Convention on the Elimination of Discrimination Against Women

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ABSTRACT

We study the macroeconomic determinants of the commodity futures volatility (which includes agricultural commodities like cocoa, coffee, corn lumber, soya bean oil, soya bean, sugar and wheat), in New York Mercantile Exchange (NYMEX). The macroeconomic variable used is business cycle changes or state of the economy which includes inflation rate, industrial production growth, Unemployment Rate, Producers confidence index, consumer confidence index and National Activity index (NAI). We incorporate a recent developed GARCH- MIDAS approach which collectively inculcates the daily commodity futures price volatility and relatively less-frequent macro finance variables. We infer that there in commodity futures, there is a long-run component of volatility and most of tested less frequent macro finance determinants those are positively related to the long-run variance of commodity futures. Our results suggest that macro finance information plays significant role in determining the price volatility of the NYME commodity futures. This study also emphasizes the fact that commodities can better be used as hedging instrument instead of stocks and bonds for the investors, govt., policy makers, consumers. This study also reveals that commodities can also be used an alternative asset class for the investors.

Keywords: Macro Finance determinants, Commodity futures volatility, GARCH-MIDAS

GEL Classifications: E37, E44, E47, F44, G17, Q02, Q10, Q43

Introduction

The dramatic rise in the participation of commodity futures market is witnessed soon after the collapse of stock market in 2000 and with the switching of open/telephone trading platform to electronic/computer order matching platform. The 2000's stock market crash turned the focus of investors to be shifted from stocks to other assets such as commodity futures and identifying them as an alternative asset class (Mo, Gupta, Li & Singh, 2019). The investor's increased attention permitted the investment banks to promote commodity futures as new/alternative investment class. However, this view of investment in commodity futures is further strengthened with the evidence of negative association between the commodity futures and the stocks in the episodes of negative downturn (Mo et al., 2018). The one way to achieve such lower correlations was to shift the investments in multiple asset classes. Thus, the investors started to combine different assets such as by forming portfolios of stocks and commodity futures to seek diversification benefits and overall reduced portfolio risk (Bahloul, Balcilar, Cunado and Gupta 2018).

In response to this, the commodity futures market attracted almost three Billion dollars of investment from individual as well as institutional investors. Among the individual investors, the institutional investors also started trading directly in the commodity futures contracts or in commodity indices, such as the S&P Goldman Sachs Commodity Index (GSCI) (Berger and Uddin, 2016). However, fundamental changes have been witnessed in the composition of commodity indices, in the last ten years. These changes include massive rise in trading volumes, increased participants and open interest co-movement was also observed (Kang, Mclever and Yoon 2017). The number of index traders increased up-to four times during 2000 and 2011, and the number of hedge funds also got tripled in the commodity futures market (Cheng, Kirilenko & Xiong, 2015). Contrary to the above low correlation discussion, the increased demand and the presence of index investors triggered the financialization process among the commodities markets that led to an increase in correlation (co-movement or integration) between the commodity futures themselves and with other financial assets (Tang and Xiong, 2012; Basak and Pavlova, 2016; Charlot, Darne, and Moussa, 2016; Ohashi and Okimoto, 2016). Many commodities like oil, gold, and agricultural commodities went through similar movements of prices in 2007-08 and during the same time horizon, the price volatility for so many commodity classes had risen up (Xiong, 2014; Aït-Youcef, 2019). Thus, this higher price volatility has got much attention of the individuals, investors and

for the policy maker that whether financialization has slanted commodity prices or in these markets there are more government regulations those are warranted (Gozgor, Lau & Bilgin 2016).

Since, the empirical literature provided the evidence that there are many macroeconomic factors or indicators such as; inflation, interest rates, industrial production and economic uncertainty etc., those carry significant power to elaborate the changes in movement of prices of commodities (Byrne, Fazio & Fiess, 2013; Lombardi, Osbat, and Schnatz, 2012; Shang, Yuan, & Huang, 2016). Therefore, in case of emerging economies, the aggregate demand is also considered as an another prominent factor behind the fluctuations of wide range of commodities (Kilian, 2009; Kilian & Murphy, 2014; Liu & Zhang, 2019). Thus, a question arises that whether the process of financialization had changed the nature of the commodity futures volatility those might carry crucial information for many of the stakeholders like, commodity importers and exporters, speculators, investors, commission agents and traders. Moreover, it is also unclear that whether the increased connectedness of commodities volatility with the economic/fundamental shocks of the economy is due to increased financialization or not. Therefore, it will be interesting to investigate the commodity futures volatility linkages with the economic drivers with the focus on the commodity financialization process.

Secondly, the occurrence of 2008's Global Financial Crisis is evidence that how much global markets are interconnected. This was not the only reason that US financial crisis created waves those were disseminated into other international markets and led to global crises but the main cause behind the global crises was that all the international markets were so deeply connected in a complex manner. That it was almost impossible for one market to safeguard itself from all the risks faced by other market. Thus, this interconnection of the markets had led to global financial crises and demonstrated itself as a mechanism for disseminating risk. In this respect, many researchers and analysts have mostly examined the patterns of financial markets and their impact on bond and equity markets. However, less attention is paid towards the connectedness of global commodity markets (Zhang and Broadstock, 2018). Therefore, this creates an interest to explore or investigate the commodity futures volatility linkage with economic drivers or microfinance determinants.

The two main commodity exchanges in US are the Chicago Mercantile Exchange (CME) group and New York Mercantile Exchange (NYMEX) which is also a part of CME. So, CME group is the world's top and most distinct derivative marketplace conducting roughly about 3 billion contracts annually (Chen, 2019). In this study, we explored the commodity futures volatility of agricultural commodities of NYME which is driven by macro finance determinants (Business Cycle changes) of United stated of America.

NYME is the world largest commodity exchange in the world. In addition to being the largest physical commodity market, another motivation to pick up NYMEX to study is that it is governed by the Commodity Futures Trading Commission (CFTC), which is an autonomous agency of the US govt. assigned with the task to promote of competitive and well-organized futures markets as well as the shield of investors against maneuvering, vicious trade practices, and deception. In addition to above mentioned reasons, governments and policy makers also look to the NYMEX, as a benchmark for the price direction of energy commodities like crude oil, gasoline and metals (like, Gold, silver, palladium, platinum). Nevertheless, the trading market activities like volume of trading and open interest rate in these countries is quite less for the commodities, but the price instability is fairly extreme. Therefore, given the significant role that NYMEX plays around the globe, it is substantially examining the factors of the CFV in this market.

Many of the past researches explore the effect of micro-economics; nonetheless, it is hard to disregard macroeconomic essentials while talking about the micro-economic factors with reference to commodity prices, particularly throughout the time of higher price changes (Boado, 2000). One purpose behind the rejection of the macro-economic variables might be the less-frequent of information for macro-economic variables. The investigations of time-fluctuating instability are generally founded on factors with accessibility of high-frequent information and the assessed factors are restricted to, deposit or lending rates. Less frequent factors, for example, those estimating the business cycle, money related approaches and the macro-economic factors have not been much investigated (Liu et al., 2015).

The primary objective of our paper is hence to look at macro finance variables of the instability of CFs. for the USA. In addition to this, we conjecture that the volatility

of CFs. is influenced not just by momentary data, for example, day by day price data, yet additionally due to data confined in the macro-finance environment. To get long-term volatility, lot of researches utilize conventional GARCH models which put absolute volatility as a constant. This consistent instability is probably less likely to catch genuine elements of long term commodity volatility. The succeeding issue is the non-synchronization of frequency between macro-economic determinants and CFs. Mostly, macro-economic determinants appear on monthly or quarterly duration, on the other hand commodity prices depict moderately higher frequency, i.e., every day or intra-day by day. Fusing factors with multiple frequencies in a similar model make modeling obstacles. GARCH-MIDAS approach which is being utilized by this study tackles this issue of blended frequencies and given us the causes of volatilities those are being caused in both short run and long haul. MIDAS method was presented by Ghysels et al. (2007) and further changes were made by Engle et al. (2013) to observe the time varying volatility. The significant favorable position of this model is that it permits the connection between multiple frequencies. Therefore, the predictive power of macro finance factors on the Commodity Futures Volatility (CFV) may be analyzed straightforwardly. So, our study evolves around these two research objectives. The first objective is to inspect the predictive power of variations in business cycle determinants/state of the economy determinants for the CFV. In addition to this, second objective of this study is to observe the impact of uncertainty in variables of business cycle determinants/state of the economy on the CFV.

The macro finance factors of the volatility of CFs. is imperative to study due to multiple motives. To start with, considerate the predictability elements is basic for growers, manufacturers, clients and decision makers like policy makers. Past studies just focus around factors of short-run instability; though, the CFV. is induced by short term as well as due to long term factors. This paper differentiates from past investigations in that it disintegrates the CFV into short-term and long-term segments, hence empowering the researchers to research whether the data contented in macroeconomic factors is significant for the long-standing volatility of CFs. This study has many significant financial implications. Speculators can change their investment portfolio because of macro-economic conditions, for example, consumer confidence, producers confidence in the economy, economic growth and industrial production.

Thus, the effect of global macroeconomic conditions on the unpredictability of CFs. should be considered when formulating the policy. Additionally, results can likewise help strategy creators in their decision making.

Remaining Section of this paper provides brief review of significant literature followed by section 3 which elaborates about the data and methodology. Finding and discussion has been drawn in section four which is followed b concluding remarks

Literature Review

CFs have been one of the most significant financial assets through the financialization and globalization of commodities, particularly the expansion of emerging markets of commodity futures. Several research analyzing the factors that influence commodity markets claim that the fluctuation of the commodity market is not only linked to the dynamics of supply and demand but it is also linked to the varying macro finance factors. Its response to the macro finance determinants, however, varies from other usual financial assets. Traditional financial assets, like equities or bonds, those are often viewed as liabilities of companies those may increase the company's external capital (Fabozzi et al., 2008).

As a significant driver of commodity prices, variables of macroeconomics are majorly unknown. The association among the performance of stock market and macroeconomics variables has been investigated in extensive literature. Inflation, industrial production, oil prices and interest rate are variables that contribute to the performance of the stock market. CFs. are a financial assets, but they are special. First for businesses to grow their sector, they do not increase resources. In addition, the outlook for future spot prices is expressed by commodity futures (Gorton and Rouwenhorst 2006). CFs. are viewed by investors as protection for the upcoming value of a particular commodity. Consequently, because of short-term volatility in commodity markets, commodity investors gain money. In some ways, conventional financial asset values are forward-thinking, while commodity prices are extra dependent on current economic conditions (Fabozzi et al., 2008; Gorton and Rouwenhorst, 2006).

To show the low demand for raw inputs, commodity prices would decline. Commodity futures are generally recognized as having low connection with other asset

portfolios. It is important to further analyze how CFs. react to variations in economic environment. Studies depict that macroeconomic factors played an important role in the prices of agricultural, fuel and metal commodities (Frankel and Rose, 2010). Much of the study was based on the idea at an early stage that CFs. were an asset class. Therefore, with mixed results, researchers used asset pricing models that is expended in stock markets to price CFs. (Shang et al., 2016). Dusak (1973) initially used a CAPM to analyze three contracts for agricultural CFs. from the period of 1952 to 1967, but remained unsuccessful to show that the returns of CFs. are influenced by stock market variables. Lately, in the quarterly return of twenty-three goods, Bodie and Rosansky in 1980 found a negative market risk premium.

Simple monetary policy is generally expressed by low real bank rates, which have the reverse impact, reducing inventory holding costs and hovering commodity prices further (Frankel, 2008). They claim that the contractionary monetary policy, that is based on the overshooting theory, would temporarily lift the real interest rate through rise in the minimal banking (lending) rate/decrease in projected inflation, or any of these two options. Consequently, the prices of real commodities drop until these are generally regarded as underpriced. The undervaluation, however has a potential for the appreciation of forthcoming, that is adequate to counterweighed the higher interest rate. Such studies analyze only the variables in the stock market that are well checked. With the enormous rise in emerging market demand, some analysts have shifted their attention towards these marketplaces. Arango et al. (2012) and Varadi (2013) explore that the fluctuation of product prices is closely related to some emerging economies' economic activity (Gupta and Guidi, 2012). It can deliver extra significant evidence for understanding the appliance of price. Since agricultural commodities are a non-perishable and agricultural commodity prices are strongly linked to food security concerns, food volatility and its determinants are studied in a broad series of studies. Awareness of volatile agricultural commodity prices is important for consumers and producers, as well as for the stability of a region.

In order to inspect the existence and factors of volatility in nineteen globally traded agricultural commodities, Balcombe (2011) uses both variance decomposition and panel regression. The findings show that volatility in exchange rates is a forecaster of volatility in more than half of the sequence. Balcombe (2011) also found that volatility of price is affected by levels of stocks and yields. The trade-off between the successful use of the

information found in the high-frequent data and the need to include the low-frequent macro-economic determinants in the study was addressed in research examining the causal association. By using regular prices, some researchers measure the volatility; they believe only financial variables and monetary factors as the determinants (Hayo et al., 2012, Ott, 2014; Pietola et al., 2010). However, some significant details found in high frequency observations may be missed by this approach. Roache (2010) and Karali and Power (2013) use the spline-GARCH model introduced by Engle and Rangel (2008) to solve the problem of mixed data sampling.

Low frequency volatility positively correlates among commodities (Roache, 2010) moreover, US inflation and exchange rate explain major portion of increase prices of agriculture commodities. Karali and Power (2013) explored price volatility in US agriculture, energy and metal future market in which economic factors extant alike effects of similar commodity. Spline GARCH model does not fully explain it. Advanced on the basis of spline GARCH model, GARCH MIDAS model overcomes the lacks spline GARCH model. This model allows low frequency macroeconomic variables to incorporate. Magrini and Donmez (2013) studied the key indicators of agriculture commodity price volatility of US. Findings using GARCH MIDAS provides better results than GARCH (1,1) model. Supply demand variables and the predictable speculation proxy is key to explain low frequency indicators of volatility. Economic influential and energy markets perform a vital but not a chief role. Though, in the period of 2006- 2012 prices surge, economic indicators and the interest rate becomes the imperative part in the amplification of price fluctuation of agriculture commodities. Tully and lucey (2007) employed asymmetric GARCH model to observe macroeconomic effect of commodities on gold cash and the future prices. It specifies dollar price has a negative influence with return on gold volatility and not with macroeconomic indicators. Batten et al. (2010) explains macro finance factors of metals which includes state of the economy, financial environments and monetary market sentiments using monthly volatility. Findings for gold volatility are clarified through monetary indicators like M2 etc.

It is evident that macro determinants explicate the succeeding volatility of commodity returns. Liu et al. (2015) study macroeconomic determinants of Chinese gold future using spline GARCH model for less frequent volatility. It is evident through the results, volatility in gold future in the primarily resolute by macro-economic changes and

the behavior of investor of which CPI and US dollar the key determinants of the study. Van de Elzen (2014) investigate six factors on high trade commodities employing GARCH MIDAS model. Results of the study highly inspire macroeconomic indicators support in the forecasting volatility for large horizons. US oil future dynamics by Yin and Zhou (2016) examined employ GARCH MIDAS model which resulted that global demand shocks are source of volatility during the period. Chinese gold market studied by Liu et al (2018), emerging commodity markets have a noteworthy role in macroeconomic determinants.

Moreover, sophisticated model dichotomizes daily volatility caused through high and less frequent variables. We employ GARCH MIDAS model to determine the predictive power of less frequent with potential macro finance determinants for the CFV.

Data and Methodology:

Data used in this paper is of commodity futures of agriculture commodities of New York Mercantile exchange and Business cycle changes/state of the economy. Agriculture commodity futures those are being employed includes cocoa, coffee, corn lumber, soya bean oil, soya bean, sugar and wheat and business cycle changes includes inflation rate, industrial production growth, Unemployment Rate, Producers confidence index, consumer confidence index and National Activity index (NAI). Frequency of the commodity futures prices is daily and on the other hand data of the business cycle changes is of mixed frequency i.e., monthly, quarterly, semiannually and yearly.

Sample period being employed is of Jan. 1, 2016 to Aug. 31. 2019. Selected data has been run in the E-views software and approach being used in this software is Mixed data Sampling (MIDAS), that is used to cater the mixed frequencies. Analysis has been run and results has been drawn those are mentioned in following section. Data collection technique is secondary approach. Source of whole data is *Thomson Reuters Financial data stream*.

Finding & Discussion

Current study aims at examining the short-term and long-term volatility in commodity future volatility through the business cycle of American economy. CFV is measured through a frame of agricultural-commodities (as mentioned in section 3).

Business cycle is measure through four major indicators including: inflation, term spread, unemployment and industrial production (IP).

To explore the effect of macro finance determinants on CFV, GARCH-MIDAS model was used. The GARCH-MIDAS model was proposed by Engle et al. (2013) and is used to run data series having multiple frequencies. The framework is stimulated from Ghysels, Santa-Clara, and Valkanov (2006), those employed many MIDAS regressions for examining typical risk-return trade-off. Mixed Data Sampling method brings macro finance variables in a link towards predictive factor of volatility. GARCH-MIDAS model joins mean-reverting process of unit daily GARCH, as employed in Engle and Rangel (2008), using MIDAS polynomial allowing application of less frequent macro finance determinants. In this regard, method demonstrates extraction of bi-components volatility: that is short-run volatility and other one long-term volatility. CFV follows methodology as introduced by Engle and Rangel (2008) and Engle et al. (2013): their unexpected returns are represented as:

$$r_{i,t} - E_{i-1,t}\left(r_{i,t}\right) = \sqrt{\tau_t} * gi, t\varepsilon_{i,t}$$

Note: $r_{i,t}$ is the log return on day i during time (month/quarter/year) t; $E_{i-1,t}$.

Following Engle and Rangel (2008), study assumes volatility dynamics of component $g_{i,t}$ as a (daily) GARCH (1,1) process, that is shown below:

$$g_{i,t} = (1 - \alpha - \beta) + \alpha + \frac{(r_{i-1} - \mu)^2}{\tau_t} + \beta g_{i-1,t}$$

The aim of current research was to examine macro finance determinants of CFV. By applying GARCH-MIDAS model, volatility was decomposed into short-term and the long-term by products. Huge variety of the macro finance determinants as covered in Business Cycle changes / state of the economy. It was expected that particular macro finance variables might govern long-run volatility of CFs. Study shows a linkage between commodity price volatility against macroeconomic variables. To start with, GARCH-MIDAS model was examined with volatility, to build an appropriate model along macroeconomic variables in current study. Additionally, models against realized volatility, for estimating a restricted specification were used.

Dependent Variable: CFV
Method: MIDAS
Date: 11/10/20   Time: 23:59
Sample (adjusted): 14 239
Included observations: 226 after adjustments

Method: PDL/Almon (polynomial degree: 3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.90495	5.240105	3.226070	0.0014
CFV(-1)	0.945189	0.014643	64.54898	0.0000

Page: BC Series: BCCOMPUTED (-5)   Lags: 9

PDL01	0.487932	0.649731	0.750975	0.4535
PDL02	-0.257734	0.332185	-0.775874	0.4387
PDL03	0.029064	0.033127	0.877332	0.3813

R-squared	0.953679	Mean dependent var		362.7046
Adjusted R-squared	0.952840	S.D. dependent var		32.74882
S.E. of regression	7.111835	Akaike info criterion		6.783273
Sum squared resid	11177.78	Schwarz criterion		6.858949
Log likelihood	-761.5099	Hannan-Quinn criteria.		6.813813
Durbin-Watson stat	1.931109			

BC(-5)	Lag	Coefficient	Distribution
	0	0.259262	*
	1	0.088719	*
	2	-0.023697	*
	3	-0.077986	*
	4	-0.074148	*
	5	-0.012182	*
	6	0.107910	*
	7	0.286130	*
	8	0.522477	*

From economic perspective, impact of particular macroeconomic variables upon CFV seem very low. Contrary to this, volatility of the CFs. stands statistically as well as significantly determined by macroeconomic variables. Specifically, commodities from agriculture sector react towards change in macroeconomic conditions in multiple ways. Economic activities and environment (GDP, IP) depict a significant and a positive relationship with commodities. Increase in GDP show economic growth. A GDP raise show that country is rising production in economy, hence, nation has a higher income level and willing to spend more. Resulting into a higher demand regarding goods and commodities the high demand may cause an increase in commodity volatility.

Industrial production (IP) was found to have a significant and a positive impact on agricultural sector of America (0.99); therefore, results for IP were similar to cocoa, coffee, soybean oil and soybean meal, corn and lumber. Similarly, a rise in inflation shows an economic-weaknesses, and commodity prices are highly volatile in recession period for CFs. of New York Mercantile Exchange. In general, CFV seems significantly related

to the macroeconomic variables in America. Excluding cotton and corn, all other CFs. were found to have a significant and positive relationship with inflation. This designates a rise in inflation in the America leads to increase in CFV. On the other hand, for IP, results found that selected macroeconomic variables seem negatively related towards CFV, except in case of rough rice and cocoa. In terms of the financial market information, findings reflect volatility of soybean, lumber and oats is significantly and negatively related to changes in Macroeconomic market. This demonstrates that a raise in returns of stock market will result into a fall in commodity volatility. In terms of interest rate, findings demonstrate that rise of interest rate in the market will lead to rise of CFV, excluding for cotton and corn. CFV was linked to high-frequency of market news. Though, influence of macroeconomic fundamentals might be critical considering specially in uncertainty period.

Conclusion

The CFV is mostly related with highly frequent determinants. However, the impact of macroeconomic determinants should also be taken into account. Though, research has far ignored macroeconomic fundamentals because of the two main problems, firstly due to deficiency of data availability and secondly the models those are able to bifurcate volatility in multiple data frequencies are quite limited. To combat these reasons, this study focuses on the macro finance determinants of the CFV by using the GARCH-MIDAS approach. This approach decomposes the volatility into short-term as well as long-term components. That's the reason, it allows linking of the daily CFV with macro finance determinants, those are available at lesser frequencies.

In contrast with the past studies, we conduct the analysis of a developed market i.e., United States of America and its commodity market named New York Mercantile Exchange (NYME)) and covered a huge variety of Commodity futures (CFs.) from agriculture sector of NYME. We tried to examine macro finance determinants of the CFV. Industrial production (IP) of American economy has significant and positive impact on all the commodities chosen from agriculture sector. Investigating the inflation, study shows insights that expect cotton and corn inflation has put a strong and positive impact on all other CFs.

The study contributes to the current literature observing the volatility dynamics of CFs. by extending this research area into the less examined mercantile exchanges and as

well as developing and emerging markets and macro finance determinants (like monetary policy changes, illiquidity and uncertainty measures. There is clear difference observed in current market prices and these can be determined directly. But on the other hand, prices of CFs. is predicted through macro finance determinants. This disengagement in prices of CFs. and current prices of commodities has the potential for the emergence of grey market operations which still has much potential to be explored.

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