.002114									
CRUDE	0.001191	0.003312								
GOLD	0.000593	0.00049	0.003132							
CPO	0.000997	0.001103	0.00021	0.003086						
REAL ESTATE	0.000422	0.000453	0.000492	2.251E-05	0.001864					
KLCI	-0.00021	-0.0005	-0.00023	-0.0003	0.000452	0.00463				
HANG SENG	0.000604	0.000394	0.000879	0.0001682	0.001681	0.00045	0.00258			
NIKKEI	0.00059	0.00027	-0.00049	0.0004072	0.001058	4.3E-05	0.00125	0.0027758		
NASDAQ	0.000414	0.000739	0.000478	0.000394	0.001113	0.00019	0.00149	0.0013682	0.0018676	
DAX	-0.0002	-0.0005	-0.00068	-5.85E-05	0.000186	0.00083	0.00011	3.554E-05	-9.706E-05	0.002304

The co-variance table shows the negatively correlated relationships between some commodities and Stock market indices, for example between industrial metals/DAX, gold/Nikkei, and CPO/KLCI.

Assumptions for Efficient Frontier

An important factor to consider when constructing efficient portfolios and efficient frontier are the assumptions used. The assumptions for our efficient portfolios allocation and efficient frontier calculations are:

1. Short sales are not allowed. (Meaning there will be no negative weights)
2. There is a risk-less lending and borrowing. (There will be a risk free rate)

In this study, Malaysia 3 months Treasury bill rate has been used as risk free rate. (It is assumed a Malaysian investor residing in Malaysia is considering this portfolio of risky assets to invest in, and his/her risk free rate should therefore be the Malaysian risk free rate).

Global Minimum Variance (GMV) Portfolio

The minimum variance (and subsequently) minimum standard deviations that can be achieved by a portfolio consisting of all ten asset classes are as below:

Portfolio Expected excess return	: 0.002987
Portfolio Standard Deviation	: 0.020479
Sharpe Ratio	: 0.145855

Weights of asset classes

METALS	0.114663
CRUDE OIL	0.079308
GOLD	0.126272
CPO	0.091314
REAL ESTATE	0.099795
KLCI	0.077142
HANG SENG	0.025096
NIKKEI	0.088574
NASDAQ	0.099308
DAX	0.198529

The Global Minimum Variance (GMV) Portfolio shows the highest return that can be achieved when the variance and standard deviation of the portfolio is at the minimum. The composition (weights of the asset classes) is as in the table above. The total weight of the portfolio is equal to 1.

Optimal Portfolio

To find the optimal portfolio, composition of weights that maximize the Sharpe ratio has to be found out. Sharpe ratio represents risk-adjusted returns of the portfolio.

It is represented by the expected return of the portfolio minus the risk free rate divided by the standard deviation of the portfolio.

Solver analysis has been utilized to find the different risk-return combination to find the optimal risk-adjusted return. The expected returns have been increased to 0.004, 0.005, 0.006, 0.007, 0.008, 0.009, 0.01 to find the point where Sharpe ratio is at maximum.

As the range of return is increased, the Sharpe ratio also increases. There is however a point where Sharpe ratio starts to decrease. The point where the Sharpe ratio reaches its maximum is where the optimal portfolio has been found.

Here, the Solver function can again be used to find the maximum Sharpe ratio.

In this optimal portfolio where Sharpe ratio is at its peak, the expected return of the portfolio is 0.009874 and the standard deviation is 0.028139. The maximum Sharpe ratio is 0.350919.

Portfolio Expected excess return	: 0.009874
Portfolio Standard Deviation	: 0.028139
Sharpe Ratio	: 0.350919

Weights of asset classes :

METALS	0
CRUDE OIL	0
GOLD	0.0325822
CPO	0
REAL ESTATE	0
KLCI	0.0530353
HANG SENG	0
NIKKEI	0.1129462
NASDAQ	0.4650622
DAX	0.3363741

As it is evident, in the optimal portfolio, only five asset classes are included. These are Gold, KLCI Index, Nikkei Index, Nasdaq Index and DAX Index. The weights of each asset class in this optimal portfolio are as shown above.

Constructing the Efficient Frontier

Efficient Frontier has been constructed using the risk-return combination of efficient portfolios plotted in Table 4 below.

EXCESS RETURNS	0.002987	0.004	0.005	0.006	0.007	0.008	0.009	0.009874	0.01	0.011	0.0115	0.01175
STANDARD DEVIATION	0.020479	0.0206	0.0211	0.0219	0.023	0.0244	0.02601	0.028139	0.0285	0.0325	0.0385	0.04322
SHARPE RATIO	0.145855	0.1937	0.2365	0.2734	0.304	0.3284	0.34607	0.350919	0.3508	0.3383	0.2984	0.27196
METALS	0.114663	0.0903	0.0661	0.0403	0.0145	0	0	0	0	0	0	0
CRUDE OIL	0.079308	0.0666	0.0543	0.041	0.0286	0.0115	0	0	0	0	0	0
GOLD	0.126272	0.1274	0.1286	0.1284	0.1285	0.1261	0.09869	0.032582	0.0231	0	0	0
CPO	0.091314	0.0788	0.0663	0.0536	0.0406	0.0237	0	0	0	0	0	0
REAL ESTATE	0.099795	0.0854	0.071	0.0522	0.0342	0.0117	0	0	0	0	0	0
KLCI	0.077142	0.0776	0.0782	0.0784	0.0784	0.0781	0.07081	0.053035	0.0505	0	0	0
HANG SENG	0.025096	0.0136	0.0023	0.0023	0	0	0	0	0	0	0	0
NIKKEI	0.088574	0.0992	0.1098	0.1192	0.1292	0.1378	0.13476	0.112946	0.1098	0	0	0
NASDAQ	0.099308	0.1437	0.1874	0.2299	0.2724	0.3183	0.38108	0.465062	0.4771	0.6592	0.8856	1
DAX	0.198529	0.2174	0.236	0.2548	0.2735	0.2929	0.31467	0.336374	0.3395	0.3408	0.1144	0

Table 4: Combination of proportion or weights of every asset class in a risk and return matrix.

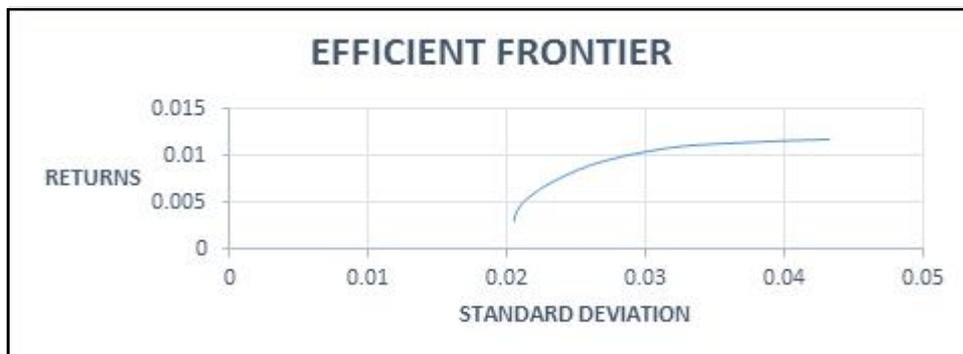


Figure 1: Efficient Frontier

CONCLUSION

In this paper the correlation between commodities and equity markets have been examined. Ten assets from two classes, which are equity and commodity, have been considered. The correlation and return for each of the assets between one to another by using multiple regression analysis have been investigated. Then, by using Microsoft Excel Solver function, efficient portfolios of the ten asset classes have been constructed in order to achieve the efficient frontier.

From the analyzed five years data of the ten different asset classes, it has been observed that commodity and equity either have very low or negative correlation between each other. Hence it is expected commodity price and index would fall upon the rise of equity index, and vice-versa.

However, from the data collected and analyzed for the last five years; only gold commodity at this moment would contribute into the optimal portfolio. This is because other commodities' total and expected returns are negative. Some of these commodities (Industrial metals, crude oil and crude palm oil) are currently experiencing a downward trend period based on this past 5 years.

However, in the future, some of these commodities can be considered for the optimal portfolio as it proven that these commodities are either having very low correlation or negative correlation with the equity markets and would contribute to an overall reduction of risk in a portfolio.

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