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Radosław Kurach
Wroclaw University of Economics

COMMODITIES' USEFULNESS IN A PORTFOLIO CONTEXT – AN EMPIRICAL STUDY

Abstract: By adopting the perspective of a US equity investor, in this study we empirically verify the diversification benefits resulting from investing in commodities. We make an assessment for specified commodity groups using the commodity sector indices. In the employed methodology we focus only on the risk characteristic of the analyzed portfolios. Our results indicate that the diversification potential of different commodity groups is highly cross-varying, however, at any time greater than the risk-reduction possibilities offered by Emerging Markets equities.

Keywords: commodities, emerging market equities, diversification benefits.

1. Introduction

In the contemporary financial world, the rule of free capital flows became a standard that has extended the set of investment opportunities. Keeping in mind the conclusion from the Markowitz [1952] seminal paper nowadays investors may look for uncorrelated assets abroad to diversify portfolio risk. In early studies, international diversification of the equities portfolio was believed to deliver the desired diversification results [Grubel 1968; Levy and Sarnat 1970]. To understand the rationale of international investing we should think about the determinants of equities' valuation. As equities are the means of property rights in the company, which is valued higher whenever it is able to generate higher profit, it is not surprising that stocks' returns are merely driven by business cycle fluctuations. However, due to the information efficiency of the financial markets, equities' valuation reflects the expected state of the economy rather than current macroeconomic conditions. Nevertheless we should think whether the business cycles in the contemporary world are really so different?

In the last twenty years several studies have noted rising business cycle interdependence. Perhaps the most frequently discussed causes were foreign trade deepening [Baxter and Kouparitsas 2004] and the liberalization of capital accounts [Imbs 2003]. The phenomenon of rising business cycle synchronization is

supported indirectly also by the literature confirming the diminishing diversification benefits from international equity investing [Sinquefield 1996; Niemczak 2010], while some of these asset allocation works recommend even a shift in asset allocation paradigm from country to sector diversification strategy [Baca et al. 2000; Brooks and Del Negro 2002].

It is not surprising that investors seek diversification benefits outside the global equity market. That is why commodity assets have grown significantly in investing popularity and numerous studies have reported low correlation with the stock and bond portfolios [Kaplan and Lummer 1998; Greer 2000].

In this study we would like to provide a more precise diversification potential assessment, making two contributions to the existing literature.

First of all, commodities are a rather heterogeneous group of assets, hence we would like to distinguish five different groups in this asset class and verify the diversification potential of each class separately.

Secondly, we base our diversification potential assessment on the portfolio standard deviation analysis, delivering easily interpretable results.

The paper continues as follows. In the next paragraph we start with discussing the fundamentals of commodities investing. We present the variety of commodity assets and discuss the ways of obtaining exposure to commodity price risk. Then we provide some theoretical explanations of business cycle – commodities co-movement and underline these points which make commodities different from stocks and bonds in the discussed area. The next paragraph contains a detailed description of data and methodology. Later we analyse the obtained results and range the diversification potential of different commodity groups. In the last section we make concluding comments and describe a possible direction for further research.

2. Investing in commodities

2.1. Defining *commodities*

Unlike with stocks and bonds, it is not easy to define commodities in a few words as a separate asset class because of its significant heterogeneity. Figure 1 presents the diversity of commodities sectors:

The example commodities for each sector are the following [Fabozzi et al. 2008, p. 8]:

- Energy: Brent Oil, Brent Oil, Crude Oil, Coal, Gas Oil, Heating Oil, Natural Gas, Unleaded Gasoline;
- Industrial Metals: Aluminium, Chrome, Copper, Lead, Mercury, Nickel, Selenium, Tin, Titanium, Zinc;
- Precious Metals: Gold, Iridium, Palladium, Platinum, Osmium, Rhodium, Ruthenium, Silver;

- Livestock: Feeder Cattle, Live Cattle, Live Hogs, Pork Bellies;
- Agriculture Softs: Coffee, Cocoa, Cotton, Orange, Juice, Rubber, Sugar, Silk, Timber, Wool;
- Agriculture Grain & Seeds: Azuki Beans, Barley, Canola, Corn, Millet, Oats, Oilseeds, Red Wheat, Rice, Rye, Sorghum, Soybeans, Soybean Meal, Wheat.

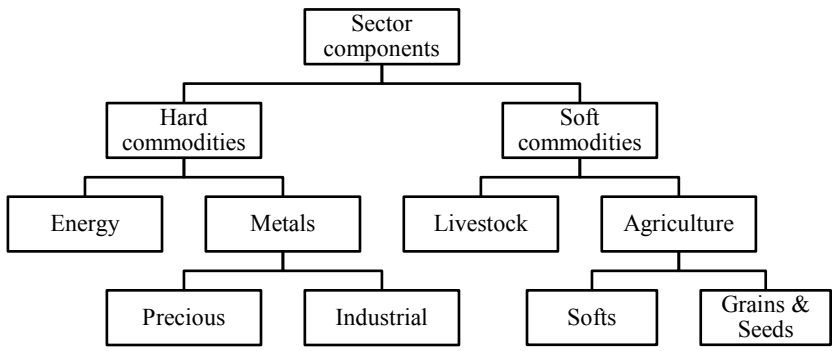

Figure 1. Commodity sectors – general classification

Source: study based on [Fabozzi et al. 2008, p. 8].

Idzorek [2006, p. 4] states that commodities are: "real return, real assets that are part of both the consumable/transformable super asset class and the store-of-value super asset class." Traditionally, by *real assets* investors have recognized tangible assets like commodities or real estates. We should underline that *real return assets* is a broader category spanning *real assets* and identify these investments that are perceived as unexpected inflation hedgers. Besides real assets, real return assets are, for example, Treasury Inflation Protected Securities (TIPS) [Strategic Investment Solutions 2011, p. 2]. The latter part of the *commodities* definition is based on the classification proposed by Greer [1997], who divided investable assets into three large groups (super asset classes): capital assets, consumable/transformable assets and store-of-value assets. In the first group we can find assets providing an ongoing source of value that can be measured by discounting future cash flows. The example assets are stocks, bonds and real estates. The second class consists of assets that do not generate a stream of cash flows, but a single cash flow. Finally, store-of-value assets like fine-art, are not consumed and do not generate income, although they have a monetary value. As we see, commodities fall into two of three distinguished groups as most of them are consumable/transformable, but a few, especially precious metals, may be treated as store-of-value assets at the same time.

2.2. Looking for an exposure to commodity price risk

Exposure to commodity price risk can be obtained in a few ways[1]. We discuss some of them, indicating their advantages and shortcomings.

Purchasing an underlying commodity seems to be the most straightforward method, but at the same time the most problematic. The owner of the physical assets should take into account the transportation and storage costs. The perishable nature of many commodities is also another downside risk for a potential investor. As a matter of fact this way of obtaining exposure is rarely used.

It also makes sense to invest in the equities of commodities related companies. Although we should remember that commodity producers' equities are exposed not only to commodity prices risk but also to broad stock market volatility as the Capital Asset Pricing Model (CAPM) predicts. Additionally the companies may hedge the commodity prices risk using futures contracts which additionally makes equity prices even less exposed to commodity market.

The third and probably the most popular way of obtaining commodities exposure is based on the use of commodity futures contracts. These instruments have more advantages than shortcomings compared to the previously discussed methods. Futures are traded on an organized exchange. This results in transparent pricing, clearinghouse security, uniform contract size and terms, and daily liquidity. Investing in futures contracts does not require automatic delivery of the underlying commodity. The investor needs only to remember about initiating the offsetting position that will close out the position of the initial futures contract. However, if an investor wishes to maintain his/her exposure to commodity prices for a long time without taking physical delivery of the underlying contract, he/she will have to close out his/her existing futures position and re-establish a new position by entering into a new futures contract. Depending on the term structure of the futures prices this process can be costly [Anson 2009, pp. 313-314].

Nowadays also exchange-traded funds (ETFs) have become an available way of gaining commodity exposure. Because of their stock-like features, investors are not required to learn how to trade derivative instruments like commodity futures. This is probably the reason for their increasing popularity among individual investors [Moser 2011].

2.3. Commodities and the business cycle

Theory predicts that commodities react to the business cycle differently than stocks and bonds, hence we should expect potential diversification benefits here. Anson [2009, pp. 329-332] lists three reasons why this might be true.

[1] In this study we mention only some of them, but the reader should be aware that, especially in the case of derivative instruments, there are many more ways of obtaining exposure than the mentioned case of futures contracts.

First of all, inflation usually leads to higher commodities prices, while having a detrimental impact on the stocks and bonds values. Frequently, rising commodity prices are a source of inflation in itself (negative supply shocks).

Secondly, commodities reflect short-term expectations, while stocks and bonds valuation is driven mainly by rather long-term forecasts. For example, rising inflation expectations due to an overheating economy leads to an increased supply of stocks and bonds. On the other hand, commodities should react positively as it indicates a higher demand for raw materials.

The last argument is based on the economic production process. The neoclassical theory states that marginal revenue (price) should equal the marginal cost. Having three factors of production, namely capital, labour, and raw materials, the returns to these three factors should equal the price of production. If we assume sticky wages in the short run, for any given price level an increase in the return to capital must be followed by a decrease in the return to raw material and vice versa. Therefore, capital assets (stocks and bonds) should exhibit a negative correlation with commodities.

3. Data and methodology

In this study we use monthly data for the period 01.2002-12.2011 For equity and commodity indices we calculate monthly logarithmic returns using indices closing values for the last business day of each month. All indices are USD denominated, therefore reflecting the perspective of the US investor.

As a measure of stock market performance we employ two regional price indices provided by Morgan Stanley Capital International, namely: World (WRD) and Emerging Markets (EM). Nowadays, the WRD covers over 6,000 securities in 24 Developed Markets countries[2], spanning large, mid, small and micro-cap securities which can be segmented across styles and sectors. The set of countries included presents the following: in the case of EM the index covers currently over 2,700 securities in 21 markets[3] [MSCI, 2012].

In measuring global equity market performance, we decide to utilize two separate indices rather than one all-country index like MSCI ACWI IMI that covers over 9,000 securities in 45 Developed and Emerging Markets. This division enables us to additionally verify if emerging stock markets still offer the risk-reduction opportunities for global equity investors from the developed markets. In this study we do not analyse the performance of the Frontier Markets, which are

[2] Canada, the United States, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, Australia, Hong Kong, Japan, New Zealand, Singapore.

[3] Brazil, Chile, Colombia, Mexico, Peru, the Czech Republic, Egypt, Hungary, Morocco, Poland, Russia, South Africa, Turkey, China, India, Indonesia, Korea, Malaysia, Philippines, Taiwan, Thailand.

characterized by lower market capitalization and liquidity comparing to Emerging Markets. Because of the mentioned limitations, Frontier Markets are not usually considered as investment opportunities by large institutional investors.

The overall commodity market performance is measured by Standard&Poors Excess Return Goldman Sachs Commodity Index (GSCI). This index is frequently used as a benchmark for commodity investments. The main features of this measure are as follows:

- a world-production weighted index. The quantity of each commodity in the index is determined by the average quantity of production in the last five years of available data;
- to comprise as many commodities as possible. The rules of excluding commodities only to retain liquidity and investability in the underlying futures markets are applied;
- contains 24 commodities from all commodity sectors: six energy products, five industrial metals, eight agricultural products, three livestock products and two precious metals;
- the broad range of constituent commodities provides the GSCI with a high level of diversification, both across sub-sectors and within each sub-sector. Hence, highly idiosyncratic events are minimized [Goldman Sachs 2012].

The GSCI components and Dollar Weights as of October 31, 2011 were as follows:

Table 1. GSCI Dollar Weights (Oct. 31, 2011)

Energy	**69,5**	**Industrial Metals**	**7**	**Precious Metals**	**3,9**	**Agriculture**	**15**	**Livestock**	**4,5**
Crude Oil	32,7	Aluminium	2,2	Gold	3,3	Wheat	2,8	Feeder Cattle	0,5
Brent Crude	16,7	Copper	3,3	Silver	0,5	Kansas Wheat	0,7	Live Cattle	2,7
Unleaded Gasoline	4,6	Lead	0,4			Corn	4,5	Lean Hogs	1,5
Heating Oil	5,4	Nickel	0,6			Soybeans	2,3		
GasOil	7,2	Zinc	0,5			Cotton	1,3		
Natural Gas	2,8					Sugar	2,2		
						Coffee	0,9		
						Cocoa	0,3		

Note: Numbers in percentage points.

Source: the study based on [Standard & Poor's 2012].

It is clear that the energy sector is the dominant driver of GSCI variation, hence the broad GSCI reflects mainly the performance of one sector.

Our target is to verify the diversification potential of different commodity groups. For this purpose we also employ commodity sector specific excess return indices: S&P GSCI Energy (ENERG), S&P GSCI Industrial Metals (INDM), S&P GSCI Precious Metal (PRECM), S&P GSCI Agriculture (AGR), S&P GSCI Livestock (LIVE).

All of the employed time series were obtained from Thomson Reuters Datastream.

There is no single method of assessment of the diversification gain size resulting from adding the specified asset(s) *N* to the existing opportunity investment set of *K* assets. In our study *K* always equals 2 (WRD and EM indices), while *N* would be 1 (one of the commodity indices). However, in the most common approach the change in the risk-return relationship is verified. Bekaert and Urias [1996] compare the improvement in the tangency portfolio's characteristic, which is defined as the one maximizing the ratio

$$\frac{R_p - R_f}{s_p} \rightarrow max, \tag{1}$$

where R_p and s_p denotes the portfolio's expected return and risk respectively, while R_f is a risk free rate.

In this study, we would like to utilize a rather non-mainstream approach and focus our attention only on the rate of risk reduction. We estimate the minimum variance portfolio (MVP) for the set of *K* assets and *K*+*N* assets. Remember that MVP is defined as the portfolio which minimizes the portfolio risk measured by standard deviation:

$$s_p = \sqrt{V_p} = \sqrt{\sum_{i=1}^{N+K} w_i^2 s_i^2 + 2\sum_{i=1}^{N+K-1}\sum_{j=1}^{N+K} w_i w_j s_i s_j \rho_{ij}} \rightarrow min, \tag{2}$$

where w_i denotes the weight of *i*-th asset in the portfolio ($i = 1,..,N+K$), s_i its standard deviation, while ρ_{ij} is the correlation coefficients between returns of assets *i* and *j*. Therefore, we are looking for the set of weights minimizing the portfolio risk.

At first glance this is a rather contradictory view to the modern portfolio theory (MPT) fundamentals, where the diversification benefit can be defined as a reduction in the level of risk for any given level of the expected return. However, following Merton [1980] and Jorion [1985], Petrella [2005] notes that the expected returns are more difficult to estimate than variance. Nowadays this conclusion can be even more meaningful than before because of the global financial market meltdown in the recent years. If we were to estimate the expected returns as the average returns from our sample period, in some of the cases we would find the returns of risky assets lower than the risk free rate or even negative. Clearly, these estimates would seriously flaw MPT, because in such cases risk-averse investors

should not take a long position in risky assets at all. Therefore, comparing only the rate of risk reduction seems to have some theoretical justification.

Finally, we need to mention we set up the investment constraints – lower and upper bounds in portfolio weights. We analyse the case where short sale is not allowed, i.e.:

$$\sum_{i=1}^{N+K} w_i = 0 \text{ and } 0 \leq w_i \leq 1. \quad (3)$$

In many cases, optimization procedure without imposing the "short-sale" constraint would deliver the result where *e.g.* one of the assets would receive a weight over 100%, while the other one would be recommended to be sold heavily getting a weight –50%. Definitely such weights are rather unrealistic in asset allocation policy, therefore this restriction seems to be justified.

4. Empirical results

Assessing the diversification potential of different commodity groups, we start from the general outlook at the data series to make a few remarks regarding time series statistics and the conclusions for risk management process.

Table 2. Indices summary statistics

	WRD	EM	GSCI	ENERG	INDM	PRECM	LIVE	AGR
Mean	5,34%	12,32%	3,61%	4,14%	9,92%	17,3%	–5,00%	–1,12%
Std. dev.	18,51%	25,6%	26,81%	34,12%	25,44%	19,46%	15,78%	24,19%
Skewness	–0,82	–0,78	–1,05	–0,76	–0,63	–0,65	–0,49	–0,32
Kurtosis	2,28	2,28	2,77	1,63	1,98	1,48	0,75	0,38
Jarque-Bera	38,42	35,08	55,56	22,58	24,97	17,6	6,96	2,72
p-value	0,000	0,000	0,000	0,003	0,000	0,000	0,038	0,256

Source: study based on: own study.

The annualized returns vary significantly, from the lowest –5% for Livestock to 17,3% for Precious Metals. These latter results are significantly affected by fears of a Eurozone break-up especially from 2010 and 2011, and Precious Metals are usually considered as "safe-haven" investments.

In cases of normal distribution, the values of skewness and kurtosis statistics should be zero. As is quite common for financial assets returns series, these parameters are mostly far from zero. For all of the analysed time series, skewness is significantly lower than zero, indicating that returns distributions are skewed to the left. On the other hand the values of kurtosis are mostly well above zero. Hence the investigated distributions have a more acute peak around the mean and fatter tails compared to a normal one. This finding indicates that the probability of extreme market moves are higher than normal distribution predicts. Finally, the Jarque-Bera test rejects the null hypothesis on normality at a 1% significance level

for the majority of indices, the only exceptions are LIVE (significant at 5%) and AGR (insignificant).

Now we move to correlation analysis. Before we start to assess the degree of interdependence between variables we need to verify the stationarity of the investigated series. Unless the time series are stationary, we are not able to obtain meaningful sample statistics.

We use two standard tests for this purpose: Augmented Dickey–Fuller (ADF) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS). In the case of the ADF test, a null hypothesis states that the series has a unit root (the variable is not stationary), while null of KPPS states that the variable is stationary. The test statistics for both of the tests are presented in Table 3.

Table 3. Stationarity tests' results

Index / Test	WRD	EM	GSCI	ENERG	INDM	PRECM	LIVE	AGR
ADF	-9,02***	-8,733***	-8,596***	-8,550***	-8,502***	-10,527***	-10,11***	-10,493***
KPPS	0,072	0,1006	0,141402	0,17312	0,128561	0,068716	0,156143	0,036122

Note: *** – significant at 1%, ** – significant at 5%, * – significant at 10%.

Source: study based on: own study.

In the case of all of the analyzed variables, KPPS test statistics are insignificant at 10% value, which strongly supports the null on stationarity. ADF test results lead also to a similar conclusion, rejecting the null hypothesis on unit root is at a 1% significance level for all of the time series. The identified stationarity of the investigated series enables us to run a correlation analysis.

We start from the contemporaneous correlations, which indicate the diversification potential of different assets. Definitely the risk reduction is higher when the correlation coefficient is lower, *ceteris paribus*.

Table 4. Indices correlation matrix

	WRD	EM	GSCI	ENERG	PRECM	INDM	AGR	LIVE
WRD	1							
EM	0,788	1						
GSCI	0,409	0,391	1					
ENERG	0,344	0,310	0,968	1				
PRECM	0,151	0,267	0,292	0,211	1			
INDM	0,471	0,489	0,503	0,392	0,318	1		
AGR	0,317	0,330	0,401	0,226	0,279	0,351	1	
LIVE	0,089	0,058	0,181	0,132	–0,053	0,083	0,0350	1

Source: study based on: own study.

What is especially interesting for us are of course the correlation coefficients between equity market indices and commodities, as we look for the diversifiers of the equity portfolio. In general, the correlation between WRD or EM and GSCI is quite moderate, confirming the stylized fact that commodities exhibit diversification potential. We note also that the risk reduction opportunities of different commodity groups are varying. While the Livestock sector seems to be uncorrelated with equities' performance, Industrial Metals exhibit a positive correlation at nearly a 0.5 level for both developed and emerging markets. Therefore the in-depth analysis of commodities, when they are considered as a rather heterogeneous group, seems to be justified.

The final point of our verification procedure focuses on the estimation of portfolio risk for the sequence of MVPs. Using *Solver*, the MS Excel add-in, we run an optimization procedure as described in (2). First we assess the risk of MVP consisting only of two equity indices. Then we add one commodity index to our opportunity set and repeat the optimization procedure. We run this procedure changing the commodity index every time, hence we estimate the risk of seven portfolios in total (one equity only, and six consisting of two equity indices and one changing commodity index). The results are displayed in Table 5.

Table 5. MVPs risk estimates

	WRD+EM only	GSCI	ENERG	PRECM	INDM	AGR	LIVE
Risk (monthly std. dev.)	5,3615%	5,2433%	5,3311%	4,3161%	5,3092%	4,9829%	3,7247%
Risk reduction (in %. pts)	n/a	–0,1182	–0,0304	–1,0454	–0,0523	–0,3786	–1,6368
*w*WRD	1	0,84	0,94	0,53	0,87	0,71	0,41
*w*EM	0	0	0	0	0	0	0
*w*Com	n/a	0,16	0,06	0,47	0,13	0,29	0,59

Note: each column heading denotes the different portfolio starting from the one which consisted of WRD and EM only. The next columns describe the portfolios which consisted of WRD, EM and one commodity index, whose name is displayed in the heading. 'Risk reduction' denotes a percentage points change in std. dev. between 'WRD+EM only' portfolio and a given portfolio with commodity assets included. The next rows denote the weight of each index in a given MVP portfolio, while *w*Com denotes the weight of changing commodity index.

Source: study based on: own study.

We see that the obtained estimates confirm the general findings based on the correlation analysis. However, now we are able to formulate more precise conclusions regarding the discussed phenomenon:

1. If an investor is oriented toward minimizing risk only, the inclusion of different commodity groups to a well-diversified global equity portfolio may result in a portfolio risk reduction of varying size. Only a minor risk reduction can be

obtained after adding the Energy sector commodities (0.03 percentage point reduction), while on the other hand the most plausible for risk minimizing seems to be the Livestock index (even a 1.64 percentage point reduction). Note that the monthly standard deviation of the MVP equity portfolio is 5.36%.

2. This type of an investor should not include Emerging Market equities into his/her portfolio. EM was found to be highly volatile and, what is more important, also highly positively correlated with developed market equities.

5. Concluding comments

In this paper we delivered empirical proof on the risk-reduction potential of commodity assets relative to a global equity portfolio. What is more important, we noted that the diversification possibilities of different commodity groups were cross-varying. Additionally, we confirmed the stylized fact described in previous literature on rising equity markets co-movement. Therefore nowadays the term "Emerging Market equity" describes rather the assets with higher risk and probably higher expected return, but unfortunately the diversification potential of Emerging Markets relative to Developed Markets equities has been significantly reduced.

The observed phenomena tends to raise some new questions, however. We reported that due to the financial crisis conditions over the last few years, the average returns in some cases were found to be negative. That is why we focused on risk estimates only. It is therefore tempting to make a similar study adding the estimates of expected returns. The commodity assets pricing models topic seems to be rather outside the mainstream asset pricing debate, hence the obtained results would provide valuable conclusions.

Literature

Anson M.J.P., *CAIA Level I. An Introduction to Core Topics in Alternative Investments*, John Wiley & Sons, Hoboken, New Jersey 2009.

Baca S.P., Garbe B., Weiss R.A., *The rise of sector effects in major equity markets*, "Financial Analysts Journal" 2000, September/October, pp. 35-40.

Baxter M., Kouparitsas M.A., *Determinants of business cycle comovement: a robust analysis*, "Journal of Monetary Economics January" 2005, vol. 52, no. 1, pp. 113-157.

Bekaert G., Urias M.S., *Diversification, integration and emerging market closed-end funds*, "NBER Working Paper 1996", no. 4990.

Brooks R., Del Negro M., *Firm-Level Evidence on Globalization*, mimeo 2002.

Fabozzi F.J., Fuss R., Kaiser D.G., *The Handbook of Commodity Investing*, JohnWiley&Sons, Inc., Hoboken, New Jersey 2008.

Goldman Sachs (2012), *S&P GSCI™ Commodity Index Approach*, http://www2.goldmansachs.com/what-we-do/securities/products-and-business-groups/products/gsci/approach.html (as on 10th March 2012).

Greer R., *What is an asset class, anyway*?, "The Journal of Portfolio Management" 1997, vol. 23, no. 2, pp. 86-91.

Greer R., *The nature of commodity index returns*, "Journal of Alternative Investments" 2000, Summer, pp. 45-52.
Grubel H.G., *Internationally diversified portfolios: welfare gains and capital flows*, "The American Economic Review" 1968, vol. 58, no. 5, pp. 1299-1314.
Idzorek T., *Strategic asset allocation and commodities,* "Ibbotson Associates" 2006, March 27.
Imbs J., *Trade, finance, specialization and synchronization*, "Review of Economics and Statistics" 2004, vol. 86, no. 3, pp. 723-734.
Jorion P., *International portfolio diversification with estimation risk*, "Journal of Business" 1985, vol. 58, no. 3, pp. 259-278.
Kaplan P.D., Lummer S.L., *Update: GSCI collateralized futures as a hedging and diversification tool for institutional portfolios*, "The Journal of Investing" 1998, vol. 7, no. 4, pp. 11-17.
Levy H., Sarnat M., *International diversification of investment portfolios*, "The American Economic Review" 1970, vol. 60, no. 4, pp. 668-675.
Markowitz H.M., *Portfolio selection*, "The Journal of Finance" 1952, vol. 7, no. 1, pp. 77-91.
Merton R., *On estimating the expected return on the market: an exploratory investigation*, "Journal of Financial Economics" 1980, vol. 8, Issue 3, pp. 323-361.
Moser D., *Beware Commodity ETFs, "Seeking Alpha" 2011*, http://seekingalpha.com/article/288832-beware-commodity-etfs (as on 10th March 2012).
MSCI, *MSCI Global Equity Indices*, http://www.msci.com/products/indices/ 1245186878016 (as on 10th March 2012).
Niemczak K., *Eastern European equity markets and the subprime crisis. Does emerging Europe still offer diversification benefits?,* "e-Finance" 2010, vol. 6, no. 3, pp. 47-63.
Petrella G., Are euro area small cap stocks an asset class? Evidence from mean-variance spanning tests, "European Financial Management" 2005, vol. 11, no. 2, pp. 229-253.
Sinquefield R.A., *Where are the gains from international diversification?,* "Financial Analysts Journal" 1996, vol. 52, no. 1, pp. 8-14.
Standard & Poor's, S&P GSCI® Index Factsheet, http://www.standardandpoors.com/indices/articles/en/us/?articleType=PDF&assetID=1245186878016 (as on 10th March 2012).
Strategic Investment Solutions, Real Return Assets, "SIS Research Paper" 2011, June.

UŻYTECZNOŚĆ AKTYWÓW TOWAROWYCH W KONTEKŚCIE BUDOWY PORTFELA – STUDIUM EMPIRYCZNE

Streszczenie: Przyjmując perspektywę amerykańskiego inwestora, dokonano empirycznej weryfikacji korzyści dywersyfikacyjnych będących rezultatem inwestycji w aktywa towarowe. Szacunki przeprowadzono osobno dla różnych grup aktywów towarowych, wykorzystując w tym celu dane dotyczące notowań indeksów sektorowych. W przyjętej metodologii skoncentrowano się jedynie na pomiarze ryzyka analizowanych portfeli. Otrzymane rezultaty wskazują, że potencjał dywersyfikacyjny dla poszczególnych grup aktywów towarowych jest znacząco różny, jakkolwiek każdorazowo wyższy niż możliwości redukcji ryzyka przy wykorzystaniu akcji rynków wschodzących.

Słowa kluczowe: aktywa towarowe, akcje rynków wschodzących, korzyści dywersyfikacyjne.