Theoretical and Applied Economics
Volume XXX (2023), No. 4(637), Winter, pp. 291-298

The relationship between google trends search and energy commodity prices

Sakthivel SANTHOSHKUMAR
(Corresponding Author)
Bharathidasan University, Tiruchirappalli, India
Sakthisanthoshkumar04@gmail.com
Murugesan SELVAM
Bharathidasan University, Tiruchirappalli, India
Balasundram MANIAM
Sam Houston State University, Texas, USA

Abstract. *An attempt has been made in the study to examine the relationship between Google Trends Search and prices of Energy Commodity. This study used daily time series data for a period of five years from 01.01.2016 to 31.12.2020. The descriptive statistics revealed that the data on Google and Energy Commodities were normally distributed. The correlation analysis showed that there was positive relationship between the sample variables, namely, Google Search and prices of Energy Commodities (crude oil, crude oil mini, natural gas and natural gas mini). The findings of the study would be useful to the investors and other participants of commodities markets, by understanding the influence of Google Trends Search on the prices Energy Commodities.*

Keywords: Energy Commodities, Crude Oil, Natural Gas, Google Trends Search.

JEL Classification: Q21; D83; L86.

1. Introduction

Now a days, the developments of the energy market and the price of energy commodities depend on the online activities of internet users and the roles of mass-media. The access to information about current state and the prospects of energy commodities markets may not be at free of cost. The costs towards searing the data need to be borne heavily by the users based on which the trading and investment decisions are made by the investors. In other words, searching of information for trading or investment opportunities is costly to some extent. It is to be noted that those commodities or assets, which are open to the mass media would be preferred by the large investors, if the mass-media reduces the search costs to some extent for the retail investors. Media attention is frequently coupled with the intensity of activity on internet search engines like Google. The effect of mass media caused the capital flow to trading or investment opportunities (O'Hara, 1995; Barber and Odean, 2008**).** In the mass media era, the attention-based behaviour of individual is expected to shape the price levels of different assets, including prices of agricultural commodities. The Google Search behaviour of market agents and other stakeholders of stock and commodity markets influences the stock and commodity prices in the market.

There has been an attempt to examine the Google Search behaviour of market participants in relation to energy commodity markets, on a periodical basis. The researchers attempted to estimate the linkage between the number of searched keywords, attached to the specific Energy commodities in Google and the price movements of energy commodities. In the past, the market participants often took investment decision based on the information obtained from the newspapers, radio, television, extension services or interpersonal communication with peers. As stated earlier, the market participants often search for information from the internet, using search engines like Google, Youtube etc., On account of internet, the attention of participants, on the specific key words was widely interiors in the search engines, that need to be measured. Besides, the search queries in Google are extensively used in the literature and have the attention-driven behaviour of participants, particularly in financial markets, that are to be explained and examined. Da et al., 2011 found that the queries in the Google search captured the attention faster, compared to other well-established attention proxies. The attention driven behaviour is relevant, particularly for the agricultural and commodity markets: because of the growth of internet penetration during the last decades, both in developed and developing countries. In developing countries, the use of mobile phones in rural areas, in the recent period, provides information access at cheaper cost to many small farmers and traders compared to the traditional forms of information dissemination. The queries of Google search reflect more attention driven behaviour from non-professional market participants, who normally devote less time and resources for information search. But, professional market participants like large trading companies, global food companies and institutional investors, usually use the well-established sources for information, which are not necessarily obtained through the internet search engines. Indeed, the energy sector is characterised by the presence of many small non-professional market participants such as small farmers and small traders (Kristoufek 2015 and Goddard et al. 2015). However, the use of internet has become the new normal way of life, leading to a greater exposure to the agents and other participants, as huge information is diffused through the mass media. On the one hand, the availability of

information permits the small agents and other participants to promote their market performance, by improving their bargaining position. The small agents may respond better to market signals, to increase the spatial arbitrage between different markets and to coordinate better between supply and demand of energy commodities, in view of stock management, timing of harvest, and packaging and planting. In short, the market performance could be improved especially if the agents and other participants could access timely market information, where the internet plays a key role.

2. Literature Review

This section presents review of select papers and research works that focused on the dynamic relationship between Google Search and price performance of Energy Commodities markets.

Hari Krishnan A.V et al (2018) examined the presence of relationship between returns of the individual stocks in NIFTY50 and Google trends. The study employed Granger Causality Test to investigate the association between Google trends and individual stock returns. Laurens Bijl et al (2016) verified whether data from Google Trends could be used to forecast the stock returns. The few previous studies found that high Google search volumes predicted high returns during the first one to two weeks, with possible subsequent price reversals. Lean Yu et al (2019) found that the rapid development of big data technologies and the internet provides a rich mine of online big data (e.g., trend spotting), that could be helpful in predicting the oil consumption. Myrthe Van Dieijen et al (2018) asserted that volatility is an important metric of financial performance, for predicting and managing the volatility for all the stakeholders. This study examined whether volatility in User-Generated Content (UGC) could spill over to the volatility in stock returns. The sources for the user-generated content include tweets, blog posts, and google searches. Neri Kim et al (2018) examined whether Google searches could explain current and future abnormal returns, trading volume and volatility of the largest companies, listed on the OSLO Stock Exchange. The study found that increased Google searches generated volatility and trading volume. Tomáš Mišečka et al (2019) studied the impact of search queries on three internationally traded agricultural commodities – Corn, Wheat and Soybean – using weakly study confirmed the fact. The results showed that there was causal and permanent relationship between Google search queries and prices of corn and wheat, confirming the presence of attention-driven behaviour.

The above literature provides an overview of some empirical studies, already undertaken on the same lines of the present research. But only few studies focused on the relationship between Google Trends Search and Commodity. Therefore, the present study is an attempt to investigate the relationship between Google Trends Search and prices of Energy Commodity in the market.

3. Methodology

a) Objective of the study

This study examined the linkages and relationship between the movements of Google Trends Search and prices of Energy Commodities

Hypotheses of the study

For the purpose of this study, following three hypotheses were developed and tested in this study.

NH1 – There is no normal distribution among the Google Trends Search and prices of Energy Commodities.

NH2 – There is no stationarity among the Google Trends Search and price of Energy Commodities.

NH3 – There is no co-relation between the Google Trends Search and price of Energy Commodities.

Sample Selection

In order to examine the relationship between the Energy Commodity and Google Trends Search, the study focused on Four traded Energy Commodities (Crude Oil, Crude Oil Mini, Natural Gas and Natural Gas Mini) as these commodities are the oldest and the most influential Energy Commodities.

Sources of Data

The present study fully mainly depended on the secondary data, relating to the sample Energy Commodities) and Google Trends Search response data. For the purpose of this study, the data regarding the sample price of Energy Commodities were collected from MCX office website (https://www.mcxindia.com/market-data/bhavcopy). The required data about Google Trends Search feed were collected from Google Trends (https://trends.google.com/trends). The other required data were collected from reputed books, journals and websites. The data, collected from the above sources were analysed through SPSS 20.0 version and E-views 7 version.

b) Period of Study

The present study covered a period of five years, from 01.01.2016 to 31.12.2023.

c) Tools used in the Study

For the purpose of achieving the above objectives, the following tools were used for the analysis of data to find out the linkage between the movements of Google trends search and closing price of sample Energy Commodities.

- Descriptive Statistics (to find out the normal distribution of returns of sample Energy Commodities and Google Trend Search).
- Unit Root Test (to test the stationarity of returns of sample Energy Commodities and Google Trend Search).
- Correlation Matrix (to find out the correlation between the returns of sample Energy Commodities and Google Trend Search).

d) Limitations of the Study

The study suffered from the following limitations.

- The present study considered only four Energy Commodities, namely, Crude Oil, Crude Oil Mini, Natural Gas and Natural Gas Mini. The period of the study was limited to five years only.
- All the limitations, associated with statistical tools used in this study, were also applicable to this study.

4. Analysis of Relationship between Google Trends Search and Energy Commodities

A) Normality of Google Trends Search and Energy Commodities
B) Stationarity of Google Trends Search and Energy Commodities, and
C) Relationship between among Google Trends Search and Energy Commodities

A) **Normality of Google Trends Search and Energy Commodities**

Table 1 shows the results of descriptive statistics for Google Trends Search and prices of sample Energy Commodities during the study period from 01.01.2016 to 31.12.2020. The summary statistic, namely, minimum, maximum, mean, standard deviation, skewness and kurtosis were used to analyse the sample variables during the study period. For the purpose of this study, Google Trends Search (GTS) was taken as the independent variable while Energy Commodities, namely, Crude Oil, Crude Oil Mini, Natural Gas and Natural Gas Mini were considered as dependent variables. It is clear from the Table that the GTS (16.50), Crude Oil Mini (31.009) and Natural Gas Mini (21.604) recorded positive mean values of return, during the study period. Similarly, the returns crude Oil Mini reported high values (16.593) of standard deviation. The analysis of skewness revealed positive values of returns for sample variables, with GTS at 1.360, Crude Oil Mini at 0.0528, and Natural Gas Mini at 0.605 while negative values were recorded at -6.202 for Crude Oil and at -4.055 for Natural Gas during the study period. The analysis of skewness and kurtosis of the prices of sample commodities and Google Trends Search indicated that there was non-symmetric distribution of return data for the sample crude Oil, Crude Oil Mini, Natural Gas and Natural Gas Mini. In other words, data of all sample variables were not normally distributed. Therefore, the null hypothesis (NH1) – There is no normal distribution among the Google Trends Search and Energy Commodities, was rejected.

Table 1. *Normality Test for Google Trends Search and Energy Commodities during the study period from 01.01.2016 to 31.12.2020*

	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Independent Variable						
GTS	0	90	16.50	24.255	1.360	1.332
Dependent Variable						
Crude Oil	-1.000	0.1476	-0.019	0.138	-6.202	44.666
Crude Oil Mini	3.990	74.3900	31.009	16.593	.528	-0.174
Natural Gas	-1.000	0.2376	-0.014	0.159	-4.055	24.685
Natural Gas Mini	0.3000	68.1400	21.604	14.766	0.605	0.585

Sources: Data collected from https://www.mcxindia.com/market-data/bhavcopy) & https://trends.google.com/trends) and Computed SPSS 20.0

B) Stationarity (Unite Root Test) for Google Trends Search and Energy Commodities

Augmented Dickey-Fuller Test (ADF) and the Phillips-Perron Test (PP) were applied to examine the stationarity among the sample independent variable (Google Trends Search) and four dependent variables (Crude Oil, Crude Oil Mini, Natural Gas and Natural Gas Mini). Table 2 shows the results of the Augmented Dickey Fuller Test (ADF) and Phillips-Perron Test (PP), for daily closing values for Google Trends and sample Energy Commodities, during the study period from 01.01.2016 to 31.01.2020. The analysis of results of ADF and PPT was made at three significant levels, namely, 1%, 5% and 10%.

The probability values (p-values) for all the sample variables were nearly zero. The statistical values, using ADF test for all the sample variables, were -7.976734 for Google Trends Search, -3.311148 for Crude Oil, -4. 057183 for Crude Oil Mini, -4.190876 for Natural Gas and -2.493481 for Natural Gas Mini. The statistical values of Phillips Perron test, for the sample variables, were at -3.453099 for Google Trends Search, -2.911730 for, -2.884680 for Crude oil Mini and -2.237605 for Natural Gas Mini during the study period. These values were less than that of test critical values at 1%, 5% and 10% levels of significance. The ADF and PP Tests clearly revealed that the data of all sample variables attained stationarity. Hence the Hypothesis. (NH2) – There is no stationarity among the Google Trends Search and Energy Commodities, was rejected.

Table 2. *Stationarity (Unite Root Test) for Google Trends Search and Energy Commodities during the study period from 01.01.2016 to 31.12.2020*

		ADF		PP	
Variables	Level	t-statistic	Prob*	t-statistic	Prob*
Google Trends Search		-7.976734	0.0000	-3.453099	0.0000
	1%	-3.546099		-3.546099	
	5%	-2.911730		-2.911730	
	10%	-2.593551		-2.593551	
Crude Oil		-3.311148		-3.453099	0.0000
	1%	-3.546099	0.0000	-3.546099	
	5%	-2.911730		-2.911730	
	10%	-2.593551		-2.593551	
Crude Oil Mini		-4.057183	0.0000	-2.884680	0.0000
	1%	-3.550396		-3.546099	
	5%	-2.913549		-2.911730	
	10%	-2.594521		-2.593551	
Natural Gas		-4.190876	0.0000	-3.014600	0.0000
	1%	-3.548208		-3.546099	
	5%	-2.912631		-2.911730	
	10%	-2.594027		-2.593551	
Natural Gas Mini		-2.493481	0.0000	-2.237605	0.0000
	1%	-3.546099		-3.546099	
	5%	-2.911730		-2.911730	
	10%	-2.593551		-2.593551	

Sources: Data were collected from https://www.mcxindia.com/market-data/bhavcopy) & https://trends.google.com/trends) and Computed SPSS 20.0

C) Relationship between Google Trends Search and Energy Commodities

The general indicator (correlation matrix) of the market was employed to find out the relationship between Google Trends Search and prices of sample Energy Commodities. The results of correlation analysis, for Google Trends Search and sample Energy Commodities, during the study period from 01.01.2016 to 31.12.2020 are given in Table 3. As stated earlier, the Google Trends Search was considered as the independent variable while four indicators, namely, Crude Oil, Crude Oil Mini, Natural Gas and Natural Gas Mini Energy commodities were used as dependent variables. According to the results of the Table, there was positive correlation between Google Trends Search and sample Energy Commodities since GTS had recorded significant values of Crude Oil (0.000), Crude Oil Mini (0.033), Natural Gas (0.025) and Natural Gas Mini (0.003), at 99% confidence level. In other words, Google Trends Search had maintained relationship with the four variables of Energy Commodities (Crude Oil, Crude Oil Mini, Natural Gas and Natural Gas Mini)

during the study period. Hence, the null hypothesis, (NH3) – There is no co-relation between the Google Trends Search and Energy Commodities, was rejected.

Table 3. *The Results of Correlation between Google Trends Search and Energy Commodities (Cotton and Menthe Oil) during the study period from 01.01.2016 to 31.12.2020*

	Google	Crude Oil	Crude Oil Mini	Natural Gas	Natural Gas Mini
Independent Variable					
GTS	1				
Dependent Variable					
Crude Oil	0.000	1			
Crude Oil Mini	0.033	0.021	1		
Natural Gas	0.025	0.035	0.004	1	
Natural Gas Mini	0.003	0.001	0.032	0.028	1

Sources: Data were collected from https://www.mcxindia.com/market-data/bhavcopy) & https://trends.google.com/trends) and Computed SPSS 20.0
Note: GTS= Google Trends Search.

Conclusion and Future Direction

An attempt has been made in this paper to find out the evidences for the presence of the attention-driven behaviour of customers, including traders, investors and other participants, on Energy commodity markets. There was strong and long-run link age between Google Trends Search (GTS) and crude Oil and Natural Gas. As per the results of descriptive, statistics the data on Google Trends Search and Energy Commodities were normally distributed. The correlation analysis clearly showed fact that there was positive relationship between the Google search and sample energy commodities. This study confirmed that the attention-driven behaviour of market participants, by searching information about Energy commodities on internet, played a key role in the price formation and price discovery mechanism. In other words, the attention-driven behaviour was not only present in the financial markets, as found in the literature but also it started impacting Energy commodity markets in India. In short, the attention of investors towards the mass media, created short-run price movements and there is possibility for permanent effect in the future on the commodity prices.

References

Bijl, L., Kringhaug, G., Molnár, P. and Sandvik, E., 2016. Google searches and stock returns. *International Review of Financial Analysis*, *45*, pp. 150-156.

Blackwell, Challet, D. and Ayed, A.B., 2014. Predicting Financial Markets with Google Trends and Not so Random Keywords. *SSRN Electronic Journal*. <doi:10.2139/ssrn.2310621>

Barber, B.M. and Odean, T., 2013. The behavior of individual investors. In *Handbook of the Economics of Finance,* Vol. 2, pp. 1533-1570. Elsevier.

Bollerslev, T. and Zhou, H., 2009. Expected Stock Returns and Variance Risk Premia. *SSRN Electronic Journal*. <doi:10.2139/ssrn.1315328>

Da, Z., Engelberg, J. and Gao, P., 2011. In search of attention. *The Journal of Finance*, *66*(5), pp. 1461-1499.

Dieijen, M., Borah, A., Tellis, G.J. and Franses, P.H., 2016. Big Data Analysis of Volatility Spillovers of Brands across Social Media and Stock Market Performance. *ERIM Report Series*.

De Long, J.B., Shleifer, A., Summers, L.H. and Waldmann, R.J., 1990. Noise trader risk in financial markets. *Journal of political Economy*, *98*(4), pp. 703-738.

Duchin, R., Gilbert, T., Harford, J. and Hrdlicka, C., 2017. Precautionary savings with risky assets: When cash is not cash. *The Journal of Finance*, *72*(2), pp. 793-852.

Fama, E.F., 1998. Market Efficiency, Long-Term Returns, and Behavioral Finance. *SSRN Electronic Journal*.

Hallet, D. and Ayed, A.B., 2014. Predicting Financial Markets with Google Trends and Not so Random Keywords. *SSRN Electronic Journal*. <doi:10.2139/ssrn.2310621>

Han, S., Lerner, J.S. and Keltner, D., 2007. Feelings and consumer decision making: The appraisal-tendency framework. *Journal of consumer psychology*, *17*(3), pp. 158-168.

Jaffe, J., Keim, D.B. and Westerfield, R., 1989. Earnings yields, market values, and stock returns. *The Journal of Finance*, *44*(1), pp. 135-148.

Joseph, K., Wintoki, B.M. and Zhang, Z., 2011. Forecasting abnormal return and trading volume using investor sentiment: Evidence from online search. *International Journal of Forecasting,* 27(4): pp. 1-21.

O'Hara, E.B., Chekanova, J.A., Ingle, C.A., Kushner, Z.E.R., Peters, E. and Kushner, S.R., 1995. Polyadenylylation helps regulate mRNA decay in Escherichia coli. Proceedings of the National Academy of Sciences, 92(6), pp. 1807-1811.

Malkiel, B.G. and Fama, E.F., 1970. Efficient capital markets: A review of theory and empirical work. *The journal of Finance*, *25*(2), pp. 383-417.

Kim, N., Lučivjanská, K., Molnár, P. and Villa, R., 2019. Google searches and stock market activity: Evidence from Norway. *Finance Research Letters*, *28*, pp. 208-220.

Lingaraja, K., Selvam, M. and Venkateswar, S., 2015. An empirical examination of returns on select Asian stock market indices. *Journal of Applied Finance and Banking*, 5(2), p. 97.

Lerner, J.S. and Keltner, D., 2000. Beyond valence: Toward a model of emotion - specific influences on judgement and choice. *Cognition & emotion*, *14*(4), pp. 473-493.

Saunders, E.M., 1993. Stock prices and Wall Street weather. *The American Economic Review*, *83*(5), pp. 1337-1345.

Santhoshkumar, S., Murugesan, Selvam, Chinnadurai, Kathiravan and Dhamotharan, Dhanasekar, An Assessment of Correlation between Twitter Sentiments Indicators and Stock Market Indicators, with Reference to BSE and NSE in India *(2021). International Journal of Financial Management*, *11*.

Takeda, F. and Wakao, T., 2014. Google search intensity and its relationship with returns and trading volume of Japanese stocks. *Pacific-Basin Finance Journal*, *27*.

Mišečka, T., Ciaian, P., Rajčániová, M. and Pokrivčák, J., 2019. In search of attention in agricultural commodity markets. *Economics Letters*, *184*, 108668.

Usman, B., Kananlua, P. and Susetyo, S., 2012. Google search traffic and its influence on bid/ask spread. The Malaysia Indonesia International Conference on Economics, Management and Accounting. University of Sriwijaya, Indonesia.

Van Dishoeck, E.F. and Black, J.H., 1986. Comprehensive models of diffuse interstellar clouds-Physical conditions and molecular abundances. *The Astrophysical Journal Supplement Series*, *62*, pp. 109-145.

Vittengl, J.R. and Holt, C.S., 1998. A time-series diary study of mood and social interaction. *Motivation and Emotion*, *22*(3), pp. 255-275.