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Contents

Article

Study on the Economic Effects of Opening Up Guangxi Higher Education to the ASEAN

Bingbing Fu [1,2,*], Zihong Lan [3] and Sui Sun [1,2]

[1] School of Finance and Insurance, Guangxi University of Finance and Economics, Nanning 530003, China

[2] Guangxi Institute of Finance and Economics, Nanning 530003, China

[3] School of International Education, Guangxi University of Finance and Economics, Nanning 530003, China

Abstract: With the promotion of the "Belt and Road" Initiative, education cooperation between China and ASEAN countries has increased, highlighting the opening of education to the outside world. In this context, exploring the opening-up pattern of higher education to ASEAN countries and the regional differences it shows, as well as the positive catalytic effect of international student mobility on regional economic development, is particularly urgent and important. By using CiteSpace, we find that the economic effect of opening up higher education to the outside world has become the focus of academic attention. Closely following this hotspot, this paper analyses the current situation of Guangxi's higher education in opening up to ASEAN countries and finds that although Guangxi has achieved initial results in attracting international students from ASEAN countries, there is still much room for improvement in terms of improving the quality of education and teaching and enhancing economic attractiveness. Moreover, opening up to ASEAN countries not only directly promotes the growth of Guangxi's outward foreign direct investment but also greatly promotes mutual benefits and creates a win–win situation between the two sides in many fields, such as education and cultural exchanges and economic and trade exchanges. Given this, the government should promote trade and investment facilitation, encourage RMB settlement, promote the integration of industry and education clusters, and create an innovation highland for higher education openness and cooperation toward ASEAN countries.

Keywords: higher education in Guangxi; ASEAN; education opening to the outside world; economic effects

1. Introduction

Against the background of economic globalization and the internationalization of education, higher education, as an important field of international exchange and cooperation, plays an indispensable role in promoting regional economic development and enhancing national soft power. Under the promotion of the "Belt and Road" initiative, educational cooperation between China and ASEAN countries is becoming increasingly close, which provides broad space and unprecedented opportunities for the opening and exchange of higher education between the two sides. Guangxi, as a frontier area bordering China and ASEAN countries, has the important responsibility of promoting regional educational cooperation and humanistic exchanges, as well as the potential to promote the transformation and upgrading of the local economy and realize high-quality development.

In recent years, with the deepening of economic and trade relationships between China and ASEAN countries, cooperation between the two sides in the field of education has also achieved remarkable results. As important bridges connecting China and ASEAN countries, Guangxi's higher education institutions have been actively engaged in international student education, scientific research cooperation and cultural exchanges, which have not only attracted many ASEAN students to study in China but also injected new vitality into the economic and social development of Guangxi and China. However, although the opening up of Guangxi's higher education to ASEAN countries has made positive progress, research on the economic effects generated in this process and its mechanism of action is still insufficient, and systematic theoretical discussion and empirical analysis are urgently needed.

2. Literature Review

To better understand the economic effect of opening up higher education to ASEAN countries, this paper adopts CiteSpace software to analyse the literature. 949 pieces of literature in total related to "opening up of education to the outside world" were collected for co-occurrence network analysis to study the hot keywords of related literature in each time period and their internal connections, to further explore the hot research content of "opening up of education to the outside world", and to obtain the research. The co-occurrence map of hotspots is shown in Figure 1.

Figure 1. Co-occurrence mapping of hotspots in education outreach research.

In this keyword co-occurrence map, we find that the high-frequency co-occurring words in the literature related to the opening up of education to the outside world are opening up to the outside world, economic growth, policy, education power, influencing factors, internationalization, human capital, development, internationalization, and Belt and Road planning according to frequency, among which the frequency of economic growth is 27, which indicates that the economic effect of opening up higher education to the outside world has become the key focus of research. From the perspective of theoretical traceability, the opening up of education to the outside world is the embodiment of the internationalization of education in China from the perspective of policy and practice. According to the Opinions of the Ministry of Education and Eight Other Departments on Accelerating and Expanding the Opening of Education to the World in the New Era, the opening of education to the outside world includes a variety of topics, such as studying abroad, studying in China, Chinese-foreign cooperative education, overseas education, and bilateral and multilateral international cooperation and exchange. For the higher education stage, internationalization is the main feature and inevitable trend of development. Combined with existing research results, we find that opening up higher education to the

outside world can realize economic growth in various ways, such as increasing consumption, investment, technological innovation and high-quality human capital. On the basis of the above understanding, we focus on research related to the economic effect of the opening up of higher education to the outside world.

2.1. Studies Related to the Economic Effects of Opening Higher Education to the Outside World

In terms of the economic effect of the inflow of international students, domestic scholars have focused mainly on analysis and empirical research from the perspectives of spatial effects and comprehensive effects. On the one hand, the inflow of international students has a promoting effect on China's economic growth. Liu Zhimin *et al*. suggested that international students from countries along the "Belt and Road" play an obvious role in promoting China's economic growth and can create more jobs for China [1]. Xue Haiping analysed the spatial spillover effect and concluded that the flow of international students can promote the economic development of local and neighboring provinces [2]. On the other hand, the inflow of international students can promote the economic growth of the home countries of international students, which is manifested mainly in the direct ways of expanding domestic demand, attracting foreign investment, developing foreign trade and promoting the development of education, as well as the indirect path of the education incentive effect and trade promotion effect [3,4]. Among them, Liu Kai and Song Ziqian's empirical study concluded that for every 1% increase in the scale of higher teaching students coming to China, China's outwards foreign direct investment in the country will increase by 0.645% [5].

In terms of the economic effects of international student outflows, domestic scholars have widely discussed the economic effects of international student outflows on their home countries. In recent years, the pattern of cross-border mobility of international students has gradually changed from a one-way flow from developing countries to developed countries and from minor developed countries to major developed countries to a talent cycle between developing and developed countries [6]. On the one hand, a large number of talent outflows constrain the rapid development of the local economy, but for regions with relatively backwards economies that are saturated with jobs, the loss of talent may directly or indirectly promote the economic development of the region [7]. On the other hand, Xu Jiayun *et al*. noted that rationally guiding the transnational mobility of talent is highly important for the accumulation of human capital in developing countries [8]. The good structure of human capital can promote economic growth through a network composed of foreign trade and migration [9].

2.2. Research Related to the Opening Up of Higher Education to ASEAN Countries

From the perspective of opening higher education to the outside world for ASEAN countries, the areas of cooperation between China and ASEAN countries in higher education have gradually increased, and many achievements have been made in the areas of cooperation in school-running, talent cultivation, scientific research, and social services. Zhou Guping and Luo Qin suggested that higher education cooperation is an effective way to deepen the relationship between China and ASEAN countries, which can help both sides increase their level of trust and dispel doubts, communicate policies, reserve talent and boost economy growth [10]. Although there is a certain extent of difference between China and ASEAN countries in many aspects, China and ASEAN countries fully respect each other's differences and have now initially formed a China-ASEAN higher education cooperation model aimed at innovation and research and development, cooperation in school running and educational assistance, and realized the mutual benefit and win–win situation of cooperation in higher education [11]. Education is a technical source of human capital accumulation and economic growth. In the context of the further deepening of multidisciplinary cooperation in the China-ASEAN Free Trade Area, higher education cooperation between China and ASEAN countries has also been further developed [12].

As a bridgehead for China's interaction with ASEAN countries, the internationalization of higher education in Guangxi has not only greatly facilitated the cross-border flow of high-end talent but also significantly strengthened the economic ties between the regions. However, although the practice of opening up higher education to ASEAN countries has achieved remarkable results, there is a relative lack of research on its economic effects. Most of the current research focuses on the field of economic and trade cooperation [13–16]. However, the research is still insufficient on how opening up higher education to the outside world promotes regional economic growth and

enhances regional competitiveness through the paths of talent cultivation and knowledge spillover.

In summary, the literature has gradually focused on the economic effects of opening up education to the outside world, such as in terms of economic growth, capital attraction and investment, but there is a lack of research on regional differences. Most studies focus on the national level and lack an in-depth analysis of specific regions. Moreover, the specific mechanism of the economic effect of the opening up of education to the outside world is still unclear. Although studies have shown that international students coming to China have a positive impact on economic growth, the specific mechanism and path are still unclear, especially how the opening of higher education to the outside world promotes regional economic development through the flow of international students. In this paper, we focus on the economic effects of the opening up of higher education to ASEAN countries and select Guangxi, which has a geographic advantage, to analyse the current situation and both the direct and indirect economic effects of the opening up of higher education in Guangxi to provide empirical evidence for China's opening up of higher education to the outside world and the development of the regional economy.

3. Analysis of the Current Situation of Guangxi's Higher Education Opening Up to the ASEAN Countries

### 3.1. Scale and Number of Students from ASEAN Countries Studying in Guangxi

With the promotion of the "Belt and Road" initiative, Guangxi's openness to the ASEAN region has continued to deepen, and international education and economic exchanges have become increasingly frequent. Through a series of initiatives, such as the China-ASEAN Vocational Education Joint Exhibition and Forum, "Study in Guangxi" International Education Exhibition, as well as a series of other initiatives, such as the establishment of scholarships for international students from ASEAN countries by the Guangxi government and vigorously building a brand of "Study in Guangxi", Guangxi promoted the development of international student education, which led to an increase in the number of ASEAN international students in Guangxi. As shown in Figure 2, the number of students from ASEAN countries studying in Guangxi increased significantly between 2016 and 2019, from 9,061 in 2016 to 10,662 in 2019. The number of ASEAN students coming to Gui in 2020 and 2021 declined due to the impact of the COVID-19 pandemic in 2019. However, with the improvement of the epidemic situation, the scale of the number of ASEAN international students coming to Gui showed rapid growth after 2023. By the end of May 2024, the total number of international students coming to Gui was 11,356, of which 7,608, made up a large proportion of 67%, were from ASEAN countries.
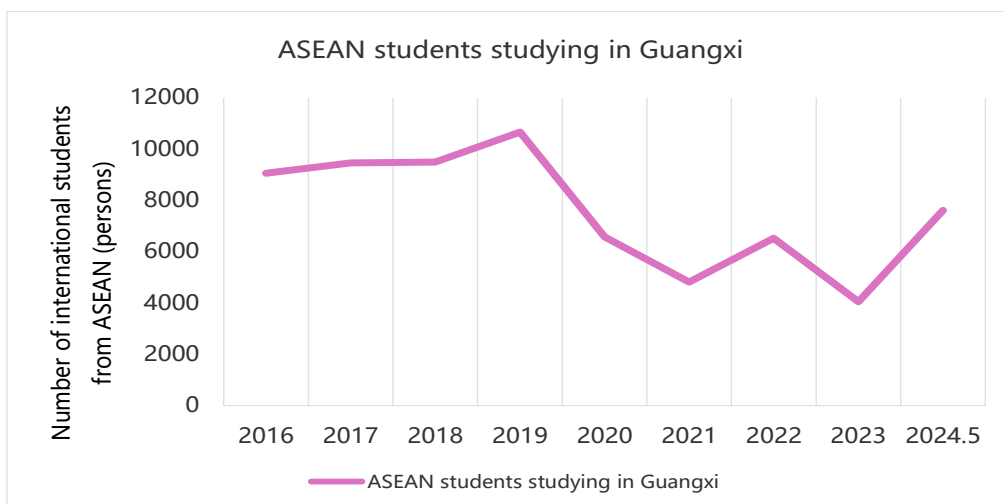
**Figure 2.** Scale of the number of international students from ASEAN countries coming to China.

As the level of economic development and the quality of education vary greatly from one ASEAN country to another, there is a significant difference among the ASEAN countries in the number of students from each ASEAN country coming to study in Gui. As shown in Figure 3, the number of international students from Vietnam is the largest among the ASEAN students coming to Guangxi, totaling 1877. This is probobaly because Guangxi shares a border with Vietnam, which has unique geographical advantages and cultural similarity to it.

Thailand is the next, with a total of 1,402 Thai students coming to Guangxi. In addition, there are 856 and 526 Lao and Indonesian students in Guangxi, respectively. Fewer students from Cambodia, Malaysia, Myanmar and the Philippines chose to study in Guangxi, whereas Brunei and Singapore, which are more economically developed and have better educational resources than Guangxi does, have no students come to study in the country for the time being.
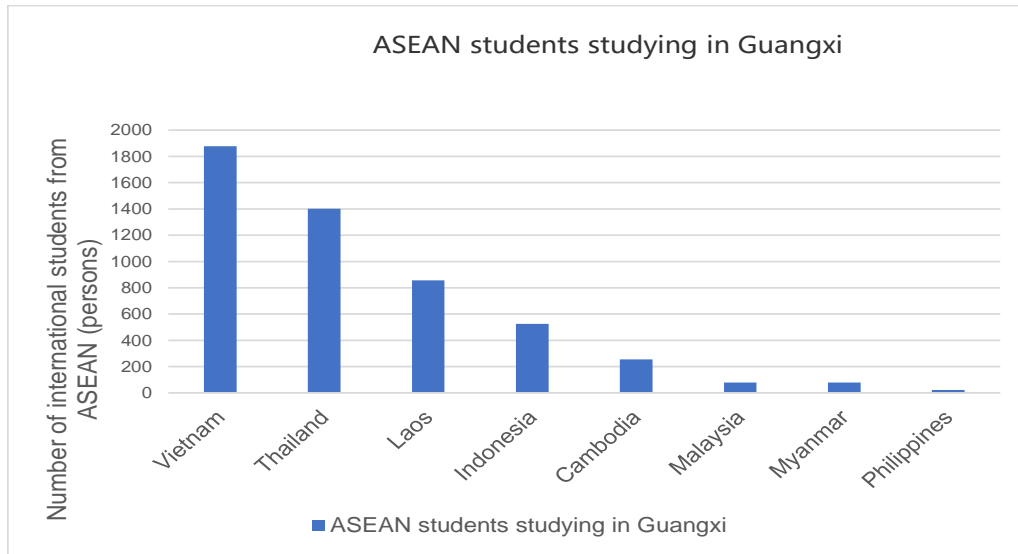
Figure 3. Main source countries of international students coming to Guangxi.

For the main inflow universities of international students from ASEAN countries to Gui, Guangxi University for Nationalities attracts the most ASEAN students, with a total of 743 ASEAN students; Guangxi University, which receives 540 ASEAN students; and Guilin University of Electronic Science and Technology and Guilin University of Science and Technology, which have relatively fewer ASEAN students (as shown in Figure 4). In terms of the top three universities, the distribution of ASEAN students is relatively wide, covering undergradute, master's, doctoral and nondegree education levels, with a certain number of international students at each level and specialty, but the number of undergraduate students is the largest, while the scale of international students with master's and doctoral degrees is still at a lower level; the specialties are mainly concentrated in liberal arts majors, such as language, economics and trade and business administration, and relatively fewer international students are science and technology majors. Specialties are concentrated mainly in language, economic and trade, business administration and other liberal arts majors, while the number of international students in science and technology majors is relatively small, indicating that China still lacks attraction to high-level students from ASEAN countries and students in more in-depth specialties in science and technology.
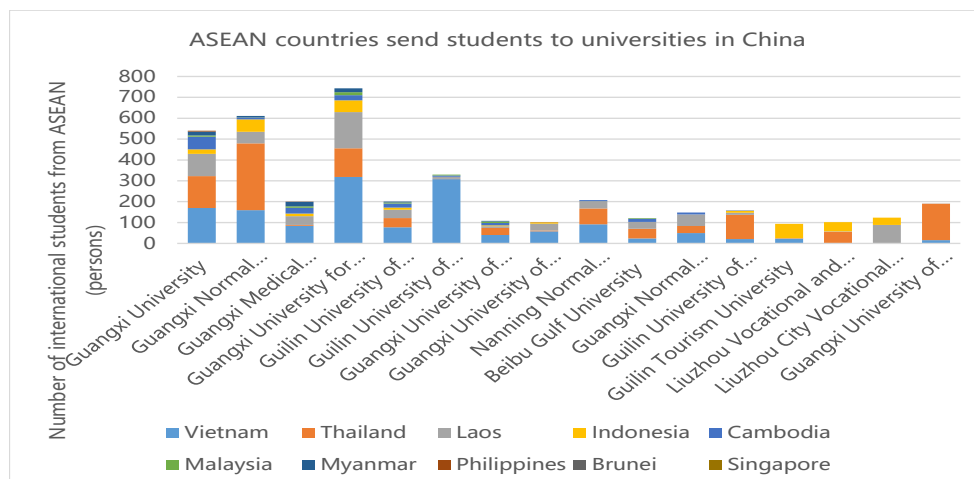
Figure 4. Major flow of international students from ASEAN countries to universities in Guangxi.

3.2. Policy Support for Opening Up Higher Education in Guangxi to ASEAN Countries

In his important discourse on education, Secretary Xi Jinping emphasized the need to promote in-depth opening up to the outside world, to coordinate "bringing in" and "going out", and to continuously enhance the international influence, competitiveness and discourse right of China's education. The spirit of these speeches provides a guiding direction for the opening up of Guangxi's education to the outside world. As shown in Table 1, to increase the degree of opening up of China-ASEAN higher education to the outside world, a series of policies and measures have been introduced at the national level and the local level of Guangxi, which not only cover macro strategic guidance but also include specific implementation paths and measures, providing a solid policy guarantee for educational cooperation.

Table 1. Policies and contents related to the liberalization of education.

Serial Number	Deal	Openness of Education-Related Content
1	Five-Year Action Plan for Lancang-Mekong Cooperation (2018–2022)	To strengthen cooperation among Lancang countries
2	China-ASEAN Strategic Partnership Vision 2030	Strengthening educational innovation and academic exchanges through platforms such as the China-ASEAN Education Exchange Week
3	Opinions of the Ministry of Education and Eight Other Departments on Accelerating and Expanding the Opening of Education to the World in the New Era	Fully support the high-quality and innovative development of education in the relevant places and regions, and create a new high ground for opening up education to the outside world
4	Program for the Construction of the China-ASEAN Pilot Area for Open Educational Cooperation	Deepening educational cooperation with ASEAN countries, jointly improving the quality of education, strengthening educational exchanges and cooperation, promoting the integration of industry and education, and enhancing the internationalization of education, etc.
5	The Fourteenth Five-Year Plan for the Development of Education in Guangxi	Focusing on ASEAN, the opening up of education to the outside world has continued to expand, strengthening educational cooperation with countries and regions along the "Belt and Road", promoting two-way study abroad, and building China-ASEAN joint universities.
6	Work Program on Accelerating and Expanding the Opening-up of Education to the World in Guangxi	Clarified the direction and focus of strengthening educational exchanges and cooperation with ASEAN and other countries and regions
7	Implementation Plan for Promoting the Clustering and Integration of Industry and Education to Create a Highland of Open Cooperation and Innovation in Vocational Education Facing ASEAN	Through the joint construction of ministries and districts and regional linkage, the quality and level of vocational education will be comprehensively improved, a new pattern of industry and education gathering and integration will be formed, and a distinctive brand of China's international cooperation in vocational education will be created.
8	Guangxi Action Plan for Opening Up Education to the World (2021–2025)	Strengthening educational cooperation with ASEAN countries, including the construction of a pilot area for China-ASEAN educational openness and cooperation, the promotion of the construction of the China (Guangxi)-Southeast Asia Technical and Vocational Education and Training Center, and the implementation of the "Study in Guangxi" brand.

Source: Compiled in this study.

3.3. Economic Support for Opening Up Higher Education in Guangxi to ASEAN Countries

To expand its openness to the outside world, Guangxi has set up a scholarship program for international students from ASEAN countries. In 2011, the Guangxi government launched "Guangxi Government Scholarships for International Students from ASEAN Countries", with an annual investment of approximately

30 million RMB, to attract outstanding students from ASEAN countries to study in higher education institutions in Guangxi for specialization, undergraduate and master's degrees and doctoral degrees. The annual investment is approximately RMB 30 million to attract outstanding students from ASEAN countries to study in higher education institutions in Guangxi for specialties, undergraduate degrees and master's and doctoral degrees. The places of the fully funded scholarship are allocated according to the specific conditions of each country; for example, Vietnam has been granted 110 places, Laos 47 places, Cambodia 20 places and Myanmar 5 places, totaling 182 places. In addition, Guangxi provides additional scholarships for international students from ASEAN countries for independent enrollment in ASEAN countries. In recent years, the implementation of scholarship programs has achieved remarkable results. Between 2016 and 2023, the numbers of new students admitted as full scholarship international students in each year are 192, 219, 385, 196, 295, 294, 225 and 320, respectively, which show that the number of awarded ASEAN international students coming to Guangxi has continued to grow, indicating that Guangxi's attractiveness to international students from ASEAN countries has continued to enhance.

To further increase the attractiveness of Guangxi's universities to international students from ASEAN countries, the Guangxi government has also invested a large amount of money in the construction and renovation of international students' apartment buildings to improve the living conditions of international students coming to Guangxi, and from 2014–2017, the government invested a total of 570 million chinese yuan to complete the comprehensive renovation and expansion of international students' apartment buildings at 12 universities, including Guangxi Normal University, Guilin University of Electronic Science and Technology, and Guilin University of Science and Technology. Comprehensive renovation and expansion of apartment buildings. This measure has effectively alleviated the problem of enrollment restrictions due to poor conditions and a shortage of beds in dormitories for international students. Optimizing the living environment for international students will not only improve the international reputation of Guangxi universities but also attract more students from ASEAN countries to study.

## 4. Analysis of the Economic Effect of Opening Guangxi's Higher Education System to ASEAN Countries

4.1. Analysis of Direct Economic Effects

In recent years, the scale of international students from ASEAN countries in Guangxi has continued to expand. In 2005, the number of international students from ASEAN countries in Guangxi was less than 1000, whereas in 2019, the number reached $10,662$. Although the number of international students from ASEAN countries who came to Guangxi decreased after 2019 due to the impact of the COVID-19 pandemic, the number gradually rebounded to 7068 by the end of May 2024, and this overall growth trend reflects not only the improvement in the quality of higher education in Guangxi but also the recognition of and increased demand for Guangxi's educational resources by ASEAN countries. According to Figure 5, Guangxi's foreign direct investment is affected by the COVID-19 pandemic, which shows a trend of first increasing but then decreasing, and there is a certain similarity with the growth of the scale of international students coming to Guangxi. At present, international students from ASEAN countries have become the main source of the international student group coming to Guangxi, and under the framework of the Regional Comprehensive Economic Partnership Agreement (RCEP), we believe that ASEAN countries will certainly become an important starting point for the growth of the scale of international students coming to China and may also further promote OFDI from Guangxi as well as China to ASEAN countries.
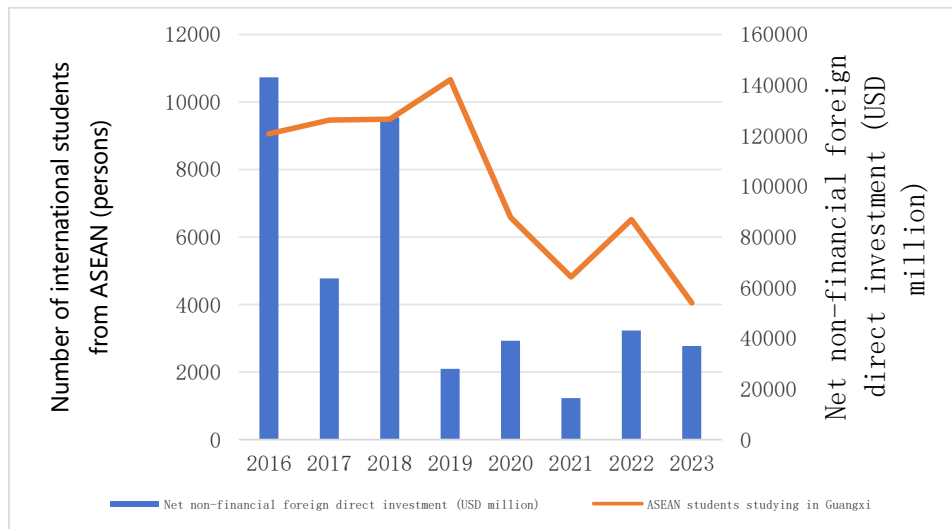
Figure 5. Scale of foreign students from ASEAN countries and net nonfinancial OFDI from Guangxi.

As shown in Figure 6, this paper fits the relation curve between the scale of international students from ASEAN countries coming to Guangxi and the scale of net nonfinancial OFDI in Guangxi. Figure 6 shows that the fitted curve is skewed to the upper right, which preliminarily confirms that there is a positive and weak correlation between the scale of international students from ASEAN countries coming to Guangxi and the net nonfinancial OFDI in Guangxi. This suggests that international students coming to Guangxi have the potential to promote the growth of Guangxi's net nonfinancial OFDI, but this promotion is not the only factor and is still influenced by a variety of other factors.
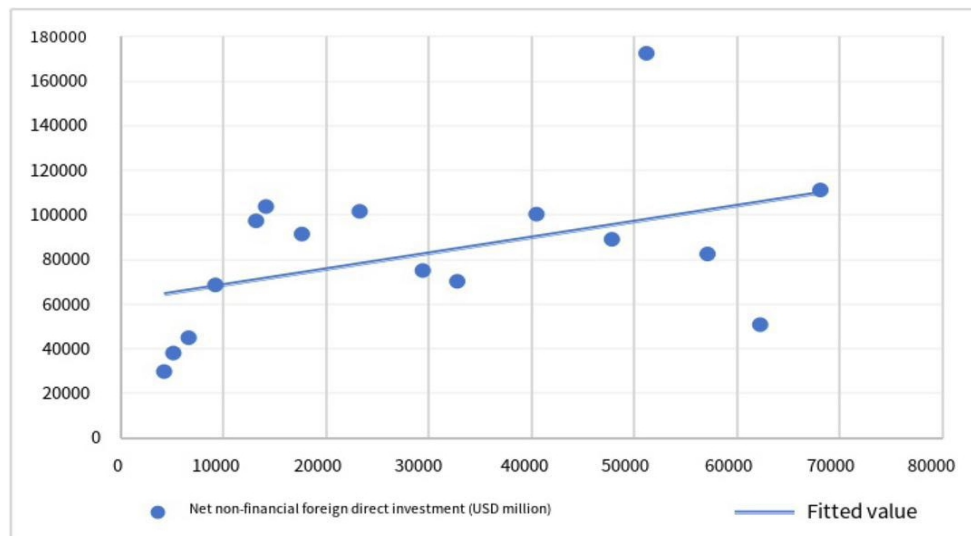
Figure 6. The fitted relationship between international students from ASEAN countries coming to Guangxi and the net nonfinancial outward FDI of Guangxi.

4.2. Analysis of Indirect Economic Effects

In addition to the direct economic benefits mentioned above, the opening up of Guangxi's higher education to the outside world for ASEAN countries will strengthen the cooperation and exchanges between Guangxi and ASEAN countries in the fields of economy and trade and promote the further development of economic and trade relationships between both sides. As shown in Figure 7, the total import and export value of Guangxi to ASEAN countries shows a rising trend annually, especially reaching the peak value in 2023. During the pandemic period, Guangxi's net exports to ASEAN countries not only did not decrease but continued to grow, benefited from the multiple impetuses of geographic advantages, policy support, economic and trade cooperation and market demand, and when the global logistics chain was impacted, the transportation of goods

between Guangxi and ASEAN countries was relatively smooth; thus, the total import and export value of Guangxi to ASEAN countries showed a more stable and continuous growth trend. This also indicates, to a certain extent, that with the more frequent flow of students between Guangxi and ASEAN countries, economic and trade cooperation will continue to deepen, and the demand for educational cooperation between Guangxi and ASEAN countries will continue to increase. Enterprises' demand for talent with international vision and cross-cultural communication ability will be more urgent, which will further promote Guangxi's higher education institutions to strengthen cooperation with ASEAN countries and cultivate more high-quality talent in line with market demand.
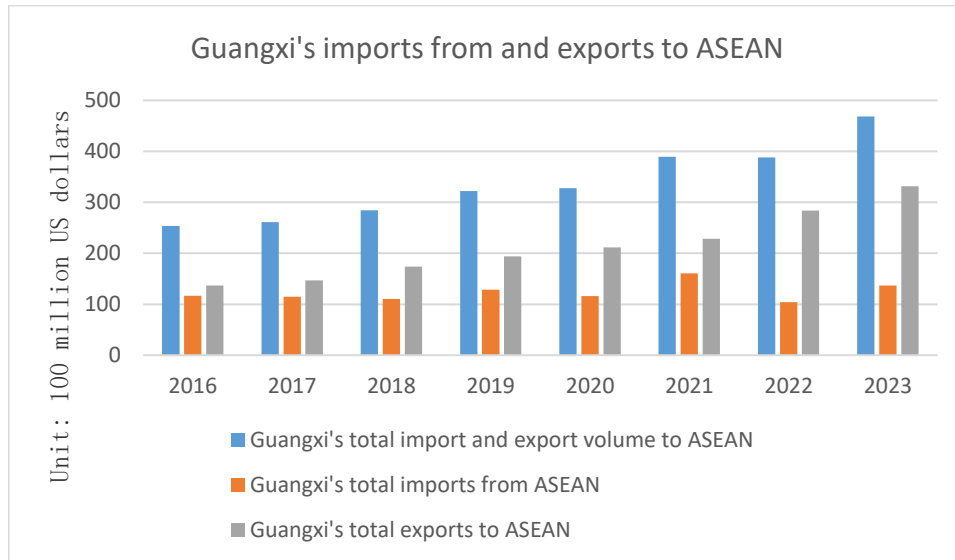
Figure 7. Guangxi imports and exports to ASEAN countries.

In terms of the level of the talent localization effect, the employment and entrepreneurial activities of ASEAN international students after completing their studies in Guangxi can have a certain degree of impact on the economic development of Guangxi and even China and ASEAN countries. As localized talent resources, these international students can not only promote economic and technological exchanges between China and ASEAN countries but also enhance the international competitiveness of Guangxi enterprises. With their deep understanding of Chinese and ASEAN cultures, as well as their professional skills and internationalized vision, they play an important role in many industries, such as international trade, information technology, cultural tourism. Through their unique cultural background and language skills, ASEAN students obtaining employment or starting businesses in Guangxi can help Chinese enterprises better expand into the ASEAN market and simultaneously facilitate the entry of ASEAN enterprises into Guangxi for investment, which promotes the deepening of bilateral economic and trade cooperation. In addition, innovative enterprises founded by ASEAN students have introduced new business models and technologies to Guangxi, promoted industrial transformation and upgrading, and breathed new life into local economic and social development.

At the level of the cultural identity effect, the opening up of higher education in Guangxi to ASEAN countries enhances the attractiveness of Guangxi to ASEAN countries. Guangxi has the opportunity to spread Chinese culture to ASEAN countries and, at the same time, has the opportunity to learn and learn from the excellent cultural achievements of ASEAN countries and promote cultural exchange and integration. As shown in Table 2, current universities in Guangxi already have cultural experience activities and exchange platforms specially designed for ASEAN students, such as traditional culture courses, festival celebration participation, folk culture study tours, etc. These activities not only deepen ASEAN students' understanding and identification with Chinese culture but also raise Guangxi's reputation in the field of international education and lay a solid cultural foundation for building a closer China-ASEAN community of destiny.

Table 2. Educational exchange activities for foreign students.

No.	Manoeuvre	Thrust
1	CJK-ASEAN "Young Ambassadors" Exchange Program	Lectures, professional exchanges, presentations, visits and on-site cultural experiences
2	China Dongxing-Vietnam Mangjie Youth Civilization Mutual Understanding Exchange and Study Activity	"Drinking Water from the Same River-Celebrating the Dragon Boat Festival Together", Boundary River Songs, and Reading Exchanges
3	China-ASEAN (Nanning) Intangible Cultural Heritage Week	323 Non-Genetic Inheritors from 17 Chinese Provinces and 6 ASEAN Countries Exchanged and Learned from Each Other
4	China-ASEAN Youth Elite Exchange Festival	The theme of the event is "Youth Joining Hands to Build the Future". Youth representatives from ASEAN countries will learn about the economic and social development of Guangxi and the results of exchanges and cooperation between Guangxi and ASEAN countries.
5	Guangxi–ASEAN Chinese Language Education Activity Week	Under the theme of "Gathering the wisdom of Chinese education elites and discussing the development of the alliance", organizing academic lectures and thematic exchanges on Chinese language education, as well as the "Learning Chinese-Storytelling" competition.
6	China-ASEAN Expo	Focusing on the construction of new land and sea corridors in the west, new quality productivity and green economy and other hot areas for thematic discussion
7	China-ASEAN Youth Talent Exchange Program	Focusing on the themes of innovation and entrepreneurship, rural revitalization, cultural communication, etc., they shared their experiences of working, studying and living in Guangxi and ASEAN, to enhance the understanding between young talents from China and ASEAN.
8	"Youth Meets Beauty" 2024 China (Guangxi)-ASEAN Youth Hand-in-Hand Activity	Implementing the "Guangxi Storytellers" project, inviting people from various countries to tell the story of China and Guangxi in the new era based on their personal experiences, and actively conveying the voice of friendship and cooperation between China and other countries in the world.

Source: Compiled in this study.

5. Conclusions and Policy Recommendations

5.1. Main Conclusions

First, the state and local governments of Guangxi have actively taken measures to significantly enhance their attractiveness to foreign students through the establishment of rich scholarship programs, the optimization of living facilities for foreign students and other multidimensional measures, which have led to rapid growth in the number of foreign students from ASEAN countries in Guangxi, with the group of foreign students from Vietnam and Thailand being particularly prominent. In terms of the distribution of disciplines, these foreign students are mainly concentrated in the fields of humanities and social sciences, such as linguistics, economics and trade, and management, whereas relatively few students are at the graduate level and in science and technology majors. This phenomenon reveals that Guangxi has the potential to attract high-level talent and international students in science and technology and that it needs to improve the quality of education and international competitiveness, as well as enhance economic incentives to attract a more diversified group of international students in the future. Second, this study reveals that Guangxi's strategy of opening higher education to ASEAN countries not only promotes exchanges in the education field but also directly positively promotes outward foreign direct investment from Guangxi, deepening the interaction and cooperation between the two sides in education, culture, economy and trade, and other dimensions. This openness not only accelerated the deepening development of economic and trade relations between the two sides but also brought positive momentum into the economic prosperity of Guangxi and ASEAN. However, given the limitations of the current data from studies abroad in Guangxi, this study fails to conduct an in-depth empirical analysis, and the conclusions drawn need to be verified with more detailed data in future studies.

5.2. Policy Recommendations

To further strengthen the economic effect of Guangxi's higher education opening up to the ASEAN countries, this paper proposes the following policy recommendations:

First, the government should attach great importance to the facilitation process between the two sides in the areas of trade and investment and continue to promote the education of international students from ASEAN countries in Guangxi to maintain a steady growth in the number of international students coming to China. The development of the Guangxi Pilot Free Trade Zone, as part of the national strategy, has led to the upgrading and transformation of industries in the region, and the demand for talent has changed. Higher education institutions in Guangxi need to pay close attention to changes in market demand and adjust their specialization settings and talent cultivation direction to better serve the development of the regional economy. Through cooperation with ASEAN countries, Guangxi's higher education institutions can cultivate more talent with an international outlook and cross-cultural communication ability to meet the demand of enterprises for internationalized talent.

Second, the government should encourage Guangxi universities and ASEAN countries to use the RMB as the settlement currency in educational cooperation, increase the acceptance and frequency of RMB use in the ASEAN region, and provide financial support for ASEAN students. With the deepening of educational cooperation between Guangxi and ASEAN countries, exchanges between the two sides in the fields of economy, trade, culture and other areas are also becoming more frequent, which provides more opportunities for the circulation and use of the RMB in the ASEAN region and helps promote the process of RMB internationalization. The Guangxi government can also consider strengthening financial cooperation with ASEAN countries to provide ASEAN students with convenient financial services by promoting the construction of a cross-border payment, clearing and settling system for the RMB in the ASEAN region and establishing a financial service system for international students. In addition, financial institutions in Guangxi should be encouraged to establish branches or cooperative organizations in ASEAN countries to provide ASEAN students with more convenient financial service channels.

Third, the government should strengthen the construction of educational cooperation mechanisms with ASEAN countries, promote the establishment of a more comprehensive cooperation framework, and promote in-depth exchanges and cooperation between the two sides in the fields of education, economy and culture. International cooperation and exchange platforms such as the China-ASEAN International Education Exhibition and the University Think Tank Alliance should continue, and the quality of education and teaching should be improved to attract more high-level students from ASEAN countries and students specializing in scientific and technological fields of study. In addition, universities should be encouraged to strengthen employment guidance for international students and help them maintain local employment after completing their studies which more effectively retain cultivated talent in Guangxi and contribute to local economic and social development.

Author Contributions

Conceptualization, B.F., Z.L. and S.S.; writing—original draft preparation and writing—review and editing, B.F., Z.L. and S.S. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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Article

An Empirical Study on the Impact of Local Financial Capacity on the Supply Efficiency of Ecological Public Goods

Xueying Liu, Yuquan Wang and Yaobo Shi *

School of Economics and Management, Xi' an University of Technology, Xi'an 710054, China

Abstract: Improving the quality and level of ecological public goods supply is crucial for enhancing the public happiness index and ensuring ecological welfare. A high-quality ecological environment generates significant positive externalities, making the provision of such goods a key focus of government expenditure. The ability of local governments to adequately fund the supply of ecological public goods depends on the strength of their financial capacity. Based on the panel data of 30 provincial-level regions in China from 2007 to 2019, this paper uses the super-efficiency Slack-Based Measure (SBM) model and the dynamic Malmquist index to measure the supply efficiency of provincial-level regional ecological public goods including undesirable outputs. Furthermore, the panel Tobit model and the system Generalized Method of Moments (GMM) model are used to empirically test the impact of local fiscal capacity on the supply efficiency of ecological public goods. The results show that fiscal absorption capacity can significantly improve the supply efficiency of ecological public goods, and the economic growth preference of fiscal allocation capacity can also significantly improve the supply efficiency of ecological public goods, indicating that under the influence of the current economic structure transformation and ecological civilization construction, the distortion of local governments in the supply of public goods has been improved, while the administrative consumption preference of fiscal allocation capacity hinders the improvement of the supply efficiency of ecological public goods, and the fiscal self-sufficiency has a lag in improving the supply efficiency of ecological public goods. Fiscal transfer payments have significantly improved the efficiency of the supply of ecological public goods.

Keywords: local financial capacity; ecological public goods; supply efficiency

1. Introduction

Good ecosystem is the foundation of sustainable development. Improving the level of supply of ecological public goods is an important way to comprehensively enhance the index of happiness of public life and to safeguard public ecological welfare. Public finance is based on meeting the basic needs of society and has important functions such as maintaining the allocation of government resources, stabilizing economic and social development, and standardizing the allocation of funds.

This paper, based on an accurate identification of the internal relationship between local fiscal capacity and the supply efficiency of ecological public goods, explores and constructs a super-efficient SBM model and a dynamic Malmquist index model with undesirable outputs. The aim is to comprehensively analyze and measure

the supply efficiency of ecological public goods at the provincial level in China from 2007 to 2019. Furthermore, the study establishes an empirical econometric model to clarify the internal mechanisms by which local fiscal capacity affects the supply efficiency of ecological public goods. Specifically, it examines how and to what extent local fiscal capacity influences the supply of these goods. The Tobit panel model and the system GMM dynamic panel econometric model are employed to empirically investigate the impact of local fiscal capacity on the supply efficiency of ecological public goods, thereby providing both theoretical and empirical foundations for improving the supply efficiency of ecological public goods and advancing the "green revolution" in ecological civilization construction.

2. Basic Model

2.1. Non-Radial, Non-Angular Super-Efficient SBM Model

The Data envelopment analysis (DEA) method was first proposed by Chames and Cooper et al. in 1978 to solve the problem of the effectiveness of decision-making units under the "multi-input and multi-output" evaluation system [1]. In the traditional DEA analysis, the Charnes-Cooper-Rhodes (CCR) and (Banker-Chames-Cooper) BCC models only consider the proportional changes of input or output, which are mainly based on the radial perspective, and do not consider the influence of relaxation variables for the invalid decision-making unit, and the results may have errors.

In order to overcome the above shortcomings, this paper refers to the research method of Tone *et al.* and adopts the non-radial and non-angular SBM efficiency evaluation model, which not only introduces the relaxation of input and output into the objective function, but also takes into account the undesirable output of environmental pollution. It can also solve the problem of input-output relaxation and the measurement bias of efficiency evaluation under the presence of undesired output, and further combines the super-efficiency DEA and SBM models, and establishes the following model.

$$min\rho = \frac{\frac{1}{m}\sum_{i=1}^{m}\left(\bar{x}/x_{ik}\right)}{\frac{1}{r_1+r_2}\left(\sum_{s=1}^{r_1}\bar{y}^d/y_{sk}^d + \sum_{q=1}^{r_2}\bar{y}^u/y_{qk}^u\right)}$$

$$\bar{x} \geq \sum_{j=1,\neq k}^{n} x_{ij}\lambda_j, i=1,2,\ldots,n$$

$$\bar{y}^d \geq \sum_{j=1,\neq k}^{n} y_{sj}^d\lambda_j, s=1,2,\ldots,r_1$$

$$\bar{y}^u \geq \sum_{j=1,\neq k}^{n} y_{qj}^d\lambda_j, q=1,2,\ldots,r_2$$

$$\lambda_i \geq 0, j=1,2,\ldots,n \qquad (1)$$
$$\bar{x} \geq x_k, k=1,2,\ldots,n$$
$$\bar{y}^d \leq y_k^d, q=1,2,\ldots,r_1$$
$$\bar{y}^u \leq y_k^u, u=1,2,\ldots,r_2$$

n represents the number of decision-making units; m represents inputs; r_1 and r_2 represent expected and undesired outputs; x represents the elements in the corresponding input matrix; y^d and y^u represent the elements in the corresponding expected and undesired output matrices; ρ is the calculated eco-efficiency value, and $\rho \geq 1$ indicates that the decision-making unit is valid. Considering the existence of technological progress, institutional change, and other factors, in order to ensure the accuracy of the results, this paper chooses the super-efficient SBM model under the condition of variable scale reward (VRS) to analyze the supply efficiency of ecological public goods, which is more in line with the actual situation, and at the same time output-oriented, so that the analysis results are more economically significant.

2.2. Malmquist Exponential Dynamic Model

Caves *et al.* incorporated the Malmquist index into the calculation of total factor productivity, and the Malmquist index well reflected the structural drivers of efficiency change, thus forming an efficiency evaluation and analysis method based on the combination of static and dynamic based on DEA-Malmquist [2]. Combining the Malmquist index with DEA makes it possible to describe the dynamic change of efficiency, and its practical application in productivity measurement is becoming more and more extensive [3]. The expression of the Malmquist exponential method is:

$$M\left(x^{t+1}, y^{t+1}, x^t, y^t\right) = \left[\frac{D^t\left(x^{t+1}, y^{t+1}\right)}{D^t\left(x^t, y^t\right)} \times \frac{D^{t+1}\left(x^{t+1}, y^{t+1}\right)}{D^{t+1}(x^t, y^t)}\right]^{\frac{1}{2}}$$

$$Effch = \frac{D^t(x^{t+1}, y^{t+1})}{D^t(x^t, y^t)}$$

$$Tech = \left[\frac{D^t(x^{t+1}, y^{t+1})}{D^{t+1}(x^{t+1}, y^{t+1})} \times \frac{D^t(x^t, y^t)}{D^{t+1}(x^t, y^t)}\right]^{\frac{1}{2}} \tag{2}$$

$$Tfpch = Effch \times Tech = (Pech \times Sech) \times Tech$$

Among them, and represent the input-output vectors in the *t* period and the *t* + 1 period, respectively, and the Malmquist index is used to measure the dynamic change index of the supply of ecological public goods from *t* to *t* + 1.

The economic significance of the Malmquist index is as follows:

(1) *M* > 1, indicating that the supply efficiency of ecological public goods was improved from *t* to *t* + 1;

(2) *M* = 1, indicating that the supply efficiency of ecological public goods goes from *t* to *t* + 1.

(3) *M* < 1, indicating that the supply efficiency of ecological public goods decreased from *t* to *t* + 1. The comprehensive technical efficiency change index *(TEC)* represents the catch-up trend of each decision-making unit relative to the production frontier from *t* to *t* + 1, that is, the change of the technical efficiency of ecological public goods supply from *t* to *t* + 1 when the decision-making unit is from *t* to *t* + 1. When *TEC* > 1, it indicates that the technical efficiency of the ecological public goods supply has improved. When *TEC* < 1, it indicates that the technical efficiency of the ecological public goods supply deteriorates.

Total factor productivity *(TFP)* represents the change in the productivity of ecological public goods in the two periods before and after the Malmquist index, and the total factor productivity shows the comprehensive productivity of each factor, when the *TFP* > 1, it indicates that the total factor productivity has improved. When *TFP* < 1, it indicates that total factor productivity has deteriorated.

3. Basic Model Empirical Study of the Impact of Local Fiscal Capacity on the Supply Efficiency of Ecological Public Goods Based on the SYS-GMM Method

3.1. Econometric Model Building

The efficiency indicators calculated by the super-efficiency SBM model are truncated data, making the Tobit model the appropriate choice for analyzing the factors influencing the supply efficiency of ecological public goods. Therefore, this paper first employs the panel Tobit model to examine the impact of local fiscal capacity on the supply efficiency of ecological public goods. The Tobit regression model can be expressed as follows:

$$Y = \begin{cases} Y^* = \alpha + \beta X + \epsilon & Y^* \alpha \\ 0 & Y^* \alpha \end{cases} \tag{3}$$

X is the vector of the independent variable; *Y* is the vector of the truncated dependent variable; α is the intercept term vector; *β* is the regression parameter vector; *ε* is the perturbation term. In this paper, the supply efficiency of ecological public goods is taken as the explanatory variable to construct a Tobit regression Model:

$$SSBMV_{it} = \alpha_i + \beta_1 CZNL_{it} + \beta_2 CZZG_{it} + \beta_3 PGDP_{it} + \beta_4 GYJG_{it} + \beta_5 CITY_{it} + \beta_6 PEOPLE_{it} +$$

$$\beta_7 HBCP_{it} + \epsilon_{it} \tag{4}$$

In the regression model, *SSBMV* is the supply efficiency of ecological public goods calculated by the super-efficient SBM model. *CZNL* stands for Local Fiscal Capacity Level; *CZZG* stands for Fiscal Self-Sufficiency;

PGDP is based on real GDP per capita in 2007; *GYJG* stands for the level of industrialization; *CITY* stands for the level of urbanization; *PEOPLE* stands for Regional Population Density; *HBCP* indicates the frequency of environment-related words in local government work reports. At the same time, considering the fitting degree of the regression model, some variables are converted into logarithmic form, and the coefficients of each variable after the logarithm is taken have strong economic significance.

3.2. Empirical Results

(1). Panel Tobit estimation

According to the regression results, it can be seen that the coefficient of fiscal absorption capacity is significantly positive, the coefficient of fiscal and economic allocation capacity is significantly positive, the coefficient of fiscal and administrative allocation capacity is significantly negative, and the coefficient of transfer payment is significantly positive, which indicates that the financial absorption capacity of local governments can significantly improve the supply efficiency of ecological public goods, and the economic growth preference of local governments can also significantly improve the supply efficiency of ecological public goods, indicating that under the influence of the current economic structure transformation and ecological civilization construction, Local governments have achieved "all-encompassing" in economic construction and the supply of ecological public goods, and the distortion of "emphasizing the economy and ignoring people's livelihood" in the supply of public goods by local governments has been improved, and ecological public goods are gradually being paid attention to [4]. However, the administrative consumption preference of local governments hinders the improvement of the supply efficiency of ecological public goods [5], and the transfer payment significantly improves the supply efficiency of ecological public goods, which is consistent with the expected assumptions in this paper (as shown in Table 1).

Table 1. TOBIT Regression Results of the Impact of Local Fiscal Capacity on the Supply Efficiency of Ecological Public Goods.

MODEL	(1)	(2)	(3)	(4)
VARIABLES	SSBMV	SSBMV	SSBMV	SSBMV
CZJQ	0.539 **			
	(0.236)			
CZPZ		0.243 ***		
		(0.084)		
CZFD			−0.014 ***	
			(0.005)	
lnPZYZF				0.047 **
				(0.024)
CZZG	0.051	0.120	0.009	0.132
	(0.076)	(0.080)	(0.077)	(0.089)
lnPGDP	−0.160 ***	−0.156 ***	−0.202 ***	−0.183 ***
	(0.058)	(0.056)	(0.062)	(0.062)
CITY	0.863 ***	0.870 ***	0.909 ***	0.934 ***
	(0.273)	(0.268)	(0.278)	(0.269)
GYJG	−0.346 **	−0.320 **	−0.366 **	−0.302 *
	(0.167)	(0.160)	(0.169)	(0.162)
lnPEOPLE	−0.063 *	−0.067 **	−0.061 *	−0.064 *
	(0.033)	(0.033)	(0.034)	(0.033)

Table 1. Cont.

MODEL	(1)	(2)	(3)	(4)
VARIABLES	SSBMV	SSBMV	SSBMV	SSBMV
lnHBCP	0.040 **	0.036 *	0.037 *	0.041 **
	(0.020)	(0.020)	(0.021)	(0.020)
Constant	2.581 ***	2.533 ***	3.139 ***	2.400 ***
	(0.526)	(0.507)	(0.607)	(0.509)
Observations	390	390	390	390
Number	30	30	30	30

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; Standard errors in parentheses.

Further observation of the regression results of the control variables shows that the per capita GDP coefficient is significantly negative, indicating that economic activities will have a negative impact on the supply efficiency of ecological public goods [6]. The coefficient of urbanization level is significantly positive, indicating that urbanization promotes the improvement of the efficiency of ecological public goods supply, and also verifies the urban bias of public goods supply. The coefficient of environmental regulation is significantly positive, indicating that environmental regulation has a positive role in protecting the environment and improving the supply efficiency of ecological public goods [7]. The coefficient of fiscal self-sufficiency is not significant, and there may be a lag effect on the impact of fiscal self-sufficiency on the supply efficiency of ecological public goods in static regression, which needs to be further studied by using a dynamic regression model.

(2). The results of SYS-GMM estimator

In this paper, the GMM model of the dynamic panel system is used to test the relationship between local fiscal capacity and the supply efficiency of ecological public goods. From the regression results, it can be seen that the first-order lag term of the explanatory variable is highly significant, indicating that the supply efficiency of ecological public goods in the previous period will have an impact on the current government decision-making, and then affect the efficiency of ecological public goods in the current period. By comparing the static panel estimation results with the estimation results of the system GMM, except for the slight difference in the significance level of the regression coefficients of individual control variables, especially the other results including the core explanatory variables are basically similar, and unlike the static regression results, the fiscal self-sufficiency is significantly positive, which verifies the effect of fiscal self-sufficiency on the improvement of the supply efficiency of ecological public goods, and further indicates that the financial self-sufficiency has a lag in improving the supply efficiency of ecological public goods. For every 1% increase in fiscal absorption capacity, the supply efficiency of ecological public goods will increase by 0.589%; For every 1% increase in fiscal and economic allocation capacity, the supply efficiency of ecological public goods will increase by 0.145%; For every 1% increase in fiscal and administrative allocation capacity, the supply efficiency of ecological public goods will decrease by 0.023%; For every 1% increase in the level of transfer payment, the supply efficiency of ecological public goods will increase by 0.077%, and the vertical transfer payment of the central government will improve the supply efficiency of ecological public goods, which further supports the need for the central government to play a greater role in the public sector. It can be seen that fiscal absorption capacity has a great impact on the supply efficiency of ecological public goods, and it is significant at the level of 1% (as shown in Table 2).

Table 2. S-GMM Regression Results of the Impact of Local Fiscal Capacity on the Supply Efficiency of Ecological Public Goods.

MODEL	(1)	(2)	(3)	(4)
VARIABLES	SSBMV	SSBMV	SSBMV	SSBMV
L.SSBMV	0.205 ***	0.188***	0.168***	0.193 ***
	(0.016)	(0.015)	(0.024)	(0.022)
CZJQ	0.589 ***			
	(0.092)			
CZPZ		0.145 ***		
		(0.021)		
CZFD			−0.023 ***	
			(0.002)	
lnPZYZF				0.077 ***
				(0.009)
CZZG	0.085 **	0.241 ***	0.060 **	0.302 ***
	(0.038)	(0.030)	(0.030)	(0.055)
lnPGDP	0.006	−0.028	−0.121 *	−0.100
	(0.030)	(0.034)	(0.065)	(0.076)
CITY	−0.212	−0.0233	0.0877	0.0582
	(0.176)	(0.242)	(0.369)	(0.386)
GYJG	−0.500 ***	−0.591 ***	−0.629 ***	−0.525 ***
	(0.066)	(0.098)	(0.065)	(0.073)
lnPEOPLE	−0.186 ***	−0.173 ***	−0.169 ***	−0.148 ***
	(0.017)	(0.019)	(0.016)	(0.028)
lnHBCP	0.012 ***	0.014 ***	0.009 ***	0.012 ***
	(0.002)	(0.003)	(0.002)	(0.003)
Constant	2.353 ***	2.502 ***	3.661 ***	2.368 ***
	(0.285)	(0.214)	(0.476)	(0.489)
AR(1)	−2.350 **	−2.306 **	−2.306 **	−2.451 **
	0.019	0.021	0.021	0.014
AR(2)	1.061	1.066	1.066	1.053
	0.289	0.287	0.287	0.292
Sargan	0.977	0.992	0.992	0.976
Observations	360	360	360	360
Number	30	30	30	30

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; Standard errors in parentheses.

3.3. Robustness Test

In this paper, the Tobit panel regression model is replaced by a linear panel regression model. According to the regression results presented in the table below, the coefficients and significance of the main explanatory variables are largely consistent with those from the Tobit panel regression model, though there are slight differences in coefficient size and significance levels. Similarly, the coefficients and significance levels of the control variables are also generally consistent with the results from the Tobit regression (as shown in Table 3).

Table 3. Panel regression results of the impact of local fiscal capacity on the supply efficiency of ecological public goods.

MODEL	(1)	(2)	(3)	(4)
VARIABLES	SSBMV	SSBMV	SSBMV	SSBMV
CZJQ	0.545 **			
	(0.242)			
CZPZ		0.242 ***		
		(0.087)		
CZFD			−0.013 **	
			(0.005)	
lnPZYZF				0.047 *
				(0.024)
CZZG	0.054	0.123	0.021	0.135
	(0.079)	(0.082)	(0.076)	(0.092)
lnPGDP	−0.162 ***	−0.157 ***	−0.187 ***	−0.182 ***
	(0.059)	(0.058)	(0.061)	(0.064)
CITY	0.867 ***	0.869 ***	0.867 ***	0.934 ***
	(0.280)	(0.276)	(0.274)	(0.276)
GYJG	−0.349 **	−0.320 *	−0.344 **	−0.299 *
	(0.171)	(0.164)	(0.166)	(0.166)
lnPEOPLE	−0.059 *	−0.062 *	−0.063 *	−0.060 *
	(0.033)	(0.032)	(0.032)	(0.032)
lnHBCP	0.040 *	0.037 *	0.044 **	0.041 **
	(0.020)	(0.020)	(0.020)	(0.020)
Constant	2.568 ***	2.503 ***	2.972 ***	2.364 ***
	(0.541)	(0.518)	(0.591)	(0.518)
Observations	390	390	390	390
Number	30	30	30	30

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; Standard errors in parentheses.

3.4. Discussion

This paper empirically examines the impact of local fiscal capacity on the supply efficiency of ecological public goods by taking China's inter-provincial panel data from 2007 to 2019 as a sample. Firstly, the panel Tobit regression method is used to test the overall sample, and the regression results show that the financial absorption capacity of local governments can significantly improve the supply efficiency of ecological public goods, and the economic growth preference of local governments can also significantly improve the supply efficiency of ecological public goods, which indicates that with the adjustment of economic structure and the improvement of government incentive mode, the distortion of "emphasizing economy and ignoring people's livelihood" in the supply of public goods by local governments has been improved, and the supply of ecological public goods has gradually been paid attention to. The stronger a local government's financial capacity and the more financial resources at its disposal, the greater its support for public services and people's livelihoods, thereby effectively improving the supply level of ecological public goods. However, the preference for administrative consumption by local governments hinders the improvement of ecological public goods supply efficiency, while transfer payments significantly enhance this efficiency. Secondly, the results of the GMM dynamic panel regression indicate that fiscal self-sufficiency also significantly improves the supply efficiency of

ecological public goods, further suggesting that financial self-sufficiency has a delayed effect on improving this efficiency. Thirdly, the samples were classified based on different levels of fiscal absorption capacity, and the panel Tobit regression method was used to further analyze the differences in regression results across groups. Finally, in the robustness test, a model substitution method was employed to verify the impact of local fiscal capacity on the supply efficiency of ecological public goods.

4. Conclusion

Based on the evaluation method for ecological public goods supply efficiency, which combines the static and dynamic aspects of the super-efficiency SBM-Malmquist model, this paper uses provincial panel data from China spanning 2007 to 2019 as the sample. The measured efficiency of ecological public goods supply is taken as the dependent variable, with fiscal absorption capacity, fiscal allocation capacity, and transfer payments as independent variables, and fiscal self-sufficiency as the control variable. The research hypothesis is tested using the system GMM model and the instrumental variable method. Finally, the following conclusions are drawn:

First, the empirical results indicate that the supply efficiency of ecological public goods in China from 2007 to 2019 exhibited a fluctuating trend. Two-thirds of the provinces were in an efficient state, with provinces displaying low supply efficiency mostly concentrated in the central and western regions. Specifically, the eastern region generally achieved effective supply efficiency, the western region showed a stable and improving trend, while the central region ranked lowest in the country in terms of supply efficiency. Second, the Tobit panel regression results show that the coefficient for fiscal absorption capacity is significantly positive, the coefficient for fiscal and economic allocation capacity is significantly positive, the coefficient for fiscal and administrative allocation capacity is significantly negative, and the coefficient for transfer payments is significantly positive, all of which align with the theoretical expectations of this paper. Additionally, this study finds that the economic growth preference in local government fiscal allocation also significantly improves the supply efficiency of ecological public goods, which adds to the existing theoretical assumptions. Thirdly, the regression results for the control variables show that the coefficients for fiscal self-sufficiency are all significantly positive at the 1% level, indicating that fiscal self-sufficiency can significantly improve the supply efficiency of ecological public goods and exhibits a lag effect, further validating the expected hypothesis.

Author Contributions

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Conflicts of Interest

The authors declare no conflict of interest.

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The Influence of Employee Mindfulness on Customer Satisfaction under the Background of Platform Economy

Ziying Li and Hui Cheng *

School of Economics and Management, Zhaoqing University, Zhaoqing 526061, China

Abstract: Employee mindfulness can help improve employee engagement and customer satisfaction. In order to further reveal the action path of employee mindfulness and the influence of related factors, this paper reviews the internal action mechanism of employee mindfulness from the perspective of platform economy. By combing the action mechanism of the four core variables of employee mindfulness, state gratitude, work flow and customer satisfaction, a complete employee mindfulness action path is constructed to provide theoretical support and practical inspiration for enterprise managers, and help enterprises adapt to the changes of The Times and achieve healthy and sustainable development.

Keywords: employee mindfulness; customer satisfaction; state gratitude; work flow

1. Introduction

We are currently in the era of Uka (VUCA), VUCA is an abbreviation of Volatility, Uncertainty, Complexity and Ambiguity, refers to an organization in a volatile, uncertain, complex and ambiguous era. With the accelerated development of globalization and information technology, it has brought a series of adverse chain reactions to enterprises. Enterprises face the increasing uncertainty of market, technology, opportunity, risk and other factors, and are in a huge survival pressure and development dilemma. Faced with the turbulent external environment of the organization and the acceleration of internal change, employees have to adjust themselves quickly to adapt to the changes in the environment, resulting in more work pressure for employees. When employees are under high pressure, job burnout will follow, and the turnover rate will also increase, causing problems such as brain drain, low operating efficiency and cohesion breakdown, which is not conducive to the operation and development of enterprises.

As an innovative business model, platform economy is rising rapidly and profoundly changing the face of traditional economy [1]. Under the platform economy model, the quality of employees is uneven, labor relations are fuzzy, labor security is imperfect, and work is flexible, and the stability of the employment environment is poor, which greatly increases the difficulty of employee management of enterprises [2]. Due to unstable income and lack of long-term career development planning, employees are generally under great pressure, lack of professional identity, and decline in employee satisfaction and loyalty. As a result, employees are unable to actively engage in work and fail to realize their self-worth [3].

The healthy development of employees is the cornerstone of the sustainable development of enterprises. First of all, enterprises need to pay attention to employees' mental health, relieve employees' work pressure,

stimulate employees' positive emotions, and improve work engagement and enthusiasm. Secondly, customer value is the most core force for enterprise development, and improving customer satisfaction is an important force for enterprise success. In addition, the platform economy has also formed a multilateral market, through which employees can directly contact with customers. Enterprises must ensure that employees are active and healthy to work, so as to ensure the improvement of customer satisfaction.

In this context, this paper takes employee mindfulness as an important anthefactor and customer satisfaction as the ultimate goal, conducts an in-depth study on the action mechanism of employee mindfulness, illustrates its impact on customer satisfaction, and returns the final research results to enterprise operation and management practice to help enterprises establish unique competitive advantages. Provide stable and strong vitality and driving force for the healthy and sustainable development of enterprises.

2. Literature Review

2.1. Customer Satisfaction

Customer satisfaction refers to the psychological experience of happiness or disappointment formed by the comparison between the actual perceived effect of the product and the expectation of the customer [4], and it is also the real evaluation of the product or service of the enterprise [5]. Therefore, customer satisfaction is the recognition attitude of customers towards products or services and reflects the interaction effect between customers and enterprises. It will affect the business development of enterprises through the dissemination of brand word of mouth, the rate of re-purchase of goods and the increase rate of new customers, and is the key factor for enterprises to form competitive advantages.

Customer satisfaction is a dynamic index, which requires enterprises to focus on the needs of different customer groups, improve the diversification and individuation of products and services, and improve customer satisfaction horizontally. It is also necessary to continuously track customer feedback and evaluation, continuously optimize products and services, improve the durability of customer satisfaction vertically, improve the competitiveness of enterprises by creating customer value and establishing win-win cooperative relations, and provide a solid and powerful core driving force for the healthy and sustainable development of enterprises.

2.2. Employee Mindfulness

2.2.1. The Concept of Employee Mindfulness

Mindfulness refers to the state in which individuals focus their attention on the present situation and accept things without evaluation [6]. Employee mindfulness is a kind of psychological resource that helps employees to enhance work involvement and optimize internal development, so that employees can better notice the existence of their own mental control, and thus enhance their grasp of the organizational environment, self-efficacy and self-regulation ability.

2.2.2. Influencing Factors of Employee Mindfulness

Individual Level

Individuals with different experiences also have differences in the level of mindfulness state [7]. With the accumulation of individual work proficiency and experience, their sensitivity to emotional responses will decrease, and their level of mindfulness will also decline [8]. Chen *et al*. take travel as an example to show that the situation an individual is in can affect the change of mindfulness level [9]. Mindfulness intervention training is currently the most effective way to form mindfulness, the core of which is to focus attention through meditation, meditation or retreat [10]. Studies have shown that mindfulness intervention training greatly improves the level of individual mindfulness, effectively reduces employee burnout and perceived pressure, and significantly improves individual psychological and behavioral performance after intervention [7 – 11], and significantly enhances individual work efficiency and happiness experience [12]. Employees' own Big Five personality also has an impact on mindfulness. Giluk used meta-analysis to explore the significant correlation between neuroticism, conscientiousness and mindfulness in the big five personality [13]. Literature Association

found that the Big five personality factors have a significant positive impact on individual task engagement and creative thinking [14].

Organizational Level

An organization that can provide sufficient material and spiritual resources for employees can form employee mindfulness. When individuals are not supported by the organization and their personal development is limited, they will have negative emotions, resulting in inattention and failure to form employee mindfulness. Some scholars have shown through research that organizational constraints will reduce the level of individual mindfulness [11]. By providing emotional support to employees and establishing an organizational atmosphere of mutual trust, leaders can also enable employees to devote themselves to their work and effectively enhance their mindfulness [15].

To sum up, in order to achieve the improvement of employees' mindfulness, enterprises should not only make full use of employees' individual psychological laws to conduct mindfulness intervention training to improve employees' cognitive level and form a good working mood, but also take the initiative to improve organizational factors and promote a good working atmosphere.

2.2.3. The Role of Employee Mindfulness

Psychological Level

Employee mindfulness regulates employees' mental health by affecting many mental functions such as attention, cognitive flexibility, self-control and emotional reactivity [16], alleviating negative emotions and stimulating positive emotions [10]. Many studies have shown that mindfulness training can help employees better resist stress, anxiety and excessive burden [17], and promote the formation of lasting and stable occupational happiness through self-transcendence [18].

Working Level

Mindfulness enables employees to pay more attention to their work and have higher work engagement [19], shield unconscious behaviors to enhance individual motivation control [20], improve employees' emotional intelligence and work performance [21], reduce self-consumption, and promote active behavior [22]. Using the balanced experimental design, Cahn *et al.* also found that mindfulness can regulate the neural electrical activity of the individual brain, thus promoting attention, memory and learning [23].

Behavioral Level

Mindfulness influences the behavior of employees by changing their thinking patterns, cognitive levels, and mental states. Zhu Yongyue and Ma Miaohui found that mindfulness enhances employees' cognition and acceptance of self and occupation through the control of attention, and encourages employees to have professional identity and spontaneously generate proactive and innovative behaviors [24]. Yang Fan took civil servants as his research object and found that mindfulness promoted positive work behaviors by affecting the working state of civil servants [16].

2.3. State Gratitude

2.3.1. The Concept of State Gratitude

State gratitude is a state attributed to dependence or affective cognition based on the ability to empathize [10]. It is a positive emotion that occurs when an individual feels help and favor from others [25]. State gratitude can also produce a strong reward psychology, which can motivate individuals to help others, even if the cost of helping others is high [26]. State gratitude can be triggered by specific events or situations, which generally refer to receiving material or non-material help and gifts from others in daily life and work [27]. In the work context, state gratitude is closely related to employees' behavioral performance. Empirical studies have found that state gratitude can promote employees' prosocial behaviors [26].

2.3.2. The Influencing Factors of State Gratitude

Based on the current research on the influencing factors of state gratitude, the influencing factors of state gratitude can be divided into personality factors, interpersonal factors and organizational factors.

First of all, personality here specifically refers to individuals with trait gratitude personality. Spence research shows that individuals with higher trait gratitude level will have a higher level of state gratitude emotion when experiencing the kindness of the benefactor, which will last longer and have a stronger reaction [10].

Secondly, gratitude is inseparable from interpersonal interaction in the social context. The generation of gratitude should first be based on the perception of employees, who must personally feel the vested interests brought by their colleagues or leaders. Secondly, employees should make positive attribution to this perception and attribute the favor to the person who brings the favor [25].

Finally, state gratitude is a positive emotion generated by the positive behavior of others or harmonious environment, which cannot be separated from the support of the organization. Wood confirmed by diary method that employees are more likely to have feelings of gratitude in a warm and harmonious working environment; Hu *et al*. proved that an organizational culture that values cooperation, mutual assistance, fairness and justice and provides organizational support can enhance employees' state gratitude.

2.3.3. The Role of State Gratitude

State Gratitude and Job Performance

Grant and Wrzesniewski found through empirical research that expected state gratitude plays a mediating role in the process of other-oriented adjustment of job performance through core self-evaluation [28]. State gratitude also plays a mediating role in the relationship between perceived superior trust and job engagement, that is, when employees feel the trust of their superiors and have feelings of gratitude, they will have a higher level of job engagement to meet the requirements of their superiors in order to avoid their superiors' disappointment and return the benefits gained from their superiors' trust [29].

State Gratitude and Relationships

Based on the "discovery-remind-binding" theoretical model, Algoe *et al*. showed that state gratitude can effectively enhance and consolidate individual interpersonal relationships [10]. Later, studies have found that employees are more willing to interact with others after receiving goodwill from them in the organization. Gino *et al*. further demonstrated that gratitude will affect individuals' original cognition and judgment of the benefactor, and thus generate some trust in the benefactor [25].

State Gratitude and Social Relationships

Grant and Gino proposed from the perspective of the benefactor that state gratitude affects the prosocial behavior of employees [30], that is, the recipient expresses strong gratitude to the benefactor after receiving help from the benefactor, which enables the benefactor to realize self-worth and encourages the benefactor to continue to carry out prosocial behavior. McCullough *et al*. proposed three moral functions of gratitude, among which the moral incentive function prompts people to exhibit stronger prosocial behaviors [27].

2.4. Working Flow

2.4.1. The Concept of Work Flow

Mihaly Csikszentmihalai, a famous American psychologist, first proposed the concept of "flow" in 1975 and established the flow theory. He believes that flow is a state in which an individual is fully engaged in something and reaches a degree of self-absorption, accompanied by a high degree of excitement and fulfillment [31]. Flow theory emphasizes the integration of behavior and consciousness, concentration and potential sense of control in flow experience, which can not only bring individual satisfaction, but also promote individual self-growth and self-realization [32].

Work flow is the experience generated when an individual is fully engaged in work, and it is the form of

flow in work [10]. Under the experience of work flow, individuals can fully focus on the goal, and have a high sense of competence and control over it. They also ignore the perception of self and time, instead of the integration of self with the goal and environment, which forms a strong internal work driving force and is the best working state for employees.

2.4.2. Influencing Factors of Work Flow

Clear Goals and Immediate Feedback

Mihalai pointed out that mission activities require a set of rules and timely feedback [33]. According to the flow theory, clear and clear goals can help the client establish a clear, focused and logical action system and master the progress and results of the task, so as to promote the client to enter the flow state.

Concentration is the core element of flow, and concentration requires the individual to have a clear goal, but not all goals can form flow. External goals originate from the outside world and induce individuals to perform actions mainly through external incentives. The power source of action does not come from the direct interest of individuals, but the benefits brought by the result of action. According to Mihalai, although extrinsic rewards can bring demand benefits and social benefits to individuals, they cannot promote flow. Flow experiences are possible only when the individual establishes self-directed goals, which means that the individual accomplice something not because of the outcome, but because of the event itself [34].

Focused Attention

Focused attention is a key element of the flow process. The completion of various tasks requires the focus of attention in key links to ensure efficient and high-quality completion of the task. Attention concentration is a continuous process, and employees need long-term training to reach a spontaneous state [35].

However, human attention is limited, and when limited attention is faced with unlimited information, individuals may have internal disorder at the level of consciousness, for which Mihalai put forward the concept of "mental entropy". Mental entropy is the phenomenon that internal disorder occurs when external events conflict with the existing goal intention in individual consciousness [34]. Therefore, when the new event is in harmony with the existing goal intention, the flow experience can be generated, enabling the individual to concentrate on the execution of the current task.

Personal Trait

Studies have shown that individuals with higher expectations of themselves tend to have stronger psychological motivation, will make efforts to achieve self-expectations, and are more likely to obtain flow experience [10].

Balance of Strength and Challenge

How much positive emotion a task can bring depends on its complexity, says Mihalai. The task must be challenging, but within the limits of the person involved. When the individual skill level and challenge have reached a high level and can maintain a relatively balanced state [35], employees can generate a greater sense of self-efficacy and induce flow experience.

External Environment

Based on Mihalai's description of a large number of cases, it can be concluded that flow tends to occur in external environments with fewer distractions, easier focus, and higher comfort levels [33].

2.4.3. The Role of Work Flow

The role of work flow is the result of the mutual adjustment and promotion of cognitive, emotional and behavioral factors [10]. Employees feel satisfaction and gain in the process of completing the task, which promotes the formation of a positive work attitude and behavior of employees, and enables employees to

actively participate in the next task and maintain a state of focus and investment. Xie Qing and You Jie *et al*. showed that gamified teaching can enhance students' learning motivation by inducing flow experience, thus improving learning efficiency [36].

2.5. Chinese Customer Satisfaction Index Model（CCSI）

Customer Satisfaction Index (CSI) is a macro index to measure the quality of economic output and a comprehensive evaluation index of customer satisfaction based on the process of product and service consumption [37].

The CCSI model, namely the Chinese customer Satisfaction Index model, integrates the advantages of the three models of the United States, Sweden and Europe, and combines the specific national conditions of China and the consumption characteristics of Chinese customers to improve, including 7 structural variables and 12 corresponding relationships, with customer satisfaction as the core and customer loyalty as the outcome variable. The antecedent variables are composed of brand image, expected quality, perceived quality and perceived value.

With Chinese characteristics, this model can better measure the customer satisfaction of Chinese enterprise brands, better fit the actual business situation of Chinese enterprises, help enterprises sort out the factors affecting customer satisfaction, formulate a sound business strategy and customer management system, and accelerate the development of Chinese enterprises [38].

3. The Mechanism of Employee Mindfulness on Customer Satisfaction

Customer satisfaction is the true emotional reflection of customers on the products and services provided by the enterprise, and mindfulness can enable employees to adjust their emotions, make them less subject to external interference in a complex environment, focus on the needs and feelings of the current service object, and provide customers with better service in a positive and enthusiastic state, so as to meet customers' expectations on the service provided by the enterprise. This is consistent with the connotation of customer satisfaction [39]. Therefore, employee mindfulness can promote the improvement of customer satisfaction.

Employee mindfulness can promote state gratitude and work flow, give full play to and strengthen the functions of both, stimulate employees' positive emotions, regulate employees' cognitive mode and attitude, and enable employees to generate self-drive from the bottom of their hearts, further externalize into states and actions, voluntarily and proactively invest in work, improve work efficiency and work quality, and provide customers with better service (as shown in Figure 1). Ensure customers' good experience of enterprise products or services and promote the improvement of customer satisfaction.
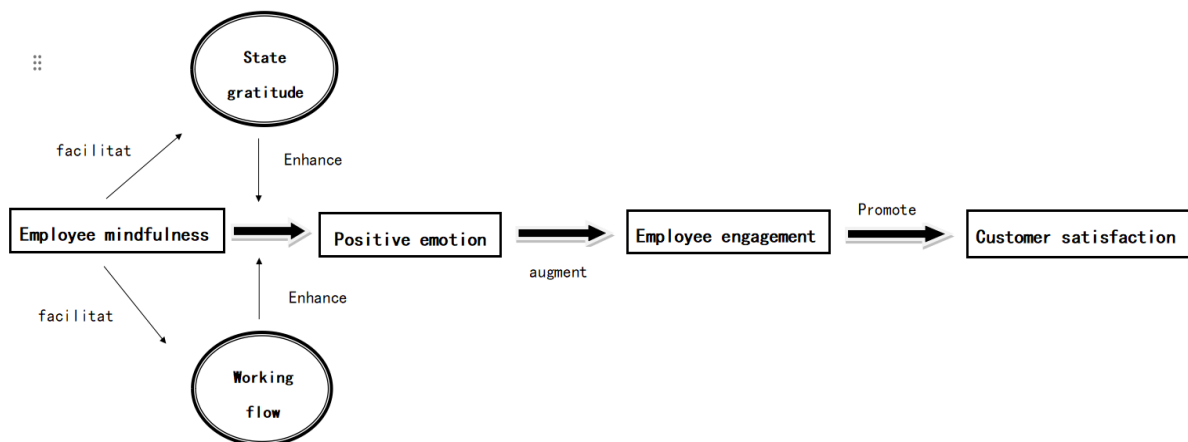
Figure 1. Mechanism of employee mindfulness.

3.1. The Modulating Effect of Positive Emotion

Based on the extended construction theory in positive psychology, it can be seen that positive emotions can

broaden people's thoughts and actions, enabling people to effectively cope with adversity [10]. The accumulation of long-term negative emotional experience will lead to the reduction of employees' initiative and spontaneity in work. As an important factor in social interaction, emotion is generally regarded as a potential mechanism to maintain a benign "employee-customer" relationship [39]. Combined with the theory of emotional infection [40], it can be concluded that mindfulness can promote the positive emotions of employees, deliver positive emotional experience to customers, and trigger customer satisfaction.

3.2. The Moral Role of State Gratitude

State gratitude is generated by employees' perception of superior trust and satisfaction of needs [14], and state gratitude is also a positive moral emotion. Studies have shown that moral emotions affect prosocial tendencies in two main ways, namely guilt and empathy [41]. According to the above analysis, state gratitude belongs to the former, which encourages individuals to improve their moral standards with the help of external situations, thus triggering rewarding behaviors and prosocial tendencies. When employees find that their own behavior is inconsistent with the organization, they will feel guilty because of the organization's commitment, so as to make compensatory behavior and increase their investment in work. State gratitude can not only produce positive work behaviors, but also its subjective positive feelings are conducive to establishing good cooperative relations between employees and customers, promoting interpersonal interaction with customers, and enhancing customer satisfaction.

The theory of moral emotion puts forward three moral functions of state gratitude, among which the function of moral stimulation and reinforcement further proves that state gratitude can stimulate and strengthen employees' behavior of returning to the organization and society. Employee mindfulness has a positive effect on the stimulation and reinforcement of state gratitude.

According to the action path of "event-emotions-behavior" proposed by the affective event theory, the regulating effect of mindfulness on state gratitude can be analyzed. In the "event-emotion" stage, when employees have state gratitude for events in daily life and work, employees with stable mindfulness traits will have a more positive attitude and attitude, and have a strong desire to pursue self-realization, so that they can pay more attention to positive information in daily work, have more intense and frequent feelings of gratitude, and greatly improve the state gratitude level. Promote the transition from state gratitude to trait gratitude, and stimulate powerful positive emotional power. In the "emotion-behavior" stage, employees with mindfulness are more focused and invested in the current work, which enhances the strengthening function of state gratitude, so that employees will not be disturbed by other events in the future, consciously make similar pro-social behaviors, and take the initiative to bring quality service experience to customers.

3.3. The Dynamic Role of Work Flow

From the previous analysis of work flow, it can be seen that the formation of work flow requires clear goals and focused attention, and is closely related to personal characteristics. Self-goal in goal classification is the key to promote long-term stable work flow, and employee mindfulness can help employees generate self-inducement to establish self-goal and form a stable internal driving force. Secondly, focused attention is limited, and employee mindfulness can improve employees' cognitive level, broaden employees' attention and tolerance, enable employees to better eliminate interference, ease the contradiction between new events and existing goals, better focus, promote flow, and thus better engage in work. Employee mindfulness is an internal psychological trait of individuals. Employees with a high level of mindfulness can generate higher self-efficacy and psychological motivation, promote flow experience, and stimulate work engagement.

There is plenty of evidence that improving mindfulness skills can improve flow and performance. For example, Smith & Smilek proposed that mindfulness and flow both focus on present-moment engagement, so mindfulness can promote flow [42]. Fu Linzhu also demonstrated that cultivating mindfulness can increase the chances of experiencing a state of flow [10].

To sum up, employees' mindfulness positively predicts work flow, enhances the generation and experience of work flow, encourages employees to devote themselves to work and enjoy the sense of gain and achievement,

and forms good work results and performance, that is, customer satisfaction level is improved.

4. Conclusion

If an enterprise wants to seek development opportunities in the tide of The Times and break through the obstacles of the waves to achieve healthy and sustainable development, it needs to establish competitive advantages in the outside and form a solid and strong core force of personnel in the inside. According to the current situation that enterprises are facing the turbulent external environment and the platform economy brings new opportunities and challenges, this paper studies the uncertainty and complexity of the external environment and the challenges of internal staff's high pressure, job burnout and low loyalty, and takes employee mindfulness as the core of the solution. Based on the theory of customer satisfaction, this paper explores the internal mechanism of employee mindfulness, explores the role of employee mindfulness in depth, and shows that employee mindfulness has a positive effect on the internal psychology and concept of employees, promotes the positive attitude and behavior of employees, thereby enhancing customer satisfaction and bringing performance to the enterprise.

The action path of employee mindfulness can be summarized as follows: Employee mindfulness promotes the formation of state gratitude and work flow, and the three work together to produce rich positive emotions. Through the moral emotional effect of state gratitude and the work motivation generated by work flow, the cognitive mode and action mechanism of employees are adjusted through the perceptual effect, so as to improve the work engagement of employees and create a positive organizational atmosphere. Promote proactive work attitude and behavior, wholeheartedly provide customers with quality services or products, thereby enhancing customer satisfaction and enterprise market competitiveness. The research results help enterprises to better understand the function path of mindfulness, explore mindfulness training strategies, find the direction and path to optimize products and services, improve the working environment and conditions of employees in new employment forms, enhance their professional identity and loyalty, and then improve the quality of internal management of enterprises, give full play to the vitality and value of employees, and improve customer satisfaction. Establish the external core competitiveness of the enterprise, better cope with risks and challenges, and achieve healthy and sustainable development of the enterprise and employees.

Author Contributions

Conceptualization, Z.L.and H.C.; writing—original draft preparation and writing—review and editing, Z.L.and H.C. All authors have read and agreed to the published version of the manuscript.

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The authors declare no conflict of interest.

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Article

Research on the Mode of E-Commerce Assisting Agricultural Innovation and Entrepreneurship under the Background of Platform Economy—A Case Study of E-Commerce Assisting Farmers in Wenchuan County

Shiqi Liang and Hui Cheng *

School of Economics and Management, Zhaoqing University, Zhaoqing 526061, China

Abstract: This paper takes the case of e-commerce aiding agriculture in Wenchuan County as an example to analyze the specific practices and economic benefits of e-commerce aiding agriculture in Wenchuan County. It is discovered that there exist problems such as backward infrastructure construction, shortage of skilled talents, and insufficient market credibility in e-commerce aiding agriculture in Wenchuan County. According to the innovation theory and in combination with the background of platform economy, this paper puts forward strategies and suggestions such as innovating the supply of industrial space, strengthening the introduction and cultivation of talents, and guaranteeing the quality and safety of agricultural products, with the aim of providing references for the development of rural e-commerce.

Keywords: platform economy; E-commerce to assist agriculture; innovation and entrepreneurship

1. Introduction

In recent years, the state attaches great importance to the development of rural e-commerce, the Ministry of Commerce and other departments issued the "Implementation Opinions on Promoting the High-quality Development of Rural e-commerce" [1], clearly proposed that it will take 5 years to build a rural e-commerce service system with perfect facilities, active subjects, smooth circulation and efficient services, and encourage and support the innovation and development of rural e-commerce. The strategy of rural revitalization is an important strategic goal of China's modernization construction, and an important document points out that rural e-commerce should be rapidly developed. Under the background of the current platform economy, e-commerce is injecting vitality into China's rural revitalization strategy. In 2023, the state further emphasizes the need to vigorously develop rural characteristic agriculture, support e-commerce and express delivery into rural areas, and inject new impetus into the development of rural e-commerce.

With consumers' growing demand for healthy, green and organic agricultural products, the rural e-commerce market has shown great potential for development. Wenchuan County has rich agricultural products resources, such as sweet cherries, green and red crisp plum, etc., which have extremely high market value. The local government has actively responded to the call of the country and made use of the opportunity of "Internet +", through the intelligent and personalized recommendation functions of the e-commerce platform, combined

with strong technical support, to sell high-quality agricultural products to the whole country and even the world, promote sales, help poverty alleviation and prosperity, and has obtained the policy and financial guarantee of national e-commerce into rural comprehensive demonstration county.

E-commerce assisting rural areas as an innovative poverty alleviation model has shown significant meaning in the context of the "Internet+" platform economy. This model broadens the sales channels for agricultural products, directly connects the production chain with consumer needs, effectively resolves supply and demand conflicts, increases farmers' income, and changes agricultural production and rural life. At the same time, e-commerce assisting rural areas drives the development of agricultural product chains, utilizes IoT, smart irrigation, etc. to solve technical application problems, enhances the added value of agricultural products and the level of agricultural modernization, and achieves industrial transformation and upgrading. In the supply chain, e-commerce assisting rural areas reduces intermediate links, optimizes logistics processes, lowers circulation and logistics costs, ensures the quality of agricultural products and accurate and timely delivery, thereby improving the circulation efficiency of agricultural products, reducing product losses and waste, and increasing farmers' income and profits. Furthermore, e-commerce assisting rural areas reduces intermediate links, optimizes logistics processes, and lowers circulation and logistics costs, thereby improving the circulation efficiency of agricultural products. By cooperating with professional logistics companies, it ensures the quality of agricultural products and rationally arranges logistics resources to achieve accurate and timely delivery.

2. Literature Review

2.1. Platform Economy and the Concept of E-Commerce to Aid Agriculture

Platform economy relies on the Internet platform, takes data as the factor and information technology as the driving force, builds a new economic form, and promotes the efficient integration of commodity production and circulation and services. With the development of information technology, the platform economy model has become increasingly powerful and has become a new economic and social organization form. Compared with the traditional industrial economic model, the platform economic model not only represents a higher level of social productivity and technology, but also a brand new economic and social organization form and way. Online shopping and shared travel are typical manifestations of the platform economy's deep penetration into daily life.

E-commerce to help agriculture is a new model of using Internet technology to promote rural economic development, to achieve efficient and convenient online sales of agricultural products. Multiple parties will work together to form a two-way circulation channel and promote the digital transformation and industrial upgrading of the rural economy. E-commerce helps farmers raise their incomes and has become an important way to get rid of poverty in poor rural areas.

### 2.2. Research Status at Home and Abroad

E-commerce assistance to agriculture plays an important role in the context of rural revitalization and platform economy. Existing academic studies on e-commerce assistance to agriculture under platform economy mainly focus on the following four aspects: First, the basic concept and significance of e-commerce to assist agriculture. Wang Haie discussed the application of e-commerce platform in assisting the sale of local characteristic agricultural products, emphasizing the important role [2]. Xiao Xiaoxiao, Fang Lu, Pan Yuxin and Xia Lijun analyzed the development status of rural e-commerce under the background of digital economy, as well as the mechanism and path [3]. Second is the development of e-commerce to help agriculture status quo and challenge, Wang Shanshan to spell a lot as an example, analyzed our country agricultural products e-commerce platform development status and the problems encountered, and put forward the corresponding countermeasures [4]. Ren Juxiang analyzed the development dilemma of agricultural product e-commerce from the perspective of big data, and put forward the corresponding development path [5]. Third, specific practical cases of e-commerce assisting agriculture. Li Xinjie analyzed six problems existing in the development of the cherry industry in Wenchuan County by using questionnaire survey and empirical research method and proposed

targeted solutions, providing new ideas [6]. Guan Jingdong conducted a comprehensive and systematic analysis of the relationship between characteristic agricultural development and rural revitalization in Wenchuan County from three aspects: mechanism innovation, industry integration and collaborative governance, and dug into the factors promoting rural revitalization from different levels. By summarizing the experience and enlightenment of developing characteristic agriculture to help rural revitalization in Wenchuan County, characteristic agriculture can effectively promote the development of rural economy and increase farmers' income, and help rural revitalization and development [7]. Fourthly, explore the innovation mode of e-commerce to assist agriculture. Lei Han, Xin Zihao, Shao Jin, Nie Xing and Wu Yuqi take Hongyan Village, Yu'an District, Lu'an City as an example to explore the new mode of organic combination of education to assist agriculture and industry to assist agriculture. Under the innovative mode of e-commerce to assist agriculture, win-win [8]. Suning analyzes several common agricultural e-commerce models from the perspective of "Internet +", and builds a new model of e-commerce assisting agriculture under the perspective of "Internet +" in order to promote the sustainable development [9].

3. The Current Situation of Agricultural Development in Wenchuan County

3.1. Agricultural Industry in Wenchuan County

Under the promotion of rural revitalization strategy and platform economy, the agricultural output value of Wenchuan County has grown steadily, the industrial structure has been optimized, and agriculture and tourism have developed together. In the first half of 2024, the total output value of agriculture, forestry, animal husbandry and fishery in the region reached 2.65 billion yuan, an increase of 2.0 [10, 11]. Among them, the planting area of Wenchuan specialty sweet cherry reached 27,000 mu, with an annual sales revenue of 600 million yuan [12]. At the same time, Wenchuan pays attention to the cultivation of public brands, and registered the trademark of "healthy and nourishing Wenchuan" for the county's agricultural products (as shown in Figure 1).
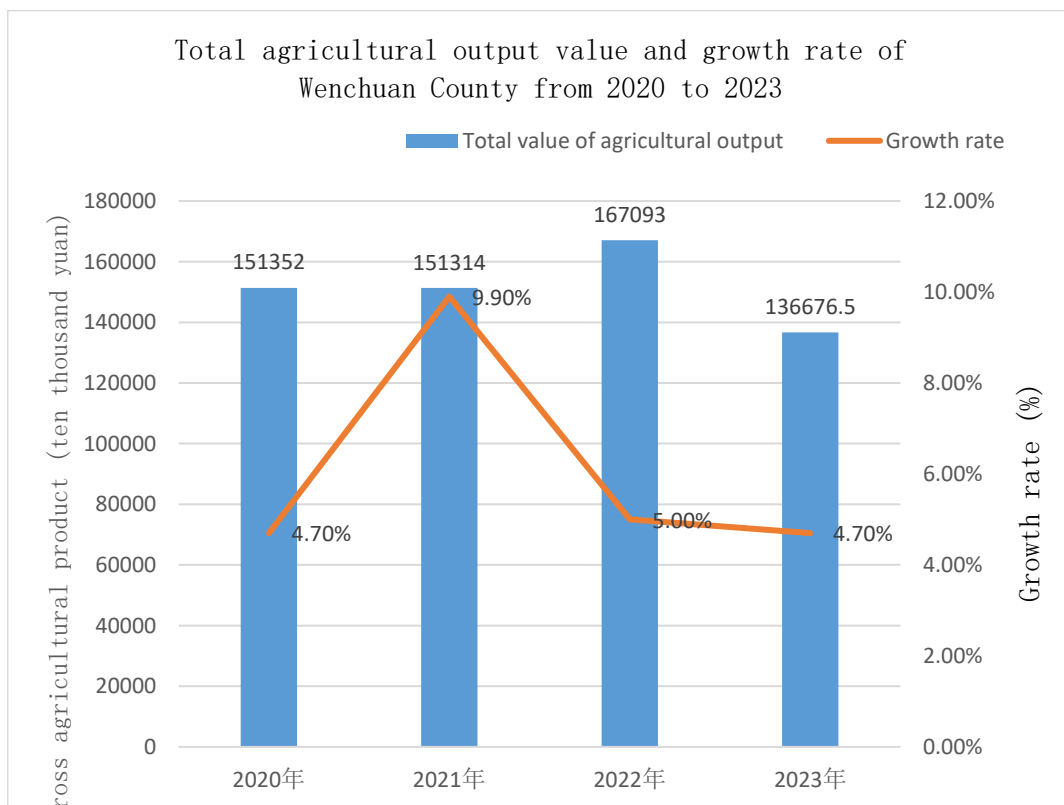
Figure 1. Gross agricultural product and its growth rate in Wenchuan County, 2020−2023. Source: Statistics Bureau of Aba Tibetan and Qiang Autonomous Prefecture.

In terms of industrial investment, Wenchuan county strongly supports family farms and cooperatives,

actively develops facility agriculture, builds greenhouses and intelligent irrigation systems, and improves production efficiency and disaster prevention capacity.

In addition, making full use of its unique natural resources and ecological environment advantages, Wenchuan county has combined agriculture with tourism and promoted the integrated development of the three industries. For example, by holding sweet cherry picking festival and other activities, it has attracted a large number of tourists to experience agricultural production and rural life. During the tour, tourists can taste local specialty agricultural products and purchase them through e-commerce platforms and other channels.

3.2. The Development Status of E-Commerce Assistance to Agriculture in Wenchuan County

In recent years, Wenchuan County has seized the opportunity of "Internet +", taken digital economy as a breakthrough, and actively promoted e-commerce to help agriculture and invigorate agriculture. The government has led, built platforms, attracted talents and innovated models, and achieved remarkable results. From January to July 2024, online retail sales reached 633 million yuan, up 16.12 percent year on year, and featured agricultural products such as sweet cherries were exported to the country [13].

In terms of platform construction, in 2023, the "Wenchuan Guoguo" e-commerce platform jointly built by Wenchuan Green Library and Wenfeng Agriculture, a state-owned enterprise under the county, entered the trial operation stage. The platform was officially launched within a month to achieve 24,000 sales, the average daily order volume is stable at about 3,000, a single delivery mode to handle more than 50,000 business, optimize the delivery process, for fruit farmers to save logistics costs [14].

In terms of government support, the government has issued specific policies in terms of capital, venue, logistics and talent training, provided e-commerce live broadcasting venues and equipment, organized skills training, built learning Bridges, and worked with e-commerce platforms and logistics enterprises to promote agricultural products upward. At the same time, investment in rural network and logistics system construction will be increased to lay the foundation for the development of e-commerce. We will invest 22 million yuan to implement the state-level e-commerce into rural areas project, build a multi-level e-commerce service network, and effectively solve the problem of the last kilometer of agricultural product e-commerce. In addition, the government provides professional e-commerce technical training and exchange activities to improve farmers' practical e-commerce skills and entrepreneurial ability.

In terms of innovative e-commerce development models, Wenchuan County has explored the exemplary model of "e-commerce + market + farmers", developed village-level e-commerce live broadcast demonstration sites, and realized digital empowerment and technological development of agriculture. To create a linkage pattern of "official characteristic museum + entrepreneurs' self-operated outlets", and promote the brand construction of agricultural products. At the same time, online and offline integration will promote sales and expand market access for agricultural products.

4. The Problems and Challenges in the Process of E-Commerce Assisting Agriculture in Wenchuan County

4.1. Backward Infrastructure Construction in Rural Areas

First, network infrastructure is lagging behind. Although the digital platform economy has brought great potential for rural revitalization, the widespread problem of lagging infrastructure construction in rural areas remains the primary challenge [5]. Incomplete broadband network coverage, slow broadband speed, unstable communication signals and imperfect logistics and distribution systems have limited the wide application of digital technologies in rural areas and the in-depth development of e-commerce. This situation has caused a "digital divide" in some rural areas, affecting the orderly promotion of e-commerce to help farmers in rural areas.

Second, transport and logistics infrastructure is lagging behind. The smooth development of e-commerce to assist agricultural activities cannot be separated from solid and reliable transportation as support. The timely and efficient delivery of agricultural products is directly related to the strength of its market competitiveness. However, in some rural areas of Wenchuan County, the maintenance and maintenance of roads and roads are

facing severe challenges. Many rural roads appear different degrees of damage, potholes uneven, which not only seriously affect the efficiency of agricultural products transportation, but also increase the risk of loss in the transportation process, reduce the quality and value of agricultural products. The weak logistics and distribution infrastructure has become a bottleneck restricting the in-depth development of e-commerce to help agriculture.

Third, there is a shortage of e-commerce professionals. Restricted by multiple factors such as geography and economy, the overall talent base is relatively small, and talents with high-level digital skills are scarce. This makes it difficult to select a sufficient number of professionals from the local talent pool when promoting digital construction. The shortage of digital skills has also constrained Wenchuan's ability to innovate in technology. The lack of support from high-end talents has made it difficult for local enterprises to make breakthroughs in technological innovation, resulting in a slow improvement in the overall technological level. In addition, it is difficult for local enterprises to attract and retain high-end digital skills talents, and some talents with digital skills may choose to develop in more developed and promising areas, resulting in a serious loss of local talents. More importantly, although there are a large number of Internet users in Wenchuan County, very few farmers have truly mastered e-commerce related technologies and concepts.

4.2. Consumers' Satisfaction with E-Commerce Agricultural Products Is Not High

Although the rise of rural e-commerce has opened up entirely new sales channels for agricultural products, consumers still face multiple obstacles when building trust in online agricultural products.

First, the freshness of agricultural products is difficult to quantify. When consumers buy agricultural products online, they are not able to directly observe and select products, so there is great uncertainty about the immediate freshness status of agricultural products. This perception gap has become a major psychological barrier for consumers when they buy agricultural products online. Freshness is one of the important indicators to measure the quality of agricultural products, and the lack of intuitive perception makes it difficult for consumers to make accurate judgments when purchasing, which affects their purchase intention and trust.

Secondly, the food safety of agricultural products has always been the focus of consumers' attention. When buying agricultural products online, consumers have doubts about whether the products meet safety standards, whether there are pesticide residues or additive abuse. Due to the variety of sources of agricultural products sold online and the difficulty of supervision, food safety issues have become an important factor restricting the development of rural e-commerce.

4.3. It Is Difficult to Verify the Authenticity of Agricultural Products Received by E-Commerce

There may be differences between the online display and the actual received goods, and the goods are not correct. Due to the low standardization of agricultural products in rural areas, there may be big differences in quality between the same batch of products. In addition, some unscrupulous merchants may mislead consumers by means such as false publicity or falsified product information. All these factors increase consumers' uncertainty about the quality of online agricultural products, which further affects the establishment of trust.

4.4. Imperfect Construction of Industrial Chain

The whole industrial chain of e-commerce agriculture in Wenchuan County is still in the early stage of construction, the relationship between upstream and downstream is not stable, the industrial structure is relatively single, and the lack of necessary linkage links between supporting industries, resulting in agricultural products dominated by traditional categories and low added value.

First of all, the primary processing link of agricultural products is weak, and the deep processing is in a blank state. At present, most of the agricultural products in Wenchuan County adopt the simple mode of instant picking and instant selling. Most of the agricultural products are packaged and sold directly after simple manual screening after picking. Local has not yet established large-scale fruit juice, preserved fruit, fruit wine and other deep processing industrial parks, the development of this field lags behind significantly, limiting the value of agricultural products added space.

Secondly, there is a lack of pre-cooling treatment facilities and a serious shortage of modern equipment such as grading and sorting. The primary processing of agricultural products in Wenchuan County mainly relies on manual operations, and agricultural products such as fruits are easily affected by the external environment due to their high water content, resulting in frequent water loss and decay. This not only affects the sales quality of agricultural products, but also brings no small economic losses to fruit farmers, highlighting the urgent need for agricultural products preservation technology.

Moreover, the homogenization of agricultural products industry tourism projects is serious, and the supporting facilities need to be improved. At present, the tourism projects in Wenchuan County are still dominated by picking experience, and the integration degree with other industries is not high, lacking of characteristics and innovation. For example, in the development and creation of Internet celebrity attractions, they have failed to fully integrate into the local minority culture and cultural landscape, and there are also gaps in publicity strategies, which have failed to achieve deep integration with local characteristic attractions. This not only limits the brand building of Wenchuan agricultural products, but also affects the improvement of its core competitiveness.

4.5. Poor Brand Image Construction

Although Wenchuan County has high-quality agricultural products such as "Wenchuan Sweet cherry" and "Wenchuan crisp Plum", the brand recognition of these products in the market is not high. Some consumers have limited understanding and even misunderstanding of the brand of agricultural products in Wenchuan County, which makes it difficult for the brand to be deeply rooted in the people's heart and affects the market competitiveness of agricultural products.

Due to the lack of support of county regional public brand and enterprise brand, Wenchuan County mainly relies on the "Pure Land Aba" regional public brand of agricultural products, but the degree of promotion of this brand is limited, and fails to give full play to its leading role. On the other hand, some small farmers still adopt traditional planting forms and techniques, lack of brand awareness, hindering the promotion and application of new technologies, affecting the overall planting level and brand shaping.

In Wenchuan County, the publicity is limited to the traditional advertisement, the publicity is insufficient, the publicity method is single, and the communication strategy of innovation and differentiation is lacking. In terms of brand homogenization of agricultural products, there are a wide variety of agricultural products, but they lack characteristics and differentiation. Some agricultural products lack innovative and personalized elements in packaging, design and other aspects, and strong brand endorsement and effective marketing strategies, making it difficult for many high-quality agricultural products to get out and attract consumers' attention.

5. Optimize the Path and Suggestions

5.1. Increase Government Support and Provide Business Incubation

Firstly, establish a comprehensive e-commerce industrial park. Integrate e-commerce resources in Wenchuan County, form a three-level e-commerce network at the county, township, and village levels, optimize logistics, and reduce costs. Build an industrial park that integrates live streaming, logistics, processing, exhibition and sales functions, attract well-known e-commerce platforms and enterprises to settle in, and promote the deep processing and industrial upgrading of agricultural products.

Secondly, improve the agricultural product supply chain system. Establish a traceability system for agricultural products, collaborate with research institutions to develop traceability technologies, reduce costs, optimize supply chains, ensure product quality and safety, build a one-stop live streaming e-commerce base, and provide comprehensive services for live streaming e-commerce.

The government invests in the construction of high standard live streaming bases, introduces professional teams, and provides one-stop services. Cooperate with universities and training institutions to cultivate live streaming talents, provide internship and employment opportunities, and obtain financial support and reduce

operating costs through cooperative sharing and other means. Through the "Internet celebrity live streaming+ short video+e-commerce" model, promote high-quality agricultural products in Wenchuan County, while introducing other high-quality products, enriching live streaming content, and expanding brand influence.

5.2. Establish a Normal Non-Inductive Supervision System

Utilize big data, cloud computing, and AI technology to build a data-driven, normalized, and seamless regulatory mechanism. Firstly, establish a live streaming e-commerce database to accurately grasp industry trends, clarify regulatory priorities, strengthen interdepartmental cooperation, share data resources, establish an information update mechanism, and ensure real-time data. Secondly, achieve deep integration between live streaming e-commerce platforms and intelligent supervision systems, by capturing real-time online data and intelligently flowing offline data back, to achieve 24/7, non intrusive supervision, and improve the efficiency and accuracy of investigation and punishment. At the same time, introducing a credit evaluation mechanism and using flexible regulatory measures to guide live streaming e-commerce entities to operate in compliance, participate in industry self-discipline, and create a fair market environment. Finally, keeping up with the new trends in the consumer sector, strengthening the construction of regulatory teams, utilizing digital platform resources to conduct online training, enhancing professional competence, and effectively responding to new challenges.

5.3. Strengthen the Introduction and Training of Talents

The first priority is to improve talent treatment and establish incentive mechanisms. Optimize treatment, enhance talent's sense of belonging and loyalty, stimulate innovation vitality, and drive industrial upgrading. Establish a system for commending and rewarding outstanding talents, provide competitive compensation and benefits, build a fair promotion channel, strengthen corporate culture construction, and stimulate innovation enthusiasm and work motivation. Attract and stabilize high-level talents, especially information technology talents, help the development of the "Internet plus agricultural products" model, solve technical problems, and promote the e-commerce process of agricultural products.

Secondly, it is necessary to strengthen the education and training of e-commerce professional knowledge. Increase investment in talent education, utilize online resources to provide diversified learning paths, such as case analysis and practical operation, vocational skills training, online distance education, broaden knowledge horizons, and enhance practical abilities. Collaborate with universities and research institutions to introduce cutting-edge technologies and management concepts.

5.4. Personalized Services to Ensure the Quality and Safety of Agricultural Products

Firstly, develop an e-commerce+agricultural product adoption model. Shorten the distance between agricultural products and consumers, provide a unique sense of participation and experience, endow agricultural products with emotional value and cultural connotation, achieve seamless connection from the field to the dining table, and promote the deep integration of agriculture and e-commerce.

Second, explore and develop the Internet plus visual agriculture model. By utilizing cutting-edge technology to fully showcase the growth process of agricultural products, we can not only reduce management costs but also strengthen quality and safety assurance, reshaping consumer confidence. Stimulate the long-term futures order effect, meet consumers' demand for food safety, and achieve full transparency. Establish a consumer feedback mechanism to promptly address and resolve consumer issues

5.5. Strengthen Supervision over the Quality and Safety of Agricultural Products

The first step is to further improve the regulatory system. Establish a sound regulatory framework for agricultural product quality and safety, strengthen interdepartmental cooperation, establish an information sharing mechanism, clarify responsibilities, strengthen supervision of production, processing, and sales processes, strictly investigate and punish illegal activities, establish a traceability system, and ensure that

problematic products can be recalled in a timely manner.

The second is to promote the certification of agricultural product quality. Promote agricultural product quality certification, establish unified standards, encourage enterprises to adopt advanced technology to improve quality, ensure fair and effective certification, and enhance consumer trust.

The third is to improve logistics efficiency and optimize the preservation process of agricultural products. Promote advanced preservation technologies, optimize logistics network layout, improve packaging and logistics systems, shorten the time from production to consumers, ensure the freshness and safety of agricultural products, strengthen logistics supervision, and prevent pollution and damage.

6. Conclusions and Prospects

6.1. Conclusion

Through the in-depth exploration and practical research of e-commerce assistance to agriculture in Wenchuan County, this paper systematically analyzes the innovation and entrepreneurship mode of e-commerce assistance to agriculture under the platform economy and its significance. The research found that with its rich agricultural resources and the determination to actively respond to the national rural revitalization strategy, Wenchuan County successfully realized the precision marketing, intelligent warehousing and efficient logistics of agricultural products through the support of e-commerce platform and technology, broke the geographical restrictions, broadened the sales channels of agricultural products, effectively promoted the sales of agricultural products, and helped local villagers get rid of poverty and get rich. The practical exploration of e-commerce assistance to agriculture in Wenchuan County has achieved remarkable results, which not only promoted the sales of agricultural products and the economic income of farmers, but also promoted the process of agricultural modernization and rural revitalization. As a new mode of rural economic development, e-commerce assistance to agriculture has broad development prospects and important strategic significance.

6.2. Prospect

With the continuous evolution of platform economy and the continuous deepening of the implementation of the country's rural revitalization strategy, e-commerce will usher in broader development space and unprecedented opportunities. At present, the development of e-commerce assistance to agriculture in Wenchuan County is moving steadily towards the direction of modernization and industrialization. In the face of the continuous progress of platform economy and the rapid development of science and technology, the development of e-commerce agriculture in Wenchuan County needs to constantly adapt to market demand, continue to innovate and improve the e-commerce innovation and entrepreneurship model, in order to further expand the sales channels and market space of agricultural products. On the one hand, it is necessary to increase investment in e-commerce infrastructure, further improve the network, transportation and logistics infrastructure in rural areas, and provide more convenient and efficient support for e-commerce to assist agriculture. On the other hand, it is necessary to actively introduce and train more high-quality e-commerce talents, strengthen brand building and market promotion of agricultural products, and enhance the visibility and reputation of agricultural products.

Author Contributions

Conceptualization, data collection, analysis, S.L. and H.C.; writing—original draft preparation, S.L. and H.C.; writing—review and editing, S.L. and H.C. All of the authors read and agreed to the published the final manuscript.

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Article

The Influence of Acculturation on the Sense of Gain of International Students in China: Perspective from Indonesia Students

Baby Natasia Chandrinova

School of Economics and Management, Qingdao University of Science and Technology, Qingdao266061, China

Abstract: Before the outbreak, statistical data from 2016 revealed that China was the third most significant global destination for international students by hosting 442,773 individuals. By 2018, this number had risen to 492,185, representing a 10.49 % increase from the previous year. Indonesia is notably among the top ten countries contributing to this demographic, with its students comprising 3.06% of the international student body in Chinese universities. The divergent cultural norms and academic expectations between China and Indonesia are anticipated to engender a unique form of acculturative stress among these international students. In the context of the perceived sense of gain among international students, certain scholars posit that these individuals are more predisposed to developing proficient mastery skills, which means that the sense of gain often facilitates the acquisition of new knowledge, thereby establishing a positive feedback loop associated with factors pertinent to college students' acculturation or cross-cultural adaptation. This study examines the influence of acculturation on the sense of gain experienced by Indonesian international students. This paper investigates how Indonesian international students' sense of gain was impacted by acculturation. For the sense of gain or satisfaction factor, the author will employ four variables in this study: satisfaction, psychological, social, and local culture. The data was analyzed using SPSS 26, which indicates that every independent variable is positive.

Keywords: acculturation; cross-cultural adaptability; sense of gain; Indonesia international students

1. Introduction

Beginning in early 2020, the COVID-19 epidemic has significantly influenced the evolution of higher education in several ways, including the transition from in-person to online instruction, the postponement of athletic events, and the emergence of a "new normal" in higher education [1]. The epidemic has significantly diminished international student mobility but has also changed. Higher education now faces several issues related to teaching, learning, research cooperation, and institutional governance.

Many students worldwide study abroad to further their education and enhance their lives. Before the rise of COVID-19, more than 400,000 overseas students studied in China during the 2003–2017 school year. These international students from around the globe encounter various challenges when acclimating to the culture of their new country, particularly in the initial years of their stay. International students may find it challenging or frightening to develop a sense of accomplishment in a new cultural setting since they live far from their home countries in China and because of the many obstacles posed by cultural differences. As a result, when

international students move from one culture to another, they may encounter particular difficulties that locals cannot even fathom [2,3].

"Uprooting disorder" refers to the recognized psychological symptoms of alienation, loneliness, nostalgia, despair, and helplessness that international students encounter as a result of migrating. International students face various emotional challenges, cultural shock, and cultural differences, such as cuisine, climate, language, communication methods, values, customs, speed of life, etc. [4].

The data report from the Indonesian Embassy in China indicates that $14,233$ Indonesian students are enrolled in educational institutions in China. Indonesian overseas students in China may encounter distinct acculturation pressures owing to the divergent cultural norms and academic expectations of Indonesian and Chinese societies [5].

Upon entering a new country, international students must confront many adjustment challenges within an unfamiliar social and academic context. These issues may encompass challenges in language and communication, housing and accommodation difficulties, adaptation to diverse cuisines and flavors, climatic variations, and obstacles in forming social connections. The academic achievement of overseas students may be influenced by their capacity to manage these challenges. It is logical to expect kids with superior adjustment abilities to exhibit more extraordinary academic achievement than their less adaptable counterparts. Cultural adjustment is crucial for completing overseas students' educational programs [6].

At the Central Leading Group for Comprehensively Deepening Reform's tenth meeting, the term "sense of gain" was first proposed. It was once again stressed in the report of the 19th National Congress of the Communist Party of China to "ensure that all the people have a greater sense of gain in the joint construction and shared development." In recent years, the word "sense of gain" has come to mean contentment, happiness, and security. People's wants, fulfillment, and life experiences are frequently evaluated using happiness, a sense of security, and satisfaction. The sensation of gain plays a vital role in the development of society and people. Nonetheless, there is a shortage of studies on the perception of gain.

A comprehensive analysis of the cross-cultural communication experiences of Indonesian students in China highlights the challenges in adapting to the local culture, including language barriers and differences in social norms. It also highlights the strategies they employ to cope with cultural shock and the importance of language skills and cultural intelligence in cultural adaptation [7]. Understanding the cross-cultural adaption elements that might contribute to international students' sense of gain is necessary because they are integral to the institution [8].

To assist international students in completing their academic programs, higher education institutions should be aware of the challenges they confront. Thus, this paper investigates how cultural adaptation and international students' sense of gain, particularly for Indonesian students, are affected. International students' perception of gain was significantly correlated with cultural adjustment. In light of the importance of research on Indonesian international students mentioned above, I aim to examine potential elements that may influence the acculturation of international students about their sense of gain. The outcome or dependent variable will be Satisfaction or Sense of Gain. The author will examine four factors in the present study: (a) Psychological dimension, (b) Social life dimension, (c) Local culture Dimension, and (d) Satisfaction (Sense of Gain) Dimension. The research questions and hypotheses concentrated on the influence of each element on the result variable.

Research Question

Do acculturation factors (Psychological, Social Life, and Local Culture) influence Indonesian students' Sense of Gain?

Hypothesis:

1. It is predicted that the psychological variable's acculturation factor has significantly influenced Indonesian students' Sense of Gain. *h1a*

2. It is predicted that the social life variable's acculturation factor has significantly influenced Indonesian students' Sense of Gain. *h1b*

3. It is predicted that the local culture variable's acculturation factor has significantly influenced Indonesian

students' Sense of Gain. *h1c*

2. Review of Literature

2.1. Acculturation or Cross-Cultural Adaptation

At first, acculturation was thought to be a one-dimensional process exclusive to migrants. It was believed that those entering the new culture would reject their personal views and embrace those of the new society [9]. The process that occurs when two or more cultures come into contact for an extended time is called acculturation [10, 11]. Acculturation does not imply that a person would instantly abandon their cultural background, values, beliefs, and customs. Although not always evident, acculturation can be recognized as a visible process. Contact between two or more cultural groups and their members may be described as a twofold cultural and psychological transformation [12].

International students pursuing education in China successfully integrate into the culture. However, acculturation may have beneficial or destructive repercussions, depending on the culture being altered. In the normative framework, political domination indicates that one cultural group is complacent in a position of superiority and suggests that a group is in a position of power [13]. Acculturation may be more difficult since international students are followers rather than creators of cultural norms. Therefore, they must adhere to social standards rather than establish them. For instance, international students who have been educated differently their entire lives may find that the teaching methods of the new culture are very different. This is a process that international students must go through [14].

Psychological adjustment and sociocultural adjustment are two essential aspects of cross-cultural adaptation. The perceived levels of contentment and happiness are called psychological adjustment. Several elements will impact psychological adjustment, including pressure, local friends, life changes, attitude toward contacts with local friends, and other personal traits [15]. On the other hand, social learning theory serves as the foundation for sociocultural adjustment elements. Thus, they incorporate evaluations based on the models and foundations of interactions, including duration of residency, cross-cultural contact, cultural distance, and prior cross-cultural experiences [16].

The connection between the sense of gain and cross-cultural adaption of international students, the linguistic proficiency gained via studying overseas, and how they influence one another. Studying and researching health and emotions, relationships with others, local culture, and financial circumstances are among the elements of the scale [17].

2.2. Sense of Gain or Satisfaction

The sense of gain represents people's desire for a better existence and incorporates the idea of being people-centered. The feeling of acquisition is comparable to some of the most often used concepts in foreign social governance, such as subjective quality of life and well-being. The term sense of acquisition describes the favorable psychological reactions people experience due to acquisition [18]. A sense of acquisition is both tangible and intangible, spiritual and material. For me, the sense of acquisition stresses a genuine acquisition based on being and alludes to the long-lasting happiness that comes from achieving the material and spiritual level [19].

However, in foreign studies, related vocabulary concepts describe the sense of gains, such as quality of life or life satisfaction and subjective happiness (subjective well-being), and other ideas similar to the meaning of the sense of gain that refer to cross-cultural adaptation in psychological adjustment. Life satisfaction is the overall evaluation of the quality of life in their fields, such as family and social environment, within a certain period according to their standards. Subjective happiness is a cognitive evaluation of people's life satisfaction. These concepts related to the sense of gain can inspire the definition of the sense of acquisition concept.

The sensation of meeting one's wants is the sense of acquisition intimately tied to human needs on several levels. Other groups have different demands because of the circumstances and peculiarities of the group. The criteria fluctuate. Therefore, the sensation of acquisition varies even when the same group is present at various

periods. Happiness requires hard work and active engagement; it does not appear out of nowhere or be bestowed by others [20].

The sensation of acquisition may frequently encourage the acquisition of new knowledge and create a positive feedback loop since some research suggests that students with a sense of gain are more likely to have a pleasant learning experience. Students feel they have gained more knowledge and skills, can reach their full potential, respect and develop their personalities, have a strong sense of social responsibility and good moral character, have harmonious interpersonal relationships, a healthy mind, and nature, and are generally satisfied with their university education. Students' subjective psychological perception of their learning information and skills is the primary source of their sense of gain when seen through the lens of their educational experience [21].

According to an analysis of a survey on students' sense of gain at private universities, the term "student sense of gain" refers to the time spent studying because the educational services the institution offers satisfy the needs of the students' lives and studies. The opportunity to participate was acquired, and the students received recognition for their accomplishments, which resulted in a positive, all-encompassing psychological feeling [22].

3. Research Methodology

This section describes the research strategy employed to investigate the experiences of Indonesian international students. It covers the participants, materials, data collection procedures, operationalization, and theoretical framework.

3.1. Participants

Respondents were international students currently studying in China and international students who had some semesters in China before the outbreak cause the students cannot continue their studies in China or take classes with the online method but have some direct experiences while studying in China. They must know the initial introduction to university life in China

3.2. Materials

The materials used in this research were a small-scale questionnaire. The questionnaire was divided into Part A and Part B. Part A contained the respondent's data. The respondents provided demographic characteristics information, including their age, gender, major, religion, status, etc. Part B is divided into four sections: Section A related to respondent experiences in studying and researching while in universities or respondent or sense of gain (Satisfaction Dimension), section B on health and emotional situation issues (Psychological Dimension), and section C related to respondent social life concerns (Social Dimension), section D on adaptation experience to local culture issues (Local Culture Dimension). The Likert Scale employed a $1-5$ point system with the following designations: 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree. These were intended to appeal to psychological adjustment, acculturation adaption, and sense of gain. The Likert scale permitted a nuanced answer and could have implied that extremes are acceptable, particularly in societies that place a higher value on harmony than criticism. The questionnaire's main goal was to gather data for an analysis of how cross-cultural adaptation, or acculturation, affects Indonesian international students' sense of gain.

3.3. Data Collection Procedure

Chain referrals were initially employed to increase student involvement in the electronic survey forms. I invited my close friends who fulfill all the prerequisites for Indonesian international students, both undergraduate and graduate, to participate and connect with their friends who were also Indonesian international students. The focus group comprises international undergraduate and postgraduate students from Indonesia who are now enrolled full-time at universities in China. To guarantee the integrity of the data, each international student was required to fulfill particular criteria for participation. Students now in China or who have previously studied in China may reside on-campus or off-campus to participate, and 40 replies were gathered from the

computerized questionnaires and using SPSS 26 to do the analysis data.

3.4. Operationalization

To assess stress related to food norms among students who have studied or are currently studying on campus, I inquired about the availability of their cultural cuisines both on- and off-campus, their preferences for the available food alternatives, and their desire to experience the local cuisine. To assess language skills, I inquired whether the participant felt at ease conversing in Mandarin with native speakers, comprehending course subjects, grasping slang, and requesting a self-assessment of their Mandarin proficiency level. I inquired if the participants understood the region's social norms, nonverbal cues, and modes of interaction according to these norms. These inquiries provide a solid foundation for comprehending the students' perceptions of their acculturation.

3.5. Theoretical Framework

Description:

x1 = Psychological Dimension

x2 = Social Life Dimension

x3 = Local Culture Dimension

y = Satisfaction (Sense of Gain)

4. Results and Analysis

4.1. Data Analysis

Forty students participated in the poll over three weeks. Table 1 displays the demographic details of the pupils. The original sample included 72.5% undergraduate students and 27.5% graduate students. The participants' average age was 23. Ninety percent of the students were unmarried, and the majority (55%) were female. In contrast, most students have 45% HSK IV competency in linguistic proficiency (HSK).

An online questionnaire was used as the survey method in this qualitative investigation. Four categories are included in the questionnaire: psychological, social life, local culture, and satisfaction (or feeling of gaining something). Every dimension has a few components. This survey was completed by all international students,

Table 1. Surveyed International Students' Demographic Details.

Characteristics		Number	Percentage
Gender	Female	22	55.0
	Male	18	45.0
Age	17–25 years old	31	77.5
	25–35 years old	9	22.5
Degree Category	Undergraduate	29	72.5
	Postgraduate	11	27.5
Marital Status	Single	36	90.0
	Engaged	3	7.5
	Married-With Childre	1	2.5
Language Proficiency	HSK I	1	2.5
	HSK III	1	2.5
	HSK IV	18	45.0
	HSK V	16	40.0
	No	4	10.0

Source: Processed data.

with a 100% return rate (N = 40). Several conclusions may be drawn from the four aspects noticed after distributing the questionnaire. Table 2 lists the dimensions: psychological, social life, local culture, and satisfaction.

Table 2. Dimensions and items of the adaptation.

No.	Dimensions	Items	1	2	3	4	5
1		I have been happy since the first time I studied in China.	1	2	5	14	18
2		I feel satisfied with my study in China.	1	0	6	12	21
3		I am satisfied with my current situation.	7	1	13	16	3
4	Satisfaction Dimension	I am satisfied with the result of my study.	2	2	10	17	9
5		I understand the study easily.	1	4	16	13	6
6		I have precise pursuits or goals for the future.	1	2	12	18	7
7		I am very satisfied with the teaching activities arranged by the school.	1	5	13	12	9
8		I am satisfied with the teaching staff of my university.	1	2	12	19	6
9		I have had good health since the first time I came to China.	1	1	7	12	19
10		I have had good health recently.	1	1	7	14	17
11		I do not feel anxious about the weather.	1	2	8	21	8
12	Psychological Dimension	I have a stable mood.	1	2	14	16	7
13		I do not often feel homesick.	4	4	9	13	10
14		I can concentrate well when doing something.	3	0	10	19	8
15		I can sleep well.	1	5	7	11	16
16		I am confident about my future	2	1	16	13	8
17		I have many local friends.	2	4	16	10	8
18		I have many friends from other countries.	2	4	8	19	7
19		I often get along with many local friends.	4	4	17	9	6
20	Social Dimention	I do not have difficulty communicating with local people.	1	3	11	16	9
21		I can communicate well with the lecturers.	1	1	12	17	9
22		I like to join many campus activities.	1	2	14	16	7
23		I like how Chinese people have a good way of making friends.	1	0	13	20	6
24		I prefer to make friends with students from the same country.	2	7	17	9	5
25		I understand and can integrate Chinese culture into my life.	0	0	12	17	11
26		Although I am a foreigner, I have integrated into the local life.	1	0	9	22	8
27		I can easily participate in Chinese cultural activities.	1	2	6	21	10
28	Local Culture Dimention	Chinese people are friendly, even to a foreigner like me.	1	1	10	17	11
29		I eat Chinese food more often than my country's food daily.	2	4	8	15	11
30		I like to eat Chinese food on or off campus.	2	1	7	13	17
31		I like the climate in the city where I live.	3	3	7	17	10
32		I can adapt well to the weather and season in China.	1	1	10	15	13

Source: Processed data.

The participants expressed satisfaction with their education in China and the classroom learning experience. Of all the respondents, 16 concur that they are delighted with their recent research. Nonetheless, from the start of the survey, 18 respondents were content. 13 also said they could comprehend the lecture during the learning process. Nevertheless, 17 respondents expressed satisfaction with their research's outcome.

The participant's perception of a sense of happiness or sense of gain from their research may be influenced by a few things. Lecturers generally understand overseas students' issues and are patient while instructing them. Due to their varied educational backgrounds, local and international students also have distinct learning standards. Additionally, they are frequently included in group discussions by local students in the same class. However, because students must adjust to the Indonesian educational system, few have been content from the start of their studies.

Participants in the psychological component, which comes next, show little signs of anxiousness. They stated that their health has been generally excellent lately despite the differing seasons in China and Indonesia, especially when they first moved to China. They can convert China's four seasons—autumn, spring, winter, and summer—into two distinct seasons: dry and wet. This might be a result of Indonesian seasons being milder than Chinese ones. In contrast, only one responder disclosed mentally that they experience mood swings. Additionally, they seldom experience homesickness.

The participants mentioned similar issues about the social life factor. They can readily join in the everyday discourse with local pupils despite not indicating any problem interacting with locals. Since overseas students have acquired Mandarin and English, there are no issues with any language.

This study also noted a local cultural feature due to the cultural variations between China and Indonesia. According to 17 respondents, they can comprehend and incorporate Indonesian culture into everyday life. The friendliness of Chinese people is one cause. This makes it easier for them to fit in with Chinese culture. They frequently participate in Chinese cultural events.

A questionnaire with a Likert scale score of 1–5 is used to gather data. Test the research tool using reliability (Cronbach alpha) and validity (product-moment Pearson correlation) tests. The multicollinearity, autocorrelation, heteroscedasticity, and normalcy tests were all employed in the traditional assumption test. Using multiple linear regression analysis, the hypothesis is being tested concurrently. Using the following formula, this study examines how the independent variables—psychological, social life, and local culture—affect the dependent variable or sense of gain

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + e$$

Description:

Y = Sense of Gain

A = Constant

X_1, X_2, X_3 = Psychological, social life and local culture

$b_{1,2,3}$ = Regression coefficient

e = Error

Data was analyzed using the Statistical Package for Social Sciences (SPSS-26). The product-moment Pearson correlation validity test is valid since the research instrument is practicable when the p-value is less than 0.05. Cronbach's alpha score > 0.60 indicates reliability for the psychological variable (0.828), social life variable (0.811), local culture variable (0.883), and satisfaction variable (0.867).

Hypothesis testing is now possible because all of the classic assumption tests—the multicollinearity, autocorrelation, heteroscedasticity, and normalcy tests are passed.

4.2. Test Results

Beta Test

The values for the psychological, social life and local culture dimensions are 0.272, 0.576, and 0.232, respectively, while constant (a) in column B of the coefficient table is −2.125. To write the regression/equation model (as shown in Table 3). The perception of gain is primarily influenced by social life, which is the largest. Following hypothesis testing, the following regression equation was created for this study model:

Y = a+b X1+b X2+b X3 + e

Y = −2.125 + 0.272 X1+ 0.576 X2 + 0.232 X3 + 2.954 (e = from Std. Error)

Table 3. Multiple Linear Regression Test Results.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	−2.125	3.108		−0.683	0.499		
Psychological imention	0.272	0.109	0.264	2.507	0.017	0.609	1.642
Social Life Dimention	0.576	0.119	0.525	4.843	0.000	0.575	1.739
Local Culture Dimention	0.232	0.101	0.234	2.299	0.027	0.653	1.531

[a] Dependent Variable: Satisfaction (Sense of Gain) Dimention. Source: Processed data.

The regression coefficient's value does not show the algebraic sign, whether it is positive or negative. Nevertheless, it indicates the relationship's direction or, to put it more clearly, how the independent variable affects the dependent variable. When the B value is positive, the value of the dependent variable is positively impacted by the independent variable. Conversely, the negative B value indicates that the independent variable has a negative impact on the dependent variable's value.

The negative constant value of −2.125 indicates the independent variable's detrimental influence. If the independent variable rises or influences one unit, the Sense of Gain variable will fall or be satisfied.

For every unit increase in the psychological variable regression coefficient of 0.272, the sense of gain will rise by 0.272, or 27.2%. Similarly, the local culture and social life variables will increase by 23.2% and 57.6%, respectively.

Measuring Multicollinearity

The VIF value must be less than 10, and the tolerance value with the provisions must be greater than 0.1. Based on the results, the regression model does not contain multicollinearity. The VIF and all independent variables, including tolerance, meet these requirements.

t Test

The psychological variable t has a value of 2.507 and a significance level of 0.017, which is less than 0.050. This indicates a substantial influence on the sense of gain; hence, h1a is supported.

The Social Life variable t has a value of 4.843 and a significance level of 0.000, less than 0.050, indicating a significant partial effect on the perception of gain; hence, h1b is supported.

The local Culture variable t has a value of 2.299, with a significance level of 0.027, which is less than 0.050. This indicates a substantial partial or individual effect on the sensation of gain; hence, h1c is supported.

Table 4 above explains the coefficient of determination resulting from squaring R and the correlation value (R) size, which is 0.870. It also shows the proportion of effect that the independent variable has on the dependent variable. According to the result, the independent variable has a 75.7% impact on the dependent variable, with a coefficient of determination (R2) of 0.757. In contrast, various factors affect the remaining 24.3%.

Table 4. R Square Value Results.

Model	R	R Square	Adjusted R Square	Std. Error of The Estimate
1	0.870[a]	0.757	0.737	2.95405

[a] Dependent Variable: Satisfaction (Sense of Gain) Dimention. [b] Predictors: (Constant), Local Culture Dimention, Psychological Dimention, Social Life Dimention. Source: Processed data.

Describe if the independent factors have a substantial impact on the dependent variable. The results show that the regression model may be used to forecast that the Sense of Gain variable has an influence (H1

supported) with the computed F = 37,389 at a significance/probability threshold of 0.000 < 0.050 (as shown in Table 5).

Table 5. F Test Results.

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	978.824	3	326.275	37.389	0.000[b]
Residual	314.151	36	8.726		
Total	1292.975	39			

[a] Predictors: (Constant), Local Culture Dimention, Psychological Dimention, Social Life Dimention. [b] Dependent Variable: Satisfaction (Sense of Gain) Dimention. Source: Processed data.

5. Conclusion and Suggestions

5.1. Conclusion

Based on the results and analysis, international students' sense of gain about the social life component is the greatest of the three aspects this study examined. The primary causes are the frequency with which overseas students get along with local students and the gap in their socialization. The regional cultural dimension, on the other hand, receives the lowest adaption score. The native language, traditional performances, cuisine, and other aspects of Chinese culture are all included in this dimension.

All higher education institutions are often required to focus on the primary goal of globalization, which is to make international students feel welcome at their schools due to the process. The results indicated that the rate of cultural adaption for overseas students is modest and improving with time. The different learning atmosphere, the teacher's uncooperative demeanor, the unclear teaching methods, and the administrative staff's lack of focus are all issues for international students. The study's findings also showed that international students are satisfied with the general university atmosphere and the excellent behavior of Indonesian students, both of which are crucial for assuring their cultural adjustment. The correlation coefficient's results showed a strong link between international students' sense of gain or satisfaction and their level of cultural adaption.

5.2. Limitations

Additionally, because this study only included a limited sample of Indonesia international students, it might not be able to represent the experiences of international students among Indonesian students accurately.

5.3. Suggestions

The influence of acculturation on the sense of gain of Indonesian international students in China has significant implications for higher education institutions and policymakers. Here are some key considerations:

1. Cultural Adaptation Programs

Institutions can implement orientation programs that focus on helping international students understand and navigate cultural and academic differences. Tailoring these programs to address common cultural gaps, particularly between Indonesian and Chinese cultural norms, may ease students' transition and improve their sense of belonging and academic confidence. These programs should include language training, cultural workshops, and social integration activities to facilitate smoother acculturation. Universities can collaborate with student organizations, cultural centers, and local communities to offer a range of cultural experiences and support networks.

2. Support Services

Psychological Support: Psychological adjustment is a key factor influencing students' sense of gain, so universities might consider expanding mental health services with culturally sensitive counseling. Employing counselors familiar with Indonesian students' specific challenges could help alleviate acculturative stress, promoting well-being and academic success.

Academic Support: Providing academic advising and tutoring services tailored to Indonesian students' needs can enhance their academic performance and sense of achievement.

3. Social or Community Building

Fostering interaction between international and local students through structured activities, such as language exchange programs, peer mentorships, and social events, encouraging the formation of international student organizations and clubs, organizing cultural events and festivals can celebrate their country heritage while promoting cultural exchange and understanding among students from different backgrounds may significantly impact students' social satisfaction. These interactions can reduce isolation, help international students build support networks, and encourage smoother cultural adaptation, all contributing to an enhanced sense of gain.

4. Funding for Support Services

Policymakers may need to consider financial support for universities to develop targeted programs for international students, such as language and culture immersion classes or scholarships that incentivize participation in cultural adaptation initiatives. Adequate funding would enable universities to build robust support systems essential for student satisfaction and academic success.

5. Policies on Intercultural Competence Development

Encouraging universities to adopt frameworks that promote intercultural competence within their curriculums could prepare students for cross-cultural academic environments. This emphasis on intercultural skills could benefit international and domestic students, fostering a mutually respectful and inclusive campus culture.

6. Evaluation of Acculturation Outcomes

Developing policies that require universities to monitor and report on acculturation outcomes for international students could enhance the accountability and effectiveness of these programs. Such data would provide insights into areas needing improvement and help policymakers and institutions assess the overall impact on students' academic and personal growth.

Since acculturation is a significant predictor of a greater sense of gain for international students, combined efforts may be undertaken to reduce adjustment-related concerns for these students. Future research must also observe more samples to gauge the sensation of benefit experienced by overseas students.

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The author declares no conflict of interest.

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Article

Enhancing Industrial Management through AI Integration: A Comprehensive Review of Risk Assessment, Machine Learning Applications, and Data-Driven Strategies

Tian Tian [1,*], Sihan Jia [2], Jindi Lin [3], Zichen Huang[3], Kei O Wang [3] and Yubing Tang [4]

[1] *Stuart Business School, Illinois Institute of Technology, Chicago, IL60661, USA*

[2] *Mathematics and Statistics, Georgia State University, Atlanta, GA30303, USA*

[3] *University of Illinois Urbana-Champaign, Urbana, IL61801, USA*

[4] *Stuart Business School, Illinois Institute of Technology, Chicago, IL60661, USA*

Abstract: This research investigates the transformative potential of integrating artificial intelligence (AI) with comprehensive risk management frameworks in industrial management. While AI applications have advanced in industrial settings, there is a lack of studies that fully integrate AI with macro risk factors such as PESTLE (political, economic, social, technological, legal, and environmental) and ESG (environmental, social, and governance) factors. These factors, often rooted in human activities and decisions, are critical to understanding and mitigating risks in complex industrial environments. By incorporating AI methods, such as machine learning and deep neural networks, organizations can enhance their ability to identify, analyze, and mitigate these risks efficiently. Recent developments, including OpenAI's language models, further strengthen this approach by enabling large-scale data analysis and supporting real-time risk assessment and decision-making. OpenAI's tools can interpret vast volumes of regulatory, economic, and social data, providing valuable insights to decision-makers. This research underscores the innovative potential of AI-driven risk management to enhance the stability and resilience of industrial management. By reducing human error and adapting to dynamic risk factors, this integration offers a forward-looking strategy for optimizing performance, ensuring operational excellence, and supporting sustainable practices across sectors.

Keywords: risk factors; PESTLE; ESG; AI; OpenAI; industrial management

1. Introduction

Industrial management plays a critical role in enhancing productivity, reducing costs, and promoting sustainability across multiple sectors. With the integration of artificial intelligence (AI) technologies, the potential for transformative improvements in industrial management is vast. This article provides a comprehensive review of AI-driven techniques that support risk assessment, operational efficiency, and data-driven strategies within industrial management. In addition, it examines the associated challenges, risks, and future directions of AI integration within this evolving field.

1.1. Importance and Scope of Industrial Management

Industrial management is widely recognized as a high-risk field encompassing diverse activities, from project planning and operations to maintenance and investment. It involves a structured approach to optimizing organizational processes, improving customer service, and creating business value across industries [1,2]. While crucial to the success of industries like construction, manufacturing, and logistics, industrial management requires frameworks that address project complexities, cost uncertainties, and scheduling risks [3]. Effective management practices play a pivotal role in mitigating these challenges by standardizing scope validation, risk assessment, and change management processes throughout the project life cycle [4,5].

1.2. Challenges and Risk Factors in Industrial Management

The high-risk nature of industrial management involves numerous challenges. Common issues include scope creep, budget overruns, and project delays due to expanding project boundaries or unanticipated factors. Industrial management must address these risks by encompassing essential processes such as conceptual development, scope statement, work authorization, reporting, control systems, and project closeout [6]. While various standards and guidelines exist, there is no universally applicable methodology, making adaptability essential for managing unique project demands and mitigating risks across diverse industries [7–9]. Effective risk management frameworks, such as PESTLE (political, economic, social, technological, legal, and environmental) and ESG (environmental, social, and governance), help in comprehensively assessing both external and internal factors affecting industrial operations [10].

1.3. The Role of AI in Enhancing Industrial Management

Artificial intelligence, particularly Machine Learning (ML), Deep Learning (DL) and OpenAI, is gaining recognition for its applications in industrial management. AI has shown significant potential in areas such as financial management, risk prediction, safety monitoring, and productivity estimation, offering insights that assist investors, optimize decision-making, and improve safety [11,12]. However, despite AI's recognition in frameworks like the Gartner Hype Cycle for Emerging Technologies, its application in industrial management remains underexplored. Integrating AI methodologies can enable advanced risk assessment and automate complex decision-making processes, helping managers reduce human error and better address high-risk aspects of industrial management [5,13].

1.4. Structure of the Paper

This paper provides a comprehensive overview of AI integration in industrial management. Section 2 explores various risk factors, including PESTLE and ESG, covering areas such as process design, quality control, equipment and technology, environmental impact, supply chain management, and safety and risk management. Section 3 examines AI methods as well as OpenAI, focusing on the challenges, current applications, and future potential of AI in supporting risk management and operational optimization. Finally, Section 4 concludes the research, highlighting how AI integration and structured risk frameworks can significantly advance industrial management practices, promoting safer, more efficient, and adaptable operations [14,15].

Overall, this research addresses the scarcity of literature on combining risk factors and AI to enhance industrial management across various sectors. The integration of these elements can pave the way for significant advancements in industrial management, minimizing risks and optimizing outcomes. This review highlights the potential of AI and structured risk frameworks in transforming industrial management practices, contributing to safer, more efficient, and more adaptable operations [16–18].

2. Challenges

This section addresses current challenges in industrial management, recognizing that accurately identifying and categorizing risks across diverse processes remains an area for improvement in achieving effective risk assessment and mitigation across projects.

2.1. Current Problems of Risk Assessment

Different researchers [19–22] have stated that organizational dynamics and multidisciplinary characteristics of the business environment can work as standards to label most risks. However, the network of project processing elements of uncertainty and risk distribution is broadened because of the current multi-stakeholder-based business environment [23 – 25]. Under these circumstances, the challenge of risk process management using heavy machine products, as the example shown in Figure 1 is not understanding the cause of any uncertainty [26] and identifying how to understand the cause of any delay [27]—but identifying all types of risks with a certain probability over the whole project process.
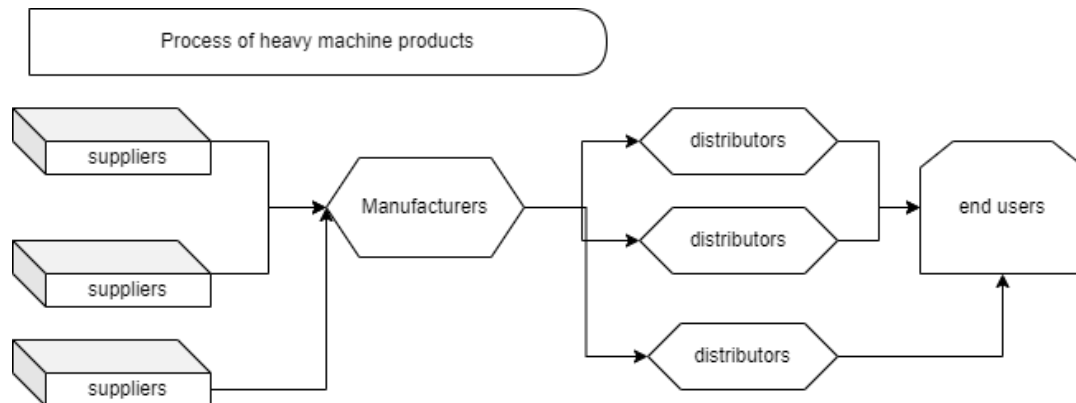
Figure 1. An example of process management in heavy machine products.

Currently, most existing risk identification or classification methods need more source-oriented groupings for precise risk exposure [28]. In addition, Harvest [29] stated that a significantly large number of projects often fail due to the increases in project complexity over time. Such complexity makes identified risks in different projects do not have the same or similar weight to impact all projects [30,31].

Possible risks in process management, which are difficult to identify a certain probability over the whole project process and are the crucial part of assessing risks, are listed below:

Lack of standardization: Inconsistent processes [32] can lead to inefficiencies, errors, and decreased productivity. B. Münstermann proposed that business process standardization (BPS) could positively impact business process performance, serving as a driver of process success. Through empirical analysis of data from 156 firms, the study finds that BPS significantly impacts process performance, particularly in terms of time, cost, and quality, emphasizing its importance as a vital tool in a firm's BPM toolbox and highlighting the need to consider process standardization in both research and management of business processes [33].

Poor quality control: Lack of proper checks and controls [34, 35] can result in lower-quality outputs. B. Klefsjö highlighted the perspective of Six Sigma as a methodology for total quality management. The paper emphasized the integration of Six Sigma principles into various quality management practices to enhance organizational performance and achieve higher levels of quality control [36].

Resistance to change: Employees may resist changes [37, 38] to established processes, making process improvement initiatives difficult to implement. A. Vas challenges the traditional view that resistance to change is irrational and solely originates from low-level employees. Through an in-depth case study of a telecommunications company, the research reveals that both implicit and explicit resistance exists at all levels of the organization, highlighting the critical role of middle managers in facilitating strategic organizational change [39]

nadequate resources: Limited resources, including budget, personnel, and technology [40], can impede process improvement and innovation. M. Arias. et al. presented a systematic mapping study on human resource allocation in business process management (BPM) and process mining. The findings highlighted the evolving nature of this research area, where new recommendations are applied to real case studies, and the need for further validation and evaluation through simulations and case studies [41].

Business disruptions: Unplanned events such as natural disasters or pandemics can disrupt processes and

negatively impact operations [42]. M. A. Cohen et al. provided a comprehensive review of Paul Kleindorfer's contributions to operations management, focusing on his risk management research. Kleindorfer proposed various topics including optimal control theory, decision science, investment planning, and supply chain risk to maintain sustainable operations and develop contract and risk hedging frameworks in supply management [43].

2.2. Identify Risk Factors of Macro and Quality Dimensions

In industrial management, effective risk management requires identifying and categorizing risk factors across both macro and quality dimensions, with an increasing emphasis on Environmental, Social, and Governance (ESG) considerations. ESG factors provide a framework for assessing an organization's impact on the environment, social stakeholders, and governance structures, which is essential for aligning industrial operations with evolving stakeholder expectations and regulatory demands. By integrating ESG with structured frameworks like PESTEL, organizations can gain a comprehensive understanding of the external and internal elements influencing their business environment.

This section provides an integrated review of relevant research related to industrial management, exploring how PESTEL and ESG analysis can aid in identifying and managing these diverse risk factors. Through this approach, businesses can assess potential impacts on productivity, operational stability, and market positioning and develop appropriate strategies for risk mitigation. Leveraging these frameworks enables organizations to proactively manage risks in both macro and quality dimensions, thereby enhancing resilience, optimizing outcomes, and fostering sustainable growth within industrial management practices.

2.2.1. PESTEL Risk Factors

When it comes to risk management in industrial processes, there are various risk factors that can be categorized into macro and quality dimensions. By considering the PESTEL elements, it becomes possible to identify risk factors in both macro and quality dimensions. The PESTEL framework provides a structured approach to understanding the external factors impacting a business environment, enabling organizations to assess risks and develop appropriate strategies for risk management. Numerous studies have highlighted the significance of political, design, and economic risks in various industries [44]. Figure 2 illustrates the elements of PESTEL analysis, including Political, Economic, Social, Technological, Environmental, and Legal factors, which are strategic factors used to evaluate the business environment of a firm.
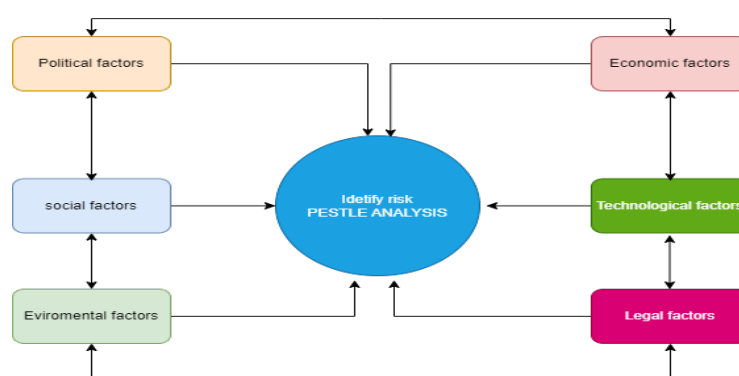
Figure 2. PESTEL Risk Factors.

Political Factors: Political factors encompass government regulations, policies, and stability. Changes in political landscapes or shifts in government priorities can impact industrial processes through new regulations or policy changes. Political risks [45] pose uncertain financing and often lead to a potential revenue decline. Industries such as construction, manufacturing, and heavy machinery operate in nations with distinct political issues. The growing tensions and instabilities in the global political climate, particularly national rivalries [46–48], can impact business growth and limit market expansion.

Economic Factors: Economic risk factors encompass the determination of aggregate demand and aggregate

investment in an economy, influenced by macroeconomic factors such as inflation rate, savings rate, interest rate, foreign exchange rate, and economic cycle. Micro-environmental elements [49], such as competition standards, affect the industry's competitive advantage [50]. The economic downturn following COVID-19 will present several challenges to market players as customers' purchasing power is affected [51].

Social Factors: Social factors consider societal attitudes, demographics, cultural norms, and consumer behavior. Shifts in social trends or consumer preferences can impact industrial processes, such as the socioeconomic trend of improving wealth distribution [52] expands people's purchasing power. However, describing employment and earnings within the industry is complex [53].

Technological Factors: Technological factors involve advancements and innovations in technology that can impact industrial processes, such as the Internet of Things (IoT) [54] and AI, which can deliver the required level of effectiveness for sustaining a high return on investment in supply-chain systems. Automation, artificial intelligence, and machine learning continuously enhance supply chain systems [55].

Environmental Factors: Environmental factors consider industrial processes' ecological aspects and sustainability [56]. Risks related to environmental factors include climate change impacts, resource scarcity, pollution, and environmental regulations. Failure to address these risks can lead to reputational damage and legal consequences [57].

Legal Factors: Legal factors come into play for industries operating in challenging environments governed by distribution legislation [58], such as manufacturing, construction, and heavy machinery. Businesses also encounter challenges related to economic crime or fraud, navigating the regulatory landscape in their home nation and every jurisdiction where they conduct business.

By utilizing the PESTEL framework, organizations can systematically analyze and understand the various risk factors associated with macro dimensions (external factors) and quality dimensions (internal factors). This comprehensive approach enables proactive risk management and allows organizations to develop strategies to mitigate, monitor, and respond to these risks effectively.

2.2.2. ESG Risk Factors

In industrial management, Environmental, Social, and Governance (ESG) risk factors are crucial for assessing an organization's impact and resilience. Integrating ESG considerations into industrial management practices allows organizations to evaluate risks associated with environmental impact, stakeholder relations, and governance structures. This approach provides valuable insights into operational vulnerabilities, enabling more sustainable decision-making. ESG risk data is increasingly important for understanding regulatory, reputational, and financial exposures, allowing organizations to address these risks proactively. As stakeholders and investors demand higher standards of transparency and accountability, ESG integration in industrial management helps align organizational goals with these expectations.

ESG risk factors focus on an organization's effect on the environment, its treatment of stakeholders (such as employees and communities), and its governance practices. Within industrial management, ESG data sheds light on potential risks and opportunities related to the organization's operations, products, and services [59-61]. By collecting and analyzing ESG risk data, companies can assess their exposure to various risks, including regulatory and reputational risks, which can influence financial performance [62,63]. This data-driven approach supports informed decision-making aimed at minimizing risks and enhancing ESG performance [64]. As investors increasingly consider ESG factors in their investment decisions, organizations are expected to demonstrate transparency and accountability in these areas.

However, collecting ESG risk data presents challenges. Data availability is often limited [65], particularly for smaller organizations or those operating in emerging markets, where data on ESG risks may be scarce. Additionally, data standardization is a significant challenge, as there is often inconsistency in how ESG data is collected and reported, complicating comparisons across organizations [66].

Despite these challenges, ESG risk data collection and analysis are becoming essential in industrial management. By proactively managing ESG risks, organizations can meet higher standards of transparency and accountability and align with stakeholder and investor expectations. Incorporating ESG data into industrial

management enables organizations to identify areas for improvement, mitigate risks, and enhance overall performance regarding environmental impact, social responsibility, and governance practices.

2.3. Additional Risk Factors in Industrial Management

Beyond PESTEL and ESG factors, other key risk factors in industrial management include design, quality control [67], equipment and technology, environmental impact [68], supply chain management, and safety and risk management. Addressing these factors within industrial management frameworks is essential for achieving consistent outcomes, minimizing risks, and improving overall process performance. Effective risk management in these areas allows organizations to navigate uncertainties, reduce errors, and increase the likelihood of project success.

Process Design: Designing effective industrial processes requires a thorough understanding of physical and chemical principles [69]. Researchers may focus on factors such as material properties, reaction kinetics, and process optimization to develop efficient, cost-effective processes that align with industrial goals and regulatory standards.

Quality Control: Ensuring consistent product quality is essential in industrial management [70]. Researchers and practitioners use process monitoring, statistical process control, and quality assurance measures to maintain standards and identify areas for improvement, ensuring products meet predefined quality criteria [71–74].

Equipment and Technology: Industrial processes often rely on specialized equipment and advanced technologies [75,76]. Equipment reliability, maintenance requirements, and emerging technological advancements are key areas of focus for researchers and practitioners aiming to improve efficiency, reduce costs, and enhance operational resilience in industrial management.

Environmental Impact: Industrial processes can have significant environmental consequences, such as emissions, waste generation, and resource consumption [77, 78]. Industrial management increasingly considers environmental regulations, sustainability metrics, and life cycle analysis to assess and mitigate these impacts, promoting sustainable practices within organizations.

Supply Chain Management: Industrial processes are frequently integrated within a broader supply chain, where disruptions or inefficiencies can significantly affect process performance [79,80]. Researchers emphasize supplier relationships, logistics, and inventory management to identify and address potential risks, ensuring a seamless and resilient supply chain.

Safety and Risk Management: Industrial processes carry inherent safety risks, including potential for fires, explosions, and chemical spills. Effective industrial management requires hazard analysis, risk assessment, and emergency response planning to ensure safe operations and minimize accident risks [81,82].

Each of these risk factors plays a vital role in industrial management, and the relevance of specific factors depends on the industry and process context. By focusing on these dimensions, organizations can create robust industrial management practices that support resilience, enhance operational outcomes, and promote long-term success.

3. AI Techniques Used in Industrial Management

As industries undergo digital transformation, artificial intelligence (AI) is playing an increasingly vital role in enhancing industrial management practices. By integrating machine learning, data mining, natural language processing (NLP), and advanced predictive technologies, AI is helping organizations manage risks, optimize processes, and reduce costs across various sectors. This section reviews AI-driven methodologies tailored to industrial management, with a focus on improving safety, quality, and operational efficiency. Table 1. provides an overview of machine learning techniques and applications, illustrating diverse datasets, methods, and specific implementations across sectors such as construction, mining, manufacturing, and after-sales services.

3.1. Machine Learning-Driven Approaches

Machine learning (ML) technologies are becoming indispensable in many industries, including manufacturing [83–85] and healthcare [85,86], to address the challenges of digital transformation. (Table 1 summarizes methods

used in industrial management.) Gartner has pointed out the expanding demand for ML, predicting that organizations expect to double the number of ML projects within a year [87]. However, while ML is gaining traction in machinery industries, its full adoption in heavy machinery and construction sectors remains limited [88,89].

In industrial management, ML approaches offer significant potential for reducing productivity risks by continuously optimizing interactions among employees, clients, and stakeholders. Technological investments [90,91] in ML can position the heavy machinery and construction sectors to stay competitive and profitable.

For instance, a study [92] (illustrated in Figure 3) showed that identifying risk factors and generating predictive models using ML could assist in managing industrial risks. The study identified key risk factors, including before-accident and after-accident conditions, and found that the Gradient Boosting model was the most effective in predicting critical risk events.
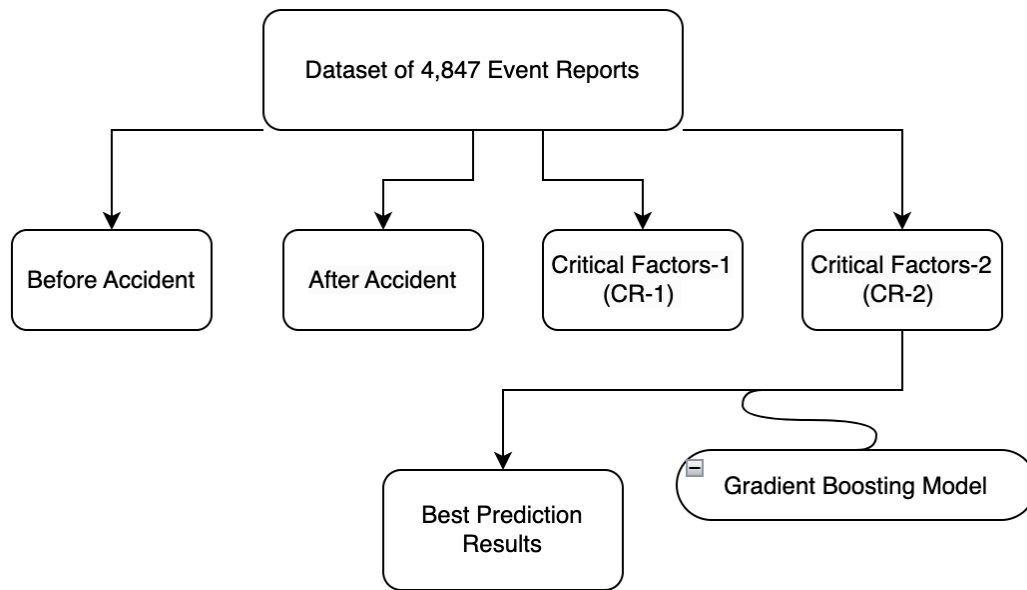
Figure 3. Flowchart of Study [93].

In another study [93], accident data from Singapore's construction industry was analyzed using neural networks, helping identify incidents and develop effective mitigation strategies. ML is proving valuable for stakeholders in predicting and reducing industrial risks. For example, a study [94] employed sequential minimal optimization for soft-margin support vector machines with n-fold cross-validation to assess constructability in technology projects, enabling accurate risk assessment for industrial management applications.

3.2. Data Mining and Collection Methodologies

Data mining and data collection are integral to managing macro risks in industrial management. However, there are challenges:

Data Availability: Reliable data to assess macro risks is often scarce, especially in emerging markets where access to ESG and operational data may be limited.

Data Privacy and Security: Protecting sensitive information is essential, as macro risk data can contain confidential elements that require secure handling.

Resource Constraints: Time, budget, and personnel limitations may impede effective data collection and analysis.

A survey of technology companies [95] revealed that 75–85% of ML projects do not meet expectations, mainly due to data and software quality issues [96]. The Cross-Industry Standard Process Model for Data Mining (CRISP-DM) [97-99] is frequently used to ensure consistency in industrial projects and is considered an ideal process model for industrial data mining [100, 101]. Applications of CRISP-DM are expanding across sectors, from quality diagnostics [102–104] to marketing [105], warranty management [106], and other industrial research areas.

CRISP-DM can serve as a framework [107] for exploring industrial data, such as safety records and incident

reports, enabling organizations to conduct targeted interventions. For instance, random forest (RF) modeling has been employed for monthly safety performance projections, achieving an accuracy of 0.78.
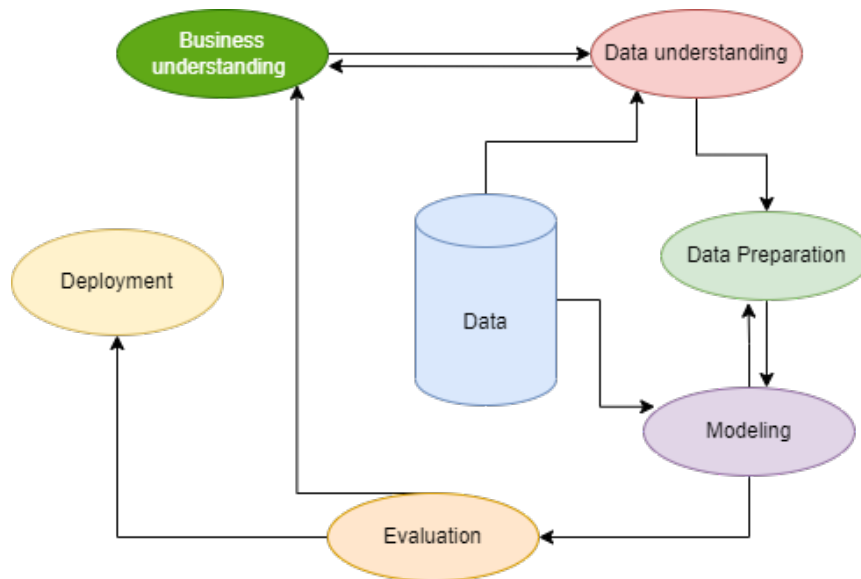
Figure 4. CRISP-DM construction.

Additional ML techniques, such as random under-sampling (RUS), random over-sampling (ROS), and synthetic minority over-sampling technique (SMOTE), have been used to predict industrial accidents, particularly in construction. Techniques like random forest (RF), Naïve Bayes (NB), K-Nearest Neighbor (KNN), and artificial neural networks (ANNs) enhance predictive accuracy, as shown in Figure 4.

3.3. Nlp Method Used For Accident Prediction By Extracting Textual Data

For accident prediction in NLP, machine learning algorithms such as decision trees, random forests, and support vector machines are commonly used. In addition, natural languages processing techniques such as sentiment analysis, text classification, and entity recognition are also utilized to extract relevant information from text data such as news articles or social media posts. The goal of these methods is to identify patterns and relationships between text data and accident occurrences and make predictions about potential accidents based on this analysis.

Aside from that, the NLP extracted textual construction injury reports with Natural Language Processing, featured them with attributes and categorical safety outcomes and then applied Random Forest (RF) and Stochastic Gradient Tree Boosting (SGTB) to the dataset. Due to the binary and physical Nature of the input variables, the outcomes can provide a reliable prediction of accidents.

3.4. Future Direction of AI Used to Reduce Risks Associated with Process Management

Human error is a significant contributor to many accidents and incidents in industrial processes, and AI can help to mitigate this risk in several ways:

Autonomous control: AI can be used to automate certain processes, reducing the need for human intervention and minimizing the risk of errors.

Intelligent decision support: AI can provide intelligent decision support to operators, helping them to make informed decisions and reducing the risk of errors.

Training and simulation: AI can create realistic training and simulation scenarios that allow operators to practice responding to various situations, reducing the risk of errors during real operations.

Monitoring and alerting: AI can continuously monitor process data and alert operators to potential issues, allowing them to take corrective action before an incident occurs.

Root cause analysis: In the event of an incident, AI can be used to perform root cause analysis to identify

the underlying causes and help prevent similar incidents from occurring in the future.

L. Li et al. discussed the application of artificial intelligence (AI) in drinking water treatment (DWT) processes. By leveraging AI technology, the goal is to minimize human errors and improve efficiency in managing and operating DWT systems by realizing water quality diagnoses, autonomous decision-making, and operation process optimization based on data analysis and evolutionary learning mechanisms [108].

H. Khayyam et al. discovered that human error is the leading cause of automotive crashes. Therefore, AI and Internet of Things (IoT) technologies play an essential role in the development of fully autonomous vehicles by enabling the transformation by combining real-world and digital knowledge, reducing human errors, and increasing vehicle safety [109].

3.5. Leveraging OpenAI for Data-Driven Decision Making and Operational Efficiency in Industrial Management

OpenAI and other advanced AI technologies hold significant potential for enhancing industrial management by reducing risks and improving operational efficiency across several key areas:

Predictive Maintenance: AI can analyze data from sensors and other sources to identify patterns and predict when equipment is likely to fail, allowing for proactive maintenance. This predictive approach helps prevent costly downtime and safety incidents, enhancing equipment reliability and operational continuity in industrial settings.

Process Optimization: By analyzing large datasets and running simulations, AI identifies optimal operating conditions for various processes. This optimization reduces the likelihood of accidents and ensures consistent product quality, which is crucial for maintaining competitiveness and efficiency in industrial operations.

Fault Detection and Diagnosis: AI algorithms analyze real-time data from sensors to detect anomalies and diagnose faults quickly, enabling rapid responses to potential safety incidents or production losses. Fault detection minimizes downtime and maintains the integrity of industrial processes, contributing to overall resilience.

Safety Planning and Response: AI can simulate various operational scenarios, predicting potential safety incidents and identifying appropriate response measures. These insights allow industrial managers to prepare effective safety plans, mitigating risks to personnel and the environment.

Compliance: By continuously monitoring and analyzing operational data, AI helps ensure that processes adhere to regulatory standards, reducing the risk of fines, legal actions, and reputational damage. Automated compliance monitoring supports adherence to complex regulatory requirements and ensures sustainable operations.

In reviewing 500 case studies, S.L. Wamba-Taguimdje et al. found that AI aids in optimizing processes, enhancing automation, managing information, and transforming organizational outcomes. The study also highlights AI's capability to detect, predict, and engage interactively with various industrial processes, demonstrating its transformative impact on performance [110].

OpenAI's Contribution to Industrial Management: OpenAI's advanced AI technologies, including language models like ChatGPT, further support industrial management by facilitating complex data analysis and interpretation, offering valuable insights for decision-making. OpenAI's language models enable managers to recognize patterns, monitor trends, and assess potential risks, improving strategic and operational decisions. These tools assist in optimizing process design, quality control measures, supply chain management, and safety protocols, making operations more efficient and adaptable to changes [111,112].

Additionally, OpenAI's AI capabilities allow for automation and optimization across industrial processes, which reduces human errors, enhances productivity, and improves overall performance. With the integration of AI-driven analysis, data interpretation, and automation, OpenAI's technologies offer industrial managers the ability to reduce risk, improve safety and compliance, and achieve higher levels of productivity and sustainability [113]. By incorporating these capabilities, organizations in the industrial sector can reduce incidents, maintain compliance, and achieve operational excellence, improving both their safety and bottom line.

Table 1. Summary of Machine Learning Techniques and Applications in Industrial Management across Various Sectors.

Name/Reference	Environment	Summary and Specialty	Techniques		Dataset
			ML Methods	Theoretical Background	
Vineeth, V.S., Kusetogullari, H., & Boone, A. (2020, August) https://doi.org/10.1109/ IS48319.2020.9200128	Python	- Machine Learning - Forecasting sales model for truck components in Volvo Trucks	- SVM - Ridge Regression - Gradient Boosting Regression - Random Forest Regression		- Historical sales data of truck components for a period of 24 months including information about the product type, the month of sales, and quantity sold
Sharma, P., Khater, S., & Vashisht, V. (2021, January) https://doi.org/10.1109/ ICCAKM50778.2021.9357751	Python	- Machine Learning - Prediction of turnover of a company which is helpful for better understanding A17of market trends and stocks	- Linear regression - Random forest		- Data covered the sales data from 5 automotive companies in Indian market from 2019 to 2021
McClelland, J., & Rust, J. (2018) https://doi.org/10.1515/jbnst-2018-0023	Python	- Dynamic programming model - Estimate key relationships of the optimal timing of replacement of rental equipment owned by a large multi-location firm in the equipment rental industry	- SVM - LR - IBL	- Dynamic programming model	- Dataset includes information on 486 forest road construction projects, including data on project design, construction, and environmental factors for a period of over 20 years
Plisson, J., Mladenić, D., Ljubič, P., Lavrač, N., & Grobelnik, M. (2005) https://citeseerx.ist.psu.edu/ document?repid=rep1&type=pdf& doi=10c5ec32e8e4b76f0428409aa73 8e03ca6ca3d24	Python	- Machine Learning - Identifying and structuring the expertise of employees within a company	- Clustering - Classification		- Data from Yahoo's employee database
Swink, M., Narasimhan, R., & Kim, S. W. (2005) https://doi.org/10.1111/j.1540-5414.2005.00079.x		- Study of the relationship between practices and performance - Trategy integration and enhanced manufacturing capabilities such as cost efficiency and flexibility serve as intermediaries by which practices affect performance			- Data from 57 North American manufacturing plants that are past winners and finalists in Industry Week's "American's Best" competition
Diefenbach, U., Wald, A., & Gleich, R. (2018) https://doi.org/10.1007/s00187-018-0261-5		- Cost management for organisational performance - Develop a model for a cost management control system (CMCS)			- Data of 251 European companies
Hjeltnes, T. A., & Hansson, B. (2005) http://www2.tisip.no/quis/public_ files/wp7-cost-effectiveness-efficiency.pdf		- Comparison the cost-effectiveness and efficiancy of SMEs across industries and countries in seven European countries			- The data covered SMEs in manufacturing and service sectors in Austria, Finland, France, Germany, Italy, Spain, and the United Kingdom - The sample consisted of 7,234 SMEs, with sizes ranging from 10 to 249 employees.

Table 1. Cont.

Name/Reference	Environment	Summary and Specialty	Techniques		Dataset
			ML Methods	Theoretical Background	
Lombrano, A. (2009) https://doi.org/10.1016/j.resconrec.2009.04.017		- Machine Learning - Time Series Model - Comparison of four forecasting methods for the fluctuation demand for spare parts products at an Indonesian company			- Percentage of separate collection, collection and transport cost for normal waste, collection and transport cost for separated waste for the years of 2002, 2003, and 2004 for each Italian region
Ghanadiof, O. (2021) https://doi.org/10.24018/ejbmr.2021.6.3.903	SPSS	- Statistical method - Study of relationship between brand equity with an intention to buy agagin		- Descriptive statistics - Multiple regreesion - AMOS	- Data from survey to managers of the mining businesses and owners of machines
Aktepe, A., Yanık, E., & Ersöz, S. (2021) https://doi.org/10.1007/s10845-021-01737-8	Python	- Machine Learning - Demand forecasting - Forecast the number of spare parts of construction machinery requested in the future period by customer	- Linear regression - Multuple non-linear regression - Artificial neural networks - Support vector regression	-	- Data composed of the sales amount of 2010 to 2018 belonging to the manifold product group - Number of construction machine sold in the world - USD exchange rate and monthly impact rate
Ihnatovich, H. (2017) http://urn.kb.se/resolve?urn=urn%3Anbn%3Ase%3Akth%3Adiva-209044		- Machine Learning - Demand forecasting - Support construction equipment manufacturers, distributors, and suppliers in apprehending the equipment market	- ANN		- Economic indicators data for the time period 2005 quarter 1 (Q1) to 2016 quarter 4 is available through Oxford Economics database - Quarterly construction equipment sales data for the selected countries is gathered from Committee for European Construction Equipment (2017) and Hargrove & Associates, Inc (2017) databases
Kargul, A., Glaese, A., Kessler, S., & Günthner, W. A. (2017) http://www.ijscer.com/uploadfile/2017/0427/20170427032411542.pdf	Python	- Machine Learning - Prediction of heavy equipment demand	- SVM		- Sample data from over 111 construction projects between 2013 and 2015
Kusumastuti, R. D., & Bustaman, Y. (2022) https://doi.org/10.33555/embm.v9i2.197	Python	- Machine Learning - Time Series Model - Comparison of four forecasting methods for the fluctuation demand for spare parts products at an Indonesian company	- A-B-C Analysis - Moving Average - Simple Exponetial Smoothing (SES) - Exponential Smoothing (ES)		- Qualititive data included a description of the activities that compnay PT XYZ carries out in managing inventory - Quantatitive data in form of salesdata, inventory data, quantity data of the arrival of goods in the company PT XYZ
Mitchell Jr, Z. W. (1998) https://tc.idm.oclc.org/login?url=https://www.proquest.com/dissertations-theses/statistical-analysis-construction-equipment/docview/304463576/se-2	Python	- Machine Learning - Equipment management - Prediction of internal rental rates of machinery	- Linear regression model - Non-linear regression model	- Cumulative Cost Model	- Field data on 270 heavy construction machines from four different companies

Table 1. Cont.

Name/Reference	Environment	Summary and Specialty	Techniques		Dataset
			ML Methods	Theoretical Background	
Liu, C., AbouRizk, S., Morley, D., & Lei, Z. (2020) https://ascelibrary.org/doi/full/10.1061/%28ASCE%29CO.1943-7862.0001816?casa_token=afh2o_GC1dMAAAAA:uuXxUX8VO2szF17Yusq-GzB_CkXiCd4bZs205vb2WuAMkK5zJkD-ZGo97M29FONRWdtkjGYBHCaD	Python/Matlab	- Machine Learning - Accurately quantify the equipment lifecycle cost, incorporating both maintenance and ownership costs	- K-means clustering - Expectation-maximization (EM) algorithms		- A historical data set of ownership and maintenance costs for a mining truck model
Egonsson, E., Ly, T. T., & Bayarsaikhan, K. (2013) urn:nbn:se:lnu:diva-27427		- The importance of after-sales service in Swedish heavy equipment machinery industry - Customer relationship among three classified sizes of after-sales service providers			- Semi-structured interviews with three organization (one small, one medium and one large size after-sales service providers)

4. Conclusion

Industrial management can benefit from a comprehensive approach that incorporates macro risk factors, integrates AI technologies, and leverages insights from advanced scientific methods. By considering macro risk factors such as PESTLE (political, economic, social, technological, legal, and environmental) and ESG (environmental, social, and governance) in industrial management strategies, organizations can better navigate complex business environments, mitigate risks, and capitalize on emerging opportunities. AI technologies, including automation, data analysis, and predictive modeling, hold the potential to revolutionize industrial management by enhancing efficiency, reducing waste, and supporting informed decision-making. Recent advancements in AI, including OpenAI's language models and data analytics tools, offer valuable support for industrial management by analyzing complex datasets and providing actionable insights. These tools enable organizations to optimize decision-making, thereby achieving higher levels of productivity, sustainability, and resilience in industrial operations. OpenAI's contributions to AI innovation empower industrial managers to address both strategic and operational challenges more effectively.

In conclusion, integrating macro risk factors, AI technologies, and data-driven insights into industrial management promotes greater efficiency, reduces operational costs, enhances safety, and boosts productivity. As organizations adopt these advancements, industrial management is positioned for transformative growth, fostering operational excellence and sustainability across sectors.

Author Contributions

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The authors declare no conflict of interest.

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Article

Research on Marketing Innovation of Beihai Nanzhu in "Internet Plus" Era

Dan Wang

School of Communication, Guangxi Vocational Normal University, Nanning 530007, China

Abstract: In view of the development status and existing problems of marketing of Beihai Nanzhu in the era of "internet plus", innovative countermeasures such as dual-matrix layout, innovative design, joint-name IP, differentiated marketing and integration of literature and tourism can not only continuously optimize the marketing model of Beihai Nanzhu, but also expand its popularity and reputation.

Keywords: Beihai Nanzhu; "internet plus"; marketing innovation

Pearl in the north of Guangxi is recognized as the world's top-grade pearl, so Beihai is called "the hometown of southern pearl" and "the pearl city". As early as the Shang Dynasty, more than 200 years ago, Hepu Nanzhu in Beihai had become an important tribute of emperors and nobles in China, and it was also one of the main trading materials in the Maritime Silk Road Economic Belt at that time. Beihai Nanzhu was listed as a national geographical indication protection product in 2004 and sold all over the country. Since 2000, affected by the natural environment and industrialization, the Nanzhu industry in Beihai has shown a downward trend. In the era of "internet plus", how to innovate the marketing strategy of Beihai Nanzhu is of great significance for revitalizing Beihai Nanzhu industry and improving Beihai's popularity and reputation.

1. The Development Status of Beihai Nanzhu Industry

Pearl mining in Beihai City, Guangxi has a history of more than 3000 years. Especially in recent years, Beihai City has vigorously supported the development of Nanzhu industry, and Beihai Nanzhu industry has now taken shape.

(A) the industrial scale of Beihai Nanzhu

In April, 2017, General Secretary Xi Jinping made important instructions during his inspection work in Beihai. He asked the China municipal government and relevant enterprises to cooperate with each other by taking advantage of the resources in the Beibu Gulf area of China, and stressed: "To build a coastal economy and write a new chapter of the Maritime Silk Road in the new century". In response to the call of the country to "build a coastal economy" and revive the glory of Nanzhu industry, Beihai Municipal Party Committee and Municipal Government set up a leading group for revitalizing Nanzhu industry in Beihai, and formulated the Opinions on Accelerating the Revitalization of Nanzhu Industry and various preferential policies to give strong support to Nanzhu enterprises. In 2021, 18 South Pearl breeding enterprises (cooperatives) in Beihai City have completed a total of 12.682 million shells, with a breeding area of 4300 mu in the city. It is estimated that the annual output of Beihai Nanzhu will be 1100 kg, with an output value exceeding 10 billion yuan [1]. The output

of Beihai Nanzhu reached about 5000 tons [2]. The output value reached 25 billion yuan [3]. Beihai Nanzhu accounts for more than 70% of the country's output, with a planting area of 3.5 million mu. It is the largest pearl producing area in China and the main pearl producing area in the world [4]. The industrial chain of Beihai Nanzhu is relatively perfect. With the vigorous promotion of Beihai City, Beihai Nanzhu enterprises have promoted standardized farming and formed a whole industrial chain of breeding, processing, design and sales. The output of Nanzhu has been continuously improved and the industrial scale has been continuously expanded.

(B) Problems existing in the development of Beihai Nanzhu industry

1. The technical equipment is backward, and the quality of Nanzhu is declining. In recent years, due to the quick success and instant benefit of the people of Pearl River, the quality of Nanzhu has plummeted. At present, traditional techniques are mostly used in Nanzhu aquaculture, but emerging technologies are not introduced. For example, nuclear insertion technology is the key technology to improve the yield and quality of pearls, but at present, the application of this technology is not extensive enough, and there are problems of uneven technical level. Coupled with the lack of innovation in scientific research, the reproductive quality of pearl oyster has plummeted. For example, the conservation, breeding and seedling raising of Pinctada martensii need to be undertaken by powerful enterprises, but the work in this area is not perfect at present. The backwardness of technology, talents and equipment makes Nanzhu low in survival rate, poor in quality, low in economic benefit and wide in technological level, which leads to overcapacity and product homogenization. In addition, the lagging market information and weak sense of intangible cultural heritage make Nanzhu lack competitiveness in the market.

2. A large number of Nanzhu are accumulated, and the industrial chain is short. The processing capacity of Nanzhu is generally low. Except a few excellent pearls are directly purchased, most of the cultured shells in farms are sold separately from the raw shells and shellfish meat. The raw shells are roughly processed and sold, with little demand and low price, and a large number of shells are hoarded. Shell meat is treated at a low price and the overall economic benefit is low. The degree of industrialization in Nanzhu is low, and most of them are self-employed. The decline of market price makes some farmers face the pressure of production capacity, and the business level is uneven, which leads to the high-end products and high value-added industrial chain links can not keep up with the market demand, which is easy to cause market confusion.

3. Serious environmental pollution and lack of unified management. Environmental problems have improved, but disease problems have appeared from time to time, affecting the stability of yield and quality. In recent years, due to the vigorous development of industrialized economy in Beibu Gulf, factors such as waste gas and sewage discharged from factories, oily sewage from ships and man-made water pollution have threatened the aquaculture industry in Nanzhu, and the varieties of Nanzhu have deteriorated, and their breeding and pest resistance have weakened. At the same time, there is no unified planning and management for Nanzhu aquaculture by government departments and social industry organizations, resulting in unlimited stocking of farms, and a large number of pearls are accumulated, which reduces the value of pearls.

2. The Industry and Market Prospects

(A) the history and prospects of the industry

Beihai Nanzhu has a long and profound history. Nanzhu in history is famous because it is delicate and dignified, smooth and crystal clear, round and transparent, and its quality is superior to that of jewelry products. Beihai Nanzhu integrates natural growth and nature, and adopts the production mode of "once every three years" or "once every five years" in the local area, giving Beihai Nanzhu enough time to cultivate pearls. With the advantage of Beibu Gulf sea resources, Beihai Nanzhu has been bred and put on the market for more than 30 years, and has made great progress in aquaculture area, commodity quality, processing and comprehensive development. From one commodity to several derivative commodities, Nanzhu commodity chain has been formed, which effectively promoted the local economic development of Beihai. At the same time, Beihai local government aimed at this unusual business opportunity, and actively introduced relevant technical talents and formulated personalized policies, which provided great support for the development of Nanzhu.

### (2). Market size and growth trend

After real estate, automobiles and electronic goods, fine jewelry, whose sales growth rate exceeds 15% in recent years, is called the fourth largest consumption hotspot, and the consumption demand of pearl goods and their derivatives market is huge. At present, the jewelry market of Zhenzhu accounts for a small proportion of the total market, so the market potential needs to be tapped. However, the scale of fine jewelry in China remains at a high level even if it is affected by the epidemic (see Figure 1), and the future development space has a great rise, which also provides us with a good opportunity to start a business. Taking this opportunity, this venture mainly develops the sales of low-end goods, attracts new consumers by using innovative sales methods, and after gaining a certain reputation in the jewelry market, it will go to the economy.
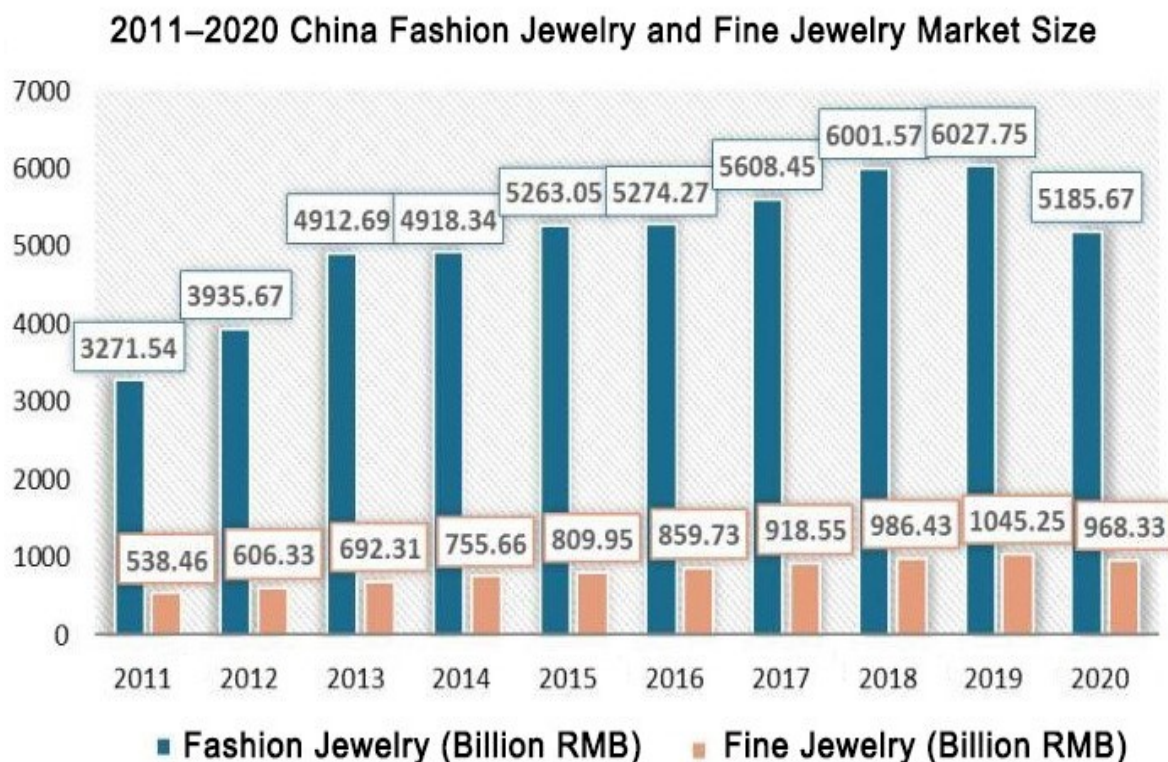
Figure 1. China's Fashion Fine and Fashion Jewelry Market Scale from 2011 to 2020 Source: Guanyan Tianxia Data Center-Research Report on the Development Status and Investment Prospect of China Women's Consumer Industry.

At the same time, the female market accounts for a large proportion. At the moment when online shopping is popular, our sales still adhere to the two operating modes of online and offline. Combined with the rapid popularization of the Internet, the online market is gradually expanding, which can be explained by the following facts: 70% of online e-commerce sales are contributed by female consumers, and female consumer groups occupy a dominant position in purchasing decisions. The concept of "her economy" is gaining a firm foothold in the market step by step. The data shows that the market scale of "her economy" has reached 4.5 trillion yuan in 2019. With the continuous development of the Internet and the continuous updating of e-commerce sales models, the market scale of "her economy" will increase in 2020, reaching 4.8 trillion yuan. According to the development trend forecast, the market scale of "her economy" is expected to reach 10 trillion yuan in 2025 (see Figure 2). The large market for women in pearl trading makes the project feasible.
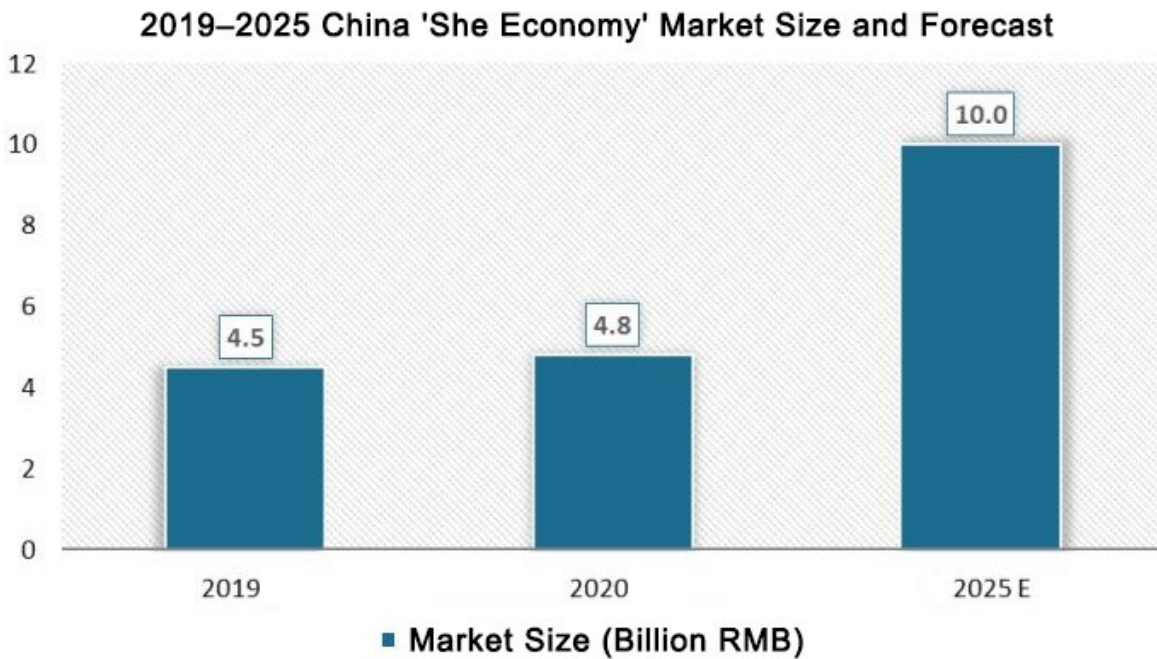
Figure 2. China's "Other Economy" Market Scale and Forecast Data Source: Guanyan Tianxia Data Center-" Research Report on the Development Status and Investment Prospect of Women's Consumer Industry in China".

3. The Marketing Status and Existing Problems of Beihai Nanzhu

(A) Beihai Nanzhu marketing status

With the increasing influence and popularity of Beihai Nanzhu brand, its share in the domestic high-end jewelry market is also increasing, and it has expanded its export market to emerging markets such as the Middle East and Southeast Asia.

Over the years, Nanzhu marketing has focused on offline marketing. Enterprises actively participate in relevant exhibitions, organize public welfare activities to expand their popularity, and advertisements are mainly based on posters, electronic screens in shopping malls and traditional marketing promotion of print media. The pearl market and retailers are the main sales channels, and the proportion of online channel sales is not high, accounting for only about 15–20% of the total sales [5]. The retail industry accounts for a large proportion and the publicity is small. With e-commerce as an emerging format, it has attracted countless individuals and enterprises to join it. Beihai is no exception. The government pays close attention to the development of e-commerce, actively attracts investment and construction, and takes well-known enterprises such as Nanzhu Palace as the "leader" to vigorously promote the rapid development of local e-commerce industry. On 19 October 2021, when the only official jewelry Shifuyuan live broadcast base in Guangxi was completed, it provided high-quality services in various aspects, such as broadcasting, promotion and operation, anchor training, testing and supporting facilities, and used e-commerce network marketing to transform the traditional pearl industry into a new economy, improve the visibility and reputation of Nanzhu, and promote economic development.

(B) Beihai Nanzhu marketing problems

1. The homogenization of products is serious, and the market share is small.

First, the added value of products is low. More than 95% of Beihai Nanzhu enterprises are small and medium-sized enterprises, mainly in Nanzhu, lacking other supporting products, with low investment in brand building, low added value of products, serious homogenization, weak pricing power, weak development of high-end products, and fake and shoddy products and derivatives flooding the market [6]. Secondly, product design and style homogenization. The products of Beihai Nanzhu have not changed much in color, material and modeling, mainly in traditional elegant style, with conservative design, insufficient novelty and fashion sense,

which makes it difficult to attract more consumers, lacking personalized and fashionable innovative design and unable to cater to young consumers. Third, the product upgrade speed is slow. The product innovation ability of Beihai Nanzhu industry is weak, the investment in new product research and development is limited, and the iterative cycle of product upgrading is long, which is easy to lose consumer interest. Fourth, competition is weak. Big brands such as Chow Tai Fook, Ruan Shi and Luk Fook Jewelry have a large market share, which leads to the weak competition scale, mode and intensity in South Pearl.

2. The marketing method is single and the advertising effect is not good.

First, relying on the dealer model, online and offline integration is insufficient. At present, the commodity positioning of Nanzhu is not obvious enough, and the sales scope is too small. The main consumer groups are local residents and tourist consumers. They sell through traditional dealer channels, and the development and application of e-commerce and new retail channels are insufficient. Beihai Nanzhu e-commerce channel sales only account for about 10%, and the online and offline integration is low, and a complete e-commerce ecosystem has not been formed [7]. Industrial digitalization and high-tech application are limited, which fails to give full play to the marketing advantages of the Internet. Second, community marketing and content marketing are weak. Beihai Nanzhu enterprises do not make good use of social media and content marketing methods, and have insufficient interaction and communication with target consumers. The marketing methods are relatively simple, and the number and types of products put in are too few. Although technology can be used, product information is affected by advertising space fees, delivery methods, innovative design, peer-to-peer communication and other factors. Consumers have the initiative and can choose according to their own preferences, which makes it difficult to produce brand communication effects. Third, mobile marketing is arbitrary. The mobile marketing of Beihai Nanzhu industry mainly stays in the enterprise website building and product display, and the application of advertising and promotion means on the mobile side is not much, which fails to realize the marketing value of mobile Internet. Therefore, to a certain extent, the promotion effect and cost input of enterprises are not equal in marketing promotion. Shrimp soldiers, traditional means of promotion. The promotion activities of Beihai Nanzhu industry mainly focus on holidays, and the promotion method is relatively simple, and it is difficult to achieve sustainable sales growth without using differentiated and omni-channel promotion means.

3. Brand awareness is low and marketing promotion is blocked.

First, the investment in corporate brand building is insufficient. Beihai Nanzhu enterprises don't pay much attention to brand building. Beihai Nanzhu has excellent pearls but no brands with high social reputation. Even if the brand is established with the cooperation of the government and enterprises, the brand influence is difficult to improve due to insufficient marketing propaganda and limited brand promotion activities [8]. Second, the spokesperson and brand ambassador are not properly selected. Consumers attach great importance to business reputation, brand awareness, product quality and after-sales service. The brand spokespersons and brand ambassadors selected by Beihai Nanzhu enterprises are traditional, which can not produce obvious brand communication effects, especially for young consumers, which also makes Beihai Nanzhu marketing fall into development difficulties. Third, the brand pricing strategy is not good. The market saturation of jewelry industry is serious. The price system and pricing strategy of Beihai Nanzhu products do not match the brand positioning. The high-end brands are priced at a low level and the low-end brands are priced at a high level, which is not conducive to brand upgrading.

4. Lack of industrial linkage and slow industrial development.

First, the cooperation mechanism between upstream and downstream enterprises is not perfect. The production and marketing channels of Beihai Nanzhu products are characterized by low-end production capacity, but high-end consumer groups are unbalanced [9]. There is a lack of long-term and stable cooperation mechanism between upstream and downstream enterprises in Beihai Nanzhu industry, and the degree of cooperation in business is not high, so it is difficult to play a synergistic effect. Second, Industry-University-Research has poor combination. The cooperation between Beihai Nanzhu industry and universities and scientific research institutions is relatively loose, and the product research and development process is relatively independent, which fails to give full play to the technical support role of universities and scientific research

institutions. Third, the influence of leading enterprises is limited. Beihai Nanzhu industry lacks the leading role of leading enterprises, which have little influence on the upstream and downstream enterprises in the industrial chain, and have not played the leading role in technological innovation, brand building and channel development, so it is difficult to promote the rapid development of the industry as a whole.

5. The orientation of internationalization is vague and the level of globalization is limited.

First of all, the export market is single. Beihai Nanzhu products are mainly oriented to the domestic market, and the export business is small. The export market is concentrated in Southeast Asia and other places, and the export pattern is relatively simple. At present, Beihai Nanzhu products mainly rely on tourists' consumption (60 –70%) and jewelry wholesale market (20–30%), and e-commerce and terminal retail channels only account for about 10%. The channel is too simple, and the regional market share is as high as 90% [10], failed to effectively explore the national market, limiting the space for industrial development. Secondly, the brand has a low reputation in the international market. Beihai Nanzhu products and corporate brands are not well-known and influential in the international jewelry market, and it is difficult to gain wide recognition on a global scale. Third, the international marketing means is insufficient. The international marketing business of Beihai Nanzhu enterprises mainly depends on participating in international jewelry exhibitions, while other international marketing methods such as digital marketing and community marketing are seldom used. Fourth, adapt to the lack of international product development. The design style of Beihai Nanzhu products is mostly oriented to the domestic market, and the degree of customization and personalization of products is weak, which fails to fit the aesthetic habits and cultural background of international consumers well. Fifth, the enterprise internationalization strategy is not clear. The strategic goal of the internationalization development of Beihai Nanzhu enterprises is unclear, the market research and consumer insight in the international market are low, and the pace of internationalization development is difficult to accelerate. Sixth, the foundation of industrial international cooperation is weak. There are few exchanges and cooperation between Beihai Nanzhu Industry and other major international jewelry industry centers, and the ability to understand the global industrial development trends and technological frontiers is limited.

4. The Innovative Countermeasures of Beihai Nanzhu Marketing Model

In the era of "internet plus", how to carry out marketing, better realize product realization and industrial transformation and upgrading, and enhance product value through marketing are the problems that Beihai Nanzhu enterprises need to face and solve in the development process under the new format.

(1) Create a live broadcast matrix and customize high-quality scenes [11].

There are many wholesale and retail industries in Beihai Nanzhu, but few official jewelry enterprises. For example, Beihai Nanzhu Palace, as the most representative "time-honored" enterprise in Guangxi, should match the live account, anchor personnel and live scenes. In addition to showing Nanzhu's main account, it should also set up category numbers such as beauty and skin care, hotel management, build suitable scenes according to different live content, and attach importance to communication and conversation with fans. On the one hand, it can enhance users' shopping enthusiasm, on the other hand, it can attract new users into the live room with the participation of real users. As of January, 2023, the number of users in Tik Tok is as high as 800 million. Brand self-broadcasting and big V cooperation can be concentrated in Tik Tok and Aauto Quicker platforms. Brand self-broadcasting can be simulcasted with category accounts, and big V cooperation can cooperate with Guangxi head anchors and famous online celebrity stars, which can not only expand the scope of communication, but also rely on fan traffic to promote product realization.

(B) innovative design elements, heritage of cultural significance

From traditional pearl jewelry to China fashion jewelry and fashion items pursued by young people, the public's demand for new consumer culture is increasing. The inspiration of innovative design can come from popular art, popular games, movie characters, costume design, traditional culture and so on. For example, the diamond inlaid pearl daisy pattern elements in the classic film The Great Gatsby are integrated into the trend jewelry design to create elegant trend jewelry. It has also become a trend to blend in with the national fashion. Nanzhu culture comes from Hepu Zhuhuan, a legendary story recorded in Meng Changzhuan, the later Han

Dynasty, which shows that Nanzhu brand has a certain traditional cultural heritage. For example, the dance drama Blue Sea Silk Road, which is set in Hepu County, Beihai City, makes the public know more about Nanzhu culture, and takes this opportunity to let culture and history speak, and integrate Chinese excellent traditional cultural elements into product design, extending from product name and product design to product CCTV, enjoying the beauty of Nanzhu, continuing Chinese cultural confidence and inheriting Chinese culture.

(3). Co-branded super products to create a younger IP

The new consumption concept is no longer limited to cost performance and quality, but also pays more attention to the needs of individuality, uniqueness and innovation. Jewelry is no longer a female patent. For example, Neymar, a world star, wears a pearl necklace, which shows the tenderness of an iron man. Pearl tide brand joint works, based on the theme, design a series of characters, color series, natural theme series and other related styles. Pearl consumers are also showing an obvious trend of youthfulness, and creating a young IP is the top priority. Such as HelloKitty bracelet, Pang Hu necklace, seahorse baby earrings, etc. The diversification of Nanzhu styles provides consumers with a variety of choices, stimulates enterprises to innovate, and introduces more high-quality and creative products to attract consumers.

(D) product differentiation marketing, improve channel sales

Strengthen online and offline operations at the same time, or differentiate marketing of different styles of the same product. Marketing can be carried out by dividing product grades and cycles. Taking Nanzhu Palace as an example, Nanzhu Palace operates high-end jewelry as an offline entity, while online products are developing in the direction of cost performance, fashion, innovation and personalization, with prices close to the public, while ensuring the diversification of online products, such as beauty and skin care, health food, arts and crafts, and reducing marketing costs. You can also sell out-of-season goods or old products through online channels to clear inventory, and use products, promotions and prices to implement limited-time sales, coupons and other activities to attract consumers.

(E) The deep integration of literature and tourism to promote brand marketing.

The government and enterprises cooperate to carry out offline marketing promotion on the basis of the integration of literature and tourism. In Beihai Highlights Tourism Project, exclusive characteristic elements are incorporated, with Nanzhu as the starting point, and a unique Nanzhu characteristic town is built with the cooperation of the government and enterprises. The government can provide stamp album punching in Beihai Highlights Tourism Area in a fixed place, and give small gifts such as souvenirs, commemorative coins and imitation Nanzhu pendants provided by enterprises to attract consumers to buy in enterprises or shops. As a favorite tourist game, stamp collection punching can attract more people to "trace by chapter" and provide consumers with tourism directions. The deep integration of cultural tourism has started the intangible culture of Beihai and the brand of Nanzhu, attracted public attention, and promoted the harmonious development of Beihai society with the intercommunication, integration and interaction of economy and culture.

5. Conclusion

Under the trend of rapid development of "internet plus", Guangxi Beihai Nanzhu, as one of the traditional industries, has been impacted. It is necessary to make full use of the marketing environment, formulate scientific and reasonable marketing strategies, attach importance to its own resource elements, implement appropriate development strategies, find innovative and effective marketing models, understand the public trend and adapt to the changes in market demand, so as to make Beihai Nanzhu stand on the forefront in the complex marketing environment and maintain its competitive advantage. This will not only promote the revitalization and prosperity of Beihai industry, but also promote the common development of China pearl industry.

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Conflicts of Interest

The author declares no conflict of interest.

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Article

Research on Cross-Border E-Commerce of China's Agricultural Sector and Its Enlightenment to Vietnam

Thi Bich Ngoc Bui [*] **and Hua Dong**

School of Economics and Management, Qingdao University of Science and Technology, Qingdao 266061, China

Abstract: China leads the world in import and export activities through e-commerce. With substantial production capacity, China's export market spans a wide range of goods, with agricultural products among the first to benefit from cross-border e-commerce (CBEC), achieving significant success. In contrast, although agricultural products are a key export sector for Vietnam, the adoption of e-commerce in this area has faced numerous challenges from the outset. This study examines China's experience with CBEC in agricultural exports and identifies lessons to enhance Vietnam's effectiveness in applying CBEC to its agricultural exports.

Keywords: China; cross-border e-commerce (CBEC); agricultural exports; Vietnam

1. Introduction

With the advancement of globalization and internet technologies, cross-border e-commerce (CBEC) has become a critical channel for the distribution of agricultural products. As a major agricultural nation with abundant resources and vast market potential, China has identified CBEC as a strategic tool to enhance the international competitiveness of its agricultural products and promote rural revitalization. The Chinese government has implemented a series of supportive policies to accelerate the development of CBEC. For example, the Central Economic Work Conference held in late 2023 emphasized the importance of cultivating new drivers for foreign trade, consolidating the foundations of foreign trade and foreign investment, and expanding intermediate goods trade, service trade, digital trade, and cross-border e-commerce exports.

Local governments have also responded proactively by introducing policies to promote agricultural CBEC. As a result, various e-commerce platforms have emerged nationwide, ranging from comprehensive platforms such as Alibaba, JD. com, and Pinduoduo to specialized agricultural platforms such as Huinongwang and Bainongwang. The active participation of these corporations has created a dynamic ecosystem, accelerating the development of e-commerce for the import and export of fresh agricultural products. These platforms have established new sales channels for agricultural enterprises, presenting both opportunities and challenges for agricultural trade. The rapid expansion of the digital economy has diversified agricultural sales models. These platforms not only improve supply chain efficiency but also broaden international market access for Chinese agricultural products, paving the way for the growth of CBEC.

In the context of globalization and the rapid expansion of e-commerce, Vietnam has recognized the strategic importance of developing cross-border e-commerce as a key channel to promote exports of its major agricultural products, such as coffee, rice, cashews, and tropical fruits. Both Vietnam and China are developing economies

* Corresponding: Bui Thi Bich Ngoc (Ngocreal88@gmail.com)

where agriculture plays a central role, with many similarities in geography, climate, culture, and political institutions. The strong growth of cross-border e-commerce in China, particularly in the agricultural sector, provides a valuable model for Vietnam to adopt. China's successful strategies can support Vietnam in enhancing supply chain efficiency, improving product quality, and significantly expanding access to international markets. Such improvements not only strengthen the global competitiveness of Vietnam's agricultural products but also ensure sustainable and efficient export activities in the digital era, contributing to the overall economic development of the country.

2. Development Conditions for Cross-Border E-Commerce in China's Agricultural Exports

2.1. Policy Environment Supporting Cross-Border E-Commerce Development

The growth of cross-border e-commerce in agricultural exports requires robust state policy support. As early as 2015, the Chinese government recognized the potential of cross-border e-commerce. However, it was not until 2020, during the global economic crisis triggered by the COVID-19 pandemic, that the unique online operational model of e-commerce gained significant attention in export activities. The pandemic underscored the importance of cross-border e-commerce, driving rapid growth in demand for this trade model. To ensure sustainable national economic development, China intensified its support for cross-border e-commerce by promoting the establishment of comprehensive cross-border e-commerce zones, fostering favorable conditions for the sector's expansion.

Since 2021, the Chinese government has implemented a series of supportive policies to encourage innovation and development in the sector. Among the most prominent are policies related to the creation of cross-border e-commerce pilot zones. These pilot zones, developed in phases, aim to align regional development with global trade trends, enabling nationwide growth in cross-border e-commerce exports. Additionally, the pilot zones allow each region to leverage and enhance its competitive advantages, promoting balanced development across the country.

In addition to domestic initiatives, China has actively pursued international cooperation in e-commerce. Approximately 60% of the 22 free trade agreements (FTAs) signed by China contain provisions related to e-commerce. Moreover, China has taken a leading role in signing the Regional Comprehensive Economic Partnership (RCEP). Chapter 12 of RCEP, titled "E-Commerce" is regarded as the first comprehensive and high-level multilateral framework for e-commerce in the Asia-Pacific region, effectively facilitating trade exchange and cooperation throughout the region [1].

The "E-commerce Silk Road" initiative has also achieved significant success. According to the "E-commerce Silk Road Cooperation Development Report (2016–2023)" released by the Chinese Ministry of Commerce's Institute of International Trade and Economic Cooperation, as of October 2023, China had established e-commerce cooperation dialogue mechanisms with 30 countries across Central and Eastern Europe, Central Asia, and other regions. The expanding "circle of friends" under the "E-commerce Silk Road" initiative continues to generate new momentum for the high-quality development of the Belt and Road Initiative (BRI) [2].

2.2. Stability and Development of Agricultural Exports

Given its significant agricultural potential, China has implemented comprehensive policies and allocate--d substantial financial support to advance its agricultural sector. These efforts have resulted in notable progress. Since acceding to the World Trade Organization (WTO), China's agricultural exports have achieved sustained growth and diversification.

Recent data from the Ministry of Agriculture and Rural Affairs of the People's Republic of China reveal that the export value of agricultural products has steadily increased over the past five years, as depicted in Figure 1.
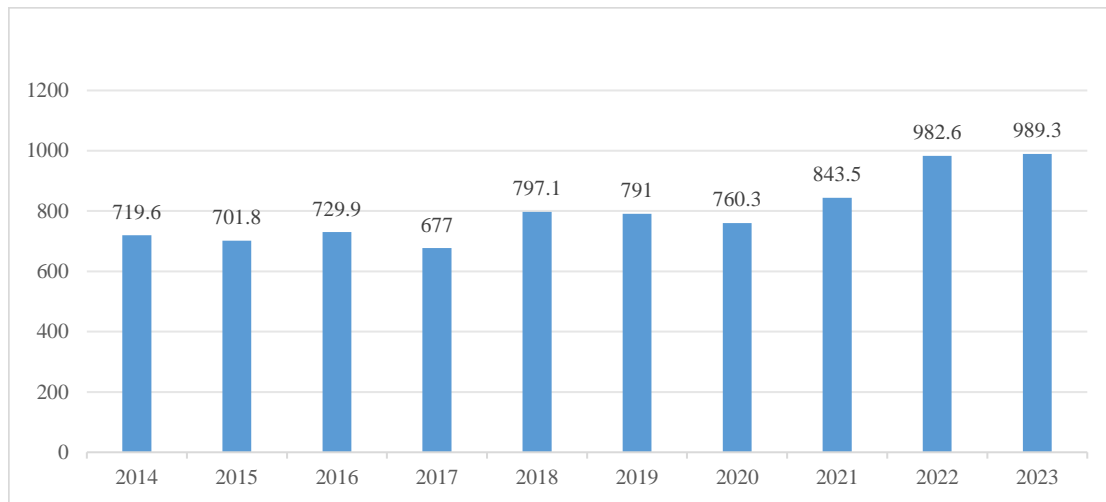
Figure 1. Value of Export of China's Agricultural Products from 2014 to 2023 (billions U.S dollars). Source: General Administration of Customs of the People's Republic of China (http://www.customs.gov.cn).

According to the data shown in the chart, China's agricultural exports have fluctuated since 2014, but the overall trend indicates continuous expansion. Export value, which stood at USD 719.6 billion in 2014, declined slightly between 2014 and 2017, reaching a low of USD 677 billion in 2017. This decline resulted from several complex factors related to the global economic and trade environment. One major factor was reduced import demand from key partners, particularly the United States, amid escalating trade tensions. Additionally, the decline was influenced by China's domestic policy adjustments, emphasizing import controls and domestic production to ensure food security and promote sustainable economic growth.

From 2018 to 2019, the sector experienced recovery, with exports increasing to USD 797.1 billion in 2018 and stabilizing at approximately USD 791 billion in 2019. Although the sector was heavily impacted by the COVID-19 pandemic in 2020, with exports falling to USD 760.3 billion, China maintained its position as the world's fifth-largest agricultural exporter. By 2023, agricultural exports rebounded to USD 989.3 billion, reflecting a rapid post-pandemic recovery and demonstrating China's ability to adapt and expand its market share in the global agricultural sector.

China's efforts in agricultural investment and international cooperation have also deepened. The country has established broad agricultural partnerships with over 140 countries and maintained stable cooperative relationships with 94 nations worldwide [3].

In conclusion, the consistent growth of China's agricultural exports, combined with the expansion of agricultural investment and cooperation, provides a solid foundation for the further development of agricultural exports through cross-border e-commerce.

2.3. High Global Demand for Agricultural Products

The consumption of agricultural products has been a fundamental and indispensable need throughout human history. It is estimated that by 2050, the global population is projected to reach 9.1 billion, with the majority of growth concentrated in developing countries that lack adequate resources and advanced technology to invest in agriculture [4]. This demographic shift is expected to significantly increase the demand for agricultural products. Consequently, the importance of international trade in ensuring food security will grow, resulting in a substantial rise in global agricultural trade transactions in the future.

2.4. Competitive Advantages of China's Cross-Border E-Commerce Sector

China boasts the largest and fastest-growing cross-border e-commerce sector in the world. According to statistics from the General Administration of Customs of China, the scale of China's cross-border e-commerce imports and exports increased nearly tenfold between 2019 and 2023. In recent years, the sector has sustained a high annual growth rate, averaging 15% [5]. This rapid development is driven by several factors, with the

following being the most critical elements directly influencing the industry's expansion.

First, a favorable policy environment has provided strong momentum for the sector's growth. Government policies and guidelines introduced since 2021 have created an enabling environment, facilitating favorable conditions for the development of e-commerce in general and cross-border e-commerce in particular.

Second, a well-developed logistics infrastructure has been essential in transforming the concept of cross-border e-commerce into reality. Logistics plays a critical role in ensuring seamless cross-border trade. According to the China Federation of Logistics and Purchasing, the market value of China's logistics sector surpassed USD 48.27 trillion in 2023. Additionally, the country hosts more than 9,000 A-grade logistics companies, with the combined revenue of the top 50 logistics firms exceeding USD 249 billion [6]. These impressive figures place China's logistics sector among the largest in the world for seven consecutive years and confirm its status as the largest logistics market in the Asia-Pacific region [7].

Third, Chinese cross-border e-commerce enterprises demonstrate strong competitiveness. As of the first quarter of 2024, China had 120,000 cross-border e-commerce companies [8]. In addition to the large number of enterprises, platforms such as Alibaba and JD.com consistently rank among the top global cross-border e-commerce companies.

2.5. Development Scale Analysis

Data from the China Customs Administration reveals that the scale of China's agricultural imports and exports has steadily grown from 2019 to 2023, reaching approximately USD 3,330.4 billion in 2023. The "Big Data Analysis Report on Regional Development of E-commerce in China" indicates significant growth in agricultural logistics, with the total value surpassing USD 700 billion annually for three consecutive years, from 2021 to 2023 [9].

The foreign trade market has become increasingly essential to agricultural trade. Since the outbreak of the COVID-19 pandemic, many agricultural exporters have shifted to online platforms, utilizing B2B e-commerce to promote their products, which has driven rapid growth. Data from Alibaba's international platform shows that in 2020, cross-border e-commerce exports of agricultural products increased by 183% compared to the same period in 2019 [10].

From the perspective of trade partners, the top five markets for China's cross-border e-commerce agricultural exports are Hong Kong (China), Taiwan (China), the Philippines, Malaysia, and Russia. Notably, the export value of agricultural products to Hong Kong (China) amounts to approximately USD 300 million [11].

3. Development Characteristics

3.1. Structure of Exported Agricultural Products

According to data from the ECBD, China's primary agricultural exports predominantly consist of easily preserved goods. In 2023, the leading agricultural products exported through cross-border e-commerce included powdered milk, fruits, garlic, and spices. The main export markets are Japan, South Korea, and the United States, with Japan alone contributing approximately 10.4% of China's total cross-border e-commerce revenue, equivalent to USD 11 billion [12].

Additionally, various dried agricultural products, spices, and other easily preserved agricultural goods have begun to be exported through foreign e-commerce platforms and social commerce channels. Notably, Laoganma sauces and Chinese strawberries are now available on Amazon.

3.2. Agricultural Product Export Models

Currently, China's cross-border e-commerce for agricultural products has established dominant models such as B2B (Business-to-Business), B2C (Business-to-Consumer), and B2B2C (Business-to-Business-to-Consumer). Among them, the two primary models are the direct B2B export model and the overseas warehouse export model.

3.2.1. Direct B2B Cross-Border E-Commerce Export Model

This model enables domestic enterprises to conduct transactions with foreign businesses through cross-border e-commerce platforms, allowing them to export goods, including agricultural products, directly to international buyers with the support of cross-border logistics services. This model helps mitigate risks related to non-receipt of goods by importers. However, it involves high costs and longer processing times, as exporters must passively wait for demand to arise, potentially delaying the supply chain. Pilot zones for cross-border e-commerce exports under this model have been established, covering a diverse range of products. For instance, data compiled by the Information Center of the Ministry of Agriculture and Rural Affairs reveals that in May 2021, dried celery and dried chili, valued at USD 48,887, were declared at Huzhou Customs and exported for the first time under the B2B e-commerce model [13].

3.2.2. Cross-border E-commerce Export Model with Overseas Warehouses

Under this model, domestic enterprises export goods, including agricultural products, to overseas warehouses through cross-border logistics. Transactions are conducted on cross-border e-commerce platforms, with products shipped directly to end consumers from the overseas warehouses. This approach enables faster delivery to buyers but presents risks, such as the potential accumulation of unsold inventory after export. The overseas warehouse export model has been widely adopted in China. According to data from the Information Center of the Ministry of Agriculture and Rural Affairs, in December 2021, the first B2B cross-border e-commerce export warehouse in the Tianshui Comprehensive Cross-border E-commerce Pilot Zone successfully processed a shipment of 6375 boxes (120 tons) of fresh apples, which were transported overland to Gyirong Port and subsequently delivered to an overseas warehouse in Nepal. Additionally, in December 2021, the Deyang Comprehensive Cross-border E-commerce Pilot Zone exported various food products, including spices and salted fish, to overseas warehouses in Hong Kong (China) through its B2B e-commerce export warehouse network [13].

Although it has not evolved as extensively as the other two models, the B2C model targeting end consumers has nonetheless delivered noteworthy results and presents promising prospects for the export of agricultural products. The share of the B2C cross-border e-commerce model in agricultural product trade has steadily increased each year, becoming a key driver of growth in the cross-border e-commerce market. This expansion has also generated additional demand for cross-border e-commerce logistics. According to iResearch, B2C exports accounted for 32.2% of cross-border e-commerce in 2022, with projections suggesting that this share will reach 33.6% by 2025. Furthermore, data from China Communications Research indicates that the B2C cross-border e-commerce market was valued at 532 billion USD in 2022 [14].

3.3. Marketing Strategies and Brand Promotion

In 2021, under the sustained impact of the COVID-19 pandemic, local governments across China seized the opportunity to develop new forms of cross-border e-commerce. They actively explored and established new channels to market agricultural products through cross-border e-commerce, helping agricultural enterprises secure international orders and creating new avenues for agricultural products to enter global markets. As a result, the "e-commerce + agricultural products" marketing strategy emerged, significantly boosting sales, building brand recognition, and expanding agricultural distribution channels.

A key component of this model is strengthening information connectivity throughout the production and consumption chain—from cultivation to supply, and from agricultural producers to consumers—thereby preventing blind or uncoordinated agricultural production. In this strategy, sellers select online marketing methods tailored to their products, resources, and target audiences. In China, the most effective marketing approach has been "webcasting + agricultural products" commonly referred to as live-streamed agricultural sales. This method enhances consumer engagement, dispels doubts about product quality, and promotes the visual appeal of agricultural products.

The success of live-streaming in promoting agricultural exports is well-documented. For example, in

Tianshui City, Gansu Province, the Tianshui Comprehensive Cross-border E-Commerce Pilot Zone organized multiple live-streaming events to highlight local specialty agricultural products, including Huaniu apples, Qin'an peaches, cherries, onions, garlic, and Chinese medicinal herbs from Zhangjiachuan County. These products were introduced to foreign trade markets for the first time through these events, resulting in significant breakthroughs in Gansu's agricultural exports. In one notable event, 300 tons of Huaniu apples were sold through live-streaming, with most purchases originating from Malaysia, generating USD 248,695 in revenue. Additionally, 90 tons of Tianshui peaches were pre-sold to Singapore, with an estimated value of USD 262,511.

Another notable example comes from Yunnan Province, where Pu-erh tea producers have actively utilized live-streaming platforms to promote their products in international markets. These producers have organized live-stream sessions that not only showcase the unique production process of Pu-erh tea—highlighting traditional fermentation methods and the influence of various tea-growing regions on flavor—but also include interactive tea-tasting sessions. These interactive elements have attracted significant interest from international tea enthusiasts. As a result of these live-streaming efforts, Yunnan's Pu-erh tea has successfully penetrated key international markets, including the United States, the European Union, and Japan.

In addition to live-streaming, short videos have become an increasingly popular tool for marketing agricultural products. In Xinjiang, local agricultural cooperatives have produced a series of short videos showcasing their melons. These videos highlight the vast melon fields basking in bright sunlight, the traditional farming methods passed down through generations, and the process of cutting open the juicy, sweet melons. In addition to their visual appeal, the videos convey a sense of authenticity, emphasizing the quality and heritage of the products. Widely shared on international social media platforms, these videos have successfully captured the attention of overseas importers. Consequently, the export volume of Xinjiang melons has significantly increased.

In conclusion, these various marketing strategies and case studies vividly demonstrate the effectiveness of different online marketing techniques in promoting China's agricultural products in the cross-border e-commerce environment. They also underline the significance of brand promotion and targeted marketing within this context.

3.4. Customs Management and Supervision

Compared to traditional trade, foreign trade conducted through cross-border e-commerce is characterized by decentralization and high transaction frequency, posing significant challenges to customs supervision. In recent years, Chinese customs authorities have researched and implemented new supervision methods tailored to these evolving dynamics. They have also proposed improvements to the supervision model to enhance the efficiency of cross-border e-commerce management, particularly for agricultural products. To streamline export operations, four customs supervision models—1210, 9610, 9710, and 9810—are currently in use, each serving distinct functions:

Model 1210: This model follows the warehouse entry regime. Its primary function is to divide bulk shipments into smaller portions. Cross-border e-commerce platforms send goods to domestic bonded logistics centers, where they are processed for retail distribution through online sales channels for customs clearance. Unsold goods remain in the bonded center without requiring customs declarations and can be directly returned overseas if not sold.

Model 9610: This model applies to goods that have already been sold and are stored in a temporary bonded warehouse while awaiting clearance and subsequent domestic delivery.

Model 9710: Known as "direct B2B cross-border e-commerce export" this model allows buyers and sellers to complete transactions online, with goods delivered directly to buyers through transportation services.

Model 9810: Referred to as the "overseas B2B cross-border e-commerce warehouse model" this model involves sellers storing goods in overseas warehouses. When a transaction is completed online, the goods are shipped directly from the overseas warehouse, eliminating the need to transport them from the seller's country for each order.

The diversity of these supervision methods and models provides effective tools for monitoring import and export activities. Moreover, they enable enterprises to benefit from more favorable customs procedures, logistics

operations, and inspection processes.

4. Evaluation of Agricultural Exports through Cross-Border E-Commerce in China

Based on the analysis of the conditions, scale, development characteristics, and practices of China's agricultural exports through cross-border e-commerce, it is clear that China holds significant advantages. These advantages are driven by international demand and the inherent strengths of the country's agricultural and e-commerce sectors. However, the success of China's progress in this field is inseparable from the role and contributions of the government. Through policies and region-specific development strategies targeting key areas and different phases, alongside rigorous supervision that monitors industry trends and evolving demands, the Chinese government has built a robust foundation for the growth of agricultural exports via cross-border e-commerce.

The active involvement and engagement of local governments in promptly resolving challenges for enterprises also play a crucial role in facilitating the adoption of cross-border e-commerce for agricultural exports. Many regions are actively exploring and investing in competitive specialty agricultural products. For example, to promote strawberry exports, Yinchuan City in Ningxia has allocated special funds to support cross-border e-commerce in brand development, infrastructure improvement, and logistics operations. The city has also sought to attract Amazon to establish an e-commerce innovation center, further enhancing its position in the cross-border trade ecosystem.

Despite these efforts, the application of cross-border e-commerce (CBEC) in China's agricultural exports continues to encounter several challenges and difficulties, including:

(1) Limited International Competitiveness

Exporting agricultural products through e-commerce demands a high level of standardization. In China, most agricultural exports are produced by farmers, whose capacity for quality control and production is constrained by low skill levels. In addition, the processing depth of export products remains insufficient. As of now, China's agricultural product processing rate stands at 68%, approximately 20 percentage points lower than that of developed countries [15]. Moreover, research and development (R&D) in new agricultural varieties and food products has progressed slowly, and the range of processed products remains limited, creating a weak foundation for developing new specialty products that could become global best-sellers.

Another key factor limiting the international competitiveness of China's agricultural products is the weakness of product branding. There are relatively few internationally recognized agricultural and food brands. Among the top 500 global agricultural and food brands, only five are Chinese, and three of these are wine brands.

(2) Limitations in Logistics Services

The current cross-border e-commerce trade in agricultural products primarily involves bulk shipments to ports, warehousing, customs clearance for small consignments, and express delivery to end customers. However, the development of logistics services, particularly cold chain logistics for fresh agricultural products, lags behind the rapid growth of cross-border e-commerce, leading to high logistics costs. In 2023, China's total social logistics costs amounted to 14.4% of GDP, a figure significantly higher than that of developed countries in Europe and the United States [16]. Logistics costs for certain agricultural products are especially high, accounting for one-fourth of their total market value, thereby reducing the international competitiveness of these products.

Furthermore, cold chain circulation remains underdeveloped in China. The cold chain quality maintenance rate for meat, fruits, and vegetables is approximately 30% and 20%, respectively—only one-third and one-fourth of the rates achieved by developed countries. This limitation not only hinders the improvement of agricultural product quality but also leads to significant waste during transportation, further increasing product costs.

Additionally, the logistics infrastructure in foreign markets faces challenges. Although China has intensified

overseas investments by establishing warehouses in target markets, the current number of warehouses remains insufficient to meet the high storage standards required for agricultural products. Furthermore, high construction, rental, and labor costs hinder efforts to expand both the quantity and quality of overseas storage facilities.

(3) Shortage of High-Quality Human Resources

The export of agricultural products through e-commerce demands a highly skilled and specialized workforce. However, the current education and training system has failed to meet the growing demands of the market effectively. In 2023, Chinese companies engaged in cross-border e-commerce, particularly in agricultural exports, posted more than 200,000 job openings. Yet, the supply of university graduates has fulfilled only approximately 45% of the actual market demand, resulting in a significant gap between labor supply and demand [17].

Companies seek employees with expertise not only in agriculture and international trade but also in digital tools and cross-border supply chain management. However, current training programs have not kept pace with the sector's rapid development, leading to a severe shortage of high-quality talent. This shortage presents major challenges for companies in recruiting, retraining, and retaining qualified personnel, placing substantial pressure on the sustainable development of the sector moving forward.

5. Lessons from China's Cross-Border E-Commerce of Agricultural Products for Vietnam

5.1. Enhancing the Quality and Building the Brand of Vietnamese Agricultural Products

5.1.1. Enhancing the Quality of Agricultural Products

To address the challenges related to the quality of agricultural products in Vietnam, a comprehensive and coordinated approach is essential.

The government must take a leading role by implementing key policies. Subsidy programs should be introduced to provide financial support to farmers adopting GAP, HACCP, and ISO 2000 standards. For example, partial compensation could be offered for the purchase of organic fertilizers or advanced pest-control equipment that comply with these standards, thereby reducing the financial burden on farmers.

Training and extension services are also crucial. Local training centers should be established in rural areas, where agricultural experts can conduct regular workshops covering essential topics such as the proper application of fertilizers and pesticides according to GAP standards and modern preservation techniques. To ensure broad impact, at least 10 training centers should be established within the next two years in major agricultural regions. Additionally, demonstration farms should be set up across different provinces. These farms will act as practical learning sites, showcasing best practices in agricultural production. Each province should have at least one demonstration farm within three years, allowing farmers to observe and learn firsthand.

Local governments and cooperatives also play a vital role. They should form production support teams consisting of agronomists, veterinarians (for livestock-related agriculture), and technicians. These teams should visit farms regularly, providing on-site guidance. To ensure effective coverage, each team should visit at least 50 farms per month. Moreover, knowledge-sharing platforms should be established. These platforms, both online and offline, will facilitate experience exchange among farmers. Monthly meetings or webinars should be organized, allowing successful farmers to share their experiences in implementing international standards, thereby inspiring and educating others.

Farmers must also take an active role in enhancing their expertise. At least 70% of farmers should participate in at least one training session related to international production standards annually. Additionally, joining farmer associations offers multiple benefits. These associations can facilitate collective learning and enhance farmers' bargaining power. Through these associations, farmers can negotiate better prices for inputs that meet international standards and access information on new production methods, helping them stay updated and make informed decisions to improve the quality of their agricultural products.

5.1.2. Building the Brand of Vietnamese Agricultural Products

Strong branding is critical, as it not only enhances the reputation of Vietnamese agricultural products but also increases export volumes through e-commerce channels. To achieve this, the government should lead efforts by providing guidance to both enterprises and farmers in developing authentic Vietnamese agricultural brands. Concurrently, support should be extended for geographical indications and product labeling to highlight distinctive products.

First, the government should establish Brand Development Centers in key agricultural export regions. These centers will serve as hubs for professional services such as brand design, brand strategy development, and in-depth market research. They will equip businesses and farmers with the expertise needed to develop strong, recognizable brands.

Second, geographical indication protection funds should be allocated. These funds are essential for preserving the unique identity of local products. They can be used to finance legal actions against unauthorized uses of local product names, thus safeguarding the integrity of geographical indications. Additionally, these funds can support promotional campaigns that emphasize the distinct characteristics of products tied to specific regions, enhancing their market competitiveness.

Exporting enterprises, meanwhile, must combine high product quality with effective marketing strategies on e-commerce platforms. This requires the development of comprehensive content marketing plans. These plans should include high-quality videos, blog posts, and infographics that tell the brand story, demonstrate the production process, and highlight the unique attributes of the products. For example, a coffee-exporting enterprise could produce engaging videos showcasing the traditional Vietnamese coffee-making process and emphasizing the distinct flavor profiles of Vietnamese coffee to attract consumers.

In addition, customer engagement strategies are essential. Enterprises should respond to customer inquiries within 24 hours, conduct regular surveys to collect valuable feedback, and establish customer loyalty programs. These initiatives will help foster strong customer connections, improving satisfaction and long-term loyalty.

Furthermore, brand protection is essential, as counterfeiting poses a severe threat to the reputation of Vietnamese agricultural products. To combat this issue, the government should establish Anti-Counterfeiting Task Forces in collaboration with relevant industries. These task forces will perform market inspections to identify counterfeit products and collaborate with international law enforcement agencies to take action against counterfeiters, protecting Vietnamese brands from illegal imitation in foreign markets.

Finally, enterprises should be encouraged to adopt digital brand protection tools, such as blockchain technology, to guarantee product authenticity and instill consumer confidence. The government can offer incentives or subsidies to enterprises implementing these advanced technologies, further strengthening the brand protection ecosystem for Vietnamese agricultural products.

5.2. Improving the Legal Environment and E-Commerce Infrastructure

5.2.1. Policy and Legal Environment

For the sustainable development of Vietnam's cross-border e-commerce in agricultural products, the government plays a crucial role in strengthening the legal framework for e-commerce and ensuring alignment with international regulations. This harmonization is essential to create a transparent and favorable business environment for export enterprises.

To achieve this, a dedicated E-commerce Law Revision Committee should be established. The committee, consisting of legal experts, e-commerce practitioners, and representatives from international trade organizations, will be responsible for conducting a comprehensive review of existing e-commerce laws within one year. Based on this review, they will propose amendments to adapt the legal system to the current and evolving e-commerce landscape.

Additionally, the government should actively participate in international e-commerce treaties and incorporate relevant provisions into domestic law. Specifically, at least two key international e-commerce treaties should be integrated within the next two years to ensure that Vietnam's e-commerce legal framework

aligns with global best practices.

Moreover, supportive policies are crucial to facilitating business operations. One such policy involves the development of tax incentive packages specifically for agricultural e-commerce exports. For example, export taxes could be reduced by 10–20% for products that meet predetermined quality and branding standards. These incentives must be clearly defined and effectively communicated to enterprises, encouraging them to meet these criteria and boost exports.

Another important measure is the establishment of One-stop Export Service Centers in major cities. These centers will play a critical role in simplifying the export process by handling all export-related procedures, including customs clearance, documentation, and regulatory compliance, in one location. By providing efficient services, these centers will streamline e-commerce export procedures and further facilitate the growth of agricultural e-commerce exports.

5.2.2. Developing Logistics and International Payment Infrastructure

In the context of cross-border e-commerce of agricultural products, the development of both domestic and international logistics is essential for optimizing supply chains. To achieve this, the Vietnamese government should take proactive measures. First, it should invest in logistics infrastructure and attract capital to key export regions. This involves formulating a comprehensive Logistics Infrastructure Investment Plan spanning five years. The focus of this plan should be the construction of modern warehouses, cold-storage facilities, and transportation hubs within key agricultural export areas. These facilities will enhance storage and transportation capacities, ensuring the quality and timely delivery of agricultural products.

Additionally, the creation of Special Economic Zones for Logistics in strategic locations is essential. These zones can serve as magnets by offering tax incentives and other benefits to attract logistics companies and related industries. In doing so, these zones will foster a concentrated and efficient logistics ecosystem tailored to the specific needs of agricultural exports.

However, infrastructure alone is not sufficient; logistics companies must also enhance their operational capabilities and work closely with export enterprises to mitigate transportation risks. To achieve this, they should engage in Logistics Capacity Building Programs. These programs should focus on improving supply chain management, integrating advanced tracking technologies, and elevating transportation service quality. The government can support these efforts by offering subsidies to make it more feasible for companies to upgrade their operations.

Another critical initiative is the establishment of Joint Risk-sharing Mechanisms between logistics companies and export enterprises. For example, they can jointly invest in insurance policies designed to cover potential losses during transportation. This collaborative approach will distribute risks more evenly and provide a safety net for both parties involved in the logistics process.

In terms of international payment systems, the Central Bank holds significant responsibility. It should implement supervisory policies to ensure secure transactions. Specifically, the Central Bank should issue Payment System Oversight Regulations for international payment systems, comprehensively addressing anti-money laundering (AML), fraud prevention, and data security. These measures will create a secure environment for financial transactions related to cross-border e-commerce.

To ensure compliance, regular audits of payment service providers are essential. Each major provider should undergo at least one annual audit to monitor their operations and prevent misuse or security breaches.

Export enterprises, meanwhile, must carefully evaluate appropriate payment methods for each market to ensure efficient and secure transactions. To assist them, the government, in collaboration with industry associations, should develop Payment Method Evaluation Guidelines. These guidelines should consider various factors, including market preferences, transaction costs, and security risks. Additionally, Payment Option Training should be provided to export enterprises. This training, delivered through webinars, workshops, or online courses, will equip enterprises with the knowledge needed to make informed decisions regarding payment options in international markets.

5.3. Developing a High-Quality Workforce

In the realm of cross-border e-commerce, human resources are undeniably a critical factor for success. For Vietnam, with its ambitions in this sector—particularly regarding agricultural products—prioritizing the training of a workforce with specialized skills is essential. This workforce should possess expertise in both e-commerce and agricultural products while also demonstrating proficiency in foreign languages and international trade law.

The Vietnamese government plays a crucial role in supporting these efforts by implementing policies that encourage specialized e-commerce training programs. Training grants should be provided to educational institutions and enterprises conducting e-commerce training related to agricultural exports. These grants, covering up to 50% of the training costs, will serve as incentives to develop high-quality programs. Moreover, establishing E-commerce Training Centers is necessary. Over the next three years, at least ten specialized centers should be established across the country. These centers should offer comprehensive courses ranging from basic e-commerce operations to advanced international trade and marketing strategies, equipping the workforce with a broad spectrum of relevant skills.

The education sector must also fulfill its responsibilities by aligning curricula with market demands. This requires strengthening Industry-Academia Collaboration, where educational institutions work closely with the e-commerce and agricultural industries. Industry experts should participate in curriculum design, guest lecturing, and internships. To ensure practical relevance, at least 20% of the curriculum should be developed in consultation with industry representatives. Additionally, dedicated career counseling services should be provided within educational institutions. These services should offer detailed insights into career paths in agricultural e-commerce, current job market trends, and the specific skills required for various roles. Such efforts will help students make informed career decisions and better prepare for future employment.

Enterprises also play a significant role in developing the workforce. They should allocate at least 3% of their annual revenue to in-house training programs focused on enhancing employee skills in e-commerce platforms, international marketing, and customer service. Furthermore, joint training initiatives with educational institutions should be encouraged. For instance, an enterprise could collaborate with a local university to offer a specialized course on agricultural e-commerce marketing. Through these collaborations, students gain hands-on experience by working on real-world projects, bridging the gap between theory and practice.

Finally, workers must be proactive in updating their knowledge to meet the ever-changing market demands. To support this, both the government and enterprises should provide incentives for continuous learning. These incentives could include tax breaks for individuals who complete relevant training or bonuses for employees acquiring new skills. Additionally, the use of online learning platforms offering courses related to e-commerce and international trade should be promoted. The government can facilitate access by subsidizing platform fees for workers in the agricultural e-commerce sector. This comprehensive approach will ensure the availability of high-quality human resources, thereby strengthening the competitiveness of Vietnam's cross-border e-commerce exports.

5.4. Embracing the Livestreaming Trend

Livestreaming, with its inherent convenience and visual interactivity, has emerged as a dominant shopping trend. In the context of agricultural exports, enterprises must leverage this trend to effectively connect with consumers. Through e-commerce platforms, businesses can showcase their products and cultivate distinct brand identities in an engaging manner, thereby capturing the interest of international customers.

To facilitate the adoption of livestreaming, the government and industry associations should take proactive measures. First, they should organize Livestreaming Training Programs for agricultural export enterprises. These programs should be comprehensive, covering essential aspects such as livestreaming techniques to ensure smooth and professional broadcasts, content creation strategies to produce captivating and informative streams, and audience engagement methods to foster interaction and build loyal viewership.

Second, Livestreaming Studios should be established in key agricultural export regions. These studios, equipped with professional lighting, high-quality cameras, and advanced audio equipment, will provide an

optimal environment for enterprises to conduct livestreams. To encourage their use, the government could offer subsidies, reducing the financial burden associated with accessing these state-of-the-art facilities.

In addition, Influencer Collaboration Guidelines should be developed. These guidelines will serve as a framework for agricultural export enterprises when partnering with social media influencers. The guidelines should include criteria for selecting influencers, such as their audience demographics, engagement rates, and relevance to the agricultural product niche. Additionally, contract negotiation tips should be provided to ensure fair and mutually beneficial partnerships. Best practices for collaborative livestreams should also be outlined to maximize the promotional impact of the products.

Finally, the government can play a pivotal role by launching Livestreaming Promotion Campaigns at the national level to promote Vietnamese agricultural products. These campaigns could feature well-known local and international influencers, leveraging their extensive followings and influence. To maximize visibility, these campaigns should be promoted across multiple media channels, significantly enhancing the presence of Vietnamese agricultural products in the highly competitive global livestreaming market.

6. Conclusion

In summary, by implementing appropriate policies and strategic orientations and leveraging its inherent advantages in agriculture and e-commerce, China has successfully developed cross-border e-commerce (CBEC) for agricultural exports, achieving notable milestones. The analysis of China's experience suggests that, despite Vietnam's considerable strengths in agricultural production, export capacity, and rapid e-commerce growth, several challenges remain. These challenges include enhancing product quality, building and protecting agricultural brands, and improving the legal framework, logistics infrastructure, and human resource development to meet the demands of international markets.

Furthermore, Vietnam must swiftly adapt to changing consumer behaviors, particularly the rise of livestreaming-based shopping, which has gained momentum due to its high interactivity and visual appeal. Successfully capturing and utilizing these emerging consumer trends will be crucial for businesses to access target markets and foster the sustainable growth of cross-border e-commerce in agricultural exports.

Institutional Review Board Statement

This study did not involve any human or animal subjects and therefore did not require ethics approval.

Informed Consent Statement

Not applicable.

Data Available Statement

All data used in the study were obtained from publicly available sources.

Conflicts of Interest

The authors declare no conflict of interest. There are no financial or personal relationships that could have influenced the research presented in this manuscript.

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Article

China-ASEAN Regional Bond Market Cooperation: Present Situation, Opportunity, and Strategy Choice

Xiuzhen Chen

School of Finance and Insurance, Guangxi University of Finance and Economics, Nanning 530003, China

Abstract: A report from the 20th National Congress of the Communist Party of China underscored the necessity of maintaining the trajectory of reforming the socialist market economy and enhancing global openness. Strengthening cooperation in the China-ASEAN regional bond market and advancing high-level bond market liberalization are essential in establishing financial prowess. This paper reviews and summarizes the China-ASEAN regional bond market development within the context of international cooperation initiatives like the Belt and Road Initiative and the Regional Comprehensive Economic Partnership Agreement (RCEP). It analyzes the current state of international bond markets and local currency bond markets in ASEAN nations, systematically examines the opportunities, challenges, and risks associated with the development of the China–ASEAN regional bond market, and offers strategic recommendations for bond market collaboration based on the financial cooperation realities among these countries. The report provides significant insights for enhancing the Belt and Road Initiative and China-ASEAN financial collaboration within the RCEP framework, fostering regional economic integration and strengthening bond market cooperation and development between China and ASEAN nations.

Keywords: Regional bonds; China-ASEAN; Cooperation; Strategies

1. Introduction

In the context of increasing global economic integration, China has proactively embraced a high-level opening-up strategy and is dedicated to enhancing economic collaboration with ASEAN nations. China-ASEAN bond market cooperation has emerged as a vital component in fostering regional economic integration and facilitating advanced financial deregulation, given its status as one of the most dynamic regional economies globally. In this context, enhancing the bilateral high-level accessibility of the bond market, as a vital element of the financial liberalization strategy, not only functions as an efficient conduit for executing the strategy of establishing robust financial strength but also plays an essential role in bolstering the real economy. Furthermore, it strengthens the Belt and Road Initiative, promotes RMB internationalization, and provides new impetus for regional economic development.

This study, situated within the framework of the Regional Comprehensive Economic Partnership (RCEP) and other international collaborative initiatives, concentrates on China and ASEAN nations as its primary subjects of investigation. This study employs data from reputable sources, including the World Bank and the Asian Development Bank, to examine the present condition of ASEAN countries' international and domestic

currency bond markets utilizing diverse research methodologies. This article rigorously analyzes the prospects, obstacles, and hazards associated with developing the China-ASEAN regional bond market. It provides strategic proposals for bond market collaboration grounded in the objective facts of financial cooperation among these nations. This approach offers novel insights and avenues for enhancing China-ASEAN financial collaboration within the RCEP framework and facilitating regional bond market integration.

2. Literature Discussion

2.1. Domestic and Foreign Literature Review

Research on China-ASEAN regional bond market cooperation has gradually expanded, with scholars analyzing it from various perspectives. On the one hand, scholars have emphasized the potential and advantages of bond market cooperation between the two regions. Xu Changwen, by comparing the economic development structures and import-export commodity structures of China and ASEAN countries, reported significant economic complementarities and substantial potential for economic, trade, and financial cooperation [1]. Yang Panpan, by reviewing the history of China – ASEAN financial cooperation and projecting future trends, highlighted that new trade relations are emerging in the Asian region, with new sectors and businesses flourishing, and that the development of the Regional Comprehensive Economic Partnership (RCEP) has introduced new opportunities for financial cooperation between China and ASEAN countries [2].

On the other hand, scholars have also identified challenges and problems in cooperation. Zhang Jianhua noted that, even after establishing the ASEAN Free Trade Area, trade barriers persist, and intercountry competition remains, hindering information sharing and affecting the development of trade, investment, and bond markets between China and ASEAN countries to varying degrees [3]. Liu Bin further emphasized significant disagreements in the China-ASEAN regional bond market, particularly concerning legal regulations and infrastructure, with the bond markets still needing to be more mature and uneven in development [4].

In terms of research content, domestic scholars have focused mainly on the current state, influencing factors, cooperation models, and strategies of bond market cooperation. By analyzing historical data, they mapped out the development history and current status of bond market cooperation between the two sides while exploring key factors influencing this cooperation. Several models and suggestions for cooperation have been proposed. Zhou Shaofen, from the perspective of bilateral economic and trade relations between China and ASEAN countries, proposed that the two sides collaborate regarding human resources to achieve strategic upgrades in economic and trade cooperation. Through an examination of microlevel and macrolevel regional financial cooperation between China and ASEAN countries [5]. Chen Jianbo outlined prospects such as establishing and improving cross-border trade settlement systems and developing regional bond market construction [6]. Zhang LaiMin, by analyzing the 25-year history of China-ASEAN economic cooperation since the Asian financial crisis, suggested that both sides should synchronize the implementation of supportive macroeconomic policies, strengthen policy communication, and enhance cooperation in various areas, including investment and bonds [7].

Internationally, research on regional bond market cooperation has also been extensive. Scholars examining the development of the Asian bond market, including China, have explored the role of regional bond market cooperation in promoting regional economic development and optimizing resource allocation. These studies have analyzed cases of bond market cooperation in different regions, summarizing both successful experiences and lessons learned. Satoshi Shimizu elaborated on the importance of developing Asian bond markets, including China and Japan, emphasizing the need for balanced cooperation between the two countries and the significance of bond market collaboration. He also noted the importance of addressing balance issues and provided targeted suggestions for market development [8]. Aarti Rughoo, utilizing the convergence methodology of Phillips and Sul (2007), discussed the financial integration of Asia from the perspective of capital and bond markets, explaining the crucial role that the development of Asian bond markets plays in fostering regional economic integration [9].

3. Analysis of the Current Situation of the China-ASEAN Regional Bond Market

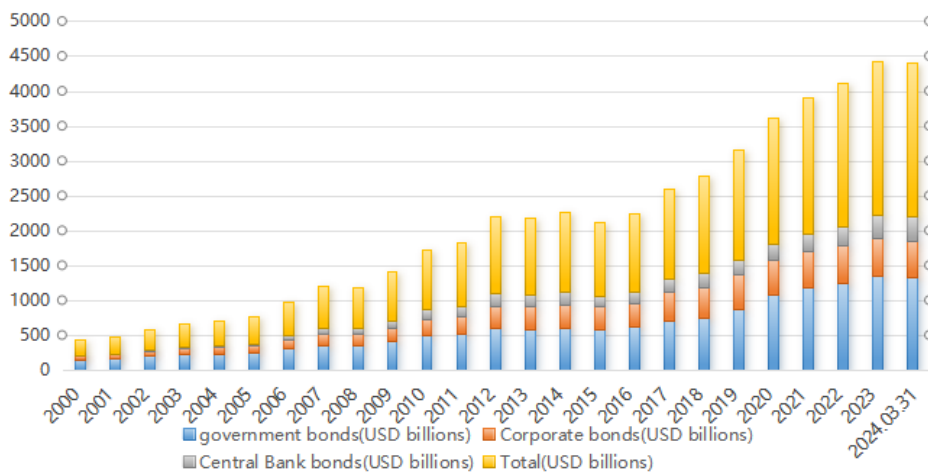*3.1. ASEAN International Bond Market Development Overview and Trends*

Following the 2008 financial crisis, international bond markets in ASEAN nations have evolved swiftly. Between 2015 and 2022, ASEAN countries' total issuance of international bonds demonstrated a variable rising trajectory, reaching a zenith of $108.1 billion in 2020, subsequently decreasing to around $80 billion in 2022 and $56 billion in 2023. Significant discrepancies exist in the development of foreign bond markets among ASEAN countries.

3.2. The Overall Status and Trajectory of the Local Currency Bond Market Development in ASEAN Nations

3.2.1. Coastline and Island Resources

In recent years, ASEAN countries' local currency bond markets have undergone swift advancement. The total issuance volume has seen an increasing trend since 2000. In 2022, ASEAN nations' total outstanding local currency bonds exceeded $2 trillion for the first time. As of March 31, 2024, the aggregate value of local currency bonds in ASEAN nations reached $2.204 trillion, with local currency government bonds comprising $1.342 trillion, or 60.9% of the total. The corporate bond inventory totaled $518 billion, accounting for 23.4% of the overall amount. Refer to Figure 1 for specifics.

Figure 1. Issuance of ASEAN local currency bonds. Source: AsianBondsOnline—Data Portal (adb.org).

From a growth standpoint, Indonesia's local currency bond market expanded from $382.24 billion in 2022 to $427.71 billion in 2023, reflecting a 7.6% gain. The Philippines increased from $200.91 billion in 2022 to $217.11 billion in 2023, indicating a growth rate of 8.0%. The principal local currency bond markets in ASEAN nations have demonstrated substantial expansion.

Regarding the allocation of member nations. Singapore, Thailand, and Malaysia constitute the three predominant local currency bond markets in ASEAN nations, with 24.7%, 21.1%, and 19.5% of the total. As of the first quarter of 2024, Vietnam's local currency bond market is the smallest, accounting for merely 5.24% of the entire market size, with a bond stock valued at $1, 156.5 billion. Vietnam's market has demonstrated significant development potential, rising 3.5% in 2023 over the prior year. Refer to Table 1 for specifics.

Table 1. Until the 1st quarter of 2024, the scale of local currency bonds of China and ASEAN countries was USD 100 million.

Economic Entity	Government Bonds	Corporate Bonds	Central Bank Bonds	Total Amount of Local Currency Bonds
China	130,314	66,338.2	20.8	196,673

Cont.

Economic Entity	Government Bonds	Corporate Bonds	Central Bank Bonds	Total Amount of Local Currency Bonds
India	3704.4	286.6	286.6	4280.4
Malaysia	2495.6	1796.3	27.5	4319.4
the Philippines	1803.8	247.1	136	2186.9
Singapore	1924	1240.9	2281.2	5446.1
Thailand	2687.4	1319.5	648	4654.9
Vietnam	811.2	286.3	59	1156.5

Source: AsianBondsOnline—Data Portal (adb.org).

Regarding market depth. The ratio of local currency bonds to GDP in China and critical ASEAN nations has consistently risen. As of the first quarter of 2024, local currency bonds in China and two ASEAN member nations exceeded 100% of their respective GDPs: China (111.63%), Malaysia (128.84%), and Singapore (107.39%). Thailand's local currency bonds were substantial, representing around 94.01% of its GDP. Singapore possesses the highest share of government bonds among ASEAN nations, accounting for 82.92% of its total local currency bond issuance.

In corporate bonds, Malaysia and Indonesia are prominent, representing 53.58% and 49.12% of their respective local currency bond markets. Even with these enhancements, the progression of local currency bond markets in ASEAN nations remains inconsistent. Vietnam's bond market indicators are comparatively low, indicating significant potential for expansion in its local currency bond market. Refer to Table 2 for specifics.

Table 2. Local currency bonds as a share of GDP in China and selected ASEAN countries as of the first quarter of 2024.

Economic Entity	Government Bonds (%GDP)	Corporate Bonds (%GDP)	Central Government Bonds (%GDP)	Proportion of Total Bonds (% GDP)
China	73.97	37.65	0.01	111.63
Indonesia	27.82	49.12	2.15	32.14
Malaysia	74.44	53.58	0.82	128.84
the Philippines	40.87	5.6	3.08	49.55
Singapore	37.94	24.47	44.98	107.39
Thailand	54.27	26.65	13.09	94.01
Vietnam	19.22	6.58	0	27.48

Source: AsianBondsOnline—Data Portal (adb.org).

4. Opportunities and Challenges Associated with China-ASEAN Regional Bond Market Cooperation

*4.1. China-ASEAN Regional Bond Market Cooperation Opportunities*

4.1.1. China's Bond Market Opening Has Made Significant Progress

The "Thirteenth Five-Year Plan" underscored the necessity to expedite the bond market's connectivity while advancing internal product innovation and improving market liquidity. It emphasizes the necessity of enhancing the efficacy of information exchange. The report of the 19th National Congress of the Communist Party of China emphasized the essential function of financial services in bolstering the real economy, promoting a more significant share of financing, and establishing a multilayered capital market. The aim was to guarantee the continued smooth operation and stability of China's bond market and scale. China's bond market is

undergoing a "golden age" of accelerated expansion, presenting unparalleled strategic potential due to its liberalization and advancement.

The history of the bond market's inception features notable milestones, including establishing the Qualified International Institutional Investor (QFII) system in 2002, which allowed sanctioned institutions to access the bond market via exchanges, thereby providing an entry point for international investors. This signified the commencement of China's initiatives to liberalize its bond market for global investors. From 2005 to 2009, the participation of the Pan Asia Fund and the Asian Debt China Fund in the interbank market significantly advanced the liberalization of China's bond market [10]. In 2010, the People's Bank of China broadened the scope of international participants by permitting overseas central banks, RMB-clearing banks in Hong Kong and Macau, and foreign participating banks to invest in the interbank bond market. The introduction of the Renminbi Qualified Foreign Institutional Investor (RQFII) system in 2011 created supplementary investment avenues for foreign RMB capital. In 2017, a significant development transpired with the launch of "Bond Connect," enabling overseas investors to engage with infrastructure institutions via Hong Kong and invest in the mainland interbank bond market. This enabled international involvement and advanced China's bond market to a higher echelon. In 2019, the State Administration of Foreign Exchange declared the elimination of QFII and RQFII investment quotas, facilitating foreign investors' market access. This time also witnessed the incorporation of RMB-denominated Chinese government and policy bank bonds into prominent global bond indices, including those of Bloomberg and JPMorgan Chase, enhancing the international prominence of China's bond market. In 2023, "Swap Connect" facilitated foreign investors' engagement in the interbank financial derivatives market, enhancing the array of investment instruments and expanding the market's depth and breadth.

China currently occupies the second-largest bond market in the world. The liberalization of China's bond market for foreign investors has progressed consistently, resulting in significant accomplishments. Fueled by extensive reforms and financial liberalization, the bond market has expanded considerably, with its global impact increasing markedly. As of the end of 2023, total bond issuance amounted to 71 trillion yuan, demonstrating an annual growth rate of 15.4% and signifying a robust impetus for ongoing expansion. From a stock standpoint, China's bond market constantly grew from 2013 to 2023, attaining 158 trillion yuan, which signifies a gain exceeding 82% since 2008. Data from the Bank for International Settlements (BIS) indicates that the total outstanding domestic bonds in China after 2023 amounted to USD 22,164.1 billion, affirming China's status as the second-largest bond market globally. Refer to Figures 2 and 3 for specifics.
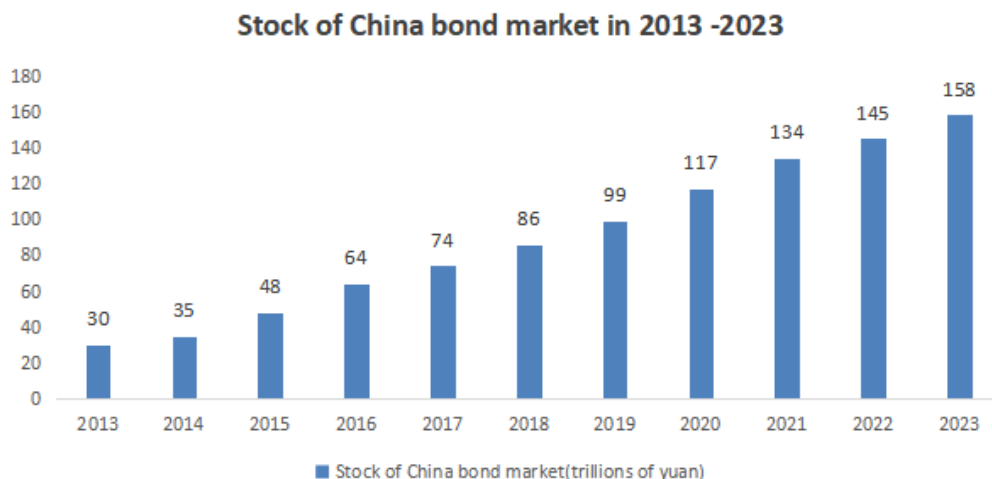
Figure 2. Stock of the China bond market from 2013–2023. Source: People's Bank of China.
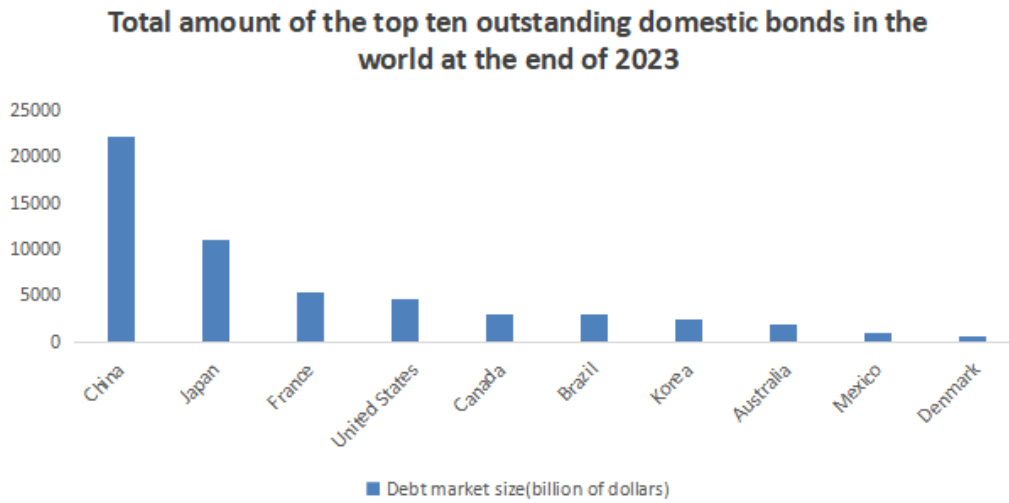
Figure 3. Total amount of the top ten outstanding domestic bonds in the world at the end of 2023. Source: Bank for International Settlements (BIS).

The quantity of players in the bond market has markedly increased in recent years. China and ASEAN nations have proactively enacted policies to stimulate foreign capital influx into their domestic bond markets while concurrently easing limitations on international investments by both domestic and foreign investors. The continuous improvement of financial infrastructure in the region has created a conducive atmosphere for heightened involvement in the bond market.

Foreign capital inflows in China's bond market have significantly increased. By the first quarter of 2024, foreign investors' total value of bonds reached 4.27 billion yuan. By the conclusion of 2023, foreign investors possessed bonds amounting to 3.67 trillion yuan, signifying an 8.3% rise relative to the end of the preceding year, constituting 2.7% of the overall bond market. Foreign investors mostly had government and policy bank bonds. Government bond holdings totaled 2.29 trillion yuan, reflecting a marginal decline of 0.1% compared to the prior year. In contrast, holdings of policy bank bonds rose to 796.3 billion yuan, reflecting a year-over-year gain of 6.8%.

The rise in foreign ownership of Chinese bonds signifies an increasing acknowledgment and involvement of international investors in China's market, consequently expanding the investor base and augmenting market activity. These accomplishments establish a robust basis for the collaborative progress of the China–ASEAN regional bond market. Refer to Table 3 for specifics.
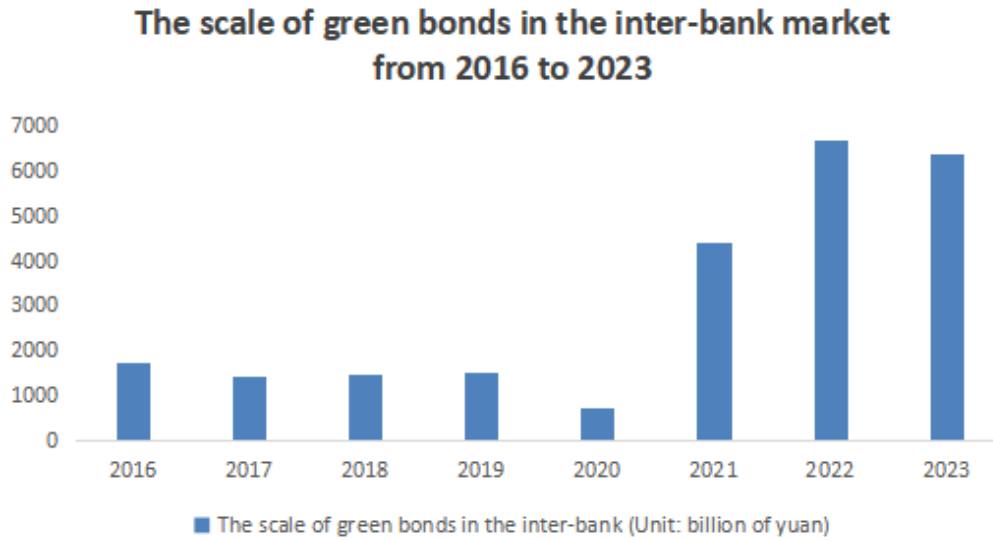
Table 3. Bond custody in the interbank market from 2022–2023 (Unit: 100 million yuan).

Mechanism type	Shanghai Clearing House		Central Clearing Company's		Total	
	2023	2022	2023	2022	2023	2022
Deposit-type financial institutions	97,597	81,706	702,489	625,061	800,086	706,767
Insurance and securities institutions	18,006	13,133	58,529	50,631	76,535	63,764
Unincorporated product	186,912	182,351	172,421	166,259	359,333	348,610
Foreign investors	5291	2728	31,399	31,145	36,689	33,872
other	31,879	29,077	51,248	51,099	83,127	80,176
total	339,684	308,995	1,016,086	924,196	1,355,770	1,233,190

Source: Shanghai Clearing House, Central Clearing Company, and China Association of Interbank Market Dealers.

The diversity of bonds in the market is constantly evolving, with new instruments like green bonds exhibiting substantial growth velocity. Between 2016 and 2023, the volume of China's green bonds

demonstrated a consistent rising trajectory, although a significant decline attributable to the pandemic in 2020. In 2022, there was a significant increase rate of 51.38% relative to the prior year, highlighting robust recovery. Refer to Figure 4 for specifics.

The scale of green bonds in the inter-bank market from 2016 to 2023

■ The scale of green bonds in the inter-bank (Unit: billion of yuan)

Figure 4. The scale of green bonds in the interbank market from 2016 to 2023. Note: Data include green financial bonds and green debt financing instruments. Source: China Interbank Market Trading Association (NAFMII).

China has become one of the significant green bond markets worldwide, as demonstrated by the rising issuance of green bonds by domestic and international companies. The variety of bond types has expanded in recent years, especially regarding green and transition bonds. As of the conclusion 2023, carbon-neutral bonds, explicitly intended to finance initiatives aimed at diminishing carbon emissions, amounted to 388.88 billion yuan. Furthermore, sustainable development-linked bonds (SLBs), which associate bond conditions with the issuer's sustainable development objectives, totaled 65 issuances, aggregating to 73.4 billion yuan. Transition bonds designed to support low-carbon transitions in industries including power and nonferrous metals raised 5.13 billion yuan. The creation and spread of new bond products have enhanced the bond market's offerings, efficiently addressing the diversified investment requirements of stakeholders.

4.1.2. The Internationalization of the RMB Facilitates the Advanced Liberalization of the Bond Market

In recent years, the significance of the RMB as a finance currency has been progressively highlighted, facilitating its nationalization. RMB-denominated bonds have garnered recognition in the international capital market due to features including comparatively low financing costs and steady currency value, enhancing foreign investors' capacity to augment their holdings of RMB bonds.

The proportion of the RMB in worldwide commerce has steadily risen. As of December 2023, the use rate reached 4.14%, reflecting an increase of 2.23 percentage points from the start of the year, positioning it as the fourth-largest payment and settlement currency globally. In February 2024, the rankings of the top five currencies were as follows: US dollar at 45.56%, euro at 23.25%, pound at 6.9%, RMB at 4%, and Japanese yen at 3.73%, with the RMB retaining its status as the fourth most active currency worldwide.

The Bank of China developed the Cross-border RMB Index (CRI), based on the International Monetary Fund's SDR review index, to evaluate the extent of RMB internationalization. The CRI, monitoring RMB cross-border activities, has exhibited a steady upward trajectory, attaining a record high of 364 points at the end of 2023, signifying a 5.8% rise from the prior year. This signifies a substantial increase in the cross-border use of the RMB. Refer to Figure 5 for specifics:

Cross-border RMB Index (CRI) of China Bank

Figure 5. Cross-border RMB Index (CRI) of the China Bank. Source: Bank of China.

Concerning the cross-border utilization of the RMB in nations along the "Belt and Road" and within the RCEP region, figures from the International Settlement System (SWIFT) demonstrate a strong growth trajectory. In 2023, the RMB customer remittance sector among RCEP member nations experienced an annual growth rate of 20.4%. The transaction volume of RMB client remittances in Belt and Road countries rose significantly by 21.1%. This indicates the increasing significance of the RMB in the payment systems of East Asian nations, along with a cheerful readiness among these countries to embrace the currency.

Significant advancements have been achieved in international financial collaboration at the infrastructural level. Forty-one countries and territories have executed bilateral local currency swap agreements of 4 trillion yuan. These agreements bolster the stability of the international financial system and provide a broader array of currency options for cross-border commerce and investment. Moreover, establishing RMB-clearing institutions in nations such as Brazil, Cambodia, and Serbia has increased the total number of locations with RMB-clearing capabilities to 33, thereby significantly expediting RMB internationalization. This advancement fosters a conducive atmosphere for the expansion of the bond market.

4.1.3. Cooperative Agreements within the Context of Regional Economic Integration

In the current age of increasing globalization, the "One Belt and One Road" initiative, the formal enactment of the Regional Comprehensive Economic Partnership Agreement (RCEP), and the establishment of financial openness with ASEAN offer substantial opportunities for advancing global economic integration and improving the accessibility of financial markets. These cooperation agreements provide a comprehensive framework for participating nations and establish advantageous conditions for China to leverage the strategic opportunity presented by the emergence of a high-level bond market.

In 2023, the RCEP—a significant free trade agreement covering one-third of the global population, economic output, and trade volume—was fully implemented for the 10 ASEAN countries and all signatory states, heralding the emergence of Free Trade Area 3.0. This milestone has unequivocally revitalized China's strategy for enhancing its high-level opening. Implementing the RCEP is anticipated to enhance the liberalization and facilitation of intraregional trade, diminishing both tariff and non-tariff obstacles. Moreover, it would enhance market potential and provide new opportunities for economic collaboration among member nations through standardized legislation and mutual recognition of standards.

In this setting, China's bond market, as a crucial element of the financial landscape, is positioned for exceptional potential for growth and advancement. This tendency enhances regional economic and financial collaboration and promotes the unrestricted movement and optimal distribution of production resources, including capital, technology, and talent. With the intensification of regional economic integration, the frequency of associated domestic and international financial transactions rises, offering substantial trading

opportunities and significant growth potential for the bond market.

4.1.4. The Facilitation of Cross-Border Investment and Financing Has Been Dramatically Improved

The continuous liberalization of financial markets and innovative tactics have greatly enhanced the unrestricted movement of cross-border capital between China and ASEAN nations, infusing essential capital into the bond market. As the Qualified Domestic Institutional Investor (QDII) system matures, domestic investors increasingly leverage QDII and other avenues to allocate overseas assets and participate extensively in international bond market investments.

"Bond Connect" is a vital conduit for international capital entering the Chinese bond market, yielding significant outcomes since its establishment. By implementing innovative strategies, including optimizing the market entry procedure and introducing a multitiered custody system, "Bond Connect" has successfully diminished transaction and time costs for foreign investors, thereby enhancing market operational efficiency. By the conclusion of May 2024, approximately 1100 international institutions from more than 70 countries and regions, including various central and commercial banks, have entered the Chinese market via this mechanism. The participation of these institutions not only broadens the investor base in the Chinese bond market but also substantially enhances market activity and global influence.

The "Exchange Link" service, initiated in May 2023, has enhanced the involvement of foreign investors in the financial derivatives markets of mainland China and Hong Kong, catering to various investor requirements in interest rate risk management. The simultaneous enhancement of the pilot "cross-border wealth management" initiative has improved investor access conditions, broadened the range of participating institutions, diversified eligible investment options, and refined marketing techniques. This advancement revitalizes the interconnectedness of cross-border capital flows and financial markets.

4.2. China-ASEAN Regional Bond Market Cooperation Challenges and Risks

4.2.1. Differences in Laws and Regulations and Regulatory Coordination Issues

The variation in national legal frameworks has resulted in notable disparities between China and ASEAN nations concerning bond market laws. This variation is evident in the fundamental differences between legal systems and specific regulations concerning market access, information disclosure standards, investor protection mechanisms, and other essential domains. Countries like Indonesia, Malaysia, and Singapore have developed local currency bond markets and sophisticated legal systems. In contrast, Vietnam and Brunei have inferior accounting and auditing standards and require more robust local accounting frameworks. This scenario exacerbates legal ambiguity in the collaboration of the China-ASEAN regional bond market.

Countries implement diverse limitations and regulatory processes for foreign money into their local bond markets, complicating and elevating transnational bond issuance costs. Divergent information disclosure standards lead to inconsistent transparency, impacting investors' decision-making efficacy and confidence. Moreover, discrepancies in investor protection systems significantly affect the protection of cross-border investors' rights. Disparities in compensation systems and legal processes among nations may impede investors' capacity to secure prompt and effective remedies against risks.

Moreover, disparities between legal systems create ambiguities in legal interpretation and execution. Courts or regulators across several countries may interpret identical legal terms divergently, heightening the risk associated with cross-border bond contract execution. This problem is especially evident in intricate legal issues like breach of contract and bankruptcy, where discrepancies in the implementation and enforcement of laws can intensify market instability and hazards.

4.2.2. Market Maturity and Investor Protection Issues

The regional bond market's maturity is comparatively low. Even with significant expansion in recent years, the bond markets of China and ASEAN nations still require advancement in scale and liquidity to match those of industrialized countries. As of 2024, although China's bond market is one of the largest in the world, ASEAN

bond markets are fragmented and need more. The market size discrepancy restricts cross-border bond issuance's diversity and appeal.

From a liquidity standpoint, the restricted number of market players and dormant trading lead to extensive bid-ask spreads and elevated transaction costs. Thus, the bond market requires greater depth to entice international investors, thereby hindering the sufficient flow of cross-border money. The regional bond market's infrastructure requires development, as it currently needs a cohesive, mature, and efficient trading system, clearing and settlement procedures, credit rating systems, and information disclosure platforms. These limitations impede market efficiency and discourage broad investor engagement. Moreover, the restricted range of bond products and services needs to satisfy the varied requirements of investors, highlighting a necessity for enhanced market maturity.

Investor protection is essential for the robust growth of the bond market, yet considerable deficiencies persist within the current China–ASEAN regional bond market. Significant disparities exist in the rules and regulations about investor protection and bond information disclosure among ASEAN nations. The disjointed legal landscape increases compliance expenses for cross-border investors and generates doubts concerning safeguarding their rights and interests. The lack or insufficiency of collaborative oversight systems hinders efficient cross-border regulatory cooperation and exacerbates the difficulties related to market risk prevention and management.

4.2.3. National Financial Risk Events

From the sovereign debt crisis standpoint, ASEAN nations are contending with escalating pressures due to rising public debt. Extended dependence on external funding and substantial fiscal deficits lead to considerable debt liabilities. Assume a nation must administer its debt efficiently. Consequently, it risks entering a sovereign debt crisis, which may negatively impact its financing capability and credit rating in the regional bond market.

Moreover, currency depreciation presents hazards. In a worldwide economy, variations in currency rates substantially influence the bond market. The globalization and stability of local currencies in ASEAN nations require enhancement. Variations in these currencies relative to the US dollar or the RMB might modify capital flows, influencing the bond market's supply-demand dynamics and pricing trends.

Furthermore, global financial instability might induce rippling effects in the regional bond market. Alterations in the Federal Reserve's monetary policy or abrupt variations in international oil prices might instigate substantial transformations in the global financial environment. The China-ASEAN regional market is susceptible to these shocks, which may disrupt the regional bond market.

5. The Strategic Choice of China-ASEAN Regional Bond Market Cooperation

5.1. China's Strategic Choice to Promote Regional Bond Market Cooperation

5.1.1. Enhancing the Ecological Framework of the Bond Market and Expediting Its Internationalization

To strengthen the bond market in the ASEAN area, China should prioritize optimizing its ecological environment, establishing an open market that fosters economic growth, and advancing globalization.

First, strengthening the infrastructure of China's bond market is essential. This includes improving the trading system, clearing and settlement mechanisms, and information disclosure platforms. Such enhancements will increase the efficiency and security of market operations, providing a solid foundation for both practical and international development.

Second, improving transparency in the bond market is crucial. Establishing a robust information disclosure system will require issuers to provide timely, accurate, and comprehensive information, thereby protecting investors' rights. Strengthening market monitoring and early warning mechanisms will help identify and address risk events, ensuring market stability and enhancing the ecological environment.

Finally, improving the openness of China's bond market is necessary. This involves gradually easing restrictions on market access, lowering entry barriers, and promoting regional interconnection. China can increase its bond market's internationalization level by facilitating resource sharing and enhancing engagement

with international capital markets.

5.1.2. This Significantly Advances the RMB Internationalization and Elevates the Global Recognition of RMB Bonds

From a macroeconomic standpoint, He Ping Scholar employed empirical analysis to demonstrate that the network effect of the payment function substantially influenced the currency composition of foreign bond-denominated currencies and advocated for the advancement of the offshore RMB market [11]. Advancing the internationalization of the RMB and augmenting the global acceptance of RMB bonds can significantly foster collaboration and growth within the China-ASEAN regional bond market.

In comparison to the trade volume between China and nations participating in the "Belt and Road" initiative, the contribution of these nations to the overall cross-border transactions in the offshore RMB market remains inadequate. Compared to 2022 data, the percentage of these nations in the worldwide RMB payment and settlement market stayed constant while their share in global RMB foreign exchange transactions rose. Nonetheless, their proportion in the worldwide RMB trade financing market experienced a minor decline. The cross-border utilization of the RMB has achieved substantial market recognition in nations participating in the Belt and Road Initiative, indicating considerable potential for enhancement in the offshore RMB market and opportunities for further internationalization of the RMB in East Asian countries involved in the initiative. As illustrated in Figure 6.
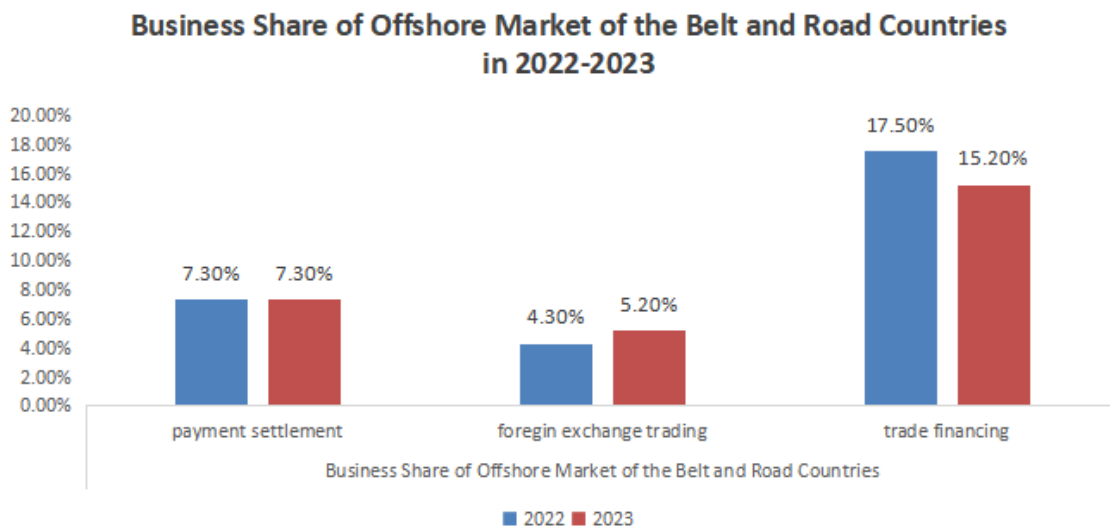
Figure 6. Business Share of the Offshore Market of the Belt and Road Countries from 2022 – 2023. Source: White Paper on the RMB Internationalization of the Bank of China.

This significantly advances the internationalization of the RMB and elevates the recognition of the RMB bond market. Initially, we should enhance the transnational utilization of the RMB. Enterprises ought to be incentivized to utilize the RMB more frequently for settlements in cross-border commerce and investment, thereby enhancing the prevalence of RMB transactions and elevating its recognition inside the international community. Furthermore, we will augment the investment and financing capabilities of the RMB; facilitate its utilization in international credit development, infrastructure investment and financing, commodity pricing, and e-commerce pricing and settlement; and strengthen the investment and financing roles of the RMB within the "Belt and Road Initiative" and the RCEP cooperation framework. Secondly, the RMB exchange rate must be stabilized, the RMB's status as an international settlement currency should be preserved, and the flexibility and market orientation of the RMB exchange rate should be enhanced. To enhance the internationalization of the RMB bond market, it is imperative to robustly develop the offshore RMB market, establish a cohesive, deep, and highly liquid offshore RMB trading network and system globally, and offer efficient RMB trading and clearing services for international investors. Furthermore, the volume of offshore bond issuance should be

augmented, and global influence should be enhanced. Leveraging the "Belt and Road" initiative and RCEP agreements, we will intensify multilateral financial collaboration, broaden RMB bonds' reach, and augment RMB bonds' international prominence.

5.1.3. Cross-Border Bond Transactions Should Be Facilitated, and Limitations on Foreign Market Access Should Be Alleviated

The transaction process for cross-border bonds requires optimization. The registration, approval, and settlement processes for cross-border bond transactions must be streamlined; electronic trading systems should be widely adopted; the online automation of these transactions should be achieved; cumbersome procedures should be minimized; operational costs should be lowered; and transaction efficiency should be enhanced. The offerings of cross-border bonds should be diversified. Promote and facilitate the issuance of varied cross-border bond instruments; endorse the advancement of emerging bonds, including green bonds, transition bonds, and other technological innovations; enhance the development of the derivatives market; offer investors a broader array of risk hedging instruments; and invigorate market dynamism and innovation. The constraints on access to overseas capital markets should be alleviated. The restrictions on foreign investment access are progressively eased, market entry barriers in manufacturing and service sectors are diminished, the criteria and standards for foreign investment are delineated, and the transparency and predictability of foreign investment access are improved. Furthermore, we may advance institutional openness, enhance the development of open platforms such as the China-ASEAN Pilot Free Trade Zone and Free Trade Port, fortify alignment and integration with international economic and trade regulations, and foster institutional openness.

5.2. Selection of the Collaboration Mechanism for the China-ASEAN Regional Bond Market

5.2.1. The Regulatory Cooperation Mechanism between the Two Parties Should Be Improved

When choosing a cooperation mechanism for the China-ASEAN regional bond market, it is crucial to enhance the supervisory cooperation framework and fortify the coordination and harmonization of laws and regulations. China and ASEAN nations have strengthened the synchronization of legal frameworks in the bond market via bilateral and multilateral agreements and international treaties. Establishing and optimizing the supervisory cooperation mechanism between the bond markets of China and ASEAN nations will promote coordinated oversight and collaborative law enforcement, ultimately improving supervisory efficacy.

Moreover, augmenting the capability for risk management and control is essential. As the bond market progressively opens, the investment accessibility for foreign institutions has enhanced; however, the criteria for their qualification assessments must remain rigorous to avert speculative capital from undermining local market stability. Due to the increasing impact of global financial cycles, adhering to the notion of macroprudence is essential. This involves increased vigilance about risk mitigation, prompt modifications to the parameters and objectives of risk surveillance, and meticulous observation of changes in market attitude and foreign policies. These measures will regulate the speed of bond market opening and provide early warning and contingency plans in reaction to substantial capital flow variations.

5.2.2. An Efficient Information-Sharing Mechanism Is Established

In China-ASEAN regional bond cooperation, establishing a practical information-sharing framework is essential for improving market transparency, cultivating trust and collaboration among market participants, and advancing the robust development of the regional bond market.

Promoting cross-border information collaboration and exchange by creating routes for disseminating market information between China and ASEAN nations is imperative, thus ensuring unobstructed access to pertinent data. Secondly, enhancing the synchronization of regulatory information is essential. China and ASEAN nations should establish a systematic regulatory exchange mechanism to disseminate information swiftly regarding bond market dynamics and regulatory advancements.

Moreover, expanding regional talent interchange is essential. Guangxi, a conduit between China and

ASEAN nations, can facilitate collaboration among universities and financial organizations in both areas. By instituting collaborative financial talent development programs, we can nurture financial professionals with global perspectives and expertise, facilitating regional bond market collaboration.

For industry professionals, regular exchange meetings and seminars can facilitate knowledge sharing and collaboration, enhancing understanding and trust among participants. Moreover, consolidating financial resources within a region and establishing a comprehensive financial service platform will enhance service quality and efficiency while offering crucial support for the collaboration and advancement of the China-ASEAN regional bond market.

5.2.3. Optimize the Bond Issuance and Trading Mechanism

Facilitating cross-border issuance is essential. The approval process for cross-border bonds should be streamlined, the issuance cycle abbreviated, the issuance costs minimized, and accessible cross-border issuance services offered to qualifying firms. Furthermore, we must enhance information rating collaboration, advocate for developing mutual recognition information rating standards between China and ASEAN nations, augment the transparency and credibility of cross-border bonds, and diminish the information acquisition costs for investors. Ultimately, collaboration between China's central depository and clearing institutions and those of ASEAN countries should be progressively advanced. Certain bonds issued in China may be transferred to foreign entities to streamline account establishment, registration, and settlement for overseas investors [12]. Enhance collaboration and advancement of the China-ASEAN regional bond market by refining and perfecting bond issuance and trading processes.

5.3. Future Prospects of China-ASEAN Regional Bond Market Cooperation

As one of the most dynamic regional economies in the world, China-ASEAN regional bond market cooperation has become a critical link in promoting regional economic integration and high-level opening of finance. Facing the cooperation opportunities in four aspects, namely, China's bond market opening has made significant progress, RMB internationalization promotes high-level opening of the bond market, cooperation agreements in the context of regional economic integration, and the facilitation of cross-border investment and financing has been significantly improved, there are also challenges and risks in terms of the differences in laws and regulations, market maturity, and the contagion of financial risks. With the deepening financial cooperation between China and ASEAN, the optimization of the bond market ecosystem, and the deepening of regional economic integration, the development of the China-ASEAN regional bond market will explode with great potential and achieve win-win economic cooperation.

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Conflicts of Interest

The author declares no conflict of interest.

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Article

Current Status and Analysis of Employment and Unemployment Statistics in China and Vietnam

Thi Thao Nguyen

School of Economics and Management, Qingdao University of Science and Technology, Qingdao 266061, China

Abstract: This research examines the employment and unemployment situation in China and Vietnam from the perspective of their employment and unemployment statistical survey systems and methods. Firstly, based on the International Labour Organization's definitions of employment and unemployment, the paper compares the conceptual definitions of employment and unemployment in China and Vietnam, further analyzing the similarities and differences in the statistical survey methods of the two countries. Secondly, it provides a comprehensive description of the basic situation of the labor market employment and unemployment in China and Vietnam from 2018 to 2023, revealing the common challenges faced by the employment markets of the two nations. Finally, based on the analysis of issues related to employment and unemployment statistics in China and Vietnam, the paper proposes targeted countermeasures and suggestions to improve the stability of the employment market and enhance the protection of workers' rights.

Keywords: China; Vietnam; employment statistics; unemployment statistics; employment situation

1. Introduction

Between 2019 and 2023, the COVID-19 pandemic had a profound impact on the global economy, causing significant fluctuations in labor markets. According to the 2022 10th edition of the ILO World of Work Monitor Report, 94% of countries and regions worldwide closed workplaces to contain the virus's spread. By early 2022, most countries had gradually lifted restrictions, with China following suit by relaxing its controls in December of that year [1]. This easing of measures led to a resurgence of economic activity across various regions; however, the recovery in labor markets varied. In developed economies, employment rates generally returned to or even surpassed pre-pandemic levels, creating a gap in labor demand. In contrast, some countries faced declining economic activity and increasing fiscal deficits due to protective policies, resulting in substantial employment pressures. In 2023, the ILO projected that global unemployment rates would remain below pre-pandemic levels in the coming years; however, low-income countries still exhibit notable employment gaps during their economic recovery.

As important neighboring countries in East Asia, both China and Vietnam implemented strict control measures during the pandemic, but differences in economic and socio-cultural backgrounds led to distinct labor market responses. China, with the world's largest population and third-largest land area, is also the world's second-largest economy, characterized by abundant labor resources and a diverse industrial structure. Vietnam, meanwhile, is a rapidly growing emerging economy in Southeast Asia, with abundant natural resources and an

active export market. Studying the current state and trends in both countries' labor markets will aid in developing more effective employment policies, optimizing human resource allocation, and supporting regional economic cooperation and cultural exchange.

Employment forms the foundation of economic and social stability and development. Understanding the current conditions and trends in the labor markets of both countries aids in formulating targeted policies and measures to promote balanced distribution of employment opportunities and the effective flow of labor. Unemployment is closely tied to social stability and public well-being; analyzing changes in unemployment rates and identifying underlying causes help reveal potential risks and issues in the labor market, allowing for timely intervention and prevention. Examining the differences and characteristics of employment and unemployment in both countries provides essential insights for economic cooperation and labor mobility, facilitating mutual growth in trade, cultural exchange, and other areas of regional collaboration. This paper comprehensively reviews and analyzes the employment and unemployment statistical survey systems, methodologies, and current conditions in China and Vietnam. It explores both countries' statistical systems, policy measures, employment conditions, and social security, with the aim of offering insights for developing more scientifically grounded employment policies, providing theoretical support for corporate recruitment and talent development, and making positive contributions to the prosperity and stability of the China-Vietnam economy.

In recent years, the issue of cross-border employment between China and Vietnam has also gained widespread attention. This phenomenon involves migration, labor mobility, and illegal employment, becoming a focal point of research. Chinese and Vietnamese scholars have conducted in-depth studies on this topic, analyzing China-Vietnam cross-border employment issues from policy, economic, and social perspectives, exploring the impact of migration policies, employment opportunities, and illegal employment, and proposing relevant countermeasures, as demonstrated by Hou Shanghong and Meng Xinxin in 2021 [2]. Another study, conducted through field surveys and data analysis, examined illegal migration and employment along the China-Vietnam border, with Chongzuo City as a case study, investigated by Li Guoliang and Pan Minyi in 2018. Their research highlighted the conflicts between border control policies and the demand for cross-border labor, proposing solutions for managing illegal immigration and employment [3]. Furthermore, the current status of Vietnamese cross-border labor was reviewed from a humanistic perspective, along with proposed human resource management measures for China-Vietnam cross-border labor, in a study by Chen Xue in 2021 [4].

Although there is extensive research on labor market issues in both China and Vietnam, comparative studies on their employment and unemployment statistical systems and methods remain scarce. In particular, with the growing focus on new forms of employment, a comparative study of the employment and unemployment statistics between China and Vietnam is increasingly important, providing a scientific reference for understanding these trends in the new era and serving as a foundation for future policy development and practice.

2. Comparison of Employment and Unemployment Statistics Systems and Methods between China and Vietnam

2.1. Overview of China and Vietnam

China and Vietnam are neighboring countries with close relations. Since the 1980s, both countries began transitioning from traditional agricultural economies and initiated market reforms—China starting in 1978 and Vietnam in 1986. Initially, both countries had similar per capita incomes; however, China's economy grew more rapidly, with its per capita GDP reaching $12,174 in 2023, compared to Vietnam's $3,817.2. Differences in land area and population size are also significant factors in the economic disparity between the two countries: China's land area is 29 times that of Vietnam, and its population exceeds 1.4 billion, while Vietnam's population stands at just over 100 million (as shown in Figure 1).
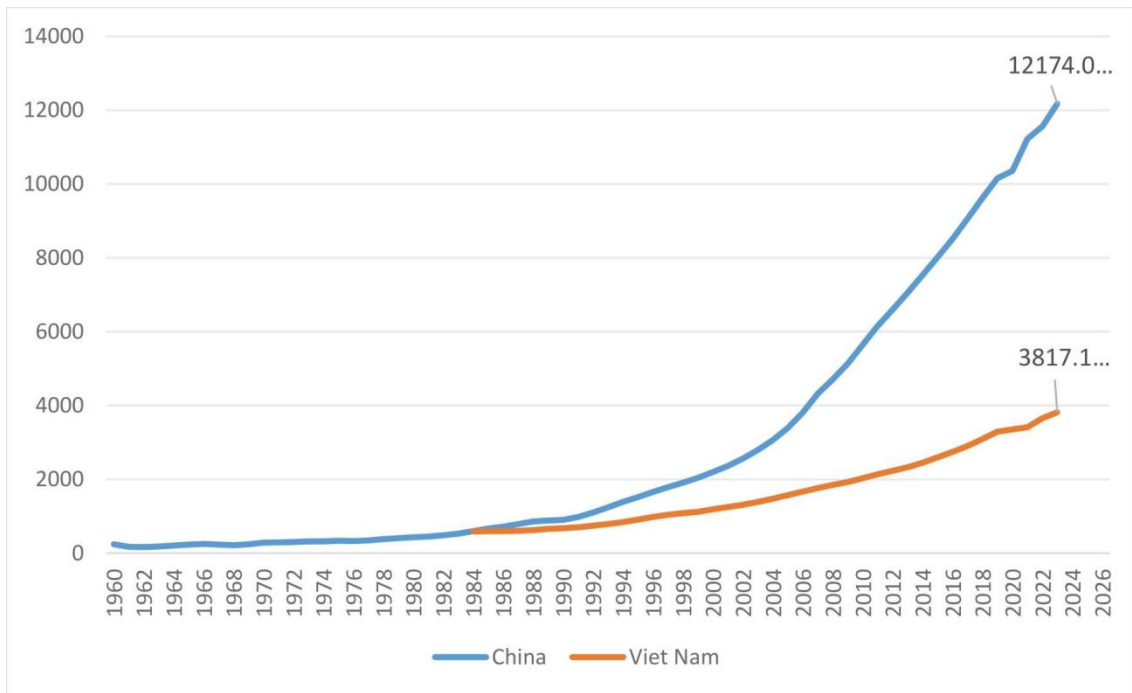
Figure 1. Comparison of GDP per capita (constant 2015 US $) between Vietnam and China (1960 – 2023). Source: World Bank Data (data.worldbank.org.cn).

Both Vietnam and China have a pyramid-shaped labor force population, with each country currently in a demographic period advantageous for labor, as the labor force comprises over 60% of the total population (As shown in Table 1). China's labor structure is gradually aging, whereas Vietnam's population remains relatively young, with 22% of the population aged 0 – 14. This youthful demographic provides Vietnam with abundant labor resources, supporting its economic development.

Table 1. Population Structure by Age in China and Vietnam in 2022.

	Vietnam			China	
Age Group	**Population （million people）**	**Proportion**	**Age Group**	**Population （million people）**	**Proportion**
0-14	22.18	22.30%	0-15	256.9385	18.20%
15-59	63.55	63.90%	16-59	875.56	62%
60-64	4.67	4.70%	60-64	70.26	4.90%
65+	9.05	9.10%	65+	209.78	14.90%

Source: National Statistics Bureau (China and Vietnam).

2.2. Comparison of Employment and Unemployment Concepts and Survey Methods

Employment and unemployment are two core indicators that reflect the current state of the labor market, indicating a country's level of economic development, policy effectiveness, and social welfare standards. These indicators are of critical importance for national and social stability. It is essential to clarify the definitions of employment and unemployment, as well as the statistical survey methods used internationally and in both China and Vietnam.

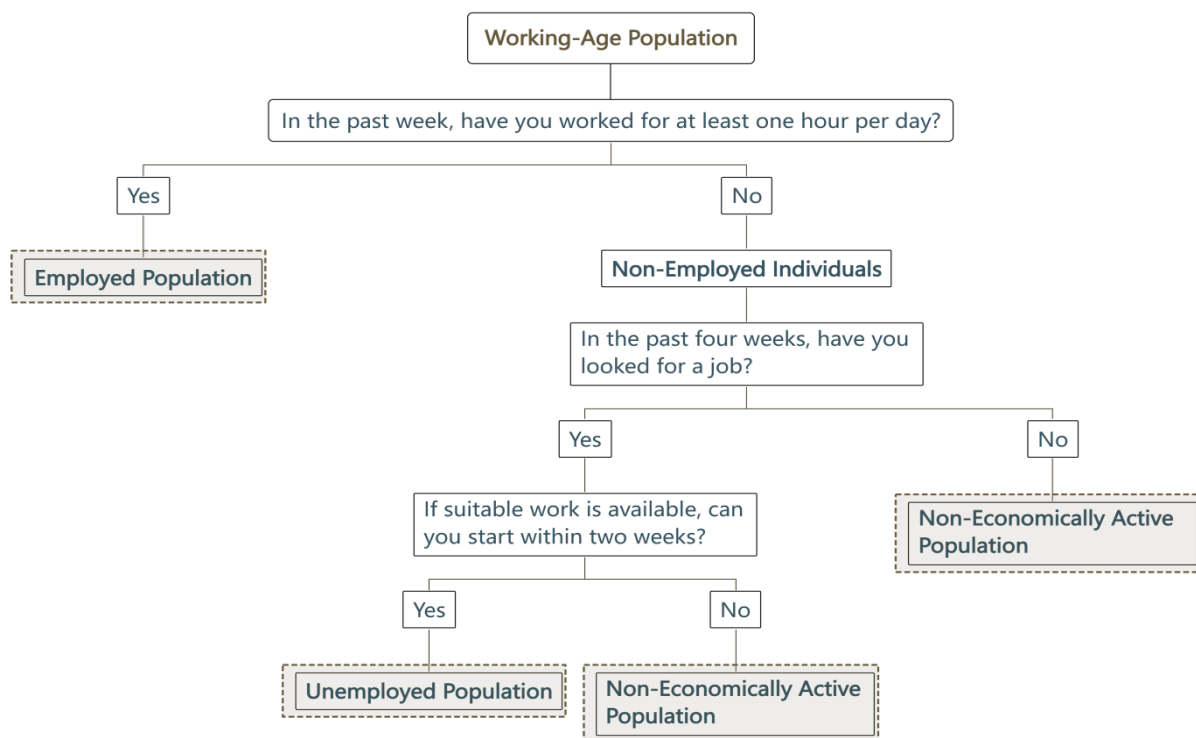2.2.1. Definitions of Employment and Unemployment by the International Labour Organization (ILO)

The 13th International Conference of Labour Statisticians (ICLS) in 1982 defined "employment" as individuals who, during the reference period (the past week), engaged in any work for pay or profit or worked

without pay in a family business or farm for more than one hour daily. Individuals temporarily absent from their jobs due to illness or other reasons were also classified as employed. Unemployment was defined as those of working age who, in the past week, had no job, were actively seeking work, and were available to start within the next two weeks. The labor force is the sum of the employed and unemployed, while the economically inactive population includes individuals of working age who are not part of the labor market (such as students, active military personnel, etc.) [5].

Figure 2 illustrates the ILO's classification logic for employment, unemployment, and economically inactive populations. For individuals of working age, those who worked at least one hour per day in the past week are classified as employed; those without work who actively sought a job in the past four weeks and are available to start within the next two weeks are considered unemployed. Others who are not actively seeking or are unwilling to work are classified as economically inactiv.

In 2013, the 19th International Conference of Labour Statisticians (ICLS 19) updated these standards by excluding "subsistence production activities" from the definition of employment, so that household labor for self-sufficiency is no longer counted as employment [6,7]. The update aimed to more accurately reflect changes in the global labor market and emerging forms of employment, such as remote work and platform-based economies. This update improved the accuracy and international comparability of statistical data, helping countries to more effectively develop policies and promote international cooperation in response to the challenges posed by technological advancements and globalization.

Figure 2. ILO Classification of Employed Population, Unemployed Population, and Economically Inactive Population.

2.2.2. Definitions of Employment and Unemployment in China and Vietnam

As members of the International Labour Organization (ILO), both Vietnam and China adhere to the ILO's conceptual framework and standards for labor and employment. However, notable differences remain in the scope of employment and unemployment definitions between the two countries. To ensure data aligns with consistent international standards, both China and Vietnam apply the ILO's standard definitions of employment and unemployment in their labor force surveys, implementing ILO-recommended standards to maintain comparability with data from other countries, which is crucial for integration into the global economic system.

Within the limits allowed by ILO-recommended standards, each country defines the working-age population

slightly differently. According to Table 2, China's legal working age starts at 16 years, covering only the urban population, while Vietnam's begins at 15 years and encompasses the entire country. In China, the definition of the employed population includes individuals who work at least one hour per week and those who are temporarily absent from work but retain a job relationship. Vietnam's definition is broader, encompassing all activities aimed at profit generation or service provision, whether involving goods production or service delivery.

Regarding the definition of unemployment, China imposes a three-month job search period and requires that unemployed individuals be available to start work within the next two weeks. Vietnam has a more inclusive definition, covering all working-age individuals who have sought work within the last 30 days but have not yet found a job. Additionally, China excludes individuals who exceed the retirement age from labor force statistics, while Vietnam includes those beyond retirement age if they are still actively seeking employment. China has also made adjustments to align with domestic labor laws, such as adding the option of "whether someone else is commissioned to seek work on their behalf" in surveys and extending the reference job search period to three months. In contrast, Vietnam follows the ILO's four-week standard. Given differences in working age, job search period, and retirement age regulations, China's unemployment data tends to be slightly higher than Vietnam's.

Table 2. Definitions of Employment and Unemployment in China and Vietnam.

Indicator	China	Vietnam
Working Age	≥16 to retirement age	≥15
Statistical Scope	Urban	National
Employed Population	Persons who worked for one hour or more during the survey week for remuneration or business profit; or individuals who did not work temporarily during the survey week due to on-the-job training, vacation, etc.; or those temporarily not working due to work stoppages or downturns in their organization.	Any activity performed for more than one hour to create or provide goods or services (not prohibited by law) for the purpose of earning wages, compensation, or profit. This also includes individuals who did not work during the survey week but still hold a job and maintain a close connection to it (e.g., receiving wages/compensation while not working or expected to return to work within one month).
Unemployed Population	Urban unemployed persons refer to individuals with non-agricultural household registration who are within a certain working age, capable of working, unemployed, and seeking employment. *Urban registration*: individuals who need to register for job-seeking at local employment service agencies. *Urban sample survey:* individuals who have actively sought employment within the three months prior to the survey date.	Unemployed individuals are those who have actively sought employment within the 30 days prior to the survey and are available to start work within the following two weeks; those who have secured a new job that begins after the survey week (without a specific time limit); individuals unable to work due to unexpected family business or temporary illness; and seasonal workers outside of their working season. This category also includes students, retirees, and homemakers actively seeking part-time or full-time employment.
Unemployment Rate	Urban unemployed population / (urban employed population + urban unemployed population)	Unemployed population / (employed population + unemployed population)

2.2.3. Employment and Unemployment Statistical Survey Methods in China and Vietnam

The content of Table 3 below presents a Comparison of Employment Statistics Systems and Methods between China and Vietnam.

China's employment and unemployment data are derived from three statistical systems: the labor force survey, labor statistics reports, and social insurance data. The labor force survey, initiated in 2005, covers individuals aged 16 and above and is conducted twice a year using sampling methods. The urban unemployment rate is published monthly. To ensure data timeliness, since 2016, the monthly survey sample size has gradually expanded to 340,000 households, covering all prefecture-level and county-level areas. Labor statistics reports, targeting enterprises, public institutions, and non-profit organizations, provide data on wage levels and

employment numbers. Social insurance and unemployment registration data are used to analyze new urban employment figures.

Table 3. Comparison of Employment Statistics Systems and Methods between China and Vietnam.

	China	Vietnam
Survey Target	Population aged 16 and above	Population aged 15 and above
Survey Unit	Housing Unit	Household Unit
Survey Time Point	Employment Status in the Previous Week; Unemployment Status in the Past 3 Months	Employment Status in the Previous Week; Unemployment Status in the Past Month
Frequency	Monthly	Quarterly
Survey Method	Using a 2-10-2 rotation sample model, each household participates in surveys for 2 consecutive months, then is excluded for the next 10 months, before participating again for another 2 months, after which it exits the sample. To ensure sample rotation: (1) Each month, 1/4 of the sample is in its first survey, 1/4 in its second, 1/4 in its third, and 1/4 in its fourth. (2) There is a 50% overlap in samples between consecutive months. (3) Within the same calendar month, 50% of the sample is repeated across years.	Using a 2-2-2 rotation sample model, each household is surveyed for 2 consecutive quarters, then removed from the sample for the next 2 quarters, and reintroduced for the following 2 consecutive quarters. This way, each household is surveyed twice a year, with a 50% overlap in samples between quarters.
Statistical Indicators	Labor Force Employed Persons Total Wage and Average Wage Registered Unemployed Persons and Unemployment Rate in Urban Areas	Labor Force Employed Persons Total and Average Wage Underemployment Status Unemployed Persons and Unemployment Rate
Release Date	National Urban Survey Unemployment Rate Data: Monthly; Other Indicators: Annual	Data reports are released quarterly, semi-annually, every nine months, and annually.

Data Source: Decision on Occupation Investigation Measures for 2022, The State Council the People's Republic of China www.gov.cn

In contrast, Vietnam uses a single labor force survey system. Since 1997, Vietnam has conducted its survey based on the ICLS 13 framework, transitioning to ICLS 19 in the first quarter of 2021. According to the "Decision on Occupation Investigation Measures for 2022" issued by the Ministry of Planning and Investment and the General Statistics Office of Vietnam, these surveys are conducted quarterly, covering 58,932 households across 63 provinces and cities nationwide. With a relatively small sample size, Vietnam employs a "2-2-2" model, whereby each household participates in surveys for two consecutive quarters, followed by a two-quarter break, to efficiently manage resources and ensure data stability [8].

According to Feng Shuaizhang in "Scientific Standardization of Survey Unemployment Rate Statistical Methods", China employs a 2-10-2 model, with a larger sample size due to its high population and mobility, with separate statistics for urban and rural areas, resulting in higher survey complexity. China's unemployment rate data is released monthly, while other indicators are published annually [9]. In comparison, Vietnam's labor force data is published quarterly, meeting the needs of government and businesses. These statistical methods reflect each country's population distribution and labor force structure, showcasing their respective statistical needs and capabilities.

3. Comparative Analysis of Employment and Unemployment Status in China and Vietnam

The data in Table 4 presents the main employment statistics indicators for China and Vietnam from 2019 to 2023. The indicator "working-age population" refers to individuals aged 15 and above in Vietnam, while in

China, it refers to those aged 16 and above. For the youth unemployment rate indicator, Vietnam's statistics cover individuals aged 15 to 24, whereas China's cover those aged 16 to 24. The primary data sources for China's employment statistics are the China Labor Statistical Yearbook (2019-2023), while Vietnam's employment statistics are derived from the Vietnam Labor and Employment Survey Report (2019-2023). All data for 2023 are preliminary estimates, and China's preliminary 2023 data is sourced from the Statistical Bulletin of the People's Republic of China on National Economic and Social Development in 2023, published by the National Bureau of Statistics [10].

Table 4. Employment Statistics Indicators in China and Vietnam.

Indicator	Vietnam					China				
	2019	2020	2021	2022	pre 2023	2019	2020	2021	2022	pre 2023
Total Population (million people)	96,48	97,58	98,5	99,46	100,31	1410,08	1412,12	1412,6	1411,75	1409,67
Working-age Population (million people)	73,18	74,37	74,6	75,41	76.335	1159,09	1143,82	1149,58	1155,6	1161,78
Labor Force (million people)	55,76	54,84	50,56	51,7	52.376	789,85	783,92	780,24	768,63	779,24
Employed Population (million people)	54,65	53,6	49,07	50,6	51.287	754,47	750,64	746,52	733,51	740,41
Urban Population (million people)	17,56	17,51	17,76	18,7	19.071	452,49	462,71	467,73	459,31	470,32
Rural Population (million people)	37,09	36,09	31,3	31,89	32.216	301,98	287,93	278,79	274,2	270,09
Employment Rate	75,3%	72,1%	65,8%	67,1%	67,2%	65,1%	65,6%	64,9%	63,5%	63,7%
Urban Employment Rate	32,13%	32,68%	36,21%	36,97%	37,18%	59,97%	61,64%	62,65%	62,62%	63,5%
Rural Employment Rate	67,87%	67,32%	63,79%	63,03%	62,80%	40,03%	38,36%	37,35%	37,38%	36,5%
Labor Force Participation Rate*	76,8%	74,4%	67,7%	68,6%	68,9%	68,1%	68,5%	67,9%	66,50%	67,1%
National Unemployment Rate	2,17%	2,48%	3,20%	2,34%	2,28%	-	-	-	-	-
Survey-based Urban Unemployment Rate	3,11%	3,89%	4,33%	2,82%	2,73%	5,20%	5,20%	5,10%	5,50%	5,20%
Registered Urban Unemployment Rate	-	-	-	-	-	3,62%	4,24%	3,96%	-	-
Youth Unemployment Rate	6,51%	7,21%	8,55%	7,78%	7,63%	11,88%	14,19%	14,26%	17,56%	14,90%

Note: * Labor force participation rate = Labor force / Population within the working age.

3.1. Recent Labor Force Trends in China and Vietnam

China's population is 14 times that of Vietnam, providing a considerably larger labor force. Although China's defined working age is one year shorter than Vietnam's, the labor participation rates in both countries are very similar. Additionally, as both countries are currently experiencing a demographic golden age in terms of labor force, fluctuations in labor supply and employment have shown similar trends in recent years.

In employment data, China's employment reached 789.85 million people in 2019, while Vietnam's reached 55.76 million. By 2021, both countries saw declines in their labor forces, with China's workforce at 780.24 million—a reduction of approximately 9.61 million, which is 1.22% of the 2019 labor force. In Vietnam, the workforce decreased to 50.56 million, a decline of about 5.20 million, or 9.32% of its 2019 labor force. It's evident that the labor markets in both China and Vietnam have been unavoidably impacted by the Covid-19 pandemic. However, China's fluctuation rate was only 1.8%, while Vietnam's was as high as 8.7%.

The difference can be attributed to China's government policies during the pandemic, which encouraged and developed new types of jobs based on the internet and software, creating more flexible employment opportunities to adapt to the complex pandemic situation. In 2021, Vietnam saw a sharp reduction in its employed population, primarily due to the adoption of the new ICLS19 framework, which no longer classifies certain self-sustaining work as employment.

After 2021, with the pandemic under control, Vietnam's socio-economic conditions stabilized, and the labor force grew. Specifically, it increased by 1.1445 million in 2022, a growth rate of 2.26%, and by 676,000 in 2023,

a growth rate of 1.31%. In contrast, China continued its "zero-Covid" policy in 2022, implementing quarantine measures to prevent virus transmission. As shown in Table 4, China's labor force decreased slightly from 780.24 million in 2021 to 768.63 million in 2022, a total reduction of 1.49%. However, at the end of 2022, China lifted its "zero-Covid" policy and reopened, leading to a positive shift in the labor market in 2023, with an increase of 10.61 million people—a 1.38% rise from 2022.

3.2. Severe Impact of COVID-19 on the Employment Markets in China and Vietnam

During the pandemic, the employment markets in China and Vietnam were severely impacted. According to the General Statistics Office of Vietnam, as of December 2020, approximately 32.1 million Vietnamese workers aged 15 and above were negatively affected by the pandemic [11]. Of these, 69.2% experienced income reduction, 39.9% had reduced working hours or were on rotational leave, and 14.0% were forced to halt work. In 2021, Vietnam's employment dropped significantly, with 5.58 million fewer employed individuals compared to 2019, marking a 10% decline and pushing the unemployment rate up to 3.2%, an increase of 1.03 percentage points from 2019. This period is regarded as the most severe for Vietnam's labor market during the pandemic.

Although Vietnam began vaccinating its population in 2021, multiple outbreaks of virus variants forced the government to implement extensive lockdowns and social distancing measures to contain the spread. Many businesses were compelled to close temporarily, resulting in a rise in the unemployment rate from 2.48% in 2020 to 3.20% in 2021. By 2022, with the population having received at least two vaccine doses, Vietnam gained some immunity to the virus, and life, along with economic activities, gradually returned to pre-pandemic levels. Consequently, the employment rate rose from 65.8% to 67.1% and the unemployment rate dropped from 3.20% to 2.34%, further declining to 2.28% in 2023. This indicates a steady stabilization of the labor market.

In contrast, China's labor force continued to decline from 2019 to 2022, with the employment rate dropping from 65.1% in 2019 to 63.5% in 2022. The urban surveyed unemployment rate rose from 5.2% in 2019 to 5.5% in 2022. While this rate increased, it remained relatively stable during 2020–2021. The pandemic significantly impacted China's economic and social development, with the average monthly urban surveyed unemployment rate in 2020 rising by 0.47% from the previous year, going from 5.15% to 5.62%. Notably, in February 2020, the urban surveyed unemployment rate reached a historic high of 6.2%. However, in 2021, the unemployment rate fell slightly, coming in 0.1 percentage points lower than in 2019, primarily due to the creation of new employment models. By 2023, China's employment rate rose by 0.2%, and the unemployment rate returned to the pre-pandemic level of 5.2%.

Overall, China's labor market remained relatively stable, with the unemployment rate fluctuating around 5.5%. Despite the general decline in labor markets in both countries from 2019 to 2021, China experienced relatively less impact compared to Vietnam and other smaller economies. From 2022 onwards, Vietnam's labor market recovery accelerated, while China demonstrated strong stability. By 2023, both countries showed positive trends in employment and unemployment rates.

3.3. Opposite Urban-Rural Employment Gaps in China and Vietnam

As both countries pursue a market economy, the number of urban workers has tended to rise during the urbanization process. However, in Vietnam, employment in rural areas remains higher. Figure 3 shows the urban-rural employment structure in both countries. In 2019, Vietnam's rural employment stood at 37.09 million, accounting for 67.87% of total employment, 2.11 times higher than urban employment. By 2023, urban employment increased by 5.05%, reducing the urban-rural gap, with rural employment now 1.68 times that of urban areas.

In contrast, China's urban employment consistently surpasses rural employment. In 2019, urban employment in China reached 452.49 million, comprising 59.97% of the national total. By 2023, urban employment had risen by 3.55% compared to 2019, while rural employment continued to decline, reaching 318.9 million, making urban employment 1.74 times higher than rural employment.

This urban-rural employment structure indicates that Vietnam's labor force is primarily concentrated in rural areas, while China's is centered in urban regions. The main reasons for this disparity in urban and rural
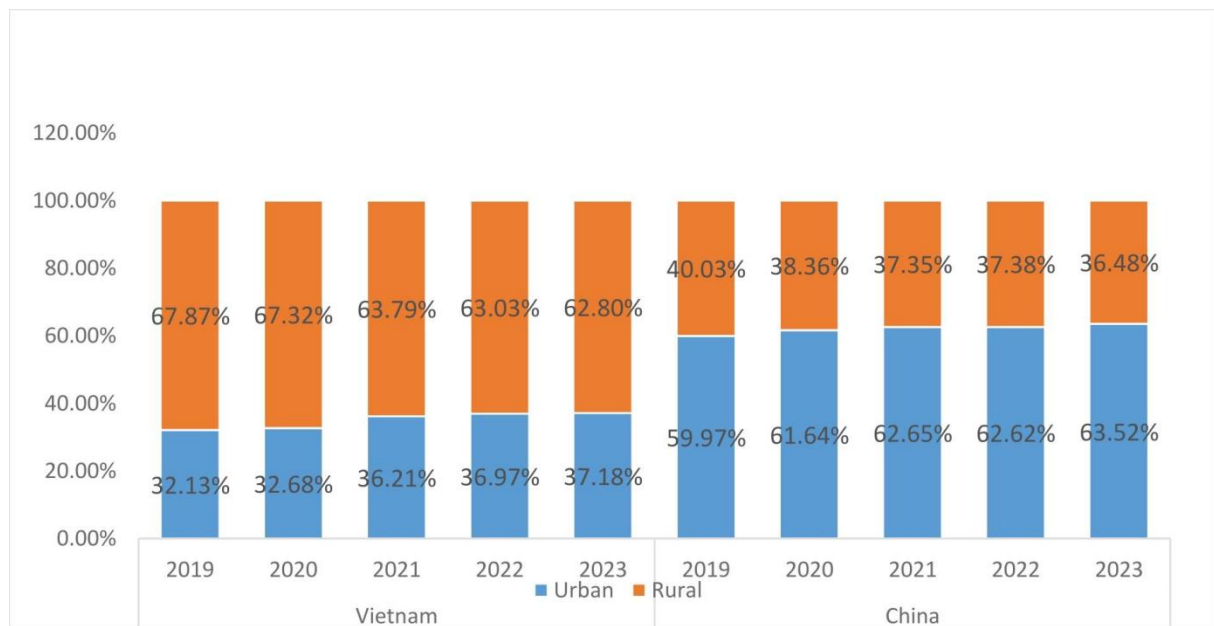
employment structures between China and Vietnam are as follows:

Economic development levels: China's higher economic development has driven rapid urbanization, while Vietnam's slower growth means rural employment remains predominant.

Agricultural and industrial itructures: China's advanced agricultural mechanization has reduced labor needs in rural areas, encouraging migration to cities. In Vietnam, agriculture still occupies a significant portion of the national economy, with most employment concentrated in rural areas.

Policy drives: China has implemented various policies to accelerate urbanization, supporting manufacturing and services that create urban employment opportunities. Vietnam, by contrast, has a slower urbanization process and policies that rely more on rural employment.

These economic, industrial, and policy differences have led to the significant disparities in urban and rural employment structures between China and Vietnam.

Figure 3. Urban-Rural Structure of Employed Population in China and Vietnam.
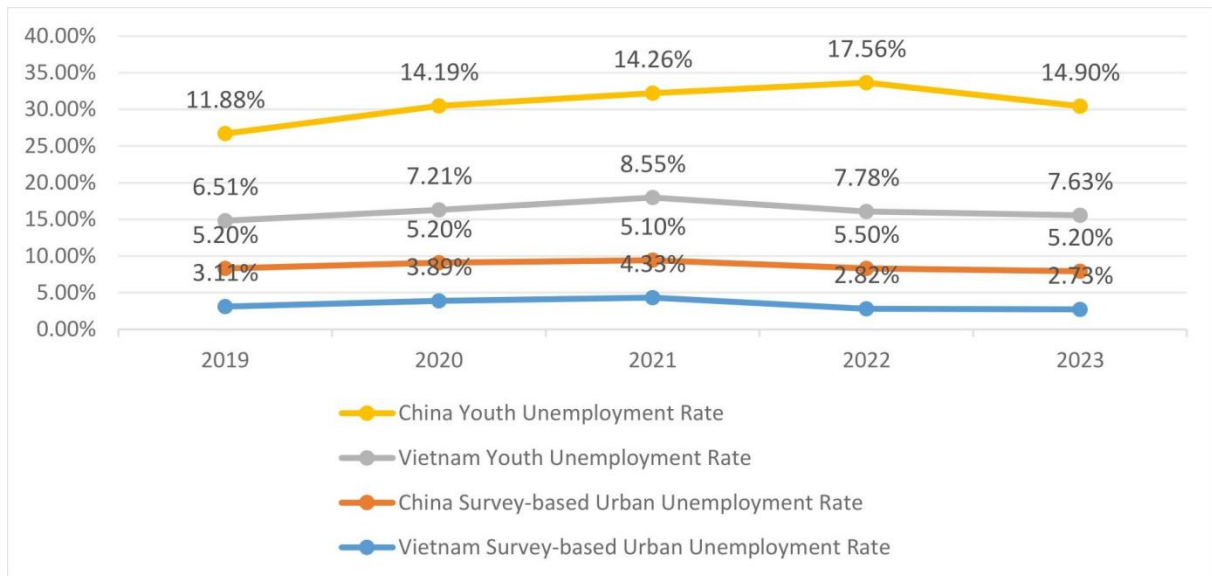
3.4. Higher Youth Unemployment Rate

According to data from the statistical offices of China and Vietnam, the youth unemployment rate among those aged 15 to 24 is high in both countries, but China's rate is significantly higher, nearly double that of Vietnam. Nevertheless, the general trend in youth unemployment is similar in both countries.

As shown in Figure 4, China's youth unemployment rate has been steadily rising from 2019 to 2022. In 2019, the urban unemployment rate among Chinese youth aged 16 to 24 was 11.88%, increasing to 14.19% in 2020 and 14.26% in 2021, and further climbing to 17.56% in 2022, a total increase of 3.3 percentage points. Meanwhile, Vietnam's youth unemployment rate rose from 6.51% in 2019 to 8.55% in 2021 but saw some relief in 2022, decreasing by 0.77 percentage points. In 2023, although China's youth unemployment rate declined slightly, it remained notably higher than that of Vietnam, where the youth unemployment rate continued to improve gradually.

In a report released on August 15, 2022, China's National Bureau of Statistics noted that in July 2022, the unemployment rate among urban youth aged 16 to 24 in China reached 19.9%, up 0.6 percentage points month-over-month—marking the highest level since this statistic began being recorded in 2018 [12]. Due to ongoing economic slowdown, the aging of sectors like internet and manufacturing, and the limited capacity of industries like education and training to absorb a large number of young workers, Chinese youth are facing significant employment pressure. In contrast, the larger scale of China's economy and stricter employment requirements have led many young people to experience "graduation unemployment". Addressing youth unemployment is a shared challenge for both China and Vietnam, requiring urgent and effective measures.

Figure 4. Comparison of Youth Unemployment Rates in China and Vietnam (2019-2023).

4. Strategies and Recommendations for Employment and Unemployment Statistics in China and Vietnam

4.1. Conclusion

From the analysis of employment and unemployment statistics and related issues in China and Vietnam, the following conclusions are drawn:

First, there are certain differences in statistical methods, survey subjects, and indicators for employment and unemployment in China and Vietnam. China's statistical methods are more complex, utilizing a larger sample size and higher-frequency surveys to ensure data comprehensiveness and accuracy. In contrast, Vietnam tends to use a simplified, resource-saving approach with a smaller sample size, focusing more on efficiency. The two countries also differ in terms of working-age definition, unemployment criteria, and survey frequency.

Second, in recent years, China's labor market has shown a slight downward trend, mainly influenced by the COVID-19 pandemic, though it has remained relatively stable overall. Urban employment has continued to grow with the urbanization process. However, the youth unemployment rate has been rising yearly, potentially related to economic restructuring and an increase in the number of graduates. Vietnam's labor market was more significantly impacted by the pandemic, with a noticeable rise in the unemployment rate, though it showed recovery in 2022. The urban-rural employment gap has narrowed, with the urban employment ratio increasing, but rural employment still occupies a substantial share. Both countries face the challenge of high youth unemployment rates.

4.2. Strategies and Recommendations for Employment and Unemployment Statistics in China and Vietnam

4.2.1. Strategies and Recommendations for Vietnam's Employment and Unemployment Statistics

Optimize Employment Survey Methods and Data Collection Techniques: The Vietnamese government should enhance employment survey methods, using scientific tools and technologies to increase sample size and data collection frequency (shifting from quarterly to monthly) to ensure data accuracy and provide a reliable basis for policy-making. More frequent publication of employment data would help the government track market changes in real-time, adjust policies accordingly, and promote economic and social stability.

Strengthen Employment Support for Youth: The government should introduce more youth employment policies, providing vocational training and entrepreneurship support, encouraging companies to increase youth hiring, and offering career advancement opportunities. Additionally, the government can offer financial and technical support to qualified young entrepreneurs, fostering innovation and injecting new momentum into the economy.

Enhance Rural Employment Levels and Narrow the Urban-Rural Gap: The government should increase support for rural employment, promote labor migration to urban areas, develop rural industries, and create more

jobs. By strengthening urban-rural integration, optimizing resource allocation, and fostering balanced economic development nationwide, Vietnam can further reduce the employment gap.

4.2.2. Strategies and Recommendations for China's Employment and Unemployment Statistics

Refine Statistical Standards and Improve Data Accuracy: In terms of measuring employment and unemployment, China's statistical criteria are relatively lenient, such as extending the job search period to three months without detailed classification of individuals at the boundary between employment, unemployment, and non-labor force status. This may lead to risks of overestimation or underestimation of employment and unemployment rates. Enhancing international comparison and learning from advanced statistical practices from international organizations and other countries could further improve China's statistical standards and capabilities. Conducting comparative research with other countries could help identify best practices suited to China's national conditions, advancing the standardization and scientific development of employment and unemployment statistics.

Address Youth Employment Challenges through Job Guidance and Entrepreneurship Support. The government can address youth employment issues in various ways, including:

Promote Education and Training: Increase investment in youth education and training to improve employability and competitiveness.

Encourage Entrepreneurship: Support youth entrepreneurship through policies and funding, providing more opportunities and platforms for young entrepreneurs.

Enhance Employment Services: Strengthen employment services and information dissemination to provide more job opportunities and position information for youth.

Encourage Companies to Increase Youth Hiring: The government can incentivize companies to increase youth hiring by formulating relevant policies to support recruitment and talent development for young employees.

4.2.3. Recommendations to Promote Cooperative Development and Increase Employment in China and Vietnam

Enhance Knowledge Exchange and Share Labor Statistics Expertise: China and Vietnam should foster in-depth cooperation by exchanging knowledge and sharing expertise in labor and unemployment statistics. Organizing joint workshops, training sessions, and research projects will help improve the quality of labor statistics in both countries and optimize measurement methodologies to suit each nation's unique conditions. Reliable labor data is essential for informed policymaking, supporting stable employment growth in both countries.

Develop Joint Vocational Training and Entrepreneurship Support Programs: Both nations can collaborate on vocational training programs, especially in high-demand fields such as information technology, industrial manufacturing, and services. These programs should focus on developing practical skills aligned with market needs, thereby enhancing the competitiveness of young workers. Additionally, joint entrepreneurship support initiatives will provide young people with opportunities to start new businesses, fostering innovation and economic growth in both countries.

Promote Labor Mobility Policies and Develop Linked Economic Zones: China and Vietnam could establish linked economic zones along their shared borders, encouraging labor from both countries to participate in joint economic projects. Facilitating labor mobility through supportive policies will allow workers to access employment in high-demand areas, reducing unemployment and driving economic growth in these regions.

Increase Investment in Rural Industrial Development: Collaborative projects in rural industrial and agricultural development will create more job opportunities and increase income sources for rural populations in both countries. This approach not only narrows the urban-rural employment gap but also stabilizes the economy by reducing unnecessary migration to large urban centers.

Strengthen Worker Rights and Social Protection Policies: Implementing policies that safeguard worker rights and provide robust social protection is crucial for establishing a sustainable labor environment. China and Vietnam should cooperate to share best practices in building programs for unemployment insurance, retraining,

and worker health benefits. By securing social protections, both countries can increase job security, enhance productivity, and minimize the adverse effects of economic fluctuations.

4.3. Limitations and Future Research Directions

First, discrepancies in statistical standards and definitions between China and Vietnam may limit data comparability, as differing interpretations of employment and unemployment can lead to variations in reported outcomes. Additionally, limitations in survey frequency and scope may affect the timeliness and comprehensiveness of findings, potentially underestimating or overestimating certain employment trends, particularly in rural and youth populations.

This study may also be limited by its focus on labor market indicators within formal employment sectors, potentially overlooking significant segments of the informal economy, especially in Vietnam's rural areas and certain urban sectors in China. Furthermore, the influence of external economic factors, such as global market shifts and technological advancements, has not been fully addressed, which could affect labor market stability and youth employment rates in unanticipated ways.

Future research could address these limitations by exploring longitudinal data across a wider range of economic sectors to capture long-term labor market dynamics. Studies on the informal labor market's role in national economies would offer a more comprehensive view of employment and social welfare standards in both countries. Additionally, future research could examine the impact of specific employment policies, such as youth programs and rural-to-urban migration incentives, on employment outcomes and regional disparities. Comparative studies with other emerging economies could provide insights into the effects of globalization and technological change on labor markets, enhancing the broader applicability of these findings.

Institutional Review Board Statement

This study did not involve any human or animal subjects and therefore did not require ethics approval. All data used in the study were obtained from publicly available sources.

Informed Consent Statement

Not applicable.

Data Availability Statement

Not applicable.

Conflicts of Interest

The author declares no conflict of interest. There are no financial or personal relationships that could have influenced the research presented in this manuscript.

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Article

The Effectiveness of Internal Control Systems in Preventing Financial Fraud: A Case Study of Multinational Corporations

Xinyan Ding

Jimei University Overseas College Fujian, Xiamen 361021, China

Abstract: This case study examines the effectiveness of internal control systems (ICS) in preventing financial fraud, with a focus on the Volkswagen (VW) emissions scandal known as 'Dieselgate'. This paper discusses the internal control problems reflected in this case, including a series of problems such as insufficient division of labor, insufficient supervision, insufficient communication and imperfect approval. These deficiencies allowed the fraud to continue for nearly a decade, resulting in significant financial penalties and reputational damage, reflecting the role of internal control failures in asserting financial fraud. As a result, the study highlights the importance of cultivating an ethical corporate culture, strengthening risk management and ensuring strong internal controls to prevent similar incidents in multinational companies.

Keywords: internal control; financial fraud; case study

1. Introduction

In recent years, multinational enterprises are facing more and more scrutiny in terms of their financial and operational practices. The scale characteristics of multinational enterprises and the obstruction of internal information communication make them more exposed to the risk of financial fraud and other factors. The VW emissions scandal stands out as a key example of how failures in internal control systems (ICS) can lead to widespread corporate misconduct, creating large factual gaps in the flow of money. The scandal, known as "Dieselgate," revealed how VW manipulated emissions tests to make its diesel cars more environmentally friendly than they actually were, leading to serious consumer fraud and financial fallout. In light of this case, which reflects the suppression of financial and business fraud by internal control mechanisms, this case study will examine how VW's internal control systems were breached, assess the weaknesses that led to the emissions scandal, and explore the lessons that can be learned from this failure.

2. Internal Control Systems: Overview

ICS is a fundamental framework that helps organizations manage risk, ensure accurate financial reporting, and comply with laws and regulations. These systems contain a variety of components that work together to protect assets and improve operational efficiency. According to Rashid, effective internal control systems play a key role in fraud prevention and detection, ensuring that organizations are able to protect their resources from

potential misconduct [1].

A fundamental aspect of ICS is that it protects the overall environment of internal control, which sets the ethical tone for the organization. Mendes de Oliveira, *et al* emphasize that a strong control environment is critical to curbing fraud because it influences employee behavior and decision-making [2]. In this regard, moral and ethical standards act on individual employees and thus work synergistically with institutional factors; Faisal *et al* argue that strengthening the ethical framework within an organization significantly affects the effectiveness of internal controls [3]. Another key component is risk assessment, which involves identifying and analyzing risks that could hinder the achievement of an organization's goals. An effective risk assessment process is essential to identify vulnerabilities, especially in fraud-prone sectors such as finance [4]. For example, Ogwiji and Lasisi emphasize the importance of assessing the risks of listed financial services companies to mitigate fraudulent activities [5].

In addition to providing an internal control framework and environment, ICS in turn consists of a series of control activities, that is, actual policies and procedures designed to mitigate risk. Maulidi and Ansell point out that organizations must establish strong control activities for their specific risks in order to effectively combat corruption and occupational fraud, as failure of control activities often results in significant financial losses and reputational damage [6]. At the same time, information and communication are essential to the effectiveness of internal controls. Companies must ensure that relevant information flows throughout the organization so that timely decisions can be made and problems resolved [7]. Without proper communication channels, control weaknesses can be overlooked, allowing fraudulent activity to persist.

On the basis of the above framework and activities, the monitoring component is essential to evaluate the effectiveness of ICS. Regular assessments and audits help organizations identify weaknesses and make necessary adjustments. As noted by Burzinji *et al*, the integration of forensic accounting with internal controls can significantly enhance fraud prevention efforts by providing an additional layer of oversight [8–12].

3. VW Emissions Scandal: Overview

In September 2015, VW was revealed to have installed cheating software in about 11 million diesel vehicles worldwide. These "defeat devices" are detected when the vehicle is undergoing emissions testing and change its performance to produce lower emissions readings. Under normal driving conditions, these vehicles emit nitrogen oxide pollutants up to 40 times the legal limit.

The scandal was so far-reaching that VW faced more than $30 billion in fines and legal fees, the company's share price plummeted, and its global reputation was severely damaged, which was difficult to recover in the long term. Martin Winterkorn, VW's chief executive, subsequently resigned and criminal charges were brought against several senior executives. From the perspective of internal control, this fraud lasted for nearly ten years, indicating that the company's governance and risk management system has deep flaws, which are analyzed and discussed in this paper.

3.1. Control Environment

The control environment is perhaps the most critical component of an effective internal control system, as it sets the ethical tone and management culture within an organization. At VW, however, the control environment was compromised by an aggressive corporate culture focused on global dominance and profit maximization.

VW's internal structure fostered an environment where performance pressures and unrealistic goals drove employees and management to cut corners. The company's ambitious plan to become the world's largest automaker created intense pressure to meet diesel emissions standards while maintaining profitability, particularly in the U.S. market. This culture likely contributed to a lack of accountability at the top levels of the organization. Additionally, senior management, including CEO Martin Winterkorn, created a highly centralized decision-making environment where employees may have felt unable to question unethical practices. As a result, key employees and engineers responsible for developing the defeat devices operated under the assumption that meeting corporate targets outweighed adherence to legal and ethical standards (as shown in Figure 1).
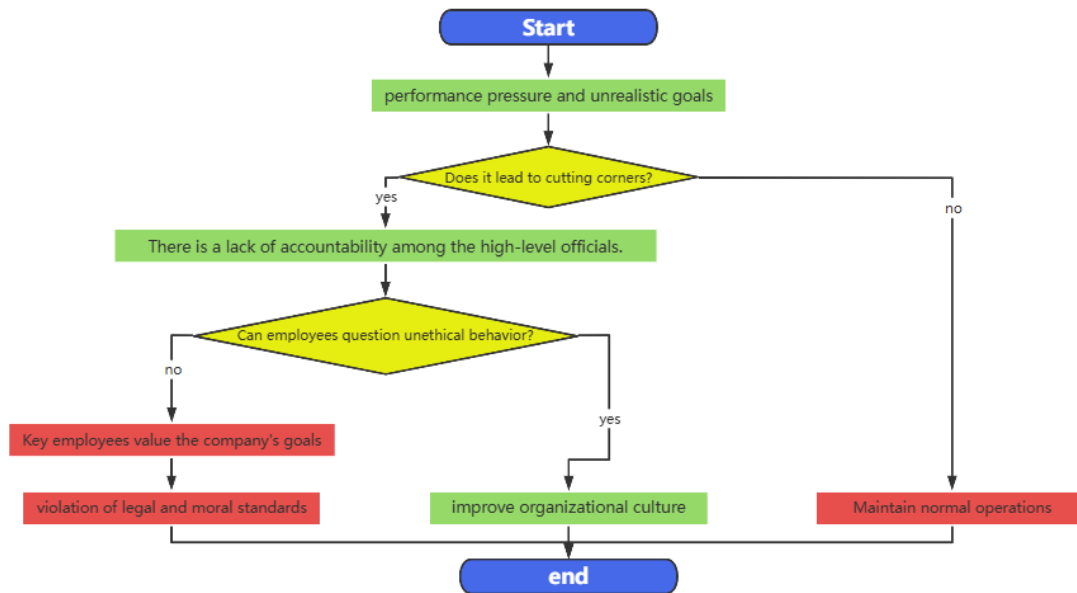
Figure 1. Control Environment.

3.2. Risk Assessment

VW's risk assessment procedures are not sufficient to identify significant risks related to compliance with regulations, in particular those related to emissions standards. A well-functioning internal control system should recognize the potential legal, financial and reputational risks associated with the use of illegal software to manipulate emissions data. However, the company's risk assessment process appears to have downplayed these concerns, lacking effective risk assessment measures and thus facing significant risks in the early stages of the internal control system, failing to identify the risks of non-compliance with emissions regulations in different markets, failing to assess the potential legal and financial penalties for non-compliance, and failing to recognize the reputational damage that a major scandal could bring. As a result, VW's leadership either failed to recognize the severity of the risks or deliberately chose to ignore them in pursuit of short-term financial gains, ultimately contributing to a long-term fraud (as shown in Figure 2).
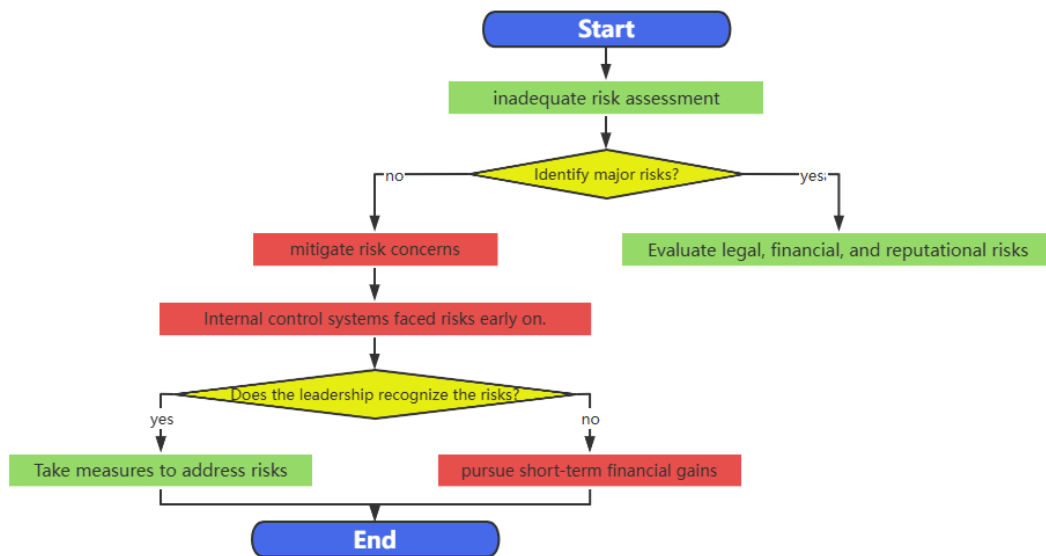
Figure 2. Risk Assessment.

3.3. Control Activities

Based on the risk assessment, the next step is the risk control activity, which is also the main content of the internal control system. At a theoretical level, risk control activities are specific procedures and policies

implemented to prevent or detect fraud and ensure compliance with regulations. In the case of Volkswagen, the engineers involved in the development of the defeat device were not adequately supervised, and the lack of segregation of duties allowed the same people responsible for product development to achieve this fraud without detection, resulting in an internal modification of software functions. At the same time, although the company had procedures for emission testing, these controls were focused on passing regulatory checks rather than ensuring compliance with emission standards under realistic conditions, and thus failed to guarantee the reliability of business activities at a practical level. The decision to install the defeat device was likely made by a small group of engineers and middle managers without proper review or authorization from senior management, which not only contributed to the fraud, but also to the lack of subsequent improvement measures. Volkswagen's internal controls failed to detect these frauds, partly because of weak oversight and partly because the employees concerned may have believed that they were acting in the best interests of the company given the performance targets set by management and more reflective of the absence of the relevant control environment and control activities.

3.4. Information and Communication

For internal control systems to function effectively, communication of risks, policies and procedures must flow freely throughout the organization. At Volkswagen, its formal code of conduct and compliance policies were replaced by a private psychological organizational structure, so that employees in key positions either did not know the ethical standards they were expected to adhere to or felt empowered to bypass them. At the same time, the lack of transparency made the development process of the device in this case further lack of information communication, and its development activities were kept secret from the internal, so its predicament and fraud were difficult to attract the attention of upper management, and could not be known by external supervisors such as auditors.

3.5. Monitoring

The monitoring component of VW's internal control system was also severely lacking. Monitoring involves ongoing evaluations of internal controls to ensure they are functioning as intended and that any weaknesses are addressed promptly. VW's internal audit functions either failed to detect the emissions fraud or were not given the resources or independence necessary to raise alarms.

Monitoring includes an ongoing assessment of internal controls to ensure they are functioning as intended and that any weaknesses are addressed in a timely manner. But in each case, VW's internal audit department either failed to detect the emissions fraud or was not given the necessary resources or independence to raise the alarm. This reflects that the internal audit and compliance functions were not robust enough to identify fraudulent activity occurring during the development of emissions software, to the extent that they failed to identify financial fraud as a result of business fraud. The fact that the devices involved in the case project went unnoticed for nearly a decade suggests that the monitoring process was ineffective or deliberately suppressed, highlighting the failure of the internal control system.

4. Conclusion

The Volkswagen emissions scandal highlights the need for strong internal controls, emphasizing ethical behavior, risk assessment, transparent processes, and independent audits to prevent fraud and foster accountability.

Informed Consent Statement

Not applicable.

Data Availability Statement

Not applicable.

Conflicts of Interest

The author declares no conflict of interest.

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