ICEB 2022 Proceedings (Bangkok, Thailand)

International Conference on Electronic Business (ICEB)

Fall 10-17-2022

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ABSTRACT

The fresh e-commerce industry has seen a sudden and substantial rise since the outbreak of COVID-19. The rapid development of this industry calls for a comprehensive and systematic review of its research status, hotspots and future trends, which will have significant implications for researchers in related fields. This paper first conducts a current situation analysis of the core literature on fresh e-commerce retrieved from four databases – CNKI, CSSCI, Wanfang and VIP – to categorize the research status of fresh e-commerce in three dimensions: the year of publication, article sources, and distribution of subjects. CiteSpace is then used to perform a bibliometric analysis of the data and to create visualized knowledge maps. The results show that the research on fresh e-commerce can be divided into three stages: rapid development (2012-2015), exploration and transformation (2016-2019), maturity and upgrade (2020-present). At each stage, the research evolves toward diversity and maturity with policy developments and changes in the external environment. Cold chain logistics, business models, freshness-keeping of products and e-commerce are ongoing research hotspots in fresh produce e-commerce, while later studies focus more on the transformation and upgrade of products, logistics, distribution and platforms to better serve consumers' consumption habits and environmental requirements. This study provides valuable insights for researchers and enterprises who are engaged in the industry and for those who are interested in the development of fresh e-commerce in China.

Keywords: fresh e-commerce; bibliometrics; hotspots and trends; COVID-19; Citespace.

INTRODUCTION

Since the COVID-19 pandemic swept the world in 2020, China has adopted strict control and prevention measures, during which process fresh e-commerce has played an important role in safeguarding people's livelihood and securing their daily necessities. The fresh e-commerce industry has witnessed a tremendous growth against this backdrop. According to the 2022 Insights Report on Fresh E-Commerce Industry in China released by MobTech, the gross merchandise value (GMV) of the fresh e-commerce industry has exceeded 400 billion yuan, with around 100 million monthly active users and a huge number of consumers that consume trillions of tons of fresh food products annually. What with the enormous consumption volume and the market potential, fresh e-commerce has been hailed as the "last blue ocean" of e-commerce. Under the "dynamic zero-case" policy and the strict control and prevention measures, the penetration rate of fresh e-commerce platforms to the traditional food market has increased from 2% in 2016 to about 10% in 2022 (Meng et al., 2019). On April 7, 2022, the State Council issued the Implementation Opinions on Accelerating the High-Quality Development of Cold Chain Logistics and Transportation, encouraging the fresh e-commerce sector to further their efforts in building "last mile" facilities. Hence, two years into the pandemic, how to solve the problems in the development of fresh e-commerce has become a research hotspot for both enterprises and academia.

The current research on fresh e-commerce has focused on cold chain logistics (Tang, 2014), pricing (Song & He, 2019; Zheng et al., 2019), distribution (Ge et al., 2018; Yu & Xiao, 2021), and decision-making of freshness-keeping efforts. As early as 2013, Shen analyzed the strategies for developing fresh product e-commerce from the three aspects of product, logistics, and government, suggesting that the government should gradually improve relevant laws and regulations to support the upgrade of agricultural products and cold chain logistics (Shen, 2013). Zhang (2014) analyzed the concept, origin, development history, status and dilemma of the e-commerce of agricultural products and proposed recommendations correspondingly. Canavari et al. (2010) analyzed the differences between fresh e-commerce and traditional retail of fresh produce so as to establish a credibility system and improve its reliability value with regards to business models and operation strategies. As an emerging industry that only makes its appearance in recent years, fresh e-commerce has yet to reach its maturity and faces many problems that need to

be solved. It is important to conduct a timely, systematic and comprehensive review of the status, hotspots and trends of fresh e-commerce for future research. However, such literature review is currently scarce, if not absent. To provide a comprehensive understanding of the current status and latest trends of research in fresh e-commerce in China, this paper analyzes relevant research on fresh e-commerce from four mainstream databases in China, with the aim to provide valuable insights for researchers and enterprises who are engaged in the industry and for those who are interested in fresh e-commerce in China. This paper will contribute to the future research of fresh e-commerce, and its results will provide a reference for new development opportunities of the industry in the context of "new retail".

This paper first retrieves literature data on fresh e-commerce research from CNKI, CSSCI, Wanfang and VIP. Meta-analysis and bibliometric analysis are then employed to sort out the status and conduct knowledge mapping of the 602 papers selected, which contributes to the better understanding of the development patterns and overall trends of fresh e-commerce research, advances future studies, and provides theoretical references for relevant research.

DATA SOURCES AND METHODOLOGY

Data Sources

This paper selects journal articles on fresh e-commerce published from January 2012 to June 2022 from CNKI, CSSCI, Wanfang and VIP databases as the research object. To ensure the authority, validity and extensiveness of the samples, we then pick the articles published in core journals as the data, which are more representative of the research hotspots and trends in this field. The fresh products in this paper include but are not limited to fruits, vegetables, meat, eggs, dairy products and aquatic products. Internationally, different terms with certain nuances of meaning have been used to describe fresh e-commerce, including: (a) fresh e-commerce; (b) fresh food e-commerce; (c) fresh produce e-commerce; and (d) fresh agricultural products e-commerce. In China, the same terms have been used consistently. In this paper, "fresh e-commerce" is used for retrieving information from the databases. Of all the articles published in core journals that are indexed in the four databases, 227 are retrieved from CNKI, 21 are from CSSCI, 572 are from Wanfang, and 174 from VIP. After importing articles and removing the duplicate ones using NoteExpress, 602 are left as the literature datasets of fresh e-commerce research for this paper.

Methodology

In this paper, we first perform a current situation analysis to count, classify and compare the 602 articles on fresh e-commerce from three dimensions – the year of publication, article sources, and distribution of subjects – to sort out the research status of the literature on fresh e-commerce. CiteSpace is then used to conduct a bibliometric analysis of the collected literature data and create visualized knowledge maps. Bibliometric analysis is a kind of quantitative analysis that uses statistical methods to describe, explain, evaluate, and predict the current status and emerging trends of relevant research by exploring the various characteristics of the literature (Baminiwatta and Solangaarachchi, 2021). CiteSpace is an open-source Java application developed by Prof. Chaomei Chen at the College of Computing and Informatics of Drexel University, USA. It is a visualization tool for analyzing scientific literature and is commonly used in bibliometric analysis. Knowledge mapping with CiteSpace takes "knowledge domain" as the subject of analysis, which can visualize the evolutionary process and structural relationship of scientific research on fresh e-commerce, and reveal the numerous, complex connections between knowledge domains in terms of structure and development (Chen, 2006). Keyword clustering, timezone, timeline, burst terms and other functions can visualize the research hotspots and trends of a specialty in a certain period of time.

DESCRIPTIVE ANALYSIS OF FRESH E-COMMERCE

Distribution of Literature

The distribution of literature can be categorized into the quantitative temporal distribution and the distribution of journals. The statistical analysis of the number of articles published annually can reveal the current status and development trends of fresh e-commerce research. Figure 1 shows the results of analysis of 602 articles. The top 3 years with the most publications are 2018, 2020 and 2021, with 92, 95, 80 published articles respectively. 2012 marked the "first year of fresh e-commerce". In that year, two classic marketing cases – "Chu Orange entering the Beijing Market" and "the Battle over Litchi in Beijing" – quickly attracted the attention of social capital and set off an investment boom. Henceforth, the research related to fresh e-commerce has been on the rise year by year. In September 2017, the State Council issued the Opinions on Accelerating the Development of Cold Chain Logistics to Ensure Food Safety and Promote Consumption Upgrading, sending out supportive messages from the national policy level, thus ushering in the first climax of fresh e-commerce research in 2018. After a year of market shuffle, in 2019, the giants began to dominate the market, while small and medium-sized enterprises (SMEs) began to make their retreat. Since the global outbreak of the COVID-19 pandemic in 2020, fresh e-commerce has played an important role in safeguarding people's livelihood and securing their daily necessities, which explains the upsurge in relevant research in the past two years.
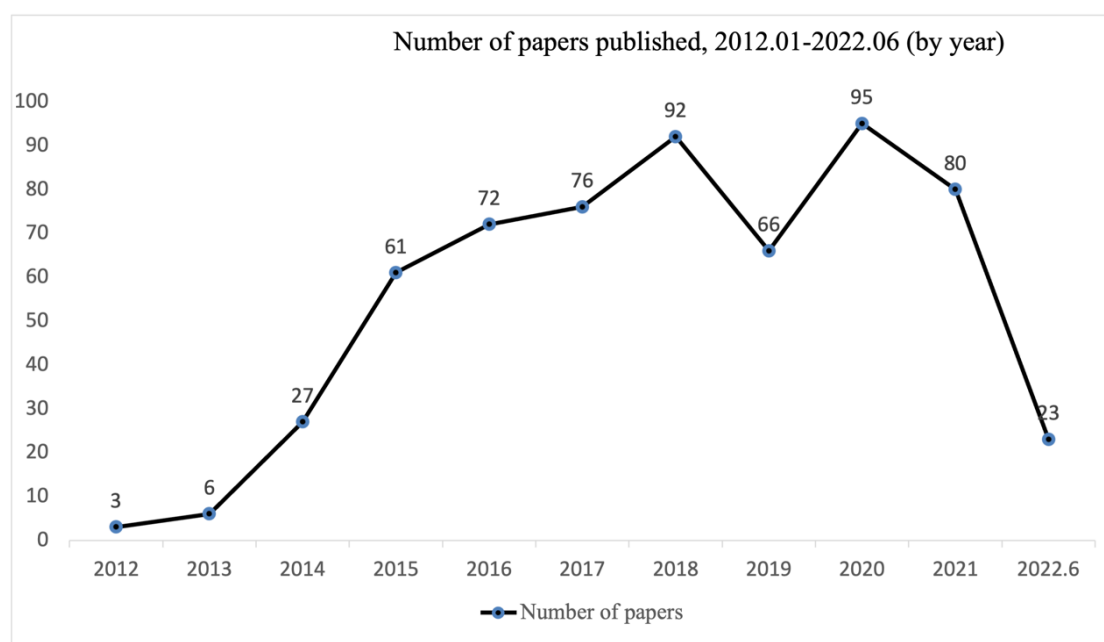
Figure 1: Number of papers on fresh e-commerce published from January 2012 to June 2022

The analysis of the distribution of journals allows for more details of the development of fresh e-commerce research from the fields involved and the scope of application. The results show that the 602 articles are published in 142 journals. Table 1 lists the top 10 journals with the most publications, of which China Food and Journal of Commercial Economics account for one quarter of the total publications. It is obvious that the field of research of fresh e-commerce publications is relatively extensive, and that there is a broad interest in such research from the academia, focusing on food, agriculture, commerce and logistics. A number of top journals have published related studies, though not in large quantities.

Table 1: Distribution of journals publishing articles on fresh e-commerce

Journal	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Account
China Food			4	10	18	13	11	8	14	3	2	83
Journal of Commercial Economics				2	7	17	13	11	8	9	2	69
China Journal of Commerce				9	7	4	2	4	4	4	2	36
Logistics Technology		1	1	5	4	3	5		6	6	1	32
Value Engineering				1		3	2	8	3	2	1	20
China Marketing	1		4	12								17
China Business and Market				1	2	2	2	2	2	5		16
Jiangsu Agricultural Sciences			1		1	2	3	4	1	1		13
Agricultural Economy				2			2	3	2	3		12
Journal of Anhui Agricultural Sciences			1	2	2	1			3	1		10
Economic Research Guide		1			1		2	2		1	2	9
Food Research and Development					1	1				2	4	8
China Logistics & Purchasing	1		1	1	5							8
Price: Theory & Practice									5	2		7
Jiangsu Commercial Forum				2	3	1					1	7
World Agriculture			1	2	2	2						7
Others	1	5	14	12	19	27	49	23	46	43	9	248
Account	3	7	27	61	72	76	91	65	94	82	24	602

Distribution of Subjects

The analysis of the distribution of subjects of fresh e-commerce research can help understand and further the application of this topic in various disciplines, as well as bring new application opportunities. This paper categorizes the 602 articles on fresh e-commerce in accordance with the Chinese Library Classification, as shown in Table 2. The distribution of subjects is divided into two categories: most of the research is distributed in agriculture, trade, enterprise, macro-management and other economic disciplines, while the other includes technical disciplines such as computer and industry.

Table 2: Distribution of subjects of fresh e-commerce research

Subject	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
Agricultural economy		3	10	31	27	34	39	18	32	19	8	221
Trade economy	2	2	10	12	28	22	25	31	29	32	6	199
Macroeconomic management and sustainable development	1	1	4	6	6	10	7	7	9	8	4	63
Enterprise economy			1	2		2	10	4	10	12	2	43
Computer software and computer application			1		2	3	2		3	1	2	14
Light industry and handicraft industry		1			1		3		1	2		8
Automation technology					3	1		2		1		7
Industrial economy			1	2			1		1			5
Mathematics							1	2		1		4
Fisheries and Fisheries				1	1				1	1		4
Others	0	0	0	7	4	4	3	1	8	5	2	34
Total	3	7	27	61	72	76	91	65	94	82	24	602

Of course, the distribution of subjects is not isolated. Nowadays, industries often integrate multiple disciplines, and so does the academic research. Fresh e-commerce research is multi-disciplinary in nature. Figure 2 demonstrates the interdisciplinarity of fresh e-commerce literature, where four disciplines – trade and economic, macroeconomic management and sustainable development, agricultural economy, and market research and information – have the most evident interdisciplinary feature, and other disciplines also show some interdisciplinary signs. It is the participation and engagement of researchers with different disciplinary backgrounds that enrich the disciplinary system and theoretical research of fresh e-commerce, which gradually evolves into a set of supporting system and guiding ideology both in theory and practice.

Figure 2: Interdisciplinarity of fresh e-commerc

ANALYSIS OF RESEARCH HOTSPOTS IN FRESH E-COMMERCE

The research hotspots are presented by first using the keywords in the literature on fresh e-commerce to construct co-occurrence networks with CiteSpace, and then calculating the centrality of the keywords and clustering them. The keywords are the essence of literature and distill the core message of a research article. The analyses of the co-occurrence network, centrality and clustering based on keywords will shed light on the research contents hotspots of fresh e-commerce.

Keyword Co-occurrence Network

In the keyword co-occurrence network, the keywords are used as nodes. The size of each node reflects the frequency of keyword occurrence, the more frequent the occurrence, the larger the node. The edge connecting a pair of keywords indicate the co-occurrence of these two words, and the more the two keywords co-occur, the thicker and darker the edge is. The keyword co-occurrence network in Figure 3 gives a clear picture of the contents and hotspots of fresh e-commerce research. There are several relatively larger nodes, such as e-commerce, cold chain logistics, supply chain, new retail, O2O, business model and fresh products, suggesting a higher co-occurrence frequency of these words and the foci of this research field. As a subset of e-commerce, fresh e-commerce has put much emphasis on cold chain logistics from its humble beginnings because the cold chain can keep the quality and freshness of the products. However, it is also the greatest weakness in fresh e-commerce. As early as 2016, Zhang discussed the status, challenges and trends of fresh e-commerce (Zhang, 2016). To adapt to the new trend in fresh food business and reduce logistics costs, Fan et al. (2015) proposed a forward/reverse logistics network and route planning model for fresh food e-commerce enterprises. Prajapati et al. (2020) proposed a clustering-based routing heuristic (CRH) to manage the vehicle routing for the last-mile logistic operations of fresh food in e-commerce. Merkuryev et al. (2009) explored the relationship of developing fresh food e-commerce and supply chain management, and argued that re-engineering the logistics network could eliminate the constraints on the development of the former. Ruiz-Garcia delineated the importance of management and maintenance of supply chain of the fresh e-commerce market (Pouratashi, 2012).

Figure 3: Keyword co-occurrence network

Keyword Centrality

However, high co-occurrence frequency alone does not lead to the conclusion that these words represent the research hotspots of fresh e-commerce. The centrality of the keyword nodes also needs to be considered to reflect the hotspots. The centrality calculated by CiteSpace is betweenness centrality, which measures the extent to which a node lies on the paths between other "couple of nodes" in the graphs. Table 3 lists the top 10 keywords in terms of centrality, which reflects the importance of these keywords in the network, as well as their intermediary roles and influence. From the perspective of centrality, "consumer" is the supporting node of the keyword network of fresh e-commerce and the focus of this research, with a frequency of 30 and a rather high centrality of 0.61. In general, the research hotspots of fresh e-commerce focus on consumers, fresh products, cold chain logistics, e-commerce, O2O, supply chain and new retail.

Table 3: Keyword centrality

Keyword	Centrality	Count	Year
Consumer	0.61	30	2013
Fresh products	0.53	69	2012
Supply chain	0.45	37	2015
Fresh e-commerce	0.41	253	2012
SF express optimization	0.40	8	2012
Cold chain logistics	0.33	67	2014
Amazon	0.31	3	2012
E-commerce	0.29	89	2013
Optimization strategy	0.24	3	2017
o2o	0.23	16	2014

Keyword Clustering

To further explore the popular research areas in fresh e-commerce, the log-likelihood ratio (LLR) test in CiteSpace is selected to cluster the keywords, which helps identify the subject matter and general direction of fresh e-commerce research. The top 10 categories are obtained after summarizing and clustering the keywords, as shown in Figure 4. In addition, Table 4 lists the top terms contained in the clusters, each with an S value above 0.9, indicating that the clustering structure is reasonable. S value refers to the mean silhouette value, which is a parameter used to evaluate the clustering effect by measuring the consistency of network clustering. The clustering result is acceptable when the S value is greater than 0.5. The mean silhouette value of this paper is 0.9723, proving the goodness of overall clustering results. After a thorough study of the collected literature, we decide to categorize the 10 clusters into 3 types of research: research on the development of e-commerce platforms, research on fresh product safety, and research on cold chain logistics strategies. The analyses are as follows.

1) Research on the development of e-commerce platforms. There are four sub-categories within this research: fresh e-commerce, new retail, e-commerce and e-commerce platform. The discussion on the e-commerce model, model innovation in the context of new retail, and platform models of fresh e-commerce have always been popular research topics. Wang (2018) divided fresh e-commerce into four types: the platform type represented by Tmall, the vertical type represented by Tootoo.com, the O2O type represented by Yonghui superstores, and the new retail type represented by Hema Fresh. Canavari et al. (2010) analyzed the differences between fresh e-commerce and traditional retail of fresh produce, and discussed the way to establishing a credibility system to improve its reliability value with regards to business models and operation strategies. Taking into consideration the new retail and the impact from COVID-19, He summarized four major changes in the business model of China's retail enterprises: deep online, socialization and fragmentation, the trend of "unmanned", and platform.

Figure 4: Keyword clustering

2) Research on fresh product safety. Three clusters are included in this category: fresh product, quality and safety, and influencing factors. Fresh products are regarded as the barometer of "people's living standard and quality". They occupy a certain portion in people's daily food consumption, and people are paying increasing attention to their quality and safety (Shen

& Liang, 2021). In China, the loss rate of vegetables and fruits during circulation is 25%-30%, causing a loss of more than 150 billion yuan every year (Wang & Chen, 2017). The business of fresh e-commerce is consumers' consumption of fresh products, and freshness is a key factor affecting their decision to buy those products (Joseph & Gary, 2009; Liu et al., 2020). Some studies have shown that freshness determines the core competitiveness of fresh product companies (Liu et al., 2021), and that the quality and safety of fresh products is of vital importance to the development of the industry.

3) Research on cold chain logistics strategies. This category contains three clusters: cold chain logistics, supply chain and circulation mode. The construction of cold chain logistics infrastructure lies at the core of fresh e-commerce industry. The integration of supply chain resources and the construction of cold chain logistics are two unavoidable challenges for fresh e-commerce enterprises. As early as 2012, Govindasamy delineated the importance of management and maintenance of the supply chain in the fresh e-commerce market (Pouratashi, 2012). Fresh products are perishable and have a short shelf life (He et al., 2019), and the low temperature provided by cold chain can keep their quality and freshness to the fullest extent possible (Zhang, 2016). A number of scholars have studied the cold chain logistics infrastructure of fresh e-commerce. Lan and Tian's research (2013) showed that the imbalance between the higher demands of fresh food and the lower capital facilities reflected one of the constraints on fresh food e-commerce, i.e., shortage of the cold chain logistics. Guritno et al. (2015) studied the influencing factors affecting the performance of the fresh product supply chain from the supply chain perspective and proposed different inventory management strategies for unique and common fresh products. To address the issue of cold chain localization, Jiang et al. (2021) studied the sustainable management of logistics services of fresh e-commerce in the context of COVID-19, and pointed out that the core task of fresh food e-commerce companies was to improve the quality of logistics services based on customer satisfaction.

Table 4: Keyword clustering

ID	Name	Size	Silhouette	Top Terms
0	Fresh e-commerce	71	0.998	fresh e-commerce, development model, double eleven, mode, evolutionary game, moral hazard, new consumption
1	Fresh product	50	0.98	fresh agricultural products, fresh products, purchasing intention, restrictive factors, driving force, fresh food management
2	Circulation mode	46	0.97	cold chain circulation, hema fresh, supply chain management, optimization strategy, third-party logistics distribution mode
3	Supply chain	35	0.969	supply chain, logistics distribution, novel coronavirus pneumonia epidemic, bayesian network, o2o operation, distribution route
4	Influencing factors	33	0.99	influencing factors. supply chain coordination, quality and safety, e-commerce of agricultural products, aquatic products, promotion effort level, preservation effort
5	E-commerce platform	28	0.978	e-commerce platform, fresh food market, food supply chain, food logistics, food community, e-commerce operation mode
6	E-commerce	27	1	e-commerce sales, fresh e-commerce, mobile internet. information technology, internet marketing, business ecosystem，mobile internet
7	New retail	27	0.985	new retail, genetic algorithm, community fresh food, particle swarm optimization algorithm, development strategy, business scene
8	Cold chain logistics	22	1	cold chain logistics, swot, vacuum precooling, two-way circulation, joint distribution, double circulation
9	Quality and safety	19	0.982	food safety, internet plus, service quality evaluation, fresh online shopping, cold chain logistics of agricultural products, consumption upgrade, quality and safety

ANALYSIS OF RESEARCH TRENDS

Burst detection in CiteSpace has supported this paper in analyzing the research trend of fresh e-commerce. The burst terms are detected from a large number of keywords by analyzing the temporal distribution of term frequencies. Rather than solely relying on the frequency level, it also draws upon the changing trend of term frequencies to identify the frontier research trends of fresh e-commerce. First, timeline analysis is used to uncover the evolution paths and the changing trends of keywords in each cluster, which sets the scene for exploring the development directions. Then, by combining the burst terms with relevant

national policies, the paper divides the development of fresh e-commerce into three stages: rapid development (2012-2015), exploration and transformation (2016-2019), maturity and upgrade (2020-present).

Timeline Analysis

Timeline analysis can visualize the evolution of the keywords in each cluster across a number of time sliced intervals, so as to analyze the trends and development directions of fresh e-commerce research. As shown in Figure 5, the larger the size of a node, the more popular the research. The link represents the evolution of the research topic over time, and the solid and dotted horizontal lines indicate the continuity of the research hotspots. The research on fresh e-commerce, fresh product and quality and safety has lasted from 2012 to 2022, while the research on new retail continues from 2017 to 2022. Cold chain logistics and circulation mode have been popular research topics from the beginning, and will keep their momentum in the future. Fresh e-commerce and fresh product became research hotspots in 2012, and that opportunity for e-commerce, cold chain logistics, supply chain, and new retail came in 2013, 2014, 2015 and 2017, respectively. The research trends in recent years can be found in Figure 5. After the pandemic hit in 2020, freshness-keeping efforts and end distribution have become the foci of research, and the government has stressed the need to improve "last mile" facilities in fresh e-commerce. As the pandemic control and prevention measures have become normalized, the studies on status, marketing, perceived value and community are expected to become the hotspots and trends in the mature upgrading stage of fresh e-commerce.

Burst Terms and Policy Analysis

Burst term is the keyword word or terminology that suddenly sees an increase in occurrence or citation frequency, or growth rate, in a short period of time. The stronger the burst, the more it can represent the latest developments and trends in that period of time. Prof. Chen Chaomei, developer of Citespace software, believes that burst keywords can explain the frontier issues in a certain discipline (Chen, 2004). This paper has detected the top 20 Keywords with the strongest citation bursts, as shown in Figure 6. Combining them with the publication trend in Figure 1, the evolution paths of fresh e-commerce research in Figure 5, as well as national policies, the paper divides the development of fresh e-commerce into three stages: rapid development (2012-2015), exploration and transformation (2016-2019), maturity and upgrade (2020-present).
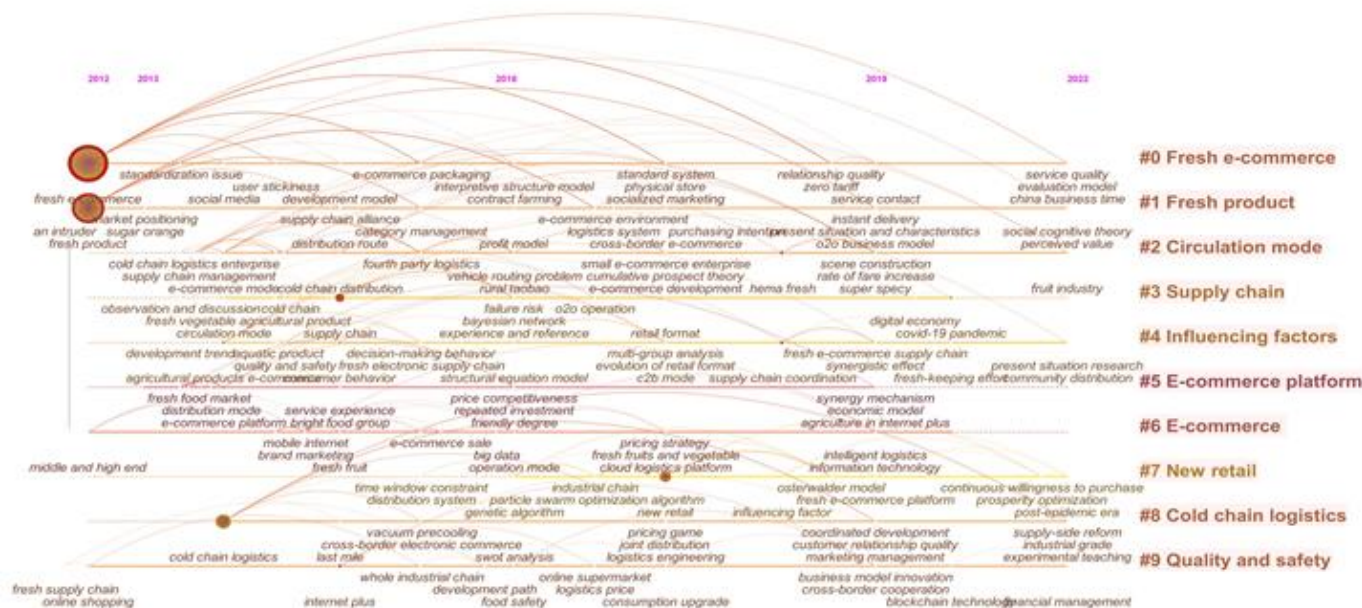

Figure 5: Evolution paths of fresh e-commerce research

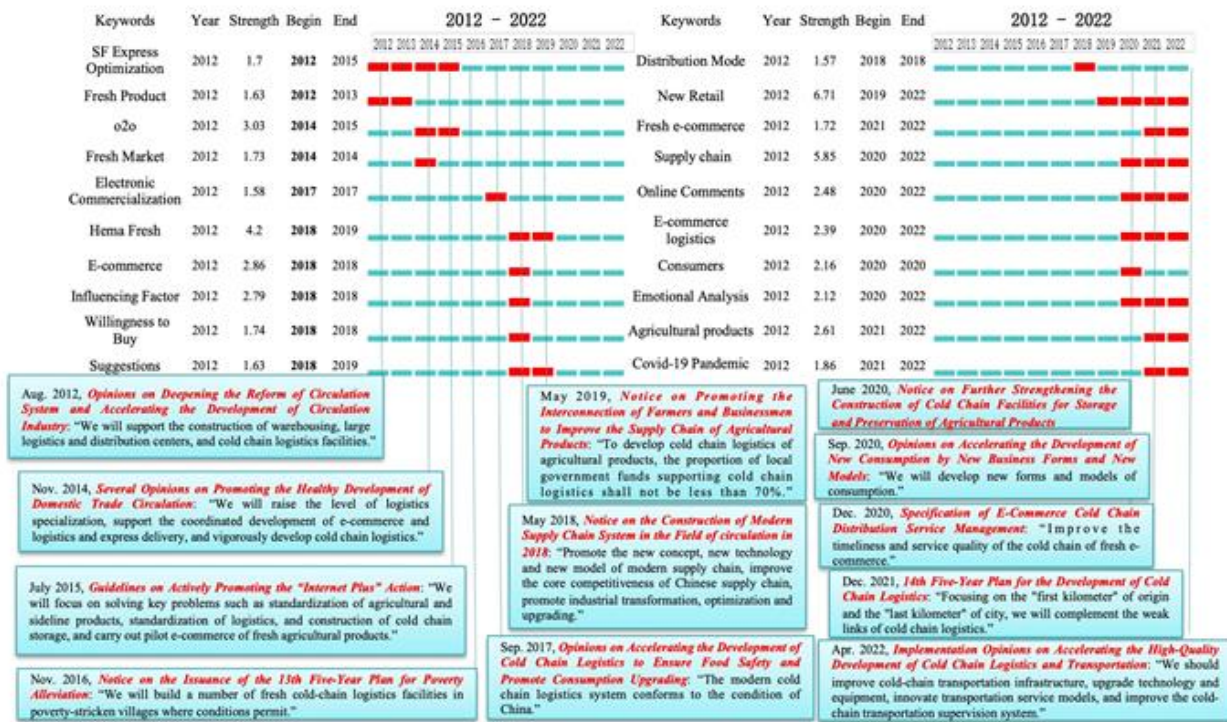Top 20 Keywords with the strongest citation bursts

Figure 6: Keyword bursts

Rapid development (2012-2015): Burst terms in this period include Shunfeng (SF) Express Select, fresh products, O2O and fresh food market. The strongest burst of O2O is 3.03. It was a period when O2O was growing fast, and SF Express, taking advantage of its own logistics, warehousing and stores, rode on the wave of O2O and fresh e-commerce, and launched SF Express Select. In 2012, the State Council issued the *Opinions on Deepening the Reform of Circulation System and Accelerating the Development of the Circulation Industry*, pointing out the need for the nation to speed up the construction of industrial circulation, in particular, the circulation of fresh products represented by agricultural products, which were counted as strategic materials. Subsequently, the *National New-type Urbanization Plan (2014-2020)* proposed "speeding up the cultivation of modern circulation modes and new forms of circulation, vigorously developing fast and efficient distribution, accelerating the development of e-commerce of agricultural products, and reducing circulation costs". In addition, the No. 1 Central Document issued in 2015 pointed to the necessity of transforming and innovating the circulation mode of agricultural products and strengthening the construction of transporting channels for agricultural products. Undoubtedly, these policies provided unprecedented support and development opportunities to the O2O model of fresh e-commerce. However, scientific research on O2O still faced numerous problems and bottlenecks that needed to be dealt with. Liu and Walsh (2019) held that O2O referred to combinations of business opportunities from both offline and the Internet and it made the Internet into a new trading platform. The huge number of orders and the time crunch for order fulfilment would affect the movement of goods. This would lead to the last-mile logistics being one of the "most inefficient and most expensive" part of the supply chain (Fernie et al., 2010). Hong et al. (2019) insisted on combining O2O and localization. Fresh e-commerce was characterized by the trend to localize, and the combination of e-commerce enterprises with local farms and offline communities. SMEs of fresh e-commerce boomed in this period, and logistics distribution became the bottleneck in their businesses. Based on the three original logistics modes, some scholars put forward the new mode of "third-party logistics + consumer pick-up / third-party delivery" to help solve the logistics problems of SMEs.

Exploration and transformation (2016-2019): Burst terms in this period include electronic commercialization, Hema Fresh, e-commerce, influencing factors, willingness to buy, advice, distribution modes, online and offline and new retail. The burst strengths of Hema Fresh and new retail are 4.2 and 6.71 respectively. It was a period when the industry gradually reach maturity, and when rural e-commerce achieved notable growth. The No. 1 Central Document issued in 2016 proposed to accelerate the development of rural e-commerce and form a two-way circulation pattern of online and offline integration, with which agricultural products could go into cities and agricultural materials and consumer goods to the countryside. The document also urged innovation of the circulation mode of agricultural products through e-commerce. In the context of the new retail, Hema Fresh, relying on the endorsement from Alibaba, adopted the new model of "one store, two warehouses and five centers" that integrated online and offline marketing, and achieved great success. During this period, the research began to move towards diversification, promoting the integration of "Internet +" with fresh products and selling fresh products with e-commerce. In terms of distribution, Li argued that under the background of new retail, the traditional logistics and supply mode of fresh product should be changed into a decentralized one, and distributive storage should be established to realize modern distribution (Qin, 2019). In terms of consumption habits, as consumers were used to consuming fresh products offline,

how to enhance their willingness to buy online and exploring the influencing factors of their purchases became the foci of research. By analyzing the mode of "organic + community distribution" of the Japanese fresh e-commerce company Daichi, some scholars put forward their thoughts on how to change the consumption habits of Chinese consumers, improve quality and ensure safety of agricultural products, increase the number of buyers and their online purchase stickiness, as well as establish trust between the production and the marketing sectors.

Maturity and upgrade (2020-present): Burst terms in this period include new retail, supply chain, online reviews, e-commerce logistics, consumers, sentiment analysis, agricultural products and COVID-19. The burst strength of supply chain is 5.85. Following the market shuffle in the transformation period, the giants began to dominate the market, while SMEs closed down, with a survival rate of less than 10%. As a result of the pandemic hit, consumers shifted to online purchase, which led to a continuing growth in online shopping and fresh e-commerce. Lockdowns in cities became common due to pandemic control and prevention, exposing the weakness of the supply chain. For example, Shanghai experienced a supply chain shortage along with rocketing prices. To ensure that the fresh e-commerce supply chain was stable, the government issued the *Notice on Further Strengthening the Construction of Cold Chain Facilities for Storage and Preservation of Agricultural Products* in 2020, the *14th Five-Year Plan for the Development of Cold Chain Logistics* in 2021, and the *Implementation Opinions on Accelerating the High-Quality Development of Cold Chain Logistics and Transportation* in 2022. To unveil to what extent consumers had shifted to online food shopping during the pandemic, Chang and Meyerhoefer (2021) found that an additional confirmed COVID-19 case increased the sales by 5.7% and the number of customers by 4.9%. The greatest demand increases were found in grains, fresh fruit and vegetables, and frozen food. Some scholars used weighted classification to measure the format of fresh e-commerce before and after the pandemic, and found that the attention on fresh e-commerce was barely noticeable in the early stage of the pandemic, partly because it ran into bottlenecks, and partly because consumers' attitudes created strict requirements for the supply chain. In the later stage, however, environmental factors offered the opportunity for fresh e-commerce to develop, and the attention on it was rising unceasingly. Online reviews, shopping experience and product quality are not only the foci of consumers, but also of researchers. By revising the index system for evaluating the quality of logistics service, Chen et al. (2021) put forward an evaluation system that covered six dimensions: security, timeliness, economy, pleasantness and convenience.

CONCLUSION

In the context of the normalization of the epidemic, people's consumption habits are accelerating towards online, and consumers' consumption concepts about fresh products are starting to change. In economically developed cities, fresh e-commerce has become a habit of white-collar workers, especially the business model of community group buying. It is very popular among consumers for its affordable price, ease of purchase and quality assurance. Fresh e-commerce not only promotes the construction of fresh produce supply chain and accelerates product circulation, but also improves people's quality of life.

In this paper, a total of 602 articles on fresh e-commerce research, retrieved from CNKI, CSSCI, Wanfang and VIP, are selected as the databases. A current situation analysis is conducted to count, classify and compare these articles from three dimensions – the year of publication, article sources, and distribution of subjects – to sort out the research status of the literature on fresh e-commerce. CiteSpace is then used to perform a bibliometric analysis of the data and to create visualized knowledge maps, and the following conclusions are drawn.

With respect to literature and subject distribution, in 2012, the "first year of fresh e-commerce", research on fresh e-commerce was only in its infancy. Its heat began and kept rising after being named the "last blue ocean" of e-commerce and receiving strong policy support from the government. Fresh e-commerce covers a wide range of research fields, and therefore has attracted broad interest from the academia. More articles are published in journals on food, agriculture, commerce and logistics. Most of the research is dispersed in agriculture, trade, enterprise, macro-management and other economic disciplines, while the other is distributed in technical disciplines such as computer and industry. What's more, the highly interdisciplinary nature of fresh e-commerce also contributes to the richness of its disciplinary system and theoretical research.

Through analyses of keyword co-occurrence network, keyword centrality and keyword clustering, we can have a clearer picture of the research content and hotspots in the field of fresh produce e-commerce. There are several larger nodes in the keyword co-occurrence network, such as e-commerce, cold chain logistics, supply chain, new retail, O2O, business model and fresh products, suggesting that more research is conducted in these areas, and that they are the research hotspots. Centrality can reflect the importance of the keywords in the network, as well as their intermediary roles and influence. In general, the research hotspots of fresh e-commerce focus on consumers, fresh products, cold chain logistics, e-commerce, O2O, supply chain and new retail. To further expand our exploration of the research hotspots of fresh e-commerce, keyword clustering is used to summarize the research directions. After the clustering, the top 10 clusters are categorized into 3 types of research: research on the development of e-commerce platforms, research on fresh product safety, and research on cold chain logistics strategies. Clustering helps identify the subject matter and general direction of fresh e-commerce research.

The environment in which fresh e-commerce develops is different in each period. The research trends have made the progress from the infrastructure construction of cold chain to the innovation of business models, and to the optimization and upgrading of services. Combining the publication trend in Figure 1, the evolution paths of fresh e-commerce research in Figure 5, the

burst terms in Figure 6, as well as national policies, the development of fresh e-commerce is divided into three stages: rapid development (2012-2015), exploration and transformation (2016-2019), maturity and upgrade (2020-present). At each stage, the research evolves toward diversity and maturity with policy developments and changes in the external environment. At present, COVID-19 has brought a critical and unprecedented opportunity for the development of fresh e-commerce, and the bottleneck and problem it faces have changed from infrastructure construction to upgrading and optimization. The logistics industry is developing towards intelligent logistics park and intelligent logistics platform (Liu, 2020). Aided by blockchain, optimized smart distribution will become the future development trend and the commanding point of competition of the fresh agricultural products logistics industry (Li et al., 2022). Fresh e-commerce enterprises should make the most of new technologies such as big data analysis, cloud computing and artificial intelligence to gradually improve the standardization process of fresh agricultural products, improve consumers' satisfaction of their experiences, and predict future market trends of the consumption of fresh agricultural products (Wei, 2021). In addition, as the consumer market is unstable, fresh e-commerce enterprises should improve quality and service models, deeply explore different consumers' preferences, and constantly improve their business models with new retail, to stabilize the consumer market.

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