ESSAYS ON EMPIRICAL TESTING
OF FINANCIALIZATION OF COMMODITIES

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ABSTRACT

ESSAYS ON EMPIRICAL TESTING OF FINANCIALIZATION OF COMMODITIES

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Over the last decade commodity derivatives market experienced a significant influx of financial institutions, which is a phenomenon referred to as financialization of commodities. The main purpose of this thesis is to investigate whether financialization bolstered the connectedness between US stock and commodity markets. Connectedness can occur in forms of either spillover or co-movement and hence we analyze each form in two essays. In the first essay, we investigate volatility spillover between 25 commodity derivatives and US stock markets. Results show that the spillover between almost all commodity and stock markets increases significantly following the financialization. Moreover, we find that the net transmitter of volatility is commodity markets during pre-financialization period, whereas transmitters happen to be stock market after the financialization. Therefore, we show that commodities do not shield the investor from downside risk in financial markets, anymore. In the second essay, we examine the explanatory power of financialization on the increasing correlations between agricultural commodities and stock markets after 2008. Even though our findings support the argument on financialization; we find that explanatory power of financialization is highly dependent upon liquidity constraints.

Keywords: Financialization, commodity, liquidity, spillover, co-movement

ÖZ

EMTİA FİNANSALLAŞMASININ AMPİRİK SINAMALARI ÜZERİNE ÇALIŞMALAR

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Ocak 2017, 193 sayfa

Emtia türev piyasaları son 10 senede ciddi anlamda finansal kurum yatırımcılarını kendine çekmiş ve bu olgunun adı "emtianın finansallaşması" olarak adlandırılmıştır. Bu tezin esas amacı, finansallaşmanın ABD hisse senedi ve emtia piyasaları arasındaki ilişkiyi güçlendirip güçlendirmediğini incelemektir. İlişki formları yayılım ya da korelasyon şeklinde olabileceğinden, her bir form farklı iki çalışmada analiz edilmektedir. Birinci çalışmada 25 farklı emtia türev piyasası ile ABD hisse senedi piyasaları arasında oynaklık yayılımı analiz edilmektedir. Sonuçlarımız kurumsal yatırımcıların girmesiyle emtia piyasaları ile hisse senetleri arasında ciddi bir yayılım başladığını göstermektedir. Aynı zamanda, net yayılımın finansallaşmadan önce emtia piyasalarından hisse senedi piyasalarına iken, finansallaşmadan sonra bunun tam tersi yönde olduğu da göze çarpmaktadır. Sonuç olarak, emtia piyasaları artık yatırımcıları finansal piyasalardaki aşağı yönlü riskten korumamaktadır. İkinci çalışmada ise finansallaşmanın tarımsal emtia ve hisse senedi piyasaları arasında 2008 yılından itibaren artan korelasyonu açıklama gücü test edilmektedir. Sonuçlarımız emtianın finansallaşması savını desteklemesine rağmen, finansallaşmanın açıklayıcı gücünün finansal piyasalardaki likidite ortamına bağlı olduğunu gösteriyoruz.

Anahtar Kelimeler: Finansallaşma, emtia, likidite, yayılım analizi, korelasyon

To my loving and caring parents

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LIST OF ABBREVIATIONS

ADCC: Asymmetric Dynamic Conditional Correlation

CFTC: U.S. Commodity Futures Trading Commission

CIT: Commodity Index Trader

DJ UBSCI: Dow Jones UBS Commodity Index

FAO: Food and Agriculture Organization of the United Nations

IATP: Institute for Agriculture and Trade Policy

N/A: Not available

S&P GSCI: Standard & Poors Goldman Sachs Commodity Index

SCOT: Supplemental Commitment of Traders Report

QR: Quantile Regression

CHAPTER 1

BACKGROUND ON FINANCIALIZATION OF COMMODITIES

1.1 Introduction

Financialization of commodities is a recent phenomenon, which argues commodities have been as popular as stocks and bonds among financial investors as an investment tool (Cheng & Xiong, 2013). Therefore, commodities, which were long believed to be a segmented market from financial markets, may have become susceptible to shocks originating from these markets. Since the interconnectedness between commodity and financial markets can be either in the form of co-movements or spillovers (Adams & Gluck, 2015), we concentrate on these forms and examine each form separately in our thesis.

Before going into deep investigation, in the first chapter, we provide background information on financialization of commodities. We initially provide theoretical review on how futures market can impact commodity spot prices and then we elaborate why institutional investors prefer to invest in commodities, at the first place. Then we explain Basak and Pavlova's (2016) theoretical model on financialization of commodities and provide a quick summary of selected empirical studies on financialization of commodities.

In the second chapter, we utilize a recent spillover methodology by Diebold and Yilmaz (2012) and examine whether financialization is a valid phenomenon. We measure gross and net spillover indices of each US-traded commodity with stocks for two sub-periods; before and after financialization. In contrast to co-movements, through this methodology we can comment on the direction of the spillover and which asset class affects the other. Our results indicate that during post-financialization period gross spillover indices have significantly increased but also we document that there is a significant net spillover from stocks to commodities in the same period. Hence, we find that financialization of commodities is a valid phenomenon and commodities have become another core investment market following increasing participation of financial investors in commodity futures. Therefore, results imply that commodities do not protect investors from downside risk in financial markets, anymore.

In the third chapter, we investigate whether commodity index trader (CIT) positions help to explain the increase in the correlations between agricultural commodities and equities starting around 2008. Given that globally, around 795 million people are undernourished and malnutrition significantly augments diseases worldwide (FAO, 2015a), mispricing of agricultural products could have severe effects on the population (FAO, 2015b).Worsening levels in food security have probably even lead to the fall of governments such as in Egypt and Tunisia in 2008 (IATP, 2011).

Some argue institutional investors who invest both in stock and commodity markets demolish the borders between these two seemingly unrelated markets and increase correlations, a recent phenomenon known as financialization. Yet, some others argue recently correlations have decreased back to historical levels and thus such increase between 2008 and 2012 was due to business cycle effect. Our results do not support one side but show that both factors are critically important to explain correlations between agricultural commodities and stocks. Furthermore, we depict CITs prefer to go back to their “circle of competence” under scarce liquidity and thus correlations decrease back to levels absent institutions. Hence, low liquidity is a significant obstacle inhibiting financialization to occur.

1.1.1 Theoretical Background on Futures and Spot Markets Nexus

Cheng and Xiong (2013) state commodity futures market affects commodity prices through two mechanisms. The first mechanism is risk sharing, which argues that market players share the commodity price risk via commodity futures market. Hence, producers/ consumers settle future prices for a comprehensive set of commodities in the commodity futures market. The second mechanism argues there is an intrinsic storage or consumption decision in commodities. If market players opt for storing since they believe prices would get higher in the future, a link between futures and commodity market is generated. Below, we further expand on these theories.

1.1.1.1 Hedging Pressure Hypothesis:

Commodity futures contract is an agreement to buy or sell a particular commodity at a future time for pre-determined price (Hull, 2012:22). Gorton and Rouwenhorst (2006) explain how this pre-determined price is settled. If one would not like to buy the asset now, they can wait and buy at future spot prices at a forthcoming time. On the other hand, future spot prices are not known. Therefore, players incorporate their expectations in futures markets and this leads to settlement in a fair futures price. For instance, if market players await higher spot prices in the future, futures prices will be higher and vice versa.

Expected changes in the market conditions or crops are already embedded in futures prices. Hence the source of return is not driven by expectations, but rather through unpredictable changes. Therefore, the trader who is long on futures prices (who buys the contract) is betting that future spot prices will be higher than the agreed futures price. On the other hand, as its name suggests, these changes are unpredictable and an investor cannot outsmart the market (Gorton & Rouwenhorst, 2006). So what is the source of return? What is the benefit in participating in this transaction?

The Hedging Pressure Hypothesis indicates that the source of return is the risk premium. Fundamentally, risk premium is the difference between today-settled futures price and expected spot price at future time. Please refer to the Figure 1.1 to understand the mechanism further. Assume that the expected spot price after 1 month from today is 15.5 US cents per pound of sugar. If the agreed-upon futures price for 1 month contract for sugar is 15 US cents per pound, the difference of 0.50 cents goes to the buyer at the end of the contract. On the other hand, if the agreed-upon futures price for 1 month contract for sugar is 16 US cents per pound, 0.50 cents accrue to the seller of the contract. Hence 0.50 cents is the risk premium and can be the source of return for the buyer or seller of the contract.

Keynes (1930) contends that the risk premium should be assumed by buyers, since buyers are the risk takers of the contract.

So let us elaborate this through an example; suppose there is one big farmer and he would like to manage his commodity price risk. Since agricultural commodity prices are dependent upon many uncontrollable factors such as weather, crop yield, or epidemic diseases; commodity price risk is the most significant risk for the producer. Therefore, he sells the futures contract and he locks in the price he would get and insures himself. The other side of the contract is a speculator. A speculator buys the contract and undertakes the commodity price risk. However, speculators enter into contract on the proviso expected spot price is higher than settled futures price. Hence, they get the risk premium for insuring the commodity producer. Thus, futures price displays normal backwardation behavior with respect to the expected spot price. On the other hand, if prices are in a decreasing trend it is called contango. Please refer to Figure 1.2.

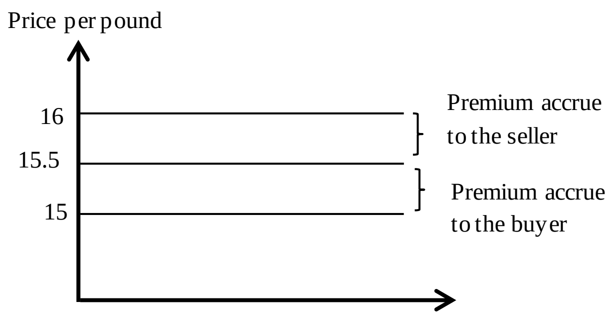

Figure 1.1 – Risk premium in futures market

Notes: Risk premium is the difference between settled price and expected spot price the day contract terminates. Settled price is determined as of contract-date and between buyer and seller of the contract. If the futures contract price is higher (lower) than expected spot price, premium accrues to the seller (buyer) of the contract.

Empirical studies supportive of the normal backwardation, is on the other hand, are not high in number (Chang, 1985; Miffre, 2016). The ones rejecting the hypothesis indicate there is no positive risk premium just for holding the long position in commodity futures market. Phillips and Weiner (1994) for oil, Dusak (1973) for wheat, corn and soybean, Bodie and Rosansky (1980) for a broad set of 23 commodities, Daskalaki, Kostakis and Skiadopoulos (2014) for 22 commodities; all find no support for the theory. Even though the theory posits rather strong arguments, Kolb (1992) indicates that commodities rarely depict normal backwardation behavior. Cootner (1960) extends the theory and shows that speculators do not necessarily need to hold long position. He contends that if the market is in contango position, meaning that commodity prices are in a decreasing trend; speculators would hold the short position. Cheng and Xiong (2013) indicate the setback of the theory is the disconnection of commodity futures market from financial markets. This creates severe inefficient risk sharing, making the theory not a good candidate for commodity price behavior.

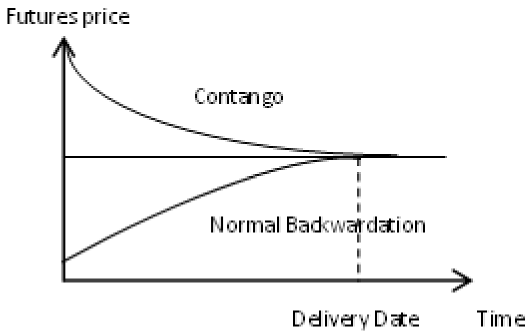

Figure 1.2 – Normal backwardation vs. contango

Notes: Agricultural business owners sell the futures contract and locks in the price, and speculators buy. Since speculators undertake the commodity price risk, they enter into contract on the proviso expected spot price is higher than settled futures price. This is called normal backwardation behavior of commodities.

Later, Hirshleifer (1988, 1990) employs CAPM and integrates the modern portfolio theory with Keynes' (1930) view (Bessembinder, 1992). Hirshleifer argues that the hedging capacity of speculators is not unlimited, since there is a fixed participation cost. Such participation costs include transaction costs as well as information cost. Moreover, he contends that the risk premium is not only dependent on hedging pressure, but also on systematic risk.

Empirical tests supporting Hirshleifer's view are comparably larger in number than Keynes' (Miffre, 2016). Bessembinder (1992) finds that hedging pressure impacts futures prices of agricultural commodities. He shows average returns of commodities, of which speculators take net short positions, that are positive and negative for net long positions. Later, de Roon et al. (2000) extends Bessembinder's findings and show that other than commodity's own hedging pressure, cross-hedging pressure across the same group also impacts futures returns. For instance, wheat is not only affected from its own hedging pressure but also other commodities in agricultural groups. They study 9 commodities and find 7 commodities display positive and significant risk premium. Rouwenhorst and Tang (2012) replicate de Roon et al. (2000)'s study for 28 commodities for the period between 1989 and 2010. They show, the results are actually not as strong as de Roon et al. (2000) argue. Only 3 of the 28 commodities display positive coefficients.

Recently, Basu and Miffre (2013) examine 27 commodity futures and investigate whether hedging pressure is helpful in attaining superior commodity futures returns. They go long the most backwardated commodities and go short the most contangoed ones. Results display higher performance compared to S&P GSCI and equally-weighted commodity portfolios. On the other hand, Daskalaki et al. (2014) indicate superior returns are not statistically significant and that hence, the hedging pressure hypothesis fails.

This carries us to the other theory on commodity spot and futures price behavior nexus, theory of storage.

1.1.1.2 Theory of Storage

Consumption decision of a commodity is a timing option. One can either consume now or store for later usage. However, if one chooses to consume later, this means that the value of consuming now is smaller than value of consuming later. Cheng and Xiong (2013) indicate that the price of commodity is the maximum of today's value versus the value at the future consumption day. On the other hand, if adequate number of consumers postpone their consumption, it means that the price of a commodity is higher than the value of consuming all available supplies, and as such, leads to convenience yield. Convenience yield occurs when holding the commodity itself is preferred over holding the derivative product. Such preference is attributable to higher benefit to hold the asset compared to its storage and financing costs (Miffre, 2016). This occurs especially when the supply of the commodity is scarce.

The Theory of Storage by Kaldor (1939), Working (1949) and Brennan (1958) argues, basis which is the difference between spot and futures prices of a commodity, is dependent upon storage and financing costs and convenience yield, so;

$$\begin{aligned} Futures\ Price - Spot\ Price \\ &= Interest\ Rate * Spot\ Price \\ &+ Warehousing\ Costs - Convenience\ Yield \end{aligned}$$

The first term in the right hand side of the equation is financing costs since trader buys the physical commodity. Second term includes, insurance, transportation and storage costs. Suppose that the basis is higher than costs, this leads to an arbitrage opportunity, because shorting the futures contract and longing the actual commodity makes profit. Therefore, the convenience yield achieves the equilibrium in the market.

Since inventory level cannot be negative, consumers cannot borrow inventory from the future, when the commodity is scarce (Cheng & Xiong, 2012). This drives convenience yield to be higher and hence yield is supposed to be a declining function of the level of inventories (Rouwenhorst & Tang, 2012). Gorton Hayashi and Rouwenhorst (2012) state a more modern approach of storage theory is presented by Deaton and Laroque (1992, 1996). Even though, Deaton and Laroque (1992, 1996) do not embed futures market into their study, they show that storage leads to smoother and serially dependent commodity prices. Furthermore, they state that the theory suggests futures prices are less volatile than spot prices if there is a supply shortage. Following these empirical implications, Fama and French (1988) test the negative relationship through spot and futures prices and their volatilities and find supporting evidence for the theory. Geman and Ohana (2009) incorporate the dataset from the 2000s and show that crude oil and natural gas futures volatilities are much less when the inventory levels are low. On top of volatilities, Ng and Pirrong (1994) indicate that correlations between future and spot prices decline under scarcity. They state the link between futures and spot prices break with stock out, and when the supply is scarce stock out is more probable. Hence authors expect correlation to decrease with higher basis levels. Once again, the results support the theory. On the other hand, please note that neither Fama and French (1988), nor Ng and Pirrong (1994) directly tested the theory of storage.

Pindyck (1994) directly test the relationship between inventory levels and convenience yield for copper, heating oil and lumber, and finds it is negative and convex. Similarly, Brennan (1991)'s findings also support implications of the theory. Dincerler, Kohkher and Simin (2004) show that crude oil, copper and natural gas display parallel findings for the period between 1995 and 2004. Gorton, Hayashi and Rouwenhorst (2012) study for a broad set of 31 commodity futures and find basis, future and spot returns all mirror the level of inventory. Moreover, they document the negative relationship between convenience yield and inventories. Carbonez, Van Nguyen and Sercu (2011) study agricultural commodities and compare early 20th century with early 21st century datasets. Results show that the 20th century findings support the theory more.

The theory of storage moves us to another strand of literature which argues that the risk premium could be modeled through inventory levels.

1.1.1.3 Roll Forward Strategies

Even though commodity futures have been traded for over a century, they are relatively an untouched area (Erb & Harvey, 2006) in finance literature. Both storage and hedging pressure theories are used in finance literature, to find a passive investment strategy of commodities. Theory of Storage states roll-yields and inventory levels can reflect whether the commodity is in contango or backwardation (Miffre, 2016) and Hedging Pressure shows that hedging positions are helpful in this respect.

Bodie and Rosansky (1980) show equally weighted commodity portfolios depict similar returns to stocks for the period between 1949 and 1976. Gorton and Rouwenhorst (2006) compare commodity futures and spot commodity returns for around 50 years. Results display that one who has invested USD 100 both in spot and futures market in 1959 end up with around USD 1,500 for futures and USD 500 for spot market investment, based on buy and hold strategy. Next, Gorton and Rouwenhorst (2006) compare risk premiums for commodities, stocks and bonds and depict commodity futures have a higher risk premium compared to other traditional financial assets. Furthermore, Sharpe ratio for commodities is considerably higher than stocks; implying that commodity investments offers less risk with almost the same return as equities.

Erb and Harvey (2006), on the other hand, decompose commodity futures returns into price return, roll return and collateral return.

$$Commodity\ Futures\ Returns = Price\ return + Roll\ return + Collateral\ return$$

Price return is the return attained through the change in the spot price of the commodity (Erb & Harvey, 2016). The second portion, roll return, on the other hand, is critical to understand commodity futures returns. Every future contract has an expiry date and therefore investors whom would like to preserve their commodity futures position should sell near to expiry and buy the next available contract. As we have mentioned in the section of Hedging Pressure Hypothesis, term structure of a commodity future displays either an upward sloping (contango) or downward sloping (backwardation) structure. If the term structure depicts a downward sloping trend, investors would sell the more expensive contract and buy a cheaper one. Hence investors would achieve roll return. Additionally, collateral return is the return of 3 month T-bills where the exposure amount of the contract is invested in a safe haven asset. The sum of collateral and roll return is the income return and Erb and Harvey (2006) state that 91.6% of commodity futures returns between December 1982 and May 2004 are attributable to income return. Since income return is dependent upon the term structure of futures prices, they state that investors, who are chasing return from commodity prices, might be mistaken in some cases.

In a more recent study, Erb and Harvey (2016) state that historical returns are not a good indicator for the future and they advise investors to maintain their “circle of competence” and not to invest in other assets that they are not competent in.

On the other hand, Bhardwaj et al (2015) replicated the study of Gorton and Rouwenhorst (2006). They show that earlier findings of Gorton and Rouwenhorst

(2006) are still valid for the period between 2005 and 2014. Even though risk premium has declined, the difference is not significantly different.

Therefore lower standard deviations of commodities' along with similar returns to stocks (Gorton & Rouwenhorst, 2006) appeal to investors. Though, this not the only advantage of commodities; literature provides further reasons why to invest in commodities

1.1.2 Why invest in commodities?

In the previous section, we present that commodities are a good source of return and have a Sharpe ratio higher than stocks and bonds. But literature proposes that these two are not the only reasons to invest in commodities. Commodities have crucial advantages over traditional asset classes, and these are of utmost importance for investment decisions. These advantages are elaborated below.

After the collapse of Bretton Woods system, the world economy experienced a sudden increase in prices. Since then, inflation has been on the table and how to hedge against inflation has been another strand of literature. Inflation at time t has two portions; one is the expected inflation at $t-1$ and the unexpected inflation at t.

Among others, Fama and Schwert (1977) find bonds are good hedges against expected inflation, though not for unexpected inflation. Expected nominal rates for bonds already incorporate expectations on inflation, but if unexpected inflation is unforeseeably high, this could lead to critically lower bond returns. Since equities are claims against real assets, they should have partial hedges against inflation (Gorton & Rouwenhorst, 2006). On the other hand, Fama (1981) show higher unexpected inflation generally occurs in contracting economies, which has a negative impact on stock performances. Research also shows that equities are poor hedges against inflation (Bodie, 1976; Jaffe & Mandelker, 1977; Gultekin, 1983; Attie & Roache, 2009). Moroever, Fama and Schwert (1977) find that stocks are not only poor hedges against unexpected, but also expected inflation.

Furthermore, contrary to stocks and bonds, commodities are good hedges against inflation. Gorton and Rouwenhorst (2006) indicate that commodity prices are directly connected with inflation and furthermore, futures prices incorporate any change in either expected or unexpected inflation through trades. Therefore, commodities are found to be good hedges against inflation (Bodie & Rosansky, 1980; Erb & Harvey, 2006; Gorton & Rouwenhorst, 2006; Basu & Miffre, 2013). Gorton and Rouwenhorst (2006) further document that stocks and bonds have negative correlation with inflation, whereas commodities have a statistically significant positive correlation. Bhardwaj et al (2015) also support previous findings with a more recent study.

Another particular advantage of commodities is their business cycle behavior during early recession and late expansion stages. In the long term, especially low correlation with stocks and bonds provide a clear-cut advantage for commodity investment. On the other hand, how commodities respond to changes in business cycle is another major factor to consider. Bailey and Chan (1993) find that the common factors affecting the spread between futures and spot prices of commodities are related to the business cycle. Later, Gorton and Rouwenhorst (2006) study how NBER cycles affect the performance of commodity futures versus stocks and bonds. They basically divide cycles into late expansion, early recession, late recession and early expansion periods. During early recession periods, stocks and bonds display negative performance, whereas commodities have positive return. Furthermore, during late expansion, when performance of stocks and bonds are below their average levels, commodities again offer higher returns (Gorton & Rouwenhorst, 2006). Similarly, Nguyen and Sercu (2010) propose that commodity investment should especially take place in late booms and recessions.

Furthermore, research show precious metal commodities have particular benefits during particular business cycle periods. One of the most popular commodities is gold, which has a rich literature on its safe haven or hedging role during contracting economies (Baur & Lucey, 2010; Miyazaki et al., 2012; Reboredo, 2013; Creti et al., 2013). Sari et al. (2010) show that other precious metals such as silver and platinum could also play a safe haven role, though gold is still the leading one.

The third advantage of commodity investing is its low correlation with traditional financial assets (Silvennoinen & Thorp, 2013) as well as across sub-commodity groups (Pirrong, 2014). Gorton and Rouwenhorst (2006) report consistently negative correlations with stocks and bonds for the period between 1959 and 2004. Similar findings have been reported by Chong and Miffre (2006) and Attie and Roache (2009).

Bearing all these advantages in mind, institutional investors started to consider commodities just like stocks and bonds (Cheng & Xiong, 2013), which is referred as financialization of commodities.

1.2 Financialization

The term of financialization came into our lives with the major change in world economy starting in the 1980s. We experienced a period where the role of markets outmaneuvered governments, domestic and international financial transactions substantially increased, and trading activity between economies elevated (Epstein, 2005). Even though the consensus on the definition has not yet been settled; Epstein (2005) defines financialization as the increasing dominance of financial markets and financial players -both institutions and individuals- on economic operations. However, the term of financialization is a relatively new phenomenon for the commodity markets.

As we have mentioned in section above, speculators generally enter into the commodities market to benefit from backwardation. On the other hand, following the increase in commodity prices by 2000s, new varieties of financial investors –not only speculators- has entered the commodity markets (Domanski & Heath, 2007). Commodity derivatives lured financial investors via diversification opportunities along with lower risk aversion (Fattouh et al., 2013). Alquist and Kilian (2010), Masters (2008), Buyuksahin et al (2008) and Tang and Xiong (2012) document that especially index funds have grown rapidly after 2004. Domanski and Heath (2007) are the first to define the increase in participation of financial investors in the commodity market as financialization of commodity markets. Irwin and Sanders (2009) attribute such increase to influential studies (Gorton & Rouwenhorst, 2006; Erb & Harvey, 2006) arguing that commodity index funds offer equity-like returns with lower risks. Though, what exactly are index funds?

Index funds chase the performance of a predetermined index, such as S&P500, via investing in particular index member assets. Their fund management aims to perform at least as well as the index, and hence they carefully select their portfolio assets. Index investment is a well-known passive investing strategy and has been found to outperform active investing (Malkiel, 2003; Barber & Odean, 2000; French, 2008). Even though index funds chasing Russell 2000, MSCI Emerging Markets or S&P500 are well-known, commodity index funds had relatively been unpopular until the 2000s. Two of the most popular commodity indices are S&P GSCI and DJ UBSCI, and they have attracted financial investors with their high performance between 2002 and 2008. Of course, the increase in index performances was attributable to high commodity prices around same time. On the other hand, some argue that commodity index funds are the culprits for the substantial increase in commodity prices (Soros, 2008a; Masters, 2008).

Testimony of Masters (2008) before the Committee on Homeland Security and Governmental Affairs at United States Senate hit the market strongly. Commodities had been experiencing a super-cycle around that time and major argument to explain the super-cycle was surging commodity demand from emerging markets (Krugman, 2008; Hamilton, 2009). However, Masters contend that traditional demand-supply cannot explain the fivefold price increase in oil. Masters (2008) show there is an humongous participation increase of institutional investors in futures market after 2003. Next he indicates index investors' long position lead to higher commodity prices, though the story does not end here. He states higher futures prices cause consumers to accumulate inventory for that particular commodity. Since inventory demand increase, the increase in spot prices is attributed to rising demand. This argument is well-known in the literature with the name "Masters' Hypothesis". Around the same time, George Soros, a well-known hedge fund owner, also gave a testimony (Soros, 2008b). He particularly concentrates on oil and provides explanations for the increase on the chief energy commodity price. He contends the behavior of oil is peculiarly similar to market crash in 1987, both is driven by the dominance of financial institutions on one side of the market (Soros, 2008a).

Empirical studies questioning financialization is relatively larger in number but theoretical background is very scarce. As of our knowledge, only Basak and Pavlova (2016) explain the impact of institution presence on commodity market fundamentals theoretically. Therefore, let us first elaborate Basak and Pavlova's (2016) model and next provide selected empirical studies on financialization.

1.2.1 Basak and Pavlova's (2016) theoretical model on financialization of commodities

Basak and Pavlova's model fundamentally shows how dominant presence of financial institutions affects commodity futures prices, volatilities and correlations. Even though some studies show financialization affect characteristics of futures; they do not clarify how it affects. Therefore, Basak and Pavlova fill this gap via theoretically separating the impact of index investor flows from demand and supply on commodity futures.

The model is a multi-period model ($t \in [0,T]$) with multiple commodities. Investors also have the option to invest in traditional financial assets; stocks and bonds. There are K number of commodities and spot and futures prices at t of these commodities are denoted by p_{kt} and f_{kt}, respectively. Authors define futures price according to the stochastic discount factor (M) and spot prices.

$$f_{kt} = E_t\left[M_{t,T} p_{kT}\right]$$

Also there is a generic good, which incorporate all goods in the economy except K number of commodities. Model shows that higher the supply of the generic good (D), higher the aggregate output of the economy. Hence, D is a crucial state variable and represents aggregate wealth (output).

Futures contracts have shorter maturity than the end period of the model, but they are rolled over until time T, where consumption occurs. Commodity index is constructed between L commodities, of which is in smaller than K number of commodities. Investors have two other options in the financial market to invest; first is the stock and second is the bond market. Stock market, S, can be thought of as a right against aggregate economy, on the other hand bond market contains only one bond which offers risk free rate of return.

There are two types of investors, normal (N) and institutional (I). Objective functions of these investors are as follows:

$$u_N(W_{NT}) = log(W_{NT})$$

$$u_I(W_{IT}) = (a + bI_T)log(W_{IT})$$

As one can note, institutional investors' utility depends on the index level (I_T) and their marginal utility increases with the rise in index level. Since performance of institutional investors is generally compared relative to a benchmark, indices play the role of an anchor. Please also note that, index futures also are crucial for hedging purposes against increases in commodity price inflation.

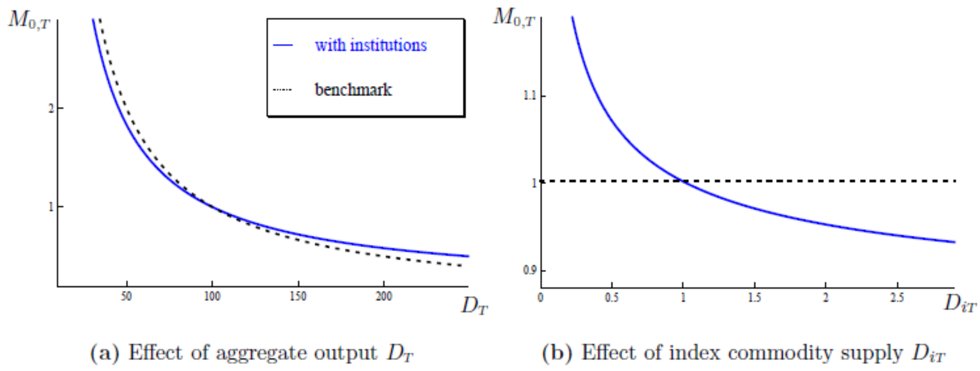

Figure 1.3 –Discount factor behavior of Basak and Pavlova's model under presence and absence of institutions

Notes. Basak and Pavlova refer an economy without institutions as benchmark economy and label with dashed line. On the other hand, how discount factor changes under presence of institutional presence is labeled with solid line. As one can note the discount factor decreases slower under presence of institutions, since commodities are now affected not only by aggregate output but also supply of any index commodity.

Discount factor channel is critical in understand financialization mechanism of Basak and Pavlova's model. Intuitively, stochastic discount factor, M, should decrease with an increase in aggregate output. Through this way, assets offering higher returns during contracting economies would be valued higher. As Figure 1.3a presents, under the presence of institutions still there is an inverse relationship but discount factor decreases more slowly. Basak and Pavlova explain this with the decrease in sensitivity of M to aggregate output, which is attributable to M also being dependent on the supply of any index commodity. As it is derived in the paper, index level is positively proportionate with aggregate output (D_T) and negatively proportionate with the supply of each commodity involved in the index (D_{iT}). Since these states are valued higher by institutional investors well-known inverse relationship gets slower.

Basak and Pavlova indicate that institutions are endowed with λ ($\lambda \epsilon (0,1)$) of stock market, whereas normal investors hold the rest (1- λ). Authors propose λ to proxy for the size of financial institutions in commodity futures markets.

1.2.1.1 Correlations of commodities within themselves and with stocks

Basak and Pavlova state complete market is not necessarily the reason for increasing correlations, unlike Tang and Xiong (2012), who state entrance of index investors in commodity markets benefited risk sharing and led to connectedness in seemingly apart commodities. They argue risk sharing in commodity markets was inefficient until financialization and under presence of financial institutions markets got integrated. However, Basak and Pavlova (2016) state there were speculators in commodity market much earlier than 2004 and we did not observe high correlations. Therefore Basak and Pavlova do not support Tang and Xiong's (2012) argument and show, institutions aim to align their performance with index and hence index becomes a common factor for all commodities, which is denoted by E_T $[I_T]$.

This common factor increases correlations especially across index commodities, since index futures are more attractive in terms of following the performance of the index. Furthermore, authors depict correlations become dependent on all state-variables including demand and supply shocks, as well as aggregate output volatility in the economy. Basak and Pavlova state output volatility can be mapped through VIX and they expect, higher the VIX higher the correlations. Although smaller, they contend correlations also are susceptible to relative size of institutions (λ).

1.2.1.2 Volatility spillover

The discount factor mechanism is vital to understand the spillovers in commodity markets. Basak and Pavlova incorporate storage theory by Deaton and Laroque (1992) and show spot prices, as well as inventories go up with financialization. Since the discount factor, M, is determined in financial markets through the size of institutional investors in commodity market; spot and futures prices are closely connected.

For instance if there is a negative supply shock to any of index commodities, this means supply for that particular commodity decreases and hence one would expect price to increase. Also producers would opt for storing not only that particular commodity but all other index commodities, since all storable index commodities are positively correlated with each other. Therefore, inventory level for all other commodities will also rise and presence of institutional investors leads commodities to be more susceptible to outside shocks originating from all other commodities. Basak and Pavlova (2016) indicate outside shocks do not solely stem from demand or supply shocks but could be any shock which is transmitted through financial markets.

Authors model the spillover from stock market to commodities to be concave up and increasing; indicating higher volatilities in financial markets would have higher impact on commodity fundamentals.

1.2.2 Selected empirical studies in financialization

After providing theoretical background on financialization, we move to empirical studies.

Even though Soros and Masters argue the culprit for the commodity price increase is commodity index traders, Singleton is one of the first academics to argue financialization affect prices (Reuters, 2011). Singleton's (2013) paper pulled great attention from scholars (Fattouh et al., 2013). He examines particularly crude oil prices and whether index funds and money managers have contributed to the boom and bust around Great Financial Crisis. Moreover, he also incorporates informational frictions in the market through heterogeneous beliefs on crude oil forecasts. Singleton follows Masters algorithm and shows the correlation of CIT imputed index positions with oil prices is 0.85, which implies financialization could have boosted prices. After controlling for US and emerging market stock returns, open interest and basis, Singleton (2013) concludes index investors and money managers led crude oil prices to deviate from fundamental value. Gilbert (2010), study 2006-2008 period and shows around 15% of increases in crude oil and metals prices are attributable to index investors. On the other hand, he does not find a support for the impact of index investors on grains market. Though, later Gilbert and Pfuderer (2014) extend the sample to 2012 and show index investor positions are helpful in predicting upcoming futures prices of grains and oilseeds.

Mou (2011) approaches financialization phenomenon from a different perspective and shows rolling strategies by index investors create a pressure on futures prices, since the size of these funds are very large. Henderson et al (2015) do not rely on CFTC data but study commodity linked notes (CLNs). Return of these notes is tied to performance of a specific commodity or a basket of commodities on top of the principal amount invested in the note. Authors depict investor flows into CLNs feed into commodity prices positively. Brunetti and Reiffen (2014) find risk premia declines when CITs hold more long positions. Cheng et al. (2014) show financial institutions have lower risk absorption capacity and thus, they decrease their long position in commodity futures when VIX increases. Authors state equilibrium futures prices would decrease following the decrease in long positions of index investors.

However, there are also a number of studies which argue that financialization is not the culprit for the increasing prices for commodities. Among others, Stoll and Whaley (2010), Irwin and Sanders (2010, 2012), Aulerich et al. (2010), Brunetti, Buyuksahin and Harris (2011), Janzen et al. (2013), Janzen et al (2014) and Hamilton and Wu (2015) all find statistically insignificant linkage between index fund positions and futures prices. They basically argue there is no recent evidence on increasing inventory levels (Krugman, 2008).

So, there is a severe discrepancy in findings which is partially attributable to data constraints. Most of studies mentioned above use publicly available CFTC datasets, some of which do not present actual index investors positions and are available in weekly frequency. On the other hand, studies co-authored by CFTC have access to proprietary dataset which are in daily frequency. Given the pace of the financial market, these differences could create a big disparity in results.

1.3 Connectedness of stock and commodity markets

Another critical aspect of financialization is interconnectedness of commodities with stock markets, since several investors took diversification benefits of commodities against traditional financial assets granted after Gorton and Rouwenhorst's (2006) findings. However, as Barberis and Shleifer (2003) and Tang and Xiong (2012) note, such advantage might disappear with the presence of institutional investors.

Interconnectedness can be in the form of co-movement or spillovers and each have separate implications. The increase in correlations between stocks and commodities around 2008 is a fact, though the agreement upon the reason is not reached yet. One group contends the increase is due to financialization and index investors integrating equity and commodity markets. (e.g. Silvennoinen & Thorp, 2013; Chong & Miffre, 2010). For instance, Buyuksahin and Robe (2014) finds that the speculators' positions predict co-movement between equity and commodity indices. Another group, though, states the correlations have returned back to pre-crisis levels after 2010; and hence is due to business cycle effect (e.g. Bhardwaj et al., 2015). Their major argument lies underneath the Global Financial Crisis effect, since business cycle impact is shared by several asset-classes.

The second form of connectedness is in spillover, which shows the transmission mechanism of returns/ volatilities between asset classes. The major advantage of spillover is showing the direction, so one can comment on which asset affects the other. Previous studies on commodities majorly focus on spillovers within commodity groups such as energy and agricultural (e.g. Nazlioglu et al., 2013). On the other hand, studies focusing on transmission between financial and commodity markets is very few in number. Moreover, from the ones examining almost all employ similar methods and particularly concentrate on the changing statistical significance after Global Financial Crisis (Nazlioglu et al., 2015). However, spillover amount between markets might provide further information on transmission dynamics.

As a result, there is still a big gap in the literature on financialization of commodities and academia has not still concluded source of increasing connectedness between financial and stocks markets. Is it attributable to financialization and is permanent or is it due to business cycle effect and is transitory? Hence, in the forthcoming chapters, we will particularly focus on connectedness and test co-movements in our first essay and volatility spillovers in the second. Related literature will be discussed in more detail in each chapter.

CHAPTER 2

COMMODITIES DO NOT SHIELD FROM RISK IN FINANCIAL MARKETS, ANYMORE

2.1 Introduction

In the last two decades, commodity derivatives market experienced an exceptional episode, with significant changes in market volatility. During similar times, world economy also underwent through a critical period of globalization, where international barriers demolished and investors sought for additional investment tools. Commodities enter into the radar of institutional investors because of their significant advantages, such as being good hedges against inflation and having low correlation with traditional financial assets (Gorton & Rouwenhorst, 2006). Hence, institutional investors started to heavily invest in commodities, of which is a process referred as the financialization of commodities (Cheng & Xiong, 2013).

Financialization hypothesis argues that the connectedness of financial and commodity markets have significantly increased following the influx of institutional investment in commodity futures. Traditionally commodity markets were viewed as widely different from financial asset markets. However, as investors started entering these markets for diversification and hedging purposes, the benefits provided by commodity markets are believed to erode over time. In fact, there are increased concerns regarding the transmission of any financial instability over to the commodity markets or vice versa.

Assets providing hedging potential during crisis episodes are of critical importance since they enhance the stability and resiliency of the system (Baur & Lucey, 2009). Financial regulation is mainly shaped around diversification phenomenon since it reduces the probability of failures of institutions. As Gorton and Rouwenhorst (2006) show, commodities offer higher returns than stocks and bonds in late expansion and early recession periods, and hence these assets shield investors from downside risk and might decrease the probability of failure. However, if institutional investors consistently trade in and out of selected commodities as well as other financial assets, they make these markets susceptible to shocks of each other (Tang & Xiong, 2012). Therefore, in this essay, we aim to examine whether transmission of financial shocks to commodity markets significantly increase after the financialization of commodities.

Commodity markets are critically important for economies and for their economic growth (Deaton & Miller, 1996) and hence the stability of commodity market has key implications. First of all instability in commodity market would bolster uncertainty in financial markets through investors trading in both markets (Gozgor , Lau & Bilgin, 2016). Secondly, a significant decline/ incline in commodity prices could lead international trading balance of commodity exporter/ importer countries to hurt severely. Thus debt repayment ratio decreases and negatively affects liquidity of banks and even triggering financial crisis for exporter countries (Kinda et al., 2016). Thirdly, volatile commodity prices would have direct impact on households' real income (Baumeister & Kilian, 2009).

Even though there is a recently growing literature on spillover studies within sub-groups of commodities (e.g. Nazlioglu, Erdem & Soytas, 2013; Mensi, Beljid, Boubaker & Managi, 2013), studies investigating the linkage of financial markets with commodity markets is scarce (Gozgor , Lau & Bilgin, 2016) and even scarcer in individual commodity basis. Different commodities may have a different relationship with asset markets. Therefore studying this linkage at the individual commodity level may provide additional insights. We aim to fill this gap and comment on the impact of financial shocks on individual commodity markets after the financialization episode.

Furthermore, majority of previous studies checking spillover between markets look for the change in statistical significance before and after crisis (e.g., Nazlioglu, Soytas & Gupta, 2015). However, having statistical (in) significance during both episodes might mislead researchers on concluding there is no financialization. However, via utilizing Diebold and Yilmaz (2012) methodology we show not only a change in the direction of volatility spillover but also a noteworthy increase in spillover amount after the financialization.

Connectedness can happen in either form of co-movements or spillovers (Adams & Gluck, 2015); though we firstly focus on the latter form since it has severe advantages over the former. First and foremost, spillover gives information on direction of transmission channel, whereas correlations only provide the common movement portion of two series. Furthermore, co-movements simultaneously respond to changes in market, while spillovers happen consecutively and hence are relatively a longer term measure.

We especially focus on stock markets since institutional investors heavily invest in such markets and if a financialization phenomenon is valid; we should definitely see a pronounced spillover from stock markets to commodities. The reason why we focus majorly on volatility spillover is two-folds. First of all, volatility is a crucial measure of risk and its spillover shows us if there is any transmission of risk across asset classes. The importance of risk lies in its superiority over return measures. Adams and Gluck (2015) indicate under uncertainty as investors try to process information and adjust their positions large positive or negative returns can be observed in the market. However, risk measures such as volatility exhibit consistently high levels during uncertainty implying the stress level in the market. Secondly, Yang and Zhou (2016) indicate volatility spillover is linked to systemic risk, since systemic risk can arise with linkages across modules of financial systems. Therefore, volatility gives vital information on the fragility of the economy and how likely the economy is prone to a systemic risk.

Yet, another argument on increasing interconnectedness between commodities and financial assets argue Global Financial Crisis in 2008 bolstered correlations (Bhardwaj et al., 2015). They contend that during downturns of economies, uncertainty would affect all assets in similar ways and hence commodity and stock markets would be more dependent on each other. We support the argument that business cycle is a key factor on asset pricing (e.g. Fama & French, 1989) and is a critical aspect of systematic risk. However, Diebold and Yilmaz (2015) state assessment of business cycle risk requires connectedness at the first place, since systematic risk cannot be diversified.

In this paper, we test connectedness of individual commodity derivative and stock markets and thus we employ daily prices of nearest future contracts of 25 commodities from energy, precious and industrial metals and agriculture sub-groups as well as for the S&P500. Since US stock market is found to be leading other stock markets (Nazlioglu, Soytas & Gupta, 2015) and S&P500 constitute around 80% of US market cap, we proxy stock markets with S&P500 index. Via utilizing GARCH (1,1) model, we calculate daily volatilities of each series and next run Diebold and Yilmaz (2012) methodology for each pair of commodity with S&P500. Diebold and Yilmaz's (2012) method is a simple yet efficient way to understand spillover mechanism through forecast error decompositions of VAR models. We locate the financialization through arbitrary selection based on previous findings (e.g. Tang & Xiong, 2012) and also via statistical selection methods.

Our results suggest three major findings. First, we find that spillover indexes for all commodities except natural gas and orange juice significantly increase during post-financialization episode compared to the pre-financialization episode. The spillover amount from stock market to commodities and from commodities to stock market, both increase significantly. However, the increase in magnitude that spills over from financial market to commodities is much more pronounced supporting theoretical propositions of Basak and Pavlova (2016). Authors indicate institutional investors benchmark their performances against well-known commodity indices, but this also makes all index commodities prone to demand and supply shocks of all other index commodities. Last but not least, we find that the sign of net connectedness change from negative to positive after the financialization. Hence, before financialization commodities were the net shock transmitters, however they turn out to be the receivers after the financialization.

Some researchers argue the interconnectedness between stocks and commodities is due to business-cycle effect and decreases after the Global Financial Crisis. In order to accommodate the global crisis and to have comparable results with the literature we divide the post-financialization period into two as January 2004 – June 2009 and

July 2009 – June 2016. Basically we divide as pre and post-crisis based on NBER business cycle episodes. If increasing connection between these markets are attributable to business cycle, we should see less spillover in the second sub-episode.

All these findings suggest that commodities have become another asset-class just like stocks for financial institutions. Moreover, Barberis and Shleifer (2003) argue that consistently investing and disinvesting in selected assets generates a common factor, between seemingly unrelated asset classes. Therefore, investors regarding commodities as financial assets create an information transmission channel between other financial assets and commodities. Barberis and Shleifer (2003) refer to this phenomenon as investment style, and our findings confirm that commodities are an investment style.

Furthermore, during pre-financialization commodities were good hedging tools for business cycle episodes (Gorton & Rouwenhorst, 2006), whereas after the influx of institutional investors in commodity futures market this advantage has vanished. This leads to a significant damage in role of commodities as caterers of stability and resilience of financial system. Recently, commodities share same business cycle episodes and same systematic risk with financial assets and hence they fail to protect investors from shocks in stock markets.

In the next section we discuss the literature review, Section 2.3 and 2.4 elaborate the methodology and describe the data, respectively. Lastly, Section 2.5 presents our results and Section 2.6 concludes the research.

2.2 Literature Review:

Globalization starting around 1980's reshaped the world economy through increasing trade activity across borders. Increased global trade in turn pushed the international financial transaction size up globally and led to increased prominence of financial markets, which is defined as financialization in a more global way (Epstein, 2005). The new financial architecture driven by globalization also linked geographically distant markets as well as seemingly unrelated asset classes such as commodities and equities. This paved the way for a new strand of literature in finance, which examines price/ volatility spillovers dynamics across geographically and characteristically diverse markets.

Spillover literature is basically composed of two branches. The first one investigates the contagion across geographical markets during crises and the second one examines particular asset classes which compensate for losses at those crisis episodes (Baur & Lucey, 2009).

2.2.1. Contagion across geographical markets

Contagion literature mainly starts with searching international stock market interdependence and how this impacts international investors (e.g. Hamao, Masulis & Ng, 1990; Bekaert & Harvey 1995; Karolyi & Stulz, 1996; Hartmann, Straetmans & de Vries, 2001). Dependence of financial markets also would mean those markets are integrated and pairwise correlation of asset prices are higher (e.g. Hilliard, 1979; Eun & Shim, 1989). Other than integration, contagion also suggests information in one market to spill over to the others. Hamao et al. (1990) study daily and intraday data for the period between 1985 and 1988 for developed markets and show volatility spillover between Tokyo, London and New York stock markets is observed only after October 1987. This time frame is no surprise since Black Monday was the biggest crash in history after Great Depression, up until that time. Subsequent to Hamao et al.'s (1990) study several examine whether one source of risk in one market is carried to other markets, just because they are integrated.

Longin and Solnik (1995) indicate correlations between international markets rises during stress periods and similarly Calvo and Reinhart (1996) state if cross-market correlation coefficients display one-off increase; the increase should be attributed to the contagion. On the other hand, Forbes and Rigobon (2002) argue Calvo and Reinhart's (1996) approach is not correct since high volatility artificially leads to upward-biased correlation coefficients. Later, Bekaert et al. (2005) take time-varying characteristics into account and indicate if two economies are economically integrated, they would also show contagion characteristics in financial crisis episodes. Though, if they are segmented, probably they would not display contagious characteristics, either. Contagion literature up until 2008 had focused only on Asian and Mexican crises since they have specific characteristics such as affecting multiple geographical markets. Later, the biggest crash of our near history, Global Financial Crisis (GFC) opened a new study line within contagion studies, since it is the first true global financial crisis after Great Depression (Bekaert, Ehrmann, Fratzcher & Mehl, 2014).

Scholars sought for contagion characteristics during 2008 turmoil, between emerging markets (e.g. Dimitriou, Kenourgios & Simos, 2013), G-8 economies (e.g. Dungey & Gajurel, 2014), EU countries (Phillippas & Siriopoulos, 2013) and a wide array of other developed and emerging countries (e.g. Bekaert, Ehrmann, Fratzscher & Mehl, 2014). Some find GFC to carry significant contagion traits (e.g. Dimitriou et al.; 2013, Dungey & Gajurel, 2014), whereas rest argues it does not (e.g. Phillippas & Siriopoulos, 2013). Furthermore right after the collapse of US economy, this time European sovereign debt crisis erupted around 2012. Beirne and Fratzscher (2013) study 31 developed and emerging countries and find financial sector has been more sensitive to economic fundamentals following the Global Financial Crisis. They argue sovereign debt yield of GIPSI (Greece, Ireland, Portugal, Spain and Italy) countries experienced significant spillover within themselves and financial markets started to react based on country characteristics.

2.2.2 Flight-to-safety within asset classes

The second strand of spillover literature examines the transmission within asset classes, which examines how the performance of selected asset classes responds to crisis. Since pandemic characteristics might be present not only in different markets but also within different asset classes, this part of the literature is quite voluminous too. However, by pandemic we do not mean to say only bad news transmits into other markets, good news in one asset class might also have positive impact on another asset class, as well. Such informational dependency between asset classes has two major implications (Ciner, Gurdgiev & Lucey, 2013). First of all portfolio construction decisions are highly dependent on correlations and therefore market participants decide on their holdings based on correlation characteristics within asset classes. Secondly if spillover is extant within asset classes, this would imply that financial-economic or monetary decisions impact other asset classes, which otherwise seem to be unrelated. Especially, linkage between asset classes would provide us the resistance of an asset class to shocks in other markets and also provide information on the flight-to-quality phenomenon.

The interdependence between asset classes can either be in the form of co-movement and/ or spillovers (Adams & Gluck, 2015). We first provide a brief review of co-movement and later mention volatility spillover studies.

2.2.2.1 Co-movements

Studies investigating co-movements across asset classes are vastly examined within flight-to-quality literature (Baur & Lucey, 2009) and earlier studies on this literature mostly focus on correlations (Ehrmann, Fratzsher & Rigobon, 2011) between equities and bonds. Given that these two asset classes are two major traditional financial assets, inaugural studies focusing on them are of no surprise. Most studies imply that the co-movement between stocks and bonds are negative (e.g. Shiller & Beltratti, 1992; Yang, Zhou & Wang, 2009). Negative correlation is intuitional and straightforward; as an increase in long-term bond yields would result in decreasing stock prices since investors are more tended to hold bonds (Shiller & Beltratti, 1992). However, several recent studies indicate negative correlations are highly dependent upon the business cycle (e.g. Illmanen, 2003, Baele, Bekaert & Ingelbrecht, 2010) and are mostly valid during economic contractions (Baele, Bekaert & Ingelbrecht, 2010).

Even though earlier studies have mainly focused on stocks and bonds, lately scholars and market participants sought for additional asset classes which have consistently negative correlation or have no spillover with traditional financial assets. Currency market (Ehrmann, Fratzsher & Rigobon, 2011), real estate market (Yang, Zhou & Leung, 2010) and selective commodities such as gold (Baur & Lucey, 2010) have been studied.

Commodity group has attracted attention of flight-to-quality literature firstly through the well-known precious metal; gold. Given that gold is the historically used monetary tool, it makes sense that the interaction between gold and currency market has pulled attention of scholars. This precious metal is found to have diversification advantage across major currency markets such as US Dollar (Reboredo, 2013), UK Pound, Euro and Japanese Yen (Pukthuanthong & Roll, 2011). Also Jaffe (1989) finds that gold plays diversification role quite well, when included in a portfolio including stocks and bonds. Other studies also mention the safe haven role of gold against equity market (Baur & McDermott, 2010); though up until Baur and Lucey (2010) the distinction between hedging or safe haven hypotheses had not been explicitly studied. Baur and Lucey (2010) indicate hedge tools are consistently negatively correlated with selected asset classes whereas safe havens display negative co-movement only during financial stress episodes. Some studies argue gold has only safe haven role against major developed (Coudert & Raymond, 2011; Chen & Lin, 2014) and emerging stock markets (Baur & McDermott, 2010). On the other hand, some other studies contend it serves as a hedge against US (Hood & Malik, 2013), UK and Japanese stock markets (Choudhry, Hassan & Sahabi, 2015). On the other hand, recent research argues that during financial turmoil the linkage between asset classes could transform and have mutual dependence (Choudhry et al., 2015). Therefore, static studies could produce biased results and thus financial turmoil periods should be approached carefully and separately.

The other major commodity included in the finance literature is oil, which is the lifeblood of economies (Ordu & Soytas, 2016) and thus oil builds a transmission mechanism between financial and commodity markets. There is a voluminous literature on the impact of oil prices on macro economy (e.g. Bruno & Sachs, 1982; Hamilton, 1983; Gisser & Goodwin, 1986) and equity valuations (e.g. Huang, Masulis & Stoll, 1996; Sadorsky, 1999). Geman and Kharoubi (2008) find that oil futures provide an excellent diversification against US equity market. Ciner et al (2013) find that oil plays a safe haven role for bond market but not for the equity market in the long term. Though, during specific crisis periods like Gulf War and Global Financial Crisis, it is advantageous for equity investors to hold oil as a financial asset. On the other hand, Lombardi and Ravazzolo (2013) state that including commodities in a portfolio increases the volatility of the portfolio and hence oil is not a perfect diversification opportunity.

Later, scholars seek whether other individual commodities other than gold and oil provide any additional diversification benefit. Even though Tang and Xiong (2012) indicate there is an observed increase in correlations between cross-markets and also within commodities after 2004, some studies show selected commodities behave differently (Adams & Gluck, 2015). Silvennoinen and Thorp (2013) indicate natural gas and platinum have low and constant correlation with US stocks. Adams and Gluck (2015) state aluminum and wheat have very low spillover with stock market, whereas Bruno et al. (2016) indicate livestock commodities do not show significantly higher co-movement with equities.

However, one should bear in mind that co-movement does not provide the direction and has relatively a more ambiguous interpretation compared to spillover studies (Adams & Gluck, 2015). Co-movement, could display instantaneous and sharp moves; though spillover has a more long-term impact and generally we do not observe one-off extreme changes. Furthermore, co-movements have no-direction, though spillover studies directly show the route of transmission either uni- or bi-directional. Direction is of utmost importance especially during turmoil periods, since it would allow the investor to understand which shocks have an impact on its portfolio. Volatility spillovers to/ from/ within commodity market is also vital, since economies are highly reliant on commodities. Hence, a severe uncertainty in commodity market could have drastic changes in the prosperity of countries.

2.2.2.2 Volatility spillover

Literature on volatility spillover is relatively less in volume compared to co-movement studies and transmission of volatility within commodities start with energy market, unsurprisingly. Lin and Tamvakis (2001) show non-synchronous trading leads to closing NYMEX prices to spill over to International Petroleum Exchange prices other morning. Ewing, Malik and Ozfidan (2002) show oil volatility spills over to natural gas markets and latter market has more volatility persistence. Chang et al. (2010) study four major benchmarks in oil market and find that Brent and WTI are world reference prices.

Following the biofuel policy change to reduce oil usage in energy production, agricultural commodities happen to be a substitute for oil, since they are used for biofuel production. Hence another strand of literature analyzes the interdependence between agricultural commodities and energy market. Given that food constitutes around 55% of household consumption, the interrelationship between these two sub-groups is highly important. Baffes (2007) study 35 major commodities in their analysis and show that crude oil spills over to other commodities and especially fertilizers and food sub-group. Chang and Su (2010) also show that there is a significant spillover between agricultural and crude oil markets. On the other hand, some studies argue that these two commodity sub-groups are actually segmented (e.g. Gilbert, 2010). Due to inconsistency within findings, Nazlioglu et al (2013) investigate whether spillover dynamics change after the crisis. Their findings imply that the spillover from oil market to agricultural commodities is statistically significant only during post-crisis period, but not before. Similarly Du, Lu and Hayes (2011) indicate the linkage between such markets strengthen by 2004.

Sari, Hammoudeh and Soytas (2010) include precious metals aside energy commodities and find there is a bi-directional transmission mechanism between gold and oil. Ji and Fan (2012) include all other non-energy commodity markets into their analysis and results imply that there has been a significant volatility spillover of crude oil market on non-energy commodity markets before the crisis but not after. They argue the major reason for higher volatility is higher commodity prices, but not vice versa.

Even though studies checking volatility spillovers within commodity markets have been recently building, studies examining the impact of financial market on commodity market stability are scarce (Gozgor, Lau & Bilgin, 2016). Since for a long time investors and scholars consider commodities to be segmented from financial markets (Bessembinder, 1992), many scholars overlook the fact that financial market instability could induce commodity volatility. On the other hand, following the intense financialization arguments, researchers start to seek whether commodities are still isolated or have become vulnerable to shocks in financial market.

Starting with Gorton and Rouwenhorst's (2006) study, interest of institutional investors on commodity investments rose significantly. Gorton and Rouwenhorst (2006) show commodities are good hedges against inflation and are negatively correlated with traditional financial assets, such as stocks and bonds. Hence, financial investors started to perceive commodities as an additional investable class especially for hedging and diversification purposes (Baffes & Haniotis, 2010; Buyuksahin & Robe, 2014). Since these investors invest both in traditional financial asset markets, which are equities and bonds, there might be a linkage between commodity fundamentals and these financial markets. If commodities are considered as an additional style along with stocks and bonds, this would lead investors not to allocate their funds into individual assets but to styles (Barberis & Shleifer, 2003). For instance, investors considering commodities as a style would result in an increasing interdependence between asset-classes they consider as styles.

Around similar times with the quintuple increase of commodity index traders in commodity market (Adams & Gluck, 2015); commodity prices also experienced historically high volatility. This parallel move pushed researchers to understand whether financial institutions distort prices and volatilities of commodities.

Relatively larger chunk of studies investigate interdependence of oil prices and equity markets. Arouri, Jouini and Nguyen (2012) show there is a significant volatility spillover from oil to European developed stock markets, but not vice versa. Malik and Hammoudeh (2007) document the same direction for Gulf equity markets. However, Arouri, Jouini and Nguyen (2011) show the spillover is bidirectional for US market and oil, implying both variables affect each other. Bhar and Nikolova (2009) study equity markets of BRIC countries and show the direction and significance of spillover between oil and stock markets are highly dependent upon country being a net importer/ exporter. Li, Yin and Zhou (2016) employ an equity uncertainty index developed by Baker et al. (2015) and show especially during crisis periods fluctuations in oil spill over to the equity market. On the other hand, Chang, McAleer and Tansuchat (2013) analyze the linkage between crude oil and UK and US stock markets and show there is little spillover for the period between 1998 and 2009. Nazlioglu et al. (2015) approach the question in a different way and employ a financial stress index (FSI) to proxy for the state of US financial market and examine the spillover of FSI with oil. Their results imply that before the crisis oil spills over to FSI but after the crisis the direction gets reversed.

Mensi, Beljid, Boubaker and Managi (2013) extend previous literature via including beverage, wheat and gold and investigate how they interact with stocks. Results imply that there is a significant spillover from US equity market to oil, beverage and gold volatilities; but not wheat. On the other hand, Sadorsky (2014) show the spillover is bidirectional between MSCI Emerging markets index - oil and MSCI Emerging markets index – wheat.

Another group of studies check the interdependence of other asset classes with commodities, but number of such studies is few (Kang et al, 2014). Researchers generally seek the linkage between oil and monetary policy (Bernanke, 1997; Frankel, 2006; Amatov & Dorfman, 2015) but not explicitly bonds. Kang et al.'s (2015) study show there is a significant unidirectional volatility spillover from bond returns to oil for the period between 1982 and 2011. Antonakakis and Kizys (2015) state investigates the interdependence between commodity and foreign exchange markets and show static analysis defines net transmitters of return and volatility to be gold, though dynamic analysis implies net transmission role significantly changes during different financial episodes. Therefore, employing a dynamic study is of utmost importance, since connections between asset classes are highly dependent upon events and time frames.

Even though results are not in concordance with each other, there is an apparent fact showing that results are dependent upon time frame, market environment and financial situation of the economy.

Therefore, previous studies pave the way for our study which examines how the interaction between commodity and stock markets changed following the financialization. However, the theoretical background investigating the relationship between institution presence in commodity markets and commodity market fundamentals is very scarce. As of our knowledge, the only theoretical explanation on the impact of financialization on commodity volatility is by Basak and Pavlova (2016).

Basak and Pavlova (2016) develop a multiple-commodity dynamic model whilst incorporating institutional and individual investors. In this model, there are K number of commodities and some of these commodities constitute an index. Performance of institutional investors is benchmarked against this index and hence institutions closely follow the index. Authors show that the major mechanism of spillover is through discount factor channel, where futures prices are determined via stochastic discount factor (M) and spot prices. M does not only depend upon the state of economy but also supply and demand of all index-member commodities and presence of institutions in the market. If institutions are highly dominant in a market, their impact on M would also be higher. Therefore a shock not only in commodity market but any shock which has an impact on commodity market changes the discount factor. However, this phenomenon is not valid for non-index commodities; since institutional investors strive not to fall behind the index, they value commodities which are a member of major indexes. Therefore, we hypothesize the financialization to be applicable for index member commodities and to observe higher spillovers for such commodities after financialization.

Basak and Pavlova (2016) especially note that outside shocks could come from financial market, since institutional investors invest both in financial markets and commodity markets. Therefore, the critical point in this model is the presence of institutional investors. Their impact on discount factor changes the dynamics in commodity market and makes commodity market highly susceptible to financial market shocks. Therefore, we will test whether the quantity of volatility transmission between commodity and stock markets has significantly increased following the financialization. For further information on Basak and Pavlova (2016), you can refer to Section 1.2.1.

One crucial point to mention; majority of all above-mentioned empirical spillover studies use similar methods based on GARCH-based models. Some of those studies employ univariate GARCH for each time series and obtain cross-correlation coefficients of standardized residuals (Nazlioglu et al., 2015) and employ causality-in-variance tests by Cheung and Ng (1996) and Hong (2001). However, Hafner and Herwartz (2006) state in leptokurtic volatility series these portmanteau tests do not provide reliable results. Hence, Hafner and Herwartz (2006) provide a new test based on Lagrange multiplier and thus another group of scholars employ Hafner and Herwartz's (2006) methodology (e.g. Nazlioglu et al., 2015). Some other scholars utilize multivariate GARCH models such as CCC, DCC and BEKK and find multivariate setting models to be superior in volatility transmission analyses (e.g. Hassan & Malik, 2007; Kang, Kang & Yoon, 2009). However, Arouri et al. (2011) indicate MGARCH models have a large number of parameters to be estimated and have a severe convergence problem if one adds exogenous variables in mean and variance equations. Hence, some researchers such as Arouri et al. (2011) and Mensi et al. (2013) use VAR-GARCH models.

Although all these models have some advantages and disadvantages over each other; they all share one major shortcoming. They do not quantify the spillover, but only provide whether the spillover between selected variables is statistically significant or not. However, even if the spillover is significant, the amount of spillover might significantly rise or decline between two periods. As of our knowledge, our paper is the first to quantify the amount of spillover between stock and individual commodity markets during pre and post financialization episodes.

So0 let us elucidate our methodology in the next section.

2.3 Methodology:

This section provides the methodology we use to quantify whether financialization has any impact on the interrelationship between commodities and equities. Our analysis is a two stage analysis – in the first stage we determine when the financialization started, precisely. There are mainly two views on the time-point of a structural change: first one argues commodity index investment significantly increased somewhere around 2004 and thus the threshold for the financialization period is the year 2004 (Tang & Xiong, 2012). Second one, on the other hand, contends the impact of vast inflows from financial institutions on the behavior of commodity did not materialize until the GFC and thus financialization started by 2008 (Adams & Gluck, 2015).

We rely on both on arbitrary selections and statistical methods to locate structural change points in commodity market fundamentals. Since some researchers use the former (e.g. Aulerich, Irwin & Garcia, 2013) and some use the latter (e.g. Adams & Gluck, 2015), we employ both and show whether findings are robust to period selections or methods.

In the second stage of our analysis, we compare how the spillover characteristics between commodities and stocks change before and after financialization. If financialization is a valid phenomenon, we should see more pronounced spillovers between stocks and commodities during post-financialization compared to pre-financialization period. The major advantage of this method is, of course quantifying the amount of spillover and comparing periods, separately. Since earlier studies generally employ GARCH based models, they only comment on the significance of volatility. Hence if they find statistically significance/ insignificance both in pre and post financialization episodes, they could mistakenly conclude that there is "no financialization". However, the change in the amount and direction of spillover would give us the required information of financialization.

2.3.1 Determining when the behavior of commodities changed – Structural breakpoint tests vs. arbitrary selections

As we have mentioned above, previous studies argue financialization of commodities started somewhere between the years 2004 and 2008 (Adams & Gluck, 2015). Mainly there are two approaches to determine these thresholds; either through arbitrary choices or via employing statistical methods. We would report both approaches and show whether our results are robust to selections of specific episodes.

Previous researches report that flow of index investment to commodity market significantly increased in 2004 (e.g. Irwin & Sanders, 2011; Tang & Xiong, 2012; Hamilton & Wu, 2015; Brunetti & Reiffen, 2014; Tang & Xiong, 2012). Moreover, Tang and Xiong (2012) show the correlation and spillover between non-energy commodities and oil display a substantial increase by the same year. Several follow Tang and Xiong's (2012) seminal paper and arbitrarily select the year 2004 as the threshold or financialization of commodities (e.g. Aulerich, Irwin & Garcia, 2013). Thus, we also run our spillover analysis for two periods before and after the year 2004.

We also rely on statistical methods and employ time-varying correlations to locate the point where commodity behavior altered. Adams and Gluck (2015) state co-movement is the major indicator to analyze how the interdependence between commodities and stocks has changed over time and hence we first compute asymmetric dynamic conditional correlations (ADCC) between each commodity and US stocks. We utilize ADCC method from GARCH family to proxy for time-varying correlations between each commodity and US stocks. ADCC method (Cappiello et al, 2006) extends dynamic conditional correlation method introduced by Engle (2002) and allows an asymmetric component to be present in correlation structure. If such asymmetric component is significant, this would suggest the correlations respond disproportionately more to negative shocks either in stocks or commodities, compared to positive shocks.

Furthermore, GARCH family method is superior over unconditional correlation methods such as rolling windows since such models are not robust to changes in volatility (Forbes & Rigobon, 2002). Fuss, Adams and Gluck (2012) argue results from multitude of MGARCH models could be misleading since each propose different correlation structures. Thus, in a similar study, Adams and Gluck (2015) employ Galeano and Wied's (2014) breakpoint detection method for correlation series. However, breakpoint dates of selected commodities reported in Adams and Gluck (2015) via Galeano and Wied (2014) method is quite similar to our results on ADCC methodology. Hence, we propose to follow ADCC method in our analysis.

Since EGARCH models are found to be more suitable for financial analysis due to the leverage effect (Soytas & Oran, 2011), we run EGARCH (1,1) models. Please note that we apply the Ljung–Box and ARCH tests to examine whether there is any remaining autocorrelation or conditional heteroscedasticity. For further information on this methodology one can refer to Section 3.3.1.

After deriving time-varying correlations for each pair of commodity with stocks, we utilize the Bai and Perron (2003) multiple breakpoint tests and decide the threshold year for the financialization episode. Since correlations provide us how the interaction between these two markets have changed over the course of time, break point of time-varying co-movement series would also give an hint on spillover dynamics.

2.3.2 Diebold and Yilmaz (2012) volatility spillover methodology

Once we locate where the financialization phenomenon start; we quantify and compare volatility spillovers between individual commodities and US stocks before and after financialization.

The connection between two separate asset classes can occur either in co-movements or spillovers, but spillovers have some advantages over co-movements (Adams & Gluck, 2015). First of all co-movement of asset i and j are identical indifferent from ordering and hence it is non-directional. On the other hand, in general, spillover from i to j or j to i are not equal and thus one learns which asset transmits the information to other through spillovers. Secondly, co-movements display sudden changes with financial market shifts, whereas spillovers occur consecutively following a shock in the market (Adams & Gluck, 2015). Therefore, it is of utmost importance to assess connectedness in financial asset markets, while giving financial investment decisions.

We especially check the volatility spillover since it measures the transmission of risk across asset classes and is closely linked to systemic risk. For instance, the roots of 2008 crisis started by real estate market and transmitted quickly to credit market with strong impact on all other asset classes; creating a systemic risk for the whole economy. Even though many scholars believed commodities are segmented from financial market; recent financialization phenomenon push us to understand whether this is still so.

We utilize Diebold and Yilmaz's (2012) rather simple but very intuitive method to measure the volatility transmission between asset classes. Fundamentally, authors run vector autoregressive models and obtain generalized variance decomposition outputs. Since, generalized variance decomposition allows shocks to affect all variables simultaneously; ordering of variables is not critical unlike Cholesky factorization.

Variance decompositions explain what proportion of the N-step ahead error variance in forecasting a is due to shocks in itself (a) or shocks to other forces. To obtain variance decomposition output, one should run a N-variable p order vector autoregressive model:

$$Y_t = \sum_{i=1}^{p} \theta_i Y_{t-i} + \varepsilon_t \qquad (2.1)$$

where $\varepsilon_t$is independent and identically distributed and covariance matrix is Σ. The moving average representation is;

$$Y_t = \sum_{i=0}^{\infty} A_i \varepsilon_{t-i} \qquad (2.2)$$

or more simply $Y_t = A(L)u_t$. Moving average coefficients denoted by $A(L)$ is of utmost importance to understand dynamics between variables. Such coefficients allow dividing the H-step-ahead forecast error variances of each variable into parts attributable to the various system shocks. There are hundreds of moving average coefficients to interpret (i.e., $A(L) = A_0 + A_1 L + A_2 L + \cdots ,$), but variance decomposition framework transform such coefficients in a readable way.

There are three types of variance decompositions namely orthogonalized, Cholesky and generalized. Unlike orthogonalized method Cholesky allow for correlated errors across equations, but strictly relies on ordering of variables. Hence results significantly change with the initial variable. On the other hand, generalized variance decomposition allows variables to be independent of ordering and hence Diebold and Yilmaz (2012) employ this method in their analysis.

Table 2.1 – Sample connectedness table

	x_1	x_2	…	x_N	From Others	Total
x_1	d_{11}	d_{12}	…	d_{1N}	$\sum_{i=1}^{N} d_{1j}, j \neq 1$	100
x_2	d_{21}	d_{22}		d_{2N}	$\sum_{i=1}^{N} d_{2j}, j \neq 1$	100
…	…	…	…	…	…	100
x_N	d_{N1}	d_{N2}	…	d_{NN}	$\sum_{i=1}^{N} d_{3j}, j \neq 1$	100
To Others	$\sum_{i=1}^{N} d_{i1}, i \neq 1$	$\sum_{i=1}^{N} d_{i2}, i \neq 2$		$\sum_{i=1}^{N} d_{iN}, i \neq N$	$\frac{1}{N}\sum_{i,j=1}^{N} d_{ij} \ i \neq j$	

Notes. Sample connectedness table by Diebold and Yilmaz (2012). x refers to variables employed in the study. d_{ij} represents contribution of a shock in i to the forecast error variance of j. To others and from others columns are basically the sum of respective column or row excluding the variable itself.

H-step ahead forecast error variance decomposition of variable i is as follows:

$$\delta_{ij} = \frac{{\sigma_{jj}}^{-1} \sum_{h=0}^{H-1} (e'_i A_h \Sigma e_j)^2}{\sum_{h=0}^{H-1} (e'_i A_h \Sigma A'_h e_i)^2} \qquad (2.3)$$

Here σ_{jj} stands for the standard deviation of ε_j, Σ is the covariance matrix for the error vector, e_j is a $Nx1$ vector with jth element unity and zeroes elsewhere. However, row sums in generalized variance decomposition matrices are not necessarily equal to 1 and thus each entry is normalized by the row sum as follows;

$$\widetilde{\delta_{ij}} = \frac{\delta_{ij}}{\sum_{j=1}^{N} \delta_{ij}} \qquad (2.4)$$

By construction, $\sum_{j=1}^{N} \delta_{ij} = 1$ and moreover $\sum_{i,j=1}^{N} \delta_{ij} = N$. Now, we are equipped with available measures to calculate gross and net connectedness.

Let us now elaborate how these measures are used. If there are N number of variables, variance decomposition output produces a $N \ x \ N$ matrix. Diebold and Yilmaz (2015) denote this matrix by $D = [d_{ij}]$ and call it *connectedness table*. So the matrix is as follows as it is presented in Diebold and Yilmaz (2015:9):

In the above table, off-diagonal elements show the pairwise connectedness. For instance, for d_{21}, shocks to x_2 are responsible d_{21}% of the H-step ahead forecast error variance in x_1. Diebold and Yilmaz provide the notation $C_{1\leftarrow 2} = d_{21}$ for this measure. One might also wish to measure net pairwise connectedness, which is found via; $C_{ij} = C_{j\leftarrow i} - C_{i\leftarrow j}$.

Diebold and Yilmaz (2012) also compute a spillover index, which is basically a measure on the connectedness. To compute spillover index, we should sum all off-diagonal elements and divide it by total column or row sums including diagonal elements. Therefore the denominator is always $N * 100$. Since our analysis contains running spillover test for each commodity with S&P500, our N is always equal to 2.

Diebold and Yilmaz (2014) explain that the connectedness C depends on three major components of variance decomposition framework; variable selection x, the horizon H and the dynamics $A(L)$. Whilst determining variable selection, one should consider the type of x studied (return or volatilities) and the frequency of x along with which variables (which assets/ markets/ companies) to include in the study. In our study, we study connectedness of each 25 commodities with US stocks and hence for each analysis we have an x of 2. We calculate daily conditional volatilities of these variables and therefore x frequency is daily and type of x is volatility.

The selection of horizon H is highly arbitrary but Diebold and Yilmaz (2012) proposes to select an H dependent upon the aim of the study. For instance authors propose H to be portfolio rebalancing period for a similar study like ours. Tokat and Wicas (2007) contend institutions generally rebalance monthly, quarterly or annual contingent upon the market characteristics, asset choices and period of the business cycle. Though they propose optimal rebalancing period to be annual to compensate for costs associated with portfolio relabancing. Diebold and Yilmaz (2014) also indicate a shock in a variable might impact the other variable only with a lag and therefore connectedness might be small for near period but larger for more distant time. Bearing these facts in mind, we majorly provide results for H=10 (bi-weekly), 21 (monthly), 63 (quarterly), 126 (semi-annual) and 252 (annual) days to split volatility transmission into short-run and long-run components and also to consider portfolio rebalancing periods of institutional investors.

Lastly, we select the lag of the VAR to be 8 to make sure the analysis is robust, though Diebold and Yilmaz (2012) show that findings are not sensitive to lag selection for the lags between 2 and 8.

2.4 Data

Our data is on trading-day basis and takes log returns of 25 commodities and S&P500 for the period between 1 January 1997 and 6 June 2016. Returns are measured via the conventional method of $r_t = \log(P_t) - \log(P_{t-1}) * 100$. On the other hand, to measure volatility is not as straightforward as returns.

Volatility is technically how much price series divert from long term level (Alghieri, 2012) and does not only mean rising prices, but also to fluctuate below historical levels. Measure of volatility has long been a debate in finance literature, including historical and conditional volatilities. Historical volatility generally assume the volatility is constant throughout time, which actually is not and thus stochastic volatility models are more commonly used (Alizadeh, Brandt & Diebold, 2002). The second widely used volatility model group is conditional volatility models and they assume volatility is not static, changes during the course of time and hence is stochastic. Even though squared and log absolute returns are widely used in finance literature as stochastic volatility proxies, Andersen and Sorensen (1997) indicate they are highly inefficient due to non-Gaussian measurement errors. Similarly generalized method of moments can also be highly inefficient (Alizadeh et al., 2002). Thus, Alizadeh et al. (2002) provide a simple measure of volatility which is based on range measure and Diebold and Yilmaz (2012) actually employ. Using daily low and high prices, they measure daily volatility as: $\widetilde{\sigma_t}^2 = 0.361 * \left(\ln(P_t{}^{max}) - \ln\left(P_t{}^{min}\right)\right)^2$ where $P_t{}^{max}$ stands for the maximum and $P_t{}^{min}$ for the minimum price on day t (Diebold and Yilmaz, 2012). If one would like to annualize above daily variance measure should calculate; $\widehat{\sigma_t} = 100 * \sqrt{252 * \widetilde{\sigma_t}^2}$; since there are circa 252 trading days in one year. On the other hand, this measure needs daily high and lows for the price series, which sometimes is not available historically. Furthermore, some commodities have relatively smaller transaction volume compared to gold or oil. Therefore, calculating volatility solely on Alizadeh et al. (2002)'s measure might arise some question marks on the robustness of the measure. Even though Diebold and Yilmaz (2012) employ Alizadeh et al.'s (2002) measure, we do not prefer to use this measure due to aforementioned problems.

Another extensively used conditional volatility measure is obtained through ARCH models (Alghieri, 2012). Although there are various ARCH models, Hansen et al. (2005) find the most parsimonious model, GARCH (1,1) model is no inferior compared to other 330 ARCH-type models. The mean and variance equations for GARCH (1,1) is as follows:

$$Y_t = X_t\theta + \varepsilon_t \tag{2.5}$$

$$\sigma_t{}^2 = \omega + \alpha(\varepsilon_{t-1}{}^2) + \beta(\sigma_{t-1}{}^2) \tag{2.6}$$

Since variance in the second equation is the forecasted variance based on the information from the prior period, is called conditional volatility. Constant term in the right hand side of the equation is the long term average for volatility. The second and third term are volatility during the previous period and fitted variance of previous period, respectively. Hence, whilst forecasting variance of this period, one bases his anticipation on afore-mentioned terms. There are various studies which use GARCH (1,1) to proxy for commodity volatilities (e.g. Malik & Ewing, 2009; Alghieri, 2012; Arouri, Jouini and Nguyen, 2012; Nazlioglu, Erdem & Soytas, 2013). For the purpose of this analysis, we base our analysis on GARCH (1,1) specifications since Alizadeh et al (2002)'s volatility measure might not provide robust results for low volume commodity markets.

Basak and Pavlova (2016) indicate outside shocks affecting a commodity spill over to other commodities' spot prices through employing storage theory of Deaton and Laroque (1992). To test for the Basak and Pavlova's (2016) proposition, we should obtain spot prices for all available commodities. However, spot markets for commodities have many varieties based on the location and quality of the product and some have severely missing data. Therefore, we employ S&P GSCI individual commodity spot indices for aluminum, biofuel, cocoa, coffee, copper, corn, cotton, Chicago wheat, gasoil, gold, heating oil, lead, lean hogs, live cattle, natural gas, nickel, orange juice, petroleum, platinum, silver, soybean, sugar, unleaded gas and zinc. These price series are available starting from 1 January 1997 except for gasoil and orange juice, of which both series start in 1999. Furthermore, via utilizing these indices, we are not prone to non-synchronous trading problem. Some of the commodities afore mentioned such as Zinc or Aluminum are traded in London Metal Exchange and while checking for volatility spillover between US stocks and such commodities, we have non-synchronous trading problem for the daily data. However, if we employ S&P GSCI indices for such individual commodities, we should not be concerned with non-synchronous trading.

Since US is found to be leading other stock markets and S&P500 covers a large portion of total US market cap, we proxy US stocks by S&P500 index. This index is also available for the same period and in 5-week day basis.

Descriptive statistics for returns are presented in Appendix Table A.2, Panel A. We observe that all commodities except natural gas and cotton to display positive returns. Moreover unsurprisingly crude oil and other energy commodities display highest maximum values alongside orange juice. In panel B, we present the correlation matrix for returns, and all correlations are positive. Positive correlations across sub-groups of commodities are a well-documented fact (e.g. Marshall et al., 2013), but we do not observe negative or even very low positive correlations with stocks as Gorton and Rouwenhorst (2006) argue. More noticeably, the correlation of crude oil with S&P500 is 0.34, which gives a hint on the interrelationship of financial and commodity markets.

We also present volatility of each commodity and S&P500 based on GARCH models in Figure 2.1 and depict descriptive statistics and correlation matrix in Table 2.2. The most volatile commodities are energy subgroup of commodities; namely natural gas and crude oil. On the other hand, as one can note US stocks are not more volatile than commodities contrary to popular belief that equities have higher risk compared to commodities. Even only this finding shows that commodities have presented quite a volatile picture in the last two decades.

Most of the volatilities display an increase during 2008 financial crisis, one more indicator of connectedness of seemingly unrelated markets. Though, we would like to also quantify the transmission mechanism and examine whether increasing volatility spillover between markets is a temporary or permanent phenomenon.

In panel B Table 2.2, we present correlation matrix. We observe positive correlations across most of the commodities not only within respective sub-groups; but also with other groups. Only orange juice and coffee present very low levels and even negative correlations with selected commodities.

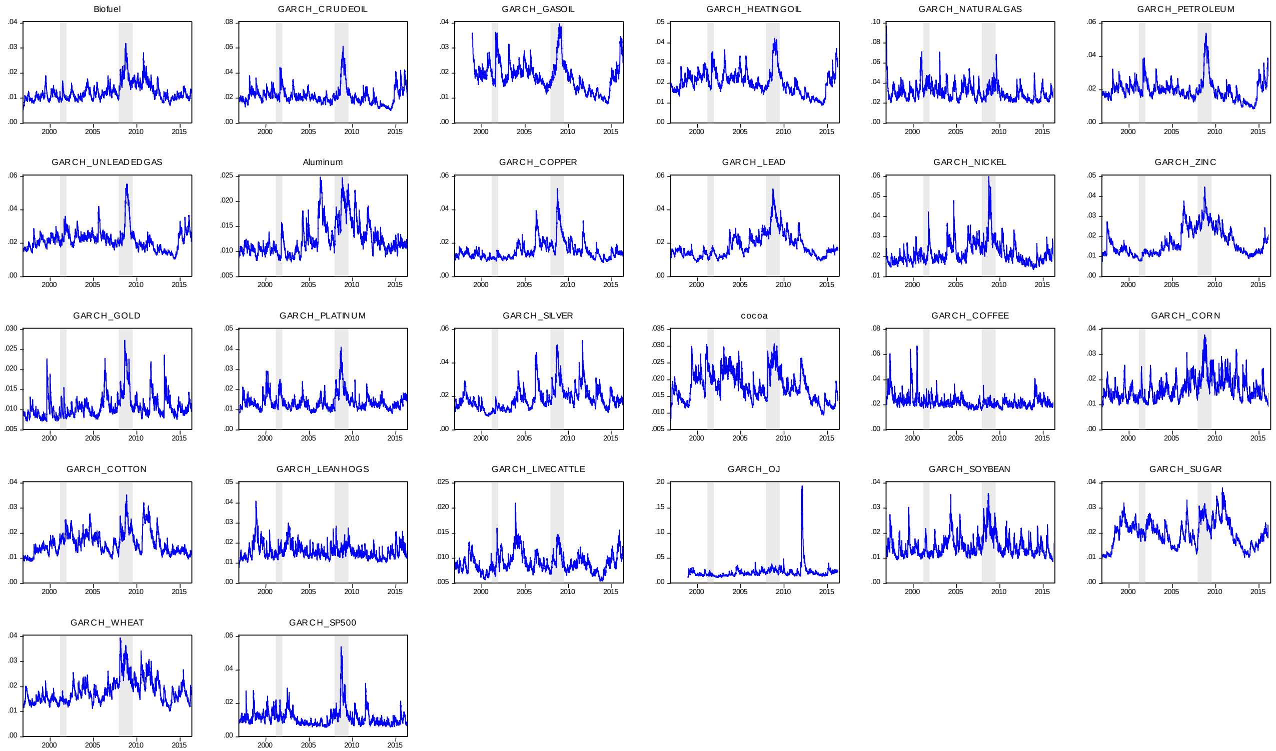

Figure 2.1 – Volatility measures of commodities and S&P500

Notes. Conditional volatilities of all individual commodities and US stocks via GARCH (1,1) model for the period between 1 January 1997 and 6 June 2016. Only gas oil and orange juice are available starting from January 1999. We obtain price series from S&P GSCI individual spot indexes. Grey shaded areas represent recession periods announced by NBER (National Bureau of Economic Research).

Table 2.2 Panel A – Descriptive statistics of daily volatilities of commodities and S&P500

	Energy							Industrial Metals					Precious Metals		
	Biofuel	Crude oil	Gas oil	Heating oil	Natural gas	Petrol.	Unlead gas	Alum.	Copper	Lead	Nickel	Zinc	Gold	Plat.	Silver
Mean	0.0121	0.0214	0.0185	0.0202	0.0301	0.0196	0.0216	0.0125	0.0151	0.0179	0.0215	0.0167	0.0107	0.0135	0.0183
Median	0.01	0.02	0.02	0.02	0.03	0.02	0.02	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.02
Maximum	0.03	0.06	0.04	0.04	0.10	0.05	0.05	0.02	0.05	0.05	0.06	0.04	0.03	0.04	0.05
Minimum	0.00	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Std. Dev.	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.01
Skewness	1.63	1.79	0.70	0.68	1.94	1.59	1.77	1.28	2.29	1.39	2.09	0.99	1.94	2.18	1.56
Kurtosis	6.58	7.89	3.70	3.90	10.57	7.48	8.78	4.15	10.03	5.17	9.77	3.32	7.53	10.25	6.31
Observations	5066	5066	4541	5066	5066	5066	5066	5066	5066	5066	5066	5066	5066	5066	5066

	Agriculture and Livestock										US Stocks
	Cocoa	Coffee	Corn	Cotton	Lean hogs	Live cattle	Orange juice	Soybean	Sugar	Wheat	S&P500
Mean	0.0179	0.0219	0.0162	0.0157	0.0157	0.0090	0.0207	0.0145	0.0196	0.0179	0.0110
Median	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.01	0.02	0.02	0.01
Maximum	0.03	0.07	0.04	0.03	0.04	0.02	0.19	0.04	0.04	0.04	0.05
Minimum	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Std. Dev.	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.01
Skewness	0.38	3.05	1.18	0.99	1.59	1.11	7.33	1.53	0.28	1.16	3.00
Kurtosis	2.40	16.82	4.67	3.79	7.47	5.09	68.57	5.74	2.66	4.42	16.67
Observations	5066	5066	5066	5066	5066	5066	4541	5066	5066	5066	5066

Notes. Descriptive statistics for conditional volatilities of all individual commodities and US stocks via GARCH (1,1) model for the period between 1 January 1997 and 6 June 2016. Only gas oil and orange juice are available starting from January 1999.

Table 3.2 Panel B – Correlation matrix for daily volatilities

		Energy							Industrial Metals					Precious Metals		
		Biof.	Crude oil	Gas oil	Heat. oil	Nat. gas	Petro.	Unl. gas	Alum.	Copper	Lead	Nickel	Zinc	Gold	Plat.	Silver
Energy	Biofuel	1.00														
	Crude oil	0.49	1.00													
	Gas oil	0.42	0.84	1.00												
	Heating oil	0.43	0.89	0.97	1.00											
	Natural gas	0.16	0.24	0.37	0.35	1.00										
	Petroleum	0.51	0.99	0.90	0.95	0.29	1.00									
	Unleaded gas	0.46	0.90	0.88	0.93	0.35	0.94	1.00								
Industrial Metals	Aluminum	0.56	0.39	0.46	0.43	0.40	0.44	0.45	1.00							
	Copper	0.58	0.59	0.55	0.57	0.33	0.62	0.65	0.81	1.00						
	Lead	0.73	0.56	0.57	0.57	0.35	0.61	0.59	0.75	0.79	1.00					
	Nickel	0.64	0.61	0.58	0.59	0.30	0.64	0.65	0.71	0.88	0.82	1.00				
	Zinc	0.67	0.46	0.53	0.53	0.34	0.52	0.53	0.83	0.84	0.87	0.83	1.00			
Precious Metals	Gold	0.46	0.47	0.36	0.36	0.19	0.47	0.47	0.53	0.70	0.56	0.58	0.54	1.00		
	Platinum	0.61	0.59	0.49	0.49	0.20	0.60	0.54	0.56	0.64	0.68	0.62	0.60	0.78	1.00	
	Silver	0.54	0.45	0.30	0.32	0.18	0.44	0.42	0.61	0.72	0.58	0.57	0.56	0.83	0.70	1.00
Agriculture and Livestock	Cocoa	0.63	0.46	0.50	0.50	0.34	0.50	0.47	0.57	0.53	0.72	0.54	0.58	0.42	0.54	0.46
	Coffee	-0.01	0.00	-0.06	-0.04	0.00	-0.02	0.01	-0.16	-0.17	-0.20	-0.13	-0.27	-0.15	-0.10	-0.13
	Corn	0.80	0.35	0.24	0.27	0.14	0.36	0.30	0.43	0.50	0.59	0.56	0.50	0.42	0.48	0.45
	Cotton	0.75	0.38	0.29	0.33	0.06	0.38	0.37	0.36	0.40	0.49	0.40	0.38	0.30	0.36	0.48
	Lean hogs	0.26	0.36	0.34	0.36	0.22	0.37	0.35	0.21	0.22	0.28	0.25	0.27	0.05	0.18	0.02
	Live cattle	0.38	0.67	0.59	0.63	0.15	0.67	0.65	0.33	0.49	0.35	0.47	0.40	0.33	0.45	0.41
	Orange juice	0.01	-0.02	-0.07	-0.06	0.11	-0.03	-0.06	0.07	0.04	0.08	-0.01	0.02	0.08	0.10	0.09
	Soybean	0.69	0.38	0.35	0.37	0.16	0.41	0.39	0.35	0.40	0.53	0.48	0.40	0.38	0.55	0.33
	Sugar	0.79	0.32	0.34	0.32	0.15	0.35	0.30	0.52	0.41	0.60	0.46	0.62	0.24	0.43	0.39
	Wheat	0.80	0.41	0.29	0.32	0.07	0.42	0.33	0.43	0.48	0.65	0.55	0.58	0.38	0.51	0.46
US Stocks	S&P500	0.61	0.69	0.51	0.55	0.13	0.68	0.64	0.48	0.69	0.71	0.69	0.57	0.66	0.74	0.62

Table 2.2 Panel B – Correlation matrix for daily volatilities (cont'd)

		Agriculture and Livestock										US Stocks
		Cocoa	Coffee	Corn	Cotton	Lean hogs	Live cattle	Orange juice	Soyb,	Sugar	Wheat	S&P500
Agriculture and Livestock	Cocoa	1.00										
	Coffee	-0.10	1.00									
	Corn	0.50	-0.05	1.00								
	Cotton	0.58	0.08	0.61	1.00							
	Lean hogs	0.17	0.14	0.19	0.18	1.00						
	Live cattle	0.29	0.04	0.26	0.32	0.37	1.00					
	Orange juice	0.34	-0.11	0.04	0.03	-0.01	0.03	1.00				
	Soybean	0.54	0.14	0.68	0.58	0.32	0.23	-0.02	1.00			
	Sugar	0.45	-0.11	0.44	0.53	0.21	0.36	-0.02	0.28	1.00		
	Wheat	0.57	0.05	0.71	0.66	0.30	0.34	0.07	0.58	0.62	1.00	
US Stocks	S&P500	0.52	0.01	0.50	0.50	0.24	0.48	0.01	0.52	0.37	0.56	1.00

Notes. Correlation matrix for conditional volatilities of commodities and S&P500 split into respective sub-groups. We compute conditional volatilities via GARCH (1,1) model for the period between 1 January 1997 and 6 June 2016. Only gas oil and orange juice are available starting from 1 January 1999.

2.5 Results

2.5.1 When did the behavior of commodities change?

First of all we should locate when the connectedness of stocks and commodities changed structurally. To make our analysis more compatible with the results of our first essay, we majorly present our analysis on arbitrary break selection. Among others Tang and Xiong (2012) indicate 2004 was the threshold year for financialization of commodities. Even though correlation patterns seem to change around 2008, intense investment of index investors in commodity markets started a few years earlier than 2008 (Masters, 2008). Therefore, to examine whether connectedness of commodity and stock markets have changed structurally following the financialization, we arbitrarily select the year 2004 as our breakpoint period.

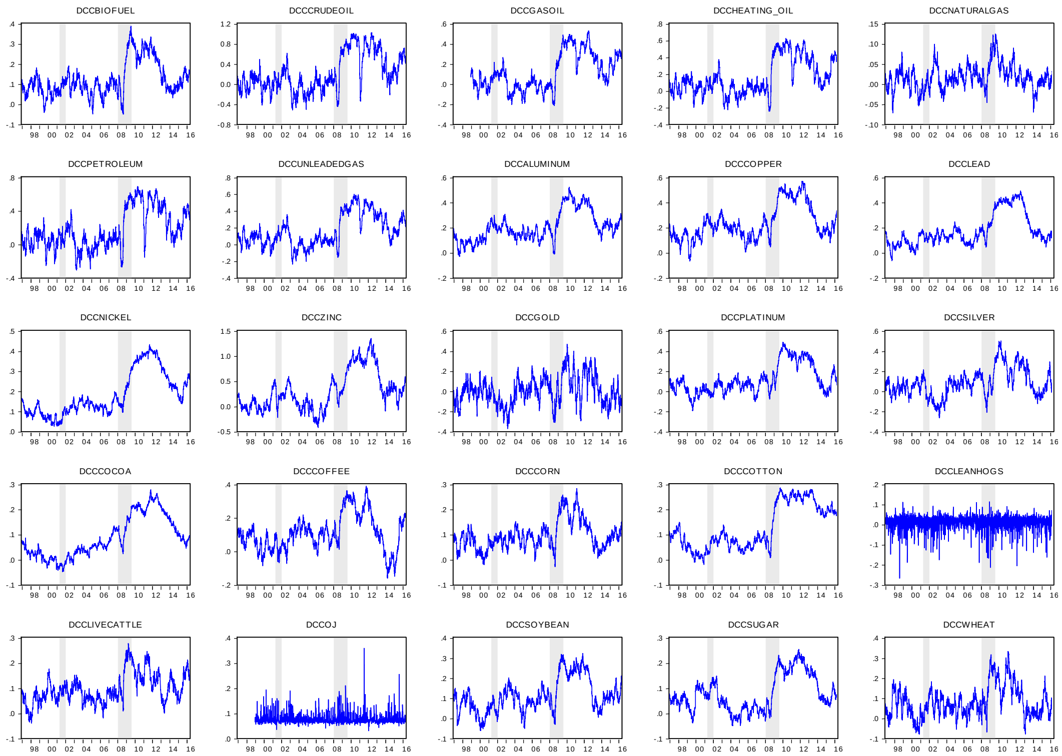

Figure 2.2 – Asymmetric dynamic conditional correlations of commodities

Notes. Time-varying correlations of each commodity with S&P500. Grey shaded areas represent NBER recession periods.

Table 2.3 – Bai and Perron (2003) structural breakpoint test results

			S&P GSCI weight (%)[i]	DJ UBSCI weight (%)[ii]
Energy	Biofuel	6-Nov-08	-	-
	Crude oil	30-Sep-08	22.8	10.0
	Gas oil	23-Oct-08	4.9	3.0
	Heating oil	1-Oct-08	4.1	2.2
	Natural gas	9-May-02	3.3	7.5
	Petroleum	30-Sep-08	-	-
	Unleaded gas	30-Sep-08	4.7	2.2
Industrial Metals	Aluminum	13-Nov-08	3.3	4.7
	Copper	16-Oct-08	4.1	10.6
	Lead	23-Oct-08	0.7	1.0
	Nickel	5-Jan-09	0.7	2.0
	Zinc	3-Apr-09	1.0	2.2
Precious Metals	Gold	14-Apr-04	4.4	9.8
	Platinum	5-May-09	-	-
	Silver	16-Jun-09	0.6	3.1
Agriculture and Livestock	Cocoa	21-Nov-08	0.6	0.6
	Coffee	7-Oct-08	1.0	1.6
	Corn	6-Nov-08	5.5	7.7
	Cotton	27-Nov-08	1.5	1.0
	Lean Hogs	N/A	2.7	1.4
	Live cattle	3-Oct-08	5.1	2.6
	Orange juice	N/A	-	-
	Soybean	6-Nov-08	3.8	11.5
	Sugar	9-Dec-08	2.5	2.4
	Wheat	14-Oct-08	3.9	3.2

Notes. We first obtain ADCC to proxy for the co-movement of each commodity with S&P500 as a time series and regress such time series on constant. Bai and Perron (2003) test provides whether there are any structural breakpoints on the connectedness of each commodity with US stocks at selected significance level, which we set to 1%. We obtain related weights in S&P GSCI and DJ UBSCI indices from website of respective companies.

On the other hand, to make sure our results are robust to period selections we also employ statistical methods to locate structural breakpoints. As we have elaborated in Methodology section, we compute time-varying correlations by employing ADCC method of Cappiello et al. (2006). First of all we take returns of each commodity and US stocks and then calculate time-varying correlations of each commodity with stocks via EGARCH (1,1) of ADCC method. The EGARCH models for each

[i] Retrieved from https://us.spindices.com/documents/index-news-and-announcements/20161006-sp-gsci-rebalance-advisory-panel.pdf?force_download=true

[ii] Retrieved from https://us.spindices.com/documents/index-news-and-announcements/20161110-djci-2017-weights.pdf?force_download=true

commodity as well as the S&P500 composite index appear to be free of autocorrelation and heteroscedasticity at the 5% significance level. Figure 2.2 presents results of each ADCC output.

After deriving time-varying correlations for each pair of commodity with stocks, we rely on the Bai-Perron multiple break point tests (Bai & Perron, 2003). This multiple change point detection test allows for heterogeneous error distributions across breaks used. Sequential estimation procedures consider one break candidate at a time and then multiple breaks by a search algorithm that minimizes the sum of squared residuals. We investigate the Bai-Perron procedure for each pair via using a simple model with a constant (Doidge, Karolyi & Stulz, 2013). For instance, to examine at what point did the interdependence between Chicago wheat and stocks change, we first employ ADCC model and obtain the proxy for the co-movement of wheat and S&P500 as a time series. Next, we regress such time series on constant and find whether there are any structural breakpoints at the co-movement. This is repeated for every commodity, separately. We select the strongest structural breakpoint under 1% significance level for all commodities. Results for the breakpoints are presented in Table 2.3. As one can note all series except for gold and natural gas, display a structural breakpoint during the 2008 financial crisis. Even though Adams and Gluck (2015) employ Galeano and Wied's (2015) methodology on structural break arguing it is more efficient than DCC method, our results are highly parallel to their findings. Lean hogs and orange juice do not display a correlation pattern at all but we still include these commodities in our analysis.

Although, our results are not sensitive to exact date selection, we determine the Lehman crash date (15 September 2008) as the structural breakpoint. Since we employ daily data and almost all commodities display nearby dates, we believe taking the same date would provide the most consistent way to compare volatility transmission between stocks and individual commodities. Furthermore, different commodity markets may be responding to a shock (i.e., Lehman Brothers) with varying response times leading to different break dates

2.5.2 Volatility transmission between commodity and stock markets

As we have mentioned in the previous section, we initially present results based on arbitrary selection of breakpoint as the year 2004. Accordingly years between 1997 and 2004 is the pre-financialization and between 2004 and 2016 is the post-financialization episode of our sample.

We employ 25 commodities from all major sub-groups of commodities including industrial and precious metals, energy and agricultural. We perform our analysis based on individual commodities since aggregated indices could overshadow unique characteristics of such commodities. If commodities have become another core investment class, as financialization proponents argue, we should see higher spillovers between both markets; since a shock in either market would impact the other, as well. We hypothesize significantly higher transmission of volatility following growing participation of financial institutions in commodity market.

Table 2.4 exhibits an example of volatility spillover output for a selected commodity (aluminum) with S&P500 for the periods before and after financialization. We obtain this output for all commodities separately and for all afore-determined horizons of H=10, 21, 63, 126 and 252 trading days. We anchor our results based on a selected horizon of 63 trading days (252 trading days divided by 4) to capture the approximate period of portfolio rebalancing of institutions. Tokat and Wicas (2007) indicate optimal rebalancing frequency is around once a year since rebalancing has some intrinsic costs such as transaction and monitoring. On the other hand, Diebold and Yilmaz (2014) indicate connectedness can increase with higher horizon days. Therefore we believe results based on quarterly would report the most reasonable findings; since one can question the robustness of findings with too long horizons. Similarly, too short horizons might not provide reasonable period for portfolio rebalancing and not provide spillover mechanism truly. However, note that results are also available for 10 (bi-weekly), 21 (monthly – 252 trading days divided by 12), 126 (semi-annual) and 252 (annual) trading days. Accordingly, we can comment on how spillovers change in the short and long-run between these markets and whether connectedness can be avoided. Even though, connectedness is not necessarily something which should be avoided; it would tell us that, an investor should not only be following its own investing area but also other asset classes, since they can make a strong impact on his assets.

Table 2.4 – Volatility spillover test results for aluminum

Pre-financialization	Stocks	Aluminum	From others
Stocks	96.95	3.05	3
Aluminum	0.34	99.66	0.3
Contribution to others	0.3	3	3.4
Contribution including own	97.3	102.7	1.70%

Post-financialization	Stocks	Aluminum	From others
Stocks	96.38	3.62	3.6
Aluminum	14.26	85.74	14.3
Contribution to others	14.3	3.6	17.9
Contribution including own	110.6	89.4	8.90%

Notes. Diebold and Yilmaz (2012) volatility spillover test output for a selected commodity, aluminum. We replicate this table for all 25 commodities, for two periods (1997-2004 and 2004-2016) and for all selected horizons (H=10, 21, 63, 126, 252 days). The percentage in the below right hand corner of the table is the spillover index and shows the share of spillovers in explaining forecast error variance of both assets, on average. Since we have two assets in every case, contribution to others and from others figures are equal to the share of shock in other assets forecast error variance.

Example output of aluminum at Table 2.4 shows us that stocks' contribution to forecast error variance to aluminum market is 0.34 and 14.26 in the pre-financialization and post-financialization period, respectively. These figures demonstrate that S&P500 explain around 0.3% of variance forecast of aluminum before 2004, whereas this figure significantly increases to 14.3% after 2004, suggesting shock in US stock market severely impacting aluminum. Moreover, this output gives us information on net connectedness between these assets, which is the net direction of the spillover. So it implies which asset has more impact on the other; or in other words which one is the transmitter or is the receiver. If one would like to compute net spillovers; should deduct off-diagonals from each other. For instance net connectedness for aluminum is -2.71 (0.34-3.05) previous to the year 2004 and 10.64 (14.26-3.62) after 2004. These figures tell us that aluminum is the net transmitter before financialization period along with low spillovers within asset classes. Though, during the post-financialization episode aluminum becomes the net receiver and spillovers increase significantly.

Last but not least Table 2.4 also exhibits total spillover index which is presented at the right hand corner of the table. This index shows us the share of spillovers in forecast error variance of both markets and it is basically the sum of off-diagonals divided by $N\ (number\ of\ assets) * 100$. This index provides us on the level of connectedness and is of utmost importance when comparing two episodes, with same assets. We replicate this table for all horizons and for all commodities but due to space constraints and to present outputs in a more clear fashion we present results in Table 2.5 for all pairs at the anchor horizon of 63 days. Results for spillover indexes at other horizons are available in Table 2.6.

2.5.2.1 Volatility transmission based on arbitrary selection of financialization period

Table 2.5 presents several interesting facts to consider, but let us first explain the information each column depicts and provide findings subsequently.

The first and second columns in Table 2.5 show the spillover index in percentage basis during the pre- and post-financialization episodes. This index explains how much of the volatility forecast error variance comes from spillovers and how connected are selected asset classes. For instance, before financialization, 2.1% of the volatility forecast error variance in copper and US stock markets come from spillovers from these markets, on average and such figure increases to 12.6% by the impact of financialization.

Table 2.5 – Volatility spillover output

		Spillover Index		Spillover from Stocks to Commodity		Spillover from Commodity to Stocks		Net Connectedness	
		Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.
Energy	Biofuel	2.0%	6.3%	0.29	7.28	3.67	5.27	-3.38	2.01
	Crude Oil	0.9%	13.4%	1.31	16.12	0.40	10.73	0.91	5.39
	Gas Oil	2.8%	6.6%	2.58	9.66	3.07	3.53	-0.49	6.13
	Heating Oil	2.0%	7.3%	3.81	10.13	0.28	4.52	3.53	5.61
	Natural Gas	2.2%	0.6%	3.93	1.17	0.53	0.01	3.40	1.16
	Petroleum	1.1%	11.9%	1.63	14.50	0.60	9.20	1.03	5.30
	Unleaded Gas	0.5%	8.2%	0.79	9.02	0.28	7.36	0.51	1.66
Industrial Metals	Aluminum	1.7%	8.9%	0.34	14.26	3.05	3.62	-2.71	10.64
	Copper	2.1%	12.6%	0.96	20.05	3.32	5.15	-2.36	14.90
	Lead	3.5%	8.0%	0.69	9.77	6.30	6.25	-5.61	3.52
	Nickel	2.0%	8.8%	3.56	11.71	0.45	5.86	3.11	5.85
	Zinc	1.6%	6.7%	2.58	9.54	0.67	3.92	1.91	5.62

Table 2.5 – Volatility spillover output (cont'd)

		Spillover Index		Spillover from Stocks to Commodity		Spillover from Commodity to Stocks		Net Connectedness	
		Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.
Precious Metals	Gold	1.0%	12.0%	0.31	18.66	1.67	5.33	-1.36	13.33
	Platinum	0.3%	13.1%	0.38	16.64	0.17	9.59	0.21	7.05
	Silver	1.5%	8.3%	0.61	11.51	2.47	5.15	-1.86	6.36
Agriculture and Livestock	Cocoa	1.6%	5.7%	1.05	11.02	2.22	0.32	-1.17	10.70
	Coffee	0.8%	1.1%	0.14	0.84	1.50	1.29	-1.36	-0.45
	Corn	0.6%	5.7%	0.74	3.33	0.39	7.99	0.35	-4.66
	Cotton	0.5%	3.9%	0.14	3.96	0.76	3.90	-0.62	0.06
	Lean Hogs	1.4%	3.3%	0.62	4.92	2.25	1.71	-1.63	3.21
	Live Cattle	1.5%	4.0%	2.73	6.73	0.28	1.30	2.45	5.43
	Orange juice	1.9%	0.5%	0.15	0.21	3.69	0.80	-3.54	-0.59
	Soybeans	1.5%	3.4%	2.40	2.84	0.60	3.87	1.80	-1.03
	Sugar	0.7%	2.7%	0.38	4.91	1.09	0.43	-0.71	4.48
	Wheat	1.8%	6.9%	3.11	3.62	0.44	10.15	2.67	-6.53

Notes. Volatility spillover outputs for all commodities at H=63 days. First two columns represent spillover indexes represent the level of connection in between selected asset classes and share of spillovers in forecast error variances. Third (fifth) and fourth (sixth) columns show the spillover from stocks (commodity) to commodity (stocks) and thus represent how the spillover changes uni-directionally. In the last two columns we calculate net connectedness by subtracting 'spillover from stocks to commodity' from 'spillover from commodity to stocks' and shows which asset is the volatility receiver/ transmitter. If the figure is negative in net connectedness column, respective commodity is the volatility transmitter and if positive commodity is the receiver.

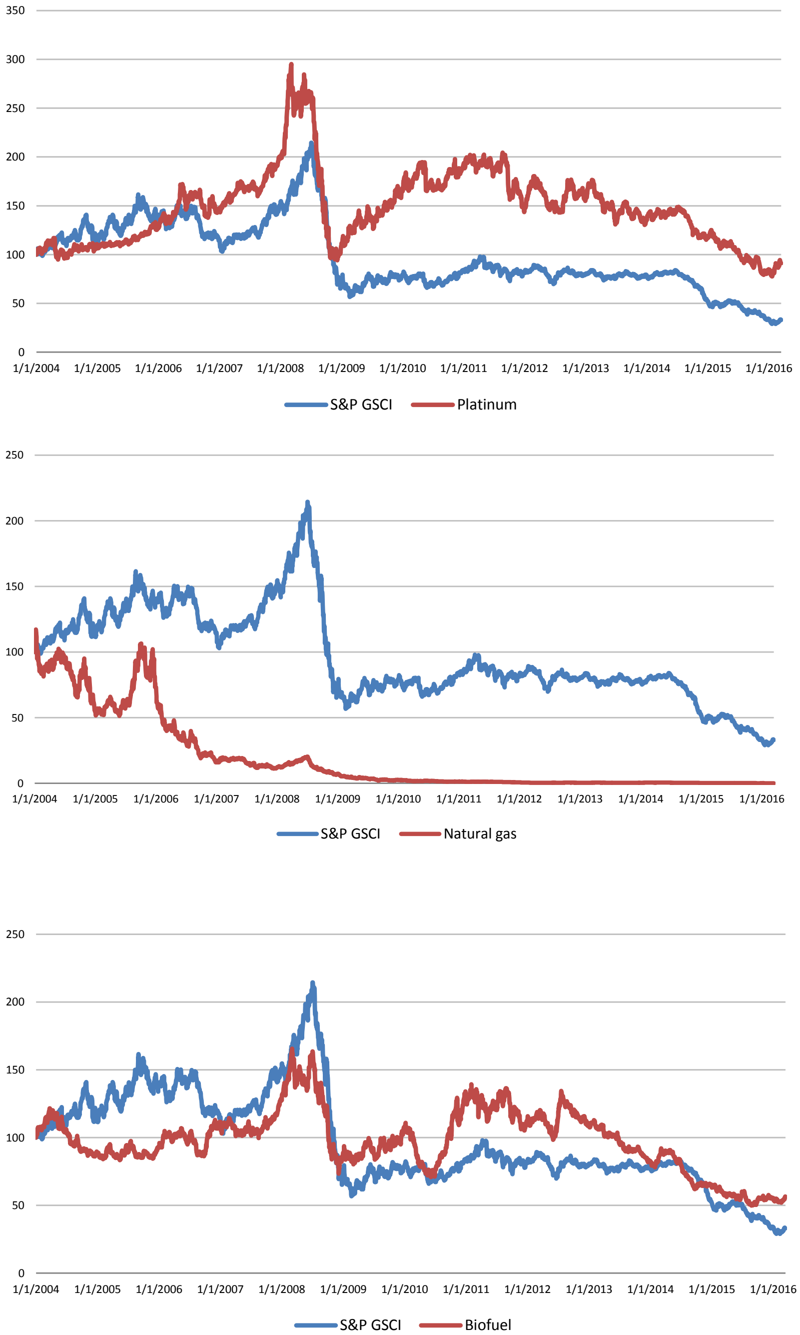

Figure 2.3 – Relative performances of selected commodities

We see that all spillover indexes for all commodities except orange juice and natural gas; noticeably increase during post-financialization compared to pre-financialization. We see that spillover index is in the range of 0.3% and 3.5% before the year 2004 and rises to the range of 0.5% and 13.4% with the inclusion of financial institutions in commodity market. Low levels of spillover index before financialization episode tells us that commodities provided a good diversification benefit and they were quite segmented from stock market back then. Hence our results support the notion that commodities were valuable especially for hedging purposes as Gorton and Rouwenhorst (2006) indicate.

However, as commodities become a popular asset class just like stocks for portfolio investors (Cheng & Xiong, 2013), immunity of commodities to financial shocks have become questionable. Spillover indexes significantly increase with the dominant presence of financial institutions in commodity markets and this supports our hypothesis on increasing transmission between stocks and commodities subsequent to financialization. As institutions invest in both markets, they make commodities just another investment style such as stocks and therefore commodities are prone to shocks from financial markets.

The findings on increasing spillover index after the year 2004 is not supported for natural gas and orange juice, which indicates these commodities are not financialized. Basak and Pavlova (2016) actually explain why such commodities might not get affected from institutional investor presence. Financial institutions benchmark their performance against the index level and hence they largely invest in well-performing index-member commodities. However, off-index commodities or bad-performing ones would not enter into radar of financial institutions.

Orange juice is not a member of well-known aggregated indices (S&P GSCI or DJ-UBSCI) and also is not a close substitute for other index-member commodities and therefore we expect orange juice not to be financialized, in the first place. On the other hand, one can argue that biofuel, petroleum and platinum are also off-index commodities, but seem to be financialized, so is this a contradiction with Basak and Palova's (2016) hypothesis? First of all, petroleum is a very close substitute of crude oil and has a correlation of 0.98 with WTI crude oil (Table A.2) and hence we would be surprised if it was not financialized. Platinum, on the other hand, is a precious metal and in the recent years, interest of funds on platinum has been rising and has around USD 1 billion under management (McCown & Shaw, 2016). Furthermore, platinum has been a well-performing commodity compared to S&P GSCI (see Figure 3.3) and Basak and Pavlova (2016) especially indicate institutional investor interest would be higher for well-performing commodities. Last but not least, biofuel is also an off-index commodity, but has received attention through policy changes regarding reduction in fossil fuels. Moreover has been a well performing commodity with respect to the S&P GSCI (see Figure 3.3). Hence, findings are in line with Basak and Pavlova's arguments.

Natural gas, on the other hand, is a crucial energy commodity and constitutes 3.3% of S&P GSCI[3]; so why natural gas is un-financialized? As we mention above, institutional investors prefer to invest in well-performing commodities, though, we see that natural gas has been a very poor performer compared to the S&P GSCI after financialization episode. Therefore, these investors would not favor investing on natural gas which leads to no significant financialization. A similar finding of no convergence of natural gas across energy commodities is also evidenced by Sensoy, Hacihasanoglu and Nguyen (2015).

Another fact is that the highest increases in spillovers are in metals and energy sub-group of commodities. Antonakakis and Kizys (2015) state a large portion of gold and to a lesser amount silver and platinum demand are for investment purposes. Furthermore, Domanski and Heath (2007) find that alongside other industrial metals; exchange-traded derivatives market size of aluminum and copper was 30-fold more than the actual production in 2005, which also gives a hint on roles of metals as an investment tool. Oil and other oil products such as petroleum, unleaded gas have very close correlation with crude oil as depicted in Table 3.2 and their critical importance in welfare of economies (Ordu & Soytas, 2016), make them a big candidate to be a financial asset. Therefore, intense financialization of such commodities is not of a surprise. Agricultural commodities, on the other hand, have entered to the radar of investors largely with US biofuel policy applications. This interaction of energy and agricultural commodities push policy-makers to follow institutional investment in food, since financialization of agricultural commodities is critical for household consumption and food price increase is largely borne by poor

[3] https://us.spindices.com/documents/index-news-and-announcements/20161006-sp-gsci-rebalance-advisory-panel.pdf?force_download=true

(deSchutter, 2010). We still see a pronounced increase in spillover indexes for this group; however, increases are not as much as metals and energy group. Relatively less spillover could be attributed to food prices depending on many factors such as weather, policy change by governments, tariffs, and diseases; which makes the predictability of agricultural products to be harder than other commodities.

Another group of researchers argue increasing connectedness between commodity and stocks markets is attributable to these assets sharing similar business cycle periods around 2008, which is the Global Financial Crisis. Bhardwaj et al. (2016) argue connectedness is temporary in nature and decreases back to previous levels after the crisis. However, Diebold and Yilmaz (2015) indicate systematic nature of business cycle risk is highly dependent upon connectedness and if and only if connected assets would share the business cycle risk. Therefore, even a temporary increase in transmission of spillovers would tell us that commodities are not the same hedging-tools as two decades ago. Since a recession period was also experienced before 2004, which was between March and November 2001, we have a counter-argument for no-financialization believers. Even though commodities and financial markets went through business cycles also before financialization, we had no increase in spillovers between 1997 and 2004. We see that commodities shielded investors from financial market volatilities before 2004, however after 2004, common business cycles affected commodities to a large extent.

The next columns in Table 2.5 are third and fourth columns which depict directional spillovers from stocks to respective commodities at pre- and post-financialization episodes. Similarly fifth and sixth columns show the spillover the other way around. These figures tell us what fraction of selected commodity's forecast error variance is attributable to a shock in stock markets or due to itself. As one would note, spillovers from stock markets to commodities surge significantly during the post-financialization episode. This finding is in line with Basak and Pavlova's (2016) proposition since they argue commodities are susceptible to outside shocks after the increasing participation of institutional investors in commodity markets. Since institutions strive to align their performance with the index, discount factor becomes sensitive to presence of institutions; which results in higher prices and volatilities.

After financialization, a shock from other index commodities as well as a shock transmitted from stock market start to affect commodity market fundamentals. Therefore authors show that an inflow from institutional investors creates a spillover not only across commodities but also from financial market to commodities.

Though transmission from commodity to stock market displays comparatively less volatility connectedness, still commodities seem to impact stock market. Since many other financial factors impact stock market, relatively fewer spills from commodity market are of no surprise. On the other hand, historically commodity market has largely been a segmented market from financial factors and hence when we compare pre- and post-financialization episodes, we see a much higher spillover from stock to commodity markets. Therefore results imply that instability in either of markets could trigger instability in the other market, which is critical for the resiliency of the financial system.

The last two columns exhibit net connectedness for pairwise spillovers, which implies which asset is the transmitter and which asset is the receiver of volatility on net basis. One can find this number simply by deducting third (fourth) from fifth (sixth) column for pre (post) -financialization period. Even though both markets transmit volatility to each other, one of them has more dominant impact on the other and net connectedness measure provides us this information. A positive figure means net spillover from commodity to equity markets and a negative figure means vice versa.

Results imply that the net connectedness in absolute values increase for most of the commodities following the financialization, which further supports our finding on surging spillover indexes after the year 2004. Furthermore, we observe that sign of the net connectedness is generally negative before financialization implying spillover was mostly from commodity to stock markets. On the other hand, sign of the net connectedness become positive for almost all commodities except coffee, corn, Chicago wheat, orange juice and soybeans. This finding is of utmost importance since it shows the receiver and transmitter assets have changed subsequent to the financialization. We see that continuous trading of institutional investors in stock and commodity markets made a pronounced spillover from financial markets to commodities following the year 2004.

2.5.2.1.1 Results from other horizons

We also present results based on horizon days of 10, 21, 126 and 252 trading days in Table 2.6. Diebold and Yilmaz (2014) notify that connectedness might surge as horizon increases, since the probability of transmission of information within markets also grows. Though, this is not necessarily valid for all asset classes or geographical markets. If selected asset markets are significantly disintegrated, horizon increase would not bolster connectedness. Moreover, connectedness gives us further information on diversification opportunities since systematic risk is concomitant with connectedness (Diebold & Yilmaz, 2015). If selected asset markets are connected, this would mean that they are prone to similar systematic business cycle risk and such risk is undiversifiable. Therefore, we can see higher connection for already connected markets, but should observe none or very mild increases for segregated markets.

Following Diebold and Yilmaz's (2015) argument, before financialization, we find a slight increase in spillover index as H increases. On the other hand, after financialization the index rises very significantly with the horizon days. Furthermore, even for the shortest horizon (10 days) spillover index still displays an increase after financialization compared to the previous episode (panel A). Therefore, we contend that horizon increase in and of itself would not artificially increase connectedness, which are for already segmented markets.

Table 2.6 Panel A – Spillover index for other horizons

		H=10 days		H=21 days		H=63 days		H=126 days		H=252 days	
		Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.
Energy	Biofuel	0.3%	1.4%	0.5%	2.4%	2.0%	6.3%	2.7%	10.7%	2.8%	13.3%
	Crude Oil	1.1%	7.5%	0.9%	9.3%	0.9%	13.4%	1.0%	17.0%	1.0%	19.2%
	Gas Oil	2.6%	3.5%	2.4%	4.4%	2.8%	6.6%	4.2%	8.9%	4.5%	11.0%
	Heating Oil	1.2%	4.5%	1.6%	5.4%	2.0%	7.3%	2.3%	9.2%	2.3%	10.9%
	Natural Gas	0.4%	0.0%	0.5%	0.1%	2.2%	0.6%	3.0%	1.3%	3.0%	1.7%
	Petroleum	1.3%	7.2%	1.2%	8.6%	1.1%	11.9%	1.3%	14.8%	1.3%	17.1%
	Unleaded Gas	0.9%	5.0%	0.8%	6.0%	0.5%	8.2%	0.5%	10.3%	0.5%	12.1%
Industrial Metals	Aluminum	0.5%	3.8%	0.4%	5.2%	1.7%	8.9%	2.7%	12.4%	2.9%	14.4%
	Copper	0.4%	4.9%	0.4%	7.3%	2.1%	12.6%	3.5%	16.9%	3.7%	19.3%
	Lead	0.2%	3.1%	0.4%	4.4%	3.5%	8.0%	6.5%	12.3%	7.4%	16.7%
	Nickel	0.1%	3.0%	0.3%	4.4%	2.0%	8.8%	2.6%	12.6%	2.6%	14.6%
	Zinc	0.1%	3.0%	0.3%	4.2%	1.6%	6.7%	2.7%	9.3%	2.7%	12.0%
Precious Metals	Gold	1.5%	6.0%	1.2%	7.9%	1.0%	12.0%	1.0%	14.9%	1.0%	16.1%
	Platinum	0.1%	5.1%	0.1%	7.8%	0.3%	13.1%	0.4%	16.7%	0.4%	18.0%
	Silver	0.4%	3.6%	0.3%	4.8%	1.5%	8.3%	3.2%	11.2%	3.9%	12.5%
Agriculture and Livestock	Cocoa	0.4%	0.6%	1.0%	1.5%	1.6%	5.7%	1.9%	10.6%	2.0%	14.1%
	Coffee	0.1%	0.3%	0.4%	0.4%	0.8%	1.1%	0.9%	1.6%	0.9%	1.8%
	Corn	0.4%	0.4%	0.5%	1.4%	0.6%	5.7%	0.7%	9.1%	0.7%	10.2%
	Cotton	0.2%	1.8%	0.2%	2.6%	0.5%	3.9%	0.9%	5.3%	1.3%	6.7%
	Lean Hogs	0.2%	0.9%	0.5%	1.7%	1.4%	3.3%	2.0%	4.0%	2.0%	4.2%
	Live Cattle	0.1%	1.3%	0.4%	2.2%	1.5%	4.0%	2.6%	4.0%	3.1%	6.7%
	OJ	0.6%	0.2%	0.4%	0.2%	1.9%	0.5%	2.9%	0.9%	3.0%	1.0%
	Soybeans	0.1%	0.8%	0.2%	1.6%	1.5%	3.4%	2.2%	4.9%	2.3%	5.6%
	Sugar	0.3%	1.1%	0.2%	1.6%	0.7%	2.7%	1.9%	4.3%	3.1%	6.5%
	Wheat	0.1%	0.9%	0.3%	1.9%	1.8%	6.9%	2.7%	12.5%	2.9%	15.9%

Panel B – Net connectedness for other horizons

		H=10 days		H=21 days		H=63 days		H=126 days		H=252 days	
		Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.
Energy	Biofuel	0.3	2.3	-0.2	3.5	-3.4	2.0	-4.9	-2.0	-5.0	-4.9
	Crude Oil	1.3	1.0	1.4	2.8	0.9	5.4	0.8	6.9	0.8	7.6
	Gas Oil	2.3	1.6	2.3	3.0	-0.5	6.1	-2.8	9.2	-3.2	11.8
	Heating Oil	2.1	2.2	2.9	3.7	3.5	5.6	3.6	6.8	3.6	7.6
	Natural Gas	-0.3	0.0	0.2	0.1	3.4	1.2	4.7	2.7	4.8	3.4
	Petroleum	1.7	1.4	1.8	3.3	1.0	5.3	0.7	6.2	0.7	6.5
	Unleaded Gas	0.9	-0.4	0.8	0.7	0.5	1.7	0.4	1.9	0.4	1.9
Industrial Metals	Aluminum	0.7	1.0	0.3	3.0	-2.7	10.6	-4.7	18.0	-5.1	22.0
	Copper	-0.1	2.8	0.0	6.5	-2.4	14.9	-4.4	21.7	-4.7	25.5
	Lead	0.1	2.6	0.1	3.6	-5.6	3.5	-11.4	0.7	-13.2	-3.8
	Nickel	0.1	0.5	0.3	2.3	3.1	5.9	4.0	8.5	4.1	9.7
	Zinc	-0.2	2.8	0.0	4.3	1.9	5.6	3.5	5.4	3.5	3.9
Precious Metals	Gold	-2.3	4.6	-1.8	7.7	-1.4	13.3	-1.4	17.2	-1.4	18.8
	Platinum	0.0	1.9	-0.1	3.8	0.2	7.1	0.4	9.0	0.5	9.7
	Silver	-0.2	2.4	-0.2	3.7	-1.9	6.4	-4.2	8.3	-5.2	9.1
Agriculture and Livestock	Cocoa	-0.4	1.1	-0.8	2.8	-1.2	10.7	-1.2	19.7	-1.2	25.9
	Coffee	-0.1	0.3	-0.5	0.4	-1.4	-0.5	-1.6	-1.3	-1.6	-1.6
	Corn	0.7	0.4	0.8	-0.1	0.4	-4.7	0.3	-8.5	0.3	-9.8
	Cotton	0.2	1.4	0.2	1.4	-0.6	0.1	-1.6	-2.0	-2.3	-4.2
	Lean Hogs	-0.3	0.8	-0.8	1.5	-1.6	3.2	-1.8	4.1	-1.8	4.2
	Live Cattle	0.1	1.1	0.5	2.4	2.5	5.4	3.6	5.4	4.0	10.2
	OJ	-0.8	0.3	-0.6	0.1	-3.5	-0.6	-5.4	-1.3	-5.6	-1.7
	Soybeans	-0.2	0.4	0.2	0.2	1.8	-1.0	2.4	-2.4	2.5	-3.1
	Sugar	0.4	2.1	0.2	3.1	-0.7	4.5	-2.2	4.5	-3.9	3.0
	C Wheat	0.2	0.5	0.6	-0.3	2.7	-6.5	3.8	-14.4	4.0	-19.4

Notes. Spillover indexes for all other selected horizons of H=10, 21, 63, 126 and 252 days. Results for H=63 days are equal to the output in Table 3.5 and only presented for comparison purposes. Panel B presents net connectedness measures and shows which asset is the volatility receiver/ transmitter. If the figure is negative respective commodity is the volatility transmitter and if positive commodity is the receiver.

However, if markets are somewhat connected; increasing horizon would mean more linkage within asset classes leading to higher connectedness. Hence, results imply that commodity and stock markets were largely segregated before the inflow of financial institutions in commodity market. However, as such investors enter into commodity market; they make these commodities integrated with the core equity market. Also, for all horizons, net connectedness (Panel B) display similar results with sign change and increasing absolute values following the financialization. Gross spillover amounts for other horizons are available in Appendix Table A.3

2.5.3.2 Volatility transmission based on breakpoint tests

We also run our results with the statistical breakpoint test of Bai and Perron (2003) to locate the beginning of financialization. Since earlier findings on financialization depicts commodity behavior changed somewhere between 2004 and 2008; we also rely on statistical tests to determine exact threshold. Breakpoint test results are reported in Table 3.3 and since breakpoints display similar dates around Global Financial Crisis we take the Lehman crash date as the breakpoint (Adams & Gluck, 2015). Results are again available for other horizons (H=10, 21, 63, 126 and 252 trading days) but we anchor our results on 63 trading days. We employ same commodities; however lean hogs and orange juice do not display an integrated structure (see Figure 3.2) and thus Bai and Perron (2003) test do not find any structural breakpoint. Though, we still include these commodities in our analysis.

Basically we run Diebold and Yilmaz (2012) methodology for all commodities before and after financialization, again; though we set the threshold date to be 15 September 2008. Results are reported in Table 3.7 for the anchor horizon of 63 days and for all other horizons in Appendix Table A.4. Findings imply similar results with the year 2004. Still (1) spillover indexes increase following the financialization at all horizons for almost all commodities (2) spillovers from commodity to stock market and vice versa surge after the year 2008. However the increase from stock market to commodity market compared to from commodity to stock market is more pronounced supporting Basak and Pavlova's (2016) argument.

Table 2.7 – Volatility spillover tests based on Bai and Perron (2003) multiple breakpoint test

		Spillover Index		Spillover from Equity to Commodity		Spillover from Commodity to Equity		Net Connectedness	
		Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.
Energy	Biofuel	0.3%	6.1%	0.50	7.28	0.09	4.92	0.41	2.36
	Crude Oil	1.8%	18.2%	2.30	21.97	1.20	14.50	1.10	7.47
	Gas Oil	1.7%	10.6%	2.31	15.45	1.09	5.68	1.22	9.77
	Heating Oil	0.6%	14.1%	1.09	20.22	0.13	7.88	0.96	12.34
	Natural Gas	0.7%	1.8%	1.36	3.15	0.10	0.46	1.26	2.69
	Petroleum	1.3%	17.3%	1.85	21.98	0.78	12.54	1.07	9.44
	Unleaded Gas	0.6%	15.5%	0.72	19.19	0.44	11.90	0.28	7.29
Industrial Metals	Aluminum	1.2%	17.0%	0.43	25.87	1.89	8.04	-1.46	17.83
	Copper	1.4%	26.2%	0.74	37.63	2.08	14.69	-1.34	22.94
	Lead	0.5%	14.9%	0.21	22.20	0.78	7.66	-0.57	14.54
	Nickel	0.8%	21.4%	0.22	29.00	1.31	13.70	-1.09	15.30
	Zinc	1.0%	14.9%	1.43	23.61	0.59	6.15	0.84	17.46

Table 2.7 – Volatility spillover tests based on Bai and Perron (2003) multiple breakpoint test (cont'd)

		Spillover Index		Spillover from Equity to Commodity		Spillover from Commodity to Equity		Net Connectedness	
		Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.
Precious Metals	Gold	0.9%	14.5%	0.95	21.50	0.82	7.49	0.13	14.01
	Silver	1.7%	12.4%	0.62	11.64	2.85	13.25	-2.23	-1.61
	Platinum	1.5%	20.3%	2.60	27.47	0.47	13.03	2.13	14.44
Agriculture and Livestock	Cocoa	2.5%	7.8%	3.86	14.15	1.23	1.39	2.63	12.76
	Coffee	0.6%	1.0%	1.21	1.27	0.06	0.81	1.15	0.46
	Corn	0.5%	6.3%	0.78	2.98	0.19	9.60	0.59	-6.62
	Cotton	0.3%	3.5%	0.28	2.04	0.26	4.90	0.02	-2.86
	Lean Hogs	3.4%	2.3%	4.40	2.14	2.31	2.39	2.09	-0.25
	Live Cattle	0.6%	6.3%	0.26	6.79	0.93	5.77	-0.67	1.02
	Orange juice	0.5%	0.1%	0.33	0.18	0.75	0.10	-0.42	0.08
	Soybeans	0.4%	4.9%	0.74	3.88	0.08	6.00	0.66	-2.12
	Sugar	1.3%	1.9%	2.30	2.96	0.34	0.80	1.96	2.16
	Wheat	0.6%	5.5%	1.05	1.07	0.09	9.92	0.96	-8.85

Notes. Volatility spillover outputs for all commodities at H=63 days based on the financialization breakpoint date 15 September 2008. First two columns represent spillover indexes which show the portion of spillovers in forecast error variances of stocks and selected commodities, on average. The last two columns represent connectedness and shows which asset is the volatility receiver/ transmitter. If the figure is negative respective commodity is the volatility transmitter and if positive commodity is the receiver

Table 2.8 – Robustness tests

		Spillover Index			Spillover from Equity to Commodity			Spillover from Commodity to Equity			Net Connectedness		
		1997-2004	2004-2009	2009-2016	1997-2004	2004-2009	2009-2016	1997-2004	2004-2009	2009-2016	1997-2004	2004-2009	2009-2016
Energy	Biofuel	2.0%	7.5%	9.5%	0.3	11.5	11.4	3.7	3.6	7.5	-3.4	8.0	3.9
	Crude Oil	0.9%	14.1%	11.6%	1.3	18.3	16.7	0.4	9.9	6.5	0.9	8.4	10.2
	Gas Oil	2.8%	9.3%	8.4%	2.6	15.4	15.3	3.1	3.2	1.5	-0.5	12.2	13.8
	Heating Oil	2.0%	7.4%	5.1%	3.8	9.9	6.9	0.3	4.8	3.3	3.5	5.1	3.7
	Natural Gas	2.2%	0.3%	0.7%	3.9	0.5	0.9	0.5	0.0	0.5	3.4	0.5	0.4
	Petroleum	1.1%	13.2%	10.4%	1.6	17.1	14.2	0.6	9.4	6.7	1.0	7.7	7.5
	Unleaded Gas	0.5%	8.0%	6.6%	0.8	8.9	8.1	0.3	7.2	5.1	0.5	1.6	3.0
Industrial Metals	Aluminum	1.7%	7.7%	5.5%	0.3	12.4	10.0	3.1	3.0	1.0	-2.7	9.4	9.0
	Copper	2.1%	11.5%	8.6%	1.0	20.4	16.6	3.3	2.6	0.7	-2.4	17.8	15.9
	Lead	3.5%	14.1%	13.0%	0.7	13.8	11.8	6.3	14.5	14.2	-5.6	-0.7	-2.4
	Nickel	2.0%	8.4%	5.7%	3.6	11.2	9.4	0.5	5.6	1.9	3.1	5.6	7.5
	Zinc	1.6%	6.9%	4.5%	2.6	9.8	5.7	0.7	4.0	3.4	1.9	5.8	2.3

Table 2.8 – Robustness tests (cont'd)

		Spillover Index			Spillover from Equity to Commodity			Spillover from Commodity to Equity			Net Connectedness		
		1997-2004	2004-2009	2009-2016	1997-2004	2004-2009	2009-2016	1997-2004	2004-2009	2009-2016	1997-2004	2004-2009	2009-2016
Precious Metals	Gold	1.0%	10.8%	12.2%	0.3	16.8	18.8	1.7	4.9	5.5	-1.4	11.9	13.3
	Platinum	0.3%	12.1%	10.4%	0.4	13.7	12.9	0.2	10.6	8.0	0.2	3.2	4.9
	Silver	1.5%	8.4%	8.2%	0.6	15.5	16.0	2.5	1.3	0.4	-1.9	14.2	15.6
Agriculture and Livestock	Cocoa	1.6%	7.9%	6.6%	1.1	15.7	13.1	2.2	0.1	0.1	-1.2	15.7	12.9
	Coffee	0.8%	1.1%	0.7%	0.1	0.4	0.3	1.5	1.8	1.2	-1.4	-1.4	-0.9
	Corn	0.6%	7.0%	6.5%	0.7	9.5	7.6	0.4	4.5	5.4	0.4	5.0	2.2
	Cotton	0.5%	5.4%	10.4%	0.1	10.1	19.3	0.8	0.7	1.5	-0.6	9.4	17.8
	Lean Hogs	1.4%	4.8%	6.7%	0.6	8.8	12.7	2.3	0.9	0.8	-1.6	7.9	11.9
	Live Cattle	1.5%	4.2%	4.3%	2.7	7.7	8.2	0.3	0.7	0.4	2.5	7.0	7.8
	OJ	1.9%	4.1%	6.7%	0.2	1.4	2.4	3.7	6.8	10.9	-3.5	-5.4	-8.5
	Soybeans	1.5%	5.2%	6.8%	2.4	6.5	8.1	0.6	3.9	5.5	1.8	2.6	2.6
	Sugar	0.7%	2.5%	4.2%	0.4	4.7	8.1	1.1	0.3	0.2	-0.7	4.4	7.8
	Wheat	1.8%	9.4%	11.2%	3.1	13.1	14.6	0.4	5.7	7.9	2.7	7.3	6.8

Notes. Volatility spillover outputs for all commodities at H=63 days of three periods; 1 January 1997 – 31 December 2003; 1 January 2004 – 30 June 2009; 1 July 2009 – 6 June 2016.

Hence, we can conclude that commodities are prone to outside shocks and they are not disintegrated from financial markets. (3) Sign of net connectedness change with the financialization, showing institutional investors had an impact on the linkage between commodity and stock markets. Since these investors invest both in stocks and commodities, make commodities susceptible to outside shocks. Similar findings with different threshold year tell us that financialization has started around some time after year 2004 and is not a temporary phenomenon.

2.5.3.3 Robustness test

Some scholars (e.g. Bhardwaj et al., 2015) argue interconnectedness between commodity and financial markets have increased due to common business cycle factors and are temporary. As a robustness test for this argument, we divide our data into three episodes as follows January 1997 – December 2003, January 2004 – June 2009 and July 2009 and June 2016. We basically divide post-financialization episode in Table 2.5 into two as crisis and post-crisis periods.

2.6 Conclusion

The noteworthy influx of institutional investors in commodity market led researchers to check the impact of such investors on commodity market prices (e.g. Singleton, 2013), volatilities (e.g. Irwin & Sanders, 2012) and connectedness of commodities with traditional financial assets (e.g. Buyuksahin & Robe, 2014). Especially the third strand is of utmost importance, since assets proposing protection against severe losses during high uncertainty episodes would also enhance stability and resiliency of the financial system (Baur & Lucey, 2009). In their seminal paper, Gorton and Rouwenhorst (2006) show that commodities are good inflation hedges and have low correlation with stocks and bonds.

Following Gorton and Rouwenhorst's (2006) paper institutional investors' interest on commodities increased significantly. Irwin and Sanders (2011) show commodity investments raise almost 15-folds from 2003 to 2009. This led such investors to consider commodities as investment tools just like stocks; a phenomenon referred as financialization of commodities (Cheng & Xiong, 2013). Basak and Pavlova (2016) contend that financialization increases interconnectedness of stock markets with commodities and also makes commodities susceptible to shocks from financial markets. At similar times, researchers also depict that co-movements of stocks with commodities increased around 2008, but later it partially decreased back to pre-crisis levels. Following the decrease in commodity prices and co-movements with stocks, a group of researchers argue financialization of commodities is not a valid hypothesis. They maintain the idea that commodity market fundamentals are mainly shaped through traditional demand and supply and the temporary increase in connectedness between financial and commodity markets is explainable through business cycle effects. However, Diebold and Yilmaz (2015) state that business cycle risk is shared only via connected markets; therefore if business cycle argument is valid this means commodity and traditional financial asset markets have become integrated, in the first place. Accordingly, we examine interconnectedness of stock and commodity markets through volatility transmission mechanism.

Barberis and Shleifer (2003) note that investors have constraints on assessing every asset in every country and hence they create investment styles at positions, where they feel knowledgeable and comfortable. Therefore, if institutional investors perceive commodities as an investment style; consistent trading in stock and commodity markets would make both markets to prone to shocks in each other.

We utilize statistical methods to locate financialization episode, but also arbitrarily select other years based on evidences from previous findings. Note that results are robust to both selection approaches. We employ Diebold and Yilmaz (2012) method which depicts not only the direction of spillover but also the change in amount of spillover in constrast to GARCH-type methods.

Our findings show that spillover index for each pair of 25 commodities with S&P500 significantly increases after financialization. Furthermore the transmission of volatility is higher both from financial to commodity and from commodity to financial markets during post-financialization. However, we find that commodities were the net transmitter of volatility before the influx of institutional investors in commodity markets. Though, after rising dominant presence of such investors, commodities become net receivers making them highly susceptible to outside shocks. We find that only natural gas and orange juice are not financialized, of which former is a very poor-performer against other energy commodities since 2007. Basak and Pavlova (2016) argue poor performers would be less financialized, since institutions are benchmarked against index and thus would not invest in poor performers. Orange juice, on the other hand, is not an index-member commodity and thus do not pull institutional investor interest, at all.

We also find a slight increase in spillover index as H increases during pre-financialization episode. However, following the dominant presence of financial investors, the spillover index rises very significantly with the horizon days. Therefore, we argue that horizon increase in and of itself would not artificially increase connectedness, but for integrated markets at long horizon diversification benefits vanish even at a higher rate.

As a result, we find that stabilizing role of commodities' on financial system is highly questionable. Therefore, one should be careful whilst investing in commodities and should bear in mind that diversification opportunities by commodities are not granted any more. If one definitely would like to include commodities in his portfolio, should be closely following financial markets as well as actions by institutional investors.

CHAPTER 3

IS FOOD FINANCIALIZED? YES; BUT ONLY WHEN LIQUIDITY IS ABUNDANT

3.1 Introduction

"The securities might be unrelated, but the same investors owned them...and when armies of financial soldiers were involved in the same securities, borders shrank. The very concept of safety through diversification would merit rethinking."

Roger Lowenstein, 2000

"But if this 70 percent level of correlation is here to stay, such guiding philosophies might need to be revised. The "new normal" for global asset prices might be contagion — good and bad."

Financial Times, 2015

Participants of commodity derivatives market have changed structurally after 2000s. Previously, there were mainly hedgers and speculators[iv]. However, in the last decade we have observed another group become a significantly big player in the commodity derivatives market (CFTC, 2008), which are commodity index traders (CIT). These investors replicate the performance of indices such as S&P GSCI through investing in individual commodities and benefit from the increase in commodity prices. Since financial institutions do not care much about commodity market fundamentals, but are rather more concerned about the financial return, major policy-makers argue that they distort commodity market characteristics (de Schutter, 2010). This indicates increasing participation of financial institutions on commodity futures market and

[iv] The former group constitutes firms, which have close commodity-based businesses and are able to hedge their commodity risk through shorting in futures market. The second group, speculators, on the other hand, earn positive premium for providing insurance to commodity producers via longing in the market (Keynes, 1930).

especially agricultural commodities should be approached carefully. The particular importance of agricultural commodity lies in its direct impact on household consumption, since food consumption constitutes 58.3% of the household expenditure globally as of 2014 (World Bank, 2014) and this rate even reaches to 80% for the poorest set of countries (de Schutter, 2010).

Other than the participants in the derivatives market, market characteristics have also changed fundamentally in the last decade. Trading volume, futures commodity prices, and volatilities have all increased recognizably. The trading volume of over-the-counter transactions for commodities augmented from USD 1.5 trillion in December 2004 to USD 13.2 trillion in June 2008 (BIS Statistics, 2015).

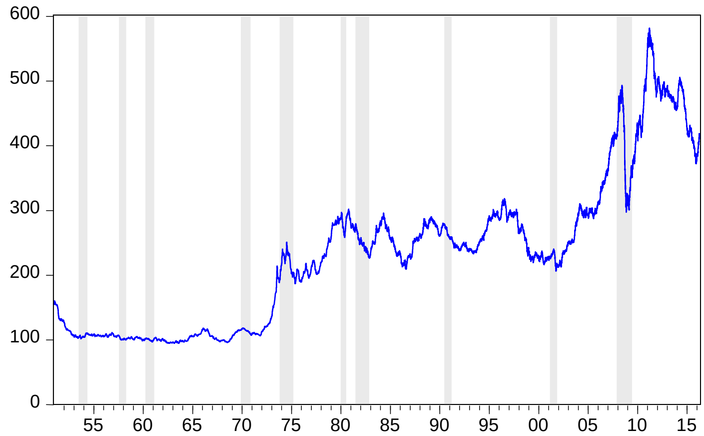

Figure 3.1 – Commodity Research Bureau index

Notes. Commodity research Bureau index total return graph. Grey shaded areas represent recession periods as determined by NBER.

Likewise, the increase in commodity index investments was reported to increase from USD 15 billion by the year-end of 2003 to USD 200 billion in June 2008 (CFTC, 2008). Parallel upsurge in the participation of financial investors on commodity futures market as well as in the commodity prices created a concern for policy-makers. Several think financial institutions are the culprit in the increase of commodity prices (e.g. Masters, 2008; Singleton, 2013; Soros, 2008a, 2008b), whereas some others argue that the historically high levels of emerging market demand pushed prices further (e.g., Hamilton, 2009; Krugman, 2008). One can observe the abnormal increase in commodity prices through The Commodity Research Bureau Index in Figure 3.1.

At similar times, researchers also reported historically high correlation levels between equity and commodity markets (e.g., Buyuksahin & Robe, 2014; Silvennoinen & Thorp, 2013), taking the financialization phenomenon one step further. Figure 2.2 presents time-varying correlations of S&PGSCI Total Index-S&P500 and S&P GSCI Agriculture Index-S&P500, respectively. As one can note co-movements have long been around zero level with temporary increases, though, by the end of Global Financial Crisis, co-movement reached to 0.54 and 0.34 for each index, respectively and the increase has been long-lasting. Since co-movement is the keystone of portfolio allocations, diversification advantages might have been swept away just because armies of financial soldiers invested in the same assets and demolished the borders, as Lowenstein (2000) argues. This process is commonly referred to as the financialization of commodities, where excessive co-movement between commodity and equity markets is observed due to increasing participation of financial investors in commodities.

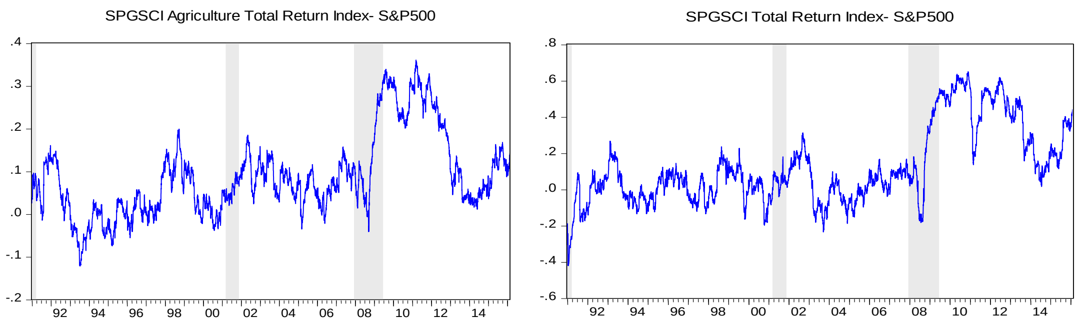

Figure 3.2 – S&P GSCI Total return and S&P GSCI Agriculture index time-varying correlations with S&P500

Notes. Time varying correlations of S&P GSCI aggregated and S&P GSCI Agricultural index with S&P500. We calculate correlations through Asymmetric Dynamic Conditional Correlations method from GARCH family. Grey shaded areas represent recession periods as determined by NBER.

Bearing all these background information in mind, the aim of our essay is to examine whether commodity index trader positions help in explaining the correlation increase between agricultural commodities and equities starting around 2008. The visual interpretation of Figure 3.2 shows that the co-movement has stayed at soaring levels until 2013, but then displayed a decrease. Even though the decrease is a severe evidence for the opponents of financialization, we aim to investigate if the co-movement would have been even lower along the absence of financialization. Therefore, the return of the correlation back to historical levels is not a counter-argument of financialization, given that the dynamics of the global economy have completely changed after the Global Financial Crisis (GFC) in 2008.

We examine agricultural commodities mainly for two reasons. First of all, results based on the aggregated level indices such as S&P GSCI (e.g., Buyuksahin & Robe, 2014) could overshadow the behavior of each sub-group of commodities. Furthermore, financialization of energy commodities has been debated relatively more frequently (e.g. Fattouh et al., 2013; Singleton, 2014), whereas agricultural commodities have drawn less interest. Among others, some studies including agricultural commodities can be listed as Silvennoinen and Thorp (2013), Aulerich, Irwin, and Garcia (2013), Alquist and Coibion (2014), Bhardwaj, Gorton, and Rouwenhorst (2013), and Brooks, Prokopczuk, and Wu (2015). However, none of these studies examine particularly agricultural commodities, but instead they examine all sub-groups of commodities. This gives rise to the analysis being more general rather than focusing on each and every commodity particularly. Moreover, among these papers, very few investigate co-movement (e.g., Bhardwaj, Gorton, & Rouwenhorst, 2013). As of our knowledge, papers which focus solely on agricultural commodities and examine co-movement are only by Lehecka (2014), Janzen, Carter, Smith, and Adjemian (2014), and Bruno, Buyuksahin, and Robe (2016). Since agricultural commodities are of critical importance in household consumption and have incomparable impact on the poor (Myers, 2006), we aim to focus on this commodity group and fill the gap in the literature.

Secondly, the availability of CIT positions is limited to agricultural commodities. Due to data limitations, majority of researchers employ swap dealers positions as proxies for CITs and analyze all 22 commodities reported by the CFTC, including copper, gold, oil, etc. On the other hand, Irwin and Sanders (2012) and Cheng et al. (2014) state that swap dealers positions are prone to severe errors if used as substitutes of CIT positions. Thus, we employ CIT positions directly provided by the CFTC and this is the most robust data available.

Even though commodity futures have been traded for over a century, it is a relatively untouched area in finance and hence we believe our findings would show the connectedness between financial and commodity markets in a detailed manner.

The theoretical background for our research question is by Basak and Pavlova (2016); who argues co-movement between equity and commodity bolsters with financialization.

Following the studies by Silvennoinen and Thorp (2013), Irwin, Sanders and Merrin (2009) and Aulerich et al. (2010, 2013), we employ net long positions of index traders on each agricultural and livestock commodity, which is calculated via subtracting short contracts from long contracts. Moreover, Basak and Pavlova (2016) indicate that co-movements would also be higher when the relative size of institutions increases. The authors propose the relative size of institutions to be the percent of total open interest held by the CITs. Therefore, we also include another measure, which is basically the normalized net long position of CITs for each agricultural commodity.

We employ quantile regression to investigate the role of CIT positions on time-varying links between each agricultural commodity and equity. Quantile regression (QR) is advantageous over ordinary least squares method, since the latter method relies on the average distribution for each independent variable. On the other hand, QR calculates one regression curve for each selected percentile of distribution, leading to a more complete picture of the relationship between the dependent and independent variables (Koenker, 2005). Hence, we can comment on whether the explanatory power of CIT positions on correlation levels changes differently at low/ high correlation states. Dynamic correlations are computed via the Asymmetric Dynamic Conditional Correlation (ADCC) method from the GARCH family. The time frame for the quantile regression is between 3 January 2006 and 22 February 2016 and the frequency is weekly. To disentangle the impact of financialization to the extent possible, we control for all variables which arguably impact co-movements such as the business cycle effect (Bhardwaj et al. 2015), the emerging market demand (Krugman, 2008), worldwide real economic activity (Krugman, 2008), the US dollar index (Tang & Xong, 2012), CBOE Volatility Index (VIX) (Cheng et al., 2014), the TED spread (Buyuksahin & Robe, 2015) and the GFC.

On the other hand, financialization might be dependent upon other market characteristics, since trading motives of CITs are contingent on financial environment. Cheng, Kirilenko and Xiong (2014) state CITs have a role to meet hedging needs of hedgers via taking long position; but also they might reduce their long position to hedge their own positions under certain conditions. Hence, the linkage between commodity and equity markets might get broken at specific episodes. Especially liquidity is critical since institutions might prefer to go back to their circle of competence under scarce liquidity. Since CITs are the major tool to invest in the commodity market (Brunetti & Reiffen, 2014), if they disappear during liquidity crunches, correlations could actually decrease. Hence, we also check how co-movements change with changing liquidity environment and whether the explanatory power of CIT positions decreases during liquidity crunches. Our findings contribute to the newly building financialization literature.

Estimation results indicate that CIT net long positions have a significant and positive impact on co-movement for eight of 11 commodities[v]. Therefore, we find that most of the agricultural commodities have been financialized in the last decade and have become another core investment market. Basak and Pavlova (2016) state that index traders invest more in the commodities which perform at least as good as the S&P GSCI index. When we investigate the remaining three commodities, we observe that these commodities have been relatively poor performers compared to the other eight. Moreover, when we examine the high and low correlation states separately, we see that the positive impact of CIT positions on co-movements is greater at high correlation states. Thus, the co-movements get even stronger when CITs increase

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[v] We exclude lean hogs from our analysis since it presents disintegrated co-movement behavior with respect to US stocks. Hence none of the coefficients at quantile regression are significant, though results are available upon request.

their net long position, whilst correlations have already been at historically high levels.

Furthermore, we find that liquidity is critical for the financialization phenomenon of agricultural commodities. We proxy liquidity constraints in the market via the TED spread (the difference between interbank loans and 3-month T-bill rates) and employ an interaction term of the TED spread with CIT positions to understand how the behavior of CITs change with altering liquidity environment. Our estimations indicate that during liquidity crunches, CITs exit from the market and they exit even on higher rates if co-movements are already at high levels. Hence, the linkage between agricultural commodities and stocks are actually quite fragile and dependent upon the liquidity in the market. Thus, financialization seems to be a valid phenomenon, but it is particularly observed at high liquidity periods. This result also explains the drastic decrease in co-movements during the GFC, as we have depicted in Figure 2.2. Therefore, we argue financialization phenomenon is highly dependent upon the liquidity availability.

We also document that the world-business cycle component significantly and positively affects all co-movements. Even though several previous studies argue that business cycle is the pushing factor for co-movements, as of our knowledge our paper is the first to include this factor in a statistical model. Therefore, as Bhardwaj and Dunsby (2013) argue, commodity and equity correlations are higher during weak economic episodes. On the other hand, we still observe that the coefficient for financialization is positive and significant after controlling for the business cycle. Therefore, our results imply that both financialization and business cycle arguments are valid and contribute to the increase in the correlations starting around 2008. Moreover, we find that a weak US dollar and higher VIX consistently bolster the correlation levels for all pairs.

In the next section we discuss the literature on the co-movement of commodities and financial assets. Then, Section 3.3 and 3.4 elaborate the methodology and describe the data, respectively. Section 3.5 presents our results both on time-varying linkages and quantile regressions and lastly Section 3.6 concludes the research.

3.2 Literature Review

Our paper is mainly related to two strands of finance literature, first one examines whether who trades matters for asset pricing and second one investigates the linkage between commodity market fundamentals (prices, volatilities and correlations) and institutional investor presence in this market. Even though commodity futures have been traded for over a century, it is a relatively untouched area in finance and thus literature especially on the second arm is not abundant.

The first strand of literature investigates the impact of investor composition on asset pricing. Theoretical studies examining how trades of financial institutions affect asset prices are scarce (Basak & Pavlova, 2013) and even scarcer for commodities. Haldane (2014) indicates that assets under management were around 50% of US GDP in 1946 and reached up to 240% of US GDP by 2013. Thus, it is of no surprise that the finance literature started to build up on individual investor sentiment issues. On the other hand, if institutional investors are holding such a substantial amount these days, they should have an impact on asset fundamentals (Basak & Pavlova, 2013). Theoretical studies show that less-constrained traders, which are institutional investors in our case, should reduce mispricing (Basak & Croitoru, 2006; Rahi & Zigrand, 2009). Moreover, Kyle and Xiong (2001) argue simultaneous holding of assets could make those assets susceptible to common factors, causing them move concurrently. Similarly, Barberis and Shelifer (2003) indicate investors do not invest in individual assets but rather in styles and asset categories.

Barberis and Shleifer (2003) argue that investors have limited capacity to assess and analyze each and every asset on earth and hence these investors create investment styles to make decisions easier. An investment style can be any group of stocks, funds or assets and leads to easier investment decisions and simpler performance comparisons. Later, Barberis et al. (2005) show there is extreme co-movement of stocks from same index or any other visible category and this is referred as asset-class effect. Wahal and Yavuz (2013) test whether commodities have become an investment style, next to traditional financial assets. The major empirical implication would be that if commodities have become another core investment opportunity, stocks and commodities should comove for a longer period of time. Since co-movement can be generated with common shocks and thus could be temporary, investment style generated co-movements are long-lasting. Actually their results imply that co-movement for these two asset groups has been long-lived in the last decade and hence commodities have become an investment style for institutional investors. Thus, if investors regard commodities as another asset class, commodities would be more correlated with equities compared to historical levels.

Our findings contribute to the debate via showing that CIT positions can be used to explain the equity-agricultural commodity co-movement and also the joint distribution of commodity and equity returns for most of the agricultural commodities. This result depicts that CITs link the seemingly unrelated equity and agricultural commodity markets since financial institutions consider commodities as an investment style.

Most importantly our paper contributes to the newly building financialization literature. Even though the increase in the correlations is a fact, a consensus on the underlying reason for the increase has not been reached yet. After seminal paper by Gorton and Rouwenhorst (2006), several investors took diversification benefits of commodities against traditional financial assets granted. However, after increasing presence of institutional investors in commodity futures market, this benefit might have vanished.

Theoretical background on financialization is very scarce and to the best of our knowledge Basak and Pavlova (2016) is the first to study the impact of financial institution transactions on commodity fundamentals[vi]. They argue that institutional investors generally have an investment mandate and performance is benchmarked against this mandate. Since capital inflow to funds is highly dependent upon performance, management strives to align with such benchmarks. Hence, Basak and Pavlova (2016) theoretically show that the expected level of the index becomes a

[vi] For further information on Basak and Pavlova (2016), please refer to Section 1.2.1.

common factor affecting both equities and commodities, and therefore this common factor strengthens the co-movement. The authors also show that the marginal utility of institutional investors is dependent upon the index level. Hence, commodities which are doing at least as well as the index are expected to be more financialized compared to the poor performing commodities.

Empirical findings supporting Basak and Pavlova's (2016) model show that behavior of commodities changed somewhere around 2004 (e.g., Tang & Xiong, 2012) and 2008 (Adams & Gluck, 2015). They argue increasing participation of financial investors in commodity futures markets led investors to consider commodities a financial asset rather than a real asset (Vivian & Wohar, 2012). Therefore, commodities have become more correlated with traditional financial assets such as stocks and bonds.

Tang and Xiong (2012) state commodities from different sub-groups such as metals, agriculture or energy were segmented before financialization. Following the higher presence of institutional investors, these commodity markets have integrated and became more correlated, by 2004. Furthermore, authors state enormous fund inflow to commodity market has also integrated traditional finance market with commodities. Furthermore, before financialization correlations of off-index and index member commodities were almost similar, though, after financialization index member commodities display much higher correlations compared to their off-index counterparts. Later, Bonato and Taschini (2015) and Nicola et al (2016) support Tang and Xiong's (2012) findings on co-movement of commodities.

Silvennoinen and Thorp (2013) particularly investigate dynamic correlation between 24 commodities and US, UK, German, French and Japanese equities and US bonds. Results indicate that strong investor interest suddenly strengthened the linkage between financial and commodity markets. Similar finding on dynamic correlation is also evidenced by Chong and Miffre (2010).

Buyuksahin and Robe (2014) investigate the prediction ability of speculators' positions on co-movement between equity and commodity indices. They employ dynamic conditional correlation methodology first, and then examine how hedge fund traders and index traders' positions predict such correlation. They find hedge fund traders' positions, financial stress and macroeconomic fundamentals have strong predictive power on the co-movement. Though, they do not find any predictive ability of index trader positions on equity-commodity correlation.

Later, a group of scholars mainly study how different time episodes affect the connection between commodity and financial markets. Martin-Barragan et al. (2015) investigate the impact of oil shocks and stock market crashes on equity-commodity co-movement. They find the correlation is around zero at relatively calm periods, though oil shocks decrease the correlation further whereas stock market crashes structurally shift to positive levels. Cheung and Miu (2010) show commodities provide diversification benefit to traditional assets in the long run, though not at highly commodity-dependent economies such as Canada. Moreover, Choudry et al. (2015) show gold investment during financially stable periods could help diversification, but not during financial stress episodes.

Yet, a large literature shows that the co-movement is driven by business cycle factors (Alquist & Coibion, 2014; Bhardwaj & Dunsby, 2013; Bhardwaj et al., 2015) and is basically due to global economic weakness (Bhardwaj & Dunsby, 2013). Similarly, Alquist and Coibion (2014) indicate co-movements occur especially when markets are prone to similar macroeconomic fundamentals and one can argue growing emerging market demand is one of these potential macroeconomic developments. Therefore, the business cycle argument constitutes essential changes in the global economy including the GFC and the increase in emerging market demand experienced around the 2000s. Likewise, Bhardwaj and Dunsby (2013), state business cycle component has higher impact on stock-commodity correlations during economic contraction periods. They argue financialization argument is not convincing, since similar high correlation levels have been experienced before 1980, as well. Likewise Bhardwaj et al (2015) contend business cycle component is the major factor to explain increasing co-movement in late 2000s. On the other hand, Bhardwaj and Dunsby (2013) find that business cycle explains the co-movement of industrial commodities with stocks, but explanation power for the agricultural commodities-stocks correlations is much less. This finding is crucial, since previous findings might have been driven largely by energy and metals group commodities.

Buyuksahin, Haigh & Robe (2010) state the co-movement between commodities and equities are dynamic in nature and the increase is temporary. They conclude commodities provide a good diversification tool, though, not during financial stress periods. Similarly, Wan and Kao (2013) examine particularly the interaction between financial markets and crude oil market. They show that the ability of crude oil on hedging is only available during normal financial stress levels at National Financial Conditions Index (NFCI) by Chicago Fed.

Bruno et al (2015) study agricultural commodities-equity co-movement via structural VAR model. They employ data for the period between 1995 and 2015 and results depict that business cycle factors have highest impact on co-movement, but speculative positions are not statistically significant.

However, Bruno et al. (2016) contends that wholly disintegrated markets would not experience strong business cycle factors, since each market would have its own risks. Therefore, the authors state that for the business cycle factor to be significant, they should have been integrated anyways. Similarly Diebold and Yilmaz (2015) contend that business cycle risk is valid only for connected markets and disconnected risks can only be diversified.

To sum up, literature has not concluded whether correlation increases are attributable to financialization or business cycle effects. On the other hand, Basak and Pavlova (2016) contend that under presence of financial institutions, correlations would increase even for seemingly unrelated index member commodities. Hence, authors rely on asset-class effect indicating a paradigm shift is on the table. Given other arguments in the literature, I will test whether their model is valid after a satisfactorily enough period of time passes following Great Recession. Because, transitory effects could signal like they are permanent, when a short time frame is considered. Given US economy shows recovery signals and already 7 years of data has accumulated after Great Recession; I will test Basak and Pavlova’s model through testing the impact of commodity index trader positions on dynamic correlations. I would also control for other possible effects mentioned in the literature, such as risk appetite of financial investors, downside risk in the economy, business cycle and financial crises.

Before getting into the model, firstly we will elaborate methodologies we utilize and then move to dataset and variables.

3.3 Methodology

In this section, we mainly elucidate our methodology in examining the explanatory power of CIT positions on agricultural commodity-equity co-movements. Our analysis has two steps; in the first step we compute time-varying co-movements between each agricultural commodity and stocks. Next, we regress these dynamic correlations on CIT net long positions and a vector of selected control variables, which have been found to have significant impact on co-movements.

3.3.1 Quantifying time varying correlations – Asymmetric Dynamic Conditional Correlation (ADCC)

To examine co-movement dynamics of each agricultural commodity with the equity, we follow asymmetric dynamic conditional correlation method (ADCC) from GARCH family. ADCC method (Cappiello et al, 2006) is an extension of dynamic conditional correlation method of GARCH family introduced by Engle (2002). Please bear in mind that ADCC method is superior over unconditional correlation methods such as rolling correlations since these earlier methods do not provide robust results to volatility changes (Forbes & Rigobon, 2002).

The method could be elaborated as follows:

Let r_t a conditionally normal asset returns vector with a size of $kx1$. Returns vector include the average and error terms, denoted by µ and e, respectively. The ADCC model includes the covariance matrix H_t, which can be broken down as follows:

$$H_t = D_t R_t D_t \tag{3.1}$$

D_t is the kxk diagonal matrix which includes time-varying standard deviations as $\sqrt{h_{kt}}$. These standard deviations are gathered from the estimation process of univariate GARCH (1,1) process as described below:

$$h_t = a + b\varepsilon^2{}_{t-1} + ch_{t-1} \tag{3.2}$$

Furthermore, R_t is the conditional correlation matrix which is

$$R_t = (diag\ Q_t)^{-\frac{1}{2}} * Q_t * (diag\ Q_t)^{-1/2} \tag{3.3}$$

where $diag\ Q_t$ is the diagonal matrix of Q_t, and Q_t is a sequence of covariance matrices of ε_t.

EGARCH models are found to be more suitable for financial analysis due to the leverage effect (Soytas and Oran, 2011) therefore we employ EGARCH models.

Estimation of the DCC model is a two-stage method. In the first stage, univariate EGARCH models are estimated for both S&P500 and each agricultural commodity returns;

$$\log(h_t) = a + b\bar{\varepsilon}_{t-1} + c\log(h_{t-1}) + d\left[\bar{\varepsilon}_{t-1} - \sqrt{\frac{2}{\pi}}\right] \tag{3.4}$$

The second step is computing standardized residuals:

$$\bar{\varepsilon}_t = \frac{\varepsilon_t}{\sqrt{h_t}} \tag{3.5}$$

which helps to compute the correlation in the DCC model as follows:

$$Q_t = (1 - \alpha - \beta)\bar{R} + \alpha\bar{\varepsilon}_{t-1}\bar{\varepsilon}'_{t-1} + \beta Q_{t-1} \tag{3.6}$$

However, we would like to include the asymmetric impact and therefore standardized negative residuals are defined as;

$$\bar{v}_t = \begin{cases} \bar{\varepsilon}_t \ if\ and\ only\ if\ \bar{\varepsilon}_t < 0 \\ 0 \end{cases} \tag{3.7}$$

So the ADCC is given by the following equation;

$$Q_t = (1-\alpha-\beta)\bar{R} - \gamma\bar{S} + \alpha\bar{\varepsilon}_{t-1}\bar{\varepsilon'}_{t-1} + \gamma\bar{v}_{t-1}\bar{v'}_{t-1} + \beta Q_{t-1} \quad (3.8)$$

$$R_t = (diag\ Q_t)^{-\frac{1}{2}} * Q_t * (diag\ Q_t)^{-1/2} \quad (3.9)$$

where $\bar{R} = E[\bar{\varepsilon}_t\bar{\varepsilon'}_t]$ and $\bar{S} = E[\bar{v}_t\bar{v'}_t]$

Q_t should be positive definite and therefore following constraint should be met;

$$\alpha + b + \delta\gamma < 1 \quad (3.10)$$

where $\delta = maximum\ eigenvalue\ [\bar{R}^{-1/2}\bar{S}\bar{R}^{-1/2}]$.

If θ is the parameter in D_t and R_t; the log-likelihood is as follows:

$$L(\theta) = -\frac{1}{2}\sum_{t=1}^{T}(n\log(2\pi) + 2log|D_t| + \varepsilon'_t D^{-1}_t D^{-1}_t \varepsilon_t) - \frac{1}{2}\sum_{t=1}^{T}(log|(R_t)| + \bar{\varepsilon'}_t R^{-1}_t \bar{\varepsilon}_t - \bar{\varepsilon'}_t\bar{\varepsilon}_t) \quad (3.11)$$

Here T and n are number of series, which is 2 in our case, since we estimate dynamic correlation between each agricultural commodity with S&P500. As a result, we calculate Rho which is the off-diagonal element of R_t.

After obtaining these dynamic correlations we regress them on a set of variables through utilizing quantile regression.

3.3.2 Quantile Regression

Quantile regression method basically minimizes weighted least absolute deviations for user-defined percentiles (Koenker & Hallock, 2001). However, in traditional OLS regression, sum of squared deviations are minimized and it explains mean value of the dependent variable. On the other hand, in some cases dependent variable could have different figures based on the value of the independent variable. Hence, quantile regression provides the researcher to interpret the impact of each percentile of independent variable on dependent variable, separately. So basically, quantile regression allows us to capture the heterogeneity in the effects (Ma & Pohlman, 2008). Furthermore, estimates are still robust even under outlier presence or heteroskedasticity (Kuo & Yu, 2013). Given quantile regression puts no assumption on the distribution of data, is highly advantageous to use in market data analysis (Boyson, Stahel & Stulz, 2010).

In the classical OLS regression, we estimate unknown parameter betas for the below model;

$$y_{it} = \alpha + \beta_1 x_{1t} + \beta_2 x_{2t} + \cdots + \beta_n x_{nt} + u_t \qquad (3.12)$$

where y is the dependent variable and shows the co-movement between each agricultural commodity and S&P500 in our case. The assumptions in OLS are errors to be serially uncorrelated, variances to be homoskedastic and variables to be normally distributed.

However, other than strict assumptions we have set, also we pool low and high co-movement values together and find a central beta estimate. Since OLS minimizes the sum of squared residuals;

$$min \sum_{i=1}^{n} (u_{it})^2 = \sum_{i=1}^{n} [(y_{it}) - (\beta_1 x_{1t} + \beta_2 x_{2t} + \cdots + \beta_n x_{nt})]^2 \quad (3.13)$$

it gives equal weight to all error terms.

On the other hand, quantile regression might provide further information on tail regions of distribution (Li & Wu, 2014). Especially, given the historical high records of co-movement has been experienced in late 2000s, the impact of each independent variable on co-movement would be investigated separately. So the quantile regression function is;

$$y_{it} = \alpha + \beta_{\theta 1} x_{1t} + \beta_{\theta 2} x_{2t} + \cdots + \beta_{\theta n} x_{nt} + u_{\theta t} \qquad (3.14)$$

where θ represents the quantile and spreads over the (0,1) interval. And the minimization technique is as follows:

$$\min \sum_{u_{\theta t} > 0} \theta * |u_{\theta t}| + \sum_{u_{\theta t} < 0} \theta * |u_{\theta t}| \qquad (3.15)$$

It minimizes the least absolute deviation and actually very similar to Least Absolute Deviation minimization technique used also in OLS. However, OLS presents results for 0.5 quantile, whereas with QR technique we can present results of any quantile. Since independent variable coefficients, βs change with θs, each β value for each θ varies and hence tail regions are well-covered.

Through this methodology, we would be interpreting whether CIT positions as well as other independent variables have differing impacts on co-movement of commodities and equities at low-high co-movement states. Given that market environment considers correlation as corrosive on investing fundamentals (Sakoui & Kaminska, 2010), we should elucidate which factors drive co-movements in each case.

We use the bootstrapped quantile regression to estimate standard errors as well as confidence intervals. Buchinsky (1995) reports quantile regression results based on Monte Carlo simulation for bootstrap, kernel and static methods and bootstrap is found to be superior especially at small sample sizes. Moreover, bootstrap confidence intervals are not symmetric around the estimate (Li & Wu, 2014), hence provides a better visual interpretation of each quantile.

3.3.3 Empirical Model:

Basak and Pavlova's (2016) hypothesis on correlations between commodities and equities explain that dynamic correlations increase under financialization. As we have elaborated in previous section, Basak and Pavlova (2016) indicate institutional investors strive to align their performances with respect to their investment mandates. Generally this investment mandate is S&P GSCI, since it is the most widely tracked index (Irwin & Sanders, 2011). Hence, the expected level of index becomes a common factor and raises the correlations of each commodity with other commodities and equities.

Therefore, our objective is to test whether Basak and Pavlova's hypothesis is empirically supported. As a first step, we first need to compute the dynamic conditional correlation of each agricultural commodity with equities. Next, we regress these time-varying correlations on a vector of control variables which have been found to have significant impact on co-movements. Basak and Pavlova indicate financialization effects are stronger at different economic episodes. Moreover, literature indicates that Global Financial Crisis would have increased the correlation level, anyways. Therefore, understanding whether the level of CIT flow affects correlation level differently at low/ high correlation episodes is another concern for us. To capture the impact of CIT along with other factors, I perform quantile regression. So what shall be other factors? A group of scholars indicate the increasing correlations are attributable to common business cycle components, such as increasing emerging market demand, the GFC, and global economic activity trends. Hence, following literature, we include Kilian's (2009) real economic activity measure (Buyuksahin & Robe, 2014) to capture the worldwide demand for global industrial commodity market, the default spread (Bhardwaj et al., 2015) to capture the business cycle component, the MSCI Emerging Markets Index (Adams & Gluck, 2015) to capture increasing emerging market demand after the 2000s, the JPM US Aggregate Bond Index (Tang & Xiong, 2012) to capture the macroeconomic information underlying in the market, and a dummy to capture the GFC. Moreover, the contagion literature shows that correlations increase during financial stress episodes, and therefore we also include the TED spread (Buyuksahin & Robe, 2014) to control for the liquidity constraints in the market and VIX (Silvennoinen & Thorp, 2013) as the fear gauge of the financial investors. Last but not least, the foreign exchange market and the interaction of agricultural commodities with energy commodities is controlled through US Dollar Index futures (Tang & Xiong, 2012) and oil futures prices (Nazlioglu & Soytas, 2012), respectively.

We shall also include an interaction term of the CIT position with the TED spread, which investigates whether index traders exit from the commodity market during liquidity crunches. Even though Buyuksahin and Robe (2014) find that the index trader positions do not affect correlations of commodities and equities, we still propose to include the term.

So our empirical model is as follows:

$$C_{ij,\theta} = \alpha_\theta + \beta_{1,\theta} CIT_i + \beta_{2,\theta} REA + \beta_{3,\theta} TED + \beta_{4,\theta} VIX + \beta_{5,\theta} DEF + \beta_{6,\theta} EM + \beta_{8,\theta} BOND + \beta_{9,\theta} USD + \beta_{10,\theta} OIL + \beta_{11,\theta} CIT * TED + \beta_{11,\theta} D \tag{3.16}$$

where i stands for individual agricultural commodities, j for S&P500, and therefore C_{ij} is the time-varying correlations of each commodity with the equity market. θ stands for the quantile for different states. For instance, the 0.5 quantile represents the average level of correlations and a normal state, whereas larger quantiles such as the 0.9 quantile display high correlation states. Therefore, we obtain different regression outputs for low and high correlation states separately, and hence could investigate how the explanatory power of CIT positions and control variables change at each state. We present results for the median percentile, as well as 10% and 90% to represent low and high correlation states, respectively. Even though these selection criteria are arbitrary, Adams and Gluck (2015) indicate there is a trade-off between leaning on a few observations or observations with only moderate risk.

As a result, we have two major hypotheses. The first one argues the higher the commodity index fund position, the higher the co-movements, implying $\beta_1 > 0$. The second one proposes that as the liquidity in the market gets scarcer and the TED spread increases, CITs exit from commodity market, and hence the explanatory power of their positions decreases, implying $\beta_{11} < 0$.

3.4 Data:

3.4.1 Return of commodities and equity:

Daily continuous futures prices of each commodity are obtained through Datastream. Thomson Reuters Datastream provides continuous prices based on a few rollover strategies of which are derived from individual contracts. Following Andreasson et al (2016) and Martin-Barragan et al (2015), we take Type 0 rollover, which basically rolls over on the first business day of the new notional contract month. Note that all price series start with the values of the nearest contract month and all possible contract months (all maturities) are used to switch from the front contract to another nearby contract. No price adjustment is made (Datastream, 2015)[vii].

[vii] Please also note that there are also other papers, which use unlevered total return of GSCI indices for each commodity (Buyuksahin and Robe, 2014; Bruno et al, 2016). Since results are very much in line with Datastream provided futures prices, we prefer to present results based on Datastream Type 0 futures prices.

Table 3.1 Panel A – Descriptive statistics for level data

	Agricultural Commodities												US Stocks
	Cocoa	Coffee	Corn	Cotton	Feeder cattle	Kansas Wheat	Lean Hogs	Live Cattle	Soybean Oil	Soybean	Sugar	Wheat	SP500
Mean	1,934	125	354	69	109	503	67	91	41	847	13	469	1,233
Median	1,653	119	305	64	99	468	65	85	39	751	11	432	1,214
Maximum	3,774	315	831	214	243	1,337	133	171	71	1,770	35	1,280	2,131
Minimum	674	42	175	29	48	249	21	55	22	410	2	224	459
Std. Dev.	741	49	158	24	40	195	17	27	10	332	6	185	367
Skewness	0.4	0.8	1.1	2.3	1.3	0.9	0.7	1.0	0.3	0.7	1.1	0.8	0.4
Kurtosis	1.9	3.8	3.3	11.7	4.2	3.0	3.9	3.0	2.0	2.3	3.9	3.1	3.1
Observations	5515	5515	5515	5515	5515	5515	5515	5515	2583	5515	5515	5515	5515

Table 3.1 Panel B – Descriptive statistics for return data

	Agricultural Commodities												US Stocks
	Cocoa	Coffee	Corn	Cotton	Feeder Cattle	Kansas Wheat	Lean Hogs	Live Cattle	Soybean Oil	Soybeans	Sugar	Wheat	SP500
Mean	0.000145	-0.000062	0.000084	-0.000081	0.000129	0.000023	0.000102	0.000112	0.000119	0.000085	-0.000264	0.000024	0.000262
Median	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum	0.10	0.21	0.10	0.17	0.06	0.08	0.28	0.09	0.07	0.08	0.24	0.23	0.11
Minimum	-0.10	-0.15	-0.25	-0.30	-0.06	-0.13	-0.27	-0.07	-0.07	-0.14	-0.49	-0.29	-0.09
Std. Dev.	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.01
Skewness	-0.09	0.11	-0.64	-1.24	-0.09	-0.10	0.33	-0.07	0.03	-0.75	-2.14	-0.15	-0.24
Kurtosis	5.69	7.86	16.24	27.11	6.53	5.60	39.72	9.66	5.29	9.35	46.41	16.10	11.35
Observations	5514	5514	5514	5514	5514	5514	5514	5514	2582	5514	5514	5514	5514

The proxy for equities is S&P500 composite index, which is also obtained through Datastream. Tang and Xiong (2012) indicate S&P500 is advantageous over world stock indices since it is not prone to exchange rate fluctuations. Moreover, all major commodities are traded in US, hence parallel markets would be considered in our analysis.

We compute daily return of each commodity and S&P500 via taking first differenced natural logarithms and we obtain stationary time series to run ADCC's. Time frame for this part of analysis is between 1 March 1995 and 22 February 2016.

Such time frame is chosen to observe the impact of financialization visually on conditional correlations. Tang and Xiong (2012) indicate financialization started somewhere around 2004, and hence around a decade pre-financialization data is incorporated. Descriptive statistics of return data for 12 agricultural commodities and S&P 500 is given in Table 3.1.

As one can note except sugar, cotton and coffee, all commodities display positive daily average return. Negative return for these commodities is partially attributable to unusually high but temporary performance increase around 2010. Since the surge in prices has not been permanent, we observe rather big moves and this causes a few observations to dominate average return figure. Highest return generator has been cocoa, with 0.015% daily average return, by dint of the recognizable price increase in the last decade.

On the other hand, daily average performance of equity is 0.026% which almost doubles even highest performing agricultural commodity. Hence, the core financial asset seems to outperform agricultural commodities from average return perspective in the last two decades. Volatility is similar for all assets; showing agricultural commodities are not less volatile than equities. Furthermore, negative skewness indicates longer tails in the negative side for all commodities except soybean oil and coffee.

3.4.2 Commodity Index Fund Positions (financialization proxy):

The major hypothesis of our study proposes the higher the financialization the higher the co-movement of agricultural commodity with the equity. On the other hand, measuring financialization is not quite straightforward. All studies testing the impact of financialization on commodities relies on either of four Commodity Futures Trading Committee's (CFTC) reports. Since every dataset has its own advantages and disadvantages, we will first elaborate these reports.

3.4.2.1 Commitments of Traders Reports (COT):

The Commodity Exchange Act is the major act to control commodity trading in United States since 1936. This act allows CFTC to establish regulations as well as gather market trader position data (CFTC, 2016a). CFTC do not report these position data individually for corporates, though presents every Tuesday open interest positions of two major groups; commercials and non-commercials.

The former group is largely hedgers, who own businesses closely tied with commodity production. CFTC defines commercials as "...engaged in business activities hedged by the use of the futures or option markets" (CFTC, 2016b). Given commodity price risk is the major risk for these businesses, futures market is clearly crucial for them to maintain their business. Hence, commercial group generally takes the short position of the market. Non-commercials, on the other hand, could be categorized as speculators (Chang et al, 2000; de Roon et al., 2000). CFTC also reports non-reportables group which is an aggregate figure for all transactions not passing the reporting level.

CFTC provides futures and options combined COT reports every Friday based on previous Tuesday data and is available commencing from 1995 and for 22 commodities including metals, energy and agriculture. Ederington and Lee (2002) find commercial group also include businesses which are not particularly commodity-based and this classification might not be robust.

One of the key problems in commercial/ non-commercial classifications is about swap dealers. To enable companies to manage their risk. Commission provided hedge exemptions on speculative limits and if any entity has been allowed to benefit from such hedge exemption, they were classified as commercial. On the other hand, with the drastic change in OTC market, CFTC was concerned that those actions were really commercial. The example they provide in Comprehensive Review of the Commitments of Traders Reporting Program (Federal Register, 2006) is by a commodity merchandising firm. The firm enters into a swap agreement with a large pension fund, where the swap agreement is based on the index level consisting of the exchange traded futures contracts of wheat, corn and soybeans. The large pension fund shorts the index, so pays to the firm if the index level is higher than the expected level. So swap dealer would like to hedge its own risk and takes the long position in commodities which make up the index. Basically it replicates the position in the index through short and long sides. Since pension fund would like to hedge its exposure on commodity price risk, it applies for hedge exemption and CFTC grants, accordingly. As a result, swap dealers are reported under commercial group. However, they do not engage in commodity-based businesses. This key example provides how COT report could be problematic.

Consequently, based on public commentary (CFTC, 2006), CFTC decided to publish two additional reports; Disaggregated COT reports and Supplemental COT reports.

3.4.2.2 Disaggregated COT (DCOT) report

As its name suggests, DCOT report provides weekly disaggregated data on trader positions beginning from 2006 for almost all commodities likewise COT report. The Commission basically separates commercial group into Swap Dealers and Processors & Merchants and non-commercial group into Managed Money & Other Reportables.

Swap dealers are defined as dealers engaging in swap transactions and they employ futures market to hedge their commodity risk arising from swap deal. Processors and Merchants, on the other hand, is the core commercial group participating in producing, processing or handling of commodities. Hence, the major concern of public regarding COT reports classification on commercial grouping is partially solved. However, another question arises that whether swap dealers are speculators or hedgers. As we have mentioned in the above case provided by CFTC, a certain portion of swap dealers are commodity index traders and several studies use this group's position to proxy for CITs (Buyuksahin & Robe, 2014; Brunetti & Buyuksahin, 2009). On the other hand, swap dealers do not only include CITs and all CITs are not only located under Swap Dealers, either.

Non-commercial group mainly consists of Money Managers and Others. The former one includes fundamentally hedge funds, commodity trading advisors and commodity pool operators which are included in futures trading on behalf of their clients. Therefore they manage money of their clients; either institutions or individuals. Other Reportables are all other remaining traders, which are not part of above classifications. However, CFTC notes that some commodity index traders might also be present in this group (CFTC, 2016b).

The next report, to the extent possible, solves CIT position data.

3.4.2.3 Supplemental COT report (SCOT):

The other report CFTC releases is SCOT report, which is publicly available commencing from 2006. This report presents three groups, commercial, non-commercial and CITs in weekly frequency but only for agricultural commodities. CITs are actually placed under both noncommercial and the commercial categories in COT reports. Non-commercial category index traders include pension and managed funds as well as other major institutional investors. There are two critical common characteristics for these institutions to be classified as CIT (CFTC, 2008). First of all, an amount equal to the notional value of the agreement should be set aside as cash or profits of the position should meet notional value of the agreement. Thus, they should be "unleveraged" and hence even the most significant changes in commodity market dynamics should not lead to rapid and drastic position liquidations. Secondly, these institutions are passively managed funds that they track a pre-determined commodity index and hence have limited trading activity. CITs located under commercial category as swap dealers which we already provided an example in section 3.4.2.1.

The summary of all above mentioned classifications are presented by Irwin and Sanders (2012), as Figure 3.3 presents.

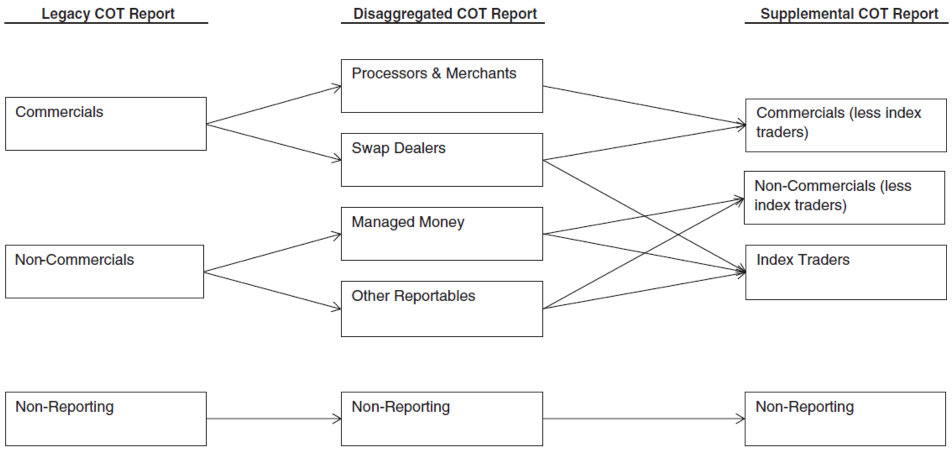


Figure 3.3 – Reports provided by US CFTC (Irwin & Sanders, 2012)

Notes. Irwin and Sanders (2012) provide how positions are grouped within separate groups in different COT reports.

Since we would like to understand how index trading affect co-movement dynamics between commodity futures and equities; the most reliable data from above-mentioned options is SCOT reports. Furthermore, Cheng et al (2014) and Irwin and Sanders (2012) state swap dealers is a noisy proxy of commodity index trading. Moreover, energy commodities and especially crude oil has been on the radar of researchers for a while, but, agricultural commodities have relatively drawn less interest. Previous studies generally focus on aggregated indices (Buyuksahin & Robe, 2014; Buyuksahin et al., 2010; Irwin and Sanders, 2012); however, disaggregated level research would provide more robust results, since some effects could net off in aggregate studies.

Given that agricultural commodities have relatively drawn less attention and are considered to be more disintegrated from other commodity markets (Bessembinder, 1992), financialization on food would be an interesting question. Moreover, agricultural commodity financialization has severe policy implications (de Schutter, 2010) since they are the core of household consumption (Myers, 2006).

Table 3.2 Panel A – Descriptive statistics for financialization (Net long positions)

	Cocoa	Coffee	Corn	Cotton	Feeder cattle	Kansas wheat	Lean Hogs	Live Cattle	Soybean	Soybean Oil	Sugar	Wheat
Mean	24,560	43,035	374,884	70,626	6,980	37,848	81,216	107,682	142,711	80,813	231,415	171,423
Median	25,010	41,688	374,349	67,512	6,599	37,692	80,744	106,173	139,151	82,167	235,870	179,981
Maximum	40,226	67,021	503,937	122,555	11,305	66,592	127,379	156,752	201,251	113,563	392,740	229,565
Minimum	5,117	22,473	223,985	42,681	3,663	16,293	46,004	57,312	86,617	36,630	106,089	103,643
Std. Dev.	8,089	10,168	55,333	15,555	1,758	10,105	14,907	23,715	24,917	15,099	63,800	32,755
Skewness	-0.1	0.1	-0.4	0.8	0.4	0.0	0.1	0.0	0.2	-0.4	0.3	-0.3
Kurtosis	1.9	2.1	3.6	3.2	2.3	2.3	3.0	2.1	2.4	3.2	2.4	1.8
Observations	529	529	529	529	529	529	529	529	529	516	529	529

Table 3.2 Panel B – Descriptive statistics for financialization (Net long positions normalized by total open interest - Lambda)

	Cocoa	Coffee	Corn	Cotton	Feeder cattle	Kansas wheat	Lean Hogs	Live Cattle	Soybean	Soybean Oil	Sugar	Wheat
Mean	0.13	0.23	0.22	0.27	0.19	0.25	0.34	0.31	0.20	0.23	0.24	0.34
Median	0.14	0.23	0.21	0.28	0.19	0.24	0.35	0.31	0.21	0.23	0.25	0.34
Maximum	0.22	0.42	0.33	0.43	0.35	0.40	0.51	0.47	0.32	0.37	0.36	0.51
Minimum	0.04	0.10	0.13	0.11	0.06	0.12	0.18	0.16	0.10	0.14	0.10	0.19
Std. Dev.	0.04	0.06	0.04	0.06	0.07	0.06	0.08	0.08	0.05	0.04	0.05	0.07
Skewness	-0.1	0.3	0.7	-0.1	0.1	0.0	-0.1	0.1	-0.1	0.6	-0.4	-0.2
Kurtosis	2.1	3.2	3.2	2.9	2.1	2.4	1.8	2.3	2.0	3.7	2.4	2.3
Observations	529	529	529	529	529	529	529	529	529	516	529	529

Notes. Descriptive statistics for net long positions and net long positions normalized by total open interest (Lambda). Net long positions for each agricultural commodity are calculated via subtracting short position from total long positions. Lambda is the relative size of institutions (Basak & Pavlova, 2016) and is basically the net long position normalized by total open interest. Data is available in weekly frequency and for the period between 1 January 2006 and 22 February 2016 for all commodities except soybean oil, which is available commencing from 4 April 2006.

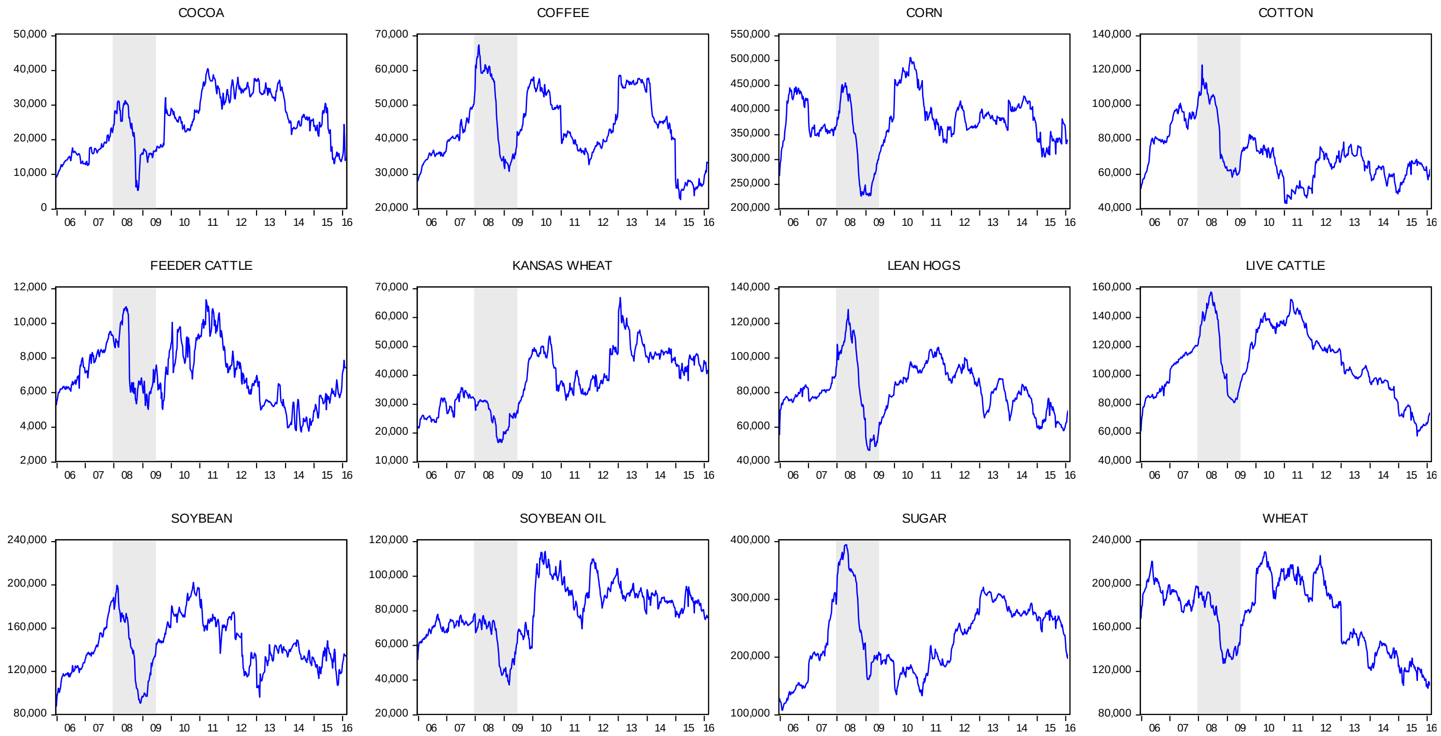


Figure 3.4 Panel A – Historical series for financialization (Net long positions)

Notes. Historical time series for net long positions of each agricultural commodity are calculated via subtracting short position from total long positions. Grey shaded areas represent recession periods as determined by NBER.

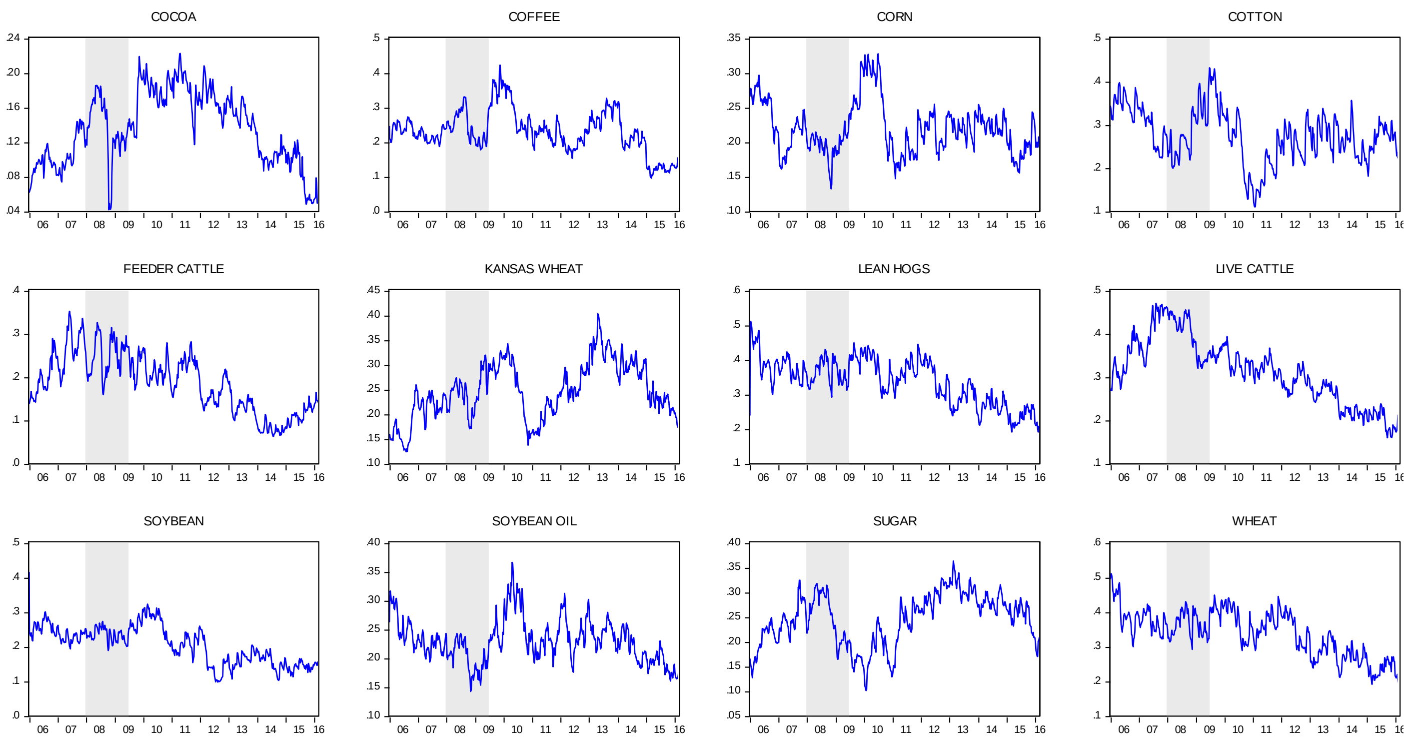


Figure 3.4 Panel B – Historical series for financialization (Net long positions normalized by total open interest - Lambda)

Notes. Lambda is the relative size of institutions (Basak & Pavlova, 2016) and is basically the net long position normalized by total open interest. Grey shaded areas represent recession periods as determined by NBER.

Following the literature, we employ net long positions of index traders to proxy for financialization (Aulerich et al., 2010 and 2013; Silvennoinen and Thorp, 2013; Sanders and Irwin, 2015). Since CITs generally hold the long position, net long positions are calculated via deducting short contracts from long contracts.

Secondly, we also employ net long position normalized by total open interest (Domanski & Heath, 2007; Silvennoinen & Thorp, 2013; Kang et al., 2014; Sanders & Irwin, 2015). Basak and Pavlova (2016) indicate institutional investors are endowed with λ (Lambda) of the stock market and thus λ proxies for the size of institutions in the market. Net long position normalized by total open interest could be considered to be the λ, since it basically shows the percentage of total positions held by CITs. Basak and Pavlova (2016) indicate correlations are sensitive to the size of institutional investors but relatively less sensitive compared to supply or demand shocks. Therefore we expect correlations to increase as λ increases. One can refer to Table 3.2 for descriptive statistics and Figure 3.4 for historical series of both proxies.

3.4.3 Control variables

Our model has economic and financial variables, of which previous studies find to significantly affect co-movement levels. Below we elucidate these variables. Please also note that since SCOT report is available commencing from 2006, our analysis starts in 1 January 2006 and extends to 22 February 2016. One can refer to the Table 3.3 Panel A for descriptive statistics and Panel B for collinearity matrix.

Since our variables are in levels and all are in different units, we decided to standardize all variables except the dummy variable to make interpretation easier. Moreover, we face a severe multicollinearity problem; therefore standardizing also solves the multicollinearity of all variables except the TED spread. Including both the TED spread and the interaction term result in variance inflation factor levels of above 20. Hence, we extract the variable with higher VIF in each case. Since the TED spread has higher VIF at all models, we run quantile regression without the TED spread. Multicollinearity tables are available upon request, though we provide one sample at Appendix Table A.1.

Table 3.3 Panel A – Descriptive statistics for explanatory variables

	BOND	DEF	EM	OIL	REA	TED	USD	VIX
Mean	104.33	1.17	953.00	80.13	0.05	0.49	82.66	20.42
Median	104.42	0.99	975.46	81.91	0.09	0.30	81.20	17.67
Maximum	110.61	3.47	1331.97	140.97	0.64	4.30	99.95	67.64
Minimum	96.81	0.54	476.16	27.94	-0.66	0.10	71.54	9.90
Std. Dev.	3.13	0.54	155.84	21.68	0.34	0.52	6.31	9.42
Skewness	0.02	2.44	-0.73	-0.14	-0.13	2.94	1.00	2.10
Kurtosis	2.16	9.25	3.72	2.58	2.08	14.21	3.63	8.48
Observations	529	529	529	529	529	529	529	529

Notes. Descriptive statistics for control variables employed in quantile regression. BOND is the JPM US Aggregate Bond Index, DEF is the default premium and is the difference between Moody's seasoned high-yield (Baa) and triple A rated corporate bonds, EM is the MSCI Emerging Market Index, OIL is the nearest contract futures prices for WTI crude oil, REA is the real economic activity index developed by Kilian (2009), TED spread is the difference between 3 month LIBOR rate and 3 month T-bill interest rate, USD is the US Dollar Index futures and VIX is the Chicago Board Options Exchange Volatility Index (VIX) and calculates implied volatility of S&P500 index options. Data is available in weekly frequency and for the period between 1 January 2006 and 22 February 2016 for all variables.

Table 3.3 Panel B – Collinearity matrix

	BOND	DEF	EM	OIL	REA	TED	USD	VIX
BOND	1.00							
DEF	-0.20	1.00						
EM	0.35	-0.64	1.00					
OIL	0.26	-0.33	0.64	1.00				
REA	-0.54	-0.05	0.17	0.22	1.00			
TED	-0.50	0.54	-0.19	0.01	0.37	1.00		
USD	-0.09	0.08	-0.49	-0.76	-0.53	-0.17	1.00	
VIX	-0.15	0.83	-0.49	-0.21	0.08	0.60	-0.09	1.00

Notes. Please see notes for Table 3.3 Panel A.

Historical price series for control variables are also depicted in Figure 3.5.

3.4.3.1 Real Economic Activity (REA)

First of all, we need to control for changes in global economic environment. Given that growing/ shrinking economies have separate impacts on financial market dynamics, we aim to measure real economic activity. Kilian (2009) proposes a measure of economic activity based on single voyage freight rates of dry cargo. Even though he aims to disentangle the impact of supply and demand shocks on oil prices in his study, he indicates the measure he computes is rather a demand for global industrial commodity market.

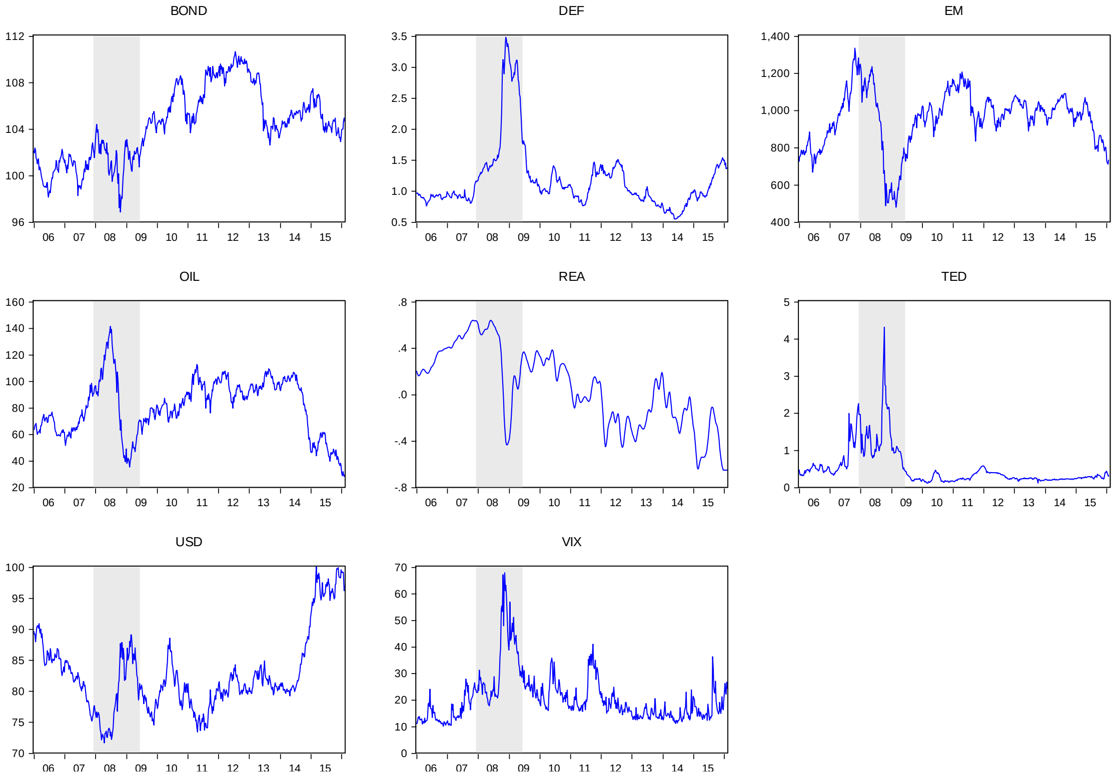


Figure 3.5 – Historical series for control variables

Notes. Please see notes for Table 3.3 Panel A.

The index by Kilian (2009) is designed firstly via obtaining single voyage freight rates for dry cargoes containing grains, oilseeds and metals and then deflating with US Consumer Price Index. Furthermore, given that shipping rates displayed a severe decline throughout years, Kilian detrends those series linearly. On the other hand, the data is available monthly starting from 1968. Since SCOT reports are weekly, we perform cubic spline on REA following Buyuksahin and Robe (2014).

Buyuksahin and Robe (2014) also employs this variable in their analysis and observe statistically significant and negative impact on co-movement between equity and S&P GSCI. Authors refer to the literature and indicate during economic downturns cross market correlations were found to be increasing. In line with previous findings, they find co-movements to increase when REA is decreasing. Bruno et al. (2016) also find similar results, though they state the impact is temporary. Hence we also expect the coefficient of REA to be negative. However, since these studies employ aggregated level indices, particular commodities might present separate behavior.

3.4.3.2 TED spread (TED)

The TED spread is the difference between 3 month LIBOR rate and 3 month T-bill interest rate and hence measures the liquidity in the market. During financially stressful periods, more fragile banks compared to their peers, might experience liquidity problems. On the other hand, identities of more fragile banks are usually not obvious. Thus, especially robustly managed banks do not provide liquidity to market and limit interbank lending. As a result liquidity decreases, individuals and institutions face credit constraints.

Historical values for the TED spread show it displayed its peak value during Global Financial Crisis and has been relatively stable since then except Greek debt crisis. Buyuksahin and Robe (2014) employs TED spread to proxy for financial market stress and to control for the impact of such stress on the co-movement between equity and commodities.

Previous findings indicate correlations for different asset classes in the same geographical market or same asset class in across border markets increase during stress periods (Longin & Solnik, 2001; Forbes & Rigobon, 2002; Bekaert & Harvey, 2003). However, Buyuksahin and Robe (2014) indicate borrowing constraints during distress episodes could make financial investors move from commodity market to equity markets. Therefore, financial investors who create the link between commodity and equity markets withdraw their investment and break the link. Therefore in a financial stress episode with severe liquidity constraints we might expect lower correlations. In light of this hypothesis, we include an interaction term of TED spread with CIT net long positions and hypothesize the term to be negative.

Cheng et al. (2014) investigate how financial traders alter their positions with changes in fear gauge of the market (VIX). They show financial traders cut their long positions at financial distress periods, and thus do not assume risk of hedgers the time they needed most. However, they employ VIX and it depicts short-lived impact on investors (Sari, Soytas and Hacihasanoglu, 2011), though we seek for a longer-lasting influence.

3.4.3.3 Volatility Index (VIX)

Chicago Board Options Exchange Volatility Index (VIX) calculates implied volatility of S&P500 index options and accommodates global risk perceptions. VIX is considered to be the fear gauge of the market and measures shocks to the risk appetite of investors (Sari et al., 2011). In recent years, research findings indicate that VIX can predict stock returns (Giot, 2005), volatility (Diavatopoulos et al. 2008), oil prices (Sari et al., 2011) and gold prices (Narayan et al., 2010). Moreover, these results indicate the linkage between equity and commodity markets.

Financial investors go long in commodity futures market and Cheng et al (2014) find that at high VIX times CITs decrease their net long positions. This finding implies that VIX is a critical indicator for CIT positions. Moreover, Silvennoinen and Thorp (2013), Le Pen and Sevi (2015) and Henderson et al (2015) find that higher VIX levels predict high commodity-equity correlation. Hence we expect even though CITs pull off from the market at volatile times, correlation to still rise, in line with previous findings. Therefore, we need to control for the VIX to disentangle the impact of financial investors on equity-commodity co-movement from the impact of high volatile times on co-movement.

3.4.3.4 Default premium (DEF)

As we have mentioned above, there are major advantages for holding commodity futures. One is the inflation hedging role and another one is low correlation with traditional asset classes implying diversification role (Gorton & Rouwenhorst, 2006; Erb and Harvey, 2005). Another main finding by Gorton and Rouwenhorst (2006) show that commodity futures behave differently compared to equities and bonds during business cycles. Unlike traditional financial assets, commodity futures provide lower returns at late expansion states, whereas higher returns at early recession periods. Hence Gorton and Rouwenhorst (2006) and Bhardwaj and Dunsby (2013) indicate there is an additional factor driving correlations between commodity futures and stocks, which is the business cycle. Similarly in a theoretical study, Alquist and Coibion (2014) find commodity correlation is mainly attributable to global business cycles.

Even though there are several macroeconomic factors, starting from Chen et al (1986), mainly default premium has been used to proxy for business cycle. Alternatively one can do factor analysis based on hundreds of economic indicators, though Bhardwaj et al (2015) find that default premium coincides well with commodity-equity co-movement. They argue the extraordinary increase around 2008 in co-movement was not attributable to financialization, it was merely the business cycle component. Following their study, we compute default premium via the difference between Moody's seasoned high-yield (Baa) and triple A rated corporate bonds.

Since default premium increases mainly in financially distressed periods, we expect the coefficient of DEF to be positive.

3.4.3.5 Emerging markets index (EM)

Just before the Global Financial Crisis, researchers as well as policy makers have sought the answer for the increase in commodity prices. The traditional supply and demand theory tells us that for a good's price to increase either its supply should decrease or demand should increase. Based on this, Krugman (2008a) argue, if a speculative action is on the table, inventory levels should increase. On the other hand, he displays that inventory levels still decay for food indicating there is no speculative action (Krugman, 2008b). Furthermore, Hamilton (2009) and Fattouh et al (2013) contend extraordinarily growing emerging market demand in the beginning of 2000s, pushed the prices further. From the co-movement point of view, Tang and Xiong (2012) document increasing correlation between commodities and the MSCI Emerging Markets Index. They show the correlation between commodity and emerging market stocks swayed around -0.4 and 0 pre-2004, whereas jumped to 0.5 in 2009. Hence we should definitely control for the emerging market demand.

In line with Tang and Xiong (2012), and traditional theorists (Kilian, 2009; Fattouh et al., 2013) we expect to find a positive impact of emerging market on co-movement between equity and commodity.

3.4.3.6 US Aggregate bond index (BOND)

Macroeconomic fundamentals are critical for commodities since their supply and demand characteristics are highly dependent upon the economy (Joets, Mignon & Razafindrabe, 2015). Especially co-movement of seemingly unrelated commodity prices makes macroeconomic factors impossible to neglect (Frankel, 2014). One of three major arguments in the surge of commodity prices is easy monetary policy. Given the major and the most crucial tool for central banks is interest rate, easy monetary policy appears through low interest rates. Not only for the surge in commodity prices before Great Financial Crisis but also for the increase around 1970s, evidence show interest rates are critical (Barsky & Kilian, 2002; Frankel, 2014). Frankel (2014) argues as interest rates decrease, cost of holding commodity decreases and demand increases. Moreover, financial traders prefer to invest in commodity assets at low interest times (Lombardi, Osbat & Schnatz, 2011). Bearing these fundamentals in mind, we employ JPM US Aggregate Bond Index to proxy for macroeconomic fundamentals (Tang & Xiong, 2012). This index includes all bonds in US including corporate, government and municipality.

Studies find that tight monetary policy actually decreases agricultural commodity prices (Frankel, 2006; Amatov & Dorfman, 2015). Furthermore, Gospodiov and Jamali (2013) find expansionary monetary policy shocks affect commodity prices through net long positions of hedgers and speculators and cause an increase in commodity prices. Therefore, monetary policies create a crucial linkage between macroeconomy, financial participants and commodity markets. Despite the consensus on the impact of interest rates on commodity prices, the impact on commodity correlations is not well studied. Apostolakis and Papadoupulos (2015) depict that an unexpected increase in interest rates leads to a stress in the market and hence co-movements would strengthen when BOND increases.

3.4.3.7 USD index (USD)

Majority of commodity transactions are settled in US Dollar and hence the strength or weakness of the exchange rate with respect to other major currencies is a critical factor (Akram, 2009). Similar to Frankel's (2006) view on easy monetary policy, weak US Dollar could also contribute to increasing commodity prices. Lombardi et al (2012) indicate US Dollar can affect both supply and demand side. They state that exporters could diminish the supply when USD depreciates. The fundamental reason for suppliers to decrease the supply is to keep purchasing power stable under weak USD, since commodity prices would increase under supply shortage. On the other hand, importers whose currency has appreciated against US Dollar increase their demand, and commodity prices increase further. Therefore, both supply and demand effects result in higher commodity prices for weak dollar. The positive impact of depreciating US Dollar on commodity prices is also evidenced not only for energy commodities but also for other sub-groups such as livestock, grains and metals (Nazlioglu & Soytas, 2012; Basher, Haug & Sadorsky, 2012; Lombardi et al. 2011). Furthermore, US Dollar is found to be the main channel of macroeconomic news affecting food prices (Abbott, Hurt & Tyner, 2011).

Following Tang and Xiong (2012) and Silvennoinen and Thorp (2013) we employ US Dollar Index futures which calculates the value of US Dollar with respect to Euro, British pound, Japanese Yen, Canadian dollar, Swedish Krona, Swiss Franc. Even though Silvennoinen and Thorp do not find significant results, Tang and Xiong (2012) show the negative coefficient implying appreciating USD to have negative impact on co-movement. Hence, we also expect negative impact of USD on equity-commodity co-movement.

3.4.3.8 Oil prices (OIL)

The increase in oil prices followed with food price spike in 2006 has driven a new strand of literature. The relationship between energy and agricultural commodities is thought of to be mainly through two channels. The first and traditional one argues oil is the major input for grain producers and hence an increase in energy prices drives agriculture prices, as well (Hertel & Beckmann, 2011). The second one, on the other hand, is attributable to biofuel demand (Nazlioglu & Soytas, 2012). Given the adoption of policies on reduction of oil in energy production, ethanol production has bolstered. Hence corn, soybeans and other agricultural products could co-move with oil (Tang & Xiong, 2012), since they become to be substitutes. In line with both channels, findings indicate that oil prices have negative impact on commodity prices (Nazlioglu & Soytas, 2012; Silvennoinen & Thorp, 2015; Boroumand et al., 2014). Furthermore, Natanelov et al (2011) find that the co-movement between agricultural commodities and oil is dynamic in nature and is affected from major macroeconomic fundamentals. Silvennoinen and Thorp (2015) find that high correlation of oil and agricultural commodity is particularly observed during high commodity prices episodes. On the other hand, they indicate grains and oilseeds have much stronger correlation dynamics compared to soft commodities such as cotton, cocoa, coffee and sugar.

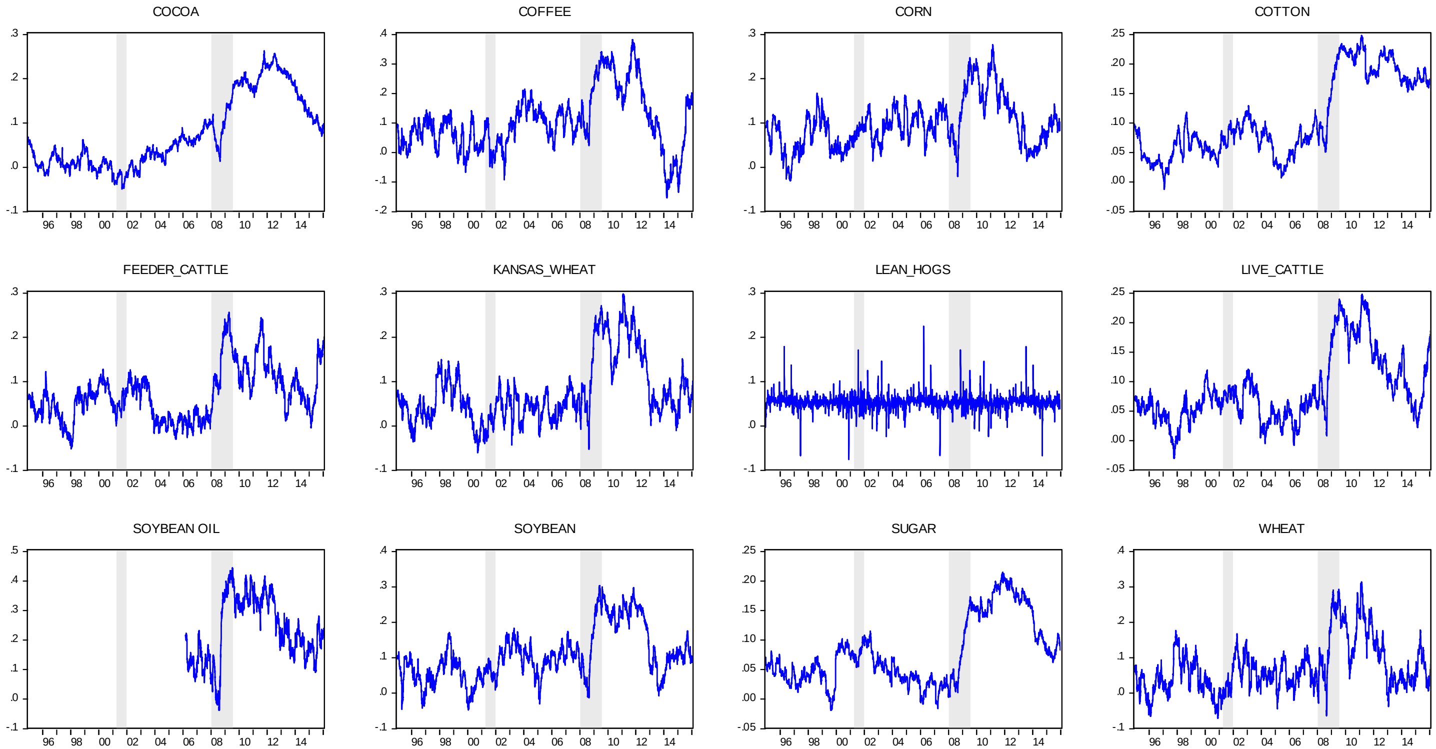
Hence, we need to exclude the hidden impact of oil on co-movement between equity and agricultural commodities. Either through input costs or biofuel policy changes, literature shows that oil has an impact on agricultural commodities. In line with the literature we expect oil to have negative impact on dynamic correlations, especially for grains.

3.4.3.9 Global Financial Crisis dummy

Last but not least we include a dummy variable for the Global Financial Crisis period. Since this extraordinary could overshadow the real impact of CIT, we include a time dummy variable D, which is equal to 1 for the period between December 2007 and June 2009. The time frame is chosen following the NBER business cycles[viii].

[viii] http://www.nber.org/cycles.html

Figure 3.6 – Time-varying correlations of each agricultural commodity with S&P500



Notes: Time-varying correlations of each agricultural commodity with S&P500. We employ Asymmetric dynamic conditional correlations method from GARCH family to proxy for time-varying correlations. Grey shaded areas represent NBER recession periods.

3.5 Results:

3.5.1 Computing time-varying co-movement between each agricultural commodity and US stocks

We investigate whether CIT positions help in explaining the co-movement between agricultural commodities and equity. Hence, we first provide ADCC results for each 12 agricultural commodities with S&P500 total return index in Figure 3.6 for the years between 1995 and 2016.

As one can note, all pairs of dynamic correlations have been swaying around similar levels until the Global Financial Crisis. On the other hand, we observe a sharp decrease during the Global Financial Crisis, and later in a short period of time we observe that correlations increase to historical high figures. Such an increase is in line with previous findings by Tang and Xiong (2012), Chong and Miffre (2010), Silvennoinen and Thorp (2013) and Buyuksahin and Robe (2014).

The visual analysis directly tells us that these correlation figures have a back-story and should be elaborated. Commodities have been relatively a less touched area in finance, and starting with Gorton and Rouwenhorst's (2006) study, we observe an increasing interest in commodity derivatives due to diversification advantages. Even though previous literature tells us that correlation levels increase during financial stress episodes, we observe that co-movement has stayed at historically high levels until 2012. Even only this finding hints us there should be another critical factor, which structurally changed correlations.

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Although ADCCs dropped back to pre-crisis levels after 2012, one question that needs further attention would be whether correlations would have been even lower under the absence of financialization.

The only exception between all pairs is the lean hogs which present a totally disintegrated structure with respect to other agricultural commodities. Please also note that we have run the analysis both via the S&P GSCI Lean Hogs Index and the nearest futures contract price available at Thomson Reuters Eikon database. All series provide similar disintegrated co-movement structures. Hence, we do not interpret the results of lean hogs since none of the coefficients are significant, though results are available upon request.

3.5.2 Does financialization increase co-movements?

After deriving ADCC results for each pair, we come to the core of our paper, where we investigate whether financialization has an impact on co-movement of agricultural commodities with equity. Since the SCOT report is available commencing from January 2006, our analysis starts in 2006 and extends to 22 February 2016. We believe that such a time frame is adequate to make robust interpretations, since it includes almost 2 years before and 8 years after Global Financial Crisis, of which 6 of 8 years consist of no-crisis period. Hence, we might provide a more satisfactory result on financialization, since most of the observations come from crisis-free periods. Moreover, if there is any irregularity in the 2006-2009 period, that would be dominated by post-GFC period. As we have mentioned in our data section, we control for macroeconomic and financial conditions to the extent possible, via referring to literature.

As we mentioned in the previous section, all variables are standardized except dummy, and hence beta coefficients show the impact of 1 standard deviation (S.D.) increase of each independent variable on co-movement pairs.

Findings for quantile regressions are provided in Table 3.4 and for selected deciles in Table 3.5. We present results for low, normal, and high correlation states via reporting the 1st, 5th, and 9th decile findings. Hence, we could elaborate on whether an increase on the CIT positions strengthens or weakens the correlations further at high correlation states compared to low or normal states. Equality of the coefficient estimates for lower quantiles with estimates for the higher or intermediate quantiles are rejected via F-test. Results are available upon request..

Our main hypothesis by Basak and Pavlova (2016) argues that financialization increases co-movement of agricultural commodities with equities. Since financial institutions are benchmarked against an investment mandate, they try to at least match the performance of this benchmark. Therefore, the benchmark becomes a common factor for equities and commodity futures, leading to an increase in covariances and correlations.

Following Aulerich et al (2010, 2013) and Irwin, Sanders and Merrin (2009) our first proxy for financialization is net long positions of CITs. Now, we need to investigate whether commodity market has become another core market for traditional financial asset markets. The hypothesis for the CIT coefficient to be positive indicates higher financial institution presence bolsters the co-movement between commodities and equities. Even though several consider commodities to shield investors from downside risk, if financialization is a valid phenomenon it might not be as useful as a decade ago.

Table 3.4 – Quantile regression results at median percentile

	Cocoa		Coffee		Corn		Cotton		Feeder cattle	
	I	II	I	II	I	II	I	II	I	II
REA	0.11		0.61	0.55	0.48	0.30	-0.14	-0.31	-0.22	
VIX	0.15	0.17	0.28	0.28	0.14	0.15	0.46	0.67	0.52	0.57
DEF	0.36	0.30	0.74	0.72	0.79	0.92	0.46	0.63	0.29	0.33
EM	-0.10				0.38	0.47	0.44	0.53		
BOND	0.44	0.51	0.28	0.30	0.15		0.20			0.14
USD	-0.11	-0.16	-0.17	-0.18	-0.18	-0.35			-0.42	-0.36
OIL	0.30	0.30	0.15		-0.31	-0.47	0.19	0.15		
D1	-1.03	-0.95	-1.54	-1.42	-1.65	-1.66	-0.93	-1.24		
CIT	0.37				-0.09				0.21	
CIT_TED	-0.27		-0.45		-0.36		-0.59		-0.46	
LAMBDA		0.21		0.15		0.14		0.18		0.10
LAMBDA_TED		-0.28		-0.42		-0.36		-0.91		-0.56

Table 3.4 – Quantile regression results at median percentile (cont'd)

	Kansas Wheat		Live Cattle		Soybeans		Soybean Oil		Sugar		Wheat	
	I	II	I	II	I	II	I	II	I	II	I	II
REA				0.19			-0.18	-0.17		-0.12		
VIX	0.18	0.24	0.52	0.53		0.12	0.14	0.20	0.24	0.16		0.14
DEF	0.98	0.97	0.63	0.67	0.81	0.76	0.56	0.62	0.69	0.69	0.86	0.90
EM	0.35	0.44	0.32	0.39		0.20		0.00			0.36	0.33
BOND					0.26	0.39	0.16	0.20	0.31	0.39	-0.14	
USD	-0.78	-0.69	-0.47	-0.64	-0.40	-0.30	-0.80	-0.63	-0.21	-0.13	-0.69	-0.65
OIL	-0.35	-0.33	-0.13	-0.27	-0.31	-0.27	-0.53	-0.43	0.36	0.42	-0.46	-0.42
D1	-1.42	-1.08	-1.12	-1.17	-1.69	-1.58	-1.14	-1.33	-1.59	-1.60	-0.70	-0.83
CIT	0.20		0.21		0.44		0.23		0.17		0.20	
CIT_TED	-0.48		-0.75		-0.26		-0.13		-0.58		-0.55	
LAMBDA		-0.09		-0.27				0.11		-0.06		0.18
LAMBDA_TED		-0.57		-0.58		-0.40		-0.19		-0.38		-0.57

Notes: Quantile regression results for the median percentile. The dependent variable is the dynamic conditional correlations of each agricultural commodity futures prices with S&P500. These conditional correlations are computed via ADCC from GARCH family. Explanatory variables are explained in Table 2.3. Model 1 tests whether net long positions of each agricultural commodity (CIT) as reported by Supplemental COT reports help to explain co-movements of each agricultural commodity with the equity index. Model 2, on the other hand, tests if normalized net long positions of each agricultural commodity help to explain these co-movements. We also test how the linkage changes with liquidity constraints in the market though the interaction terms of CIT and Lambda with TED spread. Only statistically significant findings are presented.

Table 3.5 – Quantile regression results for low, normal and high correlation states

	CIT			CIT_TED			LAMBDA			LAMBDA_TED		
	0.1	0.5	0.9	0.1	0.5	0.9	0.1	0.5	0.9	0.1	0.5	0.9
Cocoa	0.16	0.37	0.35	-0.18	-0.27	-0.26		0.21	0.26	-0.16	-0.28	-0.23
Coffee				-0.24	-0.45	-0.30	0.24	0.15	0.19	-0.18	-0.42	-0.26
Corn	0.12	-0.09	-0.16	-0.06	-0.36	-0.72		0.14			-0.36	-0.68
Cotton				-0.26	-0.59	-0.55		0.18	0.13	-0.27	-0.91	-0.69
Feeder cattle	0.35	0.21	0.26	-0.37	-0.46	-0.40				-0.29	-0.56	-0.51
Kansas wheat	0.15	0.20	0.17	-0.27	-0.48	-0.59		0.04		0.07	0.09	0.09
Live cattle	0.39	0.21	0.50	-0.60	-0.75	-0.61		-0.27	-0.19	-0.55	-0.58	-0.60
Soybean	0.30	0.44	0.37	-0.15	-0.26	-0.46	0.33		-0.26	-0.18	-0.40	-0.85
Soybean oil	0.24	0.23	0.32	-0.08	-0.13	-0.14	0.11	0.11	0.13	-0.21	-0.19	-0.27
Sugar		0.17		-0.41	-0.58	-0.49		-0.06		-0.45	-0.38	-0.41
Wheat	0.07	0.20	0.35	-0.38	-0.55	-0.80		0.18	0.22	-0.34	-0.57	-0.65

Notes. Quantile regression results for low (0.1), normal (0.5) and high (0.9) correlation states, separately. Only statistically significant findings are presented. We examine how the explanatory power of financialization on co-movements changes at low or high correlation states and during liquidity abundance or constraints.

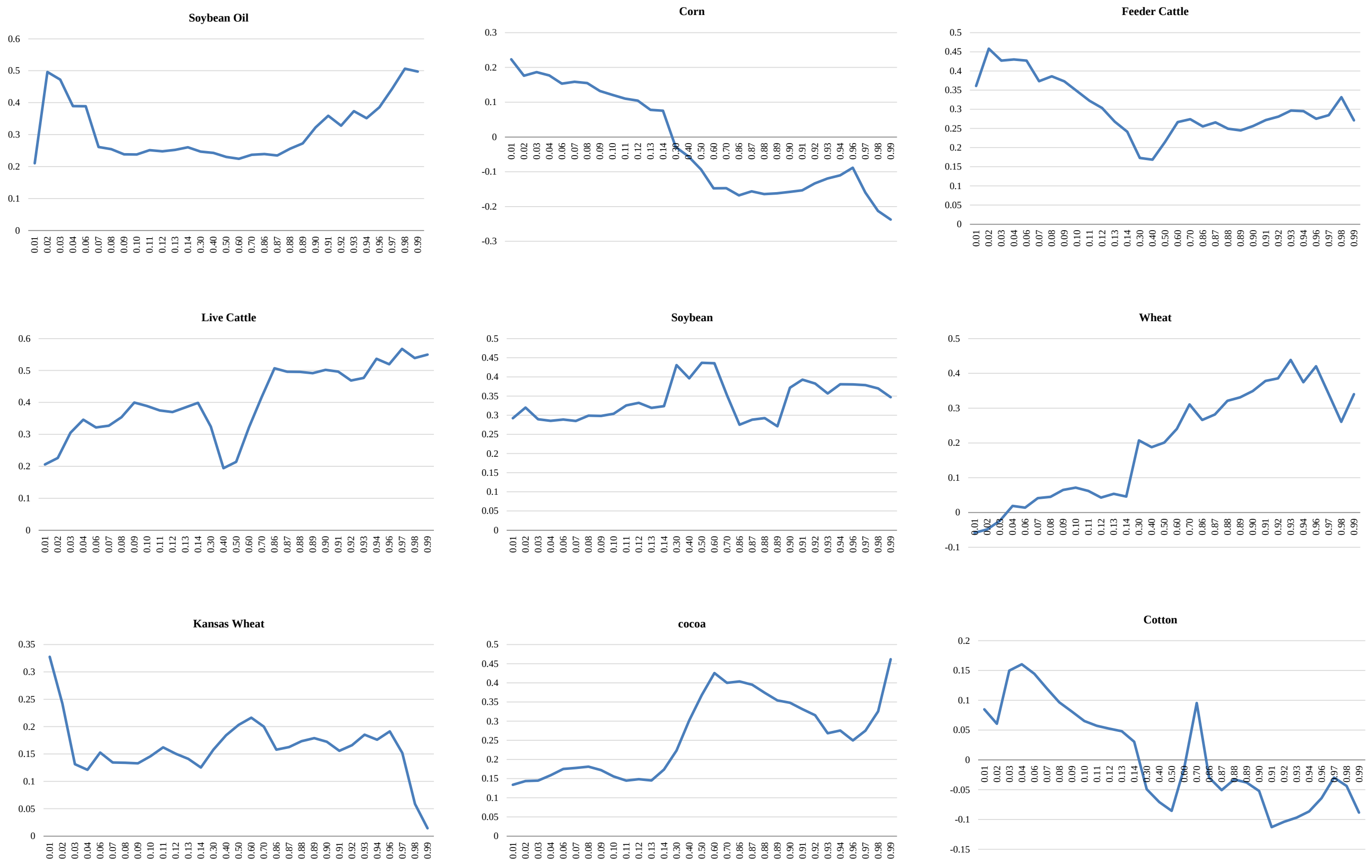

Figure 3.7 – CIT coefficient at other deciles

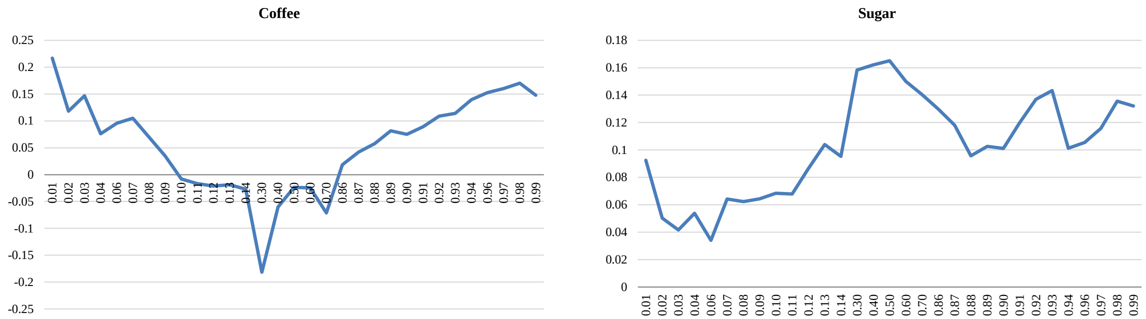

Figure 3.7 – CIT coefficient at other deciles (cont'd)

Notes. Quantile regression results for various quantiles. In each graph, y-axis shows the estimation results of CIT coefficient and x-axis depicts the quantiles. As one can note that for all commodities, estimation results are significantly different between low, median and high quantiles.

When we check the coefficient for CIT, we observe that the coefficient is positive and significant for 8 commodities; cocoa, feeder and live cattle, soybean, soybean oil, wheat, Kansas wheat, and sugar. The positive coefficient implies that as the net long positions of CITs increase, the co-movement of each particular agricultural commodity with stocks also increases. This finding is in line with Basak and Pavlova (2016), indicating that commodities are now a prominent investment tool for financial institutions. We observe financialization coefficient is between 0.20 (wheats) and 0.37 (cocoa) indicating 1 S.D. increase in CIT net long positions, lead to respective S.D. increase in co-movement of each commodity with equity.

Quantile regressions of CIT coefficient for other deciles are presented in Table 3.5. Results depict that CITs affect correlations at similar levels for low and high quantiles for most commodities. Therefore, an increase in net long positions of CITs shows increasing financialization in either case, whether it is at low or high correlation states. However, for wheat, Kansas wheat, live cattle and cocoa we see an increasing trend when moving from decile 0.1 to 0.9, proposing that CIT positions bolster the correlation of these commodities with equities, when the correlation is already at high levels.

Moreover we see that corn, cotton and coffee display negative coefficients for CIT, of which only the coefficient for corn is statistically significant. This proposes that these commodities have not been financialized but then we shall elucidate why some commodities seem to be financialized and rest is not.

3.5.2.1 Why particular commodities are financialized and rest is not?

As we have mentioned in theoretical background section, financial institutions are benchmarked against the index and hence they invest heavily in index member commodities. Since the performance of institutions is compared against the benchmark, they prefer to select commodities which have better return performances with respect to the index (Basak & Pavlova, 2016). Hence, we should see financialized commodities to be ‘at least as good as the index’-performing commodities. So we should examine relative performances of agricultural commodities with respect to the S&P GSCI index, since it is the most widely tracked benchmark in the commodity sector. We present relative performances of each agricultural commodity at Figure 3.7 starting from 2004. There are two major reasons for selecting 2004 as the benchmark year. First of all, Tang and Xiong (2012) have shown that the commodity financialization process mainly began in 2004, via increasing participation of financial institutions. Secondly, financial managers give their investment decisions based on retrospective data. Since our analysis starts in 2006, performance data for the previous 2 years would be incorporated. BIS (2003) state that some years could be dominated by over-the control events and thus short horizons would not be very appropriate to compare performance of investment professional. They argue three to four years of averaging would be robust. With the same token, only one year of historical performance of any asset might falsify investors. Therefore, including previous performance would be more proper than just comparing same periods.

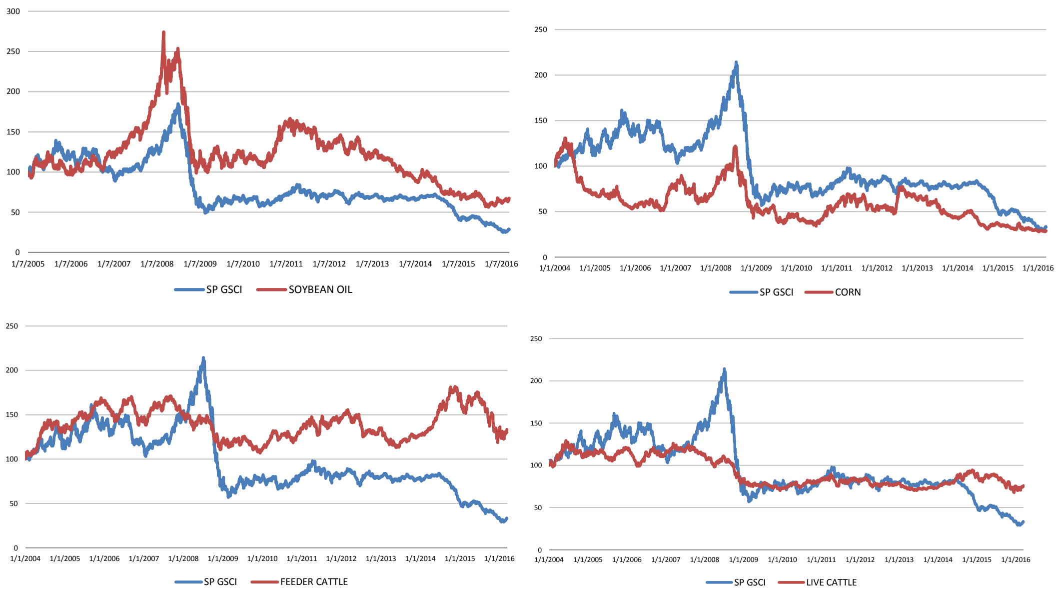

Figure 3.8 – Relative performance of each commodity vs. S&P GSCI

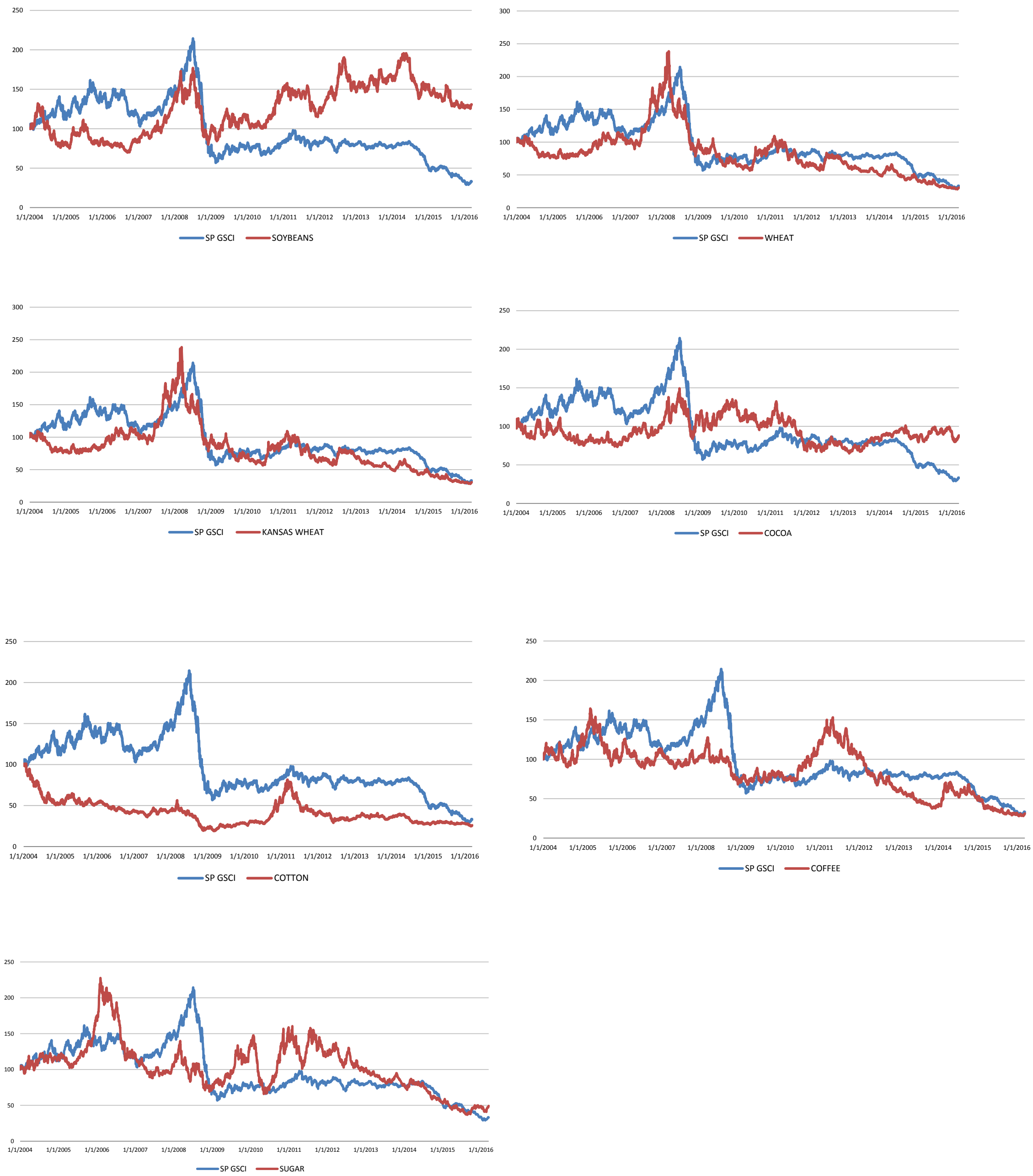

Figure 3.8 – Relative performance of each commodity vs. S&P GSCI (cont'd)

Notes. Relative performance of each agricultural commodity future with respect to the S&P GSCI. 1 January 2004 is taken as base value of 100 for both series in all graphs, unless data is not available. Blue line is S&P GSCI index and red is the respective commodity.

While considering the financialization criterion, Adams and Gluck (2015) also indicate that financial investors are highly concerned about the liquidity. Since replication strategies are highly reliant on rolling forward, liquidity is crucial for financial managers. Hence, they argue that relatively more liquid commodities should be financialized. Authors proxy liquidity via open interest, and therefore wheat is more liquid over coffee; making wheat more preferable from this perspective.

As we have mentioned above, cocoa, feeder and live cattle, soybean oil, soybean, wheat, Kansas wheat, cocoa and sugar present positive and significant CIT coefficients. This means an increase in net long positions of CITs drives the correlation between agricultural commodities and equities further. Hence CITs create a connection between traditional financial assets and commodity markets. On the other hand, CIT coefficient for corn, cotton and coffee has been negative, and significant only for corn. Therefore, we elaborate why some commodities seem to be financialized.

Visual analysis depicts quite a clear picture that performances of commodities which exhibit positive coefficients are relatively similar or much better compared to the S&P GSCI. However, corn and cotton has displayed consistently poor performances. Even though coffee has depicted relatively higher returns around 2012, poor performance at other periods probably dominates 2012 performance. Moreover, the average open interest for coffee during the period between 2004 and 2016 is 136thousand contracts, which is much lower compared to major agricultural commodities such as wheat, or corn.

3.5.2.2 Does relative size of institutions explain co-movement?

Basak and Pavlova (2016) theoretically models that normal and institutional investors are endowed with (1-λ) and λ (Lambda) of the economy, respectively. Lambda basically represents the size of financial institutions in their model. Their hypothesis regarding the correlation between commodity and equity argues that as the size of institutions increase, correlations would also increase, though sensitivity to lambda is smaller.

Authors state higher expected index levels would push institutions to hold index futures more and thus their relative wealth in the economy would be higher compared to normal investors. Hence, they would hold a higher proportion of market, which is λ, and therefore financialization would be higher when λ is higher.

We proxy λ by the share of CITs in the commodity derivatives market, which is calculated by normalizing net long of CITs by total open interest. Basically, λ (Lambda) is our second proxy for financialization which is also used at several studies (e.g. Aulerich et al., 2010, 2013; Irwin & Sanders, 2010).

We find that all commodities except live cattle, Kansas wheat and sugar support Basak and Pavlova's (2016) hypothesis, that as the share of CITs increase, co-movements also increase (Table 3.4).

However, decile results for low and high correlation states do not indicate highly consistent results across commodities (Table 3.5). We observe that as the share of institutions increase, the increase in co-movements is more pronounced for already high correlation states for wheats, soybean oil, cocoa and cotton. On the other hand, for soybean, corn and coffee we observe that the explanatory power of λ decreases at high correlation states.

3.5.3 Is the explanatory power of CIT positions or relative size of institutions dependent upon liquidity constraints in the market?

As we mention previously, trading motives of CITs could be dependent upon market characteristics. They generally meet hedging needs of hedgers in commodity markets but they might reduce their long position at stress episodes to meet their own hedging needs. In the same vein, Cheng, Kirilenko and Xiong (2014) show that financial traders unwind their long positions in commodity markets during crisis episodes and hence leave hedgers with more risk than they were supposed to hold.

Since index traders recently started to consider commodities as an investment style, they might actually exit them at the first place, when liquidity becomes scarce. Therefore, we propose to also an interaction term of CIT with the TED spread, which investigates whether index traders exit from the commodity market during liquidity crunches. Since financial institutions are believed to link commodity and equity markets (Basak & Pavlova, 2016), if they withdraw their funds from the commodity market, this potentially decreases financialization of commodities. Therefore, the co-movement is expected to decrease, amidst institutional investors' exit from commodity futures.

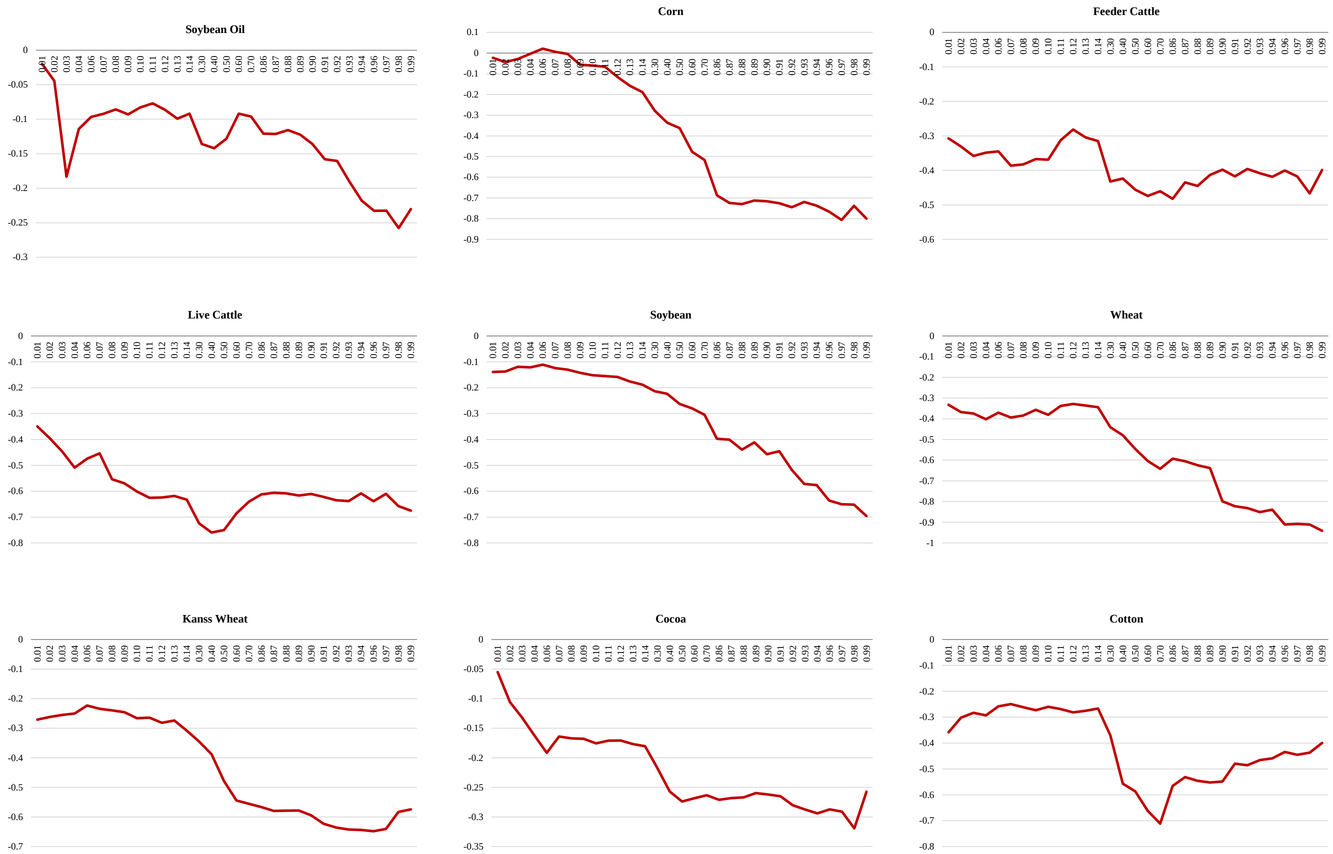

Figure 3.9 – Coefficient of interaction term at other deciles (CIT_TED)

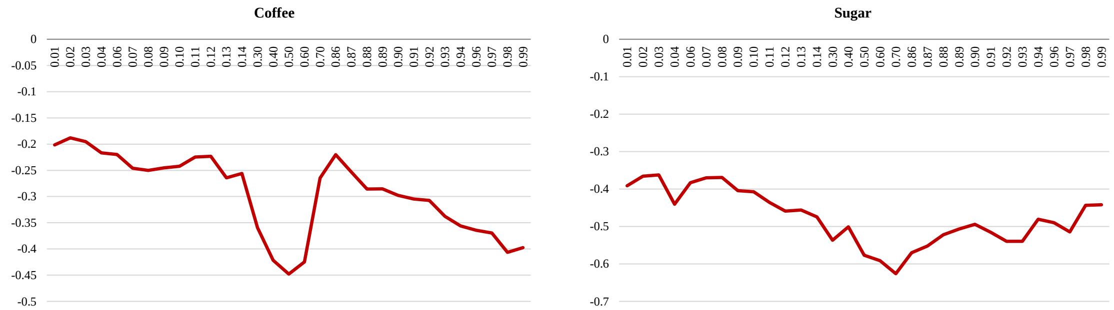

Figure 3.9 – Coefficient of interaction term at other deciles (CIT_TED) (cont'd)

Notes. Quantile regression results for various quantiles of CIT_TED. In each graph, y-axis shows the estimation results of CIT_TED coefficient and x-axis depicts the quantiles. As one can note that for all commodities, estimation results are significantly different between low, median and high quantiles. We examine how the explanatory power of CIT positions on co-movements changes during liquidity crunches.

Table 3.6 Panel A – Quantile regression results at low and high correlation states (with CIT)

	REA			**VIX**			**DEF**			**EM**			**BOND**			**USD**		
Deciles	**0.1**	**0.5**	**0.9**	**0.1**	**0.5**	**0.9**	**0.1**	**0.5**	**0.9**	**0.1**	**0.5**	**0.9**	**0.1**	**0.5**	**0.9**	**0.1**	**0.5**	**0.9**
Cocoa		0.11	0.20	0.14	0.15	0.17	0.51	0.36	0.30		-0.10	-0.21	0.52	0.44	0.40		-0.11	
Coffee	0.80	0.61	0.24		0.28	0.29	1.07	0.74	0.66				0.42	0.28	0.35		-0.17	-0.27
Corn	0.35	0.48	0.24		0.14	0.62	0.78	0.79	0.25	0.29	0.38	0.49	0.25	0.15	-0.32		-0.18	-0.36
Cotton	-0.22	-0.14		0.23	0.46	0.40	0.43	0.46	0.21	0.41	0.44	0.17	0.36	0.20	0.24	0.20		-0.10
Feeder Cattle		-0.22	-0.49	0.32	0.52	0.43		0.29	0.40	-0.13			0.26			-0.23	-0.42	-0.33
Kansas Wheat	0.30				0.18	0.79	0.87	0.98	0.80		0.35	0.50	0.20			-0.31	-0.78	-0.39
Live Cattle			-0.50	0.40	0.52	0.55	0.60	0.63	0.30	0.24	0.32		0.12		-0.48	-0.20	-0.47	-0.59
Soybean Oil		-0.18		0.30	0.14		0.56	0.56	0.44		-0.15	-0.19	0.24	0.16	0.23	-0.49	-0.80	-0.78
Soybeans	0.33					0.35	0.85	0.81	0.60				0.41	0.26			-0.40	-0.50
Sugar	-0.07		-0.17	0.29	0.24	0.37	0.48	0.69	0.32				0.47	0.31	0.23		-0.21	-0.20
Wheat	0.25					0.90	0.88	0.86	1.00		0.36	0.78		-0.14	-0.45	-0.45	-0.69	

Table 3.6 Panel A – Quantile regression results at low and high correlation states (with CIT) (cont’d)

	OIL			**CIT**			**CIT_TED**			**D1**		
Deciles	**0.1**	**0.5**	**0.9**	**0.1**	**0.5**	**0.9**	**0.1**	**0.5**	**0.9**	**0.1**	**0.5**	**0.9**
Cocoa	0.37	0.30	0.39	0.16	0.37	0.35	-0.18	-0.27	-0.26	-1.94	-1.03	-0.89
Coffee		0.15					-0.24	-0.45	-0.30	-1.63	-1.54	-0.97
Corn	-0.26	-0.31		0.12		-0.16		-0.36	-0.72	-1.42	-1.65	-1.00
Cotton	0.14	0.19	0.10				-0.26	-0.59	-0.55	-0.69	-0.93	-0.50
Feeder Cattle				0.35	0.21	0.26	-0.37	-0.46	-0.40	1.20		
Kansas Wheat		-0.35		0.15	0.20	0.17	-0.27	-0.48	-0.59	-1.42	-1.42	-1.59
Live Cattle		-0.13	-0.35	0.39	0.21	0.50	-0.60	-0.75	-0.61	-1.05	-1.12	-0.63
Soybean Oil	-0.39	-0.53	-0.70	0.24	0.23	0.32		-0.13	-0.14	-1.54	-1.14	
Soybeans	-0.26	-0.31	-0.28	0.30	0.44	0.37	-0.15	-0.26	-0.46	-1.71	-1.69	-1.04
Sugar	0.43	0.36	0.38		0.17		-0.41	-0.58	-0.49	-1.22	-1.59	-0.77
Wheat	-0.25	-0.46			0.20	0.35	-0.38	-0.55	-0.80	-1.03	-0.70	-0.93

Notes: Quantile regression results for low (0.1), normal (0.5) and high (0.9) correlation states, separately. Only statistically significant findings are presented.

Table 3.6 Panel B – Quantile regression results at low and high correlation states (with Lambda)

	REA			**VIX**			**DEF**			**EM**			**BOND**			**USD**		
Deciles	**0.1**	**0.5**	**0.9**	**0.1**	**0.5**	**0.9**	**0.1**	**0.5**	**0.9**	**0.1**	**0.5**	**0.9**	**0.1**	**0.5**	**0.9**	**0.1**	**0.5**	**0.9**
Cocoa	-0.09			0.10	0.17	0.10	0.47	0.30	0.25			-0.23	0.52	0.51	0.38	-0.20	-0.16	
Coffee	0.70	0.55	0.15		0.28	0.22	0.97	0.72	0.70			-0.10	0.49	0.30	0.32		-0.18	-0.23
Corn	0.41	0.30	0.32		0.15	0.58	0.77	0.92	0.50	0.31	0.47	0.40	0.30		-0.32		-0.35	-0.32
Cotton	-0.24	-0.31	-0.11	0.16	0.67	0.54	0.46	0.63	0.42	0.33	0.53	0.41	0.30		0.12	0.14		
Feeder Cattle			-0.55	0.32	0.57	0.71	0.42	0.33	0.51			0.35	0.36	0.14		-0.23	-0.36	-0.33
Kansas Wheat	0.10			0.09	0.07	0.14	0.13	0.10	0.16		0.11	0.10	0.06			0.16	0.08	0.16
Live Cattle	0.13	0.19	-0.32	0.40	0.53	1.05	0.74	0.67	0.27	0.33	0.39	0.59	0.14		-0.35	-0.30	-0.64	-0.74
Soybean Oil		-0.17	-0.18	0.32	0.20	0.27	0.69	0.62	0.62				0.34	0.20	0.21	-0.31	-0.63	-0.69
Soybeans				0.14	0.12	0.39	0.57	0.76	0.72	0.18	0.20	0.29	0.42	0.39			-0.30	-0.34
Sugar	-0.12	-0.12	-0.20	0.29	0.16	0.34	0.56	0.69	0.28	0.12			0.42	0.39	0.23		-0.13	-0.19
Wheat	0.20				0.14	0.90	0.83	0.90	0.88		0.33	0.90			-0.39	-0.55	-0.65	-0.25

Table 3.6 Panel B – Quantile regression results at low and high correlation states (with Lambda) (cont'd)

	OIL			LAMBDA			LAMBDA_TED			D1		
Deciles	**0.1**	**0.5**	**0.9**	**0.1**	**0.5**	**0.9**	**0.1**	**0.5**	**0.9**	**0.1**	**0.5**	**0.9**
Cocoa	0.35	0.30	0.51		0.21	0.26	-0.16	-0.28	-0.23	-1.86	-0.95	-0.75
Coffee				0.24	0.15	0.19	-0.18	-0.42	-0.26	-1.24	-1.42	-0.93
Corn	-0.28	-0.47			0.14			-0.36	-0.68	-1.35	-1.66	-1.64
Cotton	0.09	0.15	0.17		0.18	0.13	-0.27	-0.91	-0.69	-0.67	-1.24	
Feeder Cattle							-0.29	-0.56	-0.51			
Kansas Wheat		0.06			0.04		0.07	0.09	0.09	0.16	0.19	0.39
Live Cattle		-0.27	-0.43		-0.27	-0.19	-0.55	-0.58	-0.60	-1.20	-1.17	-0.83
Soybean Oil	-0.27	-0.43	-0.48	0.11	0.11	0.13	-0.21	-0.19	-0.27	-1.60	-1.33	
Soybeans	-0.23	-0.27		0.33		-0.26	-0.18	-0.40	-0.85	-1.46	-1.58	-1.18
Sugar	0.48	0.42	0.46		-0.06		-0.45	-0.38	-0.41	-1.36	-1.60	-0.75
Wheat	-0.29	-0.42			0.18	0.22	-0.34	-0.57	-0.65	-1.16	-0.83	-1.34

Notes: Quantile regression results for low (0.1), normal (0.5) and high (0.9) correlation states, separately. Only statistically significant findings are presented.

Our results imply that CITs do not share the risk of hedgers at volatile times, and especially during severe liquidity constraint episodes (Tables 3.4 and 3.5). Probably, during high liquidity episodes, financial institutions shift to other assets than they traditionally invest, since they have enough cash to invest in others. Bearing the advantages of commodities in mind, commodity futures market is one of the prominent candidates for investment. On the other hand, when the market is hesitant that there might be a liquidity crunch, either severe or mild; financial institutions exit from the commodity market right away. Therefore, the link between traditional financial asset and commodity markets got damaged and explanatory power of CIT positions on co-movement decreases significantly. To further understand the CIT behavior during stress episodes, we need to interpret decile findings.

Outcome for quantile regressions at each decile is consistent between commodities (Figure 3.7 and Table 3.5). We observe that the coefficient for the interaction term becomes even more negative at high correlation episodes. For instance, for wheat, coefficient for the 1^{st} decile is -0.27 and decreases up to -0.59 at the 9^{th} decile. Hence, one should definitely be watching for correlation level, the TED spread and whether correlation is already high or low and should decide CIT long positions have explanatory power, accordingly.

This finding implies that the explanatory power of CIT positions decrease when the financial sector experiences liquidity problems and decreases even more when the co-movement is already at high levels.

We also include an interaction term of lambda with TED and results are very much in line with previous findings. Coefficients for all these interaction terms are negative and these findings imply that the share of CITs in the derivatives market loses its explanatory power on co-movement levels, when TED spread is high. Moreover, coefficients for grains and softs groups display even more negative figures at high correlation states. This finding indicates that the explanatory power of λ decreases further at higher deciles of co-movement, and one should not rely on share of financial institutions when making portfolio allocation decisions.

3.5.4 Which factors are critical in explaining co-movement levels?

After showing that financialization is vital for explaining co-movement levels, we shall also examine whether other macroeconomic and financial control variables are statistically significant, as well.

Results for this section are available at Table 3.4 for median percentile and at Table 3.6 and 3.7 for low and high correlation states (0.1 and 0.9 percentiles).

3.5.4.1 Real economic activity (REA)

We expected real economic activity to have negative impact on co-movement, since correlations are found to be increasing during economic downturns (Forbes & Rigobon, 2002; Longin & Solnik, 2001; Creti et al., 2013). Furthermore, Buyuksahin and Robe (2014) and Bruno et al. (2016) include this variable in their studies to check the impact of economic activity on equity-commodity correlations. Both of studies find significantly negative coefficients implying economic slumps have bolstering effect on co-movements. Quantile regressions show that 7 of 11 commodities display negative coefficient at the median quantile and half of them are statistically significant. The remaining 5 commodities; live cattle, coffee, cocoa, corn and soybean, display positive coefficients of which 4 are statistically significant, with the exception of soybean. Even though the majority supports our hypothesis on increasing co-movement at economically bad times; we should dig into what drives the positive coefficient for those 4 commodities. Please also note that, Buyuksahin and Robe (2014) and Bruno et al (2016) investigate co-movement of aggregate indices with equities. Hence they could have ruled out individual commodity behavior.

Consistently positive coefficients for live cattle, coffee, cocoa, corn and soybean imply, co-movement of these agricultural commodities with equity weakens during economic slumps while strengthening in economic recoveries. corn and soybean are two major commodities in ethanol production and have gained further importance in energy production following biofuel policy changes (Nazlioglu & Soytas, 2012).

Urbanchuk (2014) find that the contribution of ethanol industry on US economy had been 44 billion USD. Hence, financial investors could prefer to invest in these commodities under higher economic activity, since use of energy increases at good states (Soytas & Sari, 2003). Therefore, corn and soybean could be more integrated with equity at prosperous economies. On the other hand, cocoa and coffee are two close substitutes and they are found to be co-integrated in the long run (Traore & Badolo, 2016). These commodities have respectively smaller shares in S&P GSCI index and average net long positions of CITs are 25 and 42 thousand contracts respectively, which are much lower compared to major agricultural commodities such as wheat, which has an average of 230 thousand contracts. Creti et al. (2013) study co-movement of each commodity with S&P500 and they also find coffee and cocoa displays separate behavior compared to other commodities. Unlike other commodities, the co-movement of coffee and cocoa with equities decrease during declining stock prices episodes. Creti et al. (2013) attribute this dissimilarity to speculative behavior, which is driven by profit-based rather than fundamental-based transactions. Even though authors do not clarify the issue further, their findings are in line with our findings of real economic activity. Since stock prices generally indicate a decreasing pattern during economic contraction periods, the positive coefficient for REA implies decreasing correlations at bad states.

Furthermore, deciles display crucial trends which should be covered. Please note that at low correlation states, the coefficient for REA for almost all commodities is either positive or low levels of negative, whereas at high correlation states, the impact of REA becomes increasingly negative. This finding indicates that when the correlation is already low, a decrease in economic activity also results in a decline or a slight increase in correlations. On the other hand, at high correlation states, a decrease in economic activity further bolsters the correlation between these two asset classes. Hence, if financialization has strengthened the link between commodity and equity markets in the beginning of 2000s, the decrease in economic activity could have carried correlation to further levels.

Also please note that by the time we have written this report, Kilian (2009) had provided REA index until December 2015. Therefore, we assumed the index to stay same till the end of the dataset, 22 February 2016 for the 8 observation points.

3.5.4.2 VIX

Basak and Pavlova (2016) indicate correlations are dependent upon states of the economy and also demand, supply shocks and aggregate output volatilities. Additionally, authors theoretically model stock market to be a claim against the output of the economy. Therefore, they state that aggregate output volatility can be proxied through VIX in the model since VIX is the implied volatility index of S&P500. Their results show that higher VIX results in higher correlations.

Our findings are in line with Basak and Pavlova (2016) that all commodities' co-movement with equity show positive response to increases in VIX. All commodities display statistically significant coefficients strong financial influences (Silvennoinen and Thorp, 2013; Cheng et al., 2014; Henderson et al., 2015). Furthermore, the integration of commodity and financial markets are further proven.

Quantile regression findings based on deciles depict that VIX has more positive impact on co-movement at higher correlation states. This implies that if correlations are already high, an increase in risk perception of investors further strengthens the integration between financial and commodity markets. This could be attributed to different asset classes being subject to same factor at stress periods (Forbes & Rigobon, 2002). Findings show that diversification benefit of commodities (Gorton & Rouwenhorst, 2006) could decrease when needed the most (Daskalaki & Skiadopoulos, 2011; Cheung & Miu, 2010; Silvennoinen & Thorp, 2013). Hence, investors should definitely follow the co-movement levels before giving any investment decisions.

3.5.4.3 Default premium (DEF)

Business cycles are critical for commodity co-movement trends. One of the key advantages of commodities lies in behavioral differences in early recession periods providing higher returns compared to equities and bonds (Bhardwaj et al., 2016).

Furthermore, the impact of business cycles on co-movements have been found to be significant (Alquist & Coibion, 2013; Bhardwaj & Dunsby, 2013; Bhardwaj et al., 2016). Even though there are multiple macroeconomic indicators available to measure the business cycle, literature has agreed upon default spread.

As we have expected, the coefficient for DEF is positive for all commodities and statistically significant for all of them. Kansas wheat presents highest coefficients for DEF indicating 1 S.D. increase in default spread leads to 0.86 S.D. increase in co-movements. The coefficient indicates that when the market gives a signal on a forthcoming recession, co-movement of all agricultural commodities with equity increases. Therefore a financial tension in the market observed through the increase in default spread puts further pressure on co-movement, as Bhardwaj et al (2016) and Bhardwaj and Dunsby (2013) have argued. Moreover, we observe that default spread is the most prominent factor between control variables, since its coefficient value is highest among all independent variables.

Furthermore, decile regressions provide almost stable figures at low and high correlations, implying business cycle is a crucial factor at all states.

3.5.4.4 JPM US Aggregate bond index (BOND)

Following Tang and Xiong (2012) we employ JPM US Aggregate Bond Index to proxy for macroeconomic environment. Such index includes not only government bonds but also corporate and municipal bonds and therefore shows the overall interest rate environment in the US.

Our results display consistently positive coefficients for BOND for 9 commodities and all show statistically significant results. This positive coefficient indicates that tight monetary policy feeds co-movement between commodity and equity markets. Since interest rate is critically important for financial markets and plays the anchoring role, statistical significance is no surprise. The remaining 3 commodities, Kansas wheat, wheat and live cattle, present negative coefficients but only wheat has a statistically significant coefficient. The coefficient for BOND is around 0.20 for significantly positive commodities (minimum is feeder cattle with 0.14 and maximum is cocoa with 0.51) implying 1 S.D. increase in bond index level increases the co-movement further by 0.20 S.D. and thus underlying macroeconomic information is a critical factor on correlations.

Decile results indicate additional findings. Visual investigation shows that at low correlations, macroeconomic environment has more positive impact on correlations. At high correlation states, the importance of macroeconomic environment decreases and even becomes negative. However, the statistical significance is lost at higher quantiles for commodities which portray a decreasing trend for BOND. Hence, it might not be highly robust to make interpretations.

3.5.4.5 Emerging markets index (EM)

Traditional view argues that commodity prices mainly increase due to either increasing demand or decreasing supply. Hence, this view attributes the increase in 2000s to growing emerging markets. Results indicate that 7 commodities display consistently positive coefficients and 5 of them are statistically significant. Therefore we can conclude that, generally, increasing demand from emerging markets has a positive impact on the commodity-equity co-movement. The remaining 4 commodities which are coffee, cocoa, soybean oil and soybean display negative coefficients for the first model and only cocoa and coffee are consistently negative between two models. The negative coefficient implies increasing emerging demand from emerging markets to decrease the co-movement. Actually, such a finding on EM is similar to REA, since both measure economic growth, the former for emerging markets, and the latter for world economy.

Quantile regression findings show almost constant impact of emerging markets across deciles for 7 of commodities. From the remaining 4, we observe that decile findings for corn, wheat, Kansas wheat and feeder cattle exhibit an increasing trend when moving from the first decile to the last decile. For instance the coefficient for the 1st decile is 0.08, whereas increases to 0.78 at the 10th decile, for wheat. Hence, one can state that at low correlation states, the impact of emerging market is much less pronounced. On the other hand, when the correlation is already high, a demand shock from emerging markets could further increase the correlation for these specific commodities.

3.5.4.6 USD index (USD)

Since commodity transactions are mainly settled in US Dollars, a structural change in the foreign exchange market could create further impact on commodity markets (Lombardi et al., 2012). As we have described in the Data section, a weak USD pushes commodity prices up for all groups of commodities. Therefore, we expect an appreciating US Dollar to have negative impact on co-movement since it decreases the demand for commodity transactions. Therefore, it can be said that the link between financial and commodity markets is partially broken.

Results are in line with expectations, such that we see negative coefficients for USD for all commodities. Therefore, an appreciating USD actually hinders the co-movement of equities with agricultural commodities, breaking the link between financial and commodity markets. We see that weakening USD affect co-movements of wheat, Kansas wheat and soybean oil the most, which have coefficients of around 0.70 implying a 1 S.D. decrease in US Dollar index, surges correlations 0.7 S.D. more. Furthermore, decile results indicate that an appreciating US Dollar has an even stronger impact at high correlation states compared to low correlation states for the majority of the commodities. For instance, coefficient for the 1st decile regression of sugar is 0.00, whereas the coefficient for the 10th decile is -0.20. This result implies appreciating USD does not change the co-movement of sugar with equities when the correlation is low, but has significantly negative impact at high correlation episodes. Therefore, we can say that valuing USD plays the calming role for intensely correlated markets.

3.5.4.7 Oil prices (OIL)

Oil is the major input for agricultural commodity production and moreover, changes in the biofuel policy have created another link between these two; oil and agricultural commodities (Nazlioglu & Soytas, 2012). Literature argues that OIL has a negative impact on agricultural commodity prices, the reason being either oil playing the major input role or it being a close substitute.

Findings depict that the coefficient of OIL for grains and livestock are negative, as expected, which implies that increasing oil prices decreases the co-movement between equity and these commodities. For instance, 1 S.D. increase in OIL decreases co-movement of corn with equity by 0.3 S.D. implying increases in oil prices have a calming impact on co-movement. On the other hand, OIL is consistently positive for softs group, namely cocoa, cotton, sugar and coffee, indicating that an increase in oil prices positively affects the co-movement of softs with equities. Even though Silvennoinen and Thorp (2015) indicate the correlation of softs with oil is much weaker compared to grains, what drives the positive coefficient is a subject of a future study.

Quantile regression results for grains display a U shape indicating the impact of oil prices on co-movement is lower at high and low correlation states. Findings for livestock group, on the other hand, show oil decreases the co-movement at high correlation states more compared to low correlation states.

3.5.4.8 Global Financial Crisis dummy (D1)

The dummy variable takes the value of 1 for observations between December 2007 and June 2009 and 0, otherwise. Since previous papers argue that financial distress periods can also increase correlations, we control the impact of the Global Financial Crisis via this variable. On the other hand, a visual analysis of Figure 2.6 shows that correlations, in fact, decreased during the crisis and increased later. The interpretation of dummy indicates that during Global Financial Crisis period, for instance the co-movement of corn decreases by 1.65 S.D.

Results support the visual analysis and the coefficient is highly significant and negative for all commodity-equity pairs, except feeder cattle, indicating that the GFC did not increase but actually decreased correlations. This finding is in line with the results on interaction term, since during Global Finance Crisis, there was a severe liquidity constraint. Therefore, index traders which link commodity and equity markets prior to the turmoil exit from the market during crisis and hence correlations decreased. Therefore, our hypothesis on financialization is further evidenced since co-movements display an increasing trend before and after the financial turmoil, but not during.

3.6 Conclusion

Over the last decade, the behavior of commodities has structurally changed. Commodity prices experienced a boom and bust, followed by abnormally high volatilities around 2008. Furthermore, the linkage between equity and commodity markets seems to get strengthened, since co-movements attained historically high figures around 2008. Since commodities are the lifeblood of economies, either being an input or output; academics, market participants, and policy-makers have sought the answer for these sharp changes in the market. In parallel times, commodity futures market participants have also experienced a structural change. A new group of market participants, CITs have become a major holder of commodity futures. The hypothesis indicating there is a relationship between the increasing presence of institutional investors and bolstering co-movements of commodities with traditional financial assets is termed as the financialization of commodities. Since the financialization literature is recently growing, most studies focus majorly on energy commodities and especially crude oil (e.g., Singleton, 2014) or the aggregated indices such as S&P GSCI (Buyuksahin & Robe, 2014). On the other hand, agricultural commodities have significant policy-making implications, since food is the major consumption item of households (World Bank, 2014). Furthermore, aggregated indices might overshadow the behavior of individual commodities, and hence employing separate models for each commodity sheds further light on the financialization phenomenon.

We employ the QR method to investigate whether financialization bolsters co-movements and examine how the explanatory power of CIT positions changes with liquidity constraints. To disentangle the impact of financialization, we control for potential factors which have been discussed in previous studies, such as business cycle (Bhardwaj et al., 2015), VIX (Silvennoinen & Thorp, 2013) and USD (Tang & Xiong, 2012). Our findings propose that financialization is a valid phenomenon for commodity market, though it is highly dependent upon the liquidity availability in the market. Buyuksahin and Robe (2014) find that hedge funds exit from the commodity market at financial stress episodes, and therefore the linkage between commodity and equity markets breaks down, but they do not find similar results for CITs. Contrary to Buyuksahin and Robe (2014), we find that CITs exit from commodities market during liquidity crunches, and thus the explanatory power of their positions decreases significantly. Therefore, we find that the critical condition for financialization to occur is the availability of high amount of cash in the market. We also find that the default spread, which proxies for the business cycle, has a very significant impact on co-movements. Therefore, not only the financialization or business cycle arguments are explanatory for the increasing co-movements around 2008, but also both are equally crucial.

Furthermore, we find that VIX bolsters co-movements, though, unlike previous evidence on increasing correlations during the economic turmoil (e.g., Forbes & Rigobon, 2002), we find that the dummy for GFC indicates the co-movements decrease significantly at that particular period. This finding is also in line with the liquidity argument that low liquidity is a significant obstacle inhibiting financialization to occur. Given the prominent tapering strategies of the Federal Reserve Bank and European Central Bank in the last decade, one might further investigate whether these strategies of central banks has impacts on the co-movements of asset classes.

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APPENDICES

A. SUPPLEMENTARY TABLES

Table A.1 – Sample multicollinearity table

	Coefficient Variance	Uncentered VIF	Centered VIF
REA	0.00	5.00	5.00
VIX	0.00	4.75	4.75
TED	0.09	116.52	116.52
DEF	0.01	8.80	8.80
EM	0.00	3.60	3.60
BOND	0.00	4.01	4.01
USD	0.00	5.65	5.65
OIL	0.00	4.94	4.94
D1	0.03	5.76	4.91
CIT	0.00	3.31	3.31
CIT_TED	0.08	104.80	104.80

Table A.2 Panel A – Descriptive statistics for return level

	Energy							Industrial Metals					Precious Metals		
	Biofuel	Crude oil	Gas oil	Heating oil	Natural gas	Petrol.	Unleaded gs	Alum.	Copper	Lead	Nickel	Zinc	Gold	Plati.	Silver
Mean	0.000140	0.000124	0.000311	0.000143	-0.000028	0.000135	0.000156	0.000001	0.000153	0.000177	0.000055	0.000125	0.000240	0.000190	0.000242
Median	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum	0.08	0.13	0.11	0.10	0.19	0.12	0.13	0.06	0.12	0.13	0.13	0.10	0.09	0.08	0.12
Minimum	-0.08	-0.17	-0.14	-0.14	-0.17	-0.15	-0.13	-0.08	-0.10	-0.13	-0.18	-0.12	-0.10	-0.09	-0.19
Std. Dev.	0.01	0.02	0.02	0.02	0.03	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.02
Skewness	-0.07	-0.19	-0.08	-0.07	0.09	-0.18	-0.19	-0.23	-0.11	-0.20	-0.13	-0.20	-0.10	-0.41	-0.82
Kurtosis	5.68	6.32	5.62	5.20	5.26	6.13	5.38	5.66	7.65	7.09	6.89	6.75	9.51	6.82	10.56
Jarque-Bera	1,520	2,353	1,302	1,027	1,087	2,094	1,223	1,539	4,571	3,558	3,213	3,010	8,968	3,218	12,623
Probability	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Observations	5067	5067	4542	5067	5067	5067	5067	5067	5067	5067	5067	5067	5067	5067	5067

	Agriculture and Livestock										
	Cocoa	Coffee	Corn	Cotton	Lean hogs	Live cattle	Orange juice	Soybean	Soybean oil	Sugar	Wheat
Mean	0.000156	0.000017	0.000095	-0.000032	0.000016	0.000117	0.000101	0.000098	0.000154	0.000105	0.000052
Median	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum	0.10	0.21	0.09	0.09	0.07	0.05	0.15	0.07	0.08	0.09	0.09
Minimum	-0.10	-0.16	-0.08	-0.07	-0.08	-0.06	-0.14	-0.07	-0.07	-0.12	-0.10
Std. Dev.	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02
Skewness	-0.14	0.04	0.05	-0.03	0.02	-0.13	-0.10	-0.20	0.09	-0.21	0.07
Kurtosis	5.87	8.36	5.25	4.65	4.37	4.77	7.78	5.30	5.38	5.14	5.10
Jarque-Bera	1,750	6,063	1,070	574	399	674	4,338	1,151	703	1,005	936
Probability	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Observations	5067	5067	5067	5067	5067	5067	4542	5067	2975	5067	5067

Table A.2 Panel B – Collinearity matrix for return level

		Energy							Industrial Metals					Precious Metals		
		Biofuel	Crude oil	Gas oil	Heating oil	Natural gas	Petroleum	Unleaded gs	Aluminum	Copper	Lead	Nickel	Zinc	Gold	Platinum	Silver
Energy	Biofuel	1.00														
	Crude oil	0.40	1.00													
	Gas oil	0.28	0.62	1.00												
	Heating oil	0.37	0.89	0.70	1.00											
	Natural gas	0.18	0.26	0.17	0.29	1.00										
	Petroleum	0.40	0.98	0.70	0.94	0.27	1.00									
	Unleaded gs	0.35	0.84	0.58	0.85	0.24	0.89	1.00								
Industrial Metals	Aluminum	0.32	0.38	0.34	0.34	0.12	0.38	0.32	1.00							
	Copper	0.36	0.43	0.39	0.39	0.11	0.43	0.37	0.70	1.00						
	Lead	0.28	0.33	0.33	0.30	0.07	0.34	0.29	0.59	0.66	1.00					
	Nickel	0.29	0.34	0.30	0.30	0.07	0.34	0.30	0.54	0.63	0.54	1.00				
	Zinc	0.29	0.33	0.33	0.31	0.07	0.34	0.29	0.69	0.75	0.69	0.59	1.00			
Precious Metals	Gold	0.25	0.27	0.23	0.25	0.07	0.28	0.24	0.32	0.36	0.28	0.25	0.32	1.00		
	Platinum	0.32	0.34	0.33	0.33	0.10	0.36	0.31	0.41	0.44	0.38	0.33	0.39	0.66	1.00	
	Silver	0.33	0.34	0.31	0.32	0.10	0.35	0.30	0.39	0.45	0.35	0.32	0.40	0.81	0.66	1.00
Agriculture and Livestock	Cocoa	0.24	0.23	0.21	0.20	0.09	0.23	0.19	0.23	0.25	0.20	0.19	0.21	0.21	0.25	0.24
	Coffee	0.32	0.23	0.19	0.22	0.09	0.23	0.19	0.20	0.22	0.17	0.19	0.20	0.18	0.23	0.24
	Corn	0.79	0.29	0.20	0.27	0.15	0.29	0.26	0.24	0.25	0.18	0.21	0.21	0.20	0.23	0.25
	Cotton	0.38	0.26	0.22	0.25	0.07	0.27	0.23	0.23	0.27	0.21	0.22	0.21	0.16	0.23	0.22
	Lean hogs	0.09	0.13	0.07	0.11	0.04	0.12	0.11	0.08	0.09	0.10	0.08	0.10	0.04	0.07	0.06
	Live cattle	0.20	0.19	0.13	0.16	0.07	0.19	0.14	0.15	0.17	0.11	0.12	0.13	0.05	0.12	0.11
	Orange juice	0.10	0.10	0.08	0.08	0.06	0.09	0.08	0.11	0.10	0.09	0.11	0.10	0.05	0.10	0.10
	Soybean	0.67	0.35	0.26	0.35	0.15	0.36	0.32	0.28	0.32	0.24	0.25	0.25	0.21	0.28	0.30
	Sugar	0.73	0.25	0.18	0.22	0.11	0.25	0.20	0.22	0.26	0.21	0.21	0.21	0.15	0.21	0.20
	Wheat	0.65	0.25	0.15	0.24	0.11	0.25	0.22	0.20	0.24	0.17	0.19	0.19	0.18	0.21	0.22
US Stocks	S&P500	0.22	0.34	0.21	0.30	0.07	0.34	0.29	0.26	0.31	0.25	0.24	0.23	0.01	0.19	0.13

Table A.2 Panel B – Collinearity matrix for return level (cont'd)

		Agriculture and Livestock										US Stocks
		Cocoa	Coffee	Corn	Cotton	Lean hogs	Live cattle	Orange juice	Soybean	Sugar	Wheat	S&P500
Agriculture and Livestock	Cocoa	1.00										
	Coffee	0.22	1.00									
	Corn	0.16	0.22	1.00								
	Cotton	0.18	0.20	0.30	1.00							
	Lean hogs	0.06	0.09	0.08	0.06	1.00						
	Live cattle	0.10	0.13	0.16	0.14	0.30	1.00					
	Orange juice	0.06	0.06	0.06	0.09	0.06	0.08	1.00				
	Soybean	0.20	0.23	0.65	0.33	0.08	0.16	0.12	1.00			
	Sugar	0.20	0.27	0.26	0.26	0.05	0.13	0.07	0.25	1.00		
	Wheat	0.16	0.22	0.66	0.28	0.10	0.15	0.03	0.51	0.23	1.00	
US Stocks	S&P500	0.17	0.15	0.16	0.21	0.05	0.17	0.09	0.18	0.14	0.15	1.00

Table A.3 Panel A – Spillover from stocks to commodity

		H=10 days		H=21 days		H=63 days		H=126 days		H=252 days	
		Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.
Energy	Biofuel	0.4	2.5	0.4	4.2	0.3	7.3	0.3	9.6	0.3	10.9
	Crude Oil	1.7	8.0	1.6	10.7	1.3	16.1	1.4	20.4	1.4	22.9
	Gas Oil	3.8	4.3	3.5	5.9	2.6	9.7	2.8	13.5	2.9	16.9
	Heating Oil	2.3	5.6	3.0	7.3	3.8	10.1	4.1	12.6	4.1	14.7
	Natural Gas	0.3	0.1	0.6	0.1	3.9	1.2	5.4	2.7	5.4	3.4
	Petroleum	2.2	7.9	2.1	10.2	1.6	14.5	1.6	18.0	1.6	20.4
	Unleaded Gas	1.3	4.8	1.2	6.4	0.8	9.0	0.7	11.2	0.7	13.0
Industrial Metals	Aluminum	0.8	4.4	0.6	6.7	0.3	14.3	0.4	21.4	0.4	25.4
	Copper	0.4	6.4	0.4	10.6	1.0	20.1	1.3	27.7	1.3	32.0
	Lead	0.2	4.5	0.5	6.2	0.7	9.8	0.8	12.7	0.8	14.8
	Nickel	0.2	3.2	0.4	5.6	3.6	11.7	4.6	16.8	4.7	19.4
	Zinc	0.0	4.4	0.4	6.4	2.6	9.5	4.4	12.0	4.4	14.0
Precious Metals	Gold	0.4	8.3	0.3	11.7	0.3	18.7	0.3	23.5	0.3	25.5
	Platinum	0.1	6.1	0.1	9.7	0.4	16.6	0.6	21.2	0.6	22.9
	Silver	0.4	4.8	0.2	6.7	0.6	11.5	1.1	15.4	1.3	17.0
Agriculture and Livestock	Cocoa	0.2	1.1	0.6	2.8	1.1	11.0	1.3	20.5	1.3	27.1
	Coffee	0.1	0.5	0.1	0.6	0.1	0.8	0.1	1.0	0.1	1.0
	Corn	0.8	0.6	0.9	1.3	0.7	3.3	0.9	4.8	0.9	5.3
	Cotton	0.2	2.5	0.3	3.3	0.1	4.0	0.1	4.3	0.1	4.6
	Lean Hogs	0.1	1.3	0.1	2.5	0.6	4.9	1.1	6.1	1.1	6.3
	Live Cattle	0.2	1.8	0.6	3.4	2.7	6.7	4.4	6.7	5.1	11.8
	OJ	0.1	0.3	0.1	0.3	0.2	0.2	0.2	0.2	0.2	0.2
	Soybeans	0.0	1.0	0.4	1.7	2.4	2.8	3.4	3.7	3.5	4.0
	Sugar	0.5	2.2	0.3	3.1	0.4	4.9	0.8	6.5	1.1	8.0
	Wheat	0.2	1.1	0.7	1.8	3.1	3.6	4.6	5.2	4.9	6.2

Table A.3 Panel B – Spillover from commodity to stocks

	H=10 days		H=21 days		H=63 days		H=126 days		H=252 days	
	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.
Biofuel	0.1	0.2	0.6	0.7	3.7	5.3	5.2	11.7	5.3	15.8
Crude Oil	0.4	7.0	0.3	7.9	0.4	10.7	0.5	13.5	0.5	15.4
Gas Oil	1.5	2.7	1.2	2.9	3.1	3.5	5.6	4.3	6.1	5.1
Heating Oil	0.2	3.4	0.1	3.6	0.3	4.5	0.5	5.8	0.6	7.1
Natural Gas	0.5	0.0	0.3	0.0	0.5	0.0	0.6	0.0	0.7	0.0
Petroleum	0.4	6.5	0.3	7.0	0.6	9.2	0.9	11.7	0.9	13.9
Unleaded Gas	0.4	5.2	0.4	5.7	0.3	7.4	0.3	9.3	0.3	11.1
Aluminum	0.1	3.3	0.2	3.7	3.1	3.6	5.1	3.5	5.4	3.4
Copper	0.5	3.5	0.4	4.1	3.3	5.2	5.7	6.0	6.0	6.5
Lead	0.1	1.8	0.4	2.5	6.3	6.3	12.2	11.9	14.0	18.6
Nickel	0.1	2.7	0.1	3.3	0.5	5.9	0.6	8.4	0.6	9.8
Zinc	.3	1.6	0.3	2.1	0.7	3.9	0.9	6.6	0.9	10.1
Gold	2.6	3.8	2.1	4.1	1.7	5.3	1.7	6.3	1.7	6.8
Platinum	0.1	4.1	0.2	5.9	0.2	9.6	0.2	12.2	0.2	13.2
Silver	0.5	2.5	0.4	3.0	2.5	5.2	5.3	7.1	6.5	7.9
Cocoa	0.6	0.0	1.4	0.1	2.2	0.3	2.5	0.8	2.6	1.2
Coffee	0.2	0.2	0.6	0.2	1.5	1.3	1.7	2.3	1.7	2.6
Corn	0.1	0.2	0.1	1.4	0.4	8.0	0.6	13.4	0.6	15.2
Cotton	0.1	1.2	0.1	2.0	0.8	3.9	1.7	6.4	2.4	8.8
Lean Hogs	0.4	0.5	0.9	1.0	2.3	1.7	2.9	2.0	3.0	2.1
Live Cattle	0.1	0.7	0.1	1.0	0.3	1.3	0.8	1.3	1.1	1.6
OJ	1.0	0.1	0.7	0.2	3.7	0.8	5.7	1.5	5.8	1.9
Soybeans	0.2	0.6	0.1	1.4	0.6	3.9	1.0	6.1	1.0	7.1
Sugar	0.1	0.1	0.1	0.0	1.1	0.4	3.0	2.0	5.0	5.0
Wheat	0.0	0.6	0.0	2.1	0.4	10.2	0.8	19.7	0.9	25.6

Table A.4 Panel A – Volatility spillover results at H=10 days (1997 – 2008; 2008 – 2016)

		Spillover Index		Spillover from Equity to Commodity		Spillover from Commodity to Equity		Net Connectedness	
		Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.
Energy	Biofuel	0.3%	1.5%	0.41	2.93	0.13	0.15	0.28	2.78
	Crude Oil	1.1%	11.1%	1.41	12.29	0.78	9.95	0.63	2.34
	Gas Oil	2.2%	4.8%	2.58	6.30	1.74	3.31	0.84	2.99
	Heating Oil	0.7%	7.6%	1.06	10.21	0.26	5.04	0.80	5.17
	Natural Gas	0.2%	0.1%	0.10	0.17	0.30	0.03	-0.20	0.14
	Petroleum	1.2%	10.4%	1.61	12.08	0.84	8.67	0.77	3.41
	Unleaded Gas	0.6%	8.1%	0.54	9.29	0.65	6.83	-0.11	2.46
Industrial Metals	Aluminum	0.6%	6.5%	0.76	7.72	0.36	5.25	0.40	2.47
	Copper	0.4%	9.8%	0.39	11.41	0.33	8.13	0.06	3.28
	Lead	0.1%	5.7%	0.18	7.91	0.07	3.54	0.11	4.37
	Nickel	0.1%	6.6%	0.08	6.67	0.06	6.58	0.02	0.09
	Zinc	0.0%	6.3%	0.02	9.71	0.07	2.91	-0.05	6.80
Precious Metals	Gold	1.5%	6.4%	1.50	7.42	1.53	5.44	-0.03	1.98
	Silver	0.8%	5.5%	1.36	4.50	0.16	6.57	1.20	-2.07
	Platinum	0.3%	7.9%	0.53	7.82	0.16	7.90	0.37	-0.08
Agriculture and Livestock	Cocoa	0.3%	1.2%	0.37	2.06	0.23	0.25	0.14	1.81
	Coffee	0.1%	0.8%	0.04	0.99	0.08	0.52	-0.04	0.47
	Corn	0.3%	0.4%	0.49	0.53	0.13	0.33	0.36	0.20
	Cotton	0.3%	1.3%	0.21	1.65	0.35	0.95	-0.14	0.70
	Lean Hogs	0.9%	0.3%	0.83	0.39	0.96	0.12	-0.13	0.27
	Live Cattle	0.1%	2.2%	0.07	2.75	0.04	1.55	0.03	1.20
	OJ	0.3%	0.2%	0.10	0.40	0.59	0.01	-0.49	0.39
	Soybeans	0.1%	1.3%	0.12	0.97	0.11	1.59	0.01	-0.62
	Sugar	0.8%	0.8%	1.57	1.54	0.12	0.04	1.45	1.50
	Wheat	0.2%	0.8%	0.39	0.70	0.05	0.99	0.34	-0.29

Table A.4 Panel B – Volatility spillover results at H=21 days (1997 – 2008; 2008 – 2016)

		Spillover Index		Spillover from Equity to Commodity		Spillover from Commodity to Equity		Net Connectedness	
		Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.
Energy	Biofuel	0.2%	2.5%	0.32	4.48	0.08	0.60	0.24	3.88
	Crude Oil	1.2%	13.4%	1.66	15.81	0.82	10.96	0.84	4.85
	Gas Oil	2.1%	6.3%	2.66	9.04	1.59	3.65	1.07	5.39
	Heating Oil	0.6%	9.8%	1.09	13.99	0.16	5.51	0.93	8.48
	Natural Gas	0.1%	0.2%	0.12	0.32	0.17	0.03	-0.05	0.29
	Petroleum	1.3%	12.5%	1.72	15.71	0.80	9.36	0.92	6.35
	Unleaded Gas	0.4%	10.4%	0.34	13.15	0.48	7.68	-0.14	5.47
Industrial Metals	Aluminum	0.4%	9.3%	0.48	12.10	0.24	6.44	0.24	5.66
	Copper	0.2%	15.2%	0.22	19.95	0.22	10.36	0.00	9.59
	Lead	0.1%	8.3%	0.10	12.25	0.06	4.31	0.04	7.94
	Nickel	0.1%	10.4%	0.05	12.35	0.17	8.38	-0.12	3.97
	Zinc	0.1%	9.3%	0.09	15.02	0.10	3.61	-0.01	11.41
Precious Metals	Gold	1.3%	8.4%	1.41	10.84	1.10	5.90	0.31	4.94
	Silver	0.7%	7.1%	1.02	5.90	0.29	8.26	0.73	-2.36
	Platinum	0.7%	11.5%	1.06	13.12	0.26	9.78	0.80	3.34
Agriculture and Livestock	Cocoa	0.8%	2.3%	1.03	4.09	0.55	0.42	0.48	3.67
	Coffee	0.1%	0.7%	0.12	1.04	0.09	0.31	0.03	0.73
	Corn	0.3%	1.5%	0.42	1.10	0.19	1.86	0.23	-0.76
	Cotton	0.3%	1.9%	0.23	1.81	0.31	1.95	-0.08	-0.14
	Lean Hogs	1.6%	0.5%	1.59	0.54	1.57	0.41	0.02	0.13
	Live Cattle	0.0%	3.5%	0.05	4.34	0.04	2.57	0.01	1.77
	OJ	0.2%	0.1%	0.07	0.26	0.40	0.01	-0.33	0.25
	Soybeans	0.1%	2.4%	0.09	1.67	0.10	3.21	-0.01	-1.54
	Sugar	1.0%	1.1%	1.92	2.16	0.08	0.04	1.84	2.12
	Wheat	0.3%	1.7%	0.51	0.79	0.03	2.51	0.48	-1.72

Table A.4 Panel C – Volatility spillover results at H=126 days (1997 – 2008; 2008 – 2016)

		Spillover Index		Spillover from Equity to Commodity		Spillover from Commodity to Equity		Net Connectedness	
		Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.
Energy	Biofuel	0.9%	10.4%	1.55	9.23	0.18	11.48	1.37	-2.25
	Crude Oil	2.0%	21.9%	2.63	25.99	1.45	17.82	1.18	8.17
	Gas Oil	2.1%	14.5%	2.11	20.56	2.13	8.49	-0.02	12.07
	Heating Oil	0.7%	17.7%	1.08	24.50	0.26	10.80	0.82	13.70
	Natural Gas	1.5%	4.1%	2.88	7.00	0.09	1.12	2.79	5.88
	Petroleum	1.3%	21.0%	1.90	26.12	0.78	15.92	1.12	10.20
	Unleaded Gas	1.4%	19.8%	1.84	22.94	0.93	16.63	0.91	6.31
Industrial Metals	Aluminum	4.0%	22.5%	1.09	35.87	6.83	9.04	-5.74	26.83
	Copper	4.5%	31.6%	1.97	45.83	6.96	17.44	-4.99	28.39
	Lead	2.1%	20.2%	0.46	28.64	3.80	11.80	-3.34	16.84
	Nickel	1.6%	27.1%	0.49	37.38	2.80	16.87	-2.31	20.51
	Zinc	2.7%	19.2%	3.71	29.04	1.71	9.26	2.00	19.78
Precious Metals	Gold	1.3%	18.4%	1.11	28.35	1.46	8.49	-0.35	19.86
	Silver	4.4%	16.5%	1.21	16.07	7.59	16.90	-6.38	-0.83
	Platinum	2.3%	24.5%	3.96	34.49	0.64	14.48	3.32	20.01
Agriculture and Livestock	Cocoa	4.4%	13.6%	6.98	24.32	1.82	2.91	5.16	21.41
	Coffee	1.2%	1.6%	2.26	1.40	0.06	1.72	2.20	-0.32
	Corn	1.1%	10.1%	2.12	4.42	0.17	15.85	1.95	-11.43
	Cotton	0.3%	5.6%	0.32	2.19	0.24	9.10	0.08	-6.91
	Lean Hogs	4.5%	3.7%	6.31	3.58	2.59	3.87	3.72	-0.29
	Live Cattle	1.8%	9.1%	0.66	8.52	2.97	9.63	-2.31	-1.11
	OJ	1.4%	0.3%	0.81	0.37	1.89	0.28	-1.08	0.09
	Soybeans	1.2%	6.7%	2.17	5.65	0.18	7.73	1.99	-2.08
	Sugar	1.8%	3.4%	2.52	3.52	1.17	3.37	1.35	0.15
	Wheat	1.0%	10.2%	1.64	1.30	0.28	19.07	1.36	-17.77

Table A.4 Panel D – Volatility spillover results at H=252 days (1997 – 2008; 2008 – 2016)

		Spillover Index		Spillover from Equity to Commodity		Spillover from Commodity to Equity		Net Connectedness	
		Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.	Pre-Fin.	Post-Fin.
Energy	Biofuel	1.3%	13.4%	2.31	10.35	0.24	16.47	2.07	-6.12
	Crude Oil	2.1%	24.2%	2.70	28.31	1.52	20.14	1.18	8.17
	Gas Oil	2.7%	18.1%	2.09	24.33	3.22	11.86	-1.13	12.47
	Heating Oil	0.7%	20.7%	1.08	27.48	0.36	13.89	0.72	13.59
	Natural Gas	1.7%	5.1%	3.35	8.82	0.09	1.45	3.26	7.37
	Petroleum	1.3%	23.7%	1.91	28.72	0.78	18.77	1.13	9.95
	Unleaded Gas	1.8%	23.0%	2.44	25.23	1.24	20.76	1.20	4.47
Industrial Metals	Aluminum	7.0%	25.1%	1.78	40.62	12.13	9.52	-10.35	31.10
	Copper	7.4%	33.8%	3.00	48.90	11.71	18.74	-8.71	30.16
	Lead	4.8%	24.3%	0.73	32.50	8.89	16.18	-8.16	16.32
	Nickel	2.1%	29.1%	0.64	40.13	3.52	18.04	-2.88	22.09
	Zinc	4.7%	22.6%	5.98	32.51	3.33	12.59	2.65	19.92
Precious Metals	Gold	1.6%	19.7%	1.34	30.54	1.92	8.82	-0.58	21.72
	Silver	6.8%	18.2%	1.91	17.94	11.63	18.43	-9.72	-0.49
	Platinum	2.6%	25.6%	4.55	36.25	0.70	14.85	3.85	21.40
Agriculture and Livestock	Cocoa	5.3%	18.0%	8.58	31.40	2.09	4.55	6.49	26.85
	Coffee	1.3%	1.7%	2.53	1.42	0.06	2.02	2.47	-0.60
	Corn	1.5%	11.4%	2.73	4.91	0.17	17.96	2.56	-13.05
	Cotton	0.3%	8.2%	0.35	2.31	0.24	14.00	0.11	-11.69
	Lean Hogs	4.7%	4.1%	6.77	4.00	2.65	4.28	4.12	-0.28
	Live Cattle	2.8%	11.3%	0.94	9.68	4.56	12.95	-3.62	-3.27
	OJ	1.8%	0.5%	1.05	0.57	2.51	0.42	-1.46	0.15
	Soybeans	1.6%	7.3%	2.88	6.30	0.24	8.32	2.64	-2.02
	Sugar	2.6%	5.9%	2.68	3.96	2.45	7.79	0.23	-3.83
	Wheat	1.3%	13.4%	2.06	1.44	0.48	25.31	1.58	-23.87

B. TURKISH SUMMARY (TÜRKÇE ÖZET)

1. Giriş

Emtia türev piyasaları oyuncuları 2000'li yıllardan sonra çok ciddi bir değişim içine girmişlerdir. Önceki senelerde oyuncular ana olarak iki gruptan oluşmaktaydı: Spekülatörler ve emtia fiyat riskine karşı vadeli teslim piyasasında kontrat alıp satan kişi veya kurumlar. Ancak son on senede emtia endeks tacirleri (CIT) türev piyasaların çok önemli bir diğer oyuncusu oldu (CFTC, 2008). Aslında CIT'lar bilinen büyük finansal ve kurumsal yatırımcılardır ve performans kriterleri bilinen emtia endekslerinin (örn., S&P GSCI) getiri oranlarını geçmektir. Bu şekilde kurumsal yatırımcılara para yatıran küçük yatırımcının yatırımını ortalamadan daha iyi bir getiriye taşımayı amaçlarlar. Bunu yaparken de endeksleri oluşturan her bir emtiaya yatırım yaparak iyi bir getiri peşinde koşarlar.

Finansal yatırımcıların artan katılımının nedenleri, emtianın geleneksel finansal araçlara karşın riskin dağıtılmasına olanak sağlaması, enflasyona kaşın koruması ve erken resesyon ve geç büyüme dönemlerinde yüksek getiri sağlamasıdır (Gorton ve Rouwenhorst, 2006). Emtia türev piyasalarına olan yatırım tutarı 2003'de 15 milyar Amerikan Doları iken 2008'de 200 milyar Amerikan Doları'na yükselmiştir. Aynı zamanlarda emtia fiyatları ve oynaklıkları da tarihsel ortalamaların oldukça üstüne çıkmıştır. CIT'ların katılımı ile aynı zamanlara denk gelen emtia piyasasındaki değişiklikler politika-yapıcılar için ciddi bir endişe yaratmıştır. Pek çokları bu yatırımcıların emtia fiyatlarını arttırdığını öne sürerken (Masters, 2008; Singleton, 2013; Soros, 2008a, 2008b), kimileri de gelişen piyasalar tarafından gelen yüksek talebin fiyatları yukarı taşıdığını ileri sürmektedir. (Hamilton, 2009; Krugman, 2008). İlk grubun savı, kurumsal yatırımcıların son dönemde artan emtia yatırım iştahı ile birlikte "emtianın finansallaşması" olmuştur. Finansal kurumlar getiri üzerine yoğunlaştıkları için, başlıca politika yapıcılar bu kurumların emtia piyasası özelliklerini bozduklarını ileri sürmektedirler (de Schutter, 2010).

Finansallaşma hipotezi, emtia ve finansal pazarlar arasındaki bağlantının emtia türev piyasalarında artan kurumsal yatırım ile birlikte oldukça güçlendiğini savunmaktadır. Bahsi geçen bağlantı, oynaklık yayılımı ve korelasyon şeklinde olmaktadır (Adams ve Glück, 2015). Bu nedenle çalışmamızı ana olarak üç bölüme ayırmaktayız. Birinci bölümde türev piyasalarının spot fiyatları nasıl etkilediğini teorik olarak özetliyor, kurumsal yatırımcıların emtia dinamikleri üzerindeki tesirini literatürde geçen çalışmalar üzerinden inceliyoruz. İkinci bölümde 25 emtia ile ABD hisse senedi piyasası (S&P500) arasında oynaklık yayılımı analizi yapıp finansallaşma hipotezini test ediyoruz. Asıl olarak incelediğimiz soru ise finansalar piyasalardaki oynaklığın emtia piyasalarına taşınmasının CIT'lar ile birlikte sayısal anlamda artıp artmadığıdır. İkinci bölümde kurumsal yatırımcıların oldukça önem verdiği risk dağılımı konusunun temelini oluşturan korelasyonu inceliyoruz. Geleneksel anlamda emtia piyasası, finansal yatırım araçları piyasasından oldukça farklı olarak algılanmaktadır. Ancak; kurumsal yatırımcıların emtia türev piyasasına girmesi ile birlikte emtia piyasalarının faydalarını zamanla kaybettiğine inanılmaktadır. Bu nedenle 12 tarımsal emtia ile S&P500 arasında korelasyona bakacak ve bu korelasyonu hangi faktörlerin güçlendirdiğini inceleyeceğiz.

2. Birinci Bölüm

Emtia türev piyasaları ile spot piyasalar arasındaki bağıntıyı açıklayan esas olarak iki teorik model vardır. Birincisi Keynes'in (1930) öncülüğünü çektiği riskten korunma baskısı hipotezidir ve getirinin bugün kararlaştırılan vadeli kontrat fiyatı ile beklenen spot fiyat arasındaki farktan (risk primi) doğduğunu kabul eder. Bu nedenle de Keynes (1930) vadeli kontratta riski üstlenen kişinin alıcı olması nedeniyle risk priminin de alıcı hesabına geçmesini öngörür. Ancak bu hipotezin temeli normal dönüklük teorisinin, yani vadeli işlem fiyatlarının spot fiyatlardan düşük olması esasına dayanır. Normal dönüklük teorisini destekleyen ise fazla ampirik çalışma bulunmamaktadır (Chang, 1985; Miffre, 2016).

İkinci model ise emtia depolama teorisidir (Kaldor, 1939) ve spot ve vadeli kontrat fiyatları arasındaki farkın depolama ve finansman giderleri ile bağıntılı olduğunu ileri sürer. Deaton ve Laroque (1992, 1996) depolamanın daha az oynak ve pürüzsüz emtia fiyatları sağladığını iddia eder. Fama ve French (1988) ise benzer ilişkiyi ampirik olarak göstermiştir.

Literatür bu iki teorik modeli kullanarak işlemi uzatma (roll forward) stratejisi ile emtianın hisse senedi piyasasından bile daha iyi bir getiri kaynağı olduğunu göstermiştir (Gorton ve Rouwenhorst, 2006). Ancak finans araştırmacılarının emtia piyasalarına olan ilgisi 2000'lere kadar sınırlı kalmış (Erb ve Harvey, 2006), Gorton ve Rouwenhorst'un (2006) çalışması ile finansal yatırımcılar emtia piyasasına yükselen bir talep göstermişlerdir. Beklenen ve beklenmedik enflasyona karşı koruma kalkanı sağlaması, bono ve hisse senedi piyasaları yatırımcılarına risk dağılımı konusunda yardımcı olurken aynı zamanda yüksek getiri sağlaması emtianın ana ilgi çekici noktaları olmuştur. Hatta, resesyon başlangıcı ve büyüme dönemlerinin sonlarına doğru kısıtlı getiri sağlayan geleneksel finansal yatırım araçlarına karşın bu dönemlerde oldukça iyi getiri sağlamaktadır (Gorton ve Rouwenhorst, 2006).

Dolayısıyla finansal kurumların emtia piyasasına olan iştahı artmış ve "emtianın finansallaşması" terimini literatüre kazandırmıştır. Teorik açıklamasını ise bilgimiz dahilinde yapan tek çalışma Başak ve Pavlova'nın (2016) çalışmasıdır. Yazarlar, kurumsal yatırımcıların performanslarının genelde bir göstergeye, genellikle iyi bilinen bir endekse göre karşılaştırıldığını söylemektedir. Kurumlarına olan sermaye akışı ise bahsi geçen endekse göre ne kadar başarı gösterdiklerine bağlı olduğu için göstergeyi olabildiğince geçmeye çalışırlar. Kurumlar hem hisse senedi hem de her bir endeks üyesi olan emtia türev piyasalarına yatırım yaptıkları için, beklenen endeks seviyesi ortak bir faktör haline gelir ve iki piyasa arasındaki korelasyonu güçlendirir. Ancak endeks üyesi olmayan emtia için bu sav geçerli değildir. Aynı şekilde endekse göre kötü performans sergileyen her bir emtia da finansallaşmayacaktır. Aynı zamanda finansallaşma ile birlikte endeks üyesi olan her bir emtia birbiri ile daha bağıntılı hale gelmektedir. Özellikle depolanabilir emtia için gelen arz veya talep şokları diğer endeks üyeleri emtiayı da etkileyecektir. Başak ve Pavlova (2016), emtianın dışarıdan gelen haberlere daha duyarlı olduğunu teorik olarak açıklarken, finansal piyasalarda oluşan şokların da emtia piyasasına daha kolay yayıldığını ifade etmektedir.

3. İkinci Bölüm

3.1. Giriş ve literatür özeti

Emtia piyasaları ekonomiler ve ekonomilerin büyümesi için oldukça önemlidir (Deaton ve Miller, 1996) ve bu nedenle emtia piyasasındaki istikrarın ya da istikrarsızlığın önemli sonuçları olabilir.

Kriz dönemlerinde çeşitli risklere karşı koruma sağlayan varlıklar finansal sistemin istikrarı ve dayanaklılığı için oldukça önemlidir (Baur ve Lucey, 2009). Hatta finansal düzenlemeler de asıl olarak riskin dağıtılması prensibi üzerine kurulur, nedeni de resesyon dönemlerinde kurumların iflasının önüne geçebilmektir. Gorton ve Rouwenhorst'un (2006) bahsettiği üzere emtia konjonktür dönemlerinde geleneksel finansal araçlardan farklı davranabilmektedir. Dolayısıyla da yatırımcıları aşağı yönlü risklerden korumakta, iflas ihtimalini düşürmektedir. Fakat, eğer kurumsal yatırımcılar sürekli olarak emtia ve hisse senedi piyasalarında al-sat yapıyorlarsa bu durum her iki pazarın birbirinin şokuna karşı daha duyarlı hale getirebilir (Tang ve Xiong, 2012). Biz de bu bölümde finansallaşma ile finansal şokların emtia piyasalarına yayılımının artıp artmadığını inceleyeceğiz.

Ayrıca yayılmanın korelasyon üzerinde iki önemli avantajı vardır. Birinci olarak korelasyon şoklara karşın ani düşüş ve yükseliş gösterebildiği için nedensellik bakımından yorumu biraz daha belirsizdir. Öte yandan yayılım analizinde hangi varlığın diğerini etkilediği daha açıktır. İkinci olarak da korelasyonda iki varlığın korelasyonu hangi varlığı önce dikkate alırsanız alın birbirine eşittir; fakat yayılım analizinde yön olgusu olduğu için eşit değildir.

Yayılım analizleri literatürde globalleşme ile öncelikle coğrafi bölgeler arasında incelendi (Hamao, Masulis ve Ng, 1990; Bekaert ve Harvey 1995). Özellikle Asya krizi, Latin Amerika krizi ve sonrasında da 2008'deki büyük kriz, farklı sonuçlar göstermekle birlikte bulaşıcılık literatürünü oldukça büyüttü.

İkinci olarak ise varlık grupları arasında bulaşıcılık analizleri yapıldı ve "emniyete uçuş" (flight-to-safety) literatürü olarak göze çarpmaya başladı. İlk başlarda bono piyasası daha çok güvenli liman olarak görülürken (Shiller ve Beltratti, 1992), sonraki senelerde gayrimenkul, altın ve petrol de dikkat çekmeye başladı (Baur ve Lucey, 2010). Ancak güvenli liman özelliklerinin zaman ve ülke seçimlerine göre oldukça değişkenlik gösterdiği de çalışmalarda vurgulanmaktadır.

Oynaklık açısından yayılım analizlerine baktığımızda hisse senedi piyasaları ile emtia piyasaları arasındaki çalışmaların daha çok petrol üzerinden yapılması petrolün ekonomiler üzerindeki önemi göz önüne alındığında şaşırtıcı değildir. Çeşitli ülkeler ile yapılan çalışmalarda oynaklık yayılımının kimileri için tek yönlü olarak hisse senedi piyasalarından petrole ya da tam tersi yönde; kimileri için ise çift yönlü olduğu gösterilmiştir (Malik ve Hammoudeh, 2007; Arouri ve ark., 2011; Bhar and Nikolova, 2009). Son zamanlarda değerli metaller, tarımsal emtia ve endüstriyel metallerin de hisse senedi piyasaları ile ilişkisi incelenmeye başlanmıştır (Mensi ve ark.,, 2013; Sadorsky, 2014). Ancak halen yapılan çalışmalar oldukça sınırlıdır ve her bir emtia piyasası bazında yapılmış çalışmalar oldukça kıttır.

3.2 Yöntem

Çalışma esas olarak iki basamaktan oluşmaktadır. Birinci basamakta finansallaşma döneminin ne zaman başladığını belirlerken, ikinci bölümde de oynaklık yayılma özelliklerinin finansallaşma öncesi ve sonrasında ne şekilde değiştiğini incelemekteyiz.

Finansallaşmanın başlangıcını belirlemek üzere literatürde ana iki yöntem vardır. Birincisi, önceki çalışmaları göz önüne alarak ihtiyari bir nokta seçmek, diğeri ise yapısal kırılma noktalarını belirleyen istatiksel metotları kullanmaktır. Biz her iki yöntemi de kullanmakla birlikte test sonuçlarının her ikisi ile de çok benzer çıkması nedeniyle bulgularımızı ihtiyari seçimimiz olan 2004 öncesi ve sonrası şeklinde sunduk.

Çalışmanın ikinci kısmında yöntem olarak Diebold ve Yılmaz'ın (2012) oldukça basit ve anlaşılması kolay olan yöntemini kullanacağız. Önceki çalışmalar daha çok GARCH bazlı testler yaptıkları için herhangi iki dönem arasındaki karşılaştırma istatiksel önem üzerinden yapılmıştır. Her iki dönemde de istatiksel önemli(siz)lik tespit edilmesi, dönemler arasında fark olmadığı ve bu nedenle de araştırmacıyı finansallaşmanın olmadığı sonucuna vardırabilir. Ancak biz Diebold ve Yılmaz'ın (2012) çalışmasını kullanarak yayılmayı nicel olarak da belirleyebilecek ve dönemler arasındaki farklılığı da analiz edebileceğiz.

Veriseti olarak 25 emtianın Datastream üzerinden elde edilen S&P GSCI spot endeks fiyatlarını kullanıyor, zaman aralığı olarak da 1 Ocak 1997 ve 6 Haziran 2016 arasını seçiyoruz.

Öncelikli olarak oynaklık için her bir emtia ve S&P500'ün GARCH (1,1)'ini hesaplıyor ve daha sonra her bir emtiayı S&P500 ile birer vektör otoregresif modele koyuyoruz. Sonrasında da genelleştirilmiş varyans ayrıştırma sonuçlarını çeşitli gün aralıkları (iş günü bazında yaptığımız için 10, 21, 63, 126 ve 252 gün) için elde ediyoruz. Sonuç olarak her bir emtianın S&P500'ün varyans açıklamasında (ya da tam tersi) ne kadar payı olduğunu öğreniyoruz. Örneğin Tablo 2.4'de alüminyum için 63 günlük sonuç tablosunu finansallaşma öncesi ve sonrası için görebilirsiniz.

Bu tablo bize hisse senedi piyasasının alüminyum varyansını açıklama gücünün finansallaşmadan önce %0.3 olduğunu, sonra ise bu sayının %14.3'e çıktığını görüyoruz. Öte yandan hangi varlığın diğerini etkilediğini görmek için net yayılımı hesaplamamız gerekmektedir. Bunun için her bir varlığın diğer varlığın varyansı üzerindeki etkisini birbirinden çıkarılarak bulunmaktadır. Örneğin alüminyum için net yayılma finansallaşmadan önce -2.71 iken (0.34-3.05), 2004 sonrasında 10.64'e (14.26-3.62) yükselmiştir. Sayının negatif olması yayılımın emtiadan hisse senedi piyasasına, pozitif olması ise hisse senedi piyasasından emtiaya yayılımın olduğunu göstermektedir. Tablo 2.4'ün sağ köşesinde yer alan sayı ise ortalama olarak her bir varlığın birbiri üzerindeki yayılım endeksini hesaplamaktadır.

Bu yöntem ile yayılmanın nicesel olarak artıp artmadığını, ortalama yayılma endeksini ve yayılmanın yönünü analiz edebileceğiz.

3.3. Bulgular

Gün aralığını seçerken sonuçlarımızın seçimimize duyarlılığını azaltmak için hem kısa, hem orta hem de uzun vadeli olarak sunduk. Ancak sonuçlarımızın yorumu asıl olarak üçer aylık dönemler (63 iş günü) bazında olan tablolardan gelecektir. Yatırım yapan kurumlar genel olarak portföylerini çok sık değiştirmedikleri için çalışmamızın amacına en çok uyan aralığın 63 gün olduğu kanısındayız.

Tablo 2.5 esas sonuçlarımızı finansallaşma öncesi ve sonrası olarak bütün emtia piyasaları için özetlemektedir ve oldukça önemli bulgular göze çarpmaktadır. Birinci olarak oynaklık yayılım endekslerinin portakal suyu ve doğalgaz dışındaki bütün emtia piyasaları için arttığını gözlemliyoruz. Finansallaşmadan önce endeks %0,3 ve %3,5 arasında seyrederken, finansal yatırımcıların emtia piyasasına katılımları ile birlikte %0,5 ve %13,4 aralığına yükselmiştir. 2004'ten önce düşük seyreden endeks bize emtia piyasasının risk dağılımında önemli bir rol oynadığını ve finansal piyasalara ilişkin aşağı yönlü riskten koruduğunu göstermiştir. Bu nedenle Gorton ve Rouwenhorst'un (2006) sonuçları ile benzerlik gösteren kısımları vardır. Ancak yatırımcıların emtia türev piyasasına artan iştahları ile birlikte finansal şoklara olan bağışıklıkları sorgulanabilir hale gelmiştir.

Diğer taraftan, doğalgaz ve portakal suyunun finansallaşmamış olmasının nedenini incelediğimizde, Başak ve Pavlova'nın (2016) modelinin bir cevabı olduğunu görüyoruz. Önceden de bahsettiğimiz gibi EET'ler endeks üyesi emtia piyasalarına yatırım yapmaktadırlar ve endeks üyelerinden de kendi performans göstergelerine göre daha iyi getiri sağlayanları seçmektedirler. Portakal suyu herhangi bilindik bir endeks üyesi emtia değildir; dolayısıyla finansallaşmaması teori ile uyumludur. Doğalgaz ise endeks üyesi olmakla birlikte karşılaştırmalı olarak gösterge endeksi ile bakıldığında (Figür 2.3) oldukça kötü performans sergilemiş olduğunu görebiliyoruz. Sonuç olarak Başak ve Pavlova'nın (2016) bahsettiği üzere bulgularımız finansal yatırımcıların endeks üyelerini ve bu üyelerden de en az kendi göstergeleri kadar iyi performans sergileyenleri seçtiğini gösteriyor.

Tablo 3.5'den çıkan bir diğer sonuç da değerli ve endüstriyel metallerin ile enerji grubunun tarımsal emtiaya göre daha çok finansallaşmış olmasıdır. Değerli metallerin yatırım amaçlı kullanımı bilinen bir gerçektir (Antonakakis ve Kizys, 2015). Endüstriyel metaller ve enerji grubu ise ekonomilerin önemli girdilerindendir ve bu nedenle finansal piyasalarla olan ilişkisinin daha güçlü olması şaşırtıcı değildir (Ordu ve Soytaş, 2016). Tarımsal emtia ise yatırım amacı ile bu gruplar arasında en az dikkat çekendir. Fakat, yakın zamanda ABD'nin biyoyakıt politikasındaki değişiklik nedeniyle tarımsal emtia enerji grubunun ikamesi olmuştur.

Tablo 2.5'den çıkan bir diğer bulgu da net yayılmanın finansallaşma öncesinde emtia piyasasından hisse senedi piyasasına, finansallaşma sonrasında ise tam tersi yönde olduğudur. Dolayısıyla emtianın finansal şoklara karşı artan hassasiyeti ise emtianın en önemli avantajlarından birinin ortadan kalkmaya başladığını göstermektedir.

Diebold ve Yılmaz (2012) analizin zaman aralığının arttıkça daha fazla yayılma olduğu sonucu gösterebileceğini ifade etmiştir. Bu sebeple biz çalışmamızı, 2 haftalık (10 gün), aylık (21 gün), 6 aylık (126 gün) ve senelik (252 gün) olarak Tablo 2.6'da sunduk. Sonuçlar bize finansallaşma öncesinde çalışmanın zaman aralığını arttırmanın yayılma üzerinde çok ciddi bir artışa neden olmadığını göstermiştir. Dolayısıyla 2004 öncesinde emtia piyasası ciddi anlamda yatırımcıyı finansal şoklardan koruyan bir koruyucu kalkan olmuştur. Ancak finansallaşma sonrası döneme bakarsak zaman aralığı yayılım üzerinde çok ciddi bir etmen haline gelmiştir. Bu da bize emtianın kısa dönemli için kısmen aşağı yönlü risklere karşı koruyabileceğini; ancak kurumsal yatırımcılar gibi uzun vadeli yatırımcılar için bu avantajı sağlayamadığını göstermektedir.

Hisse senedi ve emtia piyasası arasında artan bağıntı üzerine finansallaşma hipotezini kabul etmeyen bir grup araştırmacı ise ilişkinin ekonomik konjonktürdeki dalgalanmalar sebebiyle arttığını ileri sürmektedir (Bhardwaj ve ark., 2016). Bu nedenle 2004 sonrasındaki bölümü NBER'in belirlemiş olduğu resesyon süresini dikkate alarak kriz sonrası (2009 ve 2016) ve öncesi (2004 ve 2009) olarak iki bölüme ayırdık. Bu şekilde kriz nedeniyle oluşmuş bir bağıntı varsa kriz sonrası bunun "normal" seviyelere inmesini bekliyoruz. Ancak Tablo 2.7 bize durumun böyle olmadığını kriz öncesi ve sonrası dönemde ciddi bir finansallaşma olduğunu ve bunun geçici bir dönem olmadığını göstermektedir.

4. Üçüncü Bölüm

4.1. Giriş ve Literatür Özeti

CIT'larin emtia türev piyasalarına girmesi ile birlikte emtia fiyatları ve oynaklıkları tarihsel ortalamaların oldukça üzerine çıkmıştır. Aynı şekilde hisse senedi piyasaları ile emtia arasındaki korelasyon da yükselmiş, (Büyükşahin ve Robe, 2014) finansallaşma olgusunu bir adım öteye taşımıştır. Figür 3.2'de görebileceğiniz gibi korelasyon uzun süre 0 değerlerinde gezinmesine rağmen, S&P GSCI için 0.54'e S&P GSCI tarımsal emtia endeksi için 0.34'lere kadar artmış ve uzun süre bu seviyelerde kalmıştır.

Çalışmanın amacı CIT net pozisyonlarının özellikle 2008'den sonra gözlenen hisse senedi ve tarımsal emtia korelasyon artışını açıklayıp açıklayamadığını ve bu şekilde finansallaşmanın tarımsal emtialar için geçerliliğini incelemektir. Tarımsal emtia seçimimizin ana olarak iki sebebi vardır. Birinci olarak S&P GSCI gibi toplu endeksler üzerinden yapılan çalışmalar her bir alt grubun ve emtianın kendine özgü davranışını gölgeleyebilir. Aynı zamanda emtia bazında yapılan çalışmalar da daha çok enerji emtiası bazında yapılmış (örn., Fattouh ve ark., 2013; Singleton, 2014), ancak tarımsal emtia daha az dikkat çekmiştir. Oysa gıdanın mesken harcamasındaki oranının globalde %58,3 ve olduğu göz önüne alınırsa, tarımsal emtianın dinamiğindeki herhangi bir değişimin ciddi sonuçları olabilir. Bu nedenle de özellikle tarımsal emtiayı çalışmamızda inceleme kararı aldık. İkinci olarak da kullanacağımız CIT net pozisyon veri seti sadece tarımsal emtia için mevcuttur. Başka çalışmalar farklı veri setleri kullanmış ve Cheng ve ark. (2014) bu verilerde ciddi hatalar olduğunu ve CIT pozisyonları yerine kullanılmaması gerektiğini ifade etmiştir.

Çalışmamız ana olarak iki kol literatür ile yakından ilintilidir, birincisi yatırımcıların özelliklerinin varlık fiyatlamasına etkisi olup olmadığı iken, ikincisi ise kurumsal yatırımcıların emtia piyasası temellerine etkisini araştırır.

Birinci kısım literatüre baktığımızda yatırımcı profilinin (kurumsal/ bireysel yatırımcı) varlık fiyatlaması üzerindeki etkisini inceleyen teorik oldukça az makale olduğunu görüyoruz (Başak ve Pavlova, 2013). Profesyonel yönetim altında olan varlıklar 1946'da ABD gayri safi yurtiçi hasılasının %50'si iken bu sayı 2013 itibariyle %240'a çıkmıştır (Haldane, 2014). Bu nedenle de CAPM gibi geleneksel varlık fiyatlama modellerinin bireysel yatırımcı özelliklerinden ortaya çıkması çok da şaşırtıcı değildir. Ancak günümüzde profesyonel yatırımlar bu kadar çok artmışsa kurumların varlıklar üzerinde etkisinin olması da kaçınılmazdır (Başak ve Pavlova, 2013). Örneğin Başak ve Croitoru (2006), kısıtı daha az olan yatırımcıların (bizim durumumuzda kurumsal yatırımcıların) varlıklardaki yanlış fiyatlandırmanın önüne geçtiğini savunur. Kyle ve Xıong'da (2001) yatırımcıların aynı anda portföyünde tuttuğu varlıkların birbirlerine karşı daha duyarlı olacaklarını ve korelasyonlarının artacağını öngörmektedir. Öte yandan, dünyada onlarca farklı ülkeden yüzlerce farklı varlık vardır. Bu nedenle de korelasyonun artışını gözlemlemek zor olabilir. Ancak Barberis ve Shleifer (2003) yatırımcıların bütün varlıkları analiz edip seçmek için kısıtlı kapasiteleri olduğunu ve karar sürecini kolaylaştırmak için yatırım tarzları oluşturduklarını savunur. Yazarlar yatırım tarzının herhangi bir grup hisse senedi, fon, varlık olabileceğini söyler. Barberis ve ark. (2005) ise bahsi geçen makaleden yola çıkarak herhangi aynı kategoride olan varlıkların birbiriyle daha çok korelasyon sergilediklerini ifade eder. Wahal ve Yavuz'da (2013), emtianın finansallaşmayı müteakip bir yatırım tarzı haline gelip gelmediğini incelemek için bir model kurar ve sonuçlar emtianın bir tarz hale geldiğini savunmaktadır.

Çalışmamızın ilgilendiği ikinci literatür dalı ise "emtianın finansallaşması" konusudur. Bilgimiz dahilinde kurumsal yatırımcıların emtia piyasası dinamiklerini teorik bir modelde ele alan tek çalışma Başak ve Pavlova'nın (2016) tarafından olanıdır. Daha önce de bahsettiğimiz gibi, yazarlar finansallaşma ile birlikte hisse senedi ve emtia piyasaları arasındaki bağıntının arttığını savunmaktadır. Finansallaşma konusu emtia için oldukça yeni gelişen bir literatür olduğu için ampirik çalışmalarda henüz bir ortak görüş oluşmamıştır. Başak ve Pavlova'yı (2016) destekleyen makalelerin başlıcası Tang ve Xiong (2012) tarafından yapılmış ve oldukça dikkat çekmiştir. Yazarların çalışması emtia piyasası dinamiklerinin 2004 yılı itibariyle değiştiğini ve kurumsal yatırımcıların artık emtiayı bir yatırım aracı olarak kabul ettiğini göstermektedir. Diğer ampirik çalışmalar da Amerikan hisse senedi piyasası ile seçilmiş emtia piyasalarını dikkate alarak yapılmış olmakla birlikte (örn., Irwin ve ark., 2009), farklı hisse senedi ve bono piyasaları da çalışmalara eklenmeye başlamıştır (örn., Silvennoinen ve Thorp, 2013).

Cheng ve ark. (2014) ise CIT'lerin emtia piyasalarına girişlerinin finansal piyasalardaki ortam ile yakından ilintili olabildiğini göstermiştir. Normal şartlar altında CIT'ler emtia türev piyasalarında alım pozisyonu alarak kendilerini çeşitli risklere karşı güvence altına alan kurumların karşısında yer alırlar. Ancak Cheng ve ark. (2014), finansal piyasalarda korkunun arttığı dönemlerde CIT'lerin emtia piyasalarından çıktıklarını ve kendini güvence altına almaya çalışan kurumları normal zamanlardan daha büyük riskle karşı karşıya bıraktıklarını göstermişlerdir. Benzer şekilde Büyükşahin ve Robe'da (2014) koruma amaçlı fonların (hedge fund) hisse senedi-emtia korelasyonunu açıklamada önemli olduğunu ancak piyasada likidite sıkıntısı olduğu zaman benzer pozisyonların korelasyonu açıklayamadığını göstermiştir. Bu nedenle de finansallaşma olgusu kimi koşullara, özellikle de piyasadaki likiditeye bağımlı olabilir. Çünkü finansal kurumlar likidite bolluğunda yatırım yapılacak yeni varlıklar ararken, likidite kısıntısı ile birlikte kendi yeterlik bölgelerine geri dönebilirler. Bu da hisse senedi ve emtia piyasası arasındaki ilişkiyi zayıflatabilir.

Genel olarak bütün çalışmalar korelasyonun arttığını göstermekle birlikte neden arttığı üzerindeki tartışma henüz son bulmamıştır. Bir grup araştırmacı finansallaşmanın olmadığını, finansal ve emtia piyasaları arasında artan bağıntının ekonomik konjonktür ile açıklandığını savunur (örn., Alquist ve Coibion, 2014; Bhardwaj ve Dunsby, 2013; Bhardwaj ve ark., 2015). Özellikle 2000 yılından sonra hızla artan gelişen piyasa talebini karşılamak üzere emtia fiyatlarının arttığını, korelasyonun da sonrasında ortaya çıkan 2008 krizi ile açıklanabildiğini iddia etmektedirler. Alquist ve Coibion (2014) piyasaların benzer faktörlere eğilimli ve hassas oldukları durumlarda korelasyonun arttığını, kriz ortamlarının da buna iyi bir örnek olduğunu savunur. Aslında bulaşıcılık literatürü de benzer sonuçları göstermiştir (Bekaert ve Harvey 1995). Daha sonra Bhardwaj ve ark. (2015) ekonomik konjonktür ile hisse senedi-emtia piyasaları arasındaki korelasyona bakmış ve oldukça yüksek bir oran bulmuştur. Bruno ve ark.'da (2015) finansallaşmanın korelasyon üzerinde büyük bir etkisi olmadığını bulmakla birlikte ekonomik konjonktür değişkeni istatiksel olarak önemli çıkmıştır. Ancak yazarlar bunu finansallaşmanın olmadığı sonucuna bağlamamıştır. Ekonomik konjonktür değişkeninin önemli çıkması aslında iki piyasanın birbirine entegre olmaya başladığını gösterdiğini, bunun başka türlü çıkmayacağını iddia etmiştir.

Biz de literatürde bahsi geçen önemli faktörleri dikkate alarak, finansallaşmanın hisse senedi-tarımsal emtia korelasyonu üzerindeki etkisini inceleyeceğiz.

4.2 Yöntem

Araştırma sorumuzun cevabını incelemek için yöntem olarak iki basamaklı bir yöntem kullanacağız. Birinci olarak korelasyonu hesaplayabilmek için GARCH ailesinden bir yöntem olan asimetrik dinamik koşullu korelasyon (ADCC) metodunu kullanacağız (Cappiello ve ark., 2006). Bu yöntem bize S&P500 ve her bir tarımsal emtia arasında zaman içinde değişen korelasyon konusunda bilgi verirken, negatif veya pozitif yönde oluşan şokları da dikkate alarak bir zaman serisi sunuyor.

Çalışmanın ikinci basamağında hesapladığımız korelasyonu finansallaşma ve diğer faktörler ile birlikte bir kantil regresyon modeline (Quantile Regression - QR) ekleyeceğiz. QR yöntemi esas olarak ağırlıklandırılmış en küçük mutlak sapmalar yöntemine göre regresyon sonuçlarını sunar ve kullanıcının istediği yüzdelik dilimler için farklı sonuçlar verebilir. Geleneksel regresyon yöntemi sıradan en küçük kareler yöntemi ile katsayıları ortalama bir değer üzerinden hesaplar ve ciddi varsayımlar üzerinden hareket eder. Bu varsayımlardan bazıları normallik ve eş varyanslılıktır ve finansal veri setlerinde genelde çok zor bulunan özelliklerdir. Aynı zamanda regresyonlar aykırı gözlem noktalarına karşı aşırı hassastırlar ve sonuçlar bir kaç aşırı gözlem ile ciddi ölçüde değişebilmektedir. Diğer taraftan QR, bu sorunları ortadan kaldırarak daha anlamlı analiz sonuçları verebilmektedir.

QR yönteminde bağımlı değişken için olan değerler kullanıcının seçtiği dilimlere ayrılarak karşılık gelen her bir bağımsız değişken ayrı ayrı regresyonlara konar. Bu şekilde bağımlı ve bağımsız değişkenler arasındaki ilişkiye dair resim daha net bir şekilde önümüze çıkar (Koenker, 2005). Özellikle korelasyon değerlerinin zaman içerisinde çok farklı değerler göstermesi QR yönteminin kullanımını öne çıkarmıştır. Korelasyonun yüksek ya da düşük seyrettiği dönemlerde bağımsız değişkenlerin açıklama gücünün ne ölçüde değiştiğini ve arada asimetrik bir ilişki olup olmadığı incelenebilecektir. Aynı zamanda geleneksel regresyon yöntemindeki varsayımlar bizi çok ilgilendirmeyecek ve sonuçlarımızın farklı durumlarda ne şekilde değiştiğini inceleyebileceğiz.

Korelasyon hesaplaması için 12 adet tarımsal emtianın en yakın zamanlı türev kontratının günlük fiyatlarını 1 Ocak 1995 ve 22 Şubat 2016 arası için elde ettik. Aynı şekilde S&P500'ün de günlük endeks fiyatlarını çekerek, bütün serilerin getirilerini hesap ettik ve durağan olan zaman serilerini hesapladık. Daha sonra her bir emtia ile S&P500'ü eşleştirerek, 12 adet korelasyon verisini hesapladık.

İkinci aşamada kullandığımız veri setinde ise başlıca bağımsız değişkenimiz, finansallaşma için kullandığımız CIT net pozisyonlarıdır. Ancak bu veri seti sadece haftalık bazda ve 1 Ocak 2006'dan sonrası için mevcuttur. Diğer bağımsız değişkenler sırasıyla şu şekildedir: Global ekonomik durumu yansıtmak için Kilian'ın (2009) geliştirdiği gerçek ekonomi faaliyeti endeksini, ekonomik konjonktür durumunu yansıtmak için Moodys'in Baa ve Aaa özel sektör borçlanma senetleri arasındaki faiz farkını, gelişen ülke tarafından gelen talep miktarını yansıtmak için MSCI gelişen ülke endeksini, makroekonomik gelişmeler için JP Morgan bono endeksini, piyasadaki likidite durumunu yansıtmak için TED farkını, finansal piyasalardaki korku için VIX endeksini, foreks piyasasındaki değişiklikleri yansıtmak için de Amerikan Doları endeksinin en yakın vadeli kontrat fiyatını ve son olarak da biyoyakıt politikasındaki değişiklikleri de kontrol etmek için petrol fiyatlarını kullandık. Modelimiz denklem 3.16'da mevcuttur.

4.3 Bulgular

Çoklu ortak doğrusallık probleminin önüne geçmek ve yorumların daha anlamlı olması için bütün değişkenler (kukla değişken dışında) standardize edilmiştir.

Figür 3.6'da görebileceğimiz gibi korelasyonların hepsi oldukça paralel bir trend göstermektedirler. 2008 krizi döneminde hepsinde ciddi bir düşüş gözlemlenirken, kriz ertesi artış uzun sürelerle devam etmiştir. Aslında literatürün uzun süre üzerinde durduğu riskin dağıtılması için iyi bir oyuncu olarak kabul edilen emtianın, özellikle 2008 sonrası çok da iyi olmadığını göstermektedir.

Araştırma sorumuzun cevabı için Tablo 3.4'e göz atabilirsiniz. Başak ve Pavlova'nın (2016) temel hipotezi finansallaşma ile birlikte korelasyonların artması gerektiğidir. Bu nedenle CIT değişkeni için katsayıları incelediğimizde, 8 emtia için pozitif ve istatistiki olarak önemli olduğunu görüyoruz. Sonuç bize bahsi geçen 8 emtianın finansallaştığını göstermektedir. Örneğin CIT net pozisyonundaki 1 standart sapma değişim kakaonun S&P500 ile olan korelasyonu 0.37 standart sapma kadar attırmaktadır.

Diğer seçilmiş yüzdelik dilimler için de sonuçlar Tablo 3.5'de mevcuttur. Sonuçlar CIT katsayıları için neredeyse benzer sayılar göstermektedir, dolayısıyla CIT pozisyonlarının korelasyon üzerindeki gücü düşük ya da yüksek korelasyon seviyelerinde bir kaç emtia dışında değişiklik göstermemektedir.

Fakat, bir diğer önemli bulgumuz, mısır, pamuk ve kahve için finansallaşma olmadığı yönündedir. Daha önce de bahsettiğimiz gibi kurumsal yatırımcılar kendi gösterge endekslerine göre daha iyi performans sergileyen emtiayı seçerek onlara yatırım yapmaktadırlar (Başak ve Pavlova, 2016). Bu nedenle bütün emtia getirilerini S&P GSCI endeksi ile 2004 yılından itibaren karşılaştırmalı olarak Figür 3.8'de sunuyoruz. Göze çarpan en önemli sonuç kahve, pamuk ve mısırın endekse göre daha düşük getiri sağlamalarına rağmen, diğer 8 emtianın en azından endeks kadar iyi performans sergilemiş olmalarıdır. Bu da aslında tam olarak teorik altyapımızın bize sunduğu önermedir .

Bir diğer önemli konu CIT pozisyonlarının korelasyonu açıklama gücünün finansal piyasalardaki likiditeye bağlı olup olmadığının incelenmesidir. Cheng ve ark.'nın (2014) bahsettiği üzere eğer CIT'lar kimi zamanlarda emtia piyasasına girip kimi zamanlarda çıkıyorlarsa korelasyon da buna bağlı olarak değişebilir. Finansallaşma hipotezinin gerçekten CIT'ların emtia türev piyasalarında aldığı pozisyon ile ilintililiği de bu şekilde test edilmiş olacaktır. Test etmek için ise modele bir CIT ve TED arasında bir etkileşim terimi koyarak katsayının istatistiki önemine baktık. Katsayılar önceki bulgularla uyumlu olarak ve beklediğimiz gibi negatif çıktı. Yani CIT net pozisyonu her ne kadar korelasyonu açıklasa da, kıt likidite dönemlerinde açıklama gücünü kaybetmektedir. Dolayısıyla, CIT'lar likiditenin bol olduğu dönemlerde kendi "yeterlik bölgeleri"nden çıkıp emtia piyasalarına yatırım yapmaya başlar ve böylece finansal ve emtia piyasalarını birbirine daha çok bağlarlar. Ancak likidite kısıldığı anda emtia piyasasından çıkarak bu bağıntıyı zayıflatırlar. Yüzdelik dilimler arasındaki sonuçlara baktığımızda ise bütün emtia piyasaları için yüksek korelasyonda negatif katsayının daha da büyüdüğünü gözlemliyoruz. Bu da bize CIT'ların yüksek korelasyon ortamlarında emtia piyasasından daha da hızlı çıktıklarını göstermektedir.

Diğer değişkenlerin katsayılarına baktığımızda ise önemli bulgular göze çarpmaktadır. Birinci olarak, bir grup araştırmacının daha önce de bahsettiği üzere ekonomik konjonktür korelasyonları açıklamada oldukça önemli bir faktördür. Ayrıca 2008 krizi dönemini kontrol etmek üzere koyduğumuz kukla değişkenin katsayısı bütün korelasyonlar için negatiftir. Bulaşıcılık literatürü kriz dönemlerinde korelasyonların farklı varlık grupları için artabileceğini göstermektedir (Bekaert ve Harvey, 1995). Bizim bulgumuz bunun tersini savunmakla birlikte, 2008 krizindeki kıt likidite ortamı dikkate alındığında önceki savımız ile uyumludur. Başak ve Pavlova (2016) aynı zamanda VIX'in de korelasyonlar üzerinde arttırıcı bir etkisi olduğunu ifade etmektedir. Sonuçlara baktığımızda VIX'in pozitif katsayısının bütün korelasyonlar için geçerli olduğunu görüyor, finansal piyasalardaki korkunun emtia piyasaları üzerinde de etkisi olabileceğini göstermekteyiz.

Tarımsal emtianın hepsi Amerikan Doları üzerinden alıp satılmaktadır. Diğer majör yabancı paralara göre değerlenen Amerikan Doları emtiaya yönelik talebi azaltacağı için korelasyonlar üzerinde negatif bir etki yapabilir. Beklentilerimiz ile uyumlu olarak, bulgularımız USD katsayısının negatif olduğunu göstermektedir. Piyasalar arasındaki ciddi etkileşim de bu şekilde daha da göze çarpmaktadır.

5. Sonuç

Son 10 sene içerisinde emtia piyasası dinamikleri ciddi ölçüde değişmiştir. Emtia fiyatları 2008 çok ciddi fiyat artışları ve düşüşleri yaşamış; sonuç olarak da oynaklık tarihi seviyelerin çok üstüne çıkmıştır. Benzer zamanlarda ABD hisse senedi ile emtia piyasaları arasındaki bağıntı da güçlenmiş ve bütün bu gelişmeler politika yapıcılar üzerinde baskı yaratmıştır. Emtia piyasalarının ekonomiler ve bütün dünya vatandaşları açısından önemi göz önünde bulundurulduğunda bu baskının yansımasının pek çok kişisel ve kurumsal yatırımcı, kar amacı gütmeyen organizasyon, akademik araştırmacılar ve karar vericiler üzerinde olduğu da bir gerçektir. CIT'ların yatırımlarının artışı ile emtia piyasasında görülen tarihi değişiklikler paralellik göstermeye başlayınca emtianın finansallaşması hipotezi de ilk olarak Domanski ve Heath (2005) tarafindan dillendirilmiştir.

Bu tezin esas amacı ise ABD hisse senedi ve emtia piyasaları arasındaki bağıntının artışının finansallaşma ile açıklanıp açıklanamadığını incelemektir. Hipotezin yankı bulmasıyla beraber ampirik çalışmalarda hız kazanmış ve hem doğrulayan hem de desteklemeyen yönde çıktılar görülmüştür. Birinci görüş finansallaşma hipotezinin geçerli olduğunu göstermekte ve piyasaların artık geri döndürülemez şekilde bağlandığını savunmaktadır (örn., Tang ve Xiong, 2012). İkinci görüş ise son 10 senede dünya ekonomisinin yaşamış olduğu ekonomik konjonktür gereği bütün varlıkların daha bağıntılı hale geldiğini ancak bunun geçici olduğunu ifade etmektedir (örn., Bhardwaj ve ark., 2015). Ampirik çalışmalar yeni yeni büyüse de teorik olarak finansallaşmayı açıklayan, bizim bilgimiz dahilinde tek bir çalışma vardır (Başak ve Pavlova, 2016).

Başak ve Pavlova (2016) kurumsal yatırımcıların finansal piyasalara girmesiyle birlikte emtianın finansallaştığını modellerinde göstermektedir. Ancak bu yatırımcılar hem ABD hisse senedi hem de emtia piyasalarında yatırım yapmaları nedeniyle, birbirlerindeki şoklardan daha fazla etkilenmektedirler. Bu nedenle ilk çalışmamızda 25 emtia türev piyasası ile ABD hisse senedi piyasası arasında oynaklık yayılımını incelemekteyiz. Sonuçlar Başak ve Pavlova'nın (2016) savunduğu üzere çoğunluk emtianın finansallaştığını, kalanların ise düşük getiri sağlayan ve endeks üyesi olmayan emtia piyasaları olduğunu göstermektedir.

İkinci çalışmada ise hisse senedi ve tarımsal emtia piyasaları arasındaki korelasyon zaman serisini inceledik. Modelimizde ekonomik konjonktür ve gelişen ülke piyasaları tarafından artan talebi de göz önünde bulundurarak, finansallaşmanın korelasyonları nasıl etkilediğini inceledik. Bulgularımız artan kurumsal yatırımcı pozisyonlarının korelasyonu arttırdığını; ancak yine bu yatırımcıların piyasalarda gözlemlenen bir likidite sıkıntısı ile birlikte emtia piyasalarından çıktığını göstermektedir. Dolayısıyla emtia piyasaları CIT'ların likidite bol olduğunda giriş yaptığı; kıt likiditede ise çıkış yaptığı bir piyasa özelliği kazanmıştır. Ancak giriş yaptıkları anda da emtia piyasalarının kabul edilegelmiş risk dağıtma özelliği de ortadan kısmen kalkmaktadır.

C. CURRICULUM VITAE

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EDUCATION

Degree	**Institution**	**Year of Graduation**
MFin	University of Cambridge, Judge Business School	2012
BSc	Bilkent University, Business Administration	2005
High School	TED Ankara College Foundation Private High School	2001

WORK EXPERIENCE

Year	**Place**	**Enrollment**
2012- Present	Yıldırım Beyazıt University, Business Administration Faculty	Research Assistant
2007-2010	KPMG Transaction and Restructuring Services Department	Manager
2005-2007	PricewaterhouseCoopers Audit Department	Experienced Audit Assistant Associate

PUBLICATIONS

1. Ordu, B. M., & Soytas, U. (2016). The Relationship Between Energy Commodity Prices and Electricity and Market Index Performances: Evidence from an Emerging Market. *Emerging Markets Finance and Trade*, 52(9), 2149-2164. http://dx.doi.org/10.1080/1540496X.2015.1068067

2. Ordu, B. M., Oran, A. & Soytas, U. Time-Varying Linkage between Equities and Oil. In: Hammoudeh, S. & Balcilar, M. eds. Commodity Markets. Emerald Publishing. (Forthcoming)

PROFESSIONAL QUALIFICATIONS

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D. TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

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Bölümü : İşletme

TEZİN ADI (İngilizce) : ESSAYS ON EMPIRICAL TESTING OF FINANCIALIZATION OF COMMODITIES

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