Is Financialization Killing Commodity Investments?

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Arguably, commodity futures once were thought to serve as a holy grail for hedging stock-market portfolios. Nearly a decade ago several crucial studies raised the possibility that commodity investments could increase the return expected on an investment portfolio while simultaneously reducing its risk. The publications were quickly followed by an explosion of various commodity investment vehicles and a significant inflow of capital into commodity markets. "The increase in investor activity" was subsequently described as the "financialization" of commodity markets (Domanski and Heath [2007]). Since then, the landscape of commodity markets has drastically changed. Once a market of refineries, mines, and farms, it has been transformed into the market of hedge funds, exchange-traded funds (ETFs), and commodity advisors. Although the role of speculators was recognized a long time ago, never before was it so important.

Effects of financialization on commodity markets are still the subject of discussion. Some researchers believe that they have undergone a deep and structural change. The literature concerning this subject usually indicates an increased correlation between commodities and other asset classes (United Nations [2009]; Tang and Xiong [2012]; Silvennoinen and Thorp [2009]), and changes within the term structure of commodity markets (Mayer [2010]; Tang and Xiong [2012]; Vdovenko [2013]; Brunetti and Reiffen [2011]; Mou [2011]). Some research strands also revealed the emergence of price bubbles (Masters [2008]; Gilbert [2009, 2010]; Einloth [2009]); however, other studies reached different conclusions in this matter (Plante and Yucel [2011]; Buyuksahin [2012]; Huntington et al. [2014]; Cevik and Sedik [2011]; Irwin [2013]).

Financialization is a relatively new phenomenon; thus, there are still no firm answers as to whether and how financialization may have changed commodity futures markets. Additionally, the scope of the effects of financialization on investment conditions and opportunities in commodity markets is still unknown even though this knowledge is crucial from the investors' perspective.

This article aims to investigate a single aspect of the consequences of financialization—that is, changes in future roll returns—and to assess implications of this phenomenon for commodity investors. The analysis is performed from the perspective of ordinary U.S. investors who maintain their funds in the stock and bond markets. In other words, this article makes an attempt to prove whether investing in commodities in view of financialization and its impact on the term structure is still economically justified.

This article is organized as follows. First, the characteristic properties of commodity investments are described, together with the listing of methods to obtain exposure to commodities and the description of their key return sources. The existing literature referring to the potential benefits of commodity investments is also reviewed. Second, the concept of financialization is defined and an independent, proprietary research hypothesis is developed. The third section includes a description of research methods and data sources. A new measure of the level of financialization is also introduced. Furthermore, the results of an empirical, twofold analysis are presented. Its first stage includes the performance of a regression analysis in order to assess the potential impact of financialization on commodity markets. In the second stage, we adjust expected commodity futures returns based on this regression and examine what this decline in expected returns would mean for a diversified portfolio's efficient frontier of stocks, bonds, and commodity investments. The empirical research is based on returns on various asset classes and other related variables over the period between 1990 and 2012. Finally, the article ends with concluding remarks and recommendations for future research.

COMMODITIES AS INVESTMENT ASSETS

One of the key distinguishing features of commodities as an asset class is the variety of methods available to investors for obtaining exposure to them. In practice, there are three basic methods (Idzorek [2007]):

1. direct physical purchase,
2. commodity-related stocks, and
3. commodity futures.

Each of these methods of exposure has its own risk and return characteristics. Physical investment is simply too impractical as some commodities (particularly cattle and some agricultural commodities) tend to perish quickly, even those that do not require complicated storage and transportation. In fact, the only exceptions are precious metals, such as gold or silver. Other types of direct physical investment are still fairly rare.[1]

Commodity-related stocks seem to be part of a broader asset class of equities rather than commodities. They provide exposure to business skills of managers and specific factors related to companies, and in many cases, may even hedge out their commodity exposure. Therefore, some analyses may often indicate stronger correlation between commodity-related stocks and equities than between such stocks and commodities themselves. Gorton and Rouwenhorst [2006] created a portfolio of commodity stocks on the basis of SIC codes and investigated its behavior over the period of 41 years. The correlation between the portfolio and the commodity futures index was 0.40, whereas in the case of the S&P 500 Index, it was 0.57. Moreover, it also appears that commodity stocks not only resemble equities rather than commodities but also result in lower rates of return and are not explicitly defined as an efficient inflation hedge (Gorton and Rouwenhorst [2006]). As a result, many researchers conclude that a portfolio of commodity-related stocks is not a sufficient method of obtaining exposure to commodities.

The third method, widely recognized as the most appropriate one, comprises direct investment in a commodity futures portfolio. This can be achieved either by hiring a professional portfolio manager (CTA) to actively manage the portfolio (managed futures) or through a passive long position in a commodity index. In a later section of this article, the focus will be placed on the second method as the one that it is free from influence of active investment strategies.

The passive index investment defines first and foremost the purchase of a portfolio of fully collateralized commodity futures being systematically rolled on or prior to their maturity. According to previous studies in this field, such investments are of particular interest to traditional equity and bond investors due to a variety of distinctive features of commodities: the positive skewness of return distributions (Deaton and Laroque [1992]; Armstead and Venkatraman [2007]), the mean-reverting feature of commodity prices (Sorensen [2002]), the hedging properties against inflation (Bodie [1983]; Gorton and Rouwenhorst [2006]; Froot [1995]; Till and Eagleeye [2003a,b]; Akey [2007]), the potential long-term positive risk premium (Till [2007a,b,c]), and the low correlation with traditional asset classes such as stocks or bonds (Ankrim and Hensley [1993]; Becker and Finnerty [1994]; Kaplan and Lummer [1998]; Anson [1999]; Abanomey and Mathur [2001]; Georgiev [2001]; Gorton and Rouwenhorst [2006]).

RISK PREMIUM OF COMMODITIES AND ITS ROLE IN PORTFOLIO OPTIMIZATION

The two previously mentioned characteristic features of commodity futures, low correlation and the long-term risk premium, might translate into a particular attractiveness of commodity futures contracts in terms of strategic asset allocation. Since the 1970s, researchers (Till [2007a]) have shown interest in this field; thus, the subject literature is relatively in-depth. The following studies are presented in chronological order.

Initial studies focused on the U.S. agricultural market but did not deliver promising results. Dusak [1973], who analyzed listings of singular commodities over the period between 1962 and 1967, was not able to prove the existence of positive risk premium. Breakthrough in this field can be attributed to Greer [1978], who treated commodities as an asset class. Greer showed that risks associated with commodity investment may be effectively reduced through full collateralization. On the basis of a price index developed between 1960 and 1976, he calculated that an investment in commodity futures had performed better than an equity investment, particularly by delivering higher returns and lower drawdowns than equities. In their most often cited study, Bodie and Rosansky [1980] argued that commodity futures have a positive risk premium. They showed that a risk premium was present in 22 out of 23 analyzed markets over the period between 1950 and 1973; however, the statistical significance of results was rather low. It is probably due to relatively high volatility of single futures; therefore, Bodie and Rosansky performed similar computations also for a commodity index delivering statistically significant rates of return. Similar results were later obtained by Bodie [1983], Carter et al. [1983], Chang [1985], and Fama and French [1987]. Bessembinder [1992] noted that the presence and amount of risk premium is dependent on the term structure, whereas Bjornson and Carter [1997] observed that the risk premium correlates with macroeconomic factors: economic activity, inflation, and interest rates. Historically, expected returns to commodities were lower during times of high interest rates and expected inflation. Similar conclusions were drawn by Chong and Miffre [2006]. Kaplan and Lummer [1998], who focused on fully collateralized investments in S&P GSCI Index, noted that, historically, index investments achieved higher returns but also bore higher risks than investments in equities. Returns in commodity markets were also a subject of interest to Greer [2000], Till [2000a, 2000b], and Dunsby et al. [2008].

The latest studies on the risk premium of commodities emphasize the difference between risk premiums with respect to indexes and to single commodities. Garcia and Leuthold [2004] found the presence of a risk premium for indexes over the period between 1982 and 2004; however, they didn't reach unequivocal conclusions concerning single instruments. According to calculations conducted by Anson [2006], commodity portfolios achieved higher return than bonds and equities between 1970 and 2000, but at a slightly higher risk. Erb and Harvey [2006a] believed that the acceptance or rejection of the risk premium hypothesis is highly dependent on research data and the research methodology. A significant breakthrough was experienced in 2004 upon the first publication of Gorton and Rouwenhorst's working paper. The Gorton and Rouwenhorst [2006] article "Facts and Fantasies about Commodity Futures" is widely recognized as providing the credibility for the emergence of commodities as an asset class (Rogers [2007]; Authers [2010]). Gorton and Rouwenhorst found the statistically significant presence of a risk premium for 36 commodities over the period between 1959 and 2004. According to them, the portfolio performed about equal to equities, and its Sharpe ratio was even higher due to a lower standard deviation. And conversely, they were unable to confirm statistically significant rates of return for single markets. A number of later studies confirmed the findings of Gorton and Rouwenhorst. Kat and Oomen [2007a] did not find risk premiums in a broad spectrum of 42 commodities over the period between 1965 and 2005; whereas Scherer and He [2008] found the presence of risk premiums between 1989 and 2006 for Deutsche Bank indexes, but not for all constituents. Long-term return rates on indexes were also found by Hafner and Heiden [2008] in their analysis for the period between 1991 and 2006, and by Füss et al. [2008] in the analysis for the period between 2001 and 2006, as well as by Shore [2008], who investigated the S&P GSCI over the period between 1969 and 2006. Positive rates of return, higher than return rates of stocks and bonds, were documented by Nijman and Swinkels [2008]; however, they also observed historically higher volatility than in the case of traditional asset classes. Risk premiums in commodity markets were also analyzed by Gorton et al. [2012].

Another important aspect of commodity research is diversification properties and the resulting benefits for an investment portfolio. The first scientific analysis of this kind is believed to be performed by Greer in 1978. In his pioneering work, Greer [1978] showed that a rebalanced portfolio of commodities, stocks, and bonds delivers more stable and higher rates of return than a pure bond-and-stock portfolio. Bodie and Rosansky [1980] noted that an allocation of 40% of a portfolio to commodity futures had resulted in risk reduction and a simultaneous increase in expected return. Similar conclusions on the historical benefits of commodity investing were later drawn 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], and Anson [2006]. In his calculations conducted for Ibbotson Associates, Idzorek [2006] showed that there had been a low correlation between commodities and stocks and bonds as commodities, contrary to stocks and bonds, were positively related to inflation. Kat and Oomen [2007a] showed that a partial allocation to the GSCI improved a portfolio's Sharpe ratio, whereas according to Woodard [2008], between 1989 and 2006 commodity futures exhibited a positive risk premium, which was impossible to be explained in terms of returns on stocks or bonds. The shift in the efficient frontier, resulting from the commodity allocation, was also discussed by Scherer and He [2008] with several important caveats and by Shore [2008]. However, the most interesting study among the latest ones is by Heidorn and Demidova-Menzel [2008], who analyzed return patterns of portfolios comprising equities, sovereign and corporate bonds, and real estate properties between 1973 and 1997. They concluded that investors should allocate between 5% and 36% of their portfolio to commodities. Other recent studies concerning the benefits of commodities in terms of strategic asset allocation are those conducted by Doeswijk et al. [2012] and Bekkers et al. [2009].

SOURCES OF RETURN IN COMMODITY FUTURES MARKET

One essential question with regard to this article is the following: what are the sources of return in commodity futures markets? An answer to this question could be formed on the basis of an accounting perspective or from an economic perspective.

With respect to the accounting perspective, there are three key sources of return in commodity futures markets.[2] The first one is spot return (price return)—this is the component of return that arises from changes in nearby prices (Shimko and Masters [1994]). Interestingly, early studies demonstrate that long-term spot returns are close to zero (Grilli and Yang [1988]). In other words, changes in spot prices have not resulted in significant, long-term real (inflation-adjusted) returns; thus, the existence of risk premiums would have to be due to such other factors as pricing of commodity futures relative to spot prices, strategy design, or portfolio composition. Similar evidence is found in Cuddington [1992], Cashin et al. [1999], and Burkart [2006] and is confirmed by Gorton and Rouwenhorst [2006] and Erb and Harvey [2006a]. Interesting conclusions were also drawn by Anson [2006], who believed that despite the fact that the long-term risk premium is determined by other factors, it is the spot return that is responsible for the diversification properties of commodities.

The second source of return is collateral yield, inseparably bound to the full collateralization of total return indexes. Historically, collateral yields constituted a relatively high percentage of total return due to particularly high inflation and interest rates in the 1970s and 1980s. However, based on simple arithmetical principles, collateral yields are, obviously, no reason for the existence of risk premiums.

The third source of return, apparently the most important one, is roll yield.[3] The roll return is the return from the passage of time (carry) assuming the term structure of futures contract does not change. If a market is in a backwardation (with a downward-sloping term structure), the return from rolling up the curve (for example, selling a three-month futures after one month as a two-month future) is positive, while it is negative if markets are in contango (upward-sloping term structure). The greater the slope of the term structure, the more pronounced these effects are (Scherer and He [2008, p. 257]). If the market experiences backwardation, the new price is lower; while in the case of contango, it is higher. In respect to commodity index computation, roll return constitutes the difference between excess return and spot return.

Many researchers believe that roll return is the key factor in determining long-term returns on particular commodities (Nash [2001]; Till and Eagleeye [2003a]; Kat and Oomen [2007a, b]). According to Erb and Harvey [2006], 92% of cross-sectional variation in excess return on commodities is explained by roll returns. This was confirmed by Markert and Zimmermann [2008]. Their regression yielded an R-squared of 88.6%.

Furthermore, besides the three aforementioned sources of return, there are also other index-specific factors, such as a return from diversification (interpreted by Willenbrock [2011] as a return on rebalancing), which is also demonstrated and/or discussed in several other papers (Erb and Harvey [2006a,b]; Scherer and He [2008]; De Chiara and Raab [2002]; Plaxco and Arnott [2002]).

From an economic perspective, there are several theories explaining pricing in commodity futures markets and defining possible sources of a risk premium. One of the most prominent is the "theory of normal backwardation," dating back to Keynes [1930] and Hicks [1946]. According to this theory, the commodity futures markets provide some traits of insurance. If producers hedge their production with short positions, they must compensate risk-averse long investors with a risk premium. The described concept evolved later into a more general form called the "hedging pressure hypothesis," according to which the risk premium may result from either producers or consumers, depending upon which type of market participant exerts stronger hedging pressure. In a nutshell, in accordance with the hedging pressure hypothesis, in commodity futures markets, the risk is transferred from hedgers to speculators, who earn a premium for bearing the risk. The hedging pressure hypothesis was later incorporated in many models and confirmed by many researchers (Houthakker [1961]; Cootner [1960]; Chang [1985]; Bessembinder [1992]; De Roon et al. [2000]; Anderson and Danthine [1981]). Supporting evidence was also revealed by recent studies, including those of Basu and Miffre [2013], and Acharya et al. [2013].

According to this theory, the general formula defining the futures contract price is the following one:

$$F_{tT} = e^{-rp(T-t)}E_t[S_T] \qquad (1)$$

where rp denotes risk premium and $E_T\ [S_T\ ]$ is an expected price at time T. An interesting observation in this model is the fact that neither the risk premium nor the expected spot price is directly visible. Markert and Zimmermann [2008] provided an interesting derivation that shows the link between the risk premium and the common accounting return decomposition into spot, roll and collateral yields, and the convenience yield. According to Markert and Zimmerman, roll yield ($r\gamma$) may be described as

$$r\gamma = rp - \alpha_s \qquad (2)$$

where rp is the risk premium and α_S denotes the expected growth rate of spot price. In other words, if expected growth rate of a spot price is equal to zero, then ex post roll return is equal to the risk premium.

In addition, there are several other theories. The most popular is the theory of storage.[4] It assumes that a holder of a physical commodity has some indispensable benefits (e.g., lower risk in the case of commodity shortage in the market due to production stoppage or increased demand) that a holder of futures is deprived of. Introduced by Kaldor [1939], the term "convenience yield" defines additional profits on the part of a physical commodity holder.[5] The concepts other than the theory of storage and the hedging pressure hypothesis are not so broadly recognized and extensively documented.[6]

MARKET FINANCIALIZATION AND HYPOTHESIS DEVELOPMENT

In recent years we experienced a massive influx of capital into commodity futures–related products. It is said that at least 100 billion dollars moved into the commodity futures markets between 2004 and 2008 (Irwin and Sanders [2011]). Trading volume increased dramatically, and the presence of financial investors has also been constantly increasing. According to the U.S. Commodity Futures Trading Commission (CFTC), the share of open interest held by non commercial market participants surged from 15% in the beginning of 1990 to more than 42% in the end of 2012. Domanski and Heath [2007] coined the "financialization" term to describe the growing presence and importance of financial institutions in commodity markets. Changes do not seem to be temporal but rather structural (Irwin and Sanders [2012]).

One could reasonably assume that such profound changes could have somehow altered the functioning of commodity markets. Lots of studies have been conducted in this field. As noted, there are several structural changes discussed in research papers that could have taken place in commodity markets as the result of financialization, including the emergence of price bubbles, increased correlation among commodities and with other asset classes, as well as changes in the term structure of commodity markets (Mayer [2010]; Tang and Xiong [2012]; Vdovenko [2013]; Brunetti and Reiffen [2011]). Structural changes in commodity markets might be of great importance for commodity investors. The theories explaining commodity risk premiums, described previously, argue that the risk premium compensates for the risk transfer from hedgers to investors (speculators). If the amount of hedging is relatively constant and the number of investors grows, the share of the risk premium per investor simply shrinks. In other words, financialization may result in a decrease in risk premiums for long-position commodity investors. If we take the risk premium as described as in Equation (2), then the decline in risk premium, ceteris paribus, might imply the decrease in roll yields. As a result of commodities financialization, the roll yields constituting a substantial component of long-term returns on commodities might be structurally lowered in the future. If this statement holds true, this could be detrimental for future commodity investments. A lower long-term risk premium may put into question the usefulness of commodities as an asset class, either as a portfolio enhancer or as a stand-alone investment.

It should be noted that it is not only the reduction of roll yields that may jeopardize the rationale for including commodities in a diversified portfolio. The other impediment may be the decrease of profitability of strategies based on term structure (Zaremba [2014a]). Furthermore, the increase in correlation between the commodities as an asset class and equities, investigated by, for example, Tang and Xiong [2012], could have a negative impact on the benefits of commodity investments (Zaremba [2014b]). However, whether the changes in correlations are related to financialization is still an issue in an ongoing debate. Norrish et al. [2014] argued that the level of correlations with other asset classes was actually declining in year 2014. Also Daskalaki and Skiadopoulos [2011] contested the benefits of commodities in a portfolio. These authors tested the hypothesis that commodities should be an integral part of any investment portfolio because they offer diversification that results from negative correlations with traditional asset classes: stocks and bonds. The period examined was 1989–2009. The authors concluded that investor utility is maximized in a traditional portfolio and risk-adjusted returns fall after the addition of commodities. In other words, the addition of commodities does not offer value in terms of higher risk-adjusted returns for investors. This observation is consistent for longer and shorter periods with the exception of the short commodity boom period of 2005–2008. Daskalaki and Skiadopoulos related the erosion of diversification benefits to the rising investment of funds in commodity indexes.

DATA SOURCES AND RESEARCH DESIGN

In this article, the empirical analysis is divided into two stages. First of all, its aim is to investigate whether an increased presence of commodity investors translates into the decrease in roll yields and to assess the size of its impact. Second, the study will investigate whether commodities as an asset class are still beneficial as a portfolio enhancer, given a potential continued decrease in roll yields. The article will do so by evaluating the change in the efficient frontier when adding commodities, both with and without reduced roll yields. The reduction in roll yields is calculated from the empirical link between the increase in financialization and the reduction in roll yields. We construct both a classic mean–variance efficient frontier as well as one taking into consideration the skewness and kurtosis of portfolio returns. We also use a Monte Carlo method to examine the potential change in a portfolio's Sharpe ratio by including commodities, using both historical returns and reduced returns. Like the efficient frontier analysis, we calculate classic Sharpe ratios and modified Sharpe ratios, with the latter ratio providing a measure of return per extreme risk.

In order to study the relationship between roll returns and investor presence, a simple ordinary least squares (OLS) regression was performed with the use of the JP Morgan Commodity Curve Index (JPMCCI) as a proxy for returns on commodities as an asset class. Currently, there are many indexes available, but the JPMCCI was chosen for several reasons. First and foremost, it dates back to December 1989, thus representing a relatively long time series. Second, it is calculated in total, excess, and spot return conventions. Third, it avoids a common front-run bias because it exposes an index investor to a full commodity curve. Then, its constituents are weighted in accordance with open interest, arguably a good representation of investors' universe.

Finally, it does not assume any sophisticated active portfolio allocation methods that could distort pure returns on commodities as an asset class. It should also be noted that the JPMCCI is used to represent investment commodities as an asset class, not as an investment in a particular commodity index. Therefore, the results may differ from other commodity indexes focused merely on a specific part of commodity curve or that employ an active allocation strategy.

In our study, at each time t forward-looking ex post roll returns are calculated on the basis of a subsequent period of one month. The specific formula is the following one:

$$ry_{T-t} = \ln\frac{P_T^E}{P_t^E} - \ln\frac{P_T^S}{P_t^S} \quad (3)$$

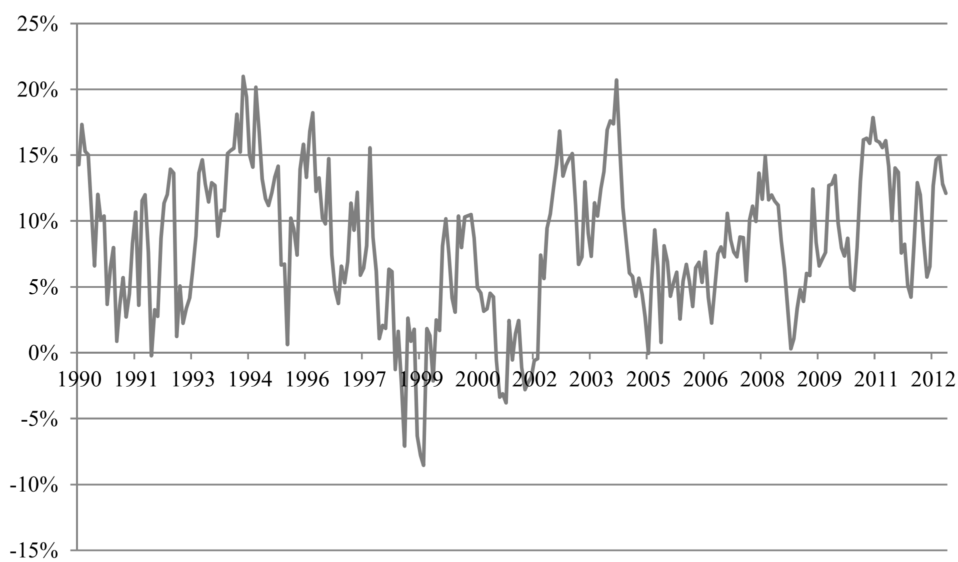
where ry is a logarithmic roll return in the period $T-t$ and $T > t$ and P^E and P^S are values of excess and spot indexes.[7] Roll yields are regressed against several variables. First, a hedging pressure variable was considered and the following formula was implemented to describe it:

$$hp_t = \frac{CS_t - CL_t}{CS_t + CL_t} \quad (4)$$

where hp denotes hedging pressure and CS_t and CL_t are consecutive quantities of commercial long and short positions in month t. The source of this data is the CFTC, and the traditional CFTC classifications of traders into the following categories is used: commercial, non-commercial, spread, and unclassified. Only futures positions (excluding options, swaps, and so on) were taken into account. Because roll yields were calculated on the basis of the entire commodity index, the hedging pressure was also calculated as a sum of traders' positions in several markets, including cocoa, coffee, copper, corn, crude oil, gold, heating oil, lean hogs, live cattle, natural gas, platinum, RBOB gasoline, silver, soya, soybean, oil, sugar, and wheat. This approach not only represents a marketwide perspective on the level of hedging pressure, but also matches roughly the structure of hedging pressure within the JP Morgan index.

Exhibit 1 presents the level of hp during the analyzed period. It should be noted that hedging pressure across commodities was almost always in positive

EXHIBIT 1
Hedging Pressure in Commodity Markets



Note: Hedging pressure was calculated as a sum of traders' positions in commodity markets, including cocoa, coffee, copper, corn, crude oil, gold, heating oil, lean hogs, live cattle, natural gas, platinum, RBOB gasoline, silver, soya, soybean oil, sugar, and wheat, according to Equation (4).

Source: Based on data from the CFTC.

territory, which means that there were usually more commercial short positions than long.

Furthermore, another variable—market financialization—was introduced. As there are few common and well-documented measures of the level of financialization in commodities market,[8] the following variable is suggested:

$$fin_t = \frac{NCL_t + NCS_t + 2 \times NCSP_t}{OI_t} \quad (5)$$

In other words, the financialization variable, *fin*, is defined as the share of all non commercial traders' positions in the market (*NCL*—non commercial longs; *NCS*—non commercial shorts; *NCSP*—non commercial spreads) as a fraction of the total open interest. As shown in Exhibit 2, the share of non commercial traders in the market has systematically increased for the last 20 years at a more or less even pace, starting from 15% in the beginning of the 1990s to more than 42% at the end of 2012.

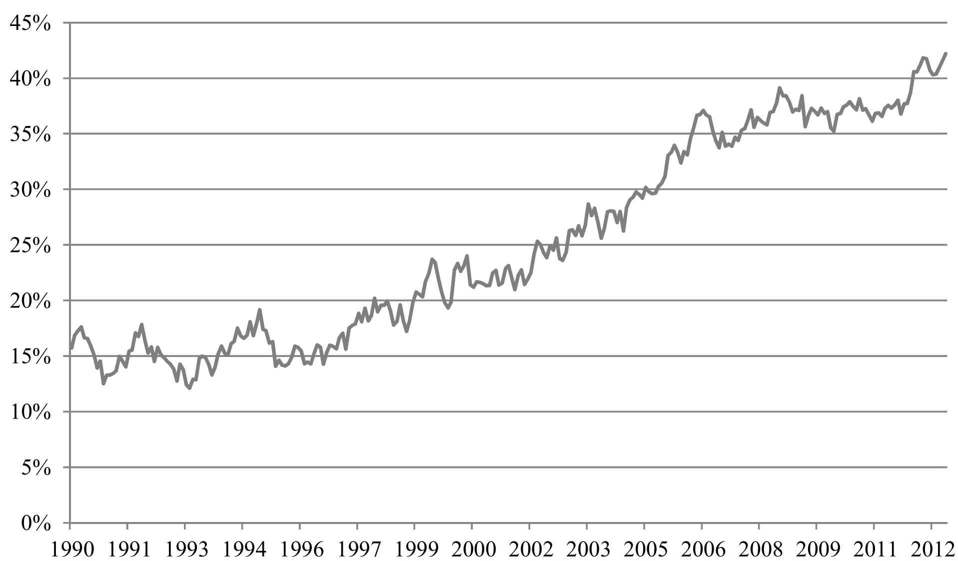
Some studies indicate other factors that may also affect roll yield and slope of the term structure.[9] Therefore, several control variables were introduced, as discussed later. Nevertheless, none of these control variables actually made much difference to the final results.

Hong and Yogo [2012] provided theoretical and empirical evidence, according to which open interest reveals some important information on future economic activity or inflation that cannot be attributed to futures prices or supply and demand imbalances. The authors theorize that the amount of open positions may be procyclical, as producers and consumers take additional positions in anticipation of higher demand. Hong and Yogo indicated that an average growth rate of an open interest is positively correlated with market excess returns. The concept developed by the abovementioned researchers is consistent with the hypothesis of Sockin and Xiong [2013], who believed that open interest increases with the expectations of higher demand among commodity consumers. To sum up, it is plausible to assume that there might be some positive correlation between the past growth of open interest and future roll yields. Thus, open interest dynamics variable, *oid,* was added as a variable:

$$oid_t = \ln\left(\frac{OI_t}{OI_{t-1}}\right) \quad (6)$$

Exhibit 2

The Financialization Level in the Commodity Markets



Note: The financialization variable was computed according to Equation (5).

Source: Based on data from the CFTC.

The *oid* variable is defined as the monthly logarithmic growth of open interest *OI*.

Some articles (Frankel [2006]; Fama and French [1988]; Hong and Yogo [2009]) documented the relationship between interest rates and the term structure that results from various economic forces. Thus, an *int* variable, represented by a one-month USD LIBOR (London Interbank Offer Level) level, was introduced.

Bailey and Chan [1993] examined the impact of corporate spread on the futures basis. According to them, such corporate spread may represent "a systematic risk of an underlying commodity" (Vdovenko [2013]). Bailey and Chan [1993] interpreted the relationship of the corporate spread and the futures basis from the perspective of equilibrium asset-pricing theories. They used the corporate spread as a popular reflection of the systematic risks in the economy, which should be compensated with the risk premium. If the roll yields are the key component of the risk premiums, then variation in premiums for systematic risks can cause common variability in the roll yields. As suggested by Acharya et al. [2013], the term yield involves some information on default risk as it could incline producers to hedge more in a risky environment. Producers may be prone to hedge more if the perceived risk of default is high. To summarize, there might be some correlation between present credit risk and future returns. Although the influence of this phenomenon might already be included within the hedging pressure variable, the U.S. corporate BAA spread, calculated over a 10-year yield (*baa*), was implemented as a control variable.

Hong and Yogo [2009] implied that market volatility might also drive the term structure of the commodity futures. They analyzed the VIX index of implied option volatility. Despite the fact that the correlation observed by Hong and Yogo was of no statistical significance, the VIX was used as a control variable, because some papers suggest that the VIX level may influence the expected returns in commodity markets (Munenzon [2012]).

Finally, there are many studies exploring the positive relationship to economic activity (Adams et al. [2008]; Armstead and Venkatraman [2007]; Gorton and Rouwenhorst [2006]; Kat and Oomen [2007a,b]; Strongin and Petch [1995, 1996]). Economic intuition may suggest that the state of economy could also exert some impact on the commodity futures term structure. A high pace of economic growth may induce bigger demand for commodities and, therefore, may "push up" spot prices related to medium- and long-term futures. In fact, spot prices may increase even as a result of a pure anticipation of economic improvement. In other words, the better the shape of the economy, the lower the future roll yields. This concept appears to correspond with Hamilton's [2011] observations, according to which 10 out of 11 recessions were preceded by a substantial surge of spot prices. On the other hand, Dempster et al. [2012] indicated a positive correlation between convenience yields and the term structure in bonds market perceived by them as a proxy for an upcoming recession.[10] In other words, when the term structure in bonds market is downward sloping, this is a sign of a final wave of growth of the economy and that a recession is ahead. This, in turn, translates into lower expected roll yields. Thus, to estimate the relationship to present and future economy conditions, two additional control variables representing the present and anticipated state of the economy were introduced—the U.S. ISM Manufacturing Index (*ism*) and the U.S. government bond term structure (*term*), calculated as the difference between the yield-to-maturity rates (YTMs) of 10-year and 2-year benchmark bonds.

Exhibit 3 summarizes all the explanatory variables included in the research and their expected impact on future roll yields. Exhibits 4 and 5 present the basic statistical characteristics of all regression inputs and the correlation matrix between variables.

All the data come from Bloomberg and the CFTC website. Time series are computed on a monthly basis, consistent with the analyses performed later in the study.

EXHIBIT 3
Explanatory Variables

Variable	Notation	Expected impact on future roll returns
Corporate spread	*baa*	positive
Financialization	*fin*	negative
Hedging pressure	*hp*	positive
Interest rates	*int*	positive
Market volatility	*vix*	positive
Open interest dynamics	*oid*	negative
Recession	*term*	positive
State of the economy	*ism*	negative

EXHIBIT 4
Basic Characteristics of the Variables Included in the Regression

	ry_{1m}	*baa*	*fin*	*hp*	*ism*	*int*	*oid*	*vix*	*term*
Average	-0.001	234.461	0.252	0.082	51.640	3.708	0.007	20.439	1.163
Standard deviation	0.006	81.767	0.091	0.055	5.155	2.315	0.042	7.779	0.919
Skewness	0.413	1.751	0.295	-0.272	-0.819	-0.131	1.357	1.583	0.092
Kurtosis	1.692	4.608	-1.425	-0.110	0.949	-1.097	9.624	4.009	-1.364
No. of observations	275	275	275	275	275	275	275	275	275

Notes: This exhibit presents the basic statistical characteristics of the independent and the dependent variable. Monthly observations are used. The first variable is the dependent variable, which is the time series of the one-month roll returns. The next variables are independent and described according to the notation in Exhibit 1.

Source: Based on data from the CFTC and Bloomberg.

EXHIBIT 5
Correlations between the Explanatory Variables

	fin	*hp*	*term*	*vix*	*oid*	*rf*	*baa*	*ism*
fin	1.00							
hp	0.05	1.00						
term	0.26	0.28	1.00					
vix	0.22	-0.26	0.17	1.00				
oid	0.02	0.05	-0.03	-0.14	1.00			
rf	-0.65	-0.19	-0.80	-0.18	-0.03	1.00		
baa	0.52	-0.11	0.51	0.72	-0.13	-0.62	1.00	
ism	0.10	0.37	0.07	-0.45	0.17	-0.18	-0.47	1.00

Notes: The computations are based on monthly observations. The notation of the variables is presented in the Table 1.

Source: Based on data from the CFTC and Bloomberg.

Thus, the initial regression was also performed on the basis of monthly data. The second research stage comprises two analyses. The first one was based on historical data and essentially examines the historical relationship between financialization and roll yields. We assume the detected relationship is one of causality. We also assume that the detected impact of financialization from the first regression will continue into the future, and so the second set of studies simulates the portfolio properties of commodities using lower returns than historical returns. Further details on our analyses are provided in the following.

The mean–variance spanning test is designed to verify whether inclusion of an asset class in a portfolio results in the expansion of investor's efficient frontier. The test was initially proposed by Huberman and Kandel [1987] and later developed by Ferson et al. [1993], De Santis [1993], and Bekaert and Urias [1996]. In addition, Jobson and Korkie [1989] as well as Chen and Knez [1996] showed that such a test could be used in order to assess investment performance. De Roon and Nijman [2001] proved that it might be used in terms of non-marketable assets.[11] Finally, it should be noted that many examples of mean–variance spanning tests performed with respect to commodities are also available.

The mean–variance spanning test examines whether an investor's efficient frontier is significantly augmented due to inclusion of a new asset class. If a risk-free asset is available, it is sufficient to examine the shift of the tangency portfolio (Kan and Zhou [2012]). If the tangency portfolio is moved, an investor is able to build better optimal portfolios composed of a risk-free asset and a tangency portfolio. It is worth noticing that the improvement in a tangency portfolio equals, in fact, the improvement in the Sharpe ratio.

In what follows, we examine whether the inclusion of commodities expands the efficient frontier of a traditional portfolio comprising stocks and bonds. The test is made from the perspective of the U.S. investor, comprising dollar-denominated assets. The equities as an asset class are represented by Wilshire 5000 Total Market, and the proxy for U.S. government bonds is the Bloomberg/EFFAS U.S. Government Bonds All 1+. Once again, the JP Morgan Commodity Curve Index is used as the commodity portfolio. All the indexes are calculated in a total return regime. Additionally, USD one-month LIBOR is used in order to calculate excess returns on risk-free assets. All the data come from Bloomberg for the period between December 31, 1991, and December 31, 2012. Thus, all three indexes are calculated from the very beginning. Arithmetical rates of return are computed on a monthly basis.

In this article, the mean–variance spanning is tested in two ways: using traditional OLS regression and with the use of Monte Carlo analysis. The second method is based on two distinct risk measures. The details of both methods are described in the following.

The majority of mean–variance spanning tests are based on total rates of return. Therefore, it is plausible to assume that exposure to various asset classes should sum up to 1. In this research, however, risk premiums defined as excess returns on financial market were used. In the regression tests, the approach of Scherer and He [2008, p. 246] is used. The regression model is as follows:

$$R_{it} - c_t = \alpha_i + \sum_{k=1}^{K} \beta_{ik} \times (R_{kt} - c_t) + \varepsilon_{it} \qquad (7)$$

where R_{it} is the return on the examined asset class (commodities), c_t denotes financial market return in month t, and R_{kt} is k-asset's rate of return (stocks and bonds). If α, as specified in the model, 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. If this statement does not hold true, however, an investor can probably replicate i's returns without bearing higher risk or losing some of their returns.

This method is consistent with remarks of Anson [2006] and was used in respect to the commodity market by, for example, Nijman and Swinkels [2008]. The risk premium approach appears to be reasonable for at least three reasons. First, it does not imply that the betas need to sum up to 1. A missing allocation can be filled with cash or negative cash in the case of leverage. Second, it facilitates the graphical interpretation and further analysis as the tangency line of the tangency portfolio is drawn from the origins of the coordinate system. Finally, it seems more practical as it corresponds with futures contracts employed in order to obtain exposure to particular asset classes.

The main issue with the traditional OLS regression in the case of commodities is that the return distribution of commodities seems to be far from normal (Anson [2006]; Gorton and Rouwenhorst [2006]; Erb and Harvey [2006a]). In consequence, the standard deviation might underestimate the true level of investor risk due to skewed distributions and fat tails, if an investor has skewness and kurtosis preferences. The problem is further explored by Johanning et al. [2006]. According to some studies in this field, it is recommended that one take into account also higher moments in the process of portfolio analysis (Arditti and Levy [1975]; Markowitz [1952]; Samuelson [1970]; Harvey et al. [2004]; Cvitanic et al. [2008]; Fang and Lai [1997]; Dittmar [2002]).

Therefore, the second type of testing of the mean–variance spanning comprises two different risk measures: the traditional standard deviation and the modified value at risk ($MVaR$) proposed by Favre and Galeano [2002]:

$$MVaR = \mu - \left[z_c + \frac{1}{6}\left(z_c^2 - 1\right)S + \frac{1}{24}\left(z_c^3 - 3z\right)K - \frac{1}{36}\left(2z_c^3 - 5z_c\right)S^2 \right]\sigma \qquad (8)$$

where μ denotes the mean return, σ is the standard deviation, S is skewness, K is kurtosis, and z_c is the number of standard deviations appropriate for the calculated *VaR*. Contrary to the traditional VaR, *MVaR* does not assume that the distribution of return can be accurately estimated within the normal distribution. The *MVaR* is analytical in its character, but thanks to the Cornish–Fisher *VaR* expansion (Cornish and Fisher [1937]), it approximates distributions different from normal in a much more effective way.[12] Using *MVaR* is consistent with the approach of investors who prefer a return distribution with positive skewness and low kurtosis (Scott and Horvath [1980]; Pratt and Zeckhauser [1987]).

Thus, in the second approach, the statistical analysis was produced as follows. First, monthly arithmetic excess returns over USD one-month LIBOR were calculated for commodities, equities, and bonds. These three asset classes (commodities, equities, and bonds) were represented by the JP Morgan Commodity Curve Total Return Index, Wilshire 5000 Total Markets, and Bloomberg/EFFAS U.S. Government Bonds All 1+ Total Return Index, respectively. As a result of that, we obtained a set of data of excess returns (risk premiums) for three (N) assets (commodities, equities, bonds) over 252 (T) monthly time periods. Second, a standard bootstrap (Efron [1979]) was used to randomly draw (with replacements) 10,000 new samples of returns $\left\{R^{(b)}_{i\tau(t)}, \tau(1),\ldots,\tau(T); i = 0,1,\ldots,\mathrm{N}\right\}$, where $\tau(t)$ is the new time index, which is a random draw from the original set $\{1,\ldots,T\}$. It is important to point out that the time index τ(t) is common across the assets in order to preserve the cross-sectional dependencies in returns. Third, for each draw a risk–return efficient frontier (based on excess returns) for stocks and bonds only was found. In other words, it was assumed at this step that an investor does not allocate the portfolio into commodities. The efficient frontier was computed using two approaches with distinctive risk measures: the standard deviation and the *MVaR*. It was assumed that an investor holds a long-only portfolio (no short positions), does not use credit or leverage, and is fully invested (no spare cash in a portfolio). Next, commodities were added to the asset class universe and efficient frontiers for all three asset classes were explored. Furthermore, we calculated Sharpe ratios for tangency portfolios for both efficient frontiers (i.e., excluding and including commodity investments).[13] We performed this calculation for both risk approaches: standard deviation and *MVaR* (in other words, we obtained four Sharpe ratios in total). (It should be also noted that in terms of the *MVaR*, the measure is, in fact, dubbed the modified Sharpe ratio by Bacon [2008, p. 102].) Subsequently, we computed the improvement in Sharpe ratios, which resulted from the commodities inclusion. As has already been noted in the case of the excess return framework (or in other words, the risk premium framework), the improvement in the maximum achievable Sharpe ratio is, in fact, equal to augmentation (upward and/or leftward shift) of the efficient frontier. We then counted the number of times where the Sharpe ratio *did not* improve. When divided by the total number of bootstraps (10,000), this was interpreted as the *p*-value. One of the benefits of the resampling approach described here is that it does not require any special assumptions regarding the underlying distribution of return. However, its disadvantage is that it does not take into consideration the path-dependency of data.

In a nutshell, the whole analysis described was conducted twice: first, with no consideration of any decrease in roll yields; second, after simulating a decrease in roll yields due to financialization. The size of this decline was derived from the results of the regression analysis reported in the next section.

RESULTS AND INTERPRETATION

Exhibit 6 presents the results of regression analysis of monthly roll returns against the variables described in the earlier part of this article. The regression was performed in a few configurations; however, in any case, only financialization and hedging pressure are statistically significant at the level of 5%. In fact, the level of the significance of financialization is the strongest of all the variables. Additionally, the corporate spread is also significant at the level of 5% in one of the regressions; however, contrary to the underlying theory, the sign of a corresponding parameter is negative. Therefore, this parameter was not used in the further stage of the analysis. The regression, which comprises the highest number of parameters with significance at minimum 1%, includes only two variables: financialization and hedging pressure (see formula (1) in Exhibit 6). This regression bears also the highest *F*-statistics. The formula allows one to perform a simple assessment of the impact of financialization on roll yields:

$$\Delta r\gamma_t = -0.0226\Delta fin_t \tag{9}$$

The average financialization level in the period between 1990 and 2012 was 25.2%; however, in the end of 2012, it grew to 42.2%. In line with Equation (9) the corresponding decline in roll yields should equal about 0.38 percentage points per month (long-term return). In any further mean–variance simulations, therefore, the aforementioned amount of 0.38 percentage points (= –0.0226 * (0.422 – 0.252)) will be used as the estimate of a potential decrease in roll yields. In other words, all the monthly returns on commodities will be lowered by 0.38 percentage points. The 95% confidence interval for the beta estimated in Equation (9), calculated based on standard errors (Aczel [2009, p. 445]), accounts for less than –0.030 (–0.015>). Therefore, any further simulation based on the estimated decrease should be regarded as an approximate simulation of the potential effects of financialization rather than its precise estimate. It is worth noting that the estimated –0.38 percentage points was computed to obtain some basis for the further simulation of possible impact of financialization and should not be perceived as the exact estimate of financialization.

Finally, it should be noted that the results presented in Exhibit 6 support in a general manner the hypothesis

Exhibit 6
The Impact of the Explanatory Variables on the Roll Return

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
intercept	0.003***	0.003***	0.004***	0.003***	0.004	0.004***	0.000	0.017*
	(-2.67)	(2.75)	(2.74)	(2.70)	(1.09)	(3.34)	(0.09)	(1.85)
baa						0.000**		0.000**
						(-2.01)		(-2.24)
fin	-0.023***	-0.021***	-0.022***	-0.023***	-0.022***	-0.018***	-0.017***	-0.012*
	(-5.79)	(-5.28)	(-5.37)	(-5.78)	(-5.74)	(-3.86)	(-3.31)	(-1.83)
hp	0.019***	0.021***	0.017**	0.019***	0.02***	0.017**	0.021***	0.021***
	(2.91)	(3.16)	(2.52)	(2.97)	(2.80)	(2.56)	(3.2)	(2.86)
ism					0.000			0.000*
					(-0.29)			(-1.818)
oid				-0.011				(-0.012)
				(-1.28)				(-1.46)
rf							0.000***	0.000
							(1.66)	(-0.25)
term		-0.001						0.000
		(-1.29)						(0.28)
vix			0.000					0.000
			(-1.03)					(0.77)
No. of Obs.	275	275	275	275	275	275	275	275
Adj. R^2	0.123	0.125	0.123	0.125	0.12	0.133	0.129	0.138
F-Stat	20.185	14.04	13.814	14.031	13.439	14.956	14.469	6.481

*Notes: The regression model estimated for the roll returns of the JP Morgan Commodity Curve Index is based on monthly observations. We run eight distinct multivariate regressions with various combinations of explanatory variables. The variables are named according to the notation in Exhibit 1. The first number in each cell is the OLS estimation of the coefficient for the corresponded variable. The t-statistics are shown in parentheses. *, **, and *** denote statistical significance at the 10%, 5%. and 1% levels.*

Source: Based on data from the CFTC and Bloomberg.

that the financialization of commodities may impede the roll yields and may jeopardize the rationale for including commodities in a diversified portfolio, whereas a low R-squared might suggest that the evidence is not conclusive due some other factors playing a vital role. Norrish and Molina [2010] argued, for example, that a decline in roll yields may result from temporary or permanent factors that are idiosyncratic to particular commodities, rather common to the whole asset class. Particularly, they argued that the scale of outperformance of deferred indexes relative to nearby benchmarks is unlikely to last because this phase has been primarily due to the combination of robust long-term price expectations and weak fundamentals in oil and metals markets. It is also plausible to assume that there are some common factors omitted in this research that drive both the reduction in roll yields and increase in non commercial open interest. These issues should be investigated in a more precise and detailed way in future research.

Exhibit 8 depicts the expansion of the efficient frontier as a result of inclusion of commodities, based on raw historical data (without calculating any impact of financialization). The efficient frontiers are "pushed" upward and leftward after the inclusion of commodities both in the mean–variance approach and in the mean–*MVar* approach.

However, this conclusion does not hold true after calculation of the impact of financialization. As shown

EXHIBIT 7
The Mean–Variance Spanning Test: The OLS Approach

	(1)	(2)
Intercept	0.005	0.001
	(1.722)*	(0.423)
Stocks	-0.351	-0.351
	(-1.604)	(1.604)
Bonds	0.005	0.005
	(0.074)	(0.074)
No. of Obs.	252	252
adj. R^2	0.002	0.002
F-test	1.292	1.292

*Notes: This regression analysis tests whether adding commodities to the traditional portfolio of stocks and bonds results in a shift of the efficient frontier. Two regressions are performed: (1) with no consideration of any decrease in roll yields, and (2) after simulating a decrease in roll yields due to financialization. The OLS mean–variance spanning test is based on monthly excess returns over the USD one-month LIBOR. The dependent variable is the JP Morgan Commodity Curve Index TR. The independent variables are the Wilshire 5000 To1tal Market Index (stocks) and Bloomberg/EFFAS U.S. Government Bonds All 1+ Index (bonds). The first number in each cell is the OLS estimation of the coefficient for the corresponded variable. The t-statistics are shown in parentheses. *, **, and *** denote statistical significance at the 10%, 5%. and 1% levels.*

Source: Based on data from the CFTC and Bloomberg.

in Exhibit 9, neither efficient frontiers in Panels A and B offer better investment opportunities once one adds commodities. Exhibit 7 presents the results of mean–variance spanning test analysis using the regression approach described in the previous section. It has generally confirmed that conclusions drawn from the mean–variance approach graphical analysis were justified. Prior to the calculation of the impact of financialization, the intercept was positive and statistically significant at the level of 10%. Afterwards, however, it is still positive but no longer statistically significant at any reasonable level. In other words, the benefits of commodity futures in a traditional stock/bond portfolio cannot be conclusively confirmed.

These observations are further confirmed by the results of Monte Carlo analysis. Exhibit 10 presents the results of Monte Carlo simulations under no consideration of changes. The increase in distribution of Sharpe ratios indicate that in the case of both approaches (variance and *MVaR*), the maximum attainable Sharpe ratio is significantly increased. Only 4.0% of mean–variance draws and 7.3% of mean-MVaR draws indicated no rise in the Sharpe ratio. Again, this does not hold true under consideration of the impact of financialization. As it follows from Exhibit 11, 32.4% of mean–variance draws and 42.8% of mean-MVaR draws did not indicate any improvement in investors' opportunities. To sum up, it seems that after taking into account the impact of financialization, there is no reason to firmly state that it is still economically justified to invest some share of a stock/bond portfolio in commodities in the risk–return framework.

CONCLUSIONS AND AREAS FOR FURTHER RESEARCH

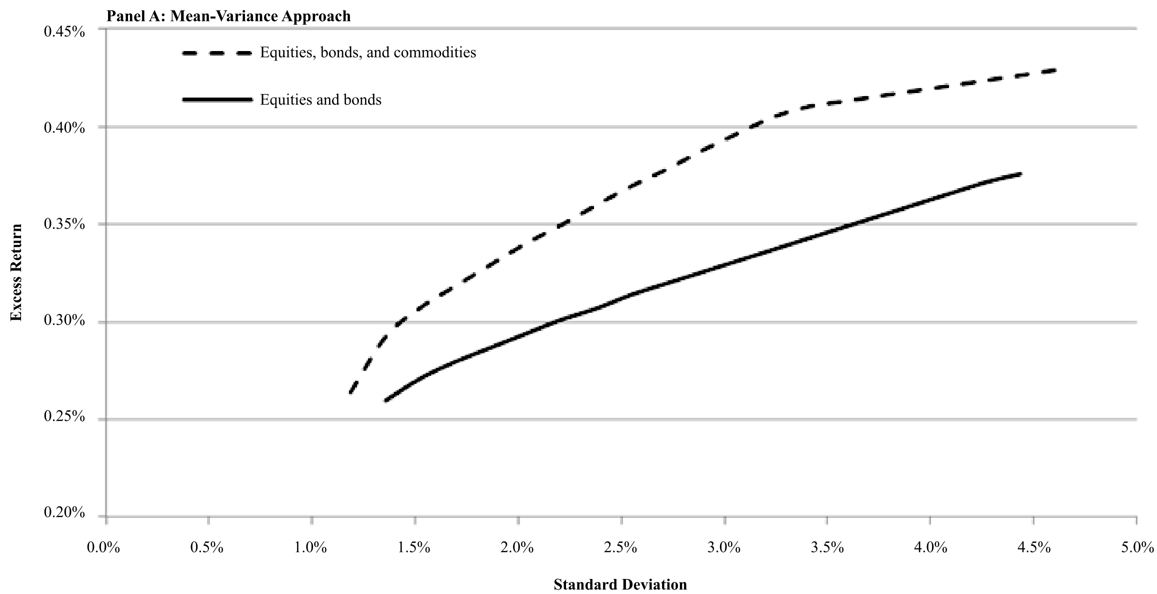
The main focus of this article is the benefits of passive commodity investments in the context of financialization. According to recent literature concerning this subject, financialization might have affected the advisability of passive commodity investments. A number of areas where financialization's influence could have taken place were identified based on other literature, for example, a bubble behavior or increased correlations and distortions of the term curve. One of the key areas of impact could be a structural decrease in roll yields, which, in consequence, led to a decline in the expected returns on commodities.

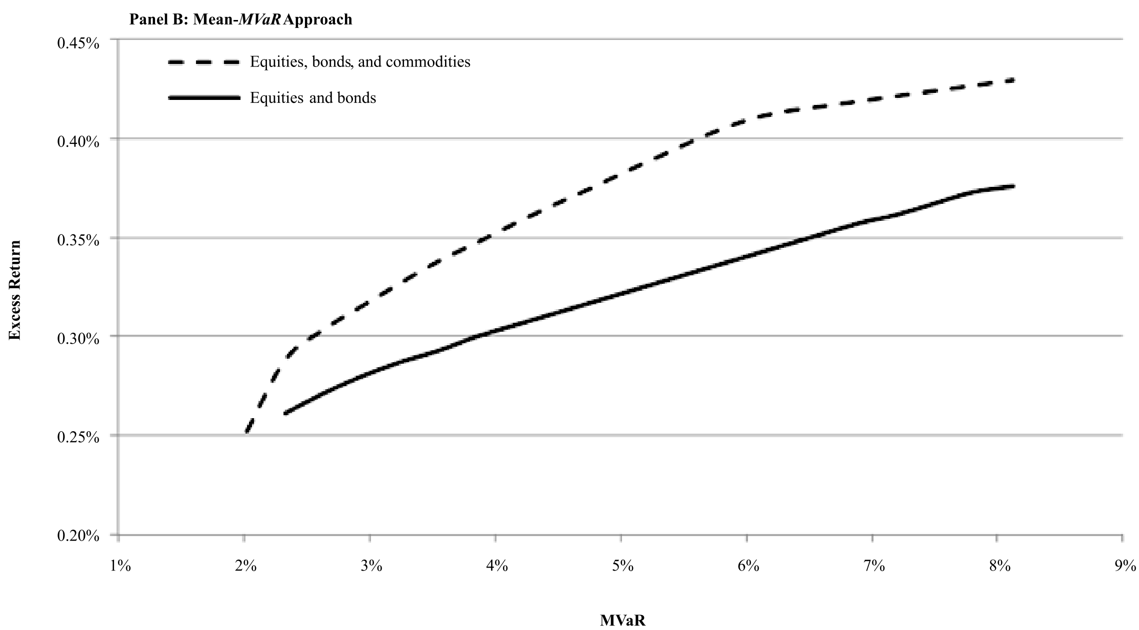
The results of the study's regression analysis indicated that the level of futures market financialization may contribute to the decline in expected roll returns. The results of computations implied that the expected roll yield might be lower by about 0.38 percentage points per month than the average over the period between 1991 and 2012. However, this number should be regarded as an approximate estimate.

The decline in roll returns brings up the following issue: Should some parts of an investment portfolio be allocated to commodities? According to the mean–variance spanning tests, it was true some 10 or 20 years ago, but it may no longer hold true. Due to the decrease in roll yields, the inclusion of commodity futures in a traditional stock/bond portfolio appears to be no longer reasonable. In other words, as a result of the process of commodity markets' financialization, the benefits of commodity investments in terms of portfolio may not be valid anymore.

Exhibit 8

Commodity Investments and the Shift of the Efficient Frontier: Non-Financialized Markets

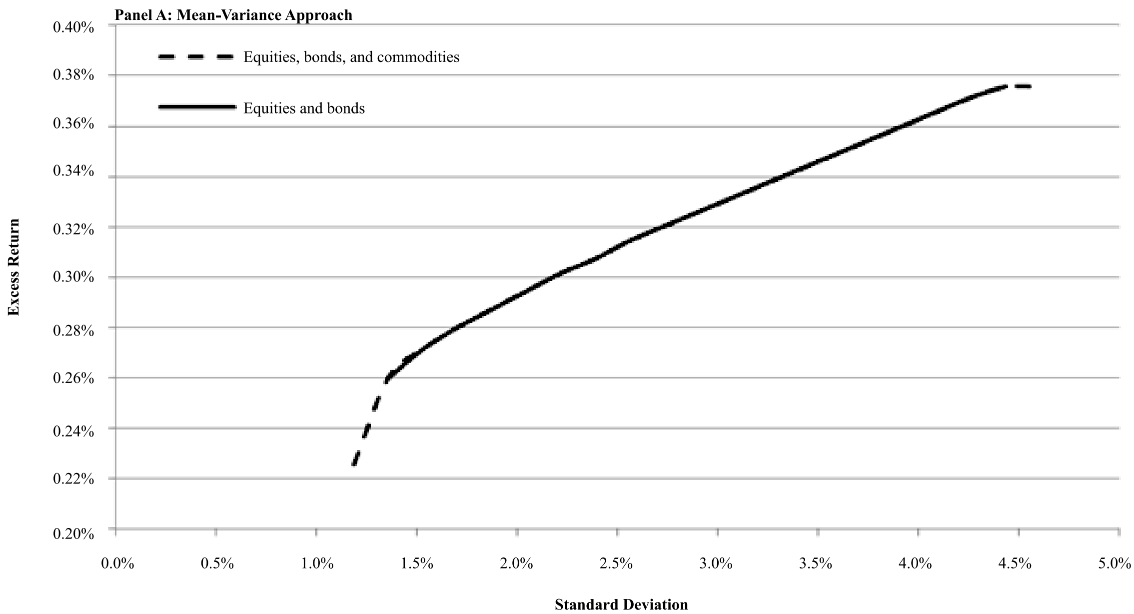


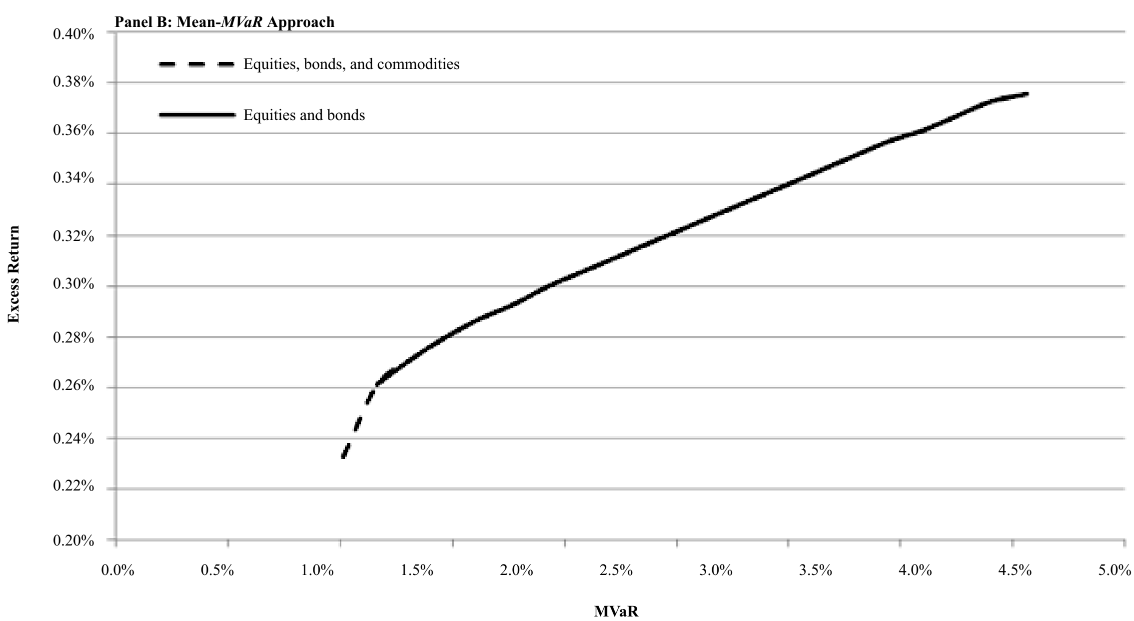


Notes: This exhibit depicts the shift of the efficient frontier after the inclusion of commodities and before accounting for the impact of the financialization. Equities are represented by the Wilshire 5000 Total Market Index, bonds by the Bloomberg/EFFAS U.S. Government Bonds All 1+ Index, and commodities by the JP Morgan Commodity Curve Index. All the three indexes are characterized by the total return calculation methodology. The monthly arithmetical returns are computed in the excess return convention with USD one-month LIBOR as the proxy for the risk-free rate.

Source: Based on data from Bloomberg for December 31, 1991–December 31, 2012.

Exhibit 9
Commodity Investments and the Shift of the Efficient Frontier: Financialized Markets



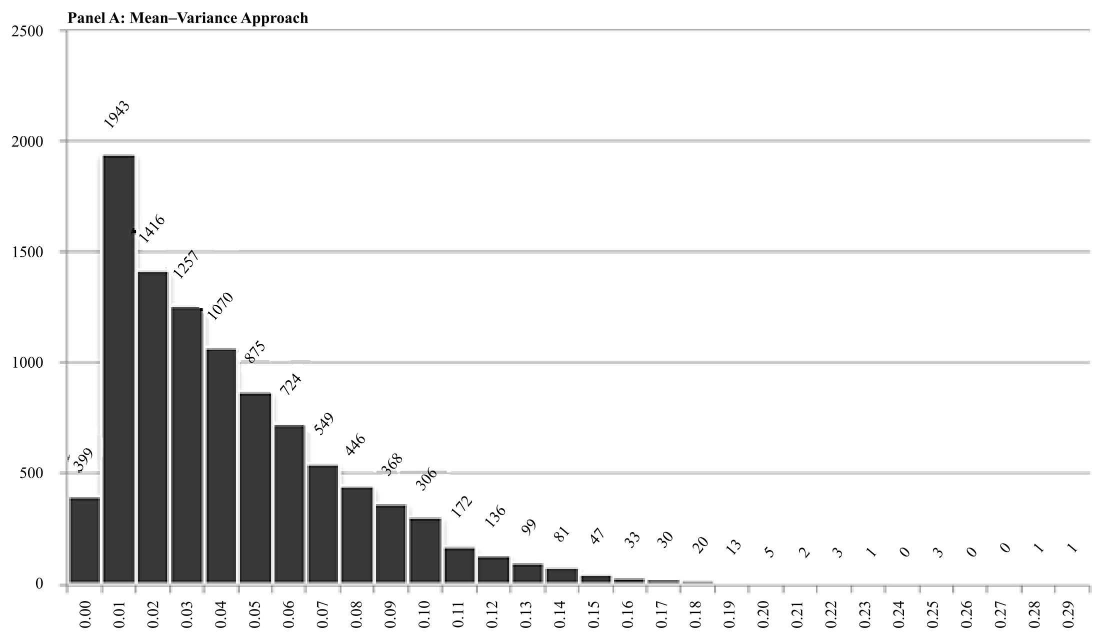


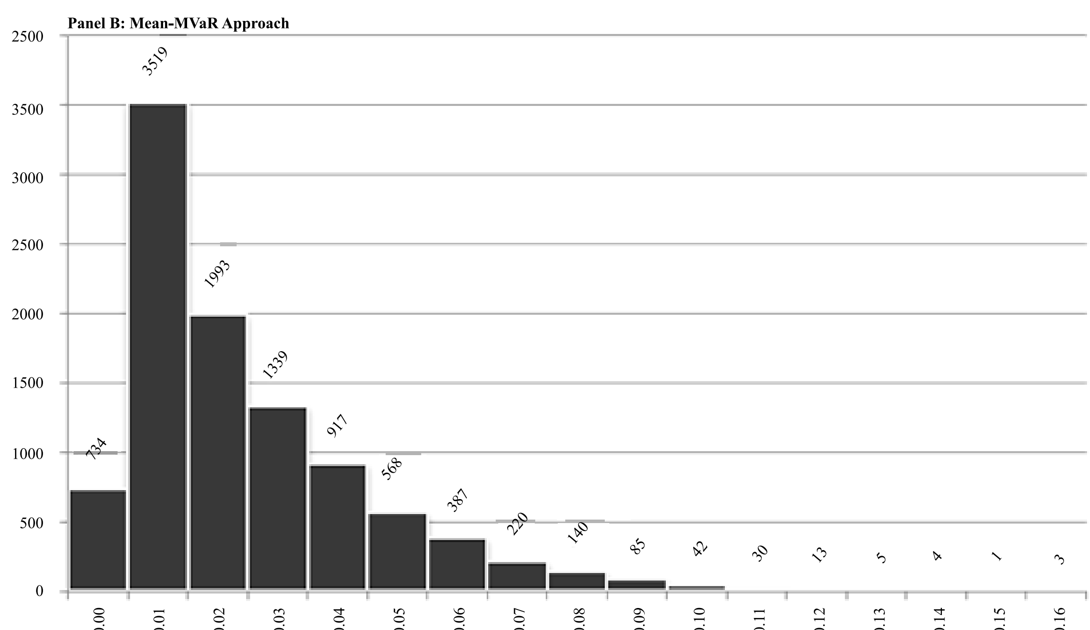
Notes: This exhibit depicts the shift of the efficient frontier after the inclusion of commodities and after accounting for the impact of the financialization. Equities are represented by the Wilshire 5000 Total Market Index, bonds by the Bloomberg/EFFAS U.S. Government Bonds All 1+ Index, and commodities by the JP Morgan Commodity Curve Index. All the three indexes are characterized by the total return calculation methodology. The monthly arithmetical returns are computed in the excess return convention with USD one-month LIBOR as the proxy for the risk-free rate.

Source: Based on data from Bloomberg for December 31, 1991–December 31, 2012.

EXHIBIT 10

Improvement in Maximum Sharpe Ratios: Non-Financialized Markets

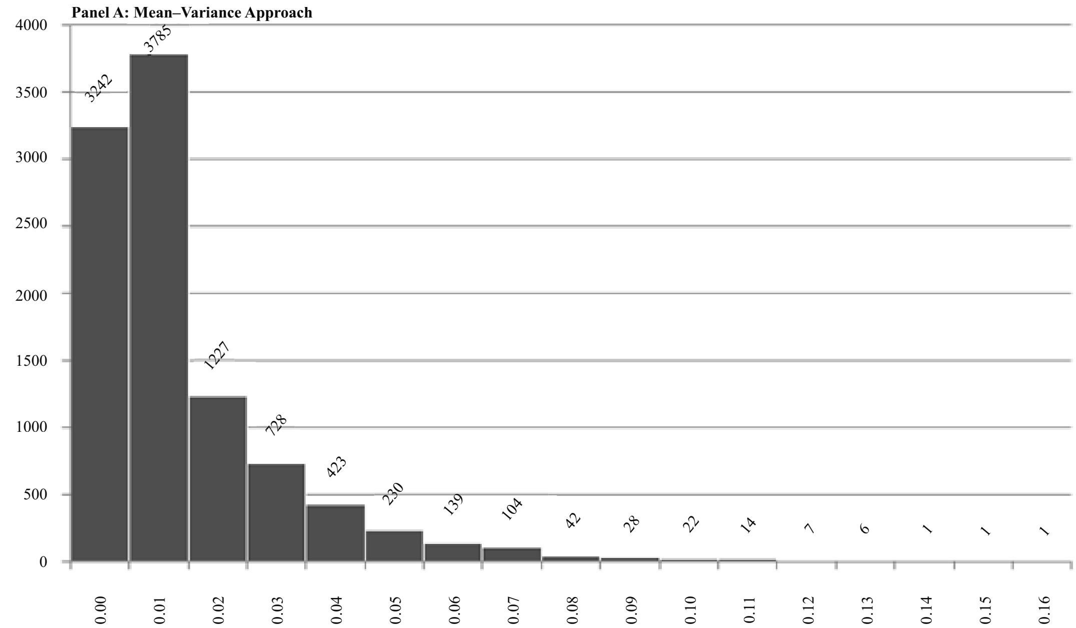


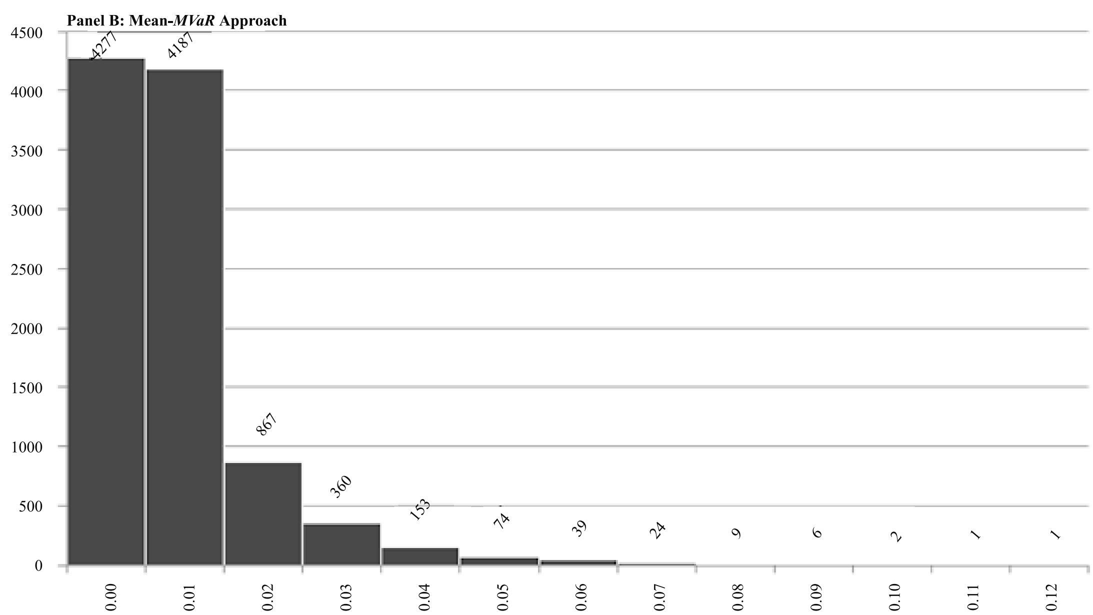


Notes: This exhibit presents the results of 10,000 Monte Carlo simulations of the maximum attainable Sharpe ratio improvement due to the inclusion of commodity investments. The calculations are performed before accounting for the impact of financialization.

Exhibit 11

Improvement in Maximum Sharpe Ratios: Non-Financialized Markets





Notes: This exhibit presents the results of 10,000 Monte Carlo simulations of the maximum attainable Sharpe ratio improvement due to the inclusion of commodity investments. The calculations are performed after accounting for the impact of financialization.

The article's analysis bears two important implications for market practitioners. First of all, commodity investments may be not beneficial in the low roll-yield environment, but still they may turn attractive if roll yields enter their positive territory anew. This an interesting observation as at the end of 2013, and at the beginning of 2014 roll yields were again positive contributors in terms of some commodities (Johnson and Sharenow [2014]; Greer et al. [2014]). Currie et al. [2014] argued that commodities follow multi year cycles of exploitation and investment. According to them, the roll yields are usually lower during the investment phase and higher during the exploitation phase, which began in 2011. Second, investors should evaluate whether strategies that are targeted at maximizing roll yields would provide different results than this study. Such strategies include ones that have dynamic allocations in commodity markets and commodity indexes that are especially designed to maximize roll yields. Such issues are further discussed, for example, by Campbell & Company [2014] and by Greer et al. [2012].

Any further research should focus on several issues. First of all, it would be interesting to test the correlation between financialization and roll yields and its impact on the benefits of commodity investing at the level of single commodities. Second, it would be valuable to identify and include some other factors that may influence roll yields and open interest in the research, with the aim to assess the impact of financialization in a much more precise way. Then, from the perspective of a practitioner, it would be useful to explore the extent to which employing some specific commodity indexes or pursuing active strategies may mitigate the negative impact of financialization. Finally, the impact of other phenomena related to financialization, such as changes in interdependencies between returns of various asset classes, should be explored.

ENDNOTES

[1]A notable exception could be also farmland and timberland ownership at the institutional level, which is sometimes regarded as a type of commodity investment. The benefits of farmland and timberland investing are investigated by, for example, Hennings et al. [2005], Scholtens and Spierdijk [2010], Painter [2010], and Koeniger [2014].

[2]The split of historical commodity returns into three sources (spot returns, roll yields, and collateral yields) can be found, for instance, in the research of Markert and Zimmermann [2008], Füss et al. [2008], Hafner and Heiden [2008], Mezger [2008], and Shore [2008].

[3]The terms "roll return" and "roll yield" are interchangeable in this article.

[4]This idea originated from Kaldor [1939] and was later developed and interpreted by many other researchers (Working [1948, 1949], Telser [1958, 1960], Helmuth [1981], Brennan [1991], Erb and Harvey [2006a], Till [2008], and Spurgin and Donohue [2009]). The theory of storage appears to have solid foundations of empirical research as it was proven by, for example, Fama and French [1988] and Ng and Pirrong [1994]. Recent studies in this field include papers prepared by Dinceler et al. [2004] and Gorton et al. [2012], providing solid support for the theory of storage.

[5]It is worth pointing out that the storage and hedging pressure hypotheses are not mutually exclusive (Fama and French [1988]). Several attempts have been made to connect both concepts (e.g., Cootner [1967]; Khan et al. [2008]). The aim was finally reached by Hirshleifer [1990] who actually synthesized the papers of Keynes [1930] and Working [1949]. According to Gorton et al. [2012], hedging demand correlates with inventory levels, implying that time-varying hedging pressure is dependent on the storage risks (Gorton et al. [2012]).

[6]Other theories include the theory of rational expectations (Hicks [1946]; Hurwicz [1946]), market segmentation, liquidity preference (Spurgin and Donohue [2009]), and the option theories (Litzenberg and Rabinowitz [1995]; Milonas and Thomadakis [1997]; Zulauf et al. [2006]). The detailed description of these theories is beyond the scope of this study.

[7]Such definition is consistent with definitions cited in Till [2007a, p. 74].

[8]One exception is a measure called "speculative T-index" ascribed to Working [1960], which was recently employed by, for example, Sanders and Irwin [2010]. However, the intention of this article is to isolate the effects connected with financialization and hedging pressure separately, so two individual measures are used.

[9]A good review is offered by Vdovenko [2013].

[10]There is a popular interpretation of the yield curve spread as a proxy for recession (Estrella and Mishkin [1998]).

[11]Mean–variance spanning tests were reviewed De Roon and Nijman [2001].

[12]An important pitfall of the Cornish–Fisher expansion is the limited domain of validity of the formula. In the case of this study, however, the dataset fits the required assumption, so the accuracy of the Cornish–Fisher expansion is sufficient. The issue is discussed in articles by Chernozhukov et al. [2010] and Maillard [2012].

[13]The tangency portfolios are characterized in this case by the maximum attainable Sharpe ratios.

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