

Connectedness of Agricultural Commodity Markets: An Empirical Analysis

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ABSTRACT

Agricultural commodities are significant trade items, affecting food security, trade balances, and agricultural policies, and agricultural policies are also affected by trade balances. The paper will discuss the linkages between agricultural commodity markets, and address the impact of shocks in one market on another. We measure the spillovers between the major agricultural commodities like corn, wheat, soybeans and rice using Vector Auto Regression (VAR) models and the Diebold-Yilmaz connectedness framework. The results show that there are very strong linkages between the markets, with relevant policy and investment implications.

Keywords: Agricultural commodities, Connectedness, Price of the commodities and Metals

INTRODUCTION

The agricultural commodity markets are a multi-lateral market which is interesting in terms of the type of interdependency, and what external factors can impact the market. Agricultural markets are a crucial component of the global economy and are influenced by various factors, such as economic changes, geopolitical events, and environmental impacts. These interconnections can be analysed in detail, revealing the intricate interplay of factors that influence price dynamics and market trends. This analysis needs to be data-driven, with statistical methods for scientifically analysing the interdependencies and relationships among a range of commodities. It is an empirical study that can contribute to better understanding of commodity markets, besides being an important tool for those who need to understand the dynamics of commodity markets in order to make strategic decisions.

Market Relationships and Interdependencies:

Agricultural commodity markets are connected, with complex relationships and interdependencies between markets. It can be through the price transmission and the substitution effect, as a change in the market condition of a commodity has a big impact on another commodity. There is a large degree of linkage between agricultural commodities through production and consumption chains, which also affect the price dynamics and volatilities of commodities. There is a significant cross-interdependence between oil and agriculture commodities and can be examined on various time scales (Mokni & Youssef, 2020).

The relationship of interdependencies is essential to understanding the market behaviours and to the decision

making process for market players in relation to risk management and trading. For instance, the linkage and interdependence of markets between grain and livestock markets is a good illustration of market linkages and interdependence among agricultural commodity markets. Grain price is a fundamental input to livestock production and changes in grain prices can directly affect livestock production costs. Meat and milk prices are therefore likely to rise as well with the increase in grain prices. Furthermore, in macroeconomic volatile periods this relationship can be heightened by external factors that impact these markets and result in additional cost volatility. The interaction dynamics highlight the importance of grasping the interdependence of markets to better manage the risks and make strategies in the agricultural sector (Gong & Xu, 2002).

In addition, these linkages can contribute to greater price volatility, and can cause large-scale market shocks to agricultural commodity markets. The initial effect of geopolitical or economic events in the world can also be amplified by the volatility of the commodity price spreading to other commodities (Gong & Xu, 2022). Many of these ripple effects are due to the interconnections among these commodities: a disturbance in one can result in unexpected effects in another. The shocks in prices could force the market and lead to price volatility that requires a different set of assumptions and forecasting techniques in the market (Mokni & Youssef, 2020). Therefore, it's crucial to understand those intertwined volatilities for the participants who must weather the risk and do everything to avoid the potential negative monetary impacts on these complex markets.

Recognize use of statistical techniques to analyse:

Different statistical techniques are used to analyse the interactions between agricultural commodity markets. Among these, the correlation coefficients are most important to quantify a linear association among commodities. For deeper understanding, multivariate analysis, like Vector Auto Regression (VAR) models, are employed that consider the interdependent relationship between market variables. Gong and Xu (2022) are interested in analysing the influence of other shocks on the connectedness of markets, especially geopolitical risks, and find that VAR models are particularly well suited to this purpose. These can be combined to gain a broad overview of market interactions, which can then provide a useful set of metrics based on data to inform stakeholders of what might be linked and dependent. Moreover, agricultural market analysis using statistical methods such as the correlation coefficients, and Vector Auto Regression (VAR) models, has a number of advantages.

The relationships and direction of the different commodities in these methods can be analysed and measured, and they can be used to gain a better understanding of the effect of market changes in one commodity on another. A correlation coefficient, for example, could be calculated to find out whether there is a linear relationship that could be used to make predictions in commodities that are correlated with each other. The VAR models, however, offers a more in-depth model, allowing for all of the multi-variate characteristics of market variables to be taken into account, and for the linkages between markets to be analysed accurately over time, while also taking into consideration the external market influences such as geopolitical risks (Gong & Xu, 2022).

If used in empirical research, these techniques can give stakeholders solid facts-based information that is crucial when making strategy decisions in the agricultural commodity world. In real-world applications to agricultural commodity markets, however, there are some limitations and challenges of applying the statistical techniques, including the correlation coefficient and VAR models. A relevant challenge is quality and availability of data as data may be missing, or there may be inconsistencies in time in the data that makes it difficult to analyse the data (Spangler et al., 2020).

Moreover, the agricultural market is affected by many external factors, such as the geopolitical, environmental factors, etc., which can bring complexity to the agricultural market, while the traditional models are difficult to capture the complexity of the market (Cong & Xu, 2022). Assumptions of these statistical methods may not be valid, such as linear relationships and normality, and may result in incorrect conclusions (Fang & Shao, 2022). Besides, during global crises, market volatilities add other challenges for modelling with precision the interconnectedness of agricultural commodities (Cong & Xu, 2022).

Empirical Data Utilization:

Empirical data of different types are needed to present the complete picture of the behaviour of agricultural commodity markets for commodity markets analysis. Historical price data is an essential tool that enables researchers to view price patterns over time and to gain

insight into historic price trends (Jacks 2019). These data points are crucial to identify trends, with regards to the impact on price stability or volatility in case of a major event like an economic shock. One of the important datasets is market trends that provides information about the trend of commodity prices, and can signal a period of commodity price boom or bust, sometimes due to outside events like policy changes or technological innovation (Jacks, 2019).

When these empirical data sources are integrated, they offer a solid basis for analysis, and allow a detailed insight into the intricate market dynamics, while also allowing for the extraction of relevant insights for actors. Besides, data collection and preparation is very important in doing empirical analysis in agricultural commodity markets. First, a lot of historical data of prices of agricultural commodities is collected to be used in analysing the long-term trend and the pattern of volatility in the price data. Due to the potential issues associated with missing data, data interpolation or data cleaning methods are applied to the data sets to ensure completeness and accuracy in the data sets (Spangienet al, 2020). The data is collected, anomalies are rectified and then it is normalized to make the comparison of commodities and different units easier. This approach to the empirical preparation of data makes the data analysis more reliable, and provides a good foundation for the use of further statistical tools like vector auto-regression to study the interdependencies of markets. Indeed, the validity and reliability of data are crucial to arrive at the final conclusion in the empirical research of agricultural commodities markets. Poorly designed or Incompletely constructed datasets can lead to skewed results and to misinterpretation that can lead to the wrong direction in theory and practice (Spangler et al., 2020). Careful examination of missing data, outliers and inconsistencies is important for high quality data, as is often done for commodity price data from the past (Jacks, 2019).

The processing of data is not just rigorous and valid for subsequent statistical analysis, but it can also improve the robustness of the analysis model to deal with the complexity of the real world (Gong & Xu, 2022). Stakeholders' use of these data in the decision-making process is therefore contingent on the precision and reliability of these data, which also influences the directions of the strategic choices and risk analyses carried out in agricultural markets.

This is a case study on the interaction of commodities.

The dynamics of these markets in this regard can be analysed in more intricate manner by analysing the interactions between crude oil and farm products. There are close ties between these markets and during an economic crisis, price fluctuations in oil can have different impacts on agricultural goods. Oil price changes can also significantly impact prices of other commodities, such as corn and soybeans, for biofuel production and transportation expenses, as reported by Mokni and Youssef (2020).

This correlation reflects key linkages that exist between the oil price and the cost of agricultural production and supply-demand dynamics in the agriculture markets that are likely to be influenced by changes in oil prices. The results emphasize the need for a flexible stance on the part

of stakeholders and the effect of the broader aspects of energy prices on agricultural production and the resulting price stability, thus showing the complexity of the interlinkages between energy and agricultural markets. The case study then illustrates unique patterns and trends in the linkages between oil and agricultural commodity markets in a period of economic uncertainty. Oil price changes impact transportation costs and prices but have also profound implications on commodities used in biofuel production such as corn and soybeans (Mokni & Youssef, 2020).

This linkage points to an observed phenomenon that oil price volatilities tend to get passed through the agricultural sector with resulting variances in production cost frameworks, and changes in supply-demand dynamics. As the data shows, the interdependencies grow in the recession, and result in more volatility and larger market changes in both markets. The findings are significant to the stakeholders because they indicate that there is a need to consider wider market trends and integrate them in agricultural strategic planning for a buffer against the oil price effect on agricultural markets. This makes the key dynamic interdependencies in the case study a challenge for the market actors to change their strategy accordingly taking these complex linkages into account. As an example, the fluctuations in prices of crude oil can significantly influence the agricultural commodity markets, which in turn will impact the production and pricing decision of the market, as noted by Mokni & Youssef (2020). The interdependence suggests that if the participants are able to monitor and analyse the trend of oil prices with success, they will be better equipped to be prepared for a potential fall in oil prices, which will improve their risk management procedures. Furthermore, understanding these market trends can empower investors and traders to make informed decisions regarding their investment and trading strategies, enabling them to better withstand economic uncertainties. It is therefore imperative that these learnings are translated into agricultural commodity strategic planning to effectively navigate the challenges of agricultural commodity markets.

Factors affecting the dynamics of a market:

It is crucial to understand the determinants of agricultural commodity market dynamics in order to better understand the interconnected nature of these markets. Weather is also an important factor to consider since a drought or food can disrupt production and consequently impact prices, having an effect on ancillary markets (Spangler et al., 2020). Further, any change in policy, more specifically subsidy or trade tariff have direct implications on supply and demand, which affects market stability and hence new interaction between commodities.

In addition, the dynamics are intensified by the global trade, which make trade pattern volatile due to changes in trade agreement/conflict in the international market, affecting the market pattern structure (Fang 3, 5nao, 2022). These all illustrate the complexity of agricultural markets, and the need for stakeholders to adapt their behaviour to the short- and long-term fluctuations of agriculture under external shocks.

Natural disasters, in particular, have been strong external shocks that have a deep impact on the linkages between

agricultural commodity markets. These events, such as droughts, floods, and hurricanes, can significantly change the supply chain dynamics, creating an immediate strain on production capacity, and impacting distribution channels. This disruption can lead to commodity prices being highly volatile, which can feed through to the commodity affected markets, and have an unpredictable impact on commodity prices (Spangler et al., 2020).

This instability can further strengthen market trends and create market imbalance in several commodities and markets, impacting different market participants who need market stability for decision making. The ability of the agricultural markets to absorb and respond to these shocks is a measure of their resilience and can suggest that there are adaptive policies, tools and strategies to limit potential economic impacts if such shocks occur unexpectedly. On the other hand, the technological developments have started to change the structure and paradigm of interaction of agricultural commodity markets. Farm automation, such as precision agriculture, can result in less resource use and thus impact farm production costs and prices. Big data analytics is used to gain insight into market trends, to which stakeholders must be able to respond in advance and to be able to counteract risks (Spangler et al., 2020).

Furthermore, innovation in biotechnology could affect commodity value chain and introduce elements of instability and unpredictability in markets. So, the agricultural advances in technology will not only boost agricultural productivity efficiency and predictability, but also may lead to changes in the agricultural market interactions and it becomes even more crucial for the stakeholders to be aware and ready for changes in the agricultural technological advancements to keep their competitiveness.

Implications for Stakeholders:

The linkages of agricultural commodity markets have significant consequences for various stakeholders, such as farmers, traders and policy makers. Market linkage and its influence on production processes, productivity and prices are also challenges that farmers face, requiring them to adapt to external market shocks and price fluctuations (Umar et al., 2021). However, traders have to be ready to do a cross commodity market analysis in order to feed into their risk management and investment decisions to benefit from the opportunities that emerge when markets become interconnected, which would require some market analysis (Mokni & Youssef, 2020).

Interconnectedness of markets from a policy perspective enables policymakers to craft policies with greater precision to achieve market stability and safeguard economic interests especially in times of geopolitical crises (Gong & Xu, 2022). Overall, these observations highlight the need for having a thorough knowledge of the market situation to ensure that stakeholders in the agricultural commodity sectors make the best possible decisions. As such, there are a few options available for stakeholders to take in order to respond to the complexities of interdependencies and risks of agricultural commodity markets. One of the strategies is to diversify investments among different commodities to minimise the impact of the volatility of commodity prices on individual commodities (Umar et al., 2021).

Furthermore, utilizing strong hedging methods, like futures contracts, can safeguard against unfavourable price fluctuations, giving a financial cushion during unpredictable market conditions (Umar et al., 2021).

Moreover, establishing linkages between the value chain can help spread the risks, stabilize the value chain and make stakeholders better prepared for every unexpected risk (Morni & toussel, 2020). Policy interventions are thus very important for the stabilisation of the interdependent agricultural commodity markets. They can assist in reducing volatility by establishing price protection measures that do not cause excessive risk of price fluctuation in a sudden move. In turn, the imposition of subsidies or price supports may help to keep commodity markets from becoming volatile, thus cushioning the blow for producers and farmers. In the last decades, federal agricultural policies have become more and more involved in the market by taking a more data-driven approach to manage these volatilities (Spangler et al., 2020).

Moreover, international trade policies involving tariffs and quotas can help to provide a stabilizing influence, causing a balance in the supply/demand chain in the international trade. Furthermore, the participation of stakeholders in solving the problem of the markets in the agricultural commodity sector is very important. Collaborations can be leveraged for sharing information and resources to address challenges such as price instability and supply chain disruptions. Besides enabling effective communication through the value chain and facilitate a better reaction to external shocks such as natural hazards or geopolitical change, implementation of cross-commodity analyses also enables the stakeholders to develop strategies that reduce risk through diversification and hedging (Uma: al ah 2021). Together, stakeholders strengthen market resilience, ensuring stability and adaptation of the infrastructure to withstand different perturbations.

CONCLUSION

The study very clearly demonstrated the complex interdependence of agricultural commodity markets and the effect of interdependencies on market behaviour. These relationships can be complex and can help to improve decision making on managing price volatility and external risks. Thanks to the statistical methods (correlation coefficients, VAR models) used in the empirical approach, important insights into the dynamics of interaction and the way that these markets react to various influences were gained. In addition, the case studies demonstrated the interdependence of oil and agricultural commodities, and demonstrated the general implications of the market dynamics. Finally, the importance of analysing information for informed decision-making in agriculture markets, which are dynamic and continually developing is highlighted.

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