Business and Finance
Society for the Study

International Journal of Finance & Banking Studies *IJFBS*
Vol.4 No.1, 2015 ISSN: 2147-4486
available online at www.ssbfnet.com

Portfolio Diversification with Commodities in Times of Financialization

Adam Zaremba[a]

[a,] *Poznań University of Economics, al. Niepodległosci, 61-875 Poznań, Poland.*

Abstract

The study concentrates on the benefits of passive commodity investments in the context of the phenomenon of financialization. The research investigates the implications of increase in the correlation coefficients between equity and commodity investments for investors in financial markets. The paper is composed of several parts. First, the attributes of commodity investments and their benefits in the portfolio optimization are explored. Second, the phenomenon of the financialization is described and the research hypothesis is developed. Next, an empirical analysis is performed. I simulate the mean-variance spanning tests to examine the benefits of commodity investments before and after accounting for the impact of financialization. I proceed separate analysis for pre- and post-financialization period. The empirical research is based on asset classes' returns and other related variables from years 1991-2012. The performed investigations indicate that the market financialization may have significant implications for commodity investors. Due to increase in correlation coefficients, the inclusion of the commodity futures in the traditional stock-bond portfolio appears to be no longer reasonable.

Keywords: *Commodities, Commodity Futures, Financialization, Mean-Variance Spanning Test, Strategic Asset Allocation.*

1. Introduction

The commodity futures once seemed to be a holy grail of financial investments. Almost a decade ago a few influencing papers documented that commodity investment are able to increase the portfolio expected return and at the same time decrease its risk. The publications were quickly followed by an explosion of various commodity investment vehicles and a huge inflow of money into the commodity markets. This process was later described as the "financialization" (Domanski & Heath, 2007). From this time on, the landscape of the commodity markets has changed profoundly. From the market of refineries, mines and farmers, which it once was, it became a market of hedge funds, exchange traded funds and commodity advisors.

It is still under discussion how the financialization affected the commodity markets. Some researchers suppose that it underwent a deep and structural change.

The financial literature usually indicates emerging of price bubbles (Masters, 2008; Gilbert, 2009, 2010; Einloth, 2009), increased correlation among commodities and with other asset classes (TDR, 2009; Tang & Xiong, 2012; Silvennoinen & Thorp, 2009) and changes in term structure of commodity markets (Schindler, 2007; Mayer, 2010, Tang & Xiong, 2010; Vdovenko, 2013; Brunetti & Reiffen, 2011).

As the phenomenon of the financialization is relatively new, we still do not have firm answers if and how it did change the commodity markets. Additionally, what is the most important from the investors' perspective, we do not know, how it affected the investment conditions and opportunities in the commodity markets.

This paper aims to investigate a single aspect financialization's consequences – the increase in correlation coefficients with the equity market – and assess its implications for the commodity investors. The analysis is performed from the point of view of a traditional US dollar stock and bond investor. In other words, what I try to achieve, is to find an answer to a question, whether after accounting for the changes in the correlation patterns due to the financialization, it still makes sense to invest in commodities.

The paper is composed of several parts. First, I describe the characteristics of commodity investments. I also review the existing literature referring to the benefits of commodity investments. Second, I define the phenomenon of the financialization and develop my research hypothesis. The third section includes description of the research methods employed and the data sources. Next, I present the results of the empirical analysis, which consists of two main stages. In the first stage, I perform the correlation analysis, to assess the impact of financialization on the commodity markets. In the second stage, I simulate mean-variance spanning tests to examine the benefits of commodity investments after accounting for the impact of financialization. The empirical research is based on asset classes' returns and other related variables from years 1990-2012. Finally, the paper ends with the concluding remarks and indication of some areas for further researcha.

[a] The results of the study in this paper were presented at the 5th International Scientific Conference on Economic and, Social Development and 2nd Eastern European ESD-Conference on Social Responsibility - Belgrade, 10-11 April, 2014.

2. Commodities as an Investment Asset

One of the key distinctions of commodities as an asset class is that there is no single way an investor can obtain exposure to them. In practice, there are three basic methods (Idzorek, 2007): direct physical purchase, commodity related stocks, commodity futures.

Each way of the exposures above has different risk and return characteristics. The physical investment is simply not very practical. Some commodities (particularly cattle and agricultural commodities) tend to perish quickly. Even those who do not perish, demand complicated storage and transportation. Actually, the only exceptions are precious metals, like gold or silver. Besides them, direct physical investment is fairly rare.

Commodity related stocks seem rather a part of a broader asset class of equities than commodities. They provide exposure to business skills of managers and specific factors related to companies, which in many cases may even hedge out their equity exposure. Therefore, Gorton and Rouwenhorst (2006) indicate that commodity-related stocks tend to be stronger correlated with equities rather than with commodities. These authors build commodity stocks portfolio based on SIC codes and investigate its behavior during 41 years period. The correlation to a commodity futures index is 0.40, while in case of S&P500 it is 0.57. Moreover, it appears that commodity stocks not only resemble rather equities than commodities, but also deliver lower rates of return and it is not very clear if they are an efficient inflation hedge (Gorton and Rouwenhorst, 2006). Summing up, the portfolio of commodity related stocks is not a satisfactory way to gain exposure to commodities.

The third method, widely recognized as the most appropriate, is a direct investment in a portfolio of commodity futures. It can be done either by hiring a professional portfolio manager (CTA), who will actively manage the portfolio (managed futures) or by taking a passive long position in a commodity index. Further on, I will concentrate on the second way, as it is free from influence of active investment strategies.

The passive index investment is basically a purchase of a fully collateralized commodity futures portfolio, which are systematically rolled when (or before) they mature. The previous research in the field indicates numerous traits of such investments which make them particularly interesting for traditional equity and bond investors: positive skewness of the returns' distribution (Deaton & Laroque, 1992; Armstead & Venkatraman 2007), returns' mean reversion properties, (Sorensen, 2002), hedging properties against inflation (Bodie, 1983; Gorton & Rouwenhorst, 2006; Froot, 1995; Till & Eagleeye 2003a; Till & Eagleeye 2003b; Akey, 2007), long-term positive risk premium (Till, 2007a; Till, 2007b; Till 2007c), and low correlation with traditional asset classes, like stocks or bonds (Ankrim & Hensel, 1993; Becker & Finnerty, 1994; Kaplan & Lummer, 1998; Anson, 1998; Abanomey & Mathur, 2001; Georgiev, 2001; Gorton & Rouwenhorst, 2006).

The two previously mentioned characteristics – low correlation and long term risk premium, which is not fully explained by the behavior of other asset classes - make commodity futures particularly attractive for the strategic asset allocation. This issue has been in the scope of interest of researchers since the '70s in the twentieth century (Till, 2007a), so the literature in the field is relatively rich. The papers below are presented in chronological order.

The initial research focuses on the agricultural market in the USA and do not deliver promising results. Dusak, who in 1973 (Dusak, 1973) analyses listings of singular commodities in years 1962-67, is not able to confirm existence of the positive risk premium. The breakthrough in the field should be subscribed to Greer (1978), who treats commodities as an asset class. Greer shows that a risk associated with commodity investment may be effectively reduced by a full collateralization. Using a price index from years 1960-76 Greer documents that commodity investment performs better than equities, particularly by delivering higher returns with lower drawdowns than equities. Bodie and Rosansky, in their frequently cited paper from 1980 (Bodie & Rosansky, 1980), argue that commodity futures deliver the positive risk premium. They confirmed that the risk premiums was present in 22 out of 23 analyzed markets in years 1950-73, however the statistical significance is rather weak. The reason is probably that the relatively high volatility of single futures, so Bodie and Rosansky perform also similar computations for a commodity index, which provided statistically significant rates of return. Similar results are later delivered by Bodie (1983), Carter et al. (1983), Chang (1985) and Fama and French (1987). Bessembinder (1992) notices that the presence and size of risk premium is dependent on the term structure, and Bjornson and Carter (1997) observed that the premium is correlated with macroeconomic factors: economic activity, inflation and interest rates. The higher risk premiums were historically usually observed when the interest rates were downward sloping, while the downward sloping interest rate curve coincided with the lower premiums. The research of Chong and Miffre (2006) reaches similar conclusions. Kaplan and Lummer (1998) concentrate on fully collateralized investments in S&P GSCI index and finds that the index investment historically achieved higher returns than equities, but at higher risk. The returns in the commodity markets are also in the scope of interest of Greer (2000), Till (2000a, 2000b) and Dunsby et al. (2008).

The more recent research on commodities' risk premium emphasizes the difference between premiums delivered by indices and by single commodities. Garcia and Leuthold (2004) confirmed the risk premium for an index in years 1982-2004, but reached equivocal conclusions concerning single future. Anson (2006) calculated, that commodity portfolios achieved higher returns than bonds and equities in years 1970-2000, but at slightly higher risk. Erb and Harver (2006a) conclude that a confirmation or rejection of the risk premium hypothesis is highly dependent on research data and methodology. An important breakthrough happened in 2004, when a working paper of Gorton and Rouwenhorst was first time published. The article entitled "Facts and Fantasies about Commodity Futures" (Gorton & Rouwenhorst, 2006) is widely recognized as a birth of commodities as an asset class (Rogers, 2007; Authors, 2010). Gorton and Rouwenhorst find the statistically valid risk premium for a 36-commodities index in years 1959-2004. The portfolio performed slightly better than equities, particularly in the risk terms. On the other hand, they are unable to confirm statistically significant rates of return in single markets. The most of later papers confirms the findings of Gorton and Rouwenhorst. Kat and Oomen (2007a) do not prove risk premium for a broad spectrum of 42 commodities in years 1965-2005, and Scherer and He (2008) document risk premiums in years 1989-2006 for Deutsche Bank indices, but not for their constituents. Long-term index returns are also indicated by Hafner and Heiden (2008) in their analysis of years 1991–2006, Fuss et al. (2008) in the analysis of years 2001–2006, and Shore (2008), who observe the S&P GSCI index in years 1969–2006. Positive rates of return higher than these of stocks and bond are also documented by Nijman and Swinkels (2008), but the authors notice, that the volatility was historically higher than in

case of the traditional asset classes. The risk premiums in commodity markets are also analyzed by Gorton et al. (2012).

Another important field in the commodity research is the diversification properties and their benefits in portfolio context. Probably the first scientific analysis of this kind is performed by Greer in 1978. In his pioneer work (Greer, 1978) Greer proves, that the rebalanced portfolio of commodities, stocks and bonds delivers more stable and higher rates of return than pure bond-stock portfolio. Bodie and Rosansky (1980) notice, than allocation of 40% of portfolio to commodity future decreases risk while simultaneously increasing expected returns. Similar conclusions concerning benefits of commodity investing, are later reached by Jaffe (1989), Satyanarayan and Varangis (1994), Froot (1995), Kaplan and Lummer (1998) Fortenberry and Houser (1990), Jensen et al. (2000), Woodard et al. (2006) ,Anson (2006). Idzorek (2006) in calculations performed for Ibbotson Associates proves that commodities are weakly correlated witch stocks and bonds, because they are correlated to inflation, which is not true in case of stocks and bonds. Kat and Oomen (2007a) present that allocation of a part of portfolio to GSCI improves the portfolio's Sharpe ratio, and Woodard (2008) documents that commodities in years 1989-2006 delivered positive risk premium, which could not be explained by returns of stocks or bonds. The shift in efficient frontier due to commodity allocation was indicated also by Scherer and He (2008) and Shore (2008). Finally, a paper of Heidon and Demidova-Manzel (2008) is one of the most interesting among the newest research. Both authors analyze return patterns of portfolio made of equities, sovereign and corporate bonds and real estate in years 1973-97, and conclude that investors should allocate between 5% to 36% proc. of their portfolio to commodities. Among the most recent researches, the benefits of commodities in the context of strategic asset allocation were also documented by Doeswijk et al. (2012) and Bekkers et al. (2012).

3. Financialization of Commodity Markets

Recent years brought a massive influx of money into commodity related products. It is said that at least 100 billion dollars moved into commodity futures markets during years 2004-08 (Irwin & Sanders, 2011). Trading volume increased dramatically, and the presence of financial investors was constantly increasing. According to Zaremba (2014a), the participation of non-commercial traders has increased from 23% in 1986 to 45% in 2013. Domanski and Heath (2007) coined term the "financialization" to describe the growing presence and importance of financial institutions in the commodity markets. The changes don't seem to be temporal, but rather structural (Irwin & Sanders, 2012).

It seems rather rational to suppose, that such profound changes could have somehow altered the way the commodity markets work. A lot of research has been done in this field. Recent papers pointed a few structural changes, that could took place in the commodity markets as the result of financialization: emerging of price bubbles (Masters 2008, Gilbert 2009, 2010, Einloth 2009), increased correlation among commodities and with other asset classes (TDR 2009, Tang and Xiong 2012, Silvennoinen and Thorp 2009), changes in term structure of commodity markets (Schindler,

2007; Mayer, 2010; Tang & Xiong, 2012; Vdovenko, 2013; Brunetti & Reiffen, 2011; Zaremba, 2014b), and disturbed relations with macroeconomic variables (Zaremba, 2014c).

In this paper I concentrate on a single particular aspect of the financialization: the increase in correlation coefficients with equities. Numerous publications on benefits of investing in commodities and their diversification properties triggered a surge in popularity of commodity-related investments among institutional investors: investment funds, retirement funds and university endowments. The phenomenon is nicely depicted by the famous example of the Harvard University Endowment (Faber & Richardson, 2009). The allocation to commodities in years 1995-2010 increased over twice. The result of the increased presence of financial investors in the commodity markets may be some rise in correlation with traditional asset classes and lower diversification properties, than it is often suggested in popular research (Büyüksahin et al., 2008; Chong & Miffre, 2008).

There are two primary mechanisms which may lead to the soar in correlation. The first of them functions at the strategic allocation level and the other on the tactical allocation level. When the increasing number of investors has similar investment portfolios allocated to stocks, bonds and commodities, and the investors try to keep more or less stable asset allocation structure, then the external shocks resulting in capital outflows will enforce selling of all the asset classes in the portfolio. On the other hand, the capital inflows will result in the bigger demand for all the asset classes (Kyle & Xiong, 2001). As the result, the external shocks affecting stocks will also affect commodities, so the correlation will rise. What is more, in many papers the commodities are described as an asset class which benefits from the economic growth (Strongin & Petch, 1995; Strongin & Petch, 1996; Gorton & Rouwenhorst, 2006; Armstead & Venkatraman, 2007; Kat & Oomen, 2007a; Kat & Oomen, 2007b). It this way, that makes them similar to equities, so the demand for equities may be somehow synchronized with the demand for commodities. It may be an additional factor contributing to the correlation.

Increased correlation is documented in the paper of Tang and Xiong (2012). Similar conclusion are drawn by Silvennoinen and Thorp (2009), who analyzed correlations between 24 commodities an equity indices in the USA, Great Britain, Germany and France. The computations are based on weekly data from the period May 1990 - July 2009. The research indicates growing cointegration of various asset classes, even after accounting for various external factors, like changes in volatility. The increase in intra-asset class correlation is also investigated and documented in papers of Tang (2011), Inamura et. al. (2010), Oztek and Ocal (2013), Dwyer et al. (2011), and Bhardwaj and Dunsby (2013).

4. Data and Research Design

In the empirical analysis in this paper I try to investigate whether commodities as an asset class are still beneficial in a portfolio context after taking into account for the increase in the correlation. Therefore, I simulate mean-variance spanning tests with and without potential changes. The mean-variance spanning test is designed to verify whether inclusion of an asset class into portfolio results in expanding investor's efficient frontier. The test was initially proposed by Huberman and Kendel (1987), and later developed by for example Ferson et al. (1993), DeSantis (1993)

and Bekaert and Urias (1996). Additionally Jobson and Korkie (1988) as well as Chen and Knez (1996) showed, that such test could be used to asses investment performance, and DeRoon, Nijman and Werger (2001) proved, that the test may be used for non-marketable assetsb. Finally, there are many examples of mean-variance spanning test performed in the context of the commodities.

Let K denotes the set of benchmark assets with rates of return R1t, and N are the tested assets with rates of return R2t. Then, the formal test (the notation of Kan and Zhou (2001)) based usually on a simple OLS regression looks as follows (Kooli, 2006):

$$R_{2t} = \alpha + \beta R_{t1} + \xi_t, \quad t = 1, 2, ..., T \ , \tag{1}$$

where the null hypothesis of mean-variance spanning is that:

$$H_0 : \quad \alpha = 0_N, \quad \delta = 1_N - \beta 1_K = 0_N, \tag{2}$$

where0N is defined as N-element vector of zeros. Kooli (2006) notices, that the test may be divided into two stages. The first stage is the verification of the shift of the tangency portfolio. If the tangency portfolio is moved, than an investor is able to build better optimal portfolios composed of risk-free asset and the tangency portfolio. It is worth noticing, that the improvement in the tangency portfolio is actually the improvement in the Sharpe ratio.

The aim of the mean variance spanning test in this paper is to examine, whether inclusion of commodities expands the efficient frontier of traditional portfolio composed of stocks and bonds. The test is made from the perspective of an US investor, so it encompasses dollar denominated assets. The equities as an asset class are represented by Wilshire 5000 Total Market and the proxy for US government bonds is Bloomberg/EFFAS US Government Bonds All 1+. The JP Morgan Commodity Curve Index is used as the commodity portfolio. There are now many indices available, however JPM CCI is chosen due to several reasons. Firstly, it is dated back to December 1989, so it represents relatively long time series. Secondly, it is calculated in total, excess and spot return convention. Thirdly, it avoids a common front-run bias, because it exposes an index investor to a full commodity curve. Fourthly, its constituents are weighted according to open interests, which seem to be a good representation of investors' universe. Finally, it does not assume any sophisticated active portfolio allocation methods that could distort the pure returns to commodities as an asset class. All the indices are calculated in a total return regime. Additionally, USD BBA 1-month Libor is used so as to calculate excess returns over the risk-free asset (interpreted as the risk premium). All the data comes from Bloomberg and encompasses time-series 12/31/1991-12/31/2012, so from the very beginning all three indices are calculated. I compute arithmetical rates of return on a monthly basis.

In this paper I test the mean-variance spanning in two ways: using traditional OLS regression and with help of Monte Carlo analysis. The details of both methods are described below.

[b] A nice review of mean-variance spanning tests could be found in a paper by DeRoon and Nijman (2001).

Most of mean-variance spanning test are based on total rates of return. In such case, it is rational to assume, that expositions to various asset classes should sum up to 1. However, in this research, I use risk-premiums defined as excess returns over money market. The regression model looks as follows:

$$R_{it} - c_t = \alpha_i + \sum_{k=1}^{K} \beta_{ik} \times (R_{kt} - c_t) + \varepsilon_{it} \ , \qquad (3)$$

where Rit is the return on the examined asset class' (commodities), ct denotes money-market return in month t, and Rkt is k-asset's rate of return (stocks and bonds). If α, as specified in the model above, turns out to be statistically different from and higher than 0, one can say, that i constitutes a distinct asset class that generates its own risk premium. However, if that does not hold true, than an investor can probably replicate i's returns without bearing higher risk or losing some of return.

This method is consistent with remarks of Anson (2009) and Scherer and He (2008), and was used in the commodity market for instance by Nijman and Swinkels (2008). The risk premium approach appears to be reasonable due to at least three reasons. Firstly, it does not imply, that the betas need to sum up to 1. Missing allocation can be filled with cash, or negative cash in case of leverage. Secondly, it makes the graphical interpretation and further analysis easier, because the tangency line of the tangency portfolio comes out from the origin of the coordinate system. Finally, it seems more practical as it corresponds with employing futures contracts in order to gain exposition to particular asset classes.

The main problem with the asset traditional OLS regression in case of commodities is that the return distribution of commodities seems to be far from normal (Anson, 2009; Gorton & Rouwenhorst, 2006; Erb & Harvey, 2006). In consequence, due to skewed distributions and fat-tails, the standard deviation may underestimate the true risk level. The problem is further explored by Johaning et al. (2006). Some papers in the field suggest taking into account also higher moments in the process of portfolio analysis (Arditti & Levy, 1975; Markowitz, 1952; Samuelson, 1970; Harvey et al., 2004; Cvitanic, 2005; Fang & Lai, 1997; Dittmar, 2002).

Therefore, in the second way I test the mean-variance spanning using a simulation approach. As the risk measure, I use the modified value at risk (MVaR) proposed by Favre and Galeano (2002):

$$MVaR = \mu - \left[z_c + \frac{1}{6}\left(z_c^2 - 1\right)S + \frac{1}{24}\left(z_c^3 - 3z\right)K - \frac{1}{36}\left(2z_c^3 - 5z_c\right)S^2 \right]\sigma \ , \qquad (4)$$

where μ denotes the mean return, σ is the standard deviation, S is skewness, K is kurtosis, and zc is the number of standard deviations appropriate for the calculated VaR. The MVaR is analytical in its character, but thanks to VaR Cornish-Fisher expansion (Cornish & Fisher, 1937) it better approximates distributions different from normal. Using

MVaR is consistent with investor's approach, who prefers distributions with positive skewness and low kurtosis (Scott & Horvath, 1980; Pratt & Zeckhauser, 1987)[c].

So in the second approach, I proceed the statistical analysis as follows. First, I resample 10 000 times the panel data encompassing four time-series of monthly arithmetical returns, which included JP Morgan Commodity Curve Total Return Index, Wilshire 5000 Total Markets, Bloomberg/EFFAS US Government Bonds All 1+ and USD BBA 1-month Libor. Second, for each resampling, I compute three monthly risk-premiums' time series, which are differences between returns asset class' indices and preceding month-end's Libor. Third, in each case I find the risk-return efficient frontier based on excess frontier for stocks and bonds the MVaR as the proxy for risk. I assume long only investors which uses no leverage. Fourth, I add the commodities to the asset class' universe and find the efficient frontiers for all the three asset classes. Fifth, I calculate the tangency portfolios' Sharpe ratios[d] for both efficient frontiers. It is worth noting, that in the case of the MVaR approach, it is actually a measure called modified Sharpe ratio, which was described by Bacon (2008, p. 102). Sixth, I compute the improvement in Sharpe ratios, as the difference between the values after and before the commodity inclusion. As I noted this before, in the case of excess return framework (or in other words: risk premium framework), the improvement in the maximum achievable Sharpe ratio is actually equal with the mean-variance intersection. So seventh, I calculated the percentage of resampled efficient frontiers (out of 10.000), which involved Sharpe ratio's improvement. The percentage of the cases, in which the Sharpe ratios did not increased, is my p-value.

Finally, all the analysis above is performed for three time-frames. First, for the full research period 1991-2012. Second, for the period of the low correlation ending in December 2004. Third, for the high correlation period beginning in January 2005. The dates are chosen intentionally, as the year 2004 is a symbolic breakthrough, it was the year when "Facts and Fantasies about Commodity Futures" were published for the first time. Finally, it is important to point out that the average monthly returns in the sample subperiods are demeaned and then adjusted in order to equalize them with the full sample period. Thanks to this operation, the mean-variance simulation will emphasize the changes in the covariance matrix, while ignoring the changes in expected rates of return.

5. Results and Discussion

Figure 1 represents the 5-year rolling correlation between monthly returns of equities and commodities along with its volatility bounds. The computations are based on monthly returns. One can see, that the correlation was clearly steadily increasing in the recent years.

[c] Some examples of alternative investments' analysis with the MVaR can be found in papers by Lamm (2003), Signer and Favre (2002), Amenc *et al.*,(2005), Kooli (2006), Coste *et al.,* (2011).
[d] The tangency portfolios are characterised in this case by the maximum attainable Sharpe ratios.

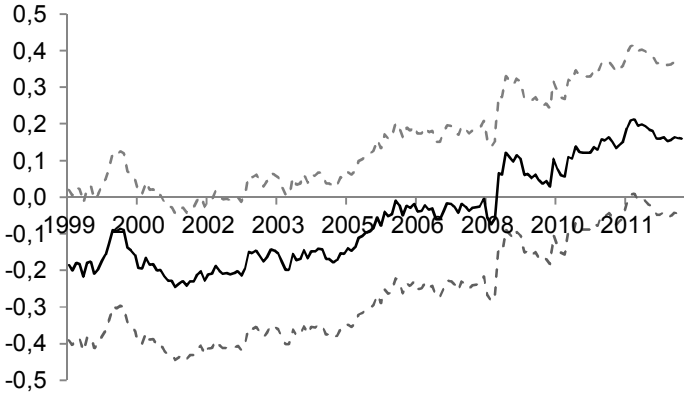

Figure 1. The correlation between equity and commodity returns in years 1991-2012.

Source: author's elaboration based on data from Bloomberg.

Figure 2 depicts the shift of the efficient frontier due to inclusion of the commodities based on raw historical data 1991-2012. The efficient frontier is "pushed" upward and leftward after inclusion of the commodities both in the mean-variance approach and in the mean-MVaR approach. This effect is even stronger in the pre-financialization period (Figure 3). If we look at the years 1991-2004, the expansion is actually more visible.

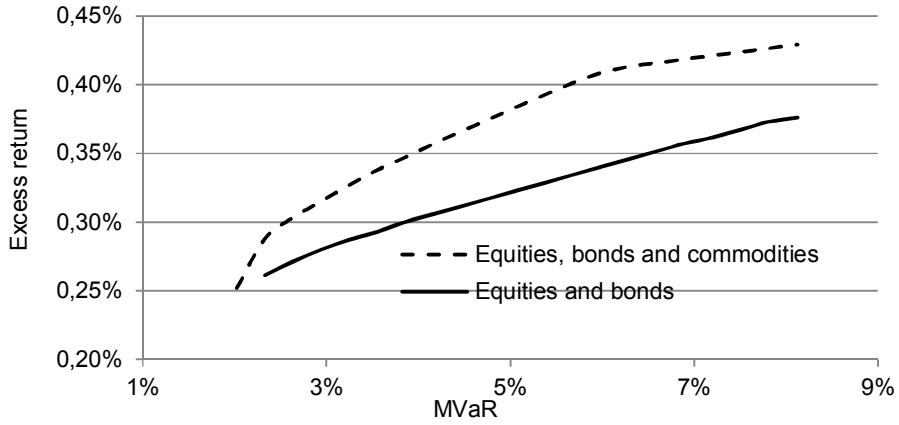

Figure 2. Commodity investments and the shift of the efficient frontier: years 1991-2012.

Source: author's elaboration based on data from Bloomberg.

However, this conclusion does not entirely hold true after accounting for the impact of financialization. As one can see in the Figure 4, the commodities offer not much better investment opportunities. The frontier is shifted only a little.

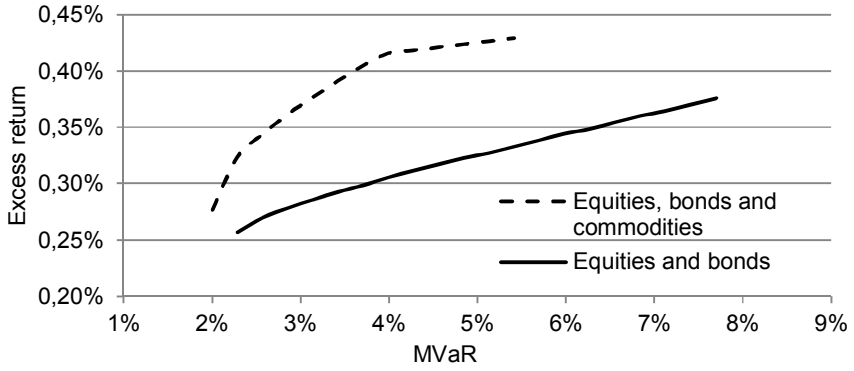

Figure 3. Commodity investments and the shift of the efficient frontier: years 1991-2004.

Source: author's elaboration based on data from Bloomberg.

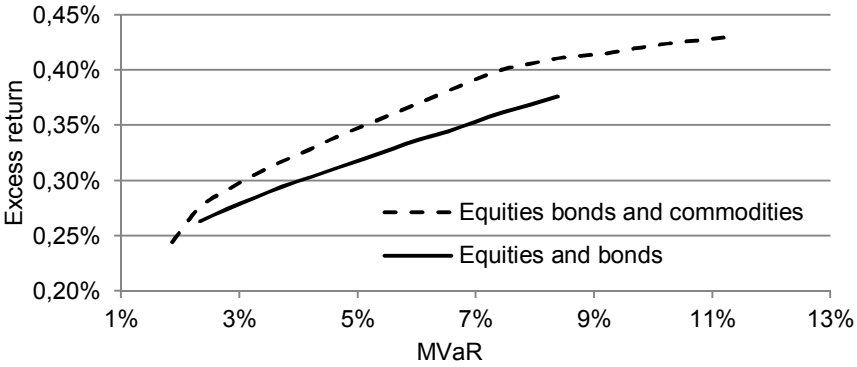

Figure 4. Commodity investments and the shift of the efficient frontier: years 2005-2012.

Source: author's elaboration based on data from Bloomberg.

Table 1 presents the results of mean variance spanning test analysis using the regression approach described in the previous section. The results generally confirm, what can be concluded from the mean-variance approach graphical analysis. Before accounting for the impact of the financialization, the intercept was positive and statistically significant at 5% level. It even remains so, when we look at the entire analyzed period. However, after accounting for the changes, the intercept is still positive, but not statistically significant at any reasonable level. In other word, the benefits of the commodity futures in the traditional stock-bond portfolio cannot be still confirmed.

Table 1. The Mean-Variance Spanning Test: the OLS Approach

	1991-2012	1991-2004	2005-2012
intercept	0.005	0.005	0.007
	(1.722)*	(1.973)**	(1.11)
stocks	-0.351	-0.116	0.202
	(-1.604)	(-1.821)*	(1.525)
bonds	0.005	0.112	-1.192
	(0.074)	(0.548)	(-2.608)***
N	252	156	96
adj. R^2	0.002	0.011	0.067
F-test	1.292	1.876	4.426

Note. The symbols *, **, and *** denote the statistical significance at the 10%, 5% and 1% levels. Source: author's elaboration based on data from Bloomberg.

The observations above are confirmed by the results of the Monte Carlo analysis. The Table 2 presents the results of the Monte Carlo simulations for the sample. The distributions of Sharpe ratios increases indicate, that in both approaches (variance and MVaR) the maximum attainable Sharpe ratio is significantly increased. Only 7.4% in case of draws the Sharp ratio does not go up. The situation changes when I split the sample into the two subsamples. Although the benefits in portfolio optimization are strongly emphasized in the pre-2005 period (4%), this is definitely not true after taking account the impact of financialization. As we can see, in 22.2% of MVaR draws, the investor opportunity set is not improved.

Table 2. *P*-values in the Monte Carlo Aapproach.

	1991-2012	1991-2004	2005-2012
p-value	7.40%	4.00%	22.20%

Note Source: author's elaboration based on data from Bloomberg.

Summing up, it seems, that after taking into account the impact of financialization, one cannot firmly state, that in the risk-return framework it still make sense to invest some share of a stock-bond portfolio in commodities.

6. Conclusions and Areas for Further Research

In this paper I focused on the benefits of passive commodity investments in the context of financialization. The increase of the correlation comes not without an impact on the question whether some part of an investment portfolio should be allocated to the commodities. The mean-variance spanning tests show that what were true 10 or 20 years ago, may not bet true right now. Because of the soaring correlations, the inclusion of the commodity futures in the traditional stock-bond portfolio appears to be no longer reasonable. In other words, due to the process of commodity markets' financialization, the benefits of commodity investments in the portfolio context may not be valid anymore.
The paper's analysis bears two important implications for market practitioners. First of all, commodity investments may be not beneficial in the high-correlation environment, but still they may turn attractive if roll yields enter their positive territory anew. Second, investors should explore carry-, volatility-, and momentum- based strategies at the strategic level of asset allocation, as the pure passive investment may be no longer beneficial.

Any further research shall focus on several issues. First, it would be valuable to identify the precise factors that may influence the level of correlation, with the aim to assess the impact of financialization in a much more precise way. Second, from perspective of practitioners, it would be useful to explore the extent to which employing some specific commodity indices or pursuing active strategies may mitigate the negative impact of financialization. Finally, also the impact of other phenomena related to financialization, such as changes in the term structure or inflation hedging abilities, should be examined.

References

Abanomeyn W.S. & Mathurn I. (2001). Intercontinental Portfolios with Commodity Futures and Currency Forward Contracts. *Journal of Investing*, 10 (3), 61–68. http://dx.doi.org/10.3905/joi.2001.319474

Akey, R.P. (2007). Alpha, Beta, and Commodities: Can a Commodities Investment be Both a High-Risk-Ajdusted Return Source and a Portfolio Hedge?. In H. Till, J. Eagleeye (eds.)., *Intelligent Commodity Investing: New Strategies and Practical Insights for Informed Decision Makings*, London, Risk Books, 377–417.

Ankrim, E.M. & Hensel, C.R. (1993). Commodities in Asset Allocation: A Real-Asset Alternative to Real Estate? *Financial Analyst Journal*, 49 (3), 20–29. http://dx.doi.org/10.2469/faj.v49.n3.20

Anson, M.J.P. (1998). Spot Returns, Roll Yield and Diversification with Commodity Futures, *Journal of Alternative Investments*, 1 (3), 16-32. http://dx.doi.org/10.3905/jai.1998.407861

Anson, M.J.P. (2006). *Handbook of Alternative Investments*, Hoboken, John Wiley & Sons.

Arditti, E.D. & Levy, H. (1975). Portfolio Efficiency Analysis in Three Moments: The Multiperiod Case, *Journal of Finance*, 30 (3), 797–809. http://dx.doi.org/10.1111/j.1540-6261.1975.tb01851.x

Armstead, K.J. & Venkatraman, R. (2007). Commodity Returns - Implications for Active Management. In H. Till, J. Eagleeye (eds.)., *Intelligent Commodity Investing: New Strategies and Practical Insights for Informed Decision Makings*, London, Risk Books, 293–312.

Authers, J. (2010). *The Fearful Rise of Markets*. Upper Saddle River, FT Press.

Bacon, C.R. (2008). *Practical Portfolio Performance Measurement and Attribution.* Chichester, John Wiley.

Basu, D. & Miffre, J. (2013). *Capturing the Risk Premium of Commodity Futures: The Role of Hedging Pressure.* EDHEC Working Paper.

Becker, K.G. & Finnerty, J.E. (1994). *Indexed Commodity Futures and the Risk of Institutional Portfolios.* OFOR working paper (94–02, January.

Bekaert, G. & Urias, M.S. (1996). Diversification, Integration and Emerging Market Closed-end Funds, *Journal of Finance*, 51 (3), 835. http://dx.doi.org/10.2307/2329224

Bekkers, N., Doeswijk, R.Q., & Lam T.W. (2009). Asset Allocation: Determining the Optimal Portfolio with Ten Asset Classes. *The Journal of Wealth Management*, 12 (3), 61-77. http://dx.doi.org/10.3905/jwm.2009.12.3.061

Bessembinder, H. (1992). Systematic Risk, Hedging Pressure and Risk Premiums in Futures Markets. *Review of Financial Studies*, 5 (4), 637–667. http://dx.doi.org/10.1093/rfs/5.4.637

Bhardwaj, G. & Dunsby, A. (2013). Of Commodities and Correlations, Journal of Indexes, online: http://www.indexuniverse.com/publications/journalofindexes/joi-articles/19085-of-commodities-and-correlations.html?showall=&fullart=1&start=6.

Bjornson, B. & Carter, C.A. (1997). New Evidence on Agricultural Commodity Return Perfomance under Time-Varying Risk. *American Journal of Agricultural Economics,* 79 (3), 918–930. http://dx.doi.org/10.2307/1244432

Bodie, Z. & Rosansky, V.I. (1980). Risk and Return in Commodity Futures, Financial Analyst Journal, 36 (3), 27–39. http://dx.doi.org/10.3905/jpm.9.3.12

Bodie, Z. (1983). Commodity Futures as a Hedge against Inflation, Journal of Portfolio Management, 9 (3) , 12–17.

Brennan, M.J. (1991). The Price of Convenience and the Valuation of Commodity Contingent Claims. In D. Land, B. Oeksendal (eds.)., *Stochastic Models and Options Values.* Elsevier Science Publications.

Brunetti, C. & Reiffen, D. (2011). *Commodity Index Trading and Hedging Costs, Division of Research & Statistics and Monetary Affairs*. Washington D.C., Federal Reserve Board.

Büyüksahin, B., Haigh,M.S., & Robe, M.A. (2008). *Commodities and Equities: A Market of One?* Working paper, Commodity Futures Trading Commission.

Carter, C.A., Rausser, G.C., & Schmitz A. (1983). Efficient Asset Portfolios and the Theory of Normal Backwardation, Journal of Political Economy, 91 (2), 319–331. http://dx.doi.org/10.1086/261215

Chang, E.C. (1985). Returns to Speculators and the Theory of Normal Backwardation, *Journal of Finance*, 40 (1), 193–208. http://dx.doi.org/10.1111/j.1540-6261.1985.tb04944.x

Chen, Z. & Knez, P.J. (1996). Portfolio Performance Measurement: Theory and Applications. *Review of Financial Studies*, 9 (2), 511-555.

Chong, J. & Miffre, J. (2006). *Conditional Risk Premia, Volatilities and Correlations in Commodity Futures Markets.* Working Paper, http://www.edhec-risk.com/edhec_publications/RISKReview.2007-03-30.4614?newsletter=yes.

Cornish, E.A. & Fisher, R.A., 1937, Moments and cumulants in the specification of distributions. *Review of the International Statistical Institute*, 5 (3), 307–320. http://dx.doi.org/10.2307/1400905

Cvitanic, J., Polimenish, V. & Zapaterox, F. (2005). *Optimal Portfolio Allocation with Higher Moments.* Working paper, http://people.hss.caltech.edu/~cvitanic/PAPERS/Optlevy11.pdf.

De Roon, F.A., Nijman, T.E., & Werker, B.J.M. (2001). Testing for mean-variance spanning with short sales constraints and transaction costs: the case of emerging markets. *Journal of Finance*, 56 (2), 721-742. http://dx.doi.org/10.1111/0022-1082.00343

Deaton, A. & Laroque, G. (1992). On the Behavior of Commodity Prices. Review of Economic Studies, 59, 1-23.

DeRoon, F.A. & Nijman, T.E. (2001). Testing for Mean Variance Spanning: A Survey. *Journal of Empirical Finance*, 8 (2), 111-155. http://dx.doi.org/10.1016/s0927-5398(01)00022-6

DeSantis, G. (1993). *Volatility bounds for stochastic discount factors: tests and implications from international financial markets*. Unpublished working paper, University of. Southern California.

Dittmar, R.F. (2002). Nonlinear Pricing Kernels, Kurtosis Preference, and Evidence from the Cross Section of Equity Returns. *Journal of Finance*, 57 (1), 369-403. http://dx.doi.org/10.1111/1540-6261.00425

Doeswijk, R.Q., Lam, T.W. & Swinkels, L.A.P. (2012). *Strategic Asset Allocation: The Global Multi-Asset Market Portfolio 1959-2011.* Working paper, SSRN.

Domanski, D. & Heath, A. (2007). Financial Investors and Commodity Markets. Bank of *International Settlements Quarterly Review*, 53-67.

Dunsby, A., Eckstein, J., Gaspar, J., & Mulholland, S. (2008). *Commodity Investing. Maximizing Returns through Fundamental Analysis*, Hoboken, John Wiley & Sons.

Dusak, K. (1973). Futures Trading and Investor Returns: An Investigation of Commodity Market Risk Premiums. *Journal of Political Economy*, 81 (6), 1387–1406. http://dx.doi.org/10.1086/260133

Dwyer, A., Gardner, G., & Williams, T. (2011). *Global Commodity Markets – Price Volatility and Financialisation*. Reserve Bank of Australia Bulletin, June, online: http://www.rba.gov.au/publications/bulletin/2011/jun/pdf/bu-0611-7.pdf.

Einloth, J.T. (2009). *Speculation and Recent Volatility in the Price of Oil*. FDIC working paper.

Erb, C.B. & Harvey C.R., (2006b). *Unconditional Alpha*. Working paper, Duke University.

Erb, C.B. & Harvey, C.R. (2006a). The Tactical and Strategic Value of Commodity Future. *Financial Analysts Journal*, 62 (2), 69–97. http://dx.doi.org/10.2469/faj.v62.n2.4084

Faber, M., & Richardson, E. (2009). *The Ivy Portfolio: How to Invest Like the Top Endowments and Avoid Bear Markets*, New York, Wiley.

Fama, E.F. & French, K.R. (1987). Commodity Futures Prices: Some Evidence of Forecast Power, Premiums, and the Theory of Storage. *Journal of Business*, 60 (1), 55–73. http://dx.doi.org/10.1086/296385

Fama, E.F. & French, K.R. (1988). Business Cycles and the Behavior of Metals Prices. *Journal of Finance*, 43 (5), 1075-1093. http://dx.doi.org/10.1111/j.1540-6261.1988.tb03957.x

Fang, H. & Lai, T.Y. (1997). Co-Kurtosis and Capital Asset Pricing. *Financial Review*, 32 (2), 292–307. http://dx.doi.org/10.1111/j.1540-6288.1997.tb00426.x

Favre, L. & Galeano, J. (2002). Mean-modified Value-at-Risk Optimization with Hedge Funds. Journal of Alternative Investments, 5 (2), 21-25. http://dx.doi.org/10.3905/jai.2002.319052

Ferson, W., Foerster, S.R., & Keim, D.B. (1993). General tests of latent variable models and mean-variance spanning. Journal of Finance, 48 (1), 131-156. http://dx.doi.org/10.1111/j.1540-6261.1993.tb04704.x

Froot, K.A., 1995, Hedging Portfolios with Real Assets. Journal of Portfolio Management, 21 (4), 60–77. http://dx.doi.org/10.3905/jpm.1995.409527

Fuss, R., Hoppe, C., & Kaiser, D.G. (2008). Review of Commodity Futures Performance Benchmarks. In F.J. Fabozzi, R. Fuss, D.G. Kaiser (eds.)., *The Handbook of Commodity Investing*, Hoboken, John Wiley & Sons.

Fuss, R., Kaiser, D.G., Rehkugler, H., & Butina, I. (2006). Long-Term Co-Movements Between Hedge Funds and Financial Asset Markets. In G.N. Gregoriou, D.G. Kaiser (eds.), *Hedge Funds and Managed Futures: A Handbook for Institutional Investors*. London, Risk Books.

Garcia, P. & Leuthold, R., 2004, A Selected Review of Agricultural Commodity Futures and Option Markets. European Review of Agricultural Economics 31 (3), 235–272. http://dx.doi.org/10.1093/erae/31.3.235

Georgiev, G. (2001). Benefits of Commodity Investment. *Journal of Alternative Investments*, 4 (1), 40–48. http://dx.doi.org/10.3905/jai.2001.318997

Gilbert, C.L. (2009). *Speculative Influences on Commodity Futures Prices, 2006–2008*. University of Trento working paper.

Gilbert, C.L. (2010). How to Understand High Food Prices. *Journal of Agricultural Economics*, 61 (2), 398–425. http://dx.doi.org/10.1111/j.1477-9552.2010.00248.x

Gorton, G., & Rouwenhorst, K.G. (2006). Facts and Fantasies about Commodity Futures. *Financial Analyst Journal*, 62 (2), 47–68. http://dx.doi.org/10.2469/faj.v62.n2.4083

Greer, R.J. (1978). Conservative Commodities: A Key Inflation Hedge. J*ournal of Portfolio Management*, 4 (4), 26–29. http://dx.doi.org/10.3905/jpm.1978.408649

Greer, R.J. (2000). The Nature of Commodity Index Returns. *Journal of Alternative Investments*, 3 (1), 45–52. http://dx.doi.org/10.3905/jai.2000.318924

Hafner, R. & Heiden, M. (2008). Statistical Analysis of Commodity Futures Returns. In F.J. Fabozzi, R. Fuss, D.G. Kaiser, (eds.)., *The Handbook of Commodity Investing*. Hoboken, John Wiley & Sons, 227–240.

Hamilton, J.D. (2011). Nonlinearities and the Macroeconomic effects of Oil Prices. *Macroeconomics Dynamics*, 15 (S3), 364-378.

Harvey, C.R., Liechty, J.C., Liechty, M.W.,& Muller, P. (2004) *Portfolio Selection With Higher Moments.* working paper, https://faculty.fuqua.duke.edu/~charvey/Research/Working_Papers/W70_Portfolio_selection_with.pdf.

Heidorn, T. & Demidova-Menzel, N. (2008). The Effect of Gold in a Traditional Portfolio. In F.J. Fabozzi, R. Fuss, & D.G. Kaiser (eds.), *The Handbook of Commodity Investing*, Hoboken, John Wiley & Sons, 736–762.

Huberman, G., & Kandel, S. (1987). Mean-variance spanning. *Journal of Finance*, 42 (4), 873-888. http://dx.doi.org/10.1111/j.1540-6261.1987.tb03917.x

Idzorek, T.M. (2006). *Strategic Asset Allocation and Commodities*. Ibbotson Associates White Paper, March.

Idzorek, T.M. (2007). Commodities and Strategic Asset Allocation. In H. Till & J. Eagleeye (eds.), *Intelligent Commodity Investing. New Strategies and Practical Insights for Informed Decision Making*, London, Risk Books.

Inamura, Y., Kimata, T., Kimura, T.,& Muto, T. (2011). *Recent Surge in Global Commodity Prices – Impact of Financialization of Commodities and globally Accommodative Monetary Conditions.* Working paper, Bank of Japan Review, http://www.boj.or.jp/en/research/wps_rev/rev_2011/data/rev11e02.pdf.

Irwin, S.H. & Sanders, D.R. (2011). Index Funds, Financialization and Commodity Futures Markets. *Applied Economics Perspectives and Policy*, 33 (1), 1-31. http://dx.doi.org/10.1093/aepp/ppq032

Irwin, S.H. & Sanders. D.R. (2012). Financialization and structural change in commodity futures markets. *Journal of Agricultural and Applied Economics*, 44 (3), 371-396. http://dx.doi.org/10.1093/aepp/ppq032

Jaffe, J.F. (1989). Gold and Gold Stocks as Investments for Institutional Portfolios., Financial Analyst Journal, 45 (2), 53–60. http://dx.doi.org/10.2469/faj.v45.n2.53

Jensen, G.R., Johnson, R.R., & Mercer, J.M (2000). Efficient Use of Commodity Futures in Diversified Portfolios. *Journal of Futures Markets*, 20 (5), 489–506. http://dx.doi.org/10.1002/(sici)1096-9934(200005)20:5%3C489::aid-fut5%3E3.0.co;2-a

Jobson, J.D., Korkie, B.M. (1989). A Performance Interpretation of Multivariate Tests of Intersection, Spanning and Asset Pricing. *Journal of Financial and Quantitative Analysis*, 24 (2), 185. http://dx.doi.org/10.2307/2330771

Johanning, L., Proelss, J., Rosenbush, A.Ph.,& Schweizer, D. (2006). Strategy Selection for Hedge Fund and Managed Futures Portfolios using Higher Moments. In G.N. Gregoriou, D.G. (ed.), *Hedge Funds and Managed Futures: A Handbook for Institutional Investors*. London, Risk Books, 301–322.

Kaplan, P.D. & Lummer, S.L. (1998). GSCI Collateralized Futures as a Hedging and Diversification Tool for Institutional Portfolios. The Journal of Investing, 7 (4), 11–17. http://dx.doi.org/10.3905/joi.2.2.75

Kat, H.M. & Oomen, R.C.A. (2007a). What Every Investor Schould Know about Commodities, Part I: Univariate Return Analysis. *Journal of Investment Management*, 5 (1), 1–25.

Kat, H.M. & Oomen, R.C.A. (2007b). What Every Investor Should Know About Commodities, Part II: Multivariate Return Analysis. *Journal of Investment Management*, 5 (3), 1–25.

Kooli, M. (2006). Funds of funds and the diversification effect. In G.N. Gregoriou (ed)., *Funds of Hedge Funds. Performance, Assessment, Diversification and Statistical Properties*. Oxford, Elsevier, 239–250.

Kyle, A. & Xiong, W. (2001). Contagion as a Wealth Effect. *Journal of Finance*, 56 (4), 1401–1440. http://dx.doi.org/10.1111/0022-1082.00373

Markowitz, H.M. (1952). Portfolio Selection. *Journal of Finance*, 7 (1), 77–91.

Masters, M.W. (2008). *Testimony before Committee on Homeland Security and Government Affairs*. U.S. Senate, 20 May, 2008.

Mayer, J. (2010). *The Financialization of Commodity Markets and Commodity Price Volatility*. UNCTAD the Financial and Economic Crisis of 2008–2009 and Developing Countries report, 73–98.

Nijman, T.E. & Swinkels, L.A.P. (2008). Strategic and Tactical Allocation to commodities for Retirement Savings Schemes. In F.J. Fabozzi, R. Fuss,& D.G. Kaiser (eds.). *The Handbook of Commodity Investing*, Hoboken, John Wiley & Sons, 522–547.

Oztek, M.F. & Ocal, N. (2013). *Financial Crises, Financialization of Commodity Markets and Correlation of Agricultural Commodity Index with Precious Metal Index and S&P500*. ERC Working Papers in Economics 13/02.

Pratt, J. & Zeckhauser, R. (1987). Proper Risk Aversion, Econometrica, 55 (1), 143–154. http://dx.doi.org/10.2307/1911160

Rogers, J. (2004/2007). *Hot Commodities: How Anyone Can Invest Profitably in the World's Best Market.* New York, Random House.

Samuelson, P.A. (1970). The Fundamental Approximation Theorem of Portfolio Analysis in Terms of Means, Variances and Higher Moments. *Review of Economic Studies*, 37 (4), 537–542. http://dx.doi.org/10.2307/2296483

Satyanarayan, S. & Varangis, P. (1994*). An Efficient Frontier for International Portfolio and Commodity Assets.* Policy Research Working Paper 1266, World Bank, March.

Scherer, B. & He, L. (2008). The Diversification Benefits of Commodity Futures Indexes: A Mean-Variance Spanning Test. In F.J. Fabozzi, R. Fuss, & D.G. Kaiser (eds.), *The Handbook of Commodity Investing*, Hoboken, John Wiley & Sons, 266–310.

Scott, R.. & Horvath, P. (1980). On the Direction of Preference for Moments of Higher Order than the Variance. *Journal of Finance*, 35 (4), 915–919. http://dx.doi.org/10.1111/j.1540-6261.1980.tb03509.x

Shore, M.S. (2008). Introducing Alternative Investments in a Traditional Portfolio: The Case of Commodities, Hedge Funds, and Managed Futures. In F.J. Fabozzi, R. Fuss, & D.G. Kaiser, *The Handbook of Commodity Investing*, Hoboken, John Wiley & Sons, 504–512.

Silvennoinen, A., & Thorp, S. (2009). *Financialization, crisis and commodity correlation dynamics.* Working paper, https://editorialexpress.com/cgi-bin/conference/download.cgi?db_name=SNDE2010&paper_id=105.

Sorensen, C. (2002). Modelling Seasonality In Agricultural Commodity Futures. *Journal of Futures Markets*, 22 (5), 393-426. http://dx.doi.org/10.1002/fut.10017

Strongin ,S. & Petch, M. (1995). *The Mid-Cycle Pause: A Buy Signal for Commodities*. Unpublished white paper, Goldman Sachs Commodity Research.

Strongin, S. & Petch, M. (1996). *Asset Returns and the Economic Environment*. Unpublished white paper, Goldman Sachs Commodity Research.

Tang K., Xiong W. (2012). Index Investment and Financialization of Commodities. Financial Analyst Journal, 68 (6), 54-74. http://dx.doi.org/10.2469/faj.v68.n6.5

Tang, K. (2011). *Financialization of Commodities*. Presentation at the Global Commodities Forum, 31.01.-01.02.2011, Geneva, Switzerland, http://www.unctad.info/upload/GCF2011/doc/A4-A8/gcf2011_A4_KeTang.en.pdf.

TDR (2009). *Trade and Development Report*. United Nations Conference on Trade and Development, Geneva.

Till H., Eagleeye J. (2003b). Timing is Everything, Especially with a Commodity Index. *Futures: News, Analysis & Strategies for Futures, Options & Derivatives*, 32 (10), 46.

Till, H. & Eageleye J. (2003a). The Risks of Commodity Investing. In L. Jaeger (ed.)., *The New Generation of risk Management for Hedge Fund and Private Equity Investments*, London, Euromoney Books.

Till, H. (2000a). Passive Strategies in the Commodity Futures Markets. *Derivatives Quarterly*, Autumn, http://www.premiacap.com/publications/DQ_Fall00.pdf.

Till, H. (2000b). Two Types of Systematic Returns Available in The Commodity Futures markets. *Commodities Now*, August 2000, 1–5.

Till, H. (2007a). Part I of a Long Term Perspective on Commodity Futures Returns: Review of Historical Literature. In H. Till & J. Eagleeye (ed.)., *Intelligent Commodity Investing: New Strategies and Practical Insights for Informed Decision Makings*, London, Risk Books, 39–82.

Till, H. (2007b). Introduction to A Long-Term Perspective on Commodity Futures Returns, In: H. Till & J. Eagleeye (red.)., *Intelligent Commodity Investing: New Strategies and Practical Insights for Informed Decision Makings*, London, Risk Books, 35–38.

Till, H. (2007c). Part II of a Long Term Perspective on Commodity Futures Returns: Term Structure as the Primary Driver of Returns. In H. Till & J. Eagleeye (ed.)., *Intelligent Commodity Investing: New Strategies and Practical Insights for Informed Decision Makings*, London, Risk Books, 83–94.

Till, H. (2008). Amaranth Lessons Thus Far. *Journal of Alternative Investments*, 10 (4), 82-98. http://dx.doi.org/10.3905/jai.2008.705534

Vdovenko, A. (2013). *Impact of Financializtion on the Roll Return of Commodities*. Master Thesis, Tilburg University, Tilburg.

Zaremba, A. (2014a). Strategies Based on Momentum and Term Structure in Financialized Commodity Markets. Working paper, available at SSRN: http://ssrn.com/abstract=2469407 or http://dx.doi.org/10.2139/ssrn.2469407.

Zaremba, A. (2014b). Is Financialization Killing Commodity Investments? Working paper, available at SSRN: http://ssrn.com/abstract=2349903 or http://dx.doi.org/10.2139/ssrn.2349903.

Zaremba, A. (2014c). Inflation, Business Cycles, and Commodity Investing in Financialized Markets. Working paper, available at SSRN: http://ssrn.com/abstract=2389297 or http://dx.doi.org/10.2139/ssrn.2389297.