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Inflation, Business Cycles, and Commodity Investing in Financialized Markets

Adam Zaremba[a]

Abstract: *Financialization of commodity markets has been a broadly discussed topic in recent years. However, its implications for commodity investors have not yet been fully explored. This paper concentrates on the macroeconomic determinants of commodity returns in financialized and non-financialized markets and on their role for a tactical asset allocation. The study aims to contribute to the academic literature in four ways. First, it provides fresh evidence on the interdependences between commodity returns, inflation and the business activity. Second, it documents increased correlation of the commodity returns with the business activity in the financialized markets. Third, it explores changes in the lead/lag relationship of commodity prices and the business cycle. Fourth, it proves that the commodities retained their inflation hedging abilities in the financialized markets. The computations are based on listings of various commodity indices, which are calculated by S&P-GSCI, JP Morgan, and Dow Jones-UBS, between 1970 and 2013.*

Keywords: Commodities, inflation hedging, macroeconomic determinants, business cycle, financialization.

JEL Classification: G11, G13, Q02

1. Introduction

Commodities as an asset class have made a huge career in recent years. Commodity markets are no longer a meeting points for refineries, mines and lone traders. They became a popular playground for highly-specialized hedge funds, ETF's, retirement funds, and traditional investors. Commodities are now a common asset class in investment portfolios.

The above-described changes are clearly visible, when one looks at the investors' structure. Cheng and Xiong (2014) indicate, that according to an estimate provided by the CFTC in 2008, investment inflows to commodity indices from early 2000 to June 30, 2008 amounted about 200 billion $ (CFTC, 2008). The CFTC in its statistics divides market participants into commercial, who are basically hedgers, and non-commercial, who are speculators. For example, in the crude oil market, the participation of traders reported as non -commercial grew from as low as 2-6% in the beginning of the '90 to 32-38% in 2012. In the case of cotton market the increase was from about 1% to over 30%. The changes for other commodity markets were quite similar.

The described process has been named "financialization", according to the term coined by Domanski and Heath (2007), and it has become an area of interest for many research papers (Irwin & Sanders, 2011, Irwin & Sanders, 2012; Tang & Xiong, 2012; Vdovenko, 2013).

[a] PhD., Poznań University of Economics, Faculty of Management, Department of Investment and Capital Markets, Poland, adam.zaremba@ue.poznan.pl

The crucial question is: how the structural changes affected the way market works? Does the soaring investors' presence impact the price formation process? Can it cause bubbles? Does it alter the way the commodity prices behave? Two opposite views have crystalized as a result of this debate. On the one hand, some economists (Krugman, 2008; Stoll & Whale, 2010; Irwin & Sanders, 2010; Irwin & Sanders, 2012; Fattouh et al. 2012) argue, that speculators do business as usual and should not be a cause for concern. Additionally, the evidence for the systematic impact of commodity investors is rather scarce and unconvincing. On the other hand, supporters of the "bubble" hypothesis suppose, that the "commodity financialization" is important for the price formation (Masters; 2008). A noticeable number of studies provides interesting theoretical and empirical evidence. The apparent impact may take a few forms, for instance by inducing bubble formation (Masters, 2008; Gilbert, 2009; Gilbert, 2010; Einloth, 2009), influencing the term-structure of commodities and thus the roll-yields (Mayer, 2010; Tang & Xiong, 2012; Vdovenko, 2013, Brunetti & Reiffen, 2011; Zaremba 2014a), impacting correlations across distinct commodities and correlations of commodities with a different asset class (Silvennoinen & Thorp, 2009; Tang & Xiong, 2012; Zaremba, 2014b), or even influencing the profitability of a tactical asset allocation in commodity markets (Zaremba, 2014c). With regard to this paper, the last issue is of particular importance.

How does the increased presence of commodity investors distorts the correlations? The basic mechanism may look as follows. Let's take an investor, who holds a constant portion of his investment portfolio (for example 10%) allocated to long-only positions in commodity futures and the rest of the portfolio in more traditional asset classes, like stocksor bonds. If the stock prices fall, and the commodity prices remain constant, then the fraction of the portfolio invested in commodities increases. So as to rebalance the portfolio, the investor has to reduce (or just short) the commodities. Due to this process, the external shocks from the equity market are transferred into the commodity markets.

There are a few reasons why investors include commodities in their portfolios. First, diversified commodity portfolios tend to provide long-term positive risk premiums and equity -like returns (Till, 2007a; Till, 2007b; Till, 2007c; Erb & Harvey, 2006; Gorton & Rouvenhorst, 2006). Second, commodity returns are not fully correlated with traditional asset classes, so they may be effectively used in a strategic asset allocation in order to expand the existing mean-variance frontier (Ankrim & Hensel, 1993; Becker & Finnerty, 1994; Kaplan & Lummer, 1998; Anso, 1999, Abanomey & Mathur, 2001; Georgiev, 2001; Gorton & Rouwenhorst 2006). Third, some commodities may provide a hedge against the tail risk (Deaton & Laroque, 1992; Armstead & Venkatraman, 2007). Fourth, commodity indices reveal some inflation-hedging properties (Umar & Spierdijk, 2011). Fifth, a range of studies documents, that commodities may be also employed for a tactical asset allocation (Erb & Harvey, 2006; Adams et al., 2008).

There seems to be a broad consensus among the economists, that there are plenty of benefits of commodity investing. However, how these benefits are affected by the financialization, is still an open question. Some papers indicate that the changes in the term structure and correlations could have casted some doubt on the validity of the inclusion of commodities in the strategic asset allocation (Zaremba 2014a, Zaremba 2014b). The aim of this paper is to focus on the two other traits: the inflation hedging abilities and the tactical asset allocation across the business cycle. As far as I am concerned, this issue has not been explored in financial literature so far. The main rationale of this study is to fill this gap.

The main rationale of the paper is to investigate whether the finacialization impacted the inflation hedging abilities of commodity investments, as well as whether it influenced the relationship of commodities with a business cycle. As far as the author is concerned, this is the first study devoted to this topic.

The paper concentrates on the macroeconomic determinants of commodity returns and how the interrelations between commodities and economic aggregates changed since the market became “financialized”. It targets to contribute to the economic literature in four ways. First, it provides the fresh evidence on the interdepences between commodity returns, inflation and the business activity. Second, it tests whether the dependence of commodity prices on the business activity became stronger in recent years. Third, it is examined whether the lead/lag relation of commodity prices with regard to the business cycle have changed. Fourth, it investigates if the commodities retained their inflation hedging abilities.

The paper is composed of three main sections. First, it presents the theoretical basis for the research. Second, it introduces the research methods employed and data sources. Third, it discusses research results. The paper ends with conclusions and indications for further research.

2. Theoretical Basis

There is an extensive financial literature exploring macroeconomic determinants of commodity returns. However, two issues seem to be particularly extensively discussed: the behaviour of commodities during the business cycle and their inflation hedging properties. What is especially interesting, in both cases the behaviour of commodities is very different to equities or bonds.

With regard to the business cycle, a widely-held belief says, that the main difference is that the equities and bonds are anticipatory in their pricing, while the valuation of commodities relies more on the current economic conditions (Anson, 2009). The value of equities and bonds stems from the assessment of future financial conditions of their issuers. The better off the companies are expected to be, the higher long-term cash flows and coupon payments they generate. As a result, the prices of these assets should be the highest when the future prospects of the economy are the best, not the current conditions. In other words, their performance should be superior to other classes when the expected (not actual) economic conditions improve. However, commodities reflect the opposite pattern. The demand for raw materials from the real economy is the biggest, when the economic activity is the highest. Consequently, the commodity prices should be determined not by the future economic conditions, but by the current state of the business cycle. The prices ought to be the lowest when the economic activity is the lowest, and the highest when the economic activity is the highest.

It is important to note, that both asset classes are generally positively correlated with the business cycle, however the correlation is derived from different channels. In case of equities the relationships come from the changes in financial shapes of the companies, time-varying discount rates, wealth effects, the variation in costs of financing etc. In case of commodities, what matters to greater extent, is rather the current economic demand. As a result, although there may be some differences in the lead-lag interdependencies, the both asset classes are generally positively correlated with the business cycle.

The above-mentioned theory is consistent with empirical observations. Adams et al. (2008) indicates that commodities are characterised by positive correlations and betas with the changes in the industrial production. The relationship is particularly strong for industrial metals and energy commodities. Gorton and Rouvenhorst (2006) and Nguyen and Sercu (2010) examine returns to commodities and other asset classes during various stages of a

business cycle. They document, that commodities usually perform the best in a late stage of an economic expansion, while equities in an early stage. Some papers even indicate that the decent performance of commodities may last even to the first months or quarters when the economic growth is slowing (Anson, 2008; Gorton & Rouvenhorst, 2006). In other words, while the commodities comove with the economic activity, or even lag it slightly, the equities tend to lead a business cycle by a few months (Siegel, 1991; Backus et al. 2007).

There is a popular view in economy, that value of traditionally denominated assets, like stocks and bonds, decreases, when unexpected or realized inflation increases (Adams, Füss, & Kaiser, 2008). The reason for this lies inherently in the nature of these instruments. On the one hand, the bondholders obtain a predefined stream of cash flows, and its present value, besides the size and timing, depends on interest rates, which commonly rise in line with inflation. On the other hand, stocks often represent residual claims on fixed assets and their value usually comoves with the inflation. Nonetheless, the major part of stocks' value comes from future cash flows not related directly to these assets, and companies often operate under nominally fixed contracts on both the sales-side (contracts with customers) and the cost-side (suppliers, employees, etc.). Additionally, free cash flows to shareholders, although highly uncertain, are still discounted with inflation-determined cost of capital. Contrary to stocks and bonds, the nature of commodities with regard to inflation is very different. In fact, the behaviour of commodity futures interact with inflation in a few ways. The changes in commodity prices impact inflation, as they constitute a component of a basket of goods based on which inflation is calculated (Cheung, 2009). This impact may be direct or indirect, for instance an increase in oil prices influences transportation costs which eventually impacts the costs of transported goods. Moreover, the prices of actively traded commodity futures contract reflects expected inflation and adjust to the most up-to-date economic information (Adams, Füss & Kaiser, 2008).

The theoretical deliberations on the role of commodities in inflation hedging are backed up with some firm evidence. Early studies on inflation hedging properties of commodities include papers by Greer (1978) and Bodie and Rosansky (1980), who investigated responses of bonds, stocks and commodities to changes in inflation between 1950 and 1976. They found that, the annual excess returns of stocks and bonds are negatively correlated with the variation in inflation (correlation coefficient equal -0.48 and -0.2), while the correlation with commodities is positive (0.52). Numerous later studies confirmed these findings using more sophisticated techniques and extended samples (Becker & Finnerty, 1997; Gay & Manaster, 1982; Ankrim & Hensel, 1993; Froot, 1995; Kaplan & Lummer, 1998; Gorton & Rouwenhorst, 2006; Kat & Oomen, 2007; Hoevenaars et al. 2008; Spierdijk & Umar, 2013). The correlation tends to be particularly strong in case of unexpected inflation (Gorton & Rouwenhorst, 2006; Ankrim & Hensel, 1993) and over long horizons (Gorton & Rouwenhorst, 2006; Roache & Attie, 2009). A significant number of papers explored the hedging properties among particular subsectors of commodities or even single commodities (Erb & Harvey, 2006; Kat & Oomen, 2007; Woodard, 2008). Generally, it appears, that the correlation with inflation is especially high for energy resources and industrial metals and lower for agriculture and precious metals (Adams, Füss, & Kaiser, 2008).

What is interesting, as the most of commodities included in popular index are quoted in US dollars, the inflation hedging ability of commodities seems to be to some extend mainly a dollar phenomenon. Many papers suggest, that although the correlation of commodity returns with the US inflation is strong and significant, the relationship with for example the

European or Japanese inflation remains rather unclear (Adams, Füss & Kaiser, 2008). However, the evidence from some other less developed markets, such as India, confirms the inflation hedging properties (Joshi, 2012).

The above-described patters of commodities' price behaviour were mainly examined and evaluated in the pre-financialization period. The question, whether the structural changes denoted as financialization - influenced these patterns remains open. In this paper, we test three hypotheses about the structural changes of commodities' behaviour in the financialized markets with regard to macroeconomic determinants of commodities returns.

First, as the commodities became more correlated with equities, their interdependence with the business cycle could have strengthened. The reasoning behind this is that in non-financialized markets interrelation channels have different and uncorrelated timing, while in financialized markets both effects are to greater extent synchronized, so they may amplify each other. As a result, the question is, if the interdependence between commodities' prices and business activity is stronger in the financialized markets than in the non-financialized markets.

Second, as the equities and commodities became more correlated and changes in their prices more synchronized, it seems plausible, that traditional lead-lag patters could also be distorted. The question is, do the commodities in financialized markets still lag or coincide the business activity, or alternatively do they behave in more equity-like, anticipatory way.

Third, do commodities still constitute a decent inflation hedge? Although, there appears to be no aspect of commodity markets' finacialization, which would directly impact the interrelation with the economy-wide inflation, the influence may be indirect, for example through distortions in the interrelations with the business activity. In short, here the question is, has the commodities retained their inflation hedging properties both in financialized and non-financialized markets.

3. Data Sources and Research Methods

So as to test the robustness of the research results, a few types of data and computational approaches are used. Generally, computations are based on S&P-GSCI Commodity Index, which is probably the most popular and broadly used gauge of commodity markets, however the computations are also repeated with JP Morgan Commodity Curve Index and Dow Jones-UBS Commodity Index. Total return indexes are employed as they represent the investors point of view the best, additionally the results with S&P-GSCI spot return and excess return indices are confirmed. Moreover, I the S&P-GSCI subindices related to subsectors of commodity markets are investigated: industrial metals, energy resources, agricultural and precious metals (S&P-GSCI Industrial Metals, S&P-GSCI Energy, S&P-GSCI Agriculture, S&P-GSCI Precious Metals).

The point of view of US investor is taken into account, as this is the biggest financial market used by many foreign investors, so the results are comparable with other papers in the field. As a result, the US nominal Industrial Production Index and the US Consumer Price Index as representations of business activity and price inflation are used.

The calculations are performed on the basis of quarterly changes of economic aggregates or commodity prices. However, in order to avoid unnecessary loss of information

monthly time series of log-returns or log-changes are used and employ the Newey-West (1997) correction for formal statistical interferences. All the regressions are estimated using OLS and are tested in a parametric way.

All the computations are performed on the full sample, encompassing period 31/12/1970 to 30/11/2013, although the particular lengths of various time series may be shorter due to data availability. What is more, the sample is split into two subsamples: the pre-financialization period (31/12/1970-31/12/2003) and the financialization period (31/01/2004-30/11/2013). The border date is chosen to some extent arbitrally, but generally it was in 2004 when the widely cited paper by Gorton and Rouvenhorst (2006) initially appeared and when the huge influx of investors' money to the commodity markets began. This publication, which sparked a huge interest in commodity investments, could be regarded as a breakthrough date for financialization of commodity markets. Additionally, around the year 2004 a few important structural changes took place. First, many markets transitioned from traditional open-outcr system to electronic trading (Irwin & Sanders, 2012). Second, the trading volume in futures markets begin to rise at an unprecendenced paste. Third, the commodity exchange traded funds (ETFs) started to play an important role in the markets.Investigating the interdependence with the business cycle, the focus is on two issues particularly: on the magnitude of the relationship and its lead/lag character. First, the average returns are computed during the phases of industrial production growth and contraction (growth rate greater or smaller than 0 in an examined period). This approach is also taken by for example Fama and Schwert (1977), Schwert (1981) or Bekaert and Wang (2010). Second, simple linear correlation coefficients are calculated between changes in commodity prices and industrial output. Finally, commodities "economic betas" are found by regressing commodity returns on the variation in industrial production. This approach is consistent with for instance analysis of Adams et al. (2008), however the currency component is dropped as the currency effects are beyond the scope of this paper. The following formula is used:

$$r_t = \mu + \beta p_t + \varepsilon_t, \quad (1)$$

where: r_t is the commodities' return computed as

$$r_t = \ln\left(\frac{P_t}{P_{t-1}}\right), \quad (2)$$

p_t^n is the change in industrial output computed as

$$p_t = \ln\left(\frac{IP_t}{IP_{t-1}}\right), \quad (3)$$

P_t is the commodities' price level at time *t*, and IP_t is the size of industrial production.

Finally, the lead/lag relationship of commodities is tested with regard to the business cycle. It is performed by computing time-series correlations with various lags and leads ranging from -10 to +10 months and observing in which lead/lag configurations the correlations are the strongest.

Investigating the issue of inflation hedging requires somehow similar research instruments. the inflation hedging properties of commodities are tested using a few

methods. First, the Bodie's approach (Bodie 1982) is used, which makes use of Pearson's linear correlation coefficients, denoted ρ. Bodie shows that employing a mix of risky and nominally riskless assets, if ρ = 1, then it is possible to form a riskless real return by taking long position in the risky asset. However, if ρ is equal to 0, then the examined asset has no inflation hedging ability.

It is important to note, that in this analysis takes a point of view of an investor who is only interested in protecting the expected returns from inflation and it is assumed that the dynamics between the asset returns and inflation rates may be fully captured by a simple static regression. Investors' specific mean-variance preferences are not considered, therefor there is no advantage taken of other measures of inflation hedging capabilities, like for example hedging demand (Campbell & Viceira; 2001, Schotman & Schweizer 2000), inflation tracking portfolios (Lamont, 2001, Bekaert & Wang, 2010) or real return variance (Reilly et al. 1970, Cagan 1970 Bodie 1976). Additionally, Umar and Spierdijk (2011) discuss various inflation hedge measures and indicate that some of them, like Fisher-based measures and Schotman and Schweizer approach, generally yield consistent results. Additionally, it is also possible to hedge with an asset which is negatively correlated to price inflation, provided that it is possible to short the asset. Summing up, the higher the absolute value of correlation, the better the hedging properties. This measure is relatively intuitive, as the correlation reveals the strength of the relation between changes of assets' values. Finally, it is important to note that the correlation with expected, unexpected and realized inflation is tested.

Second, the measures related to Fisher's hypothesis (Fisher 1930) are employed, which basically state that:

$$E\left(r_t^n\right) = E\left(r_t^r\right) + E\left(i_t\right), \tag{4}$$

where: r_t^n is the asset's nominal return computed as

$$r_t^n = \ln\left(\frac{P_t}{P_{t-1}}\right), \tag{5}$$

i_t^n is the inflation rate computed as

$$i_t^n = \ln\left(\frac{I_t}{I_{t-1}}\right), \tag{6}$$

r_t^r is the corresponding asset's real return, P_t is the assets price at time *t*, and I_t is the level of a chosen price index. In other words, Fisher assumes, that the asset expected returns and expected move in parrarel, as the lost of value due to inflation need to be offset by the increase in expected nominal returns. Umar and Spierdijk (2011) indicate, that there is a broadly accepted belief in the academic literature, that if the Fisher's hypothesis holds, then an asset is a good hedge against the inflation. Fama and Schwert (1977) show how this approach may be employed to test the inflation hedging properties. In this paper, the hedging properties taking into account both expected and unexpected inflation is examined, so the following formula is used(consistent with Fama and Schwert 1977):

$$r_t^n = \mu + \beta E\left(i_t\right) + \gamma\left[i_t - E\left(i_t\right)\right] + \varepsilon_t, \tag{7}$$

where μ, β, and γ are model parameters and εt is the zero-mean disturbance term. If 0<<1, than the asset is a partial hedge against expected inflation and if β>1 than it is more than a complete hedge. The β coefficient equal to 0 denotes no hedging abilities against expected inflation and β<0 mean than the asset is a perverse hedge. The interpretation of γ analogical, however it relates to unexpected changes in inflation. One of the main weaknesses of the approach above is that the expected inflation is actually unobservable. Two distinct proxies for this are used. The short-term expected inflation (3 months) is represented by corresponding period's T-bill rate (this simple approach is commonly used, for example by Fama and Schwert, 1977; Schwert, 1981; Gorton & Rouverhorst, 2006), and the long term inflation (1 year) is represented by the University of Michigan Survey of Inflation Expectations 1 year ahead. Additionally, the nominal returns against the realized (ex-post inflation) are regressed, which is consistent with the approaches of Jaffe and Mandelker (1976), and Boudoukh and Richardson (1993):

$$r_t^n = \mu + \beta i_t + \varepsilon_t . \quad (8)$$

The β coefficient in equation (4) can be interpreted in the same way as the β coefficient in formula (3), however it is obviously not equal to it.

4. Results and Discussion

In the results section the initial focus is on the correlation with the business activity and next on the inflation hedging properties. The Table 1 exhibits average returns during periods of US industrial production growth and contraction.

Table 1. Commodity returns during economic periods of economic growth and contraction.

	GSCI TR	GSCI SR	GSCI ER	GSCI EN	GSCI AG	GSCI IN	GSCI PM	JPMCCI	DJUBS
					Full period				
Growth	3.17	1.92	2.11	3.45	1.56	3.12	1.45	2.63	1.78
Contraction	-0.99	-2.54	-2.32	-3.27	-1.02	-2.52	2.28	-1.91	-1.64
Difference	4.16	4.46	4.42	6.73	2.58	5.65	-0.83	4.54	3.42
					Pre-fin				
Growth	3.57	2.06	1.68	4.07	1.90	3.02	1.04	2.49	2.21
Contraction	0.18	-1.70	-2.50	-1.57	-0.54	-2.24	1.99	-1.64	-0.72
Difference	3.39	3.76	4.18	5.64	2.44	5.26	-0.95	4.13	2.92
					Post-fin				
Growth	1.90	1.47	3.50	2.14	0.47	3.39	2.65	2.81	1.21
Contraction	-5.23	-12.20	-8.59	-16.79	-2.30	-0.66	-0.25	-4.42	-7.97
Difference	7.13	13.67	12.09	18.93	2.77	4.05	2.89	7.24	9.19

Description: The Table depicts log-returns to commodity indices during periods of growth of the US industrial production. All the data are in %. GSCI TR, GSCI SR and GSCI ER are S&P-GSCI Commodity Indices: Total Return, Spot Return and Excess Return Indices. GSCI EN, GSCI AG, GSCI IN and GSCI PM are S&P-GSCI Commodity Subindices referring to Energy, Agriculture, Industrial Discription: Metals and Precious Metals. JPMCCI and DJUBS refer to JP Morgan Commodity Curve TR Index and Dow Jones-UBS Commodity TR Index. The examined period is 12/31/1970-11/30/2013, unless only shorter time-series are available. The pre-fin period is 12/31/1970-12/31/2003 and the post-fin period is 12/31/2003-11/30/2013. All the data come from Bloomberg.

The computations confirm that the economic conditions seem to be an important determinant of commodity returns. The increases in aggregate commodity prices were much higher than contraction during periods of economic growth, which usually coincided with falls in commodity prices. This observation is true no matter what commodity index (JPMCCI, DJUBS or GSCI) or what computational convention (TR, SR, ER) is used. However, when it comes to sector indices, the precious metals seem to be an only exceptions, as their prices usually soared more during economic contractions than expansions. Finally, the investigation of commodities behaviour during post- and pre-financialization period provides some additional insights. In the financialized markets the differences in average returns between growth and recession periods were much higher than in non-financialized markets.

The analysis of commodity-industrial production correlations allows to reach similar conclusions (Table 2). Generally, with the exception of precious metals, the correlations with changes in industrial production were positive. The interdependence is the highest for energy and industrial metals and the weakest for agriculture (except precious metals, naturally). Again, it is important to note, that the correlation in the post-2003 period was much higher than in the earlier years. For example, in the case of S&P-GSCI TR quarterly changes it increased twice, from 0.21 to 0.41. The differences were commonly statistically significant. The above-described observations are confirmed by the economic beta analysis' results (Table 3). The betas clearly increased, no matter what index, return convention or data frequency are used. Actually, the betas in the pre-financialization period were not statistically different from zero. Summing up, the observations are consistent with the first supposition of this paper.

Table 2. Correlation between commodity returns and changes in industrial production.

	GSCI TR	GSCI SR	GSCI ER	GSCI EN	GSCI AG	GSCI IN	GSCI PM	JPMCCI	DJUBS
Full sample	0.28	0.28	0.26	0.27	0.20	0.24	-0.02	0.38	0.36
	(3.73)	*(3.81)*	*(3.44)*	*(3.10)*	*(2.63)*	*(2.96)*	*(-0.19)*	*(3.90)*	*(3.62)*
Pre-fin	0.21	0.22	0.23	0.16	0.18	0.14	-0.03	0.32	0.22
	(2.39)	*(2.57)*	*(2.67)*	*(1.45)*	*(2.06)*	*(1.45)*	*(-0.38)*	*(2.45)*	*(1.54)*
Post-fin	0.41	0.41	0.35	0.39	0.23	0.41	0.08	0.41	0.41
	(2.74)	*(2.74)*	*(2.30)*	*(2.61)*	*(1.47)*	*(2.76)*	*(0.47)*	*(2.75)*	*(2.73)*
Difference	0.20	0.19	0.12	0.23	0.06	0.27	0.11	0.09	0.19
	(2.10)	*(2.08)*	*(1.66)*	*(1.91)*	*(0.97)*	*(2.13)*	*(0.49)*	*(1.69)*	*(1.77)*

Description: The Table depicts correlation coefficients between log-returns to commodity indices and logarithmic changes of industrial production in the USA. GSCI TR, GSCI SR and GSCI ER are S&P-GSCI Commodity Indices: Total Return, Spot Return and Excess Return Indices. GSCI EN, GSCI AG, GSCI IN and GSCI PM are S&P-GSCI Commodity Subindices referring to Energy, Agriculture, Industrial Metals and Precious Metals. JPMCCI and DJUBS refer to JP Morgan Commodity Curve TR Index and Dow Jones-UBS Commodity TR Index. The examined period is 12/31/1970-11/30/2013, unless only shorter time-series are available. The pre-fin period is 12/31/1970-12/31/2003 and the post-fin period is 12/31/2003-11/30/2013. All the data come from Bloomberg. The first row in each case refers to correlation coefficients and the numbers in brackets denote statistical significances.

Table 3. Economic betas of commodity indices.

	GSCI TR	GSCI SR	GSCI ER	GSCI EN	GSCI AG	GSCI IN	GSCI PM	JPMCCI	DJUBS
Full sample	1.83	1.87	1.63	3.43	1.34	2.01	-0.10	2.40	2.09
	(3.75)	*(3.83)*	*(3.46)*	*(3.13)*	*(2.64)*	*(2.98)*	*(-0.20)*	*(3.94)*	*(3.66)*
Pre-fin	1.22	1.31	1.31	2.38	1.18	1.17	-0.25	1.85	1.25
	(2.42)	*(2.60)*	*(2.70)*	*(1.48)*	*(2.08)*	*(1.47)*	*(-0.38)*	*(2.51)*	*(1.59)*
Post-fin	3.51	3.50	2.88	4.20	1.70	3.57	0.41	2.79	2.43
	(2.79)	*(2.79)*	*(2.34)*	*(2.66)*	*(1.50)*	*(2.81)*	*(0.48)*	*(2.79)*	*(2.78)*

Description: The Table exhibits commodities' economic betas computed as regression coefficients of commodity indices' log-returns against logarithmic changes of industrial production in the USA. GSCI TR, GSCI SR and GSCI ER are S&P-GSCI Commodity Indices: Total Return, Spot Return and Excess Return Indices. GSCI EN, GSCI AG, GSCI IN and GSCI PM are S&P-GSCI Commodity Subindices referring to Energy, Agriculture, Industrial Metals and Precious Metals. JPMCCI and DJUBS refer to JP Morgan Commodity Curve TR Index and Dow Jones-UBS Commodity TR Index. The examined period is 12/31/1970-11/30/2013, unless only shorter time-series are available. The pre-fin period is 12/31/1970-12/31/2003 and the post-fin period is 12/31/2003-11/30/2013. All the data comes from Bloomberg. The first row in each case refers to regression coefficients and the numbers in brackets denote statistical significances. The regression parameters are estimated using OLS and tested in a parametric way.

Table 4. Commodities and economy – lead/lag correlations.

Pre-fin				*Post-fin*			
Lead/lag	GSCI	JPMCCI	DJUBS	Lead/lag	GSCI	JPMCCI	DJUBS
-8	-0.12	-0.15	-0.09	-8	-0.09	-0.04	0.01
-7	-0.18	-0.19	-0.07	-7	-0.02	0.01	0.06
-6	-0.19	-0.22	-0.06	-6	0.10	0.13	0.19
-5	-0.16	-0.20	-0.05	-5	0.26	0.28	0.34
-4	-0.09	-0.15	-0.03	-4	0.38	0.40	0.45
-3	0.00	-0.06	0.02	-3	0.46	0.46	0.48
-2	0.10	0.08	0.09	-2	0.45	0.44	0.45
-1	0.18	0.24	0.18	-1	0.43	0.42	0.42
0	0.21	0.32	0.22	0	0.41	0.41	0.41
1	0.18	0.33	0.22	1	0.44	0.43	0.42
2	0.11	0.25	0.15	2	0.40	0.37	0.35
3	0.04	0.18	0.09	3	0.32	0.28	0.25
4	0.01	0.10	0.02	4	0.20	0.17	0.15
5	0.02	0.10	0.02	5	0.18	0.15	0.15
6	0.05	0.11	0.05	6	0.15	0.12	0.10
7	0.06	0.10	0.03	7	0.14	0.11	0.09
8	0.07	0.03	-0.02	8	0.05	0.04	0.01
Lead/lag of max corr.	0	1	1	Lead/lag of max corr.	-3	-3	-3

Description: The Table exhibits correlations between commodity quarterly log- returns and quarterly logarithmic changes in US industrial production with leads and lags ranging from -8 to +8. GSCI TR, JPMCCI and DJUBS refer to S&P-GSCI Commodity TR Index, JP Morgan Commodity Curve TR Index and Dow Jones-UBS Commodity TR Index. The examined period is 12/31/1970-11/30/2013, unless only shorter time-series are available. The pre-fin period is 12/31/1970-12/31/2003 and the post-fin period is 12/31/2003-11/30/2013. All the data come from Bloomberg. The first refers to leads and lags in commodities' time series. The final row indicates the lead or lag with the maximum correlation coefficient.

The Table 4 presents the correlation of changes in industrial production with returns to commodity markets with various leads and lags. The observations are consistent with the second supposition of this paper, that the relationship with the business cycle could have changed from coinciding or lagging to anticipatory. First, reading the data, in the pre-2004 period, the changes in commodity indices generally coincided or gently lagged the business activity. However, since 2004, the commodities seem to be a rather leading indicator, as the changes in business activity are mostly correlated with the changes in commodity prices 3 months earlier. It appears, that the lead/lag behaviour of commodity indices was quite different in the last ten years than in the preceding 30 years.

Table 5. Correlation between inflation and commodity returns.

Panel A: realized inflation.

	GSCI TR	GSCI SR	GSCI ER	GSCI EN	GSCI AG	GSCI IN	GSCI PM	JPMCCI	DJUBS
Full sample	0.33	0.29	0.26	0.55	0.19	0.17	0.14	0.61	0.56
	(4.59)	*(3.92)*	*(3.47)*	*(7.20)*	*(2.58)*	*(2.01)*	*(1.78)*	*(7.39)*	*(6.26)*
Pre-fin	0.16	0.12	0.13	0.40	0.19	0.02	0.17	0.40	0.38
	(1.89)	*(1.35)*	*(1.51)*	*(3.96)*	*(2.14)*	*(0.20)*	*(1.85)*	*(3.19)*	*(2.89)*
Post-fin	0.71	0.71	0.69	0.72	0.19	0.51	0.15	0.68	0.61
	(6.17)	*(6.07)*	*(5.72)*	*(6.30)*	*(1.18)*	*(3.57)*	*(0.95)*	*(5.70)*	*(4.68)*
Difference	0.55	0.59	0.55	0.31	0.00	0.49	-0.01	0.28	0.22
	(4.71)	*(4.66)*	*(4.43)*	*(4.38)*	*(0.66)*	*(2.90)*	*(0.48)*	*(3.70)*	*(3.00)*

Panel B: expected inflation.

	GSCI TR	GSCI SR	GSCI ER	GSCI EN	GSCI AG	GSCI IN	GSCI PM	JPMCCI	DJUBS
Full sample	0.05	-0.03	-0.08	0.10	0.03	-0.02	-0.09	0.05	0.08
	(0.61)	*(-0.37)*	*(-0.99)*	*(1.12)*	*(0.36)*	*(-0.29)*	*(-1.12)*	*(0.43)*	*(0.74)*
Pre-fin	-0.03	-0.10	-0.08	0.10	-0.04	-0.09	-0.11	-0.01	-0.08
	(-0.31)	*(-1.15)*	*(-0.91)*	*(0.90)*	*(-0.49)*	*(-0.89)*	*(-1.16)*	*(-0.10)*	*(-0.55)*
Post-fin	0.03	0.00	0.06	0.00	0.14	0.17	0.17	0.12	0.11
	(0.20)	*(0.01)*	*(0.37)*	*(0.02)*	*(0.85)*	*(1.05)*	*(1.04)*	*(0.71)*	*(0.66)*
Difference	0.06	0.10	0.14	-0.10	0.18	0.26	0.27	0.13	0.19
	(0.24)	*(0.27)*	*(0.51)*	*(-0.25)*	*(0.83)*	*(1.06)*	*(1.09)*	*(0.57)*	*(0.64)*

Panel C: unexpected inflation.

	GSCI TR	GSCI SR	GSCI ER	GSCI EN	GSCI AG	GSCI IN	GSCI PM	JPMCCI	DJUBS
Full sample	0.25	0.29	0.32	0.23	0.14	0.17	0.23	0.38	0.31
	(3.33)	*(4.00)*	*(4.41)*	*(2.65)*	*(1.90)*	*(2.05)*	*(2.95)*	*(3.99)*	*(3.06)*
Pre-fin	0.19	0.23	0.22	0.14	0.23	0.12	0.28	0.29	0.29
	(2.24)	*(2.67)*	*(2.56)*	*(1.23)*	*(2.72)*	*(1.27)*	*(3.23)*	*(2.18)*	*(2.06)*
Post-fin	0.60	0.61	0.55	0.62	0.07	0.32	0.02	0.52	0.46
	(4.52)	*(4.71)*	*(4.05)*	*(4.84)*	*(0.44)*	*(2.09)*	*(0.13)*	*(3.66)*	*(3.12)*
Difference	0.40	0.38	0.33	0.49	-0.16	0.20	-0.26	0.23	0.17
	(3.55)	*(3.67)*	*(3.17)*	*(3.59)*	*(-0.23)*	*(1.59)*	*(-0.76)*	*(2.42)*	*(1.99)*

Description: The Table exhibits correlation coefficients between quarterly log-returns of commodity indices and quarterly logarithmic changes of US Consumer Price Index. GSCI TR, GSCI SR and GSCI ER are S&P-GSCI Commodity Indices: Total Return, Spot Return and Excess Return Indices. GSCI EN, GSCI AG, GSCI IN and GSCI PM are S&P-GSCI Commodity Subindices referring to Energy, Agriculture, Industrial Metals and Precious Metals. JPMCCI and DJUBS refer to JP Morgan Commodity Curve TR Index and Dow Jones-UBS Commodity TR Index. The examined period is 12/31/1970-11/30/2013, unless only shorter time-series are available. The pre-fin period is 12/31/1970-12/31/2003 and the post-fin period is 12/31/2003-11/30/2013. All the data come from Bloomberg. The first row in each case refers to correlation coefficients and the numbers in brackets denote statistical significances.

The examination of inflation hedging properties generally confirms earlier papers in the field. Investigating the commodities' inflation correlation coefficients (Table 5), it can be seen, that the composite commodities indices' returns are clearly correlated with commodity returns. Nonetheless, this observation refers only to realized and unexpected inflation, while the expected component reveals no significant correlation. When it comes to sector subindices, the correlation is particularly strong in the cases of energy resources. Finally, it seems that the correlation significantly increased during the post-2003 period. It is true for all composite indices and energy, but not for industrial or precious metals and agriculture.

Table 6. Expected and unexpected inflation betas of commodity indices.

Panel A: composite indices.

	GSCI TR		GSCI SR		GSCI ER		JMCCI		DJUBS	
	β_1	β_2	β_1	β_2	β_1	β_2	β_1	β_2	β_1	β_2
Full sample	5.72	3.73	5.65	2.91	5.35	2.28	9.93	8.59	8.06	7.96
	(5.16)	*(3.85)*	*(5.09)*	*(3.01)*	*(5.02)*	*(2.45)*	*(7.63)*	*(6.00)*	*(6.26)*	*(5.24)*
Pre-fin	3.03	1.21	2.95	0.39	2.88	0.60	8.79	6.17	8.60	6.57
	(2.53)	*(1.12)*	*(2.46)*	*(0.36)*	*(2.49)*	*(0.57)*	*(3.81)*	*(2.87)*	*(3.23)*	*(2.37)*
Post-fin	5.72	3.73	13.77	10.64	12.59	11.08	10.31	10.18	8.03	8.02
	(5.16)	*(3.85)*	*(6.38)*	*(3.35)*	*(5.85)*	*(3.49)*	*(5.72)*	*(3.83)*	*(4.69)*	*(3.17)*

Panel B: sector indices.

	GSCI EN		GSCI AG		GSCI IN		GSCI PM	
	β_1	β_2	β_1	β_2	β_1	β_2	β_1	β_2
Full sample	17.51	16.01	3.38	2.21	3.90	2.09	3.41	1.05
	(7.23)	*(6.66)*	*(2.86)*	*(2.14)*	*(2.65)*	*(1.66)*	*(2.94)*	*(1.04)*
Pre-fin	17.90	15.82	3.95	1.47	1.63	-0.24	4.41	0.88
	(4.01)	*(3.87)*	*(2.97)*	*(1.23)*	*(0.95)*	*(-0.17)*	*(3.11)*	*(0.68)*
Post-fin	17.56	13.61	2.73	4.94	9.43	11.48	1.50	3.70
	(6.64)	*(3.49)*	*(1.06)*	*(1.30)*	*(3.48)*	*(2.88)*	*(0.80)*	*(1.33)*

Description: The Table exhibits commodities' expected and unexpected inflation betas. β_1 and β_2 refer to regression coefficients referring to unexpected and expected inflation. GSCI TR, GSCI SR and GSCI ER are S&P-GSCI Commodity Indices: Total Return, Spot Return and Excess Return Indices. GSCI EN, GSCI AG, GSCI IN and GSCI PM are S&P-GSCI Commodity Subindices referring to Energy, Agriculture, Industrial Metals and Precious Metals. JPMCCI and DJUBS refer to JP Morgan Commodity Curve TR Index and Dow Jones-UBS Commodity TR Index. The examined period is 12/31/1970-11/30/2013, unless only shorter time-series are available. The pre-fin period is 12/31/1970-12/31/2003 and the post-fin period is 12/31/2003-11/30/2013. All the data come from Bloomberg. The first row in each case refers to regression coefficients and the numbers in brackets denote statistical significances. The panel A depicts composite commodity indices, while panel B sector subindices. The computations are based on quarterly time-series.

The Table 6 presents regression coefficients computed against the expected and unexpected inflation. First, consistently with the correlation analysis, the unexpected inflation beta is usually higher than for expected inflation. Second, the betas are remarkably high for energy and composite indices. Finally, in the post-2003 period the betas visibly increased. The investigations of betas computed against realized inflation (Table 7) confirm the same observations. The changes are sometimes really impressive, as for example in the case of quarterly S&P-GSCI TR data, the correlation soared from 1.92 in the non-financialized

market to 13.46 in the financialized markets. To sum up, it can be observed that in the post-2003 period the inflation hedging properties of commodities improved and were superior to the earlier decades. In other words, this is the answer to the third question stated in the section on theorethical basis. The inflation hedging properties not only did not decline, but even show some signs of improvement.

Table 7. Realized inflation betas of commodity indices.

	GSCI TR	GSCI SR	GSCI ER	GSCI EN	GSCI AG	GSCI IN	GSCI PM	JPMCCI	DJUBS
Full sample	4.35	3.76	3.24	16.73	2.58	2.52	1.78	9.50	8.04
	(4.61)	*(3.94)*	*(3.49)*	*(7.26)*	*(2.59)*	*(2.03)*	*(1.79)*	*(7.47)*	*(6.33)*
Pre-fin	1.92	1.38	1.48	16.30	2.43	0.26	2.27	7.04	7.88
	(1.90)	*(1.35)*	*(1.51)*	*(4.02)*	*(2.16)*	*(0.19)*	*(1.87)*	*(3.27)*	*(2.98)*
Post-fin	13.46	13.32	12.37	17.00	3.04	9.72	1.82	10.29	8.03
	(6.31)	*(6.21)*	*(5.85)*	*(6.45)*	*(1.20)*	*(3.65)*	*(0.97)*	*(5.84)*	*(4.79)*

Description: The Table exhibits commodities' expected and realized inflation betas. GSCI TR, GSCI SR and GSCI ER are S&P-GSCI Commodity Indices: Total Return, Spot Return and Excess Return Indices. GSCI EN, GSCI AG, GSCI IN and GSCI PM are S&P-GSCI Commodity Subindices referring to Energy, Agriculture, Industrial Metals and Precious Metals. JPMCCI and DJUBS refer to JP Morgan Commodity Curve TR Index and Dow Jones-UBS Commodity TR Index. The examined period is 12/31/1970-11/30/2013, unless only shorter time-series are available. The pre-fin period is 12/31/1970-12/31/2003 and the post-fin period is 12/31/2003-11/30/2013. All the data come from Bloomberg. The first row in each case refers to regression coefficients and the numbers in brackets denote statistical significances.

5. Conclusions

The commodity futures markets are an important tool for the portfolio management and asset allocation. However, the recent profound changes in the markets may cast doubt whether the commodities retained their long-term characteristics and properties. The computations suggest, that commodities can still be effectively used in the tactical asset allocation, however their nature seems to have changed slightly.

First, the interdependence to the business activity seems to be stronger now than it was in previous decades. The correlation is higher and the economic betas soared. In other words, it seems that the commodity returns are now even more dependent on general economic conditions. Second, the lead/lag behaviour of commodities in relation to the economy changed slightly. Their relation with the business cycle became more equity-like. In other words, in the last decade the commodities were coinciding or even somewhat a leading indicator of business economy. This anticipatory behaviour generally contradicts with the previous theoretical and empirical evidence, which pointed that commodity prices usually lag or coincide economic activity. Thirdly, it appears, that the commodities retained their inflation hedging properties. Actually, the interrelation with the CPI changes strengthened in recent years, so inflation betas increased. It still perfectly makes sense to hedge portfolio returns against inflation with commodity futures.

The presented research has one important limitation. Although it is shown, that the interrelations between commodity markets and economic aggregates have changed since the commodity markets became financialized, this paper does not document, nor does it prove firm casual links between the two phenomena. In other words, the explanation cannot be excluded, that the alterations emerged due to some other reasons, or even that they are simply period-specific. This issue should be investigated in details in further research.

The investigations in this paper have implications mainly for commodity investors and their approach to tactical asset allocation in commodity markets. First the commodities retained their correlation with inflation, so they still can be used as an inflation hedge. Second, the relationship with the business cycle could have slightly changed. It appears, that commodity prices are now more a leading indicator, rather than a coinciding or lagged one.

References

Abanomey, W.S. & Mathur, I. (2001). Intercontinental Portfolios with Commodity Futures and Currency Forward Contracts. Journal of Investing, autumn, 61–68. DOI: 10.3905/joi.2001.319474

Adams, Z., Füss., R. & Kaiser, G.K. (2008). Macroeconomic Determinants of Commodity Futures Returns. In: Fabozzi, F.J, Füss, R., Kaiser, D.G., eds. The Handbook of Commodity Investing. New York: Wiley, 87-112. DOI: 10.1002/9781118267004

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.

Anson, M.J.P. (1999). Spot Returns, Roll Yield and Diversification with Commodity Futures. Journal of Alternative Investments, 4, 1–17. DOI: 10.3905/jai.1998.407861

Anson, M.J.P. (2009). CAIA Level I. An Introduction to Core Topics in Alternative Investments. Hoboken, New Jersey: Wiley.

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

Backus, D.K., Routledge, B.R. & Zin, S.E. (2007). Asset Prices in Business Cycle Analysis. Tepper School of Business Paper 414. Available at: http://repository.cmu.edu/tepper/414 [accessed 17 October 2014].

Becker, K.G. & Finnerty, J.E. (1994). Indexed Commodity Futures and the Risk of Institutional Portfolios. OFOR working paper, no. 94–02, January.

Becker, K.G. & Finnerty, J.E. (1997). Indexed Commodity Futures and the Risk and Return of Institutional Portfolios. In: Cheng-Few Lee, eds. Advances in Investment Management and Portfolio Analysis, vol. Greenwich: JAI Press, 1-14.

Bekaert, G. & Wang, X. (2010). Inflation Risk and the Inflation Risk Premium. Working paper. Available at: http://ssrn.com/abstract=1600312 or http://dx.doi.org/10.2139/ssrn [accessed 17 October 2014].

Bodie, Z. & Rosansky, V.I. (1980). Risk and Return in Commodity Futures. Financial Analyst Journal, 36(3), 27-39.

Bodie, Z. (1976). Common stocks as a hedge against inflation. Journal of Finance 31, 459-470. DOI: 10.1111/j.1540-6261.1976.tb01899.x

Bodie, Z. (1982). Inflation risk and capital market equilibrium. Financial Review 17, 1-25. DOI: 10.1093/rfs/7.1.45

Boudoukh, J. & Richardson, M. (1993). Stock returns and inflation: A long-horizon perspective. American Economic Review 83, 1346-1355. DOI: 10.1080/09603100600691919

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

Cagan, P. (1974). Common stock values and inflation – The historical record of many countries. National Bureau Report Supplement, New York.

Campbell, J.Y. & Viceira, L.M. (2001). Who should buy long-term bonds? American Economic Review 91, 99-127.

Cheng, I.H. & Xiong, W. (2014). The Financialization of Commodity Markets. Annual Review of Financial Economics, 6 (forthcoming).

Cheung, C. (2009). Are Commodity Prices Useful Leading Indicators of Inflation? Bank of Canada Discussion Paper 2009-05. Available at: http://www.bankofcanada.ca/wp-content/uploads/2010/01/dp09-5.pdf [accessed 17 October 2014].

Commodity Futures Trading Commission (2008). Staff report on commodity swap dealers & index traders with commission recommendations, available online: http:// www.cftc.gov/ucm/groups/public/ @newsroom/documents/file/ cftcstaffreportonswapdealers09.pdf [accessed 17 October 2014].

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

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

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

Erb, C.B. & Harvey C.R. (2006). The Strategic and Tactical Value of Commodity Futures. Financial Analyst Journal, 62(2), 69-97.

Fama, E.F. & Schwert, G.W. (1977). Asset Returns and Inflation. Journal of Financial Economics 5, 115-146.

Fattouh, B., Kilian, L. & Mahadeva, L. (2012). The role of speculation in oil markets: What have we learned so far? Working paper, University of Michigan.

Fisher, I. (1930). The Theory of Interest. New York, MacMillan.

Froot, K.A. (1995). Hedging Portfolios with Real Assets. Journal of Portfolio Management, 21 (4), 60-77. DOI: 10.3905/jpm.1995.409527

Gay, G.D. & Manaster, S. (1982). Hedging Against Commodity Price Inflation: Stocks and Bills as Substitutes for Futures Contracts. Journal of Business, 55(3), 317-343.

Georgiev, G. (2001). Benefits of Commodity Investment. Journal of Alternative Investments, summer, 40–48. : 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, 398–425. DOI: 10.1111/j.1477-9552.2010.00248.x

Gorton, G.B. & Rouwenhorst, K.G. (2006). Facts and Fantasies about Commodity Futures. Financial Analyst Journal, 62(2), 47-68.

Greer, R.J. (1978). Conservative Commodities: A Key Inflation Hedge. Journal of Portfolio Management, 4(4), 26-29. DOI: 10.3905/jpm.1978.408649

Hoevenaars, R.P.M.M., Molenaar, R.D.J., Schotman, P.C. & Steenkamp, T.B.M. (2008). Strategic asset allocation with liabilities: Beyond stocks and bonds. Journal of Economic Dynamics & Control, 32, 2939-2970.

Irwin, S.H. & Sanders, D.R (2010). The Financialization of Commodity Futures Markets or: How I Learned to Stop Worrying and Love the Index Funds. Working paper. Available at SSRN: http://ssrn.com/abstract=1699793 [accessed 17 October 2014].

Irwin, S.H. & Sanders, D.R (2011). Index Funds, Financialization and Commodity Futures Markets. Applied Economics Perspectives and Policy, 33. DOI: 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.

Jaffe, J.F. & Mandelker, G. (1976). The Fisher 'effect' for risky assets: An empirical investigation. Journal of Finance 31, 447-458. DOI: 10.1111/j.1540-6261.1976.tb01898.x

Joshi, A. (2013). Inflation Risk Hedging Strategy for Equities using Commodity Futures. International Journal of Trade, Economics and Finance, 3(2), 78-81. DOI: 10.7763/ IJTEF.2012.V3.176

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

Kat, H.M., Oomen, R.C.A. (2006). What Every Investor Should Know About Commodities, Part II: Multivariate Return Analysis. Alternative Investment Research Centre Working Paper No. 33. Available at SSRN: http://ssrn.com/abstract=908609 [accessed 17 October 2014].

Krugman, P. (2008). More on oil and speculation. New York Times, May 13.

Lamont, O.A. (2001). Economic tracking portfolios. Journal of Econometrics 105, 161-184

Masters, M. (2008). Testimony before the committee on homeland security and governmental affairs. Technical report, US Senate, May 20th.

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.

Newey, W.K. & West K.D. (1987). A Simple, Positive Semi-definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix. Econometrica, 55(3), 703–708. DOI:10.2307/1913610

Nguyen, Van T.T. & Sercu, P. (2010). Tactical Asset Allocation with Commodity Futures: Implications of Business Cycle and Monetary Policy. Paris December 2010 Finance Meeting EUROFIDAI - AFFI. Available at SSRN: http://ssrn.com/abstract=1695889 [accessed 17 October 2014].

Reilly, F.K., Johnson, G.L. & Smith, R.E. (1970). Inflation, inflation hedges, and common stocks. Financial Analysts Journal 28, 104-110.

Roache, S.K. & Attie, A.P. (2009). Inflation Hedging for Long-Term Investors (April 2009). IMF Working Paper No. 09/90. Available at SSRN: http://ssrn.com/abstract=1394810 [accessed 17 October 2014].

Schotman, P.C. & Schweitzer, M. (2000). Horizon sensitivity of the inflation hedge of stocks. Journal of Empirical Finance 7, 301-315. DOI:10.1016/S0927-5398(00)00013-X

Schwert, W. (1981), The Adjustment of Stock Prices to Information About Inflation. Journal of Finance 36, 15-29.

Siegel, J.J. (1991). The Behaviour of Stock Returns Around N.B.E.R. Turning Points: An Overview. Rodney L. White Center for Financial Research Working Papers. Available at: http://finance.wharton.upenn.edu/~rlwctr/papers/9113.PDF [accessed 17 October 2014].

Silvennoinen, A. & Thorp, S. (2009). Financialization, crisis and commodity correlation dynamics. working paper.

Spierdijk, L. & Umar, Z. (2013). Are Commodity Futures a Good Hedge Against Inflation? Netspar Discussion Paper No. 11/2010-078. Available at SSRN: http://ssrn.com/abstract=1730243 [accessed 17 October 2014].

Stoll, H. & Whaley R. (2010). Commodity index investing and commodity futures prices. Journal of Applied Finance 1, 1-40

Tang, K. & Xiong W. (2012). Index Investments and the Financialization of Commodities. Financial Analyst Journal, 68(5). 54-74.

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 (ed.), Intelligent Commodity Investing: New Strategies and Practical Insights for Informed Decision Makings. London: Risk Books, 39–82.

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, 39–82.

Umar Z. & L. Spierdijk (2011). Are Commodities a Good Hedge against Inflation? A Comparative Approach, Netspar discussion paper, http://www.rug.nl/staff/l.spierdijk/inflation_umar_spierdijk_may_2011_submitted.pdf [accessed 17 October 2014].

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

Woodard, J.D. (2008). Commodity Futures Investments: A Review of Strategic Motivations and Tactical Opportunities. In: Fabozzi, F.J, Füss, R., Kaiser, D.G., eds. The Handbook of Commodity Investing. New York: Wiley, 56-86.

Zaremba, A. (2014a). Is Financialization Killing Commodity Investments? Working paper. Available at SSRN: http://ssrn.com/abstract=2349903 or http://dx.doi.org/10.2139/ssrn.2349903 [accessed 17 October 2014] [accessed 17 October 2014].

Zaremba, A. (2014b). Implications of Financialization for Strategic Asset Allocation: The Case of Correlations. Working paper. Available at SSRN: http://ssrn.com/abstract=2349902 or http://dx.doi.org/10.2139/ssrn.2349902 [accessed 17 October 2014].

Zaremba, A. (2014c). 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 [accessed 17 October 2014].