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Market efficiency and calendar anomalies in commodity futures markets: a review

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Abstract This study reviews the literature on market efficiency and calendar anomalies in agricultural commodity futures markets in India and abroad. The study finds that most studies used ordinary least squares regression analysis to test for the weak form of market efficiency and only a few markets are found to be weakly efficient. Many studies that depict market inefficiency report the presence of calendar anomalies in metals and agricultural commodity futures. The most frequently observed calendar anomalies are the day-of-the-week effect and the month-of-the-year effect. Knowing about these market inefficiencies may help commodity market players formulate their purchase, sale, and trading strategies.

Keywords Commodity markets, futures market, calendar anomalies, day-of-the-week effect, month-of-the-year effect

JEL codes G14, Q14

Market efficiency serves as the central paradigm in explaining the behaviour of prices in financial securities and reflects the ability of markets to process information with respect to time, accuracy, speed, and quality. The efficient market hypothesis (Fama 1965), which holds that a market is efficient if asset prices reflect all the available information, implies that in efficient markets asset prices are appropriate in terms of current market knowledge and information and market participants find it difficult to earn abnormal risk-adjusted returns based on historical or current prices or on market information. Successive price changes are independent of each other, and they do not follow any pattern or trend, that is, they do not follow random walk behaviour (Malkiel 2003).

Market efficiency may be weak, semi-strong, or strong (Fama 1970). The weak form of market efficiency implies that current market prices reflect all the information contained in historical prices. This is contrary to the concept of technical analysis, which is based on historical price and volume data. Markets that are inefficient in their weak form are predictable, and

investors or traders can use the tools and indicators of technical analysis to earn supernormal profits (Ahmad et al. 2006; Arora and Singh 2017). In the semi-strong form of market efficiency current market prices reflect not only the past prices but also all publicly available information; fundamental analysis becomes futile, and market participants cannot use past prices or publicly available information to make above-average returns. The strong form of market efficiency includes not only all published and known information but also all significant information not published yet, including insider information, if any, and even insiders cannot derive above-average returns (Aktan et al. 2017).

Numerous research studies into the efficiency of financial markets have found that calendar anomalies in asset prices—or variations in asset returns that follow certain time-dimensional patterns and that are contrary to the concept of market efficiency—occur with surprising regularity (Buguk and Brorsen 2003; Nath and Dalvi 2004; Tolikas 2018). Calendar anomalies may take various effects: day-of-the-week, weekend, week-of-the-month, month-of-the-year, turn-of-the-

month, turn-of-the-year, and Halloween.

When the average daily returns of traded assets differ significantly on the trading days of the week, the anomaly is referred to as the day-of-the-week effect. Many studies have found the day-of-the-week effect in assets worldwide (Brown et al. 1983; Gao and Kling 2005). When the average trading returns on Monday are significantly different from those on the preceding Friday, the anomaly is known as the weekend effect. Numerous studies have found a negative return on Monday, significantly different from the positive return on the preceding Friday (Cross 1973; Gibbons and Hess 1981).

The month-of-the-year effect is that the returns expected on traded assets differ statistically by the month of the year. Many researchers have found this anomaly in various financial markets (Gupta and Basu 2007; Chia and Liew 2012). Many empirical studies have documented that the average returns on traded assets are significantly different in the month of January than in the other months of the year (Keim 1983; Agrawal and Tandon 1994); this effect is commonly known as the January effect.

Most researchers have also documented the turn-of-the-month effect, or the phenomenon when the average daily returns of traded assets at the turn of the month differ from the average daily returns during the rest of the month. The returns averaged during the first half of the month are generally higher than those during the second half (Ariel 1987). When the returns at the start of a year differ significantly from the returns at the end of the previous year the phenomenon is termed the turn-of-the-year effect (Rozeff and Kinney 1976; Ritter 1988). Sometimes the average returns are found to differ by season. Researchers have found that in most developed economies the returns during the winter exceed those during the summer; this effect is termed the Halloween effect (Jacobsen and Zhang 2013; Burakov et al. 2018).

Many studies have been conducted in developed and developing countries to test the efficiency of the stock market (Poshakwale 1996; Buguk and Brorsen 2003; Nath and Dalvi 2004) and of the bond market (Conroy and Rendleman 1987; Tolikas 2018). The stock market is found to be more informationally efficient than the bond market (Tolikas 2018). The empirical studies have detected the presence of various seasonal effects in the

stock markets of developed economies—such as Australia (Brown et al. 1983; Liu and Li 2011); Italy (Barone 1990); UK (Choudhry 2001); US (Davidsson 2006; Gu 2015); and Japan (Chia and Liew 2012)—and in developing economies such as Bangladesh (Rahman and Amin 2011; Abedin et al. 2015); China (Gao and Kling 2005); Colombia (Wickremasinghe 2007); and India (Ahmad et al. 2006; Gupta and Basu 2007; Srinivasan 2010; Arora and Singh 2017). These findings indicate widespread inefficiency in these markets.

The Indian bond market is inefficient—it does not follow random walk behaviour (Babu 2017)—and traders can speculate and gain abnormal returns; the presence of seasonality also implies inefficiency (Schneeweis and Woolridge 1979; Jordan and Jordan 1991; Athanassakos and Tian 1998). Bepalko (2009) employed dummy regression and the bootstrap approach to detect the presence of calendar effects in the daily bond returns of some emerging economies. The results show the day-of-the-week effect in bond returns, with significantly different returns on Tuesday and significantly higher returns at the end of the month as compared to the rest of the month, indicating inefficiency in the bond market.

The commodity market, one of the important segments of the financial market, acts as an alternative source of investment. The rates of returns on assets in commodity markets have a low correlation with those of stock or bond markets because commodity assets are more heterogeneous than stock or bond market assets. The heterogeneity of commodities allows market participants to construct a more diversified investment portfolio—consisting of stocks, bonds, and commodities—and also facilitates in protecting their portfolio from the negative effects of inflation.

In commodity futures markets buyers and sellers enter into a contract to buy or sell a commodity at a predetermined price at a future date. Futures contracts allow market traders, farmers, and producers to manage their price risk; facilitate price discovery for the commodity; and enable the current futures prices to indicate the expected spot price on the date of the maturity of the futures contract. In an efficient futures market the current futures price reflects all the market information available for predicting the futures spot price and it eliminates the possibility for market

participants to use past prices and the information available to beat the market and earn abnormal risk-adjusted returns.

Few researchers have empirically studied market efficiency in emerging economies like India (Naik and Jain 2001; Ranganathan and Ananthakumar 2014), and most of them have focused on testing the weak form of efficiency of commodity futures (Naik and Jain 2001; Lokare 2007; Inoue and Hamori 2012; Patel and Patel 2014), but some have examined both the weak and semi-strong forms of efficiency in commodity markets (Ranganathan and Ananthakumar 2014). The literature on the efficiency of commodity futures markets and calendar anomalies is limited, and this study aims to group and analyse the efforts, but the paucity of evidence is a limitation. Commodity markets are evolving, and future studies may use better research evidence to fine-tune research outcomes.

After describing the methodology performed for this literature review, the paper highlights the empirical studies on the efficiency of commodity futures markets and the empirical studies on the types of calendar anomalies in commodity markets.

Methodology

This study uses descriptive research. We explain market efficiency and attempt to identify it in commodity futures markets, especially of agricultural produce, metals, and energy. We apply a structured search on research databases—such as EBSCO (<https://search.ebscohost.com>), Google Scholar (<https://scholar.google.com>), and Elsevier (<https://www.sciencedirect.com>)—using phrases such as ‘market efficiency’ and ‘commodity markets’ to identify and collect research papers published in peer-reviewed journals and conference proceedings. We also include agricultural, metals, and energy commodity markets. The literature on commodity markets is divided into efficiency and the presence of calendar anomalies.

Market efficiency

In efficient commodity futures markets the information that current futures prices provide on spot prices in the future (maturity) is efficient, making it difficult to gain above-average returns using effective trading or hedging strategies. Efficiency in commodity futures

markets is one of the most widely studied topics in the financial literature, especially in developed countries. Tests of the efficiency of commodity futures markets have been conducted in developed countries like the US, UK, and Japan and to some extent in emerging countries like India, China, Korea, and South Africa.

Most empirical studies have focused on studying the weak form of market efficiency of futures market based on historical prices and volume data; few empirical studies have tested for other forms of market efficiency. Tests for the weak form of market efficiency are mostly based on ordinary least squares (OLS) regression analysis. Some researchers have employed econometric techniques like cointegration tests and ARIMA (autoregressive integrated moving average) or GARCH (generalized autoregressive conditional heteroscedasticity) models. Few studies have tested for the semi-strong form of market efficiency based on past data and publicly available information, and most of them are based on ARIMA models. Most studies have examined the pricing efficiency in agricultural commodities, metals, and energy futures.

The efficiency of commodity futures markets is tested by 30 studies (Table 1); 26 (86.67%) test the efficiency of agricultural futures, 5 (16.67%) test the efficiency of metal futures, and only 3 studies (10%) test the efficiency of energy futures (the percentages total more than 100 as 4 studies assess more than 1 kind of market). The market efficiency of agricultural commodities, metals, and energy futures have been tested. Agricultural commodities include black lentil, cashew, castor seed, chickpea, cocoa, coffee, corn, oats, rye, potatoes, soybeans, frozen pork bellies, live beef cattle, soybean, sugar, live hogs, orange juice, red lentil, rice, wheat, etc. Metals include aluminium, copper, lead, nickel, tin, zinc, etc. Energy futures include Brent crude, crude oil, heating oil, natural gas, etc.

To investigate efficiency the studies applied OLS regression analysis (13 studies, or 43.33%), cointegration tests (7 studies, or 23.33%), serial correlation and run tests (4 studies, or 13.33%), GARCH models (3 studies or 10%), and Granger causality tests (3 studies or 10%). Of the 30 studies, 23 (76.67%) tested for the weak form of market efficiency and the remaining 7 studies (23.33%) tested for the semi-strong form. Some studies (8, or 26.67%) documented efficiency in the market but others found

Table 1 Research studies related to market efficiency of commodity futures markets

Researcher/s (Year)	Market efficiency	Commodities/ commodity indices	Period	Test	Results/ Observations
1 Smidt (1965)	Weak	Soybeans	1952–1961	Mechanical trading rules	Mixed results
2 Stevenson and Bear (1970)	Weak	Corn and soybeans	1957–1968	Serial correlations test, run test, and filter rules test	Inefficient market
3 Tomek and Gray (1970)	Weak	Corn, potatoes, and soybeans	1952–1968	OLS regression analysis	Mixed results
4 Cargill and Rausser (1972)	Weak	Copper, corn, frozen pork bellies, live beef cattle, oats, rye, soybeans, and wheat	1962–1968	Autocorrelation function analysis, spectral density function analysis, integrated periodogram analysis	Mixed results
5 Kofi (1973)	Weak	Cocoa, coffee, corn, Maine potato, soybean, and wheat	1953–1969	OLS regression analysis	Efficient market
6 Gupta and Mayer (1981)	Semi-strong	Cocoa, coffee, copper, sugar, and tin	1976–1979	ARIMA model, MSE, and Student's t-test	Efficient market
7 Just and Rausser (1981)	Semi-strong	Cotton, corn, hogs, live cattle, soybeans, soybean meal, soybean oil, and wheat	1976–1978	RMSE and root mean squared percentage error	Mixed results
8 Spriggs (1981)	Weak	Corn	1959–1978	Box-Jenkins method, OLS regression analysis	Mixed results
9 Rausser and Carter (1983)	Semi-strong	Soybean, soybean meal, and soybean oil	1977–1980	ARIMA models, MSE criterion	Mixed results
10 Bigman et al. (1983)	Weak	Corn, soybeans, and wheat	1975–1980	OLS regression analysis, Durbin-Watson (DW) test	Inefficient market
11 Bigman and Goldfarb (1985)	Weak	Corn, soybeans, and wheat	1975–1980	Regression analysis, filter rule test, and moving averages	Inefficient market
12 Canarella and Pollard (1985)	Semi-strong	Corn, soybeans, soybean meal, soybean oil, and wheat	1960–1982	Full information maximum likelihood (FIML) test and likelihood ratio test	Efficient market
13 Gordon (1985)	Weak	Corn, cotton, live cattle, live hogs, orange juice, rough rice, soybeans, and wheat	1979–1984	Turning-point test, difference-sign test, chi-square goodness-of-fit test, squared ranks test	Mixed results
14 Aulton et al. (1997)	Weak	Pig meat, potatoes, and wheat	1986–93 (for pig meat) 1980–1993 (for wheat and potatoes)	Cointegration test	Market efficiency was found in case of wheat futures but not in case of pig meat and potato futures

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15	McKenzie and Holt (1998)	Weak	Corn, live cattle, live hogs, iced broilers, and soybean meal	1966–1995	Engle-Granger test, Johansen cointegration tests, GARCH-M, and ARCH-M models	Market efficiency was found in case of corn, live cattle, live hogs, and soybean meal futures markets but not in case of iced broiler futures
16	Kellard et al. (1999)	Weak	Brent crude, gasoil, live hogs, live cattle, soybeans and Deutschmark/dollar exchange rate	1989–1996 (Brent crude), 1990–1996 (gasoil), 1982–1996 (Live hogs and Live cattle), 1979–1996 (Soybeans) and 1976–1996 (Deutschmark/dollar exchange rate)	Johansen cointegration test	Long-run equilibrium relationship was found along with short-term inefficiency for most markets
17	King (2001)	Semi-strong	Live cattle	1980–1988	Forecast error approach and model prediction approach	Efficient markets
18	Wang and Ke (2005)	Weak	Soybean and Wheat	1998–2002	Johansen cointegration test and likelihood ratio tests	Futures market was found to be efficient for soybean futures and inefficient for wheat futures
19	Phukubje and Moholwa (2006)	Weak	Sunflower seeds and Wheat	2000–2003	Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, Ljung-Box Q-statistic	No strong support was seen for weak form inefficiency in South African futures markets for wheat and sunflower seeds
20	Kaur and Rao (2010)	Weak	Chana, guar seed, pepper and refined soya oil	2008–2009	Autocorrelation test and run test	Efficient markets
21	Ali and Gupta (2011)	Weak	12 major agricultural commodities namely black lentil, cashew, castor seed, chickpea, guar seed, pepper, maize, red lentil, rice, soybean, sugar, and wheat	N.A.	Johansen cointegration test and Granger causality test	Efficiency was found for all futures except wheat and rice futures
22	Kim et al. (2011)	Semi-strong	Leek, radish, onion, and Korean cabbage	2001–2009	Multifractal detrended fluctuation analysis (MF-DFA) method	Korean agricultural commodity market was found to be less efficient

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23	Inoue and Hamori (2012)	Weak	Multi-Commodity price indices i.e. Spot index (MCXSCOMDEX) and Futures index (MCXCOMDEX)	2006–2011	Johansen Cointegration test, fully modified OLS (FMOLS) and dynamic OLS (DOLS)	Market efficiency was found in India after July 2009
24	Kristoufek and Vosvrda (2013)	Semi- strong	4 energy futures (Brent crude oil, WTI crude oil, heating oil and natural gas), 5 metal futures (copper, gold, silver, palladium and platinum), 7 grain futures (corn, oats, rough rice, soybean meal, soybean oil, soybeans, and wheat), 5 soft futures (cocoa, coffee, cotton, orange juice and sugar) and four other agricultural commodities futures (feeder cattle, lean hogs, live cattle and lumber)	2000–2013	Efficiency index, long-term memory, fractal dimension, and approximate entropy	Heating oil is found to be most efficient followed by WTI crude oil, cotton, wheat, and coffee; and markets for live cattle and feeder cattle to be least efficient
25	Zelda (2013)	Weak	Maize and wheat	2006–2011	ADF method, Augmented Engle-Granger (AEG) cointegration test and Error Correction Model (ECM)	Inefficient market
26	Harper et al. (2015)	Weak	Silver futures	2008–2012	Autocorrelations and runs tests	Efficient market
27	Lean and Smyth (2015)	Weak	Crude palm oil	1999–2014	ADF test and GARCH unit root test with multiple structural breaks	Mixed results
28	Samal et al. (2015)	Weak	Cotton, turmeric, and castor seed	2013	OLS regression analysis and Granger causality tests	Efficient market
29	Gorska and Krawiec (2016)	Weak	Crude oil	2000–2015	Runs test, variance ratio test, autocorrelation tests	Mixed results
30	Park and Lim (2018)	Weak	Aluminium, copper, lead, nickel, tin, and zinc	2000–2016	OLS regression analysis, and GARCH (1,1) models	Markets for all the commodity futures were found to be inefficient except for zinc

Source Collected by authors

inefficiency (Stevenson and Bear 1970; Bigman et al. 1983; Bigman and Goldfarb 1985; Zelda 2013). Out of those that depicted efficiency, 5 studies (16.67%) found the markets to be weakly efficient and the remaining 3 (10%) found semi-strong efficiency.

Many studies (17, or 56.67%) documented the mixed nature of efficiency of the different types of commodity markets (Smidt 1965; Cargill and Rausser 1972; Wang and Ke 2005; Lean and Smyth 2015). Most studies used OLS regression analysis to test for the weak form of efficiency of agricultural commodity futures markets and few found markets to be weakly efficient.

Calendar anomalies

Calendar anomalies are significant variations in asset returns that follow certain patterns or trends over time. Investors and traders can gain above-average or abnormal returns if they exploit these anomalies. Most of the empirical evidence cites their existence in stock returns (Brown et al. 1983; Barone 1990; Gupta and Basu 2007; Arora and Singh 2017), but few studies discuss calendar anomalies in commodities. Calendar anomalies are found not only in agricultural commodity futures but also in non-agricultural commodity futures like precious metals (gold, silver, platinum), rubber, crude oil, heating oil, etc. The empirical evidence reports the presence of calendar anomalies—like the day-of-the-week effect, weekend effect, month-of-the-year effect, day-of-the-month effect, intra-month effect, and Halloween effect—in commodity futures in markets in developed and emerging countries (Table 2). Researchers have found the presence of calendar anomalies in agricultural futures (7 studies, or 35%), metal futures (11 studies, or 55%), and energy futures (3 studies, or 15%) (the percentages total more than 100 as some studies assess more than 1 kind of futures).

The empirical studies report the existence of calendar anomalies in agricultural commodities like wheat (Lee et al. 2013), cocoa and coffee (Burakov and Freidin 2018), soybean meal (Borowski 2015 c), rice (Arendas 2017), coarse wool (Burakov and Freidin 2018), cotton (Arendas 2017), frozen concentrated orange juice (Borowski 2015 a), barley, tea (Burakov and Freidin 2018), etc. Most studies report the day-of-the-week effect in metals (like gold, silver, platinum, palladium, aluminium, and copper) and in energy futures (like crude oil). Further, 13 studies (65%) report the day-

of-the-week effect and 9 studies (45%) report the month-of-the-year effect. Of the 13 studies that report the day-of-the-week effect, 9 studies (45%) report it in metal futures and only 3 (15%) report it in agricultural commodity futures. The month-of-the-year effect is reported by 4 studies (20%) in agricultural commodities and 3 studies (15%) in metal futures. Among the rest of the anomalies, 3 studies (15%) report the Halloween effect, 3 (15%) report the day-of-the-month effect, 2 (10%) report the weekend effect, and 2 (10%) report the semi-month or fortnight effect (the returns of the first fortnight are significantly different from second fortnight) effect in commodity futures. The day-of-the-week effect was found not only in returns of gold and silver futures (Kohli 2012) but also in the volatility of gold futures (Aksoy 2013).

The average returns for agricultural commodities were found to be significant for different days of the week, like Monday effect (feeder cattle, live cattle, lean hogs) Tuesday effect (canola oil), Wednesday effect (heating oil, natural gas, lumber, live cattle, and lean hogs), Thursday effect (rice, feeder cattle, live cattle), and Friday effect (Brent oil). Evidence has been found of the presence of the weekend effect in gold and copper market with significantly positive and higher returns on Friday and negative and lower on Monday.

Different monthly effects have been found: January effect (heating oil, natural gas, lumber), April effect (soybean futures), August effect (heating oil, soybean meal, wheat), September effect (soybean, heating oil, canola oil, soybean oil), October effect (corn, natural gas), November effect (Brent oil, lumber), and December effect (natural gas, feeder cattle, live cattle). Monthly seasonality was also observed in rubber futures and frozen concentrated orange juice futures, but not in metal futures.

The average returns during the winter were found to be higher than those during the summer in agricultural commodity markets (Arendas 2017; Burakov and Freidin 2018) and energy markets (Burakov et al. 2018), indicating the presence of the Halloween effect (higher average winter period returns). However, the 'reverse Halloween effect' (higher average summer period returns) was found only in poultry futures (Arendas 2017; Burakov and Freidin 2018) and tea futures (Burakov and Freidin 2018). The returns were also found to be significantly different on different days

Table 2 Calendar anomalies in commodity futures markets

Researcher/s (Year)	Commodities/ Commodity indices under study	Data	Period	Results/ Observations
1 Ma (1986)	Gold	Daily London gold afternoon fixings	1972–1985	Higher Wednesday returns when the next-day settlement procedure was implemented and negative weekend effect was found after imposition of same-day settlement procedures
2 Coutts and Sheikh (2000)	All Gold Index	Daily closing values from Johannesburg Stock Exchange (JSE)	1987–1997	No January effect and other monthly effects
3 Lucey and Tully (2006)	Gold and silver	COMEX gold and silver cash and futures returns	1982–2002	Negative Monday effect was found across cash and futures markets of both the metals
4 Yu and Shih (2011)	Gold and crude oil	Daily closing prices of crude oil from West Texas Intermediate (representing the oil spot market) and daily closing prices of gold from London 99.5% fine afternoon fixing (representing the gold spot market)	1986–2007	Positive Thursday effect was found in the gold market and a positive Wednesday effect was found in the oil market
5 Kohli (2012)	Gold and Silver	Daily and monthly closing prices for both the commodities from Bloomberg	1980–2012	Day-of-the-week effect was found in both gold and silver market, but a weak January effect was found in gold only
6 Aksoy (2013)	Gold and Silver	Daily reference exchange data from Istanbul Gold Exchange	2008–2011	Day-of-the-week effect was found in returns of gold only; but volatility was found in both the metals
7 Lee et al. (2013)	Four agricultural commodity futures namely corn, soybeans, soybean meal, and wheat traded on CBOT	Daily settlement prices of commodity futures from CBOT	1979–2012	Higher returns in the months of April (soybeans future), August (soybean meal future and wheat future) and October (corn future) as compared to other months
8 Tuna (2013)	Gold	Daily closing prices from Istanbul Gold Exchange	1995–2012	Significantly higher returns for Monday indicating the absence of weekend effect in Istanbul Gold Exchange
9 Gorska and Krawiec (2014)	Four precious metals: gold, silver, platinum, and palladium	London daily closing prices of metals	2008–2013	Day-of-the-week effect (Friday effect) and the month-of-the-year effect (September effect) in silver, January, and September effects in platinum and September effect was found in palladium. But no calendar effects in gold
10 Kohli (2014)	Copper and Aluminium	Daily and monthly closing prices from Bloomberg	1987–2012	Daily seasonality was found in variances of both the metals but January effect was absent in returns and variances of both the metals

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11	Borowski (2015 a)	Frozen concentrated orange juice futures	Prices of FCOJ futures	1967–2015	February and June effects in monthly average rates of return and February, June, and December effects in daily average rates of return. Average rates of returns to be different for different days of the month i.e. 2nd, 21st, 23th and 31 st and the daily average rates of return are different in the first and the second half of the month
12	Borowski (2015 b)	Rubber futures	Prices of rubber futures quoted on Tokyo Commodity Exchange	1981–2015	February, March, April, June, July, August, October and December effects in the daily average rates of return; and May and November in the monthly average rates of return. Moreover, daily average rates of returns were also found to be different on different days of the week (i.e. Thursday) and different days of the month (i.e. 15 th)
13	Borowski (2015 c)	Barley, canola, rough rice, soybean oil, and soybean meal futures contracts	Prices of barley and canola futures contracts as quoted on the Canadian ICE Futures Exchange; and prices of soybean oil futures, soybean meal futures, and rough rice futures as quoted on Chicago Mercantile Exchange	1998–2015	Month-of-the-year effects with significantly different returns in months of February and September (for soybean oil), September (for canola) and July, September and October (for soybean meal) and day-of-the-week effect with significantly different returns on Tuesdays (for canola) and Thursdays (for rough rice). Moreover, daily average rates of return for different days of the month to be significant: 4th (barley), 12th (canola), 5th (rough rice) and 9th (soybean oil and soybean meal)
14	Gorska and Krawiec (2015)	Crude oil	Daily closing prices of crude oil from West Texas Intermediate (USA origin) and Brent (North West Europe origin)	2000–2014	Day-of-the-week effect was found with significantly different returns on Monday and Friday and month-of-the-year effect was found with significantly different returns in the month of February
15	Borowski (2016)	Crude oil, Brent oil, heating oil, gas oil, natural gas, live cattle, feeder cattle, lean hogs, and lumber futures	Prices of crude oil, Brent oil, heating oil, gas oil and natural gas futures contracts as quoted on the New York Mercantile Exchange and prices of live cattle, feeder cattle, lean hogs, and lumber futures as quoted on Chicago Mercantile Exchange	1983–2016 (for crude and Brent oil), 1979–2016 (for heating oil), 1998–2016 (for gas	Month-of-the-year effects with significantly different returns in months of January (heating oil, natural gas and lumber), February (gas oil), August (heating oil), September (heating oil, natural gas and lumber), October (natural gas), November (crude oil, Brent oil and lumber) and December (natural gas and feeder

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16	Yu et al. (2016)	Gold	Daily gold spot prices of the Tokyo, London, and New York markets	oil), 1990–2016 (for natural gas), 1973–2016 (for feeder cattle and lumber), 1970–2016 (for live cattle) and 1969–2016 (for lean hogs)	cattle). Moreover, day-of-the-week effect was found with significantly different returns on Mondays (feeder cattle, live cattle, lean hogs), Tuesdays (heating oil), Wednesdays (heating oil, natural gas, live cattle, lean hogs and lumber), Thursdays (crude oil, feeder cattle, live cattle) and Fridays (Brent oil, heating oil). Daily average rates of return were also found to be different in the first and in the second half of each month in the lean hogs market
17	Arendas (2017)	20 agricultural commodities namely barley, beef, coarse wool, cocoa, coffee arabica, coffee robusta, corn, cotton, fine wool, hides, palm oil, pork, poultry, rice, rubber, soybean, soybean meal, soybean oil, sugar, and wheat	Monthly closing prices for agricultural commodities as provided by International Monetary Fund (IMF) database	1980–2015	Significantly positive Friday effect and negative Tuesday effect in average returns for all the markets Significantly higher average returns have been found during winter period than summer period in case of 10 commodities indicating the presence of 'Halloween effect'. But a 'reverse Halloween effect' was found in case of poultry only
18	Borowski and Lukasik (2017)	Gold, Silver, Platinum, Copper, and Palladium	Daily prices of metals from London Metal Exchange	1994–2014	Negative September effect was found in case of palladium market only and weekend effect was found in case of copper and gold markets
19	Burakov and Freidin (2018)	27 agricultural commodities namely Bananas, Barley, Beef, Coarse Wool, Cocoa, Coffee Arabic, Coffee Robusta, Corn, Cotton, Fine wool, Fish Meal, Hides, Lamb, Olive oil, Oranges, Palm oil, Pork, Poultry, Rice, Rubber, Soybean, Soybean meal, Soybean oil, Sugar, Sunflower oil, Tea, and Wheat	Monthly closing prices for agricultural commodities as provided by IMF database	1980–2016	Average returns during winter period are found to be significantly higher in 15 out of 27 commodities indicating the presence of 'Halloween effect' whereas significant 'reverse Halloween effect' was found in case of poultry and tea
20	Burakov et al. (2018)	Coal, Crude Oil, Hydrocarbons, and Uranium	Monthly closing prices from IMF database	1985–2016	Average returns of the winter periods are found to be higher than average returns of the year periods indicating the presence of the 'Halloween effect' in five out of seven energy markets

Source Collected by authors

of the month in some commodity futures like frozen concentrated orange juice futures, rubber futures, barley, canola, rough rice, soybeans, soybean oil, and soybean meal. Many studies report calendar anomalies in metals and agricultural commodity futures, mostly the day-of-the-week effect and month-of-the-year effect.

Conclusions

Market efficiency is the ability of commodity prices to reflect all the available information, whether public or private, quickly and fully. An efficient futures market performs the functions of price risk management and price discovery. If markets are efficient the current futures price acts as an unbiased predictor of the spot price at maturity and market participants cannot formulate effective trading strategies to earn abnormal risk-adjusted returns. Since agricultural commodities are natural products, and they display seasonality, commodity futures markets may be inefficient due to natural processes—like seasonal cycles based on monsoons, harvests, and depressions—and other weather-related events that can impact price discovery efficiency (Samal et al. 2015). In addition, government regulations and market manipulation by large traders like hoardings and price manipulations may also lead to inefficiency in pricing (Wang and Ke 2005).

Numerous studies have been conducted to test various forms of efficiency for commodity markets. The results of these studies vary by the period of study, commodities involved in the study, etc. This paper reviews 30 research studies that test the efficiency of various agricultural commodity futures markets, most of which test for the weak form of market efficiency using OLS regression analysis. A few studies find markets to be weakly efficient, or futures prices act as unbiased predictors of spot prices at maturity, and market participants can use past prices or current futures prices to forecast future spot prices. That future commodity spot prices can be forecast enables market participants to make informed decisions, depending on the commodities, on the best time and point of sale or purchase (Zelda 2013).

A few studies report inefficient markets and the presence of calendar anomalies. This paper reviews 20 studies that find a variety of calendar anomalies in metals and agricultural futures markets, especially the

day-of-the-week and month-of-the-year effects in agricultural commodities and precious metals. The monthly effects—like January effect, April effect, August effect, September effect, October effect, November effect, and December effect—are found only in agricultural commodity futures and not in metals futures. The Halloween effect is found in various agricultural commodities; the returns during the winter are significantly higher than during the summer.

Participants in agricultural commodity markets—traders, farmers/ producers, commission agents, commodity exchange participants, regulators, and policymakers—will find the results of this study useful in formulating their purchase, sale, and trading strategies. Investors, too, can use these results to make investment decisions, design trading strategies, discover price, manage risk, and evaluate portfolio performance. Policymakers can make markets, especially agricultural commodities futures markets, more efficient by designing the market microstructure so that trading volume increases and price discovery becomes finer.

Acknowledgement

The authors acknowledge the financial support received from the ICSSR on account of full-term centrally-administered Doctoral fellowship.

References

- Abedin, M Z, G Chi, and M Bin. 2015. The month of the year effect on Dhaka stock exchange. *International Journal of u- and e- Service, Science and Technology* 8(5): 275–88. doi.org/10.14257/ijunesst.2015.8.5.25
- Agrawal, A, and K Tandon. 1994. Anomalies or illusions? evidence from stock markets in eighteen countries. *Journal of International Money and Finance* 13(1): 83–106. doi.org/10.1016/0261-5606(94)90026-4
- Ahmad, K M, S Ashraf, and S Ahmed. 2006. Testing weak form efficiency for Indian stock markets. *Economic and Political Weekly* 41(1): 49–56. doi: 10.2307/4417642
- Aksoy, M. 2013. Day-of-the-week anomaly for Istanbul gold exchange: gold and silver data. *The Journal of Accounting and Finance* (57): 149–64. journal.mufad.org.tr/attachments/article/684/10.pdf
- Aktan, C, E E Sahin, and I Kucukkaptan. 2017. Testing the information efficiency in emerging markets. In *Financial management from an emerging market*

- perspective*, eds G Kucukkocaoglu and S Gokten, 49–67. IntechOpen, Janeza Trdine 9, 51000 Rijeka, Croatia. intechopen.com/books/financial-management-from-an-emerging-market-perspective/testing-the-information-efficiency-in-emerging-markets
- Ali, J, and K B Gupta. 2011. Efficiency in agricultural commodity futures markets in India: evidence from cointegration and causality tests. *Agricultural Finance Review* 71(2): 162–78. doi.org/10.1108/00021461111152555
- Arendas, P. 2017. The Halloween effect on the agricultural commodities markets. *Agricultural Economics* 63(10): 441–48. doi.org/10.17221/45/2016-AGRICECON
- Ariel, R A. 1987. A monthly effect in stock returns. *Journal of Financial Economics* 18(1): 161–74. doi.org/10.1016/0304-405X(87)90066-3
- Arora, H, and B Singh. 2017. Testing weak-form efficiency of Indian stock market using high frequency data. *Pacific Business Review International* 10(5): 7–21. pbr.co.in/2017/2017_month/Nov/1.pdf
- Athanassakos, G, and Y S Tian. 1998. Seasonality in Canadian treasury bond returns: an institutional explanation. *Review of Financial Economics* 7(1): 65–86. doi.org/10.1016/S1058-3300(99)80146-3
- Aulton, A J, C T Ennew, and A J Rayner. 1997. Efficiency tests of futures markets for UK agricultural commodities. *Journal of Agricultural Economics* 48(3): 408–24. doi.org/10.1111/j.1477-9552.1997.tb01162.x
- Babu, A S. 2017. Testing for random walk behaviour in Indian bond market. *Theoretical Economics Letters* 7: 728–36. doi.org/10.4236/tel.2017.74052
- Barone, E. 1990. The Italian stock market: efficiency and calendar anomalies. *Journal of Banking and Finance* 14(2–3): 483–510. doi.org/10.1016/0378-4266(90)90061-6
- Bespalko, M. 2009. Calendar effects in daily bond returns: case of selected emerging economies. A master's thesis. Kyiv School of Economics. Ukraine. kse.ua/wp-content/uploads/2019/03/Thesis_Mbespalko.pdf
- Bigman, D, D Goldfarb, and E Schechtman. 1983. Futures market efficiency and the time content of the information sets. *The Journal of Futures Markets* 3(3): 321–34. doi.org/10.1002/fut.3990030307
- Bigman, D, and D Goldfarb. 1985. Efficiency and efficient trading rules for food and feed grains in the world commodity markets: the Israeli experience. *The Journal of Futures Markets* 5(1): 1–10. doi.org/10.1002/fut.3990050102
- Borowski, K. 2015 a. Analysis of selected seasonality effects in market of frozen concentrated orange juice (FCOJ) future contracts. *Journal of Capital Market and Behavioral Finance* 1(1): 7–30. pdfs.semanticscholar.org/e15d/42900997fa478310b45492a0b5e73f3139af.pdf?_ga=2.72207697.356002965.1589975886-1339576651.1533284997
- Borowski, K. 2015 b. Analysis of selected seasonality effects in market of rubber future contracts quoted on Tokyo commodity exchange. *International Journal of Economics and Finance* 7(9): 15–30. doi.org/10.5539/ijef.v7n9p15
- Borowski, K. 2015 c. Analysis of selected seasonality effects in market of barley, canola, rough rice, soybean oil and soybean meal future contracts. *Journal of Economics and Management* 21(3): 73–89. ue.katowice.pl/fileadmin/user_upload/wydawnictwo/JEM_Artyku%C5%82y_1_30/JEM_21/05.pdf
- Borowski, K. 2016. Analysis of selected seasonality effects in markets of futures contracts with the following underlying instruments: crude oil, Brent oil, heating oil, gas oil, natural gas, feeder cattle, live cattle, lean hogs and lumber. *Journal of Management and Financial Sciences* 26(4): 27–44. ssl-kolegia.sgh.waw.pl/pl/KZiF/czasopisma/Journal_of_Management_and_Financial_Sciences_JMFS/Documents/Krzysztof_Borowski_26.pdf
- Borowski, K, and M Lukasik. 2017. Analysis of selected seasonality effects in the following metal markets: gold, silver, platinum, palladium and copper. *Journal of Management and Financial Sciences* 10(27): 59–86. <https://pdfs.semanticscholar.org/f69a/184cc2c3b2af41c49243b08b02dafdffe048.pdf>
- Brown, P, D B Keim, A W Kleidon, and T A Marsh. 1983. Stock return seasonalities and the tax-loss selling hypothesis. *Journal of Financial Economics* 12(1): 105–12. doi.org/10.1016/0304-405X(83)90030-2
- Buguk, C, and W Brorsen. 2003. Testing weak-form market efficiency: Evidence from the Istanbul stock exchange. *International Review of Financial Analysis* 12(5): 579–90. doi.org/10.1016/S1057-5219(03)00065-6
- Burakov, D, and M Freidin. 2018. Is the Halloween effect present on the markets for agricultural commodities? *AGRIS on-line Papers in Economics and Informatics* 10(2): 23–32. doi.org/10.22004/ag.econ.276110
- Burakov, D, M Freidin, and Y Solovyev. 2018. The Halloween effect on energy markets: an empirical study. *International Journal of Energy Economics and Policy* 8(2): 121–26. econjournals.com/index.php/ijeep/article/download/6092/3608

- Canarella, G, and S K Pollard. 1985. Efficiency of commodity futures: a vector autoregression analysis. *The Journal of Futures Markets* 5(1): 57–76. doi.org/10.1002/fut.3990050107
- Cargill, T F, and G C Rausser. 1972. Time and frequency domain representations of futures prices as a stochastic process. *Journal of American Statistical Association* 67(337): 23–30. doi: 10.2307/2284697
- Chia, R C J, and V K S Liew. 2012. Month-of-the-year and symmetrical effects in the Nikkei 225. *IOSR Journal of Business and Management* 3(2): 68–72. http://www.iosrjournals.org/iosr-jbm/papers/vol3-issue2/G0326872.pdf?id=5485
- Choudhry, T. 2001. Month of the year effect and January effect in Pre-WWI stock returns: Evidence from a non-linear GARCH model. *International Journal of Finance and Economics* 6: 1–11. doi.org/10.1002/ijfe.142
- Conroy, R M, and R J Rendleman. 1987. A test of market efficiency in government bonds. *The Journal of Portfolio Management* 13(4): 57–64. doi.org/10.3905/jpm.1987.409111
- Coutts, J A, and M A Sheikh. 2000. The January effect and monthly seasonality in the All Gold Index on the Johannesburg Stock Exchange 1987–1997. *Applied Economics Letters* 7(8): 489–92. doi: 10.1080/13504850050033229
- Cross, F. 1973. The behaviour of stock prices on Fridays and Mondays. *Financial Analysts Journal* 29(6): 67–69. jstor.org/stable/4529641
- Davidsson, M. 2006. Stock market anomalies: A literature review and estimation of calendar effects on the S&P 500 index. Bachelor Thesis in Economics, Jonkoping International Business School, Jonkoping University. diva-portal.org/smash/get/diva2:4020/fulltext01.pdf
- Fama, E F. 1965. The behaviour of stock market prices. *The Journal of Business* 38(1): 34–105. jstor.org/stable/2350752
- Fama, E F. 1970. Efficient capital markets: A review of theory and empirical work. *The Journal of Finance* 25(2): 383–417. doi: 10.2307/2325486
- Gao, L, and G Kling. 2005. Calendar effects in Chinese stock market. *Annals of Economics and Finance* 6(1): 75–88. aefweb.net/AefArticles/aef060105.pdf
- Gibbons, M R, and P Hess. 1981. Day-of-the-week effects and asset returns. *The Journal of Business* 54(4): 579–96. jstor.org/stable/2352725
- Gordon, J D. 1985. The distribution of daily changes in commodity futures prices. *Technical Bulletin* 1702. ERS USDA. doi: 10.22004/ag.econ.156817
- Gorska, A, and M Krawiec. 2014. Analysis of calendar effects in markets of precious metals. *Quantitative Methods in Economics* 15(2): 392–402. pdfs.semanticscholar.org/34d8/1cd9404a97bdc7648901fa13c88d9915cd96.pdf?_ga=2.71108946.356002965.1589975886-1339576651.1533284997
- Gorska, A, and M Krawiec. 2015. Calendar effects in the market of crude oil. *Scientific Journal Warsaw University of Life Sciences—SGGW: Problems of World Agriculture* 15(30): 62–70. doi: http://dx.doi.org/10.22004/ag.econ.230857
- Gorska, A, and M Krawiec. 2016. The analysis of weak-form efficiency in the market of crude oil. *European Journal of Economics and Business Studies* 2(2): 101–12. journals.euser.org/files/articles/ejes_may_aug_16/anna.pdf
- Gu, A Y. 2015. The June phenomenon and the changing month of the year effect. *Accounting and Finance Research* 4(3): 1–8. doi.org/10.5430/afr.v4n3p1
- Gupta, R, and P K Basu. 2007. Weak form efficiency in Indian stock markets. *International Business and Economics Research Journal* 6(3): 57–64. doi.org/10.19030/iber.v6i3.3353
- Gupta, S, and T Mayer. 1981. A test of the efficiency of futures markets in commodities. *Weltwirtschaftliches Archiv* 117(4): 661–71. jstor.org/stable/40438976
- Harper, A, Z Jin, and R Sokunle. 2015. Examining market efficiency: a view from the silver futures market. *Journal of Finance and Accountancy* 20: 1–6. aabri.com/manuscripts/152181.pdf
- Inoue, T, and S Hamori. 2012. Market efficiency of commodity futures in India. Discussion Paper 370, Institute of Developing Economies, Japan External Trade Organization (JETRO). doi.org/10.1080/13504851.2013.872751
- Jacobsen, B, and C Y Zhang. 2013. Are monthly seasonals real? a three century perspective. *Review of Finance* 17(5): 1743–785. doi.org/10.2139/ssrn.1697861
- Jordan, S D, and B D Jordan. 1991. Seasonality in daily bond returns. *The Journal of Financial and Quantitative Analysis* 26(2): 269–85. doi: 10.2307/2331269
- Just, R E, and G C Rausser. 1981. Commodity price forecasting with large-scale econometric models and the futures market. *American Journal of Agricultural Economics* 63(2): 197–208. doi.org/10.2307/1239555

- Kaur, G, and D N Rao. 2010. Efficiency of Indian commodities market: a study of agricultural commodity derivatives traded on NCDEX. doi.org/10.2139/ssrn.1600687
- Keim, D B. 1983. Size-related anomalies and stock return seasonality: further empirical evidence. *Journal of Financial Economics* 12(1): 13–32. doi.org/10.1016/0304-405X(83)90025-9
- Kellard, N, P Newbold, T Rayner, and C Ennew. 1999. The relative efficiency of commodity futures markets. *Journal of Futures Markets* 19(4): 413–32. doi.org/10.1002/(SICI)1096-9934(199906)19:4%3C413::AID-FUT2%3E3.0.CO;2-F
- Kim, H, G Oh, and S Kim. 2011. Multifractal analysis of the Korean agricultural market. *Physica A* 390: 4286–292. doi.org/10.1016/j.physa.2011.06.046
- King, J. 2001. Testing the efficient markets hypothesis with futures markets data: forecast errors, model predictions and live cattle. *Australian Economic Papers* 40(4): 581–85. doi.org/10.1111/1467-8454.00143
- Kofi, T A. 1973. A framework for comparing the efficiency of the futures markets. *American Journal of Agricultural Economics* 55(4): 584–94. doi: 10.2307/1238343
- Kohli, R K. 2012. Day-of-the-week effect and January effect examined in gold and silver metals. *Insurance Markets and Companies: Analyses and Actuarial Computations* 3(2): 21–26. businessperspectives.org/images/pdf/applications/publishing/templates/article/assets/4996/IMC_2012_02_Kohli.pdf
- Kohli, R K. 2014. Day-of-the-week effect and January effect examined in copper and aluminium metals. *Journal of Business and Economics* 5(11): 1949–956. doi: 10.15341/jbe(2155-7950)/11.05.2014/001
- Kristoufek, L, and M Vosvrda. 2013. Commodity futures and market efficiency. *Energy Economics* 42: 50–57. doi.org/10.1016/j.eneco.2013.12.001
- Lean, H H, and R Smyth. 2015. Testing for weak-form efficiency of crude palm oil spot and future markets: new evidence from a GARCH unit root test with multiple structural breaks. *Applied Economics* 47(16): 1710–721. doi.org/10.1080/00036846.2014.1002905
- Lee, K C, C H Hsu, and M C Ke. 2013. Testing the monthly effect of agricultural futures markets with stochastic dominance. *International Review of Accounting, Banking and Finance* 5(3/4): 35–60.
- Liu, B, and Li, B. 2011. Monthly seasonality in the top 50 Australian stocks. *Journal of Modern Accounting and Auditing* 7(4): 380–90. core.ac.uk/download/pdf/143888203.pdf
- Lokare, S. 2007. Commodity derivatives and price risk management: An empirical anecdote from India. *Reserve Bank of India Occasional Papers* 28(2): 27–77. citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.575.9194&rep=rep1&type=pdf
- Lucey, B M, and E Tully. 2006. Seasonality, risk and return in daily COMEX gold and silver data 1982–2002. *Applied Financial Economics* 16(4): 319–333. doi.org/10.1080/09603100500386586
- Ma, C K. 1986. A further investigation of the day-of-the-week effect in the gold market. *The Journal of Futures Markets* 6(3): 409–19. doi.org/10.1002/fut.3990060306
- Malkiel, B. 2003. The efficient market hypothesis and its critics. *Journal of Economic Perspective* 17(1): 59–82. doi: 10.1257/089533003321164958
- McKenzie, A M, and M T Holt. 2002. Market efficiency in agricultural futures markets. *Applied Economics* 34(12): 1519–532. doi.org/10.1080/00036840110102761
- Naik, G, and S K Jain. 2001. Efficiency and unbiasedness of Indian commodity futures markets. *Indian Journal of Agricultural Economics* 56(2): 185–97. ageconsearch.umn.edu/record/297809/files/ijae-440.pdf
- Nath, G C, and M Dalvi. 2004. Day-of-the-week effect and market efficiency: Evidence from Indian equity market using high frequency data of NSE. *The ICAI Journal of Applied Finance* 12(2): 1–16. doi.org/10.2139/ssrn.1092765
- Park, J, and B Lim. 2018. Testing efficiency of the London metal exchange: New evidence. *International Journal of Financial Studies* 6(1): 1–10. mdpi.com/2227-7072/6/1/32/pdf
- Patel, N, and P Patel. 2014. Weak form of market efficiency of metal commodities in India. *International Journal of Applied Financial Management Perspectives* 3(3): 1198–208. researchgate.net/profile/Nikunj_Patel26/publication/279232821_Weak_Form_of_Market_Efficiency_of_Metal_Commodities_in_India/links/55adbacff08aed614b097c10d/Weak-Form-of-Market-Efficiency-of-Metal-Commodities-in-India.pdf
- Phukubje, M. P, and M B Moholwa. 2006. Testing for weak-form efficiency in South African futures markets for wheat and sunflower seeds. *Agrekon* 45(2): 198–213. doi.org/10.1080/03031853.2006.9523743
- Poshakwale, S. 1996. Evidence on weak form efficiency and day-of-the-week effect in the Indian stock markets.

- Finance India* 10(3): 605–16. citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.470.3815&rep=rep1&type=pdf
- Rahman, M L, and A S Amin. 2011. Monthly seasonality in emerging market: Evidence from Bangladesh. *The Global Journal of Finance and Economics* 8(1): 61–76. researchgate.net/publication/332180959_MONTHLY_SEASONALITY_IN_EMERGING_MARKET_Evidence_from_Bangladesh
- Ranganathan, T, and U Ananthakumar. 2014. Market efficiency in Indian soybean futures markets. *International Journal of Emerging Markets* 9(4): 520–34. doi.org/10.1108/IJoEM-12-2011-0106
- Rausser, G C, and C Carter. 1983. Futures market efficiency in the soybean complex. *The Review of Economics and Statistics* 65(3): 469–78. [doi: 10.2307/1924192](https://doi.org/10.2307/1924192)
- Ritter, J R 1988. The buying and selling behaviour of individual investors at the turn-of-the year. *The Journal of Finance* 43(3): 701–17. [jstor.org/stable/2328193](http://www.jstor.org/stable/2328193)
- Rozeff M S, and W R Kinney. 1976. Capital market Seasonality: The case of stock returns. *Journal of Financial Economics* 3(4): 379–402. [doi.org/10.1016/0304-405X\(76\)90028-3](https://doi.org/10.1016/0304-405X(76)90028-3)
- Samal, G P, A K Swain, A Sahoo, and A Soni. 2015. Market efficiency of agricultural commodity futures in India: A case of selected commodity derivatives traded on NCDEX during 2013. *International Journal of Business and Management Invention* 4(1): 32–49. pdfs.semanticscholar.org/87a5/c34c39af5a6aa7cae110bcfd4db7c4f978cf.pdf
- Schneeweis, T, and J R Woolridge. 1979. Capital market seasonality: The case of bond returns. *The Journal of Financial and Quantitative Analysis* 14(5): 939–58. [doi: 10.2307/2330299](https://doi.org/10.2307/2330299)
- Smidt, S. 1965. A test of the serial independence of price changes in soybean futures. *Food Research Institute Studies* 5(2): 117–36. [doi: 10.22004/ag.econ.136691](https://doi.org/10.22004/ag.econ.136691)
- Spriggs, J. 1981. Forecasts of Indiana monthly farm prices using univariate box-Jenkins analysis and corn futures prices. *North Central Journal of Agricultural Economics* 3(1): 81–7. [doi: 10.2307/1349412](https://doi.org/10.2307/1349412)
- Srinivasan, P. 2010. Testing weak-form efficiency of Indian stock markets. *Asia Pacific Journal of Research in Business Management* 1(2): 1–7. skirec.org/wp-content/uploads/2017/01/2.9-Testing-Weak-Form-Efficiency-of-Indian-Stock-Markets-P.SRI_-1.pdf
- Stevenson, R A, and R M Bear. 1970. Commodity futures: trends or random walks? *Journal of Finance* 25(1): 65–81. [doi: 10.2307/2325800](https://doi.org/10.2307/2325800)
- Tolikas, K. 2018. The lead-lag relation between the stock and the bond markets. *The European Journal of Finance* 24(10): 849–66. doi.org/10.1080/1351847X.2017.1340320
- Tomek, W G, and Gray, R W. 1970. Temporal relationship among prices on commodity futures markets: Their allocative and stabilizing role. *American Journal of Agricultural Economics* 52(3): 372–80. [doi: 10.2307/1237388](https://doi.org/10.2307/1237388)
- Tuna, G. 2013. Testing of the weekend (Monday) effect for Istanbul gold exchange. *International Journal of Education and Research* 1(9): 1–10. ijern.com/journal/September-2013/16.pdf
- Wang, H H, and B Ke. 2005. Efficiency tests of agricultural commodity futures markets in China. *The Australian Journal of Agricultural and Resource Economics* 49(2): 125–41. doi.org/10.1111/j.1467-8489.2005.00283.x
- Wickremasinghe, G. 2007. Seasonality of emerging stock markets: Evidence from the Colombo stock exchange. *The ICAI Journal of Applied Finance* 13(6): 43–65.
- Yu, H C, and T L Shih. 2011. Gold, crude oil and the weekend effect: a probability distribution approach. *Investment Management and Financial Innovations* 8(2): 39–51. businessperspectives.org/images/pdf/applications/publishing/templates/article/assets/4109/imfi_en_2011_02_Yu.pdf
- Yu, H C, L C Ju, and T L Shih. 2016. Weekday effects on gold: Tokyo, London, and New York markets. *Banks and Bank Systems* 11(2): 33–44. [doi:10.21511/bbs.11\(2\).2016.04](https://doi.org/10.21511/bbs.11(2).2016.04)
- Zelda, A E O. 2013. A study of the efficiencies of maize and wheat futures markets in India. *IOSR Journal of Agriculture and Veterinary Science* 2(4): 9–14. [doi: 10.9790/2380-0240914](https://doi.org/10.9790/2380-0240914)

