New insights into an old issue: modelling the U.S. food prices

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Abstract
The study attempts to add significant outcomes to the U.S. food prices literature by performing a dynamic regression model and a frequency domain causality test to explore the causality and relationships between U.S. food prices, energy prices, economic policy uncertainty, and the value of the U.S. dollar. It is shown that dollar price negatively affects the food price index at both high and low volatility periods. Furthermore, it is presented that there is a permanent long-run causal relationship running from the dollar index to the food price index. The results indicated that there is a significant positive relationship between the energy price index and the food price index. Moreover, energy is found to be a long-run and permanent cause of the food price index. The effect of uncertainty has not been sufficiently explored in the food pricing field, the outcome of this study reveals that uncertainty increases the food price index at high volatility times. Besides, uncertainty is shown to be the long-run and permanent cause of the food price index.

Keywords Food price · U.S. · Energy · Uncertainty · Causality

JEL Classification Q18 · O13 · O24 · C58
1 Introduction

This study aimed to contribute to the United States food price literature by investigating the causality and relationships between food prices and energy, economic policy uncertainty, and dollar value. The reason behind the selection of the USA is that it owns the dollar, which is the dominant currency in international trade, is a net food exporter and is one of the largest food producers. The USA has an important and influential role in the global food system. The results to be obtained from the USA will also be useful in explaining the global food related problems. The recent COVID-19 crisis has once more revealed the importance of sustainable food security. Food security was first defined as "Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" at the 1996 World Food Summit in Rome. United Nations Population Prospects 2019 report points out that the world population will increase by 2 billion by 2050, reaching 9.7 billion in total. Furthermore, the report shows that this increase will be the result of more than doubled population increases in less developed countries. Arable lands and useable irrigation water decrease every day. The green revolution in the mid-1950s increased total agricultural production in the process, reduced global hunger, and stabilized food prices. However, despite the fact that the productivity increase stemming from the "green revolution" has come to a standstill in the current century, the demand for food continues to increase. All these facts point to a single result that agricultural production will have to provide physically and economically accessible healthy food for the increasing population in the coming period, using less land and water.

The commodity price crisis of 1974 caused serious concerns, but the effects of the 2007–2008 food price crisis lasted much longer. Global dollar prices of food commodities increased sharply between 2007–2008. This increase attracted severe attention, and many authors investigated the reasons behind the spike in food prices. Gilbert (2010) explained the case with China’s rapid economic growth and other developing Asian countries. Abbot et al. (2008) blamed the depreciation of the U.S. Dollar. Mitchell (2008), on the other hand, pointed to the increasing biofuel production. Cooke and Roble (2009) explained the price increases by speculation. Baffes (2007) indicated the increasing input costs due to rising energy prices. Similar food price increases were also experienced in the United States. The change in the U.S. Consumer Price Index for all food has been reasonably low and consistent, with an average 2.5% annual increase between 1991 and 2006 (Baek and Koo, 2010). However, this stability has first changed in 2007–2008, later in 2010–2011, and lastly in the current Covid 19 period. In 2007, United States food inflation recorded its biggest move in 17 years, increasing 4.5% annually (Baek and Koo 2010). It is very important to understand the United States in terms of food prices. The United States is one of the largest importers of many major food products and also owns the global tradable currency, the dollar.

This paper aims to explore the interactions between U.S. food prices, energy prices, economic policy uncertainty and the value of the U.S dollar. The study
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attempts to add significant outcomes to the literature by performing a dynamic regression model and a frequency domain causality test. One important significance of this study is that the Economic Policy Uncertainty Index, which is the subject of different studies in the literature, such as, Adebayo et al. (2022a, b) but used very shallowly in the explanation of food prices, is included in the models. Within the scope of this study, a study examining the relationship between economic policy uncertainty and U.S. food prices could not be found. In the literature review, it was seen that crude oil prices were chosen as data to represent energy prices. It is known that agricultural production, harvesting, further processing, storage and distribution processes and the production processes of agricultural inputs such as chemical fertilizers apply to a wide variety of energy sources. Therefore, energy prices are represented by the energy price index, which is below the US consumer price index. In this way, it is aimed to achieve more realistic results by representing energy prices more efficiently. In addition to the powerful methods it uses, the study will make significant contributions to the literature in this respect.

2 Related literature

2.1 Economic policy uncertainty and food prices

Al-Thaqeb and Algharabali (2019) defined economic policy uncertainty as "Policy uncertainty is the economic risk associated with undefined future government policies and regulatory frameworks.". Economic policy uncertainty is expected to increase in the aspect of significant financial, political, natural, international, or military events. The recent past has witnessed many events that triggered uncertainty. These events can be listed as; 9/11 terrorist attack, the 2016 Brexit referendum, U.S.-China trade tension is 2018–2019, invasion of Iraq in 2003, Russia’s annexation of Crimea in 2014, financial crises in Greece in 2011, global financial crises in 2008, military Syria events since 2011, coup attempt in Turkey in 2016 and more recently Covid-19 pandemic since the end of 2019. Uncertainty has a significant effect on the spending and investing behaviour of governments, commercial enterprises, households and entrepreneurs. In general, the parties exhibit more conservative attitudes during periods of high uncertainty.

Bloom (2009) is one of the major works in the uncertainty field. The researcher introduced a model with a time-varying second moment to analyse the effect of uncertainty shocks at the firm level. Findings showed that firms pause their activities during uncertainty shocks. This behaviour is explained as the "wait and see" attribute of firms that reduces the output and employment in return. This study built on the previous research of Barnanke (1983) and Hassler (1996). Barnanke (1983), investigated the interpretations of optimal decision rules in the case of irreversible investment decisions. The researcher put out that, in uncertain times, the firms decide between possible extra gains of early investment and possible gains of increased information by waiting. Barnanke (1983) concluded that events with uncertain long-term consequences can temporarily increase the returns of waiting for information, creating an investment cycle. Hassler (1996), investigated the links
between risk and consumption. The researcher offered two mechanisms to explain the risk and consumption relationship. The first mechanism argues that risk about the future may result in precautional savings. The second mechanism depends on the fact that waiting for more information has a cost and the consumer makes a decision between the risk and cost of waiting. Baker et al. (2016) is another influential work in the uncertainty literature. Researchers developed a new index based on newspaper coverage frequency for the United States and 11 other important economies. The study investigated the effect of economic policy uncertainty to firm-level stock price, investment, employment, and production. The results suggested that uncertainty shocks have a negative effect on firm-level financial indicators as well as macroeconomic indicators for U.S. and Europe. Kirchner (2019) studied the effect of economic policy uncertainty on global industrial production, global trade, cross-border trade, and investment. Researchers focused on Australia and United States. The finding indicated that increased global economic policy uncertainty negatively affects global industrial production and global trade volume. Research showed that economic policy uncertainty negatively affects U.S. trade, cross-border investment, and GDP. Furthermore, researchers indicated that the U.S. is more vulnerable gains the uncertainty shocks in compare with Australia. This result was explained as the fact that the dollar was accepted as a safe haven, and the benefit of the exchange rate adjustment was limited due to this feature of the dollar in high uncertainty periods. Kido (2018) explored the transmission of U.S. economic policy uncertainty to the global and Asian financial markets. Kido (2018) used a factor-augmented vector auto-regression analysis and presented that U.S. economic policy uncertainty is a significant driver of global financial markets. U.S. economic policy uncertainty affects commodity prices, equity prices, and exchange rates. Furthermore, an increase in U.S. economic policy uncertainty causes depreciation in currencies of emerging economies.

Trade policy uncertainty is an important concept of economic policy uncertainty. Trade wars started in the recent past attracted attention to trade policy uncertainty. Gopinath (2021) studied the effect of trade policy uncertainty on agriculture. Gopinath (2021) concluded that trade policy uncertainty is negatively related to U.S. Agricultural economic activity. Another study investigates the causality between trade policy uncertainty and agricultural commodity prices (Sun et al. 2021). Researchers presented that trade policy uncertainty affects both supply and demand for agricultural commodities. In the field of food prices versus economic policy uncertainty, the empirical literature is quite limited. The works of Xiao et al. (2019) and Wen et al. (2021) are two of the few studies. Both of the studies focused on China. Xiao et al. (2019) examined the effect of economic policy uncertainty on China’s grain futures prices. The findings showed that economic policy uncertainty has a significant effect on future grain prices, and the effect is limited on wheat prices in comparison to maize and soybean. Wen et al. (2021), on the other hand, explored the effect of economic policy uncertainty on food prices in China. The Linear Autoregressive Distributive Lag model showed that increase in uncertainty results in an increase in food prices at the long\short run. Nonlinear Autoregressive Distributive Lag (NARDL) model indicated that increasing uncertainty has a
significant upwards effect on food prices. However, decreasing uncertainty has an insignificant downwards effect on food prices.

### 2.2 Dollar exchange rate and food prices

The dollar is known as the currency that dominates international trade, and it’s no different for food products. As a consequence, it is not surprising that dollar price is under scope while investigating the food price volatility. It is not a new concept either, it has been under consideration since the United States abandoned Breton Wood in 1973. Many studies indicated the importance of the dollar exchange rate in the food price change explanation efforts. The general explanation claims that the depreciation in the dollar increases the international demand for food while suppressing supply from other currencies using agricultural producers. Thus, increased demand and decreased supply set up a higher food price balance. Schuh (1974) is one of the first studies that examined the dollar exchange rate and food price relationship. The researcher argued that the exchange rate has an important, often ignored role in agriculture. According to Schuh, the over-valuation of the dollar is an important factor in the farm problem, while the devaluation of the dollar is an important factor in increasing agricultural prices. The researcher argued that the over-valuation of the dollar moved the significant share of the benefits of new technological changes over time from farmers to the consumers. Orden (2002) revisited the efforts of Schuh (1974) 28 years later. Researchers argued that appreciation of the dollar between 1998 and 2002 had detrimental effects on U.S. farm policy, meaning that appreciation in the dollar decreases food prices and causes a transfer of welfare from farmer to consumer. Chambers et al. (1981) is another important work in the exchange rate versus food prices debates. Researchers investigated the effects of dollar exchange rate fluctuations on wheat, corn, and soybean prices and exports in the U.S. The findings showed that the dollar exchange rate is significantly effective on food export volumes and domestic food prices. According to the results, the adjustment in exports and prices are sharp in the short-run and gentle but again significant in the long run. Overall, the dollar’s devaluation increases export volumes and domestic food prices.

Nazlioglu and Soylas (2012) investigated the effect of global crude oil prices and the dollar on the selected food commodities. The results showed that a decrease in the value of the dollar has a positive effect on food prices. On the other hand, Baek and Koo (2010), studied on U.S Food Price Inflation. Researchers stated that depreciation in the dollar increases the price of imported agricultural inputs for U.S. producers so that the production cost. As a result, increased production costs increase domestic food prices. Dawe (2002), estimated that 10% U.S. dollar against of Thai baht results in 22$/mt decrease in global rice prices.
2.3 Energy prices and food prices

The price transmissions between energy and food have attracted interest since the 2007–2008 food price crises. It is difficult to talk about a consensus, but it can be said that the studies in the field can be gathered from two main perspectives. Some researchers focused on demand-based explanations, while others focused on supply-based explanations. Supply-based explanation depends on the fact that agricultural production, harvest storage, distribution, and furthermore, production of agricultural inputs consumes some form of energy. This means increased energy costs increase agricultural production costs directly or indirectly. As a result, increasing costs shift the supply curve to the left, and food prices increases.

On the other hand, demand-based explanation depends on the competition between food and biofuels. This competition moves through two channels. The first one is the fact that energy crops such as corn, sunflower, rapeseed, wheat, soybean, and sugarcane are also direct food crops or feed crops. This means higher energy prices increase the demand for bioenergy, thus the demand for energy crops. An increase in demand for these crops means an increase in the price of food. The second channel is the fact that arable lands and agricultural production capacity are limited, and the increase in demand for biofuels means competition for land usage and capacity. If the production of energy crops is more profitable, this means fewer lands and capacity is going to be used for food production. As a consequence, food prices increase because of less supply. The work of Baffes (2007) is a known paper for the supply-based explanation. The researcher aimed to estimate the pass-through effect of crude oil price changes to the prices of 35 globally traded major commodities by the OLS regression method. The findings showed that the fertilizer index and food index exhibited the largest two pass-through behaviours, respectively. The researcher mentioned that crude oil is a part of aggregate production functions for food commodities.

Tiwari et al. (2020) explored the lead-lag interactions between the price indices of energy fuels and individual food, metals, agricultural raw materials, industrial inputs and beverages. Researchers adopted a time–frequency domain approach and employed wavelet coherence, phase-differences and spillover indices of Diebold and Yilmaz (2012) and Krehlik and Barunik (2017). The period of study was determined as 1990m1–2017m5. Wavelet coherence analysis revealed that there is a significant relationship between fuel and food prices. Shrestha et al. (2019) investigated whether biofuel production is correlated with food price and land-use change. Researchers compared the food price inflation rates in the U.S. before and after the biofuel production boom in 2000. The complete range from 1991 to 2016 showed an average inflation rate of 2.6%, and the comparison result showed no significant difference between before and after. It is shown that increasing biofuel production is not diminishing the U.S. corn and soybean exports. Researchers presented that the food price index is highly correlated with the crude oil price. The study concluded that U.S. food prices are not affected by increasing biofuel production, and biofuel production does not compete for agricultural lands.

Pal and Mitra (2017) investigated the interactions between diesel and soybean prices in U.S. Soybean is the major crop for biofuel production as well as a feed
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Researchers used a quartile autoregressive distributed lag (QADL) model to analyse monthly price data between the period of 2004 to 2014. The findings showed significant links between diesel and soybean price in the long run. Researchers presented that the link is stronger in the upper quartiles. The paper is concluded that soybean price is led by diesel price movements and energy crops would compete with food crops (grains) for arable lands. Another study in the U.S., examined the volatility transmissions between crude oil, ethanol, and corn (Gardebroek and Hernandez 2013). Researchers employed a multivariate GARCH approach to determine the level of interdependence and nature of volatility for a period of 1997 to 2011. The findings showed a unidirectional volatility transmission from corn to ethanol prices, not vice versa. Moreover, the results did not suggest a volatility transmission from crude oil to corn prices. Indeed researchers concluded that food price volatility is not driven by biofuels (Gardebroek and Hernandez 2013). Vacha et al. (2013) employed an exceptional tool to investigate the correlations between biofuel, fuel, and food systems. Researchers applied wavelet coherence methodology, enabling them to investigate in time and cross scales (frequencies) and analysed the period of 2003–2011. Findings presented that ethanol with corn and biodiesel with German diesel is strongly correlated at low frequencies.

In our previous study, we investigated the causality between global energy prices and global food prices. We employed time-domain Toda-Yamamoto causality, Fourier Toda-Yamamoto causality, and frequency domain spectral B.C. causality test. Results indicated a strong causal relationship running from energy to food prices (Kirikkaleli & Darbaz, 2021).

Table 1  Descriptive statistics

| Variable                      | Food price index | Economic policy uncertainty | Dollar index | Energy price index |
|-------------------------------|------------------|------------------------------|--------------|--------------------|
| CODE                          | CODE FOOD        | EPU                          | DOL          | EPI                |
| Source                        | U.S. Bureau of Statistics | U.S. Bureau of Statistics | Federal Reserve | Davis (2016) |
| Mean                          | 186.1906         | 113.6319                     | 93.40789     | 157.2936           |
| Median                        | 178.8000         | 105.5414                     | 92.50000     | 136.9000           |
| Maximum                       | 281.6680         | 350.4598                     | 160.4100     | 271.1490           |
| Minimum                       | 104.7000         | 57.20262                     | 71.80000     | 82.10000           |
| Std. Dev                      | 49.47948         | 39.52892                     | 12.91788     | 56.64834           |
| Skewness                      | 0.098783         | 1.772488                     | 1.645266     | 0.289720           |
| Kurtosis                      | 1.756363         | 8.252019                     | 7.823206     | 1.499639           |
| Jarque–Bera                   | 29.13660         | 737.7664                     | 626.4206     | 47.53308           |
| Probability                   | 0.000000         | 0.000000                     | 0.000000     | 0.000000           |

Source: U.S. Bureau of Statistics; Federal Reserve; Davis (2016)
3 Data and methodology

This study aims to investigate both the effect of and the causality between energy price, economic policy uncertainty, and dollar value on food prices in the U.S. Food price and energy prices for U.S. is obtained from the U.S. Bureau of Statistics. Both data sets are seasonally adjusted. "Costumer Price Index for All Urban Consumers: Energy in U.S. City Average" data set is used to reflect energy prices in U.S. "Costumer Price Index for All Urban Consumers: Food in U.S. City Average" data set is used to reflect food prices in U.S. The work of Davis (2016), is used as a guide for uncertainty data and the data set is obtained from an online source that develops indices of economic policy uncertainty. A broad price-adjusted U.S. dollar index is used to reflect the value of the dollar and acquired from Federal Reserve. The period of study was established as 1985M1 to 2021M9, and monthly data sets were used for all variables. Table 1 reports the descriptive statistics of the time series variables. It is crucial to determine the order of integration before proceeding to cointegration tests. Granger and Newbold (1974) underlined that analyses with series containing unit-roots, may yield unrealistic results due to spurious regression problems. Stationarity analysis determines whether the series have unit roots to avoid spurious regression problems. The time series in this study were examined for stationary. Within different unit root tests, the Zivot-Andrews unit root test is preferred as it is superior in the presence of one structural break in the time series (Zivot and Andrews 1992). Long-term relationships between variables were measured by Gregory-Hansen cointegration test (Gregory and Hansen 1996). Gregory-Hansen cointegration test is preferred as it allows testing of cointegration relationship under the single structural break. Earlier cointegration tests such as Johansen (1988) and Johansen and Juselius (1990) assumed that there is no structural break.

The next step in the analysis process was the estimation of coefficients. In this study Markov Switching Model of Hamilton (1989) was preferred as a main estimator because of its superiority as in Athari et al (2022). FMOLS, DOLS as in Kirikaleli & Adebayo (2021) and CCR, cointegration methods are linear modeling approaches that are based on the condition that series are stationary at the first difference. DOLS is a parametric method, while FMOLS is nonparametric. CCR method is similar to FMOLS; however CCR employs stationary transformations. Unlike the other 3 methods, Markov Switching Model of Hamilton (1989) is a dynamic modeling approach. The method is employed because of its novel feature of using multiple equations that can describe the time series behaviors in different regimes.

As a final step causality test of Breitung and Candelon (2006) was employed as in Adebayo et al. (2022a, b). The test is developed based on the previous efforts of Geweke (1982) and Hosoya (1991). The test is a frequency domain causality test known as "spectral B.C. causality test". Frequency domain causality tests are different from time-domain causality tests. The frequency domain enables us to measure the degree of variation.
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4 Empirical findings

The study attempts to add significant outcomes to the U.S. food prices literature by performing a dynamic regression model and a frequency domain causality test to explore the causality and relationships between U.S. food prices, energy prices, economic policy uncertainty and the value of the U.S. dollar. As an initial step we

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Table 2  Unit Root Test Results (Zivot Andrew Unit Root Test)

|               | FPI (Food Price Index) | EPI (Energy Price Index) | DI (Dollar Index) | EPU (Economic Policy Uncertainty) |
|---------------|-----------------------|--------------------------|-------------------|----------------------------------|
| **Series in Levels (I(0))** |                       |                          |                   |                                  |
| C             | −2.776                | −4.155                   | −4.424            | −4.732                           |
| (2007M1)      | (2004M5)              | (2002M12)                | (2007M8)          |                                  |
| **Series in First Differences (I(1))** |                       |                          |                   |                                  |
| C             | −9.605***             | −14.603***               | −14.442***        | −14.603***                       |
| (2008M11)     | (2011M9)              | (2008M8)                | (2011M9)          |                                  |

Note: C denote constant in the Z.A. unit root test. ***, ** and * denote statistical significance at 0.01, 0.05 and 0.10 levels, respectively.

Table 3  Cointegration Analysis Results (Gregory-Hansen)

| Test statistics | Break point date | Asymptotic critical values |
|-----------------|------------------|---------------------------|
|                 |                  | 1%    | 5%    | 10%   |
| ADF             | −6.81**          | 2014M5 | −6.89 | −6.32 | −6.16 |
| Z_t             | −6.75**          | 2013M12| −6.89 | −6.33 | −6.16 |
| Z_a             | −84.03**         | 2013M12| −90.84| −78.87| −72.75|

***, ** and * and denote the 1%, 5% and 10% statistical significant levels, respectively.

Table 4  Markov switching regression model results

| Independent Variables | EPI (Energy Price Index) | DI (Dollar Index) | EPU (Economic Policy Uncertainty Index) |
|-----------------------|--------------------------|-------------------|----------------------------------------|
| Regime 1: High Volatility |                          |                   |                                        |
| 0.954***              | −0.447***                | 0.127***          | (43.571)                               |
| (43.571)              | (−4.491)                 | (6.575)           |                                        |
| Regime 2: Low Volatility |                          |                   |                                        |
| 0.645***              | −0.517***                | 0.040*            | (42.153)                               |
| (42.153)              | (−8.717)                 | (1.778)           |                                        |

***, ***, and * denote 1%, 5%, and 10% significance levels, correspondingly. () denotes the z-statistics.
employ Zivot-Andrews unit root test which is employed to determine the order of integration of food price index, energy price index, dollar index and economic policy uncertainty index under the statement that the series might have structural breaks. The results are collected and reported in Table 2. The null hypothesis is that the series has a unit root at levels. Based on the test results, the series are not stationary at the level (I(0)), meaning that the series has a unit root problem. Thus, the first differences were tested. It is seen that the series are stationary at the first differences (I(1)) by 1% significance.

The long-term relationship among the time series variables was measured by Gregory-Hansen cointegration test. The results are presented in Table 3. Test statistic − 6.81 is smaller than the critical value at the %5 level and later than the %1 level. This clearly means that food prices are cointegrated with energy prices, dollar
prices and economic policy uncertainty. In other words, there is a long-term relationship between food price and 3 independent variables.

Markov Switching Regression Model Results are presented in Table 4. In regime 1 (High Volatility), it is seen that the independent variables have an effect on food prices at 1% significance level. Similar results are obtained in regime 2 (Low Volatility). Energy prices and the dollar index have an effect of food prices at 1% significance level, while economic policy uncertainty has an effect at 5% significance. In both regimes, energy prices and economic policy uncertainty have a positive effect, while the dollar index has a negative effect on food prices. The direction of impacts was expected as it was explained above that increasing energy prices and uncertainty elevates food prices while dollar price decreases.

Following the cointegration and estimation of coefficients, the Breitung–Candelon frequency domain spectral causality test is performed to explore the causal relationship between economic policy uncertainty and food price index, dollar index and food price index, energy price index, and food price index. The findings are illustrated in Figs. 1, 2, and 3. The results show that a permanent long-run and temporary short-run causality runs from uncertainty to food prices. In Fig. 2, it is presented that at a 5% significance level, the null hypothesis that the dollar index does not Granger-cause the food price index can be rejected for the frequencies in the intervals of 0 and 0.58. The results show that there is a permanent long-run causality running from dollar to food prices. In Fig. 3, it is shown that the hypothesis that the energy price index does not Granger-cause the food price index can be rejected for all frequencies at 5% significance level. The results suggest that there is a causality running from energy prices to food prices at all frequencies.

Empirical findings are consistent with theoretical justifications in the literature section. It is seen that dollar price is in a negative relationship with food prices and the dollar is a cause of food price changes. Depreciation of the dollar increases the demand and suppresses the supply, which in turn increases food prices. It is shown that energy price is in a positive relationship with food prices, and there is significant
causality running from energy to food. Increasing energy prices increase the cost of energy used in agriculture as well the cost of agricultural inputs. Furthermore, increasing energy prices encourage biofuel production as a result, some percent of crop and land usage skip to biofuel production. Directly with the supply channel or indirectly with the demand channel, an increase in the energy prices increases the food prices. It is reported that economic policy uncertainty is in a positive relationship with food prices, and uncertainty is a cause of food price changes. In times of uncertainty, producers wait for certainty and limit their activity level. This means a reduced supply, and thus, food prices increase.

5 Discussion

The interactions between dependent variable food prices and independent variables energy price, economic policy uncertainty, and dollar price were investigated in the U.S. by performing a dynamic regression modeling and frequency domain causality test. "Customer Price Index for All Urban Consumers: Energy in the U.S. City Average" and "Costumer Price Index for All Urban Consumers: Food in U.S. City Average" data sets of the U.S. Bureau of Statistics were used to represent energy and food prices in the U.S., respectively. The work of Davis (2016), is used as a guide for uncertainty data, and the U.S. economic policy uncertainty data set is obtained from an online source that develops uncertainty indices for different countries. A broad price-adjusted U.S. dollar index is used to reflect the value of the dollar and acquired from Federal Reserve. The study employed the static regression modeling of Hamilton (1989), which enables to make estimation under high volatility and low volatility regimes as a final step frequency domain causality test of Breitung and Candelon (2006) was employed. Unlike the time domain causality tests, using a frequency-domain test enabled us to measure the causality in high and low frequencies and the degree of variation in the series. U.S. and economic policy uncertainty is a well-studied field; however, U.S. food prices and economic policy uncertainty is a virgin field. Within the scope of this study, a study examining the relationship between economic policy uncertainty and U.S. food prices could not be found. The works of Xiao et al. (2019) and Wen et al. (2021) are two of the few studies in the field; however, both of the studies focused on China. The empirical findings on economic policy uncertainty is coherent with the limited field literature. The relationship between the dollar and food prices is an old and agreed issue. It has been under scope since the collapse of Bretton Wood in 1973. The similar works of Orden (2002), Chambers et al. (1981), and Baek and Koo (2010) yielded parallel results with this study. Energy and food prices literature, however, differentiates from the others. Although there is a consensus on the fact that the energy price affects the food price, the explanations for how it affects the food price differ from each other. While some researchers say that energy prices affect food prices directly through input prices, others state that energy prices affect it through the competition created by biofuel production. Baffes (2007) is a known paper supporting input prices based explanation. The researcher mentioned that crude oil is a part of aggregate production
functions for food commodities. Tiwari et al. (2020) reported similar findings, showing that the agricultural sector is the most sensitive to volatility spillover from other markets. Chowdhury et al. (2021), suggested that a rising in energy prices leads to a greater and long-lasting influence on food prices. Pal and Mitra (2017), on the other hand, investigated the interactions between diesel and soybean prices in the U.S. The paper is concluded that soybean price is led by diesel price movements, and energy crops would compete with food crops (grains) for arable lands. Contrarily, Gardebroek & Hernandez, (2013) and Shrestha et al. (2019) reported that U.S. food prices are not driven by increasing biofuel production, and biofuel production does not compete for agricultural lands.

6 Conclusion

This study aimed to contribute to the United States food price literature by investigating the causality and relationships between food prices and energy, economic policy uncertainty, and dollar value. It is shown that there is a significant negative correlation between dollar price and food prices at both high and low volatilities. Furthermore, it is presented that there is a permanent long-run causal relationship running from dollar to food. Energy was a highly debated subject. The results indicated that the positive relationship between energy prices and food prices is at a %1 significance level. Moreover, energy is found to be a long-run and permanent cause of food prices at a %5 significance level. Uncertainty was explained as an important but not sufficiently explored field. It is seen that there is a strong positive relationship between uncertainty and food prices at high volatility times. In addition, uncertainty is shown to be the long-run and permanent cause of food prices at a %5 significance level.

Holistic strategies should be developed that support broad-based economic growth, food security, and food price stability across the food system. Public funds are scarce resources. The balance between the urgent interventions needed to manage food price risks and the long-term investments required for sustainable market development and efficiency must not be lost. Otherwise, food price crises will continue to occur again and again in a cycle. It should be noted that although the practices such as export bans, import restrictions, or subsidies for imports stabilize food prices in the short run, they demotivate the producers and the market and worsen the long-term results.

In this research, the USA, which is a regional net agricultural exporter and oil producer, is included in the scope. However, it is difficult to explain the food price movements of a developing country that is a net agricultural importer and a net oil importer. This is the main limitation of the research. Therefore, it is important to investigate regions with different conditions in future studies. In addition, although long-term relationships and causality are revealed in the analyses made within the scope of study, theoretical explanations are used to explain these relationships and causality. How these relationships work should be tested empirically in future research. Another important issue is global warming. Although its impact on sudden price movements is limited, it is a very important issue for food
prices and production. With global warming, it is expected that some regions will become uncultivable, some regions will experience an increase in productivity, and some regions will become more suitable for agriculture. Therefore, it has the potential to directly affect food prices and production in the future. It will be very valuable for the scientific world to investigate how and how much global warming will affect food prices.

Declarations

Conflict of interest We have no conflicts of interest to disclose.

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