

**Primary results from review of the previous research on the co-movements
between commodity and stock markets**

Table1

Previous studies designed to the co-movements between commodity and stock market

| No | Author | Aim | Findings |
|----|--------------------------|---|---|
| 1 | Creti et al.(2013) | To investigate the relationship between commodity and stock market | Correlation between stock and commodity market got stronger over time. Both commodity and S&P prices have dropped during the 2007-2008 financial crisis. |
| 2. | Ildırar and İşcan (2015) | To examine the impact of commodity prices on the stock market on the example of ECA countries | Stock prices and commodity prices do not move together in the long run. During the financial crisis of 2008 commodity prices experienced drop. |
| 3. | Yamori (2011) | To find out whether the correlation between commodity and equity market during last financial crisis. | Japanese equity market showed the same behavior as a commodity market during the 2008, but it was the temporary phenomenon. |
| 4. | Gulzar et al. (2019) | To investigate is there the <i>cointegration</i> between Asian emerging and the US equity markets during the financial crisis 2008. | The spillover effect as well the cointegration between Asian and the US stock markets were confirmed during the pre-, crisis and post-crisis periods. After the crisis the stock markets are highly cointegrated. |
| 5 | Roy and Roy (2017) | To examine the contagion between commodity derivative, stock, bond, foreign exchange markets in India | Increase of volatility has led to the rise of correlation during the crisis period. Mostly contagion was observed between stock and gold, in particular the stock market transmit volatility to the commodity market. |
| 6 | Öztek and Öcal (2017) | To investigate the effect of volatility and news on the correlation over time and financial crisis period. | The co-movement between commodity and stock market started before the financial crisis. In the turmoil period both precious metals and agricultural commodities experienced the high volatility and increased correlation level with the stock market. |
| 7 | Adams and Glück (2015) | To analyze the alteration the correlation patterns between commodity and stock market during pre and post-financialization period | The financial crisis was a reason of the co-movement in 2007-2009. The “style investing” caused co-movements between stock and commodity markets in the tranquil period 2009-2013. Spillover between stock and commodity market did not exist before the last financial crisis. |
| 8 | Jakpar et.al. (2013) | To measure volatility of stock markets between China and 5 ASEAN countries. | The globalization has increased co-movement between China’s and ASEAN stock markets. After the Financial crises those markets have become completely integrated. |

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| 9 | De Boyrie and Pavlova (2018) | To examine the commodity and equity co-movements in the Latin America and Asia | 1 Precious metals, agricultural commodities and stocks showed the low co- movements. 2.The stock and energy commodities showed the high level of integration . 3. The high and positive correlation and volatility has been found in the Financial crisis period. |
| 10. | Abdullah et.al. (2016) | To determine causality between crude oil prices and Islamic stock prices. | There is a clear co-movements between commodity and Islamic stock prices in a short -time period. Gold has been confirmed as a good diversification tool. |
| 11. | Azar and Chopurian (2018) | To define the relationship between commodity and stock market of the GCC countries. | The correlation between stocks and commodities was negative, thereby proving the diversification opportunities for investors. |
| 12. | Hoque and Farhan, (2017) | To examine the causality between gold, crude oil and stock markets in Thailand. | The bi-directional causality has been found between gold, crude oil and stocks. |
| 13. | Batten, Szilagyi and Wagner (2015) | To investigate the level of the relationship between commodities and stocks in the different regions of Asia | The Asia Pacific region demonstrated the low level of co-movements between stocks and commodity market. Co-movements between two markets increased in the last Financial crises of 2008. |
| 14. | Silvennoinen, Thorp (2013) | To determine the correlation between commodity and stock markets | 11 investigated commodities showed the strong correlation with stock indexes. The food and grain commodities and some metals have not illustrated the relationship with stocks. The correlation enhancement has been noticed in the last financial crisis period. |
| 15. | Huang et.al. (2017). | To investigate whether the crude oil price have influence on the stock market. | The crude oil price fluctuation can cause the changes of the stock markets in short and long periods. Increase of the crude oil price can lead to the boom of the stock market. |
| 16. | Hamma et.al. (2013). | To examine causality between stock and crude oil prices in Thunisia. | The Crude oil prices had direct and indirect impact in the different sectors of economy. There is unidirectional causality between crude oil and stock prices. |
| 17. | Kirithiga et.al. (2017) | To examine the spillover between commodity and stock market in India. | The spillover between such agricultural commodities as seed of Chana, Cotton seed oilcake, Jeera and Mustard seed, Wheat and Kapaskhali raw cotton has not been identified. |
| 18. | Baran, Ranusa (2010) | To overview and systematize the existing studies in the field of co-movements between commodity and stock market | The discussion of common co-movement patterns between commodity and stock market. |

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| 19. | Kurach (2012) | To estimate the interrelation between macroeconomic factors and equity, commodity prices in the different periods of the business cycle. | The correlation between commodity and stock indexes was low except the industrial metals prices. S&P has led the macroeconomic variables (CPI and PPI) earlier than commodity indexes however, the industrial metals behaved similar the S&P 500. Precious metals. Agricultural commodities and live stock have not affected by the business cycle fluctuations. |
| 20 | Bonato and Taschini (2016) | To prove that the co-movements of returns of three commodity indexes and commodity prices is a result of the commodity financialization. | Energy commodity prices and S&P GSCI, UBS Dow Jones CI showed the similar trend. Significant increase in co-movements has been found from 2005 between index non-energy commodities and indexes. That co-movements are results of commodity financialization process. |
| 21. | Shousha (2016) | To consider the impact of commodity prices shock on the business cycles fluctuations in advanced and emerging countries. | Commodity prices shock have a stronger effect on macroeconomic variables (the investment rate, output and real credit) in the emerging countries than in advanced countries. The impact on the interest rate factor is more stronger for emerging countries as well. This impact materializes through working capital channel. Commodity price shock can trigger the financial activity through the financial acceleration channel. |
| 22. | Claessens et.al. (2011) | To reveal the interaction between business and financial cycles. | The recession is harder in emerging countries than in advanced which is reflected in larger decline of macroeconomic variables and sharp increase of equity prices. |
| 23. | Sharma et. al. (2014) | To study the investment in commodity from the diversification perspectives. | Including the commodity futures to the portfolio gives the better return than keeping only stocks. |
| 24. | Valiante (2013) | To examine the key drivers of the commodity price formation. | The main reason for the commodity market financialization is a sharp the economic growth of such counties as China and India which are the main commodity suppliers and liberalization of world trade regulations. |
| 25. | Jégourel (2018) | To determine is there any cyclical movement of commodity prices. | There were a three super-cycles since last 19 th century. 1865-2010. The different commodities have the different cycle longitude. The cycles are usually characterized by increasing prices of industrial commodities as a main component of innovation technologies. |
| 26. | Youssef and Mokni (2019) | To investigate the dynamic correlation between oil prices and stock prices and their impact on oil importing and exporting countries Russia, Canada, Norway, China, the US, Japan | The correlation between oil and stock prices changed over time in all observed counties. It changed from the negative mean before 2006 to the strong positive during the crisis of 2008. The last crisis caused decline both the stock and oil prices. The oil and stock prices react similar to the economic and political events, |

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| 27. | Mensi (2019) | To study the co-movements between crude oil and stock markets (sectoral analysis) in Saudi Arabia | The co-movements increased in the period from 2008-2009. The stocks of petrochemical and tourism industries were most affected by oil prices. Food, media and telecommunication industries were less affected by oil price fluctuations. |
| 28. | Arfaoui and Rejeb (2017) | To determine whether the interrelation between oil, gold and stock markets. | There is a bi-lateral positive interdependence between oil, gold and stock markets (oil market is influenced by stock markets changes and vice versa). Stock market has negative relationship with the gold prices. |
| 29. | Tuna and Tuna (2019) | To determine which commodity can serve as safe haven property in the Islamic market? | 1.Agricultural commodities possess the safe haven property. 2.The energy commodities and industrial metals cannot be used for hedging purposes. 3.Presious metals have proved their strong hedging properties. |
| 30. | Lombardi and Ravazzolo (2013) | To determine whether the commodity and stock prices are both affected by the shocks. | The correlation between commodity and equity index prices steadily increased toward 2008. Also prices of both markets depends on news and general economic conditions. |
| 31. | Caballero, Farchi and Gourinchas (2008) | To investigate connection between crude oil prices and other asset prices during the financial crises of 2008 | In the first stage of the recession the correlation between crude oil and equity prices was negative. Subsequently the prices dropped in both markets. Rise of the crude oil prices increase the recession likelihood. |
| 32. | Childs and Kiawu (2009) | To determine the factors affected the rice price increasing in 2008. | The main factor, was the weakening of the US dollar, oil price and panic among rice importers. |
| 33. | Kang, Ratti, and Vespignani (2017) | To investigate the volatility of stock and commodity prices over time. | The influence of commodity prices to the stock market was stronger during the last financial crisis. |

Table 2

The empirical models and data exploited in the previous studies to identify the co-movements between commodity and stock markets

| Author | Period | Data frequency | Type of assets | Country/Region | Model/Research method |
|---------------------|--|-------------------|--|----------------|-----------------------|
| Creti et al. (2013) | January 2001-28 th November 2011. | Daily spot prices | Data includes the energy, metals, food commodity, CRBC (commodity Research Bureau) commodity index and S&P 500 index | Global data | DCC G ARCH model. |

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| Ildıran and İşcan (2015) | January 2012– May 2015 | Monthly data | Oil, rubber, wheat, iron prices. From stocks Share Prices as index for every country has been used. | ECA countries | Unit root test, Pedroni's panel cointegration test. |
| Yamori (2011) | 31 May 1986- 31 May 2010. | Daily data | Tokyo Commodity Exchange (TOCOM) and Tokyo Stock Exchange Stock Price Index (TOPIX). | Japan | The correlation calculated in Excel |
| Gulzar et al. (2019) | Period from July1 2005- 30 June 2015. | Daily data. | The USA, Malaysia, Korea, Russia, India, China, Pakistan stock indexes. | The USA, Malaysia, Korea, Russia, India, China, Pakistan | VAR, Impulse response function, DCC, GARCH model |
| Roy and Roy (2017) | Data from 3 April 2006- 31 March 2016. | Daily return | COMDEX commodity future index), gold price, SENSEX -Indian stock index | India | GARCH model has been used to determine the dynamic of contagion. VAR methods. |
| Öztek and Öcal, (2017) | 4 January 1990 to December 20, 2012. | Weekly return rate. | The agricultural (S&P-AG) and precious metal (S&P-PM) sub-indexes and S&P500 | Global | DCC GARCH model, |
| Adams and Glück, (2015) | Data (09/15/1994– 09/15/2008 and 09/15/2008- 9/30/2013. | Daily returns. | S&P 500, S&P Goldman Sachs Commodity Index (GSCI) includes : agricultural, energy commodity, industrial metals, gold, cattle. | Global | The algorithm for correlation change-point inference, VaR model (Galeano and Wied,2014) |
| Jakpar et al. (2013) | 2000-2009 | Monthly data | China and 5 ASEAN countries stock indexes | ASEAN countries | ADF test, VAR model, Impulse response function Granger causality test, Multivariate GARCH model. |
| De Boyrie and Pavlova (2018) | 2006-2016. | Daily data | MSCI World index Emerging markets Asia, Latin America, MSCI Europe. GSCI commodity index includes agriculture sector, livestock, industrial and precious metals | Global | DCC (dynamic conditional correlation) model. |
| Abdullah et al. (2016). | 28 July 2007- 28 February 2014. | Daily data | Islamic Index, Commodity: gold and corn prices | Singapore, Philippine, Malaysia, Indonesia | Granger causality and Johansen cointegration test. VAR model. |

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|------------------------------------|---|--------------------------|--|---|--|
| Azar and Chopuria, (2018) | 1 st January 2005- 28 February 2017. | Weekly data | Stock market: GCC:TASI, DFMGI, ADX, KWSE, BAX, MSM30 Commodity market: RICI (Rogers International Commodity Index) | GCC countries | Unit root test, GARCH model. RICI (Rogers International Commodity Index). |
| Hoque and Farhan, (2017) | August 1999 August 2013 | Monthly data | Data: Stock market index (MSCITH), Oil and price Gold price index from | Global | Granger causality test, VAR, VECM. Impulse Response Function |
| Batten, Szilagyi and Wagner (2015) | 1990-2012. | Monthly data | Commodity prices of crude oil WTI, natural gas, silver, steel aluminum, rice. Stock indexes of (HSI), (JCI), (KOSPI), (FBMKLCI Index), (PASHR), (MXSG), (TWSE) and (SET) | Korea, Malaysia, Indonesia, Hong Kong, Philippines, Singapore, Thailand, Taiwan | Regression analysis. |
| Silvennoinen, Thorp (2013). | May 1990- July 2009. | Weekly data. | Equity: S&P500, FTSE 100, DAX, CAC, TOPX (Japan) Grains, oilseeds, meat, livestock, food fiber, metals and petroleum | USA, Europe, Japan | DCC and GARCH model. |
| Huang et al. (2017) | October 2006 -December 2014 | Daily data | Brent oil price, SSEC (Shanghai composite index) | China | Granger causality test, VAR model. |
| Baran and Ranusa (2010) | 1959-2004 | Annual return | Trends and graphs of crude oil, gold and Nasdaq stock indexes | Global | Analysis of returns in different periods of business cycles has been made based on the |
| Kirithiga et al. (2018) | 1 January 2006- December 31, 2015. | Daily data | Indian 11 commodity indexes: MCX- COMDEX(Gold, Silver, Copper, Zinc, Aluminum, Crude oil, etc), and 8 NCDEX- Dhaanya constituents: against the NIFTY 50 futures prices | India | VAR model, Impulse response function. |
| Kurach (2012) | 01.2001– 12.2010. | Monthly logarithm return | S&P500 stock index, (GSCI) Excess Return Goldman Sachs Commodity Index (Energy, Industrial Metals, Precious Metals, Agriculture, Livestock) | Global | Correlational analysis and ADF test. |

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| Bonato and Taschini (2016) | April 9, 1998 to March 24, 2011. | 1 Minute frequency data | Data of the 25 commodity futures and S&P, GSCI, the DJ-UBS CI, and the Thomson Reuters CI. | USA | Bivariate regression. |
| Shousha (2016) | 1994:Q1-2013:Q4. | Quarterly data | commodity export prices (Soybeans, crude oil, Copper, Coal, Coffee, Gold, Platinum, Zinc etc). | Argentina, Brazil, Colombia, Australia, Peru, Canada, Norway, New Zeland | VAR model, Impulse response function. |
| Claessens et al, (2011) | 1960- 2009 | Quarterly data | MSCI Emerging Markets Index. The GDP, investment rate, consumption and unemployment indicators | 23 emerging and 21 advanced countries. | BB algorithm developed by Bry and Boschan (1971), to identify the turning points in the log level of a series. |
| Sharma et al. (2014) | 2003-2012 | Daily data | S&P CNX Nifty 50 Total Returns, Composite index(RBI) and Treasury bill index, most liquid future contracts MCX (Multi Commodity Exchange) and NCDEX (National commodity Derivatives). | India | Strategic asset allocation, Momentum, short, long strategies were used to choose the most optimal strategy. |
| Jégourel (2018) | 1900-2010. | Annual data | Energy commodity, agricultural commodity, Base Metal, Precious Metals , copper | Global | Analysis of business cycles based on the observation of annual commodity price changes. |
| Youssef and Mokni (2019) | 2008-2018 | Daily data | S&P500, SSEC China, Nikkei 225 Japan, OSEAX(OBX) Norway, S&P/TSX composite Canada and RTS index Russia | China, Japan, Norway, Canada, Russia | Dinamic Conditional correlation (DCC), FIGarch Model |
| Mensi (2019) | January 6 2007- February 6 2017. | Daily return | Brent and WTI crude oil prices. Tadawul index | Saudi Arabia | VaR analysis of and Wavelet analysis |
| Arfaoui and Rejeb (2017) | January 1995- October 2015 | Monthly data | Brent crude oil price, international gold price, the US dollar index and MSCI world stock market index. | Global | Simultaneous equation approach. |

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| Tuna and Tuna (2019) | From March 31st, 2008 - March 29th, 2018 | Daily data (Log return) | S&P Global BMI Shariah Index. The S&P GSCI Industrial Metals, S&P GSCI Energy, S&P GSCI Precious Metals, S&P GSCI Agriculture and S&P GSCI Softs Indices from commodity groups, the S&P WCI the world commodity price | Global | Baur and McDermott (2010) methodology regression analysis to identify safe haven property of commodities. Includes dummy variables of extreme movements of stocks. |
| Ravazzolo, (2013) | January 1980- December 2012 | Weekly returns | Morgan Stanley capital international equity index(MSCI), S&P Goldman Sachs commodity index (SPGSCI), | Global | DCC and GARCH model |
| Caballero, Farchi and Gourinchas (2008) | From 1988-2008. | Daily observations | WTI crude oil and S&P 500 index prices and Industrial production indexes | | OLS regression, the Model of World economy |
| Childs and Kiawu (2009) | Rice prices from 1998-2008 | Annual data | USDA, Foreign Agricultural Service, Production, Supply, and Distribution database | Vietnam, Cambodia, Pakistan, Thailand, India, China, Burma, USA | Analysis of the reasons of rice prices changes from 2000-2008. |
| Kang, Ratti and Vespignan, (2017) | 1981:M1 2014:M12. | Monthly data | World bank commodity data : coal, crude oil and natural gas prices, price index of metals, agriculture, fertilizer prices and precious metal index contains gold, silver, and platinum prices | Global | SVAR model |