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C O N T E N T S

Global Perspectives in Agricultural Commodity Futures Research: A Comprehensive Literature review and Bibliometric Analysis

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Abstract

This Research conducts a pioneering bibliometric analysis of Agricultural Commodity Futures literature, focusing on 110 papers published between 1992 and 2023. Employing various bibliometric techniques, the study aims to identify key themes, assess the current state of Agricultural Commodity Futures research, and understand the influence of significant works through performance analysis, co-citation analysis, bibliographic coupling, and scientific mapping. Noteworthy findings include the most productive years being 2015 and 2017, the University of South Australia and Pusan National University as impactful institutes, and the United States as the most influential country in Agricultural Commodity Futures research. 'Energy Economics' emerges as the most influential journal, and the most cited article focuses on "dynamic spillover effects among crude oil, precious metals, and agricultural commodity futures markets". On average, each Agricultural Commodity Futures paper involves 1.95 authors with a collaboration index of 30. Leading contributors include China and the USA. The study identifies four thematic clusters within Agricultural Commodity Futures research, providing valuable insights for researchers and outlining potential future research directions, thereby contributing significantly to the understanding and advancement of Agricultural Commodity Futures literature.

Keywords: Agricultural Commodity Futures, Bibliometric Analysis, Co-citation Analysis, Bibliographic Coupling

Introduction

Agricultural commodity futures markets serve as a foundational pillar within the global agricultural industry, functioning as a crucial mechanism for producers, consumers, and investors to manage risk, discover price information, and ensure the efficient allocation of resources (Borin & Di Nino, 2012; Bargawi & Newman, 2017; Inani, 2018). The far-reaching significance of these markets extends beyond agriculture, influencing economic stability, food security, and global trade (Liverman & Kapadia, 2012; Campbell et. al., 2016). Recognizing the pivotal role of futures in shaping our interconnected world, it becomes imperative for academics, researchers, policymakers, market participants, and stakeholders across agricultural and financial sectors to comprehend the extensive body of research in this field.

This research paper embarks on a comprehensive exploration of the literature surrounding agricultural commodity futures, utilizing both bibliometric analysis and literature review methodologies. Our primary goal is to provide a systematic and rigorous assessment of existing research, aiming to highlight key trends, seminal contributions, and knowledge gaps that have significantly contributed to our understanding of these markets.

The relevance of agricultural commodity futures becomes even more apparent in the face of the ever-changing global agriculture and finance landscape (Borch, 2007). Challenges arising from climate change, shifting consumer preferences, and geopolitical dynamics elevate the stakes for supply chain stakeholders (Basu, 2023; Lund et al., 2020). These challenges, coupled with the emergence of innovative financial instruments and technological advancements, necessitate a thorough examination of academic research. This research not only informs decision-making processes for market participants but also guides policymakers in navigating the evolving landscape of agricultural commodities.

Commencing with a historical perspective, this paper traces the evolution of commodity futures markets, showcasing their emergence as indispensable risk management tools for both agricultural producers and consumers. We delve into the intricacies of these markets, scrutinizing their functioning, the roles played by participants, and the driving forces influencing their growth and development. Subsequently, our bibliometric analysis unveils trends in research output, identifies the most influential authors and journals, and reveals the thematic breadth of the literature, shedding light on the knowledge networks that have evolved in this field.

As we navigate the current literary landscape of agricultural commodities, we address key themes, including risk management, price efficiency, speculation, and the impact of regulatory changes. This exploration provides a nuanced perspective on the contributions and controversies that have marked this discipline. Additionally, we consider the global perspective, examining the contributions of various regions and the extent to which cultural, economic, and institutional differences shape the research agenda.

Moreover, we meticulously identify gaps and opportunities within the existing literature, offering insights into areas that warrant further exploration to meet the evolving challenges and opportunities within agricultural commodity markets. Our analysis aspires to serve as a valuable resource for researchers navigating this complex and dynamic field, as well as for practitioners and policymakers seeking to make informed decisions in the ever-changing landscape of agricultural commodities.

In an era marked by increasing complexity in agricultural markets and the global financial landscape (Held et al., 1999; Mueller et al., 2021), this study underscores the importance of consolidating and synthesizing the body of knowledge surrounding agricultural commodity futures. We aim to facilitate a deeper understanding of the dynamics, risks, and opportunities within these markets and to encourage continued exploration in this critical domain. Ultimately, our contributions aim to enhance the robustness and resilience of the global agricultural industry and financial markets alike.

Background Of The Study

In the realm of academic inquiry, agricultural commodity futures (ACF) have served as a pivotal subject within the broader context of global trade and economic systems (Li et al., 2022). These financial instruments play a fundamental role in mitigating risk for agricultural producers, facilitating price discovery, and ensuring the efficient allocation of resources within the agricultural sector (Ali & Bardhan Gupta, 2011; Rao, 2015; Isakson, 2017). Given the contemporary challenges of food security, climate change, and market volatility, a comprehensive understanding of the body of knowledge surrounding agricultural commodity futures becomes increasingly imperative.

The historical trajectory of agricultural commodity futures can be traced back to the mid-19th century, originating in the United States as tools designed to assist farmers and merchants in managing price risks associated with agricultural production and trade (Pinzur, 2016; Saleuddin, 2017). Over time, these markets have evolved into a complex global system, subject to in-depth exploration in the literature. Research has delved into the historical significance of these markets and the development of regulatory frameworks that govern them (Farrell & Newman, 2010; Balleisen & Brake, 2014).

Price discovery stands out as a core function of agricultural commodity futures markets, with extensive studies examining the efficiency and effectiveness of these markets in determining fair prices for agricultural commodities (Mattos & Garcia, 2004; Aggarwal et al., 2014; RL & Mishra, 2020). Additionally, these markets serve as essential tools for risk management, a facet extensively scrutinized in research exploring their role in mitigating price volatility and ensuring the stability of the agricultural sector (Allioui & Mourdi, 2023; Farooq et al., 2022).

As the global population burgeons and climate change disrupts traditional agricultural practices, the significance of commodity futures in shaping agricultural production practices and sustainability becomes increasingly crucial (Fleming & Vanclay, 2010; Clapp & Helleiner, 2012; Buttel, 2013). The literature delves into how these markets influence decisions made by farmers, agribusinesses, and policymakers, thereby impacting the agricultural landscape and its long-term sustainability.

Market dynamics, including the role of speculators in shaping behaviour, have been subject to scrutiny, as has the impact of regulations and policies on market participants and outcomes (Petry et al., 2023; Williams, 2013). The ever-changing global landscape introduces emerging trends in agricultural commodity futures, such as the integration of technology, the influence of ESG factors, and the implications of globalization on these markets (Lo, 2021).

The roots of agricultural commodity futures markets, extending back to ancient civilizations, underscore their enduring importance in supporting agricultural activities (Pollock, 1992; Fairbairn, 2020). In the contemporary context, these markets have grown significantly, propelled by advances in transportation, communication, and financial innovations (Chui, 2012).

Emerging trends in agricultural commodity futures markets are intricately linked to environmental and sustainability issues (Noe & Alrøe, 2015). The adoption of advanced technologies, regulatory changes, and the global context shapes the contemporary landscape (Knickel et al., 2017). Blockchain, data analytics, and algorithmic trading are reshaping these markets, enhancing transparency, reducing transaction costs, and

broadening market access (Weber et al., 1999; Rejeb et al., 2020; Ababouch et al., 2023; Hidalgo et al., 2023). The efficiency of these markets remains a key area of research, exploring the extent to which futures reflect all available information, as posited by the Efficient Market Hypothesis (Konstantinidis et al., 2012). Speculators, crucial to the liquidity of agricultural commodity futures markets, contribute to both market efficiency and ongoing debates about their impact on price volatility (Ghosh et al., 2012; Will et al., 2015). Research has assessed the effectiveness of futures markets in mitigating risks for agricultural producers, revealing varying outcomes influenced by factors such as commodity type, market structure, and participant profiles (Ullah et al., 2016; Kalogeras et al., 2012).

However, to the best of our knowledge, currently there is no scientific and comprehensive analysis of ACF in the research field based on quantitative and statistical perspective. Therefore, we propose a bibliometric analysis of ACF to comprehensively map the landscape of this research field. Specifically, this paper addresses the following research question:

RQ1: What are the key authorship patterns, collaboration dynamics, publication trends, and thematic structures in Agricultural Commodities Futures Research? Furthermore, how do these factors, along with the contributions of prominent authors and influential articles, evolve over time to inform the future directions of this field?

To answer these research questions, this study conducts a bibliometric analysis on academic publications in this field during the period 1992–2023 to explore the general publication distributions, reveal the collaboration relations, discover trending keywords and analyze major research themes and their evolutions.

Methodology

In the present study, the formulation of precise search terms is of utmost importance to achieve comprehensive coverage of the diverse facets within the field of Agricultural Commodity Futures. To facilitate this, we relied on the exact match keyword, specifically "Agricultural Commodity Futures," ensuring inclusivity of all relevant components.

Article Inclusion and Exclusion Criteria

Table 1: Article Inclusion and Exclusion Criteria

Selection Criteria	**Exclude**	**Include**
Search Engine: Scopus		
Date of Search: 01 August 2023		
Period of Publications: 1992 - 2023		
Search Term: ("Agricultural Commodity Futures")	-	155
Subject Area: "Business Management and Accounting", "Social Sciences", "Economics, Econometrics and Finance", "Arts and Humanities"	34	121
Document Type: "Articles" and "Reviews"	7	114
Article Selection		
Language Screening: "Include documents in English only"	3	111
Erroneous refine record: Include documents with valid author, title, abstract etc	1	110

Source: Developed by the authors based on Scopus Database

Table 1, presented in this study, outlines the criteria used for the inclusion and exclusion of articles. This framework served as a guideline to meticulously select articles that align with the study's objectives. Our primary data source was the Scopus database, acknowledged for its comprehensive coverage of double-blind peer-reviewed publications in high-impact factor journals, surpassing the coverage provided by the Web of Science. A systematic approach was adopted to retrieve 110 articles, as depicted in Table 1. We employed specific keywords such as "Agricultural Commodity Futures" to filter for English-language articles from diverse disciplines but limited the data extraction from Scopus to articles published from 1992 onwards.

It is imperative to acknowledge that online databases, like Scopus, may contain inaccuracies stemming from incorrect bibliographical and bibliometric information due to subsequent publications. To mitigate this risk, we implemented a series of data refinement procedures in accordance with recommended methodologies. Furthermore, we harnessed the power of natural language processing tools within the VOS viewer software and Biblioshiny, allowing us to cleanse and standardize terms extracted from article titles, abstracts, and author-specific keywords, thereby enhancing data quality and analysis accuracy.

Recognizing the value of bibliometric analysis as a pivotal quantitative tool for a comprehensive exploration of available information, we deployed this approach extensively. It enabled us to identify key sources of knowledge, map the dissemination of ideas, and highlight influential works within the field, thereby enriching scholarly discourse. In pursuit of this goal, we employed a thoughtful selection of techniques. This approach provided essential context to the research landscape, offering insights into the historical development and influential personalities who have shaped the domain. Subsequently, we delved into various bibliometric analysis techniques, encompassing authorship analysis, citation analysis, bibliographic coupling, co-citation analysis, and co-word analysis. By integrating these methodologies, we were able to extract invaluable insights from the bibliographic data, uncovering connections, patterns, and trends within the scholarly corpus.

Findings

Summary Statistics:

Table 2: Summary Statistics

Description	Results
Documents	110
Sources (Journals, Books, etc)	74
Keywords Plus (ID)	198
Author's Keywords (DE)	310
Period	1992:2023
Average citations per document	18.43
Authors	215
Authors of single-authored docs	15
Authors of multi-authored docs	200
Single-authored docs	16
Documents per Author	0.511
Authors per Document	1.954
Co-Authors per Doc	2.52
Collaboration index	30

Source: Developed by the authors based on Scopus Database

In this comprehensive investigation, we delved into a total of 110 documents that spanned the years from 1992 to 2023. These documents were meticulously curated from a diverse array of 74 reputable sources, including academic journals, books, and other scholarly publications. Our analysis unearthed an average of 18.43 citations per document, underscoring the substantial recognition and influence that these works have garnered within the academic community.

This exhaustive scrutiny also unveiled 215 distinctive authors who made notable contributions to the realm of Agricultural Commodity Futures (ACF) over the designated timeframe. Noteworthy among our findings was the presence of 15 single-authored documents, juxtaposed with 200 multi-authored documents, indicating a harmonious blend of both collaborative and solitary research endeavours. On average, each document entailed the contributions of 1.95 authors, illustrating a predominant inclination towards collaborative research practices in the field of ACF.

Conversely, each author was found to have played a role in approximately 0.511 documents, signifying a commendable level of individual research productivity. A more in-depth exploration of the data further unveiled an average of 2.52 co-authors per document, pointing towards a strong culture of cooperation and mutual engagement within the ACF domain. The calculated collaboration index, standing at an impressive 30, underscores the significance of joint research undertakings and team-based projects among the scholarly community.

These results illuminate the dynamic and evolving nature of research in Agricultural Commodity Futures. The substantial number of citations, as well as the high degree of author collaboration, exemplify the increasing impact and collective commitment of researchers in advancing knowledge within this domain. The coexistence

of both single-author and multi-authored documents reflects a healthy amalgamation of independent scholarship and interdisciplinary teamwork, contributing to the overall diversity and depth of research in ACF.

Contribution by countries:

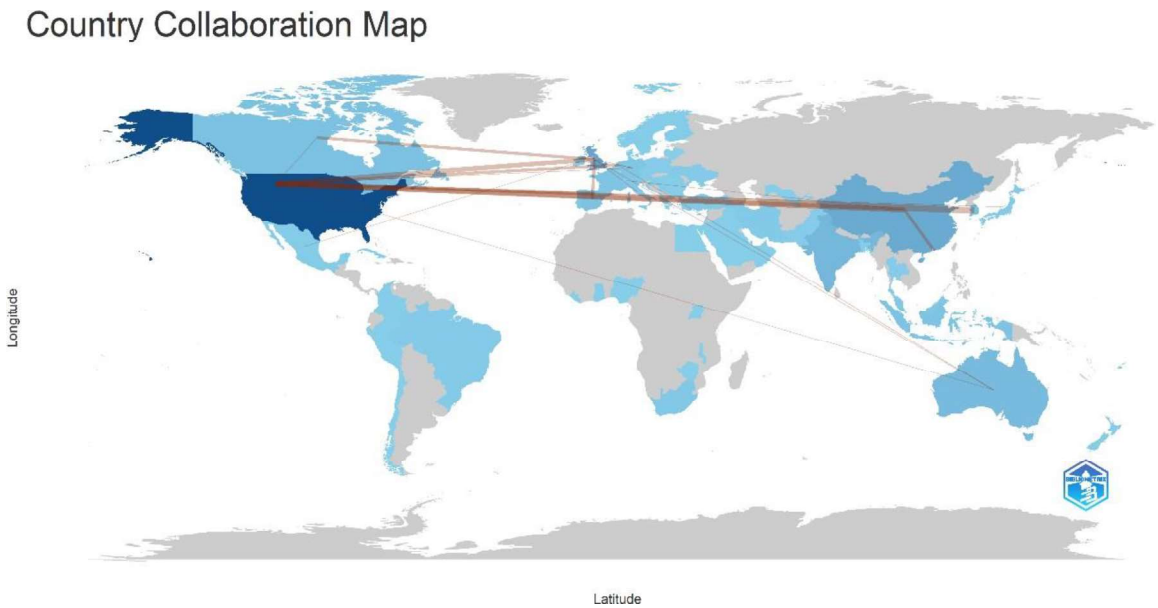

Figure 1. Country Collaboration Map

Source: Developed by the authors based on Scopus Database on R(Bibliometrix)

In examining the research contributions of various countries in the domain of Agricultural Commodity Futures (ACF), our bibliometric analysis has unveiled several noteworthy trends. China emerges as the most prolific contributor, with a remarkable total of 59 articles, underscoring its dominant role in the realm of ACF research. Following closely behind, the United States secures the second position with 51 articles, signifying its escalating influence within the field. India and Australia also emerge as notable contenders, with 35 and 23 articles, respectively, demonstrating their substantial contributions to ACF research. Interestingly, India secures the third position with 35 papers, revealing its active involvement in the burgeoning field of ACF research.

It is crucial to highlight that, despite India's third-place ranking in terms of overall article contributions, its authors secure the ninth position in terms of the Most Cited Papers (MCP). This suggests that the research originating from India carries a significant impact and influence within the field. Furthermore, Germany and the United Kingdom also exhibit substantial contributions to ACF research, while other nations, including Thailand, South Africa, France, Sweden, South Korea, Canada, Colombia, Japan, Switzerland, and Turkey, maintain more moderate levels of research output.

Our analysis delves deeper into collaboration patterns among researchers from different countries, revealing expected outcomes. China, the United States, and India, being the top contributors, naturally exhibit a higher propensity for collaborative efforts among researchers from these nations. When we view this from a continental perspective, North America, Asia, and Europe collectively contribute the most to ACF research. In contrast, countries such as Austria, Belgium, Greece, Mexico, Netherlands, Serbia, Spain, Denmark, New Zealand, Pakistan, Portugal, and Saudi Arabia exhibit limited contributions to the field.

Performance analysis

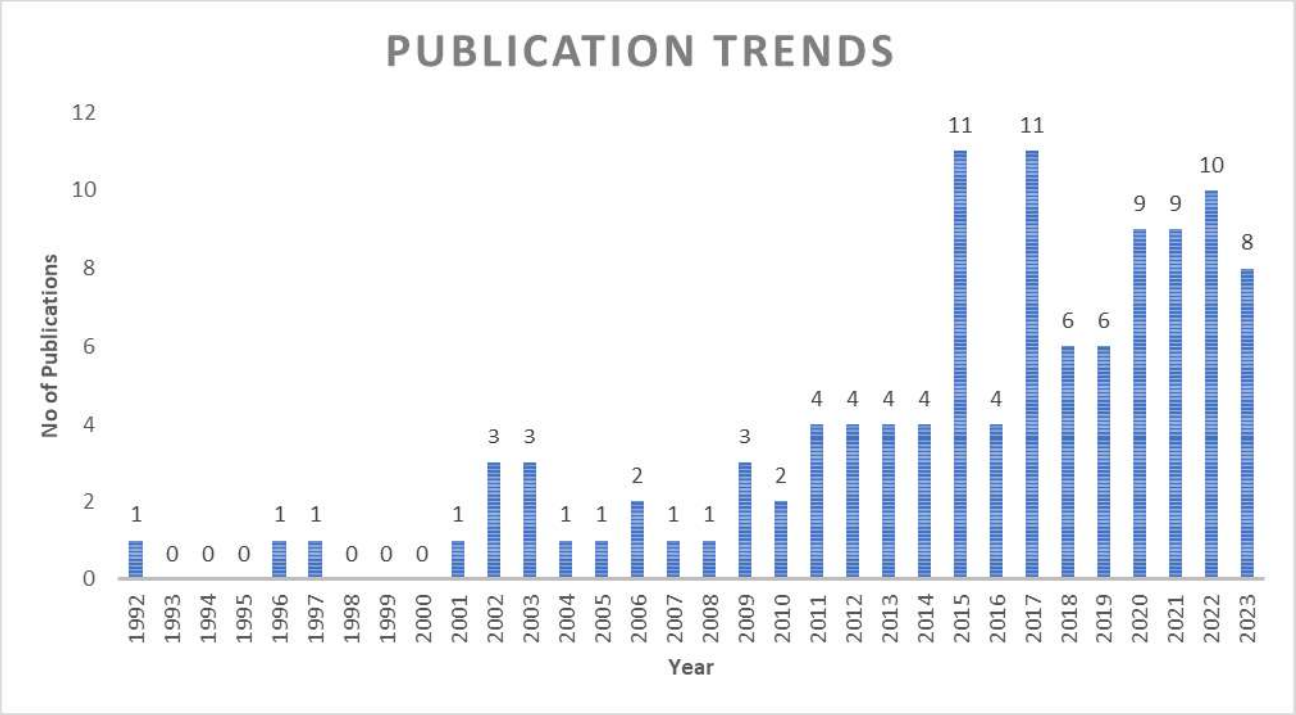

Figure 2. Publication Trends
Source: Developed by the authors based on Scopus Database on R(Bibliometrix)

The provided bar chart illustrates the trends in publications within the realm of Agricultural Commodity Futures (ACF) research. Notably, the years 2015 and 2017 emerge as the most prolific periods, as depicted in Figure 2. However, it is essential to acknowledge that the journey of research in this domain commenced with the groundbreaking work of (Frank, 1992). The initial trajectory of research in this field reveals a predilection for the term "Agricultural Commodity Futures." Commencing around 2010, there has been a gradual uptick in the prevalence of ACF research, and since 2015, there has been a pronounced surge in annual production rates. In light of the current trajectory, it is reasonable to anticipate a sustained growth in the study of ACF in the forthcoming years.

Prominent authors, organizations, and countries for ACF research

Table 3 Most influential authors, organizations, and countries

TC	Author	TP	TC	Organization	TP	TC	Country	TP
318	Kang S.H.	1	318	University of South Australia, Australia	1	550	China	24
133	Luo J.	1	318	Pusan National University, South Korea	1	490	United States	28
129	Sørensen C.	1	318	Pusan National University, South Korea	1	458	Australia	14
93	Mckenzie A.M.	1	160	South China University of Technology, China	2	362	South Korea	4
84	Xiong T.	1	133	Chinese Academy of Sciences, China	1	170	United Kingdom	10
76	Clapp J.	1	133	University of Chinese Academy of Sciences, China	1	137	Denmark	2
73	Tian F.	2	129	Copenhagen Business School, Denmark	1	136	Canada	4
71	Wang H.H.	1	93	University of Arkansas, United States	1	118	Sweden	4
70	Garcia P.	1	93	North Carolina State University, United States	1	101	India	18
56	Kavussanos M.G	1	84	Huazhong Agricultural University, China	1	96	France	4
54	Sensoy A	1	84	Huazhong University of Science and Technology, China	1	62	Turkey	3
48	Ali J.	1	76	University of Waterloo, Canada	1	57	Greece	2
44	Elder J.	2	71	Washington State University, United States	1	49	Germany	5
41	Mo D.	1	70	Univ. Illinois at Urbana-Champaign, United States	1	41	Portugal	3
38	Nguyen D.K.	1	70	Univ. Illinois at Urbana-Champaign, United States	1	37	Netherlands	3
31	Fang Y.	1	61	Sun Yat-Sen University, China	1	24	Japan	4
29	Bohl M.T.	1	61	Sun Yat-Sen University, China	1	24	Spain	2
27	Luo J.	1	61	South China University of Technology, China	1	18	Thailand	4
27	Yang J.	1	56	Athens University of Economics and Business, Greece	1	16	South Africa	4
25	Ouyang H.	1	56	World Maritime University, Sweden	1	11	Switzerland	2

Source: Developed by the authors based on Scopus Database

Note(s): TC = "total citations". TP = "total publications"

In Table 3, an overview of the most influential authors, institutions, and countries in the field of Agricultural Commodity Futures (ACF) research is presented. Kang S.H. emerges as the most influential author, boasting 318 citations and one research paper publication. Luo J. has also made significant contributions, with one document published and 133 citations to their name. In the realm of institutions, the 'University of South Australia' and 'Pusan National University' stand out as the most influential, each accumulating 318 citations with one document publication. Following closely behind is the 'South China University of Technology,' with 160 citations and one document publication for each. In terms of countries, China leads the pack as the most influential, with a substantial 550 citations stemming from 24 documents. The United States follows closely, amassing 490 citations from 28 documents. Australia has also made a notable contribution, publishing 14 documents with a total of 458 citations. Moreover, it is worth noting that the United States demonstrates its prolificacy in ACF research, emerging as the most productive country in this field.

Relationship between authors, keywords and sources:

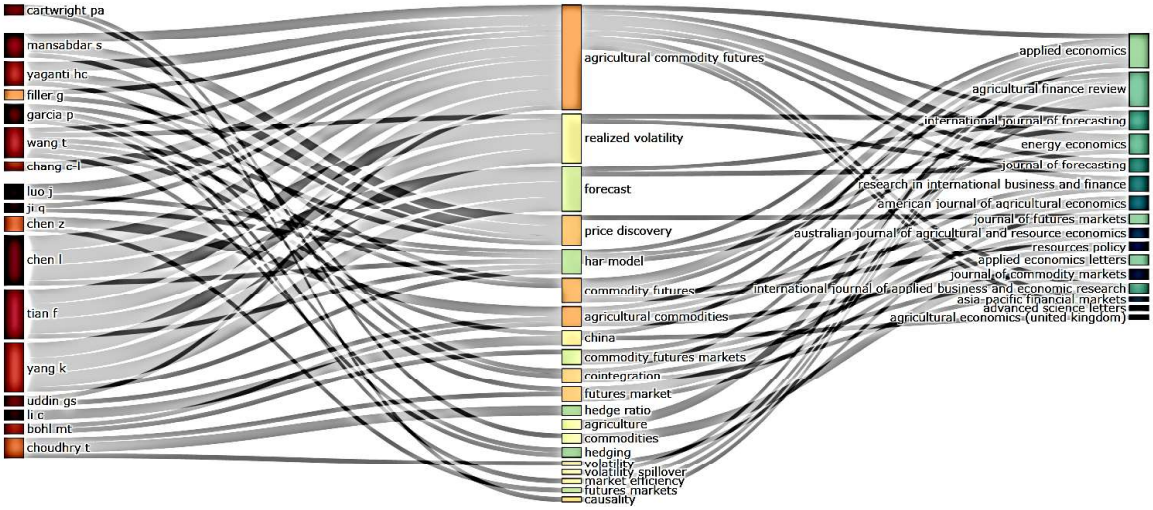

Figure 3. Three field analysis in ACF

Source: Developed by the authors based on Scopus Database on R(Bibliometrix)

In Figure 3, we conducted a comprehensive analysis of the field, focusing on the interplay between authors, keywords, and sources. The graphical representation of this analysis displayed in Figure 3 comprises three distinct columns: the left column featuring author names, the middle column housing keywords, and the right column listing the respective journal names. Our investigation unveiled a striking pattern in the selection of keywords by authors within the field. A substantial proportion of authors prominently opted for the keyword "agricultural commodity futures" as the linchpin of their research endeavours. Notwithstanding this dominant preference, our scrutiny also detected the frequent use of closely related keywords, such as “realized volatility,” “forecast,” “price discovery,” “har model,” “commodity futures,” and “agricultural commodities,” among various other variations, in the context of different research articles. It is imperative to note that authors who elected to focus on “agricultural commodity futures” as their primary keyword commonly intertwined these related terms throughout their scholarly works. Nonetheless, the data unmistakably indicates a pronounced emphasis on “agricultural commodity futures” when juxtaposed with alternative keywords. This emphasis may be attributed to the pervasive adoption and prevalence of Agricultural Commodity Futures (ACF) practices as the preferred semantic terminology to convey analogous concepts.

An opportunity for further exploration beckons through the application of Influential topics. This analytical framework categorizes keywords into four quadrants, as detailed in Figures 6, 7, 8, and 9, and ranks them based on their historical and current preference. A deeper dive into this methodological approach could offer valuable insights into the evolving dynamics of keyword utilization within the field. Turning our attention to the sources, our findings suggest a balanced distribution of research contributions across various journals, indicating a widespread interest in Agricultural Commodity Futures (ACF) research. However, certain journals, notably “Applied Economics” and the “Journal of Futures Market,” emerge as trailblazers and instrumental in advancing the body of knowledge within this domain. Their distinct prominence reflects their significance in shaping and propelling the discourse in the field of Agricultural Commodity Futures.

Performance of academic journals:

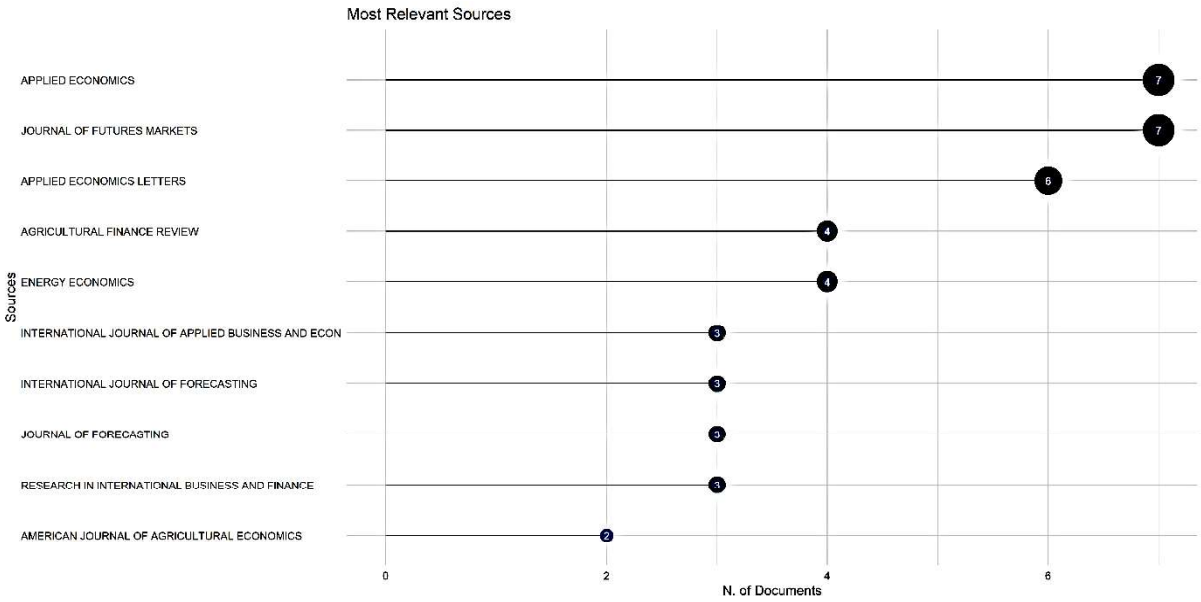

Figure 4: Most contributing journal in ACF

Source: Developed by the authors based on Scopus Database on R(Bibliometrix)

The research endeavour sought to identify the most influential academic journals in the realm of Agricultural Commodity Futures (ACF). The outcomes of this investigation have been thoughtfully illustrated in Figure 4. Notably, the "Applied Economics and Journal of Futures Market" demonstrated their supremacy as leading contributors, boasting the publication of 7 research papers each during the specified period. This substantial productivity underscores the substantial impact and influence that these journals wield within the ACF domain. Closely following this formidable duo was the journal "Applied Economics Letter," which made a noteworthy contribution by publishing 6 articles, clearly signalling its role in advancing sustainable ACF practices. Additionally, two other journals, namely "Agricultural Finance Review" and "Energy Economics," each published 4 articles, thereby cementing their significant roles in disseminating research within this field. It is intriguing to note that, despite accumulating substantial citation counts, such as the impressive 475 citations amassed by "Energy Economics," these journals found themselves ranked relatively lower on the list, holding the 5th position, respectively. These findings raise a pertinent question that warrants further investigation: why does a noticeable gap exist between citation counts (as exemplified in Table 4) and the journal rankings concerning the number of published articles? This incongruity suggests that, despite their high citation counts, some journals may not be actively publishing research related to ACF, while other journals with lower citation counts may be making significant, albeit potentially underappreciated, contributions in the field. To gain deeper insights into journal performance and impact, it is recommended to cross-reference these findings with renowned journals and their publications. Such an approach could provide a more comprehensive understanding of the scholarly landscape within ACF. As diligent researchers, it is crucial to consider these findings when selecting the most relevant journals for keeping abreast of the latest advancements and contributing to the growth of knowledge in the ever-evolving field of ACF.

Most influential journals for ACF research

Table 4 Most influential journals for ACF research

Journals	TC	FIN	ECO	TP	ABDC	1992-1998	1999-2005	2006-2012	2013-2019	2020-2023
Energy Economics	475		X	4	NA				2	2
Journal of Futures Markets	226			7	A*		2	2	2	1
Applied Economics	121		X	7	NA		1	1	1	4
International Journal of Forecasting	111			3	A				1	2
Knowledge-Based Systems	84			1	A				1	
Australian Journal of Agricultural and Resource Economics	80		X	2	A		1		1	
Third World Quarterly	76			1	NA			1		
European Review of Agricultural Economics	70		X	1	A		1			
Agricultural Finance Review	58	X		4	A			2	2	
Transportation Research Part E: Logistics and Transportation Review	56			1	C				1	
Resources Policy	54			2	A*				1	1
Journal of Forecasting	50			3	B				1	2
Applied Economics Letters	49		X	6	A		2	2	1	1
Economic Modelling	41			1	B				1	
Finance Research Letters	38	X		1	A				1	
Journal of Asian Economics	29		X	1	A				1	
International Review of Economics and Finance	25	X	X	1	B				1	
Journal of Applied Economics	25		X	1	NA				1	
Global Policy	24			1	B				1	
International Review of Financial Analysis	24	X		1	NA			1		

Source: Developed by the authors based on Scopus Database

Note(s): ABDC = "Australian Business Deans Council 2022 Journal Rank List". TC= "Total Citations". TP = "Total Publications". FIN = "X if a journal is classified as Finance" "ECO = X if a journal is classified as Economics"

The information presented in Table 4 provides a comprehensive overview of the significant sources of research in the field of Agricultural Commodity Futures (ACF) and their respective impact. Notably, "Energy Economics" emerges as the most influential source in this field, with a substantial 475 citations and 4 publications. Following closely is the "Journal of Futures Markets," which boasts 226 citations and a noteworthy 7 publications. In terms of productivity, "Applied Economics" and "Journal of Futures Markets" stand out, each contributing 7 publications. Additionally, "Energy Economics" exhibits high productivity with 4 publications. The period spanning from 2013 to 2019 appears to be the peak of productivity, particularly in the most influential journals. During this time frame, researchers contributed significantly to the body of knowledge in ACF. Noteworthy distinctions include the recognition of the "Agricultural Finance Review" as the most influential finance journal in the field, while "Applied Economics" takes the accolade for being the most influential economics journal. The "Journal of Futures Markets" distinguishes itself as the most productive non-finance and economics journal, making substantial contributions to the ACF literature. An interesting observation is that while research in ACF research commenced in 1992, it wasn't until the year 2000 that publications in high-quality journals began to appear. A critical point to highlight is the absence of publications in the most influential journals between 1992 and 1998, indicating a significant development in the recognition and dissemination of ACF research within academic circles during this period.

Most influential articles on ACF research

Table 5 Most influential articles on ACF research

Authors	Title	TC
Kang S.H et al. (2017)	"Dynamic spillover effects among crude oil, precious metal, and agricultural commodity futures markets"	318
Luo J and Ji Q. (2018)	"High-frequency volatility connectedness between the US crude oil market and China's agricultural commodity markets"	133
Sørensen C. (2002)	"Modeling Seasonality in Agricultural Commodity Futures"	129
Mckenzie A.M and Holt M.T. (2002)	"Market efficiency in agricultural futures markets"	93
Xiong T et al. (2015)	"A combination method for interval forecasting of agricultural commodity futures prices"	84
Clapp J. (2009)	"Food price volatility and vulnerability in the global South: Considering the global economic context"	76
Wang H.H and Ke B. (2005)	"Efficiency tests of agricultural commodity futures markets in China"	71
Garcia P and Leuthold R.M. (2004)	"A selected review of agricultural commodity futures and options markets"	70
Tian F et al. (2017)	"Realized volatility forecasting of agricultural commodity futures using the HAR model with time-varying sparsity"	61
Kavussanos M.G et al. (2014)	"Economic spillovers between related derivatives markets: The case of commodity and freight markets"	56
Sensoy A et al. (2015)	"Dynamic convergence of commodity futures: Not all types of commodities are alike"	54
Ali J and Gupta K.B. (2011)	"Efficiency in agricultural commodity futures markets in India: Evidence from cointegration and causality tests"	48
Mo D et al. (2018)	"The macroeconomic determinants of commodity futures volatility: Evidence from Chinese and Indian markets"	41
Nguyen D.K et al. (2015)	"Testing for asymmetric causality between U.S. equity returns and commodity futures returns"	38
Elder J and Jin H.J. (2007)	"Long memory in commodity futures volatility: A wavelet perspective"	31
Fang Y et al. (2020)	"Optimal forecast combination based on ensemble empirical mode decomposition for agricultural commodity futures pri	31
Bohl M.T et al. (2018)	"Speculative activity and returns volatility of Chinese agricultural commodity futures"	29
Luo J et al. (2022)	"Forecasting realized volatility of agricultural commodity futures with infinite Hidden Markov HAR models"	27
Yang J and Awokuse T.O. (2003)	"Asset storability and hedging effectiveness in commodity futures markets"	27
Yang K et al. (2017)	"Realized volatility forecast of agricultural futures using the HAR models with bagging and combination approaches"	25

Source: Developed by the authors based on Scopus Database

Note(s): "TC = total citations"

Table 5 offers a comprehensive compilation of the most highly cited and influential articles within the domain of Agricultural Commodity Futures (ACF) research. One noteworthy contribution is the article titled "Dynamic Spillover Effects Among Crude Oil, Precious Metal, and Agricultural Commodity Futures Markets" authored by (Kang et al., 2017) which has garnered an impressive 318 citations, establishing it as a seminal work in this field. This study illuminates novel insights into the transmission of information and interconnections across diverse commodity markets. It accentuates the heightened positive correlations that emerge during periods of financial crises, underscores the bidirectional flow of spillover effects, and underscores the pivotal roles of gold and silver as crucial information transmitters. The findings hold profound implications for investment decision-making and portfolio strategies, especially in the context of turbulent market conditions. Investors and portfolio managers can effectively leverage these findings to augment their decision-making processes and enhance risk management strategies.

Another significant study within this framework is conducted by (Luo & Ji, 2018), in their publication titled "High-Frequency Volatility Connectedness Between the US Crude Oil Market and China's Agricultural Commodity Markets." This study sheds light on the dynamic characteristics of volatility connectedness between the US crude oil futures market and the agricultural commodity futures markets in China. While this research uncovers evidence of spillover effects, it is crucial to note that these spillovers exhibit a relatively weak nature. Furthermore, the study underscores the necessity of considering the asymmetric attributes of volatility transmission, with specific attention to the amplified interdependence observed during periods of negative volatility. These observations have profound implications for devising effective risk management strategies and optimizing investment approaches in this context.

Knowledge foundations of ACF research through co-citation analysis

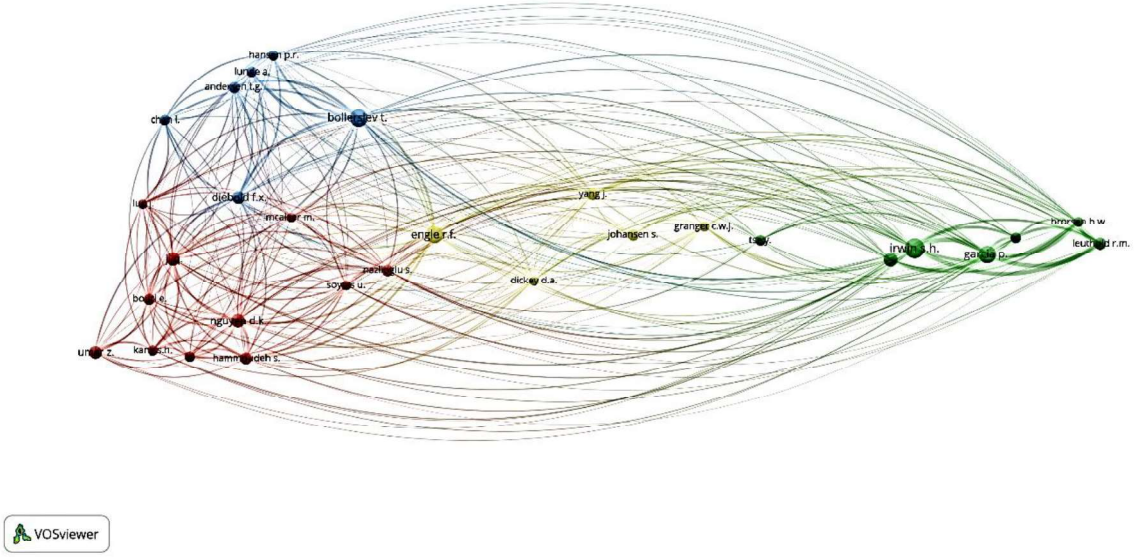

Figure 5. Co-citation of references cited by articles on ACF research

Source: Developed by the authors based on Scopus Database on R and VOS Viewer

Note(s): "A cited reference and a semantic cluster of references based on theme similarity are represented by each node. The degree of local citations is represented by the size of nodes, with larger nodes reflecting a higher intensity of local citations. Co-citations are represented by the link between nodes. The degree of co-citations is represented by the size of the link between nodes, with thicker linkages indicating more co-citation intensity."

Utilizing co-citation analysis, our research uncovers a profound revelation, unveiling the intricate web of semantic correlations woven among co-cited references. This innovative approach provides invaluable insights into the very foundation of knowledge that forms the cornerstone of a specific academic field (Donthu et al., 2021; Goel & Kaur, 2021; Zhang et al., 2022; Nandan & Soni, 2023). Figure 5 serves as an illustrative co-citation map, showcasing references that have been cited at least twenty times in the reviewed articles. Notably, within the realm of Agricultural Commodity Futures (ACF) research, certain scholars, including Irwin S.H, Gracia P, Leuthold R.M, Brorsen B.W, and Tse Y (depicted by green nodes), stand out for their extensively cited works. They have made significant contributions to a specific niche within the ACF domain. Similarly, another group of scholars, including Bollerslev T, Andersen T.G, Diebold F.X, Hansen P.R, Lunde A, and Chen I (represented by blue nodes), are prominent for their extensively cited works within a different segment of ACF research, contributing substantially to their area of expertise. Furthermore, in the field of ACF research, the contributions of scholars such as Nazlioglu S, Ji Q, Hammoudeh S, Soytas U, Nguyen D.K, Mcaleer M, Kang S.H, Luo J, and Bouri E (depicted by red nodes) are noteworthy, as their work has been extensively cited in a specific ACF subdomain. In a similar vein, scholars like Engle R.F, Yang J, Granger C.W.J, Johansen S, and Dickey D.A (represented by yellow nodes) have garnered substantial recognition for their works, which have been heavily cited within a particular segment of ACF research. Their contributions have significantly impacted and enriched this academic field.

Thematic and influence structure analysis through bibliographic coupling

Table 6 Thematic and influence structure analysis through bibliographic coupling

Theme	Authors	Title	TC
Commodity Futures and Market Efficiency	Sensoy A et al. (2015)	"Dynamic convergence of commodity futures: Not all types of commodities are alike"	54
	Mckenzie A.M and Holt M.T	"Market efficiency in agricultural futures markets"	93
	Coronado Ramírez S et al. (2015)	"Adaptive market efficiency of agricultural commodity futures contracts"	60
Futures Market and Price Discovery	Wang H.H and Ke B. (2005)	"Efficiency tests of agricultural commodity futures markets in China"	71
	Ali J and Gupta K.B. (2011)	"Efficiency in agricultural commodity futures markets in India: Evidence from cointegration and causality tests"	48
	Yang J et al. (2021)	"Price discovery in chinese agricultural futures markets: A comprehensive look"	23
Agricultural Commodities and Hedging	Xiong T et al. (2015)	"A combination method for interval forecasting of agricultural commodity futures prices"	84
	Garcia P and Leuthold R.M. (2004)	"A selected review of agricultural commodity futures and options markets"	70
	Yang J and Awokuse T.O. (2003)	"Asset storability and hedging effectiveness in commodity futures markets"	27
Agricultural Commodity Futures and Realized Volatility	Kang S.H et al. (2017)	"Dynamic spillover effects among crude oil, precious metal, and agricultural commodity futures markets"	318
	Sørensen C. (2002)	"Modeling Seasonality in Agricultural Commodity Futures"	129
	Tian F et al . (2017)	"Realized volatility forecasting of agricultural commodity futures using the HAR model with time-varying sparsity"	61

Source: Developed by the authors based on Scopus Database

Note(s): "TC= Total Citation"

Table 6 presents the theme clusters of ACF research identified through bibliographic coupling. The following four topic groupings emerged: Commodity Futures and Market Efficiency, Futures Market and Price Discovery, Agricultural Commodities and Hedging, Agricultural Commodity Futures and Realized Volatility. Additionally, the table includes the most influential articles within each cluster. These four groups comprehensively cover various aspects of ACF research, encompassing a wide range of topics in the field.

In Cluster 1, our research delves into the realm of commodity futures and market efficiency. Notable studies in this cluster include (Sensoy et al., 2015). which identified a convergence in returns for precious and industrial metal commodity futures around the mid-2000s. However, this convergence was not observed in agricultural commodity futures, indicating that the physical supply and demand balance, rather than global financial conditions, primarily influenced commodity futures prices. Another study by (McKenzie & Holt, 2002) examined market efficiency and unbiasedness in four agricultural commodity futures markets. They found that while futures prices accurately reflected expected future spot prices over the long run, short-run inefficiencies and pricing biases presented potential trading opportunities for those who could exploit these deviations. Furthermore, (Coronado Ramírez et al., 2015) investigated adaptive market efficiency in agricultural commodity futures markets and discovered evidence of nonlinear serial dependence in the returns series of selected agricultural commodity futures contracts.

Cluster 2 focuses on futures markets and price discovery. (Wang & Ke, 2005) analyzed the efficiency of Chinese futures markets for wheat and soybeans, revealing a long-term equilibrium relationship between soybean futures and cash prices but weak short-term efficiency. For wheat, the futures market was considered inefficient, possibly due to overspeculation and government intervention. These findings have significant implications for market participants, policymakers, and analysts in understanding and addressing issues in these commodity futures markets. Additionally, research by (Ali & Bardhan Gupta, 2011) highlighted the existence of cointegration between futures and spot prices for various agricultural commodities in India, shedding light on the effectiveness of futures markets for price discovery and risk management amidst evolving market dynamics and policy reforms. (Yang et al., 2021) acknowledged time and regional variations in the price discovery process and suggested that as agricultural futures markets in China mature, their influence on determining commodity prices increases.

In Cluster 3, publications revolve around agricultural commodities and hedging. (Xiong et al, 2015) introduced a modeling framework that combined linear and nonlinear elements to forecast interval-valued agricultural commodity futures prices. This approach, integrating Vector Error Correction Models (VECM) and Multi-Output Support Vector Regression (MSVR), performed well in providing interval forecasts. (Garcia & Leuthold, 2004) conducted a literature review on commodity futures and option markets, emphasizing major concerns such as price hedging, price discovery, hedging effectiveness, changing volatility, and institutional

issues. Meanwhile, (Yang & Awokuse, 2003) discussed hedging effectiveness in storable and nonstorable agricultural commodity futures markets, emphasizing the importance of considering the commodity's nature when developing hedging strategies.

Cluster 4 is dedicated to agricultural commodities futures and realized volatility. (Kang et al., 2017) explored spillover effects among six commodity futures markets, including gold, silver, West Texas Intermediate crude oil, corn, wheat, and rice. Employing the multivariate DECO-GARCH model and the spillover index, the study analyzed how returns and volatilities interconnected, particularly during global financial and European sovereign debt crises. The study also assessed optimal portfolio weights and time-varying hedge ratios. (Sørensen, 2002) examined the stochastic behavior of agricultural commodity prices, considering factors like seasonality, supply and demand dynamics, and inventory levels' influence on pricing. The Kalman filter for parameter estimation and the theory of storage were used to gain insights into the stochastic behavior of these commodity markets. Lastly, (Tian et al., 2017) introduced a novel approach to forecasting realized volatility in Chinese agricultural commodity futures markets, utilizing a time-varying HAR model and an independent normal-gamma autoregressive process for the regression coefficients. Their results indicated that this approach improved forecast accuracy significantly compared to simpler models.

Thematic trends of ACF research

Expanding upon the foundational principles and themes delineated by co-citation analysis and bibliographic coupling, this study investigates thematic patterns within the realm of Agricultural Commodity Futures (ACF) through the lens of co-occurrence analysis. Specifically, we employ authors' keywords to conduct this co-occurrence analysis. These keywords undergo a chronological filter to discern the evolutionary trajectory of key ACF issues prominently featured in no fewer than three articles within our comprehensive review corpus. The visual representation of this thematic evolution is elucidated in Figures 6 - 9.

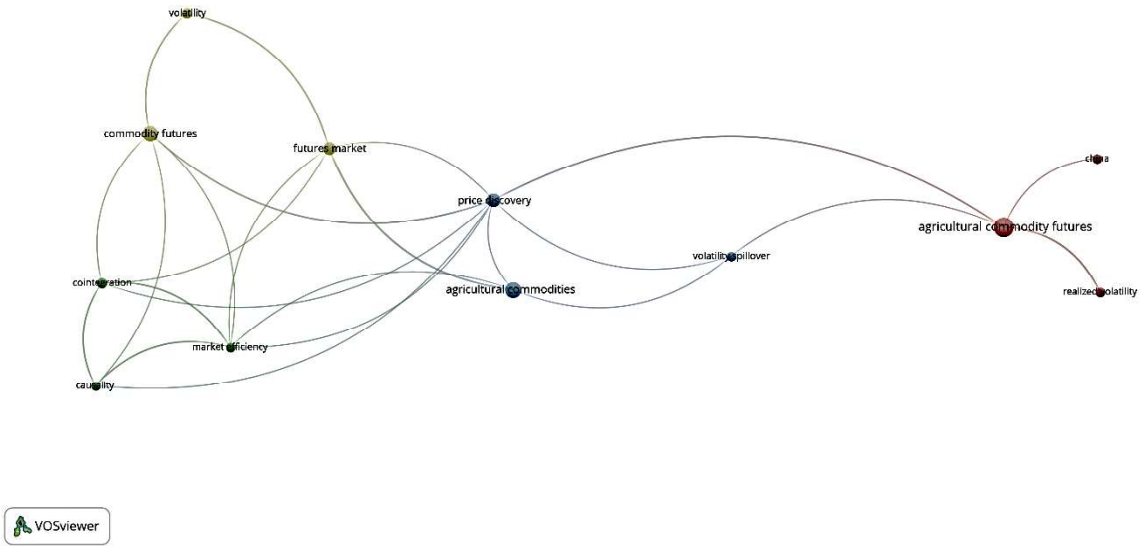

Figure 6. Influential topics in the "period of 1992 - 1999"

Source: Developed by the authors based on Scopus Database on R and VOS Viewer

Note(s): "Red Nodes = agricultural commodity futures, and realized volatility. Green Nodes = cointegration, market efficiency and causality. Blue Nodes = price discovery, volatility spillover and agricultural commodities. Yellow nodes = commodity futures, futures market and volatility."

The analysis of ACF research themes from 1992 to 1999 uncovers discernible areas of focus. This epoch witnessed a primary concentration on agricultural commodity futures and realized volatility, denoted by the red nodes. Concurrently, it accentuates the significance of cointegration, market efficiency, and causality, represented by the green nodes, in addition to the attention given to price discovery, volatility spillover, and

agricultural commodities, signified by the blue nodes. This time frame marks the nascent phase of Agricultural Commodity Futures, marked by its inception characterized by a burgeoning interest in price discovery and volatility spillover.

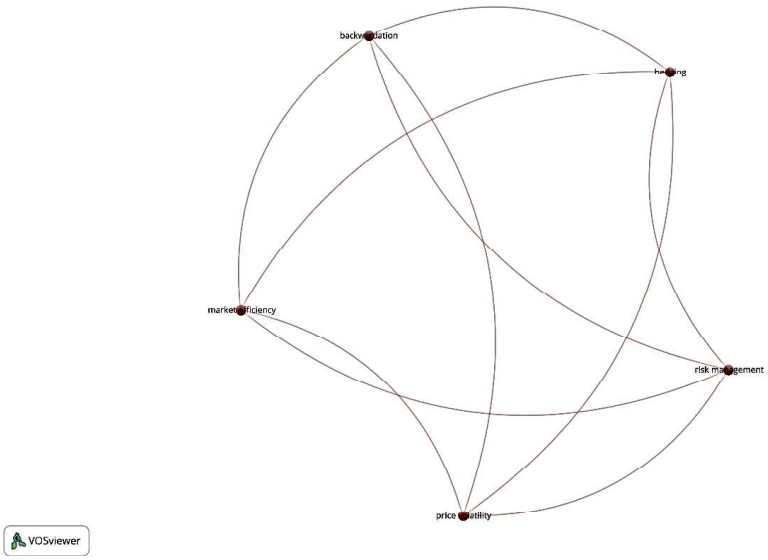

Figure 7. Influential topics in the "period of 2000 - 2007"

Source: Developed by the authors based on Scopus Database on R and VOS Viewer

Note(s): "Red Nodes = market efficiency, price volatility, risk management, backwardation and hedging."

The research spanning the years 2000 to 2007 within the domain of Agricultural Commodity Futures underscores the prevalence of specific themes in the field. Over this duration, the investigation primarily centers around market efficiency, price volatility, risk management, backwardation, and hedging, as signified by the red nodes. It is worth noting that the period from 2003 to 2007 exhibits a relative dearth of research activity in the realm of agricultural commodity futures, as evidenced by a solitary node in Figure 2.

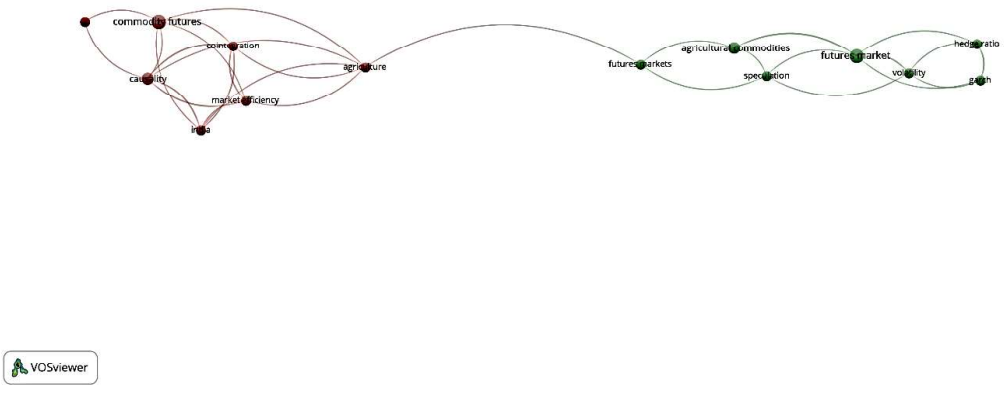

Figure 8. Influential topics in the "period of 2008 - 2015"

Source: Developed by the authors based on Scopus Database on R and VOS Viewer

Note(s): “Red Nodes = commodity futures, cointegration, market efficiency, causality, agricultural. Green Nodes = futures market, agricultural commodities, speculation, volatility, garch, hedge ratio.”

The examination conducted within the domain of Agricultural Commodity Futures research between 2008 and 2015 reveals noteworthy thematic concentrations. This research predominantly gravitates towards subjects encompassing commodity futures, cointegration, market efficiency, causality, and agriculture, as indicated by the red nodes. Furthermore, it underscores the importance of futures markets, agricultural commodities, speculation, volatility, GARCH, and hedge ratio, represented by the green nodes. These observations imply that during this specific period, Agricultural Commodity Futures research experienced significant expansion, notably in relation to commodity futures, and evolved into a more comprehensive thematic landscape for further exploration.

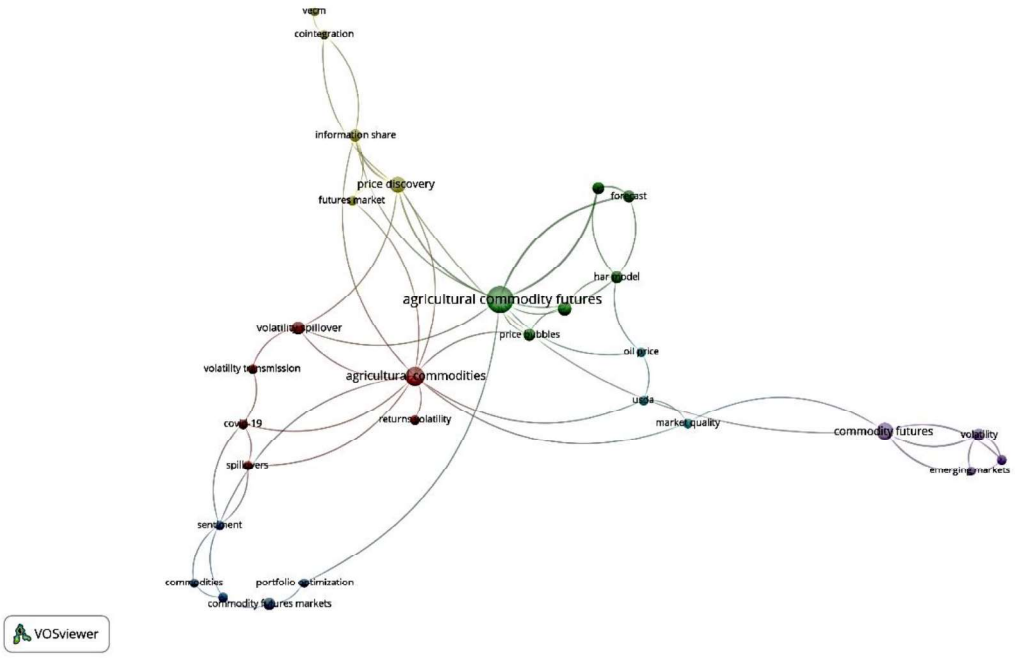

Figure 9. Influential topics in the “period of 2016 - 2023”

Source: Developed by the authors based on Scopus Database on R and VOS Viewer

Note(s): “Blue Nodes = commodity futures market, portfolio optimization, and commodities. Red Nodes = agricultural commodities, volatility spillover, volatility transmission, returns volatility, and spillovers. Green Nodes = agricultural commodity, futures, price bubbles, har model, and forecast. Yellow Nodes = price discovery, information share, futures market, cointegration and VECM. Sky Blue Nodes = oil price, market quality. Purple Nodes = commodity futures, emerging markets, and volatility.”

The research conducted in the field of Agricultural Commodity Futures between 2016 and 2023 reveals distinct thematic concentrations. This investigation primarily centers on themes such as agricultural commodities, volatility spillover, volatility transmission, returns volatility, and spillovers, denoted by the red nodes. Additionally, the study encompasses areas such as the commodity futures market, portfolio optimization, and commodities, as indicated by the Blue Nodes. Moreover, the research delves into topics including agricultural commodities, futures, price bubbles, HAR model, and forecasting, represented by the green nodes. Furthermore, the study explores the themes of price discovery, information sharing, futures market, cointegration, and VECM, highlighted by the yellow nodes. It also examines the theme of commodity futures in emerging markets and volatility, denoted by the purple nodes, as well as oil prices and market quality, signified by the sky-blue nodes.

Future Research Directions

It is imperative to assess Agricultural Commodity Futures (ACF) studies within a historical context as it plays a pivotal role in understanding the current and future implications. By thoroughly examining relevant literature, this research aims to establish a fundamental framework for the rapidly expanding field of ACF research.

A prospective study could explore how the latest advancements drive ACF to achieve superior performance. From 1992 to 1999 (see figure 6), the focus of Agricultural Commodity Futures research was primarily on agricultural commodity futures, and realized volatility, volatility spillover and agricultural commodities, commodity futures, futures market and volatility. During the period spanning from 2000 to 2007 (see figure 7), the research shifted towards topics like market efficiency, price volatility, risk management, backwardation and hedging. The subsequent phase, spanning from 2008 to 2015 (see figure 8), saw a concentration on commodity futures, cointegration, market efficiency, causality, speculation, garch, hedge ratio. As we move into more recent years, from 2016 onwards (see figure 9), the focal points in commodity futures market, portfolio optimization, commodities, price bubbles, har model, forecast, information share, oil price, market quality, emerging markets, volatility and VECM.

This research agenda encompasses a diverse range of critical issues pertaining to agricultural commodities futures markets, acknowledging the dynamic nature of this field. It delineates several key research directions that can provide valuable insights into the complexities and challenges faced by the industry. First and foremost, the impact of climate change on agricultural commodities futures prices, particularly in light of the increasing frequency of extreme weather events, merits in-depth investigation. This research seeks to assess the correlation between climate-related factors, such as droughts and temperature fluctuations, and price volatility in futures markets, with a keen focus on understanding how these changes affect stakeholders within the agricultural commodities industry.

Another crucial area of exploration centers on the indispensable role played by agricultural commodities futures markets in ensuring global food security. Researchers are encouraged to evaluate the accessibility and effectiveness of these markets, especially in developing countries, and to propose strategies for enhancing their contribution to food security, risk management, and agricultural sustainability. Furthermore, this research agenda delves into the transformative influence of emerging technologies, such as artificial intelligence and blockchain, on agricultural commodities futures markets. The inquiry seeks to investigate how these technologies can be harnessed to enhance market efficiency, transparency, and risk management, ultimately benefiting market participants and society at large. The implications of government policies, including subsidies and tariffs, on agricultural commodities prices and futures markets constitute yet another area of significant scrutiny. Researchers are encouraged to explore how these policies can be restructured to promote market efficiency, reduce price volatility, and ensure fair and sustainable market conditions.

In addition, researchers are invited to assess the adequacy of existing futures contracts and explore the development of new contract types tailored to the evolving needs of market participants. This examination aims to investigate how innovative contracts can provide improved risk management tools for farmers, producers, and investors. The research agenda also places a spotlight on understanding the precise impact of specific weather events, such as hurricanes, droughts, and floods, on agricultural commodities futures prices. This includes the development of predictive models to better comprehend the relationship between these events and price fluctuations, thereby aiding risk management strategies. Hedging strategies available to agricultural producers within commodities futures markets come under scrutiny, with an emphasis on evaluating their suitability in managing price risk, considering market dynamics and emerging challenges.

Furthermore, researchers are prompted to explore the interconnectedness of agricultural commodities futures prices with other financial markets, such as equity and currency markets. This exploration seeks to identify how factors in one market influence prices and trading behavior in the other, potentially uncovering arbitrage opportunities and risk management implications. Government interventions in the form of export bans and market stabilization efforts are also subject to analysis. Researchers will investigate the effectiveness of such interventions and their consequences for market participants. Finally, the integration of advanced technologies to optimize the efficiency and performance of agricultural commodities futures markets is explored. This includes the implementation of algorithms, high-frequency trading, and data analytics to improve trading strategies, price discovery, and risk assessment.

These research directions offer a comprehensive roadmap for studying agricultural commodities futures markets, allowing researchers to focus on specific aspects and contribute to a deeper understanding of this multifaceted field, while addressing the critical challenges that underpin it. It is noteworthy to analyse the primary contributors to this domain, such as the China, USA and India, to understand the factors driving their

substantial contributions. Conversely, it is equally imperative to examine the reasons behind the limited or lagging contributions from countries like Austria, Belgium, Greece, Mexico, Netherlands, Serbia, Spain, Denmark, New Zealand, Pakistan, Portugal, Saudi Arabia, and others in the Agricultural Commodity Futures research.

Conclusion

Our exploration of bibliometric analysis has yielded valuable insights into the landscape of Agricultural Commodity Futures (ACF) research. By utilizing the extensive Scopus database, we have examined publication and research trends, identified influential elements, and traced the thematic evolution within the ACF domain over various periods. This research significantly advances our understanding of ACF development and provides a foundation for potential future research directions. Scholars can leverage this work to explore emerging areas in ACF, offering policymakers and practitioners deeper insights into the evolving nature of this dynamic field. This exploration can uncover new opportunities and challenges within ACF-related industries and businesses.

Notably, our analysis highlights China, United States, and India as major contributors to ACF research. Over the past eight years, ACF has become a prominent and widely-discussed subject. Our research focuses on identifying extensively studied ACF domains, thereby aiding researchers in pinpointing potential research gaps that merit attention in future studies. It is evident that "Agricultural Commodity Futures" has consistently been the most frequently used keyword in studies since 2015, with notable peaks in research output in 2015 and 2017, and a projected increase in studies for 2023.

However, future researchers should expand their focus to include other regions of the world, especially in developing countries, to explore the ACF research which lead to a more comprehensive understanding of the global ACF landscape, enriching the field's knowledge with diverse and inclusive insights.

Limitations of the study

As researchers, we recognize and acknowledge the limitations inherent to this study, primarily centered on the utilization of a bibliometric approach exclusively with the Scopus database. To advance the comprehensiveness and depth of our understanding of the research landscape within the field, it is imperative for future investigations to contemplate the incorporation of data from alternative, reputable sources, such as the Web of Science. Additionally, an amalgamation of bibliographic data from both Scopus and Web of Science databases could be considered, ensuring the inclusion of high-quality publications that may be exclusive to one database or the other. Furthermore, the scope of future research endeavours could be expanded by adopting a more specialized focus, possibly concentrating solely on high-impact publications indexed in esteemed ranking systems such as SSCI, ABDC, ABS, or FT 50. This refined approach would provide invaluable insights into the research paradigm within the Agriculture Commodities Futures (ACF) domain as viewed through the lens of top-tier publications.

Implications of the study

This study provides a valuable resource for stakeholders in the Agriculture Commodities Futures (ACF) field. It offers an overview of existing research, highlighting key contributors and the current state of the domain. This information aids marketers, entrepreneurs, academics, and scholars in addressing industry challenges and enhancing problem-solving capabilities. Additionally, the study identifies research gaps and guides future directions, benefiting researchers seeking to advance ACF knowledge. For scholars aiming to publish in reputable journals, it helps align their work with established themes and trends, increasing acceptance chances and wider dissemination.

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