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## Asia Pacific Economic and Management Review

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# Application Status and Prospects of Rapid Test Kits for Crop Diseases

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**Abstract:** Rapid test kits for crop diseases are agricultural tools for early monitoring of crop diseases. Their application can reduce the use of pesticide, mitigate environmental pollution, and promote green and sustainable agricultural development. This paper reviews the research progress, categories, and applications of rapid detection kits for crop diseases, as well as existing challenges and solutions. Additionally, it provides insights into the future prospects of portable rapid test kits for crop diseases, aiming to offer valuable references for their development.

**Keywords:** Crop Diseases; Rapid Test Kits; Research Progress; Prospects

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## 1.Introduction

Most of the food that humans rely on for survival comes directly or indirectly from the roots, stems, leaves, flowers, seeds, and fruits of crops. The safety of various organs of crops affects human life and health. In recent years, green, low-carbon, and sustainable development has become the trend of global economic development. The pursuit of green and sustainable development in agriculture contributes to enhanced food safety. According to the speculation of the Food and Agriculture Organization of the United Nations, plant diseases and pests cause an annual loss of 20% to 40% of the world's crop production, affecting the main crops in countries and regions on all continents of the world <sup>[1-2]</sup>. Crop disease rapid detection kits can diagnose crop diseases at an early stage, enabling farmers to take timely and effective prevention and control measures based on the detection results. This can effectively avoid yield and economic losses. It is an important measure to help farmers achieve a bumper harvest, reduce the use of pesticides, and promote the green and sustainable development of agriculture.

In recent years, portable crop disease rapid test kits have been successively launched in the agricultural markets of countries such as the United States, the United Kingdom, and South Korea. At the end of 2021, the dot-ELISA rapid detection kit developed by Zhou Xueping's team for one major crop virus (Southern Rice Black-Streaked Dwarf Virus) and three quarantine crop viruses (Maize Chlorotic Mottle Virus, Tomato Brown Rugose Fruit Virus, and Cucumber Green Mottle Mosaic Virus) came out, ending the situation in which China could only rely on imports for crop disease rapid test kits <sup>[3]</sup>. In order to ensure national food security and the quality and safety of agricultural products, protect the ecological environment, and promote the sustainable development of agriculture, the State Council announced the Regulations on the Prevention and Control of Crop Diseases and Pests on April 3, 2020. These regulations established a monitoring system for crop diseases

and pests, emphasizing that the prevention and control of crop diseases and pests should follow the principle of prevention first and comprehensive prevention and control, and carry out green prevention and control supported by science and technology<sup>[4]</sup>. Crop disease rapid test kits can help agricultural producers and other relevant units and individuals do a good job in the early diagnosis, monitoring, and early warning of crop diseases. Their application can not only provide targeted guidance for farmers to use pesticides correctly, reduce the amount of pesticides used, and reduce the waste and pollution of pesticides, but also reduce the planting cost of crops and ensure the yield. It is one of the important measures to achieve green agriculture. However, currently in China, crop disease rapid test kits are still mainly in the stages of experimental research and government inspection and quarantine applications, and they are still very rare in agricultural input retail stores. Based on market research and online searches, this article predicts and analyzes the research progress, applications, existing problems, and prospects of crop disease rapid test kits, hoping to provide references for the research and development in this field.

## **2.The Concept and Research Progress of Crop Disease Rapid Test Kits**

### **2.1 The Concept of Crop Disease Rapid Test Kits**

The crop disease rapid test kit is a kit that quickly determines the presence of certain pathogens (fungi, bacteria, nematodes and viruses) in crops.

The well-known COVID-19 detection kit works by dipping a sample from the human nasal cavity into the reagent in the kit, shaking it well, and then dropping the reagent into the corresponding area of the kit to observe whether a horizontal line appears in the detection line to determine whether the person is infected with the COVID-19 virus. For a crop disease rapid test kit, samples are taken from areas such as the soil near the roots of crops, the root tissues of crops, or the leaf tissues of crops. After sampling, the sample is put into the reagent in the kit, shaken well, and then the reagent is dropped into the designated area of the kit. Within a few minutes, by observing whether a horizontal line appears in the detection area of the kit, it can be determined whether the crop is infected with a certain plant pathogen.

### **2.2 Research Progress of Crop Disease Rapid Test Kits**

The research on crop disease rapid test kits began in the early 1980s, originally stemming from the development of monoclonal antibodies against tobacco mosaic virus by German scientists<sup>[5]</sup>. In 1985, Diaco et al. developed an Elisa kit for detecting soybean mosaic virus in soybean seeds<sup>[6]</sup>. Richard et al.'s<sup>[7]</sup> application for a crop disease diagnostic kit was granted a patent in the US on 10 September 1991. On June 15, 1993, another patent application by Richard's<sup>[8]</sup> team, entitled "Method and a kit for diagnosing plant diseases," was also granted in US. On September 4, 2020, a kit for the simultaneous diagnosis of *Fusarium oxysporum* and *Ralstonia solanacearum* by a semi-quantitative lateral flow immunoassay applied for by Kim<sup>[9]</sup> et al. was granted a patent in South Korea. The crop disease rapid test kit developed by them has been marketed in Korea, Colombia, Cambodia, Vietnam and other countries. On March 19, 2021, Razo et al.<sup>[10]</sup> developed a new rapid detection test strip for diagnosing *Erwinia amylovora* (also known as fire blight) by a lateral flow immunoassay.

Although the research on crop disease detection technology in China started relatively late, it has developed rapidly and achieved great progress in recent years. In 1995, Wei<sup>[11]</sup> reported the technology of nucleic acid spot hybridization for detecting GFV and PVY using biotin-labeled double-stranded cDNA probes synthesized by PCR technology and a chemiluminescence system. In 1997, Zhang et al.<sup>[12]</sup> developed a colloidal gold rapid test kit for Huanglongbing bacteria. In 2001, Li et al.<sup>[13]</sup> developed an alkaline phosphatase enzyme-linked diagnostic kit for Tobacco ringspot virus and Potato virus X. This was the first kit developed in China using alkaline phosphatase labeling and the DAS-ELISA method. In 2006, Wang Lin et al. applied for patents on gene chips, nucleotide sequences and kits for detecting viruses in solanaceae crops<sup>[14]</sup> and leguminous crops<sup>[15]</sup>, respectively, and were granted in 2010. However, the above two patents are mainly used for daily quarantine work on plant-derived food, and are not applicable to on-site detection of viruses in crops grown in the field. Wei et al.<sup>[16]</sup> prepared a colloidal gold chromatography test strip that can quickly and sensitively identify the BBTV virus in banana plants. This test strip has the same detection limit as fluorescent PCR. Tian<sup>[17]</sup> prepared a colloidal gold immunochromatography test strip for detecting Tomato ringspot virus using the double antibody sandwich method. Li et al.<sup>[18]</sup> developed a TAS-ELISA kit for detecting Potato virus V. Ruan et al.<sup>[19]</sup> developed double and triple colloidal gold test strips that can simultaneously detect Tobacco mosaic virus (TMV), Cucumber mosaic virus (CMV), and Potato virus Y (PVY).

Jiang et al.<sup>[20]</sup> developed a rapid detection colloidal gold test strip for Tomato zonate spot virus (TZSV), which can obtain the detection result within 5 minutes. In 2021, the patent for the kit for detecting crop viruses and the method and application for detecting crop viruses applied for by Sun et al.<sup>[21]</sup> was publicly announced online on 2021. This invention can be applied to the detection of viruses in herbaceous and woody crops. On September 2, 2023, a patent filed by Wang et al.<sup>[22]</sup> for a PCR kit for the simultaneously detecting Tomato chlorosis virus (ToCV), Southern tomato virus (STV), and Tomato yellow leaf curl virus (TYLCV) was disclosed. On May 3, 2024, the patent for a real-time fluorescence quantitative PCR kit for detecting Tomato brown rugose fruit virus (ToBRFV) applied for by Li et al.<sup>[23]</sup> was announced. On September 6, 2024, the patent for an RT-PCR kit for detecting brown stripe pathogen in sugarcane applied for by Shan et al.<sup>[24]</sup> was published. The emergence of these recent studies reflects the great interest and widespread attention of the Chinese scientific community in crop disease kits.

### 3. Classification and Applications of Crop Disease Rapid Test Kits

#### 3.1 Classification

According to different analytical methods, crop disease kits are mainly divided into five categories: ELSIA kits, RT-PCR kits, PCR kits, lateral flow immunoassay kits, and colloidal gold chromatography test strips. Among them, some ELSIA kits, lateral flow immunoassay kits, and colloidal gold chromatography test strips have simple operation methods and do not require trained professionals to operate. These are the main categories of crop disease kits currently sold in the terminal agricultural input retail markets abroad.

#### 3.2 Applications

Currently, the crop disease rapid test kits from Agdia Inc. (US), Pocket Diagnostic (UK), and Vetall Laboratories International Veterinary Company (South Korea) have been launched into the terminal market, and their main products and properties are listed in Table 1. These test kits can provide detection results within 5 to 10 minutes, and farmers can quickly learn how to use them through the operation instructions. At present, the main test kits on the market mainly include *Erwinia amylovora* test kit, *Fusarium oxysporum* test kit, *Ralstonia solanacearum* test kit, *Phytophthora* test kit, Alfalfa mosaic virus (AMV) immunostrips, Tobacco streak virus (TSV) immunostrips, Zucchini yellow mosaic virus (ZYMV) immunostrips, and so on. These crop disease rapid test kits are convenient to carry, simple to operate, highly sensitive, and have low requirements for storage conditions. Users can quickly learn how to use them by reading the product instructions, without the need to purchase expensive equipment. They can be stored at 2-30°C for two years, and within 10 minutes, it can be determined whether the crop is infected with the pathogen, so as to determine whether pesticides need to be sprayed and which pesticides should be sprayed. Since different causes may lead to similar disease characteristics in crop diseases, to meet the market demand, South Korean kit manufacturers have provided detailed descriptions of disease symptoms according to the applicable situations of different kits, so that users can understand which kit should be selected for testing. Figure 1 shows the composition of a test kit manufactured in South Korea. If a crop shows disease symptoms, growers or agronomists can pre-judge the type of kit to be selected according to the appearance characteristics of the crop. For example, if symptoms of *Fusarium oxysporum* infection appear, a rapid kit for *Fusarium oxysporum* can be selected for detection. The changes before and after the test kit assay are presented in Figure 2. If the test result is positive, the following pesticides can be selectively used for spraying and treating the diseased crop: Thiophanate-methyl 70% WP, and Pyraclostrobin 250 g/L EC, or Carbendazim 80% WDG and Difenconazole 40% SC. If a positive result is detected by the rapid kit for *Ralstonia solanacearum*, one of the following pesticides can be selectively used for spraying and treating the diseased crop: *Bacillus subtilis* 10 billion CFU/g WP, 300 million CFU/g *Trichoderma harzianum* WP, Zhongshengmycin 3% WP, or Metalaxyl 5%+ Thiram 33% WP. The official website information of Pocket Diagnostic in the United Kingdom shows that its customer, Potadaho Seed Services in the United States, has used the Potato virus Y (PVY) kit and the *Phytophthora* Test kit in Nevada, California, Idaho, eastern Oregon, and Montana. The early use of these kits has well helped farmers avoid yield losses. Luis Gustavo Orellana Aragon, a customer of Pocket Diagnostic from Guatemala, used the bacterial wilt kit in greenhouses at the request of his local customers. He reported that the early use of the kit can help geranium farmers ensure the yield and achieve a bumper harvest.

Table 1: Main manufacturers and products of crop disease rapid Test kits

No.	Trade name (Trade mark)	Manufacturer	Application range	Pathogen types
1	ImmunoStrip®	Agdia, Inc. (USA)	corn and other gramineous crops	Maize dwarf mosaic virus (MDMV)
2	Pocket Diagnostic®	Pocket Diagnostic (UK)	Potato	potato virus YO (common strain) and potato virus YN (necrotic strain)
3	SensPert TM	Vetall Laboratories International Veterinary Company (Korea)	Tomato, eggplant, hot pepper	Fusarium oxysporum /Ralstonia solanacearum

Many institutions and university laboratories in China have achieved a lot of research results on crop disease kits, such as the beginning of this paper mentioned Zhou Xueping team developed dot-ELISA crop virus rapid detection kit is mainly used in agricultural regulatory agencies and customs inspection and quarantine. However, most of these kits are limited to inspection and quarantine and scientific research, and there is no successful case of cooperation between enterprises and research institutes to promote these kits to the end market. At present, some companies have imported some crop disease detection products as agents. However, the products are mainly used in customs inspection and quarantine, scientific research institutions and universities for experimental research. Simple, inexpensive and portable crop disease rapid kits for on-site testing in farmers' fields have not yet been pushed into the terminal retail market.

Figure 1: Composition of a kit produced by Vetall Laboratories International Veterinary Company (South Korea)

A: instructions; B: test device; C: extraction buffer; D: disposable spoon; E: disposable dropper

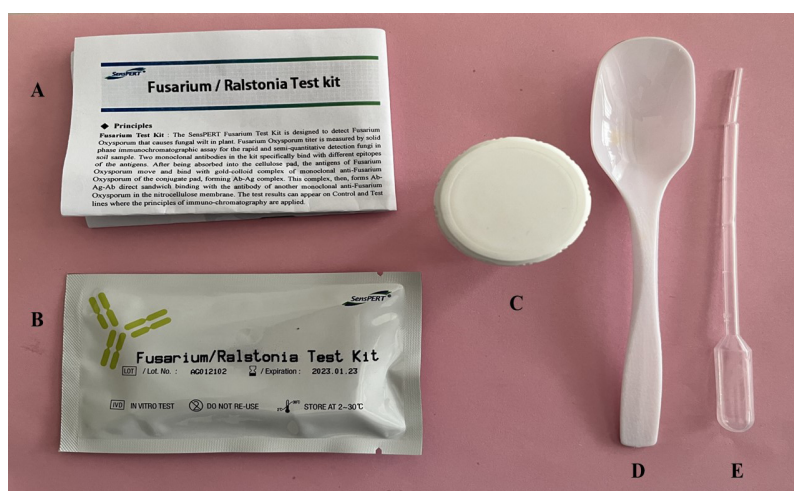


Figure 2: The changes before and after the test kit assay

A: before assay; B: after assay





#### 4. Problems and Countermeasures of Crop Disease Rapid test Kits in China

Although crop disease rapid test kits for farmers have many advantages, there are significant difficulties in promoting them domestically. The author analyzes that the main reasons are as follows: Firstly, pesticide enterprises are the most suitable for promoting such products. However, the application of these products will reduce the use of pesticides, which will inevitably affect the pesticide sales volume of pesticide manufacturers. Sales personnel are reluctant to promote these products due to concerns about their own performance and income. Secondly, there is a wide variety of bacterial and viral pathogens in crops. Enterprises need to invest time and capital to develop kits targeting different bacteria, fungi, and viruses. The early research, development, promotion, and publicity stages require substantial investment in human resources, financial resources, and material resources. Few enterprises are willing to invest the time and effort in researching, developing, and promoting such products. Finally, people have a low acceptance of new things. Most individuals and enterprises are reluctant to be the “first to take the plunge.” The difficulties in researching, developing, and promoting crop disease rapid test kits in the terminal agricultural input market have deterred many enterprises.

The crop disease rapid test kits are products that can detect early signs of crop diseases and guide users to use pesticides appropriately according to the types of detected diseases. They can help farmers nip crop diseases in the bud. The rational use of crop disease rapid test kits can not only reduce the amount of pesticides used, decrease the waste and pollution of pesticides, but also indirectly reduce pesticide residues in agricultural products and make food safer. At present, facing problems such as low marketization and difficulty in promotion of these products, government departments are needed to guide, encourage, and support enterprises to cooperate with university laboratories or scientific research institutions in jointly researching, developing, and promoting such products. The research and application of these products are in line with the Action Plan for Zero Growth of Pesticide Use by 2020 issued by the Ministry of Agriculture of China <sup>[25]</sup>, and also conform to the strategies and concepts of agricultural sustainable development, green development, and rural revitalization. The government can selectively identify and cultivate a few potential and strategic enterprises, incorporate the research and development projects of crop disease rapid test kits into the rural revitalization strategy, and let a small number of enterprises take the lead in developing such projects. Once these enterprises taste the benefits brought by the projects, it is believed that more enterprises will scramble to imitate and join the army of promoting crop disease rapid test kits.

#### 5. Prospects Analysis of Crop Disease Rapid test Kits in China

China has always paid great attention to food safety. There are many technologies and methods for detecting pesticide residues in vegetables and fruits. Some enterprises have been fined due to excessive pesticide residues, and some food enterprises have been prohibited from exporting their goods due to the same problem. The crop disease rapid test kits can help growers detect crop diseases at an early stage and control and reduce the use of pesticides, ensuring the safety of plant-derived food from the source. It is believed that after these products become popular in the terminal agricultural input retail market, food retail stores will rarely be troubled by excessive pesticide residues in their products, and food exporters will significantly reduce the situations where they cannot fulfill their contractual obligations due to excessive pesticide residues.

Currently, the whole world is pursuing a low-carbon, green, and environmentally friendly lifestyle. The research, development, promotion, and application of crop disease rapid test kits can enable farmers to reasonably reduce the use of pesticides while ensuring a bumper harvest, which will also indirectly reduce pesticide production. At present, there are not many enterprises globally engaged in researching and selling the crop disease rapid test kits. This is a good opportunity for developing and commercially promoting such kits at the terminal level. It is hoped that more technology-based enterprises will cooperate with university laboratories or scientific research institutions to engage in the industrial production of such products as soon as possible to seize the market opportunity. As the ‘crop doctor’s eyes’ of the crop disease rapid test kit, it is believed that in the near future, with the guidance and encouragement of the government, enterprises will perceive the market potential and value of crop disease rapid detection kits and enter this industry. With the development and standard improvement of on-site crop disease rapid test kits in the fields, the subsequent market will become standardized. At that time, the ultimate beneficiaries will not only be enterprises, farmers, and growers, but also the vast number of consumers, because

less pesticide spraying will make the food flowing to the terminal market safer and healthier.

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no

## Conflict of Interests

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

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# From the Perspective of Common Prosperity: A Probe into the Fiscal Reform of Chinese path to modernization

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**Abstract:** Common prosperity is an essential requirement of socialism with Chinese characteristics and a long-term historical process. As an important part of the public policy system, scientific financial and tax policies are indispensable tools for regulating income distribution and promoting common prosperity, and will play a more important role in the new historical period. Currently, China is facing a series of practical problems such as economic restructuring, uneven income distribution, and uneven regional development. To this end, it is necessary to continue active fiscal policies, promote high-quality economic development, optimize tax system structure to promote fair income distribution. At the same time, it is necessary to deepen the social security system, expand coverage, and ensure that every citizen can receive the necessary protection in critical moments such as illness and unemployment. In addition, based on the current issue of imbalanced regional development, it is also urgent to strengthen the division of financial powers between governments, improve the fiscal transfer payment system, to ensure that resources are tilted towards impoverished areas and truly achieve the goal of common prosperity. Through in-depth analysis of practical issues, this article will comprehensively explore the reform path of modern financial and tax systems, laying a solid foundation for common prosperity.

**Keywords:** Common Prosperity; Chinese Modernization Financial and Tax Reform; Practical Path

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Over the past 40 years of reform and opening up, especially since the 18th National Congress of the Communist Party of China, the reform of China's financial and tax system has been continuously promoted, and it is undergoing a transformation from compensating for "market failure" to focusing on "governing the country". Gradually, a financial system arrangement that meets China's basic national conditions and governance needs has been established. Under the socialist system with Chinese characteristics, socialist public ownership meets the fundamental prerequisite for China to achieve common prosperity. As the fiscal positioning based on public ownership rises to the level of national governance, striving towards the goal of modernizing the financial and tax governance system and governance capacity, and comprehensively building a socialist modernized country, finance plays a crucial role in promoting common prosperity. On the one hand, the financial and tax system promotes the development of productivity and wealth creation, which is conducive to expanding the cake. On the other hand, the financial and tax system promotes fair distribution of wealth, which is conducive to distributing the cake well.

## 1. Optimize resource allocation and improve initial allocation

The foundation of common prosperity is "prosperity". To achieve common prosperity for all people, it is necessary to

continue to expand the “cake” of the national economy and achieve high-quality economic development. The initial distribution is led by the market, adhering to the principle of distribution according to work as the mainstay and coexistence of multiple distribution methods. While emphasizing economic efficiency, paying attention to economic development and wealth creation, fairness should also be taken into account, and it should be the foundation and dominant position in income distribution. The financial and tax system, by adhering to the principle of tax neutrality and adjusting the structure of fiscal expenditure, avoids interfering with the allocation of market economy resources, improves enterprise production efficiency, ensures that residents receive fair and reasonable market income, and optimizes the initial distribution mechanism. The initial distribution is the distribution of the added value created by production factors among labor factors, capital factors, and government departments. The labor income obtained by residents in the initial distribution is market income. In the initial allocation stage, fiscal policy, as the main means of macroeconomic regulation, can adopt a combination of cross cycle regulation and countercyclical regulation to smooth out macroeconomic fluctuations, regulate market supply and demand structure, and promote stable, sustained, and healthy growth of the national economy.

On the one hand, in the initial distribution stage, taxation plays a policy regulatory role. Taxation is not omnipotent, and to play a regulatory role in the initial distribution stage, it is necessary to adhere to the principle of tax neutrality. From the perspective of resource allocation, market mechanisms have characteristics such as sensitive information, effective incentives, and flexible regulation, which are conducive to stimulating the vitality of economic development. Socialist market economy is the organic combination of socialist basic system and market economy, fully leveraging the decisive role of the market in resource allocation, and better leveraging the role of the government. The role of taxation in promoting common prosperity also needs to be based on the decisive role of the market. In the initial distribution stage, the government influences national wealth creation through indirect taxes mainly based on value-added tax, with the main mechanism being to change the relative price of products sold in the market. This method of imposing indirect taxes on products will distort the formation of price mechanisms, affect consumer consumption choices in the market, and thus damage market efficiency. On the other hand, from the perspective of fiscal expenditure, the government can optimize the allocation of socio-economic resources and improve the production efficiency of enterprises by adjusting the structure of fiscal expenditure. A sound and complete infrastructure system can reduce the flow cost of products and production factors, promote market integration, and thereby improve resource allocation efficiency.

## **2.Adjusting excessive income and leveraging the progressive role of the tax system**

The tax regulation mechanism is an important means of regulating income redistribution and promoting common prosperity. The government designs a progressive tax system to impose heavy taxes on excessive income, in order to stabilize the income distribution gap among residents and adjust the initial distribution pattern under market mechanisms. The degree of progression of a country’s tax system is mainly reflected in the relative weight of direct and indirect taxes in the overall tax system. In China, taxation mainly adjusts income and wealth redistribution through direct taxation. Direct tax mainly consists of income tax and property tax. Due to the difficulty in transferring the tax burden of direct tax, the tax burden of direct tax is usually attributed to the legal taxpayer themselves. Moreover, direct tax generally adopts a progressive tax rate structure, and the tax rate applicable to high-income individuals is also higher. Therefore, direct taxation can effectively regulate excessive income and help achieve the government’s “fairness” goals. Indirect taxes mainly include turnover taxes such as value-added tax and consumption tax, which are levied on the circulation of goods or labor. Compared to direct taxes, the tax burden of indirect taxes is easier to achieve and can be transferred to higher-level manufacturers or end consumers through forward or backward transfer. The tax rate structure of indirect tax usually adopts a proportional tax rate, and the setting of proportional tax rates makes indirect tax have a considerable degree of retroactivity. Compared to high-income individuals, the marginal propensity to consume is higher among middle and low-income groups, and their consumption expenditure accounts for a larger proportion of their total income. Therefore, the indirect tax burden is more borne by middle and low-income individuals. Therefore, the higher the proportion of direct taxes in a country’s tax system, the higher the degree of progression of the tax system, and the greater the role it plays in income redistribution.

The progressive effect of China’s tax system is mainly achieved by the excessive accumulation of personal income tax. The

method of comprehensive taxation can to some extent play a role in regulating excessive income, thereby smoothing out the initial income gap among residents. In addition, China also imposes a relatively high consumption tax rate on high-end consumer goods such as ultra luxury cars, high-end cosmetics, precious jewelry and jewelry, high-end watches, etc. This part of the consumption tax is mainly borne by high-income individuals and has a certain degree of progressiveness. According to calculations by Yue Ximing and others, the progressive index of China's consumption tax is positive nationwide, indicating that China's consumption tax also has progressive characteristics, which can to some extent alleviate income distribution inequality.

### **3.Assist low-income groups and achieve social security functions**

A sound social security system is an important guarantee for achieving common prosperity for all people. Firstly, in terms of adjusting the income distribution gap, unlike the effect of lowering excessively high income through personal income tax, social security expenditures stabilize the income distribution gap by increasing the income of low-income groups. The government's social security expenditure covers social relief expenditure, social insurance expenditure, and social welfare expenditure. Social relief expenditure ensures the basic survival needs of vulnerable individuals by assisting low-income groups who cannot achieve the minimum living standard. Social insurance expenditure ensures the normal living conditions of ordinary workers, while social welfare expenditure is mainly used to provide high-quality material and cultural conditions for all members of society. Secondly, in terms of productivity in social security, improving the social security system is conducive to promoting economic development and expanding the cake. On the one hand, a sound social security system helps to improve the risk resistance and consumption level of residents, and the continuously increasing consumption potential will drive economic growth; On the other hand, a sound social security system helps to explore new growth models. In the era of digital economy, data has become an important factor of production. At present, China has established a fully functional social security system with social insurance as the main body, including social assistance, social welfare, and social preferential treatment systems. Government relief transfer payments and basic social insurance have significant poverty reduction effects. China's social security expenditure is the key to solving the problem of income distribution inequality and an important guarantee for achieving common prosperity for all people.

### **4.Ensuring basic livelihood and promoting equalization of public services**

The common prosperity of all people is not only reflected in the narrowing of the gap in disposable income among residents to a reasonable range, but also requires the development achievements to benefit all people more and more fairly. As an important means for the government to redistribute wealth, equalization of basic public services is a prerequisite, solid foundation, and key link for achieving common prosperity. Basic public services focus on the most concerning, direct, and practical interests of the people, and are the most basic well-being of the people. The report of the 20th National Congress of the Communist Party of China clearly regards "achieving equalization of basic public services" as one of the overall goals for China's development by 2035, while emphasizing the need to "improve the basic public service system, enhance the public service system, enhance balance and accessibility, and solidly promote common prosperity.". However, as pointed out in the report of the Twentieth National Congress of the Communist Party of China, Chinese path to modernization is a modernization with a huge population. It is a very difficult and complex task to provide equal basic public services for more than 1.4 billion people in China. We should make progress while maintaining stability, step by step, and continue to advance. In the process of promoting the equalization of basic public services, it is inseparable from the reasonable arrangement and adjustment of fiscal expenditure. Fiscal expenditure should clarify specific expenditure responsibilities based on the service objects, service contents, and standards of various basic public services, and provide corresponding financial support on the premise of fiscal sustainability.

### **5.Encourage public welfare donations and promote the third distribution**

Unlike the initial distribution led by the market and the redistribution led by the government, the third distribution has the characteristics of voluntariness and public welfare, and is a beneficial supplement to the initial distribution and redistribution. The third distribution is driven by morality, culture, social responsibility, etc., where individuals or enterprises who become



wealthy first voluntarily allocate their disposable income and operating profits to social wealth resources through charitable means such as donations, subsidies, and fundraising. Tax policies can promote the development of charitable donations and promote social equity, mainly reflected in tax incentives that encourage enterprises and individuals to participate in charitable donations. For enterprises, eligible poverty alleviation donations are exempt from value-added tax. When calculating corporate income tax, eligible public welfare donations that do not exceed 12% of taxable profits can be directly deducted in the current year, and the excess amount can be carried forward for three years for deduction. For individuals, the portion of their donations to eligible public welfare and charitable causes that does not exceed 30% of their annual taxable income can be deducted when calculating personal income tax. In addition, to cope with major natural disasters and other special events, China has timely introduced phased tax preferential policies and reduced relevant taxes and fees. These tax incentives play a certain role in encouraging individuals and businesses to actively participate in charitable and public welfare undertakings, thereby achieving the third distribution of income.

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# Determinant of Profitability of US Commercial Banks: Panel Evidence from Period 2013-2017

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**Abstract:** The purpose of the paper is to further examine the determinants of commercial bank profitability in United State during period from 2013 to 2017. The quantitative research method is used in this paper and data of fifty commercial banks in the US are used. The results indicate that return on average assets (ROAA) is found negatively and significantly affected by bank size and large banks are influenced by tremendous all kinds of costs. The other significant determinants are credit risk and operational efficiency, both of them affect negatively on bank profitability. Turning to external factors, the growth of GDP and inflation are both insignificant in bank performance.

**Keywords:** United State; Banking; Profitability

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## 1.Introduction

When it comes to the development of the economy and the stability of finance, commercial banks play a considerable role. They support available funds and loans to investors. In the United State, commercial banks are the basis of business and finance. As of 2018, the banking asset of first five largest banks was almost equal to 56% of the US economy. Meanwhile, their annual revenue rises to nearly 240 billion dollars by 2019, earnings in the bank sector have a wide fluctuation based on economic climate and bank-specific characteristics. Following up many previous studies about the determinants of bank profitability in United States, we find that they generally separated internal and external factors (Ongore, 2013).

The aim of this paper is further examining the determinants of bank profitability in the United State. Therefore, return on average asset (ROAA) is set as a measure of bank profitability. Our group design two equations according to external and internal factors. The effect of internal factors is considered liquidity, bank size, credit risk, operational efficiency, and capital strength. The other effect of external factors is considered the growth of GDP and inflation rate. Meanwhile, we choose top fifty commercial banks based on data during the period 2013-2017 in United State. And we divide this paper into five parts, when we finish the introduction, following by the literature review section which shows different perspectives of far-famed authors associated with different factors settling bank profitability. Date and methodology will be presented at third section providing two model formulation. Next section will analysis and give the results of the research. Finally, we show the conclusion of this paper and give some recommendations to further studies.

## 2.Literature review

### 2.1 Prior research



There are numerous empirical studies about determinants of the bank profitability, including liquidity, credit risk, efficiency, capital, and macro-economy. In an early research, Bourke (1989) points that elements determining bank profitability can be classified into two categories, including the internal determinants controlled by the management of banking institutions and the external determinants that are uncontrollable and reflecting the macroeconomic or legal environment.

Molyneux & Thornton (1992, cited in Shahzad et al., 2018) argues significant and negative relationship of liquidity with profitability. In fact, if banks retain large amounts of money rather than investing, they will have sufficient liquidity and their profitability will be affected negatively (Ayanda, Christopher & Mudashiru, 2013). However, Bourke (1989) finds that the bank's liquidity and profitability are positively correlated. Similarly, some researchers have a consistent view that when liquidity falls, the profitability decreases (Rasiah, 2010; Chronopoulos et al., 2015; Rudhani, Ahmeti and Rudhani, 2016; Shahzad et al., 2018).

There are many studies which indicate a link between bank size and profitability. By achieving economies of scale, the expansion of banks can increase the bank's profitability. An example provided by Mester (2010, cited in Regehr and Sengupta, 2016) is that banks with larger assets can reduce risk through product lines, industry and regional diversification, and all above ultimately lead to the increased profitability. In contrast, ECB (2015) reveals size can significantly and negatively affect bank profitability due to complex systems and high-cost structures of larger banks. On the other hand, an argument is made by Chronopoulos et al. (2015, cited in Bikker and Vervliet, 2018), stating that there is a non-linear relationship that profitability begins to increase as the size increases, and then decreases.

It is observed by Buchory (2015) and Bhattarai (2016) that NPL has a positive association with ROAA and ROAE respectively. On the contrary, Athanasoglou, Sophocles and Matthaios (2005) and Ozurumba (2016) demonstrate the connection between credit risk and bank profitability is negative. An evidence was given by Said (2018) is to suggest that nonperforming loan ratio is inversely related to the profitability of the commercial banks with a total asset of 100million-300million in the US.

It is argued by Dietrich and Wanzenried (2014) that before and during the financial crisis, Swiss banks had negative operating efficiency indicators (cost-to-income ratios). Similarly, the view is supported by Kalaitzis and Fotiadis (2017) that this factor negatively affects the profits of UK banks. These findings are the same as in the prior literature, proving that more profitable banks are more efficient, while less cost-controlled banks have lower profits (Pasiouras and Kosmidou, 2007; Athanasoglou, Brissimis, and Delis, 2008).

Capital is a common internal variable to banks, which is significant for the determination of bank profitability. The empirical evidence of the positive relation between capitalization and profitability of banks in the US is given by Berger (1995), and similarly, Goddard et al. (2004) for European banking systems agree with it. While it is true that Tregenna (2009) finds such relationship is negative in US banks over the period 1994 to 2005 and Chronopoulos et al. (2015) indicates that capital ratio is a significant and negative variable in the regression analysis, based on 1984–2010 US banks data.

Using GDP growth as a variable has not been widely characterized in measuring bank performance. Kosmidou (2008) takes the Greek commercial banks from 1990 to 2002 as an example to examine how macroeconomic variables affect performance and his empirical result suggests a correlation between GDP and bank profitability is positive, which is consisted with finding of Arpa et al. (2001) for Austrian banks and Kok et al. (2015) for euro area banks. Whereas, it is proved that the impact of GDP on ROAA is obviously negative (Staikouras and Wood, 2003; Banerjee and Majumdar, 2014).

There is various empirical analysis showing that the correlation between inflation rate and the profitability of banks is complex. Perry (1992) describes how inflation affects the profitability depending on whether inflation could be predicted. Demirgus-Kunt and Huizinga (1999), Athanasoglou et al. (2008) and Trujillo-Ponce (2013) have an agreement that inflation rate is positively correlated with profitability, while it is demonstrated that the inflation rate is not significantly related to euro area banks' ROAA (Kok et al., 2015). Besides, an evidence suggested by Dietrich and Wanzenried (2014) that inflation has a remarkably positive effect in countries with low or middle income, but it does not affect profitability in high-income countries.

From the above, we can see some conflicts on macroeconomic variables influencing bank profitability in the different

literature results, namely concerning the effects of GDP growth and inflation. However, considering the different geographical location of the sample and the reference period between the papers, this observation is not difficult to understand.

## 2.2 Variable selection

### Performance measures

ROAA is a crucial ratio for evaluating the bank profitability and is widely used in literature. This ratio link business profits with bank owned assets, reflecting how efficient the bank utilizes its assets. And it can objectively reflect the ability of banks to use asset without being affected by refinancing. Therefore, we chose ROAA to represent top 50 US commercial bank performance from 2013 to 2017.

### Internal factors

Banks receive deposits and issue loans to create liquidity, which calculated by the ratio of loans to deposits (LODEP) (Arthur and Rabarison, 2017). Effective liquidity management enables banks to meet customer needs, and even if banks are in financial crisis, ineffective liquidity management can lead to serious consequences (Rudhani, Ahmeti and Rudhani, 2016). Although researchers have different views on the liquidity and profitability of banks, it would be predicted that higher liquidity would lead to the higher profitability.

Natural logarithm of total assets (LNSIZE) is used to measure bank size. Prior studies in which the bank size exerts a positive and negative impact on the probability of banks. Furthermore, bank size and profitability are non-linear. Since the result that size affects the bank profitability is still inconclusive, natural logarithm of total assets as a proxy is used for its size to explain how asset size affects profitability. It is assumed that size affects profitability positively because of the low rates from the US government.

The rate of non-performing loans to total loans (NPL) is an indicator ratio of credit risk (Laryea, Ntow-Gyamfi and Alu, 2016). Various studies have identified non-performing loans (NPLs) as explanatory variables that determine bank profitability and regulate the correlation between them. This factor indicates the loan quality as well, which have a strong impact on expecting bank future profitability (Said, 2018). Different results show the amount of credit loan provided, depending on bank size, affects the profitability differently. It is expected that banks with higher the non-performing loans to total loans have the higher the risk and therefore the lower the profitability.

Cost to income ratio (CTI) measures operational efficiency and a bank's success. It is also considered as a management ability's indicator to control and reduce the rate. In previous studies, it is clear that cost to income ratio affects the bank's performance negatively. Thus, we use this ratio to expect that the negative relationship between CTI and profitability since it demonstrates the management efficiency resulting in increased costs.

The equity to assets ratio (EQTA) is used for evaluating the overall capital level, referring to the adequacy of equity. Although more capital helps banks reduce the possibility of collapse, increase their market share and profitability, it results in a significant falling in leverage. Thus, we predict that EQTA is negative and insignificant in relation to bank profitability.

### External factors

The growth rate of GDP (GDPGR), the most popular macroeconomic indicator, is measured total economy activity. It is expected that GDP growth could influence many elements associated the demand and the supply of bank deposits and loans (Olalere et al, 2017). It is worth discussing whether the GDP growth rate influences the banking sector and its performance. As most analysis, we project that GDP growth rate could have a positive impact on bank profitability.

Inflation rate (INFL) is associated with market growth. Revell (1979) indicates the link between inflation and profitability influenced by salaries and operating costs of the bank. Under such circumstance, more researchers confirm a positive association between inflation and profitability. According to the view of Dietrich and Wanzenried (2014), we expect that there is no significant coloration between the two variables due to the high income of the US.

## 3.Data and methodology

### 3.1 Data

In this study, accounting data of individual banks is drawn from Orbis Bank Focus. The country- and market-specific data such as GDP growth, Inflation rate and Unemployment rate is obtained from World Bank dataset. The sample includes top

50 (ranked by assets) commercial banks based in United State over the period 2013 to 2017 consisting of 249 observations, 1 observation is omitted due to data unavailability. The time period 2013 to 2017 is chosen by data availability.

### 3.2 Model formulation

In order to examine to what extent the internal factors (e.g. bank's-specific characteristics) and external factors (e.g. macroeconomic) affect the profitability of US commercial banks, quantitative research method is used in this paper. The bank-specific equation is shown below:

The model (1) is to examine the impact of the internal factors (e.g. bank's-specific characteristics) on bank performance

$$ROAA_{it} = \beta_0 + \beta_1 LNSIZE_{it} + \beta_2 CTI_{it} + \beta_3 LODEP_{it} + \beta_4 NPL_{it} + \beta_5 EQTA_{it} + \varepsilon_{it} \quad (1)$$

Where  $\beta_0$  is a constant,  $i$  refers to an individual bank,  $t$  refers to year,  $\varepsilon$  is an error term.

The model (2) is to examine both the internal factors (e.g. bank's-specific characteristics) and external factors (e.g. macroeconomic) influence on bank performance. As shown below, the external factors of each year are added to model (1):

$$ROAA_{it} = \beta_0 + \beta_1 LNSIZE_{it} + \beta_2 CTI_{it} + \beta_3 LODEP_{it} + \beta_4 NPL_{it} + \beta_5 EQTA_{it} + \beta_6 GDPGR_{it} + \beta_7 INFL_{it} + \varepsilon \quad (2)$$

The two models are tested by heteroscedasticity and found in Table1 that heteroscedasticity exists significantly in model (1) and model (2). Therefore, In the presence of heteroscedastic errors, robust standard errors will be used. Next, the two models are tested by heterogeneity to select which model is the best and robust standard errors are used in model (1). As shown in Table2, based on Breusch-Pagan Lagrangian multiplier test and F test, the p-value successes to reject the null hypothesis so that pooled OLS model is not suitable in both two models. Furthermore, Hausman test is conducted and the result suggests that fixed effect method is better than random effect method. Therefore, we consider that the fixed effects method used in our analysis is appropriate. Finally, we do VIF test, the results in Table3 show that multicollinearity do not exist for both models.

Table1 Heteroscedasticity Test

Breusch-Pagan test	
Regression (1)	Regression (2)
0.0000	0.0000

Table2 Selection of Models

Regression	Test Method	Hypothesis	p-value
Equation (1) Internal Factors	Breusch-Pagan LM test with robust standard errors	H0: pooled OLS H1: RE	0.000
	F test	H0: pooled OLS H1: FE	0.000
	Robust to heteroskedasticity Hausman-like test	H0: RE H1: FE	0.0000
Equation (2) Overall Factors (Internal & External Factors)	Breusch-Pagan LM test with robust standard error	H0: pooled OLS H1: RE	0.000
	F test	H0: pooled OLS H1: FE	0.000
	Robust to heteroskedasticity Hausman-like test	H0: RE H1: FE	0.0000

Table 3 VIF results of two regressions

variable	VIF	
	Regression (1)	Regression (2)
LODEP	1.61	1.61
LNSIZE	1.06	1.06
NPL	1.37	1.37
CTI	1.03	1.04
EQTA	1.20	1.20
GDPGR		1.17
INFL		1.17
Mean VIF	1.25	1.23

## 4.Results

This sections provides detailed analysis of empirical results, including a general analysis of internal and external determinants on bank profitability, and results of the regressions about the two models.

### 4.1 Descriptive statistics of variables

The Table4 shows descriptive statistics for internal factors and external factors which used in the regression models, including observations, mean, standard deviation, min value and max value. These data are used to describe the basic features of factors in this research and provide simple summaries about the sample and the measures.

*Table4 Descriptive Statistics*

Variable	Obs	Mean	Std. Dev.	Min	Max
ROAA	249	1.076386	0.891087	-3.01	5.81
LNSIZE	249	11.42353	1.053858	9.5	14.38
CTI	249	57.23454	15.2513	13.57	89.95
NPL	249	1.400602	1.034148	0.05	7.18
LODEP	249	74.42329	22.73367	9	138.11
EQTA	249	12.09357	2.970676	6.39	23.97
GDPGR	250	2.174	0.5203721	1.49	2.86
INF	250	1.318	0.666056	0.12	2.13

### 4.2 Results of the regressions

The Table5 shows the results of the regressions. The first column reports the results of the model (1) which only considers the internal factors (e.g. bank's-specific characteristics) and the second column shows the result of model (2) which both internal factors (e.g. bank's-specific characteristics) and external factors (e.g. macroeconomic) are taken account to.

*Table5 Regression Results*

	Dependent variable ROAA	Dependent variable ROAA
LNSIZE	-0.6545503(0.000)***	-0.6512018(0.000)***
CTI	-0.035604(0.000)***	-0.0361899(0.000)***
LODEP	-0.0093542(0.282)	-0.0095788(0.271)
NPL	-0.6566329(0.000)***	-0.6472787(0.000)***
EQTA	-0.0242198(0.659)	-0.0228476(0.676)
GDPGR		0.0135474(0.581)
INFL		-0.0114181(0.396)
R2	0.3145	0.3154
Prob>F	0.0001	0.0001

Notes: 50 Banks, period 2013-2017, No. of observations=249, p-values in parentheses; \*Significant at the 10 per cent level, \*\*significant at the 5 per cent level, \*\*\*significant at the 1 per cent level.

As shown in Table, model (1) and (2) are very statistical significant with P-value = 0.0001. The overall explanatory power (in terms of adjusted R2) for these two models are not relatively high, which are 31.45% and 31.54% respectively. The explanatory power of the model (in terms of adjusted R2) that examines the determinants of ROAA increases slightly when factors are considered.

#### 4.2.1 Bank's-specific characteristics

##### Size

The results indicate that the relationship between size and bank performance is negative and statistically significant regardless of macroeconomic factors. Our finding consists with previous finding of ECB (2015). He provides support to the argument

that in larger banks, the structure are more complex, therefore lead to more costly structure. Furthermore, larger banks will be negative impacted on the performance of profitability by bank size. Moreover, with respect to See Tregenna (2009), it could be argued that economies of scale will be limited by size of bank, and it might suffer from diseconomies of scale owing, for example, because of agency costs, overhead costs of bureaucratic processes and other costs may influence the management of large banks. In practice, the failures of large banks are more likely to cause macroeconomic externalities compared with small bank. In order to ensure economic stability in US, the government should provide more financial assistance to large banks.

#### Credit risk

Credit risk is found to be one of the most important determinants of bank profitability in the research in both the two models and it has negative effects on bank performance which is consists with the finding of Athanasoglo, Sophocles and Matthaïos (2005) and Ozurumba (2016). This result suggests in US banking sector, it seems that managers have adopted a risk-averse strategy which is mainly used to improve screening and monitoring credit risk to maximize profits.

#### Operational efficiency

Cost-to-income ratio is significant and negatively related to bank profitability whether macroeconomic factors are considered or not. The result consists with previous research such as Dietrich and Wanzenried (2014) and Kalaitzis and Fotiadis (2017), they confirm this inverse relationship for Swiss banks and UK banks respectively. The finding supports the argument that more efficient banks will perform better and an increase in expenses of operations in banks will lead to a decrease in the profits of banks operating in the US banks. As a result, for the purpose of promoting the profitability US banks, bank managers should take the necessary actions to achieve a more efficient cost control (Pasiouras and Kosmidou, 2007).

### 4.2.2 Macroeconomic

We turn to the effects of macroeconomic, from the table, it indicates that the growth of GDP has an insignificant and positive impact on bank profitability when the level of significance is 5%. Our finding is inconsistent with the findings of Staikouras and Wood (2003), Banerjee and Majumdar (2014). Meanwhile, the positive relationship means that growing economy will bring on the increasing in the demand and supply of funds from banks so that in turn it results in higher profitability. (Anne Deraso Illo, 2011)

In addition, the table also shows that the inflation is unimportant and negative about the influence of bank profitability at 5 % level of significance. Our finding of insignificant and negative correlation between bank profitability (ROAA) and inflation which is consist with the view of Dietrich and Wanzenried (2014).

The results both the growth of GDP and inflation confirm our pervious hypothesis. There are serval reasons. First, there are the limited data our group use. Second, we analysis the period from 2013 to 2017 which is little short and relatively stable economic environment since the end of financial crisis. Last, The United State is the world financial center, in terms of external influence it combines with an enormous variety of factors.

## 5. Conclusion

### 5.1 Overview of study

This paper examines the impact of bank-specific characteristics and macroeconomic conditions, measured by return on average assets (ROAA). For this aim, a panel data is applied to data which is obtained 50 commercial banks ranking by total assets in United State covering the period 2013-2017. We find that bank size has a negative and significant impact on the profitability of banks. What's more, large banks are influenced by tremendous all kinds of costs. The other significant determinants are credit risk and cost-to-income, both of them affect negatively on bank profitability. As for external factors, the growth of GDP and inflation are insignificant. However, the growth of GDP have a positive impact on bank profit and inflation is the opposite.

### 5.2 Recommendation for further research

The further study can be extended in plenty of parts. For example, the whole bank sector may be not limited in commercial bank. There are Islamic and conventional banks. Also the further study can consider other analytical methods including GARCH model, ARCH model and VAR model. (Anne Deraso Illo, 2011). We can continue to find whether the results will be different. Additionally, the further study can address a longer period more than 5 years. At same time, it can have a wider

choices about financial and economic conditions. it will be better to add more variables, such as taxation and regulations.

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no

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The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

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# Exploring Configurational Factors Influencing Online Privacy Protection Behaviors of Internet Users

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**Abstract:** With the rapid development of the digital economy, internet users' privacy protection behaviors have become a focal point for both academia and industry. This study adopts a configurational perspective and employs fuzzy-set Qualitative Comparative Analysis (fsQCA) to investigate the synergistic mechanisms of multiple factors influencing users' privacy protection behaviors. Integrating social cognitive theory, the research constructs an analytical framework encompassing individual cognitive factors (e.g., data privacy sensitivity, self-efficacy, perceived risks/benefits) and social-environmental factors (e.g., descriptive norms, subjective norms, platform trust). Based on 357 valid questionnaires, the study identifies core condition configurations driving high-level privacy protection behaviors. Key findings include: Five distinct paths explain high-level privacy protection behaviors, with "risk-benefit trade-off" (high perceived risk + low perceived benefit) and "social norm-driven" (high descriptive norms + high subjective norms) as typical patterns; Substitution effects exist between individual cognitive factors (e.g., self-efficacy) and environmental factors (e.g., platform trust), with different user groups relying on distinct condition combinations; Configurational analysis reveals "multiple conjunctural causality" in privacy behaviors, suggesting traditional linear regression may underestimate synergistic effects among variables. The study provides differentiated strategy insights for platforms to optimize privacy design and extends the application of privacy calculus theory in configurational analysis.

**Keywords:** Configuration Effects; Privacy Protection; Influencing Factors; Information Management

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## 1.Introduction

In recent years, the proliferation of online social and economic activities has generated vast amounts of data. Enterprises frequently leverage collected information to enhance services for consumers. For instance, Didi utilizes passenger and driver location data to shorten waiting times and improve safety; Facebook employs personal data to curate posts and deliver targeted advertisements based on user preferences; online dating platforms analyze user information to recommend ideal matches. However, the ubiquitous availability of data has also led to adverse consequences. From Cambridge Analytica's exploitation of Facebook data to influence election outcomes, to health insurers predicting potential policyholders' health risks using undisclosed personal information, and private hackers targeting innocent users, privacy has emerged as one of the most critical challenges facing the digital economy.

The rapid development of mobile internet, characterized by its openness, innovation, information-sharing capabilities,



interactivity, and low cost, has fundamentally transformed how people access and share information. The rise of diverse social networking platforms and mobile devices has attracted massive user engagement, particularly in an era where 4G networks are widely accessible and 5G high-speed connectivity is rapidly penetrating all aspects of daily life, transforming societal development. Through self-presentation on social networks, individuals build interpersonal relationships and accumulate social capital. Yet, the openness of these platforms, while offering convenience, poses significant threats to user privacy. Consequently, investigating privacy protection behaviors in social networks holds significant theoretical and practical importance.

## 2.Literature Review

Regardless of the method employed to deliver targeted advertising, businesses must utilize users' personal information. The collection, sharing, sale, and use of such data inevitably heighten consumers' privacy concerns, which not only suppress individuals' willingness to disclose private information but also undermine the effectiveness of targeted ads. Evans(2009) analysis the evolution of internet advertising reveals that while targeted advertising represents an inevitable trend in the industry, it faces a fundamental and critical challenge: user privacy protection. Brandon(2013) argues that targeted ads enable consumers to better understand products, yet their reliance on personal data amplifies the risk of privacy breaches. Furthermore, the prevalent trading of consumer data in the market exacerbates user anxieties about information leakage. Zarouali (2017) through empirical analysis of retargeted ads on Facebook, demonstrate that when users exhibit low privacy concerns, targeted ads enhance purchase intentions, whereas this effect diminishes under heightened privacy concerns.

User privacy concerns directly impact corporate profitability, making effective privacy management a delicate yet essential task for businesses. From a firm-level perspective, Johnson's(2013) game-theoretic model shows that even when users employ ad-blocking tools, monopolistic firms can still profit. Vincent et al. find that when consumers can opt to block access to their purchase history, low blocking costs lead to widespread adoption, yet monopolistic enterprises remain profitable. Wang et al.,(2020) investigated the mechanisms through which privacy violation experiences influence self-disclosure behaviors, constructing a theoretical model through systematic stratified random sampling while integrating social contract theory and agency theory. Peng et al.,(2018) based on empirical research methodology and the trade-off between perceived risks and perceived benefits, concluded that privacy concerns jointly affect both privacy protection and information sharing behaviors. Cui et al.,(2019) employed game theory to enhance the practical utility of data in personalized differential privacy frameworks. Meanwhile, Sun et al.,(2020) modeled the conflicting incentives between service quality and privacy protection as an evolutionary game-theoretic model, effectively enabling users to Trade-off long-term service quality benefits against immediate privacy costs.

## 3.Research Design

### 3.1 Fuzzy-Set Qualitative Comparative Analysis (fsQCA)

This study employs Fuzzy-Set Qualitative Comparative Analysis (fsQCA) to investigate the causal relationships and mechanisms between conditional variables and outcome variables. fsQCA treats cases as configurations of conditions and outcomes, analyzing sufficiency and necessity relationships between conditional variables and outcomes to explore how these variables interact and jointly influence the results. The two most commonly used QCA approaches are crisp-set QCA (csQCA) and fuzzy-set QCA (fsQCA). While csQCA calibrates data into binary values (0 or 1), its dichotomous categorization risks oversimplification and information loss during data transformation. In contrast, fsQCA assigns continuous fuzzy membership scores ranging from 0 to 1, making it particularly suitable for handling continuous survey data. Since the numerical data obtained through the questionnaire survey in this study are continuous, fsQCA is a more appropriate methodological choice.

### 3.2 Selection of Research Variables

This study constructs an APCO model framework based on social cognitive theory to analyze antecedents and outcomes of privacy protection behaviors, selecting variables across two dimensions: individual cognition and social environment.

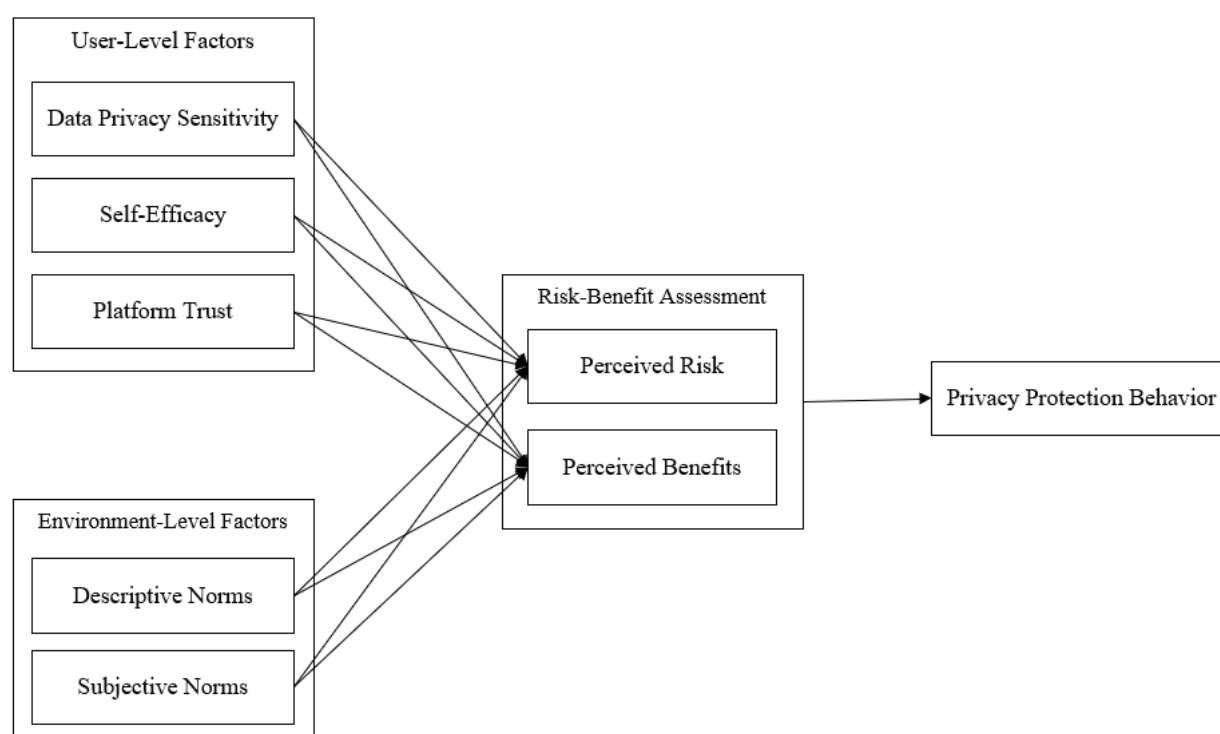
To clarify individuals' specific cognitive responses to security issues such as privacy breaches, this dimension is divided into three stages: ① Perception of Threat: Refers to the extent to which users perceive mobile IT security threats when

encountering privacy risks. ② Self-Efficacy and Response Efficacy: Self-efficacy denotes an individual's confidence in their ability to perform protective behaviors, which is tied to their perceived competence and access to resources. Response efficacy captures an individual's belief in the effectiveness of a protective behavior in mitigating threats. This evaluation is a cognitive process, forming judgments about the utility of such behaviors in addressing risks. ③ Perceived Privacy Value: Reflects a rational assessment of privacy's utility, where users weigh perceived costs (e.g., effort, inconvenience) against anticipated benefits (e.g., security, autonomy). According to social cognitive theory, individual cognition can exert measurable influence on the social environment.

Guided by social cognitive theory, two conditional variables are selected. Descriptive Norms: Describe the indirect social influence arising from widespread adoption of specific protective behaviors within a community. When individuals observe that a behavior is commonly practiced, they are more likely to adopt it themselves. Then, subjective Norms: Represent the perceived social pressure from significant others (e.g., family, friends) to engage in specific protective behaviors. Individuals often conform to these expectations to align with social approval. Empirical studies confirm that both descriptive and subjective norms significantly shape behavioral intentions.

The integrated conceptual model is illustrated in Figure 1.

Figure 1 Research Model



### 3.3 Data Collection: Questionnaire and Scale Design

This study employs a questionnaire and scale to collect user data. The questionnaire comprises three sections: an introduction, demographic characteristics survey, and measurement scales. A 5-point Likert scale is adopted to operationalize variables into multiple measurement items, with responses ranging from A (strongly disagree) to E (strongly agree). To ensure content validity, the scales were adapted from validated instruments used in prominent domestic and international studies, with linguistic adjustments tailored to this research context.

Prior to formal data collection, a pilot survey involving 20 participants was conducted from December 1 to 5, 2023, to refine the questionnaire structure, item sequencing, and wording of measurement items. Subsequently, considering that fuzzy-set Qualitative Comparative Analysis (fsQCA) prioritizes sample quality and representativeness over large sample sizes, a hybrid approach combining offline paper-based questionnaires and online electronic surveys was implemented from December 6 to 30, 2023. A total of 405 responses were collected. To address data quality concerns in online surveys, questionnaires with total completion times below 180 seconds (with a minimum response time of five seconds per question) were discarded,

resulting in 357 valid questionnaires.

### 3.4 Reliability and Validity Analysis of Scales

Reliability analysis serves as a critical method to evaluate the authenticity and accuracy of questionnaire data. This approach focuses on assessing the internal consistency and reliability of the data, typically measured using Cronbach's  $\alpha$  coefficient. According to established standards (Hair et al., 2009; Huang et al., 2018), a Cronbach's  $\alpha$  coefficient above 0.7 indicates acceptable internal consistency and reliable questionnaire quality, while values below 0.6 suggest significant discrepancies among scale items, rendering the data unsuitable for subsequent hypothesis testing.

In this study, reliability analysis revealed that all eight variables—privacy protection behaviors, data privacy sensitivity, self-efficacy, platform trust, descriptive norms, subjective norms, perceived risks, and perceived benefits—achieved Cronbach's  $\alpha$  coefficients exceeding 0.7. These results confirm high internal consistency among the scale items and validate the questionnaires reliability. The scales used in this empirical study, along with their reliability test results, are summarized in Table 1.

*Table 1 Reliability Test Results of the Questionnaire*

Construct	Cronbach's $\alpha$	Number
Privacy Protection Behavior (PP)	0.908	4
Data Privacy Sensitivity(DS)	0.918	3
Self-Efficacy(SE)	0.901	3
Platform Trust(ET)	0.889	3
Descriptive Norms(DN)	0.897	3
Subjective Norms(SN)	0.897	3
Perceived Risk(PR)	0.868	3
Perceived Benefits(PB)	0.769	3

Discriminant validity is used to determine whether measurement items genuinely reflect distinct variables or constructs, ensuring they are differentiated. Specifically, it verifies whether items should be assigned to separate factors or variables, thereby avoiding the measurement of divergent concepts under the same factor. As shown in Tables 2, the square roots of the average variance extracted (AVE) for all variables exceed the absolute values of their corresponding correlation coefficients. This indicates that while the variables exhibit moderate correlations, they remain statistically distinct. Consequently, the scales demonstrate satisfactory discriminant validity.

*Table 2 Correlation Coefficient Matrix and Square Roots of AVE Test Results*

	PP	DS	SE	ET	DN	SN	PR	PB
PP	0.797							
DS	0.262	0.811						
SE	0.402	0.365	0.781					
ET	-0.252	-0.071	-0.052	0.773				
DN	0.421	0.442	0.630	-0.131	0.807			
SN	0.342	0.526	0.501	-0.108	-0.180	0.785		
PR	0.379	-0.028	-0.377	0.678	0.619	-0.097	0.904	
PB	-0.361	0.372	0.323	0.687	0.591	-0.111	0.262	0.738

## 4.Data Analysis

### 4.1 Variable Calibration

Qualitative Comparative Analysis (QCA) operates on Boolean algebra principles, calibrating variables against specific sets to determine their degree of membership within those sets. The calibrated values obtained through this process serve as the foundation for subsequent data analysis. The calibration process transforms variables into sets by defining three critical thresholds: Full membership, Crossover point and Full non-membership. This study employs the direct calibration method to convert relevant antecedent and outcome variables into fuzzy-set membership scores, with transformed membership degrees ranging between 0 and 1. Following this methodology, the calibration anchor points for all variables are presented in Table 3.

*Table 3 Calibration Anchor Points for Variables*

Research Variables			Target Set	Anchor Points		
				Full Non-membership	Crossover Point	Full Membership
Conditional Variable	User-Level Factors	DS	High data privacy sensitivity	1	3	5
		SE	High self-efficacy	1	3	5
		ET	High platform trust	1	3	5
	Environment-Level Factors	DN	High descriptive norms	1	3	5
		SN	High subjective norms	1	3	5
		PR	High perceived risk	1	3	5
		PB	High perceived benefits	1	3	5
Outcome Variable		PP	high privacy protection behavior	1	3	5
			No-high privacy protection behavior	1	3	5

### 4.2 Necessary Condition Analysis

Prior to examining configurational effects, we first conducted a necessity analysis to determine whether individual antecedent conditions constitute necessary conditions for achieving specific outcomes (privacy protection/non-protection behaviors). Subsequently, for conditions that failed to demonstrate necessity individually, we performed sufficiency analysis to identify the most explanatory configuration of conditions for the outcome variables. The results of the necessary condition analysis are presented in Table 4.

*Table 4 Necessary Condition Analysis*

conditional variables	high privacy protection behavior	
	Consistency	Raw Coverage
High data privacy sensitivity	0.924	0.952
Low data privacy sensitivity	0.222	0.597
High self-efficacy	0.928	0.957

conditional variables	high privacy protection behavior	
	Consistency	Raw Coverage
Low self-efficacy	0.228	0.612
High platform trust	0.270	0.643
Low platform trust	0.879	0.953
High descriptive norms	0.949	0.955
Low descriptive norm	0.204	0.585
High subjective norms	0.948	0.951
Low subjective norms	0.201	0.582
High perceived risk	0.956	0.958
Low perceived risk	0.194	0.562
High perceived benefits	0.193	0.557
Low perceived benefits	0.947	0.951

As shown in Table 4, among the seven conditional variables influencing users' privacy protection behaviors, six variables demonstrate consistency scores exceeding 0.9: high data privacy sensitivity, high self-efficacy, high descriptive norms, high subjective norms, high perceived risks, and low perceived benefits. This indicates that these six variables constitute necessary conditions for privacy protection behaviors. These variables directly influence the outcome variable, meaning that without these six factors, users are unlikely to adopt any privacy protection measures. Meanwhile, low platform trust shows a consistency score above 0.8 but below 0.9, suggesting that while this variable exerts some influence on users' privacy protection behaviors, it does not qualify as a necessary condition.

### 4.3 Configurational Analysis

This study employed fsQCA 3.0 software for data analysis with a frequency threshold set at 1. Under the conditions of consistency scores exceeding 0.8 and PRI consistency greater than 0.75, we obtained the results presented in Table 5. The analysis revealed five distinct configurational paths influencing users' privacy protection behaviors, with consistency scores of 0.992, 0.992, 0.991, 0.972, and 0.992 respectively, indicating a high level of consistency. The overall solution consistency reached 0.986, demonstrating that 98.6% of individuals exhibited strong privacy protection behaviors under these five configurations, showing a clear and significant pattern. These results confirm the substantial impact of these configurations on privacy protection behaviors. Additionally, the overall solution coverage of 0.909 suggests that these five configurations can explain the privacy protection behaviors of 90.9% of the participants, indicating their strong explanatory power for high-level privacy protection behaviors. This finding further confirms that these configurations are prevalent within the sample and can be widely applied to improve and manage privacy protection behaviors.

Table 5 Configurational Paths of Conditional Variables

conditional variables	high privacy protection behavior				
	Path 1	Path 2	Path 3	Path 4	Path 5
Data Privacy Sensitivity (DS)				•	•
Self-Efficacy (SE)	•		•	•	•
Platform Trust (ET)	⊗	⊗			•
Descriptive Norms (DN)	•	•	•	•	•
Subjective Norms (SN)		•	•	⊗	

conditional variables	high privacy protection behavior				
	Path 1	Path 2	Path 3	Path 4	Path 5
Perceived Risk (PR)	•	•	•	•	•
Perceived Benefits (PB)	⊗	⊗	⊗	•	•
Consistency	0.992	0.992	0.991	0.976	0.992
Raw Coverage	0.813	0.825	0.873	0.138	0.142
Unique Coverage	0.007	0.020	0.066	0.001	0.003
Solution Consistency	0.986				
Solution Coverage	0.909				

Note : • indicates the presence of a core causal condition, ⊗ indicates the absence of a core causal condition, • indicates the presence of a peripheral causal condition, Blank space indicates the condition may be either present or absent in the configuration.

## 5. Research Findings

The seven variables—data privacy sensitivity, self-efficacy, platform trust, descriptive norms, subjective norms, perceived risk, and perceived benefits—can be combined in five distinct configurations to explain high-level user privacy protection behaviors.

Path 1: SE\*DN\*PR\*~PB\*~ET. High self-efficacy + High descriptive norms + High perceived risk + Low perceived benefits + Low platform trust → High privacy protection behavior (raw coverage=0.813, consistency=0.992). For users with high self-efficacy, when they perceive that most people around them are cautious about cross-platform targeted recommendations and refrain from easily providing personal information, their trust in platforms decreases. This elevates perceived risks and leads to strong privacy protection behaviors. Users confident in their ability to control personal information are significantly influenced by societal attitudes.

Path 2: DN\*SN\*PR~PB\*~ET. High descriptive norms + High subjective norms + High perceived risk + Low perceived benefits + Low platform trust → High privacy protection behavior (raw coverage=0.825, consistency=0.992). This path highlights the combined influence of societal factors, perceived risk, perceived benefits, and platform trust. When both societal trends (e.g., general public caution) and close social circles (e.g., family/friends) express skepticism toward cross-platform targeted recommendations, users perceive greater privacy risks. As most users are risk-averse, they adopt a wait-and-see approach toward novel advertising models like cross-platform targeting. The collective societal stance amplifies privacy concerns, driving protective actions.

Paths 1 and 2 represent risk-benefit trade-off configurations, aligning with privacy calculus theory. When perceived risks outweigh benefits (high risk + low benefit), users rationally opt for privacy protection. Both paths cover >80% of the sample, indicating broad applicability.

Path 3: DS\*SE\*DN~SN\*PR\*PB. High self-efficacy + High descriptive norms + Low subjective norms + High perceived risk + High perceived benefits → High privacy protection behavior (raw coverage=0.873, consistency=0.991). Here, users confident in their ability to implement protective measures (high self-efficacy) and observing widespread privacy-conscious behaviors (high descriptive norms) still exhibit strong protection behaviors, despite the convenience and utility of cross-platform recommendations. High self-efficacy users feel their data is excessively controlled by third parties, heightening privacy concerns. Even when benefits are significant, perceived risks trigger protective actions.

Path 4: DS\*SE\*DN~SN\*PR\*PB. High data privacy sensitivity + High self-efficacy + High descriptive norms + Low subjective norms + High perceived risk + High perceived benefits → High privacy protection behavior (raw coverage=0.138, consistency=0.976).

This path emphasizes the interplay of individual traits and societal norms. Privacy-sensitive users actively monitor platform-

related risks and adopt protective measures, even when societal pressure is low.

Path 5: DS\*SE\*DN\*PR\*ET. High data privacy sensitivity + High self-efficacy + High descriptive norms + High perceived risk + High platform trust → High privacy protection behavior (raw coverage=0.142, consistency=0.992). Even users who trust platforms due to strong brand reputation or privacy policies may adopt protection behaviors if they are inherently privacy-sensitive and perceive high risks.

Paths 4 and 5 underscore that individual characteristics are pivotal in driving privacy behaviors, regardless of external incentives or trust.

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The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

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# Knowledge Structure and Hotspot Evolution of “Greenwashing”: Based on Citespace and Text Analysis Perspectives

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**Abstract:** In the context of the country’s promotion of ecological civilization and the fulfillment of the “dual-carbon” goal, green and sustainable development should be an important part of the enterprise’s connotative development, rather than just “greenwashing” packaging. Although the research on “greening” related topics has been increasing in China, there are deficiencies in quantitative and systematic research. Therefore, in this paper, by studying the overall trend of articles published on web of science from 2013 to 2023, we use citespace to comprehensively and systematically portray the hotspot evolution law in the field of Green Washing. At the same time, we use python to partition the content of the related news Green Washingwashing text, and with the help of mining methods such as neologism discovery and LDA theme model, we identify the hotspot keywords and carry out the evolutionary analysis. The results show that the greenwashing themes mainly focus on greenwashing behavior, green development, green finance, carbon neutrality, information disclosure, social responsibility, sustainable development and environmental performance. Finally, the paper further outlines the existing research framework on greenwash from the theoretical perspective of sustainable development, and offers a perspective on the future direction of article on greenwash governance from three parts: government, business and individuals.

**Keywords:** Greenwashing; LDA; Text Mining; Evolutionary Analysis; Sustainable Development

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## 1.Introduction

“Greenwashing” evolved from “whitewashing, which refers to the behavior of enterprises’ false green propaganda and whitewashing for profit, emphasizing their environmental deception (Yang et al. 2020) <sup>[1]</sup>. This concept originated in 1986, the American environmentalist Jay Westerveld of the United States hotel “recycled towels” environmental protection behavior of reflection, used to describe the enterprise for the purpose of making profit and make false environmental protection propaganda behavior (Tong et al.,2025; Ma et al.,2025) <sup>[2,3]</sup>.

“Greenwashing” is a key concern in addressing climate and environmental change, and despite the increasing diversity and complexity of the phenomenon, the existing literature is still insufficiently in-depth. Formally, enterprises promised to



undertake social responsibility in front of the public, but in essence, they didn't take corresponding actions or even violate their social responsibility, and "greenwashing" was a kind of pseudo-social responsibility behavior (Szabo & Webster, 2021; Lu and Zeng, 2023; Abedin et al., 2024) <sup>[4,5,6]</sup>. Due to the existence of business competition, it was necessary for companies to establish a green brand image and make eco-friendliness an important asset in their business process (Wen et al., 2024; Zeng et al., 2024) <sup>[7,8]</sup>. Torelli et al (2020) argued that "greenwashing" advertising was a target strategy to enhance the social awareness and reputation of products and companies, to create a responsible corporate or product image, and was based on semantic manipulation and green worship, symbolising "green"<sup>[9]</sup>. The marketing strategy was based on semantic manipulation and green worship, which symbolised "green" and obscured the cognition of investors and consumers during the dissemination process (Ma et al.,2025) <sup>[10]</sup>. Deepening the development of green finance was an important path for China to achieve the aim of "double carbon", and "greenwashing" was the main obstacle to its green development (Lu et al., 2023; Zeng et al., 2023; Zeng et al., 2024) <sup>[11,12,13]</sup>. Free et al (2024) argued that on the investment side, investors catered to the capital market's preference for ESG investments, but failed to conduct effective ESG-specific reviews and include "non-green" targets <sup>[14]</sup>. On the issuance side, the funds raised by green bonds were not invested in accordance with the promised framework, the environmental benefits of the invested projects were not disclosed, or the invested projects did not reach the promised targets of green development, resulting in an imbalance between the advancement of green financial projects and the construction of green infrastructure (Duan et al.,2025) <sup>[15]</sup>. Once the "greenwashing" behaviour was exposed, it weakened investor trust and had a negative effect on the financial market.

So this paper combed the domestic and foreign "greenwashing" related research literature, through the Citespace software to draw the visualization of the knowledge map, the study found that the overall growth of foreign "greenwash" research articles from 2013-2023 tends to be the same, foreign journals are more dispersed. The distribution of foreign journals is relatively decentralized, and the cooperation between authors and institutions is not close enough to form a stable academic cluster. Further comparative analysis has expanded the research review on "greenwashing" to a certain extent. In light of the bibliometric analysis of the existing study, we summarize the characteristics of the article on the topic of "greenwashing" and the places to be expanded. Meanwhile, we make lexical processing on the text related to greenwash and summarize the hot topics in the past ten years by using the LDA model, so as to provide certain references for the deepening of the theoretical research on greenwash in the future.

## 2.Literature Review

The theoretical study on the topic of "greenwashing" in China started late, but the behavior of "greenwashing" accompanies the whole process of the emergence of climate and environmental problems, which not only impacts the construction of business ethics (Zhang et al.,2025; Wang et al.,2024) <sup>[16,17]</sup>, but also relates to the attainment of the goal of "dual-carbon" and the implementation of sustainable development strategy (Ma et al.,2024) <sup>[18]</sup>. It not only affects the construction of business ethics, but also relates to the attainment of the "dual-carbon" goal and the implementation of the sustainable development strategy (Zeng et al., 2025; Zhang et al.,2024) <sup>[19,20]</sup>. Therefore, under the premise of adhering to the problem effect orientation, it is necessary to continue to deepen the research on the topic of "greenwash" in China to serve the national and regional high-quality development (Zou et al.,2024; Wen et al.,2025) <sup>[21,22]</sup>. On the one hand, the research on the theme of "greening" should innovate the scientific research mode and further deepen the "organised scientific research". Its "organised nature" is manifested in the systematic and oriented nature of scientific research, which represents that scientific research will pay more attention to the selection of research topics, processes, tools and means, and synergistic innovation of different subjects (Li et al.,2025; Shen et al.,2025) <sup>[23,24]</sup>. Therefore, in determining research topics and in the research process, we cannot limit our vision to environmental science and ecological theory(Tong et al.,2024)<sup>[25]</sup>, but should actively expand interdisciplinary cross-research on the basis of multidimensional disciplines such as behavioral economics, management, journalism and communication, philosophy and ethics, computers, law, etc., to break down barriers between traditional disciplines, and strive to promote the construction of the academic community (Wu et al., 2025;Wen et al.,2025)<sup>[26,27]</sup>.

To prevent the trap of "greening" in the rapid development of green finance, more attention should be paid to the national strategic goal orientation, and the fiscal and taxation policy tools should be actively used to optimise the decision-making and

deployment of “anti-greening”, low-carbon transformation. Regarding research methodology, the study of “greenwashing” should insist on linking theory to practice and combining qualitative and quantitative methods (Zeng et al., 2024) <sup>[28]</sup>. The research method of qualitative analysis alone may not be persuasive enough in terms of the certainty of causal inference, and it needs to be enriched to provide support for its corresponding conclusions and internalise the practice of empirical methods as a kind of academic self-consciousness (Seele & Schultz, 2022) <sup>[29]</sup>.

At present, there were fewer empirical articles in domestic and international research, and one important reason was that there is insufficient sample data of corporate “greenwashing”(Li et al.,2023) <sup>[30]</sup>. To solve the problem of untrue, untimely and incomplete disclosure of environmental performance data, it was necessary not only to improve the information disclosure system from the policy and regulatory level, but also to encourage and guide the enterprises to build the “soft law system” of corporate green compliance culture, so as to realize the effectiveness of environmental information disclosure (Wang et al., 2024) <sup>[31]</sup>. As the main body of research, universities, as the main force of scientific research, should be based on the new stage of development, give full play to the advantages of disciplinary level improvement, platform connotation construction, accumulation of innovative talents, transfer and transformation of achievements and reform of the institutional mechanism, and aim at the major needs of the country to conduct scientific research and innovation practices in an oriented and directional manner (Wu et al., 2024) <sup>[32]</sup>. On the other hand, the content research in the field of “Green Washing” should be progressive from shallow to deep. Firstly, on the basis of clarifying the connotation, motivation, type, characteristics and negative impact of enterprise “greenwash”, and in view of the hidden nature of the “greenwash” behavior (Zeng et al., 2025) <sup>[33]</sup>, we should find out how to quickly identify and perceive the effective methods of “greenwash” traps, and find out how to quickly identify and perceive the effective methods of “greenwash” traps. Based on the hidden nature of “greenwashing” behavior, it is important to find out how to quickly identify and perceive “greenwashing” traps, and to quantify the “green content” and “green quality” of project construction (Mateo-Márquez et al, 2022) <sup>[34]</sup>. Wen et al (2025) explored the design of more effective “greening” governance measures and risk prevention mechanisms from the perspectives of enterprises, government and society, such as the path of corporate internal control, environmental accounting, environmental information disclosure laws and regulations, the construction of quantitative indexes for ESG investment audits, and the channels for improving the emission rights trading market, construction of investor claim mechanism, the supervisory utility of non-profit organizations and news media, etc <sup>[35]</sup>. Secondly, the combination of internationalization and localization should be done well, such as analyzing the influencing factors of different countries or large-scale multinational enterprises’ “greenwashing” phenomenon, such as the willingness of enterprises to disclose environmental information, management’s decision-making preference, the intensity of local administrative control or differences in the economic system, etc., or borrowing from other countries and regions to analyze the impacts of “greenwashing” phenomenon(Wu et al.,2025;Wu et al., 2024)<sup>[36,37]</sup>. It also draws on the experience of other countries and regions in effectively managing “greenwashing”, and is dedicated on addressing the practical problems in the process of building China’s ecological civilization and synergistic development of the economy and society (Wang et al.,2025; Shen et al.,2024) <sup>[38,39]</sup>.

### 3.Data Source

#### 3.1 Description

The Web of Science (WOS), a product developed by Clarivate, comprised authoritative journals across all academic disciplines from three principal citation indices (SCI, SSCI and A&HCI). Due to its stringent selection standards and thorough citation indexing methodology, WOS stood as a fundamental assessment tool within bibliometric and scientometric analyses. To deliver a comprehensive global examination regarding greenwashing research status, specific search parameters were established utilising the WOS Core Set database that aligned with the research objectives: (1) Titles containing “greenwashing”, “wash green”, “wash brown”, “wash blue” or “green shine”; (2) Indices including SCI-EXPANDED, SSCI, AHCI, ESCI, CPCI-S, CPCI-SSH, BKCI-S or Book Citation Index-Social Sciences; (3) Document categories encompassing “article”, “early access”, “review article” or “conference paper”; (4) Publication timeframe spanning “2013-01-01 through 2023-12-31”. Furthermore, incomplete manuscripts were excluded from consideration. Following these designated search criteria and subsequent manual verification to eliminate duplicates and irrelevant submissions, a total of 456 publications

were ultimately acquired.

### 3.2 Analytical tools

Citespace, an information visualisation application constructed upon JAVA programming language, functioned as the most commonly employed knowledge mapping instrument throughout academic literature. This tool rendered visual representations of trending subjects and frontier developments, thereby assisting researchers in grasping both current conditions and future trajectories within scholarly publications. The analytical process incorporated LDA (Latent Dirichlet Allocation), a probabilistic framework extensively applied throughout text mining and natural language processing domains. Its primary function involved uncovering concealed thematic structures within textual information—specifically identifying potential topics present across document collections whilst determining which themes appeared in individual manuscripts and which terminologies constituted each subject area. For this investigation, the researchers utilised the most recent Citespace programme alongside Python to examine structural characteristics and thematic variations among documents concerning “Green Washing”, aiming to disclose underlying connections and implicit information embedded within the literature.

## 4. Results and Discussion

This article shows a visual depiction of greenwashing research is presented through the lens of scientometric analysis. This section delves into an examination and description of the contemporary state and prospective trajectories of greenwashing research, utilizing co-citation analysis, collaborative network analysis, and analysis of emerging trends as analytical frameworks.

### 4.1 Reference Co-citation

Two references can be considered to have a co-citation linkage when they are jointly cited by a number ( $n$ , where  $n$  equals 1 or 2) of other references simultaneously, with the intensity of their co-citation being equivalent to  $n$ . This co-citation intensity is commonly employed as a metric to gauge the thematic proximity or content-relatedness of the two references in question. Given that co-cited literature typically shares thematic similarities, co-citation intensity essentially quantifies the degree of content-based affinity between the referenced works. The co-citation checks of references was used to assess the mapping of cited references to 456 works in the area of “Green Washing”, with a total of 741 nodes and 2043 rows been added. In the reference co-citation network, each node symbolizes a specific reference, with the connections between these nodes illustrating the co-citation relationships. The spatial proximity of these nodes serves as an indicator of the thematic or disciplinary affinity among the referenced literature. Furthermore, the edges linking distinct nodes not only denote the citation interactions between pairs of references but are also color-coded to represent distinct temporal segments (with each color corresponding to a particular year). It is worth noting that the representation of citation links through edges and their color-coding for time slices has been redundantly mentioned in the original context, but here it is streamlined into a single coherent description. The size of each node correlates with the frequency of citations its associated reference has received, thereby reflecting its scholarly impact, as visually demonstrated in Figure 1.

### 4.2 Institutional Cooperation Cited

To depict both meso- and micro-collaborative frameworks, this paper adapted various network illustrations as presented in Fig.2. Individual reference points appeared merely as isolated dots without forming meaningful linkages, thus contributing negligibly to collaborative structures; consequently, such elements were entirely omitted from our visualisation. The graphical representation concerning dual-subject collaboration patterns displayed remarkably thin connections, indicating minimal partnership intensity; nonetheless, this phase constituted a fundamental foundation for subsequent network expansion. Upon this dual-subject base, triadic participant relationships further developed, ultimately generating actual collaborative webs. Although multi-participant cooperation lacked a definitive central hub, it demonstrated considerably greater maturity compared with earlier collaborative arrangements. Furthermore, as additional participants gradually joined, these interaction systems possessed heightened potential for evolving into comprehensive, large-scale cooperative frameworks.

These modest collaborative structures exhibited notable diversity and geographical dispersion. When examining such networks, conventional mapping techniques typically resulted in visual disarray, hampering clear identification regarding specific information contained within different collaborative categories—particularly concerning quantity, temporal aspects,

Figure1: Reference co-citation network



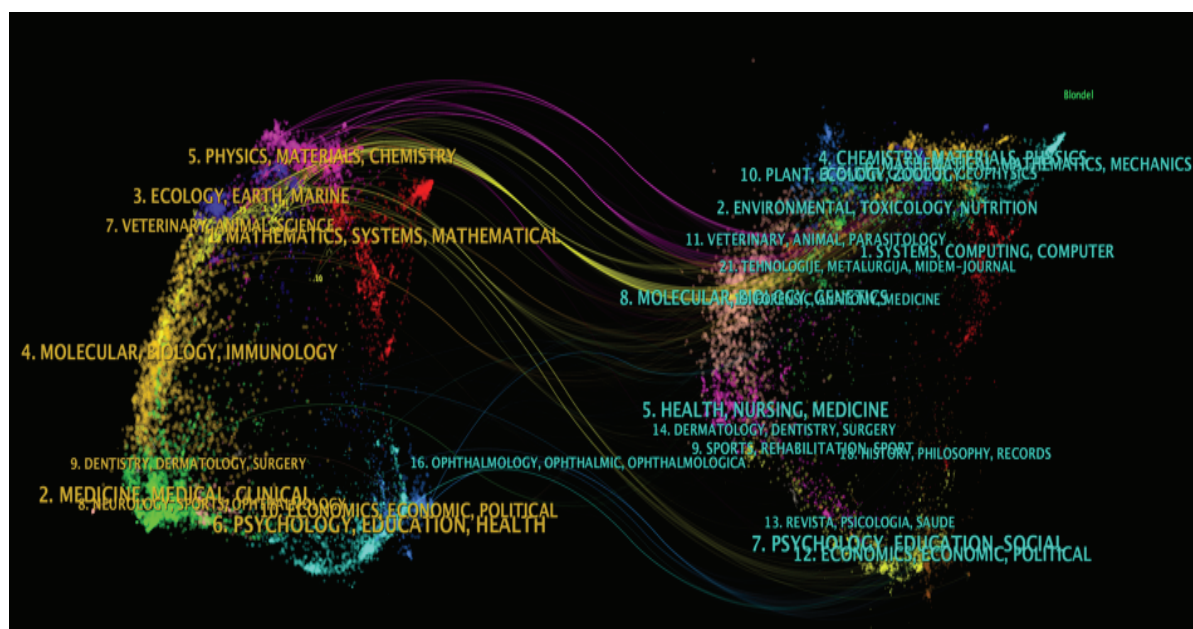


The number of articles released is an important measure of a research institution's research base and research strength in a particular field. Taking the research institutions as the co-occurrence analysis object, the research institutions that show the number of studies published is 20 and above, and get the ecotourism research institutions' cooperative relationship network diagram (as Figure 2). It can be seen that University of Arizona, USDA, CSIC, University of California Davis, University of California system, Oklahoma State University-Stillwater, etc. are the main research institutions. research institutions and colleges as the center of several partnership networks. Institutions with a high number of publications include: University of Arizona (45), USDA (39), CSIC (32), University of California Davis (29), University of California system (23), Oklahoma State University-Stillwater (21). Most of the institutions with a high number of publications have a disciplinary background in forestry, ecology, and environmental studies, while showing an intermingling of the natural and social sciences. The institutional partnerships depicted exhibited a remarkably fragmented structure overall. These cooperative arrangements predominantly manifested as diminutive, autonomous clusters across the landscape. Simultaneously, academic institutions from Western Europe and North America tended to dominate both leadership positions and general participation within these scholarly alliances. Their research endeavours progressed along largely separate trajectories, whilst the established collaborative frameworks that eventually emerged demonstrated both tardy formation and gradual developmental progression. The interconnected webs of organisational cooperation had neither cohered rapidly nor expanded swiftly throughout the examined period.

## 4.2 Journal dual graph overlay analysis

Journal double-map overlays analysis can visualize the disciplinary distribution of citing and cited papers. In Figure 3, the discipline distribution of cited papers on the left side can be regarded as the application field of Green Washing research, and the discipline distribution of cited papers on the right side represents which disciplines are mainly cited in Green Washing research, which can be regarded as the basis of Green Washing research. In the depicted ellipse, the vertical axis signifies the quantity of papers within the discipline, whereas the horizontal axis denotes the number of authors. The results of the analysis show that during the period 2013-2023, the basic research areas of Green Washing mainly include Systems, Computing, Environmental, Toxicology, Nutrition, Chemistry, Materials, Physics, Health, Medicine and Molecular disciplines. Application areas include Mathematics, Systems, Medicine, Clinical, Ecology, Earth, Marine, Molecular, Biology, Immunology, Physics, Materials, Chemistry, Psychology, Education, Health, Veterinary, Animal, Science, and Neurology. There are more basic research fields in Green Washing, but the overall division between core and marginal fields is more obvious, which shows that the basic research of Green Washing involves a wider range of disciplines, and the application of this field involves more disciplines, and the core fields are clear. The core areas are clear.

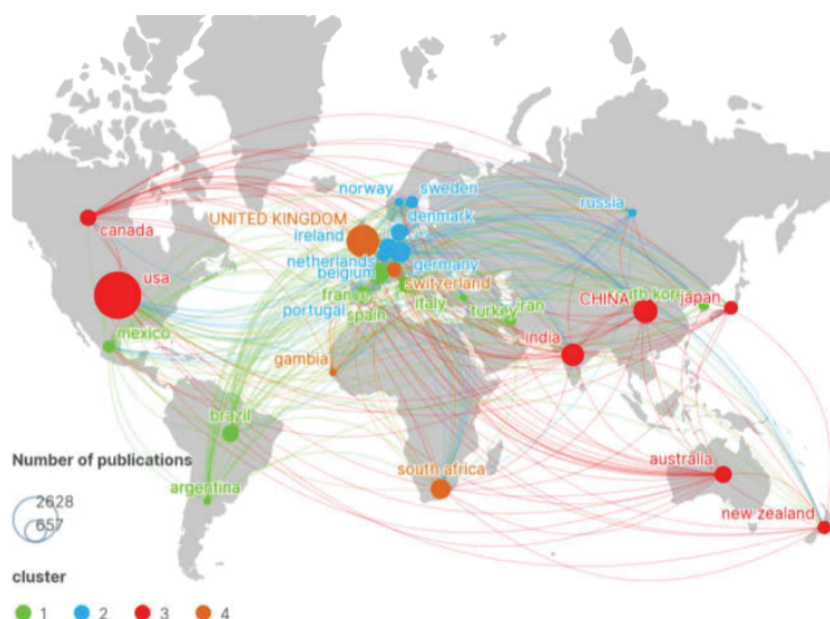
Figure 3: Journal double image overlay



### 4.3 Journal Dual Chart Stacking Analysis

CiteSpace alongside Scimago Graphica facilitated the creation of geographical distribution maps that illuminated various territories' contributions towards Green Washing scholarship. This investigation categorised 30 nations from amongst 132 countries (each having produced minimally 10 publications) into four distinct groupings, utilising the proportion of participating nations relative to total country count as classification criteria (illustrated in Figure 4). The analytical results revealed that: (1) The initial grouping encompassed nine nations: France, Brazil, Mexico, Italy, Korea, Turkey, Iran, Argentina, and Spain. (2) The second category primarily comprised European territories (Norway, Sweden, Denmark, Ireland, the Netherlands, Portugal, and Germany) alongside Russia. (3) The third classification incorporated the United States, China, India, Australia, Canada, New Zealand, and Japan. (4) The fourth segment featured Great Britain as its predominant constituent, whilst additionally including Switzerland, Gambia, and South Africa. Regarding international research partnerships, American institutions demonstrated the highest collaboration frequency, with British and Chinese establishments following subsequently. Such statistical evidence indicated that America, Britain and France maintained their leadership positions throughout Green Washing academic inquiry concerning both quantitative output and qualitative standards. Concurrently, developing economies such as India and China continued experiencing considerable disparities compared with industrialised nations. The Chinese situation proved particularly noteworthy; despite rapidly accelerating publication quantities, significant improvements regarding scholarly excellence remained necessary.

Figure 4: Country maps



### 4.4 Study on the Calculation of Green Text

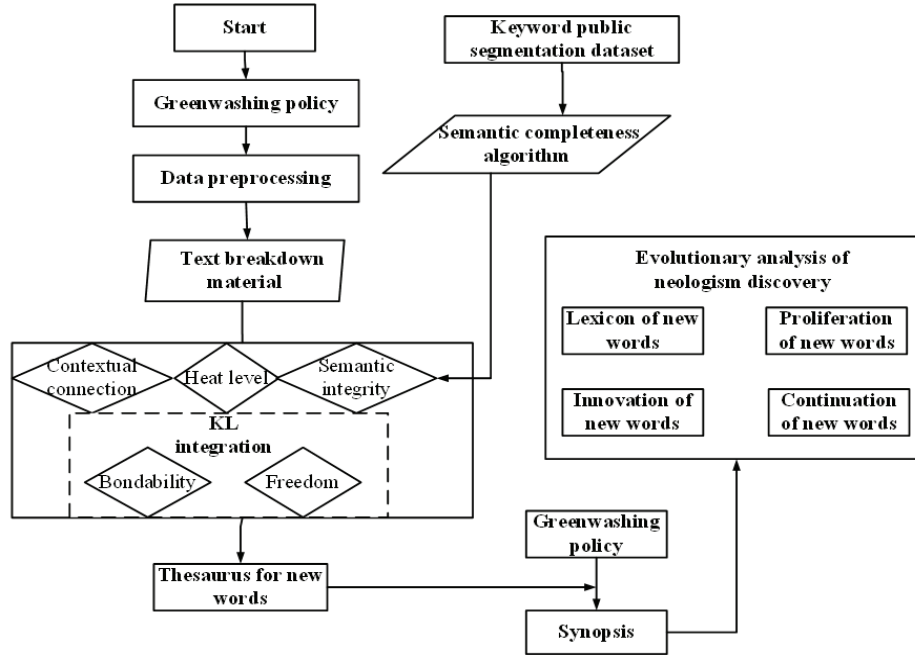
Textual computing is a framework based on the theories of computer science, linguistics, and political science aimed at mining and computational analysis of massive amounts of text, which advocates the use of text encoding, lexicon of textual concepts, and mapping relations between text and language for automatic recognition and processing of textual concepts, involving textual data processing, textual content analysis, and text mining.

Policy text analysis based on text data processing and text mining usually relies on open-source Chinese word segmentation tools. Using the corpus after lexical segmentation for statistical or econometric analysis of themes, types, sentiments, etc., or applying co-occurrence or co-occurrence to analyze the changing rules of policy growth, policy diffusion, policy change, inter-governmental relations, policy evolution, policy evolution, etc., or to carry out the potential discovery of semantic knowledge, association rule discovery, clustering analysis, automatic classification and so on. Open-source Chinese lexical tools are less adaptable to policy texts, less sensitive to unregistered words and new words, and difficult to capture emerging vocabulary and emerging concepts in the field. The lack of specialized thesaurus also limits the application of text mining techniques in policy analysis.

#### 4.5 Analysis of Greenwashing Evolution Based on Neologism Discovery

This paper intends to construct an AI policy thesaurus to assist word division through the neologism discovery algorithm, and conduct an evolutionary analysis of the innovation, continuation, and diffusion of AI policies based on the results of policy neologism discovery, so as to help the policy audience capture the industry development direction and the policy support orientation in a timely manner, and to help the local policy makers follow up on the emerging fields in a timely manner, so as to realize the policy innovation and the targeted development. The research process is shown in Figure 5, including the neologism discovery algorithm and the policy evolution analysis based on neologism discovery.

Figure 5: MFF New Word Discovery and Policy Text Analysis



#### 4.6 MFF Multi-feature New Word Discovery Algorithm

The ever-emerging technical neologisms bring a great test to Chinese word segmentation, which affects the accuracy of word segmentation. In order to consider the features of words in different dimensions more comprehensively and capture richer semantic information, this article proposes a new word discovery algorithm (MFF) that fuses multiple features. The MFF multi-feature contains word hotness, contextual relevance, semantic completeness and KL fusion, defined as follows:

- (1) Heat (Heat, H): this can be expressed in terms of word frequency. Word frequency is the frequency of occurrence of a word in a text, and high-frequency words appearing in a certain period of time may be candidate neologisms.
- (2) Contextual Association (CA): units separated by the same word show high similarity in the vector representation space, and may be potential neologisms when connected subwords show high association in context.
- (3) Semantic Completeness (SC): scoring the semantic completeness of a word can determine whether a word and its similar words can be neologisms. In this paper, we use Transformer for global and self-attentive cyclic sequence modeling, and train the semantic completeness judgment algorithm with the help of keywords and publicly available participle data from AI literature.
- (4) KL Fusion (KLFusion, KLF): KL Scatter (Kullback-Leibler Divergence) is used to measure the difference between two probability distributions, while KL Fusion utilizes KL Scatter to jointly compute the degree of union and the degree of freedom, which is used to quantify the difference between the internal structure of the word and the external environment, and to obtain more robust and reasonable result of new word discovery with the following formula:

$$KLFusion = \begin{cases} KLF\_Value & P(\text{word}) > 0 \text{ and } Q(\text{word}) > 0 \\ 100 & P(\text{word}) = 0 \text{ or } Q(\text{word}) = 0 \end{cases} \quad (1)$$

$$KLF\_Value = \frac{P(\text{word}) \times \log\left(\frac{P(\text{word})}{Q(\text{word})}\right) + Q(\text{word}) \times \log\left(\frac{Q(\text{word})}{P(\text{word})}\right)}{2.0} \quad (2)$$

Where  $P(\text{word})$  is the binding degree, calculated by mutual information.  $x, y$  are the left and right subwords of the candidate neologism,  $P(x, y)$  is the co-occurrence probability of  $x$  and  $y$ ,  $P(x)P(y)$  is the independent occurrence probability of  $x$  and  $y$ , and  $\text{PMI}(x, y)$  denotes the probability of word formation of the candidate neologism.

$$\text{PMI}(x, y) = \log \left( \frac{P(x, y)}{P(x)P(y)} \right) \quad (3)$$

$Q(\text{word})$  is the degree of freedom, which is calculated by the neighbor entropy. Neighbor entropy can measure the uncertainty of the left and right neighbors of a new word, and the larger its uncertainty, the higher its probability of becoming a word.  $sl$  is the set of left neighbors of the candidate new word,  $Sr$  is the set of right neighbors,  $P(W_l|W)$  denotes the probability of the left neighbor of the candidate new word,  $P(W_r|W)$  denotes the probability of the right neighbor of the candidate new word, and  $N(W_l, W)$  and  $N(W_r, W)$  denote the number of times that the left and right words appear with  $W$ , and  $N(W)$  denotes the number of times that  $W$  appears together.  $N(W_l, W)$  and  $N(W_r, W)$  denote the number of times the left and right words co-occur with  $W$ , respectively, and  $N(W)$  denotes the number of times  $W$  appears.

$$Q(\text{word}) = \begin{cases} - \sum_{w_l \in S_l} P(W_l|W) \log P(W_l|W) \\ - \sum_{w_r \in S_r} P(W_r|W) \log P(W_r|W) \end{cases} \quad (4)$$

$$P(W_l|W) = \frac{N(W_l, W)}{N(W)} \quad (5)$$

$$\text{NewWord} = \begin{cases} 1 & \text{if } f_1 \geq T_1 \text{ AND } f_2 \geq T_2 \text{ AND } f_3 \geq T_3 \text{ AND } f_4 \geq T_4 \\ 0 & \text{Otherwise} \end{cases} \quad (6)$$

Where  $f_1, f_2, f_3, f_4$  are the values of  $H, CA, SC$ , and  $KLF$ , respectively; and  $T_1, T_2, T_3, T_4$  are the thresholds of  $H, CA, SC$ , and  $KLF$ , respectively.

#### 4.6 LDA-based News Topic Recognition Model Construction

In this paper, the LDA topic model is used to construct a topic recognition model for science and technology news, and three logical hierarchical structures are established: document layer, topic layer, and vocabulary layer, and each layer is regulated with corresponding variables and parameters. Combined with the given probability sampling method, the topic variables are used to generate the words in the document, and the topic recognition generation process is as follows: first, for the  $j$ th topic, the distribution probability vector of polynomials  $\phi_{zi}$ , which is the feature word on the topic, is computed through the Dirichlet distribution  $j = \text{Dir}(\beta)$ , and  $N$  is selected using the Poisson distribution  $N = \text{Poisson}(\xi)$  where  $N$  represents the length of a single tech news document. Second,  $\theta$  is determined based on  $\theta \sim \text{Dir}(\alpha)$ , where  $\theta$  obeys the Dirichlet( $\alpha$ ) distribution, and  $\theta$  represents the probability of occurrence of each topic that  $\alpha$  is a parameter of the Dirichlet distribution. Again, a topic  $zn$  is selected for each of the  $k$  feature words  $w$  contained in each science and technology news document,  $zn$  obeys the Multinomial( $\theta$ ) distribution vector  $\theta$  over the topic distribution  $\theta$  multinomial distribution, and  $zn$  is a randomly selected topic. A feature word  $wn$  is randomly selected from the above selected topic  $zn$  according to  $p(wn|zn; \beta)$ . where  $p$  is the topic  $zn$  of the multinomial distribution;  $\beta$  is a  $K \times N$ -dimensional matrix;  $\beta_{ij} = P(w_i = 1 | z_j = 1)$ , indicating that  $\beta$  is the probability of generating the feature word  $w_i$  for the record topic  $z_j$ . The generation probability  $p(w_i)$  of  $w_i$  in the technology news document  $d$  is:

$$p(w_i) = \sum_{j=1}^T 1 P(w_i|z_i = j) P(z_i = j) \quad (7)$$

Where  $w_i$  represents the  $i$ th theme that appears in theme  $z_i$ ;  $p(w_i|z_i = j)$  denotes the occurrence of the feature word in theme  $z_i$   $w_i$ ;  $p(z_i = j)$  is the probability that topic  $z_i$  occurs in the document. Therefore, the probability that the feature word  $w$  appears in the technology news document  $d$ ,  $p(w|d)$  is:

$$p(w|d) = \sum_{\theta \sim \text{Dir}(\alpha)} \sum_{\phi \sim \text{Dir}(\beta)} \prod_{j=1}^T \phi_j^{n_j} \quad (8)$$

Finally, the EM algorithm is used to obtain the approximate solution of  $\alpha, \beta$ , which in turn builds the LDA three-layer model:

$$I(\alpha|\beta) = \sum_{i=1}^M \log p(d_i|\alpha, \beta) \quad (9)$$

The LDA model is constructed to analyze the internal semantics of the science and technology news document set, and the three-layer model of text-topic-feature word of science and technology news is obtained and presented in the form of a matrix.



## 4.7 News Record Subject Identification

In this paper, the LDA topic model is utilized to identify the topics of the Green Washing news text set of local websites from 2013-2023. First, the optimal number of topics is determined by the perplexity curve. (as shown in Figure 6). In order to avoid overfitting, this paper combined with the interpretability of the theme after many experiments, the curve appeared a turning point at T=8, so the number of themes of this text dataset was set as T=8. Second, obtain the record theme recognition results. According to the results of theme-feature word distribution obtained from LDA theme modeling analysis, combined with manual screening, each theme is reserved for 8 feature words that are relatively able to reflect the meaning of the theme and summarize the theme name. Finally, it can be found that in the past 10 years, the Green Washing theme focuses on eight areas: Green Washing behavior, green development, green finance, carbon neutrality, information disclosure, social responsibility, sustainable development and environmental performance. The word cloud map of the bleached green text is shown in Figure 7.

Figure 6: Theme-confusion degree model

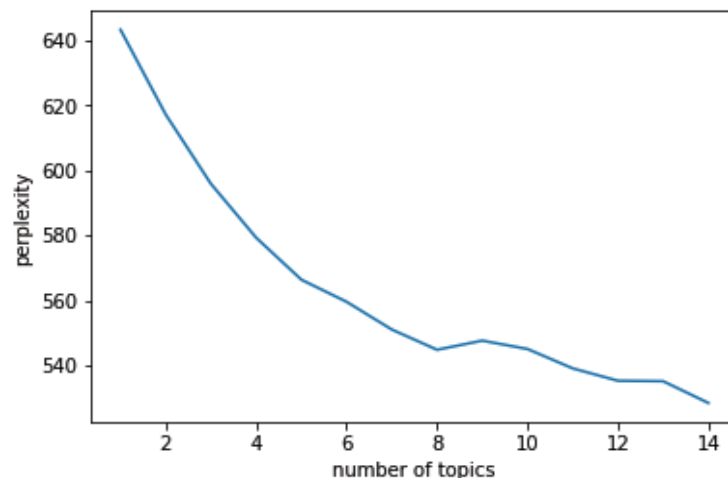


Figure 7: World cloud



Theme 1 is greenwashing behavior. Like a quietly growing vine, greenwashing behavior is gradually spreading in all walks of life. It refers to the false propaganda or misleading tactics adopted by some enterprises or organizations in terms of environmental protection and sustainable development in order to cover up their real environmental impacts. This behavior not only misleads consumers and investors, but also poses a great obstacle to environmental protection. Over time, the forms of greenwash behavior have become more diverse. Some companies have begun to offset their actual emissions by purchasing carbon credits or engaging in carbon trading to achieve the illusion of “zero emissions”. This reminds us that we must remain

vigilant in the pursuit of environmental protection and sustainable development, and avoid being confused by greenwash. As environmental awareness increases and regulation is strengthened, it is believed that greenwash will gradually decrease and true environmental protection and sustainable development will become mainstream.

Theme 2 is green development. There is a growing global call for green development, and people are generally pursuing a sustainable development path that harmonizes the economy with the environment. However, against this backdrop, greenwash is like a dark current, posing considerable challenges to the process of green development. At the same time, greenwashing behavior has weakened people's confidence in green development and affected the consensus and action power of the whole society on environmental protection. Although greenwashing has brought some trouble to the process of green development, we have also seen more enterprises and organizations begin to actively participate in the green cause and practice the concept of green development with practical actions. phase

Theme 3 is green finance. Green finance, as an important force for promoting sustainable development, has attracted much attention globally. Green finance aims to promote the harmonious development of the economy and the environment by directing capital flows to environmentally friendly, low-carbon and sustainable projects and enterprises through financial innovation and financial instruments. However, in the course of the development of green finance, some institutions and enterprises have begun to adopt green-bleaching behaviors in order to pursue short-term economic benefits, i.e., claiming to support green finance on the surface but failing to truly implement the green principles in reality. These green-bleaching behaviors include, but are not limited to, falsely publicizing their green investment results, exaggerating the scale and benefits of green projects, or packaging non-green projects as green projects to attract investors. These behaviors not only mislead investors and consumers, but also have a negative influence on the healthy development of green finance.

Theme 4 is carbon neutrality. With the global awareness of environmental protection, carbon neutrality has become a hot topic. However, in this green wave, there is no lack of "greenwashing". In order to change this situation, more and more companies are beginning to realize that true carbon neutrality requires reducing carbon emissions at the source rather than relying solely on offsets. They have begun to adopt cleaner energy, improve energy efficiency, and promote green travel to reduce their own carbon emissions. At the same time, the government has also stepped up its efforts to combat greenwashing, by enacting stricter environmental regulations and strengthening supervision to regulate the environmental behavior of enterprises.

Theme 5 is information disclosure. As public attention to environmental protection and corporate social responsibility continues to grow, information disclosure has become an important way for companies to demonstrate their green development and environmental practices. However, in this process, the so-called "greenwashing" phenomenon has also emerged, i.e., enterprises exaggerate their environmental achievements or conceal their real environmental problems in information disclosure in order to build up their environmental image. In addition, the development of greenwashing is also reflected in the interpretation and publicity of environmental policies by enterprises, who may package their products and services with labels such as "green innovation" and "sustainable development" in order to attract the attention of consumers and investors. However, with the deepening of social awareness of greenwashing behavior, the public has also put forward higher requirements for corporate environmental disclosure. More and more investors and consumers are paying attention to the real environmental performance of companies rather than just looking at their superficial environmental image. At the same time, regulators are also strengthening their supervision of corporate environmental disclosure, requiring companies to disclose their environmental information truthfully, accurately and completely.

Theme 6 is social responsibility. Social responsibility has become one of the indispensable core values of enterprises. Green Washing development refers to the superficial and formalized practices of some enterprises in assuming social responsibility, using false environmental commitments, non-transparent information disclosure, or over-packaged publicity tactics to build up their positive social image without actually fulfilling their social responsibility. Enterprises may attract the attention of the public and investors by releasing vague and non-specific social responsibility reports that exaggerate their environmental protection commitments, charitable donations and other social responsibility practices. However, behind these flashy figures often lie neglect and concealment of real problems such as environmental damage and labor rights infringement. Behind the

bleached-green development, it reflects the neglect and misunderstanding of social responsibility of some enterprises in the pursuit of economic benefits.

Theme 7 is sustainable development. Sustainable development is now recognized as a global priority, and the phenomenon of greenwashing not only misleads the public and investors, but also hinders the advancement of the cause of true sustainable development. Truly sustainable development requires enterprises to change their business concepts and approaches at the source, and to realize the harmonization of economic, social and environmental benefits through technological innovation, green production and circular economy. In addition, the government, social organizations and the public should also strengthen the supervision and constraints on enterprises' Green Washing development. The government should formulate stricter environmental protection regulations and policies, and strengthen the supervision and punishment of enterprises' environmental protection behaviors.

Theme 8 is environmental performance. With increasing global concern about environmental issues, environmental performance has become an important component of corporate competitiveness. In order to meet the challenges of Green Washing development, enterprises need to abandon the practice of false advertising and report their environmental performance truthfully and accurately. Enterprises should establish a strict environmental management system, strengthen internal supervision and self-restraint, and ensure that all environmental protection measures are effectively implemented. Simultaneously, enterprises should strengthen technological research and development and innovation, promote green, low-carbon and recycling production methods, decrease environmental contamination and material waste, and enhance environmental performance. The government should strengthen the creation and application of environmental regulations and improve the requirements for monitoring and evaluating the environmental performance of enterprises.

## Conclusion

With numerous organisations learning and emulating “Green Washing” practices, this phenomenon experienced significant expansion, whilst its negative consequences extended throughout all dimensions of production and everyday existence. Hence, a comprehensive examination of scholarly literature became necessary to analyse this marketing strategy based upon extant research. This investigation employed CiteSpace software to render visual representations of fundamental publications within the greenwashing domain from the WOS database. The research dissected inherent characteristics of the “greenwashing” occurrence and synthesised its evolutionary patterns, thereby facilitating more rational, scientific, efficacious and precise determination, monitoring, assessment and regulation of “greenwashing” activities to bolster environmentally responsible advancement.

Concerning scholarly focus areas, business economics and environmental science disciplines generated the predominant proportion of literature in this field, constituting 77.8%. Regarding publication territories and academic establishments, economically advanced nations maintained supremacy, with American institutions and the European Research Universities Consortium (ERUC) occupying premier positions across geographical regions and research organisations respectively. This circumstance enabled American academics to control global discourse substantially. The co-citation analytical diagram illustrated progressive increases in publications exerting considerable influence on greenwashing investigations and demonstrated relationships between traditional concepts and innovative approaches. Moreover, influential scholars who initiated earlier studies within the greenwashing sphere continuously enhanced theoretical frameworks whilst simultaneously attracting additional researchers to this domain. Network collaboration visualisations revealed robust partnerships amongst developed economies including European nations and America; however, insufficient cooperation existed between emerging economies across Southeast Asia, South America, and African regions. Institutional collaborative arrangements appeared loosely distributed and featured primarily small cooperative clusters. Furthermore, academic collaboration generally displayed fragmentation, whilst individual researchers demonstrated inadequate investigative depth.

Throughout greenwashing research evolution, scholarly attention concentrated on definitional aspects and conceptual elucidation, influential variables, resultant effects and governance structures. Methodological approaches gradually transitioned from normative investigations towards empirical analyses and subsequently combined methodologies. Additionally, research paradigms progressively transcended national boundaries to encompass global perspectives,

emphasising universal applicability whilst diminishing contextual specificity. This progression further enriched and perfected the research framework from defining greenwashing (identifying its nature) to tracking its occurrence (understanding causal factors) to evaluating consequential impacts to controlling its proliferation. Ultimately, greenwashing textual content underwent subdivision utilising Python technology, whilst the LDA thematic model was applied to analyse eight principal greenwashing subject areas over the preceding decade. These focal domains encompassed greenwashing behaviour, environmental advancement, green financial systems, carbon neutrality objectives, information disclosure practices, social responsibility initiatives, sustainable development principles and environmental performance metrics, with detailed explanations provided regarding evolutionary developments within each respective area.

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## Conflict of Interests

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

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# Management and Quality Assurance of Undergraduate Theses in Private Universities: Strategies and Implications

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**Abstract:** Undergraduate theses are critical components of higher education, reflecting students' comprehensive abilities and innovative thinking. However, private universities in China face unique challenges in thesis management and quality assurance. This study analyzes existing issues, proposes systematic strategies, and constructs a quality control framework to enhance thesis outcomes. By integrating process optimization, faculty development, student engagement, and technological tools, this research provides actionable insights for improving academic standards in private higher education institutions.

**Keywords:** Private Universities; Undergraduate Thesis; Quality Management; Academic Integrity; Process Optimization

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## 1.Introduction

### 1.1 Research Background and Importance

Private undergraduate education has become a vital component of China's higher education system. As a critical practical teaching element in private universities, the undergraduate thesis (design) serves as a key indicator for evaluating educational quality and an essential part of talent development programs. It plays a significant role in enhancing students' practical skills, employability, and the overall quality of applied talent cultivation.

To strengthen the quality of undergraduate theses (designs), the Chinese Ministry of Education (MOE) has implemented several policies and regulations. In December 2012, the MOE issued the Measures for Handling Academic Misconduct in Degree Theses, which established strict guidelines to address plagiarism and ensure academic integrity. Furthermore, in 2020, the Sampling and Inspection Measures for Undergraduate Theses (Designs) (Trial) mandated annual inspections starting from January 2021. These inspections target theses from the previous academic year, with a minimum sampling rate of 2%, to enhance quality supervision and assessment at the national level.

The promulgation of these policies underscores the MOE's commitment to upholding academic standards and institutionalizing ethical research practices. Such measures not only align with China's broader goals of improving higher education quality but also reinforce the principle of "rooting education in Chinese realities." By imposing rigorous quality controls on undergraduate theses, these policies aim to foster a culture of academic excellence and accountability.

Compared to public universities, private institutions face more pressing challenges in thesis management and quality assurance. Disparities in resources, faculty expertise, and institutional oversight necessitate targeted research to develop tailored strategies for private undergraduate education. Addressing these gaps is critical to ensuring equitable educational outcomes and advancing the competitiveness of private universities within China's evolving academic landscape.

## Challenges in Thesis Quality at Private Undergraduate Universities

Aspect	Description
<b>Insufficient Resources</b>	Private institutions often face limitations in faculty qualifications and experimental facilities, negatively impacting students' research capabilities and practical skill development.
<b>Ambiguous Research Orientation</b>	Emphasis on applied talent cultivation overshadows research training, resulting in deficiencies in research methodology and subject exploration.
<b>Inconsistent Faculty Expertise</b>	Challenges in attracting high-level scholars coupled with heavy teaching/research workloads diminish thesis supervision quality and research literacy cultivation.
<b>Weak Academic Ecosystem</b>	Lack of academic exchange platforms and research support systems reduces scholarly stimulation, adversely affecting thesis depth and quality.
<b>Student Competency Gap</b>	Lower admission standards correlate with heterogeneous academic preparedness and motivation levels, influencing thesis commitment and output quality.

Consequently, these disparities do not uniformly apply to all private institutions. Significant variations exist due to differences in institutional priorities, resource allocation, and governance models. High-performing private universities often rival public counterparts in academic rigor, underscoring the importance of recognizing institutional heterogeneity in policy formulation and quality assessment frameworks.

## 1.2 Research Objectives

### 1.2.1 Proposing Improvement Strategies for Thesis/Dissertation Management and Quality Assurance in Private Undergraduate Universities

Based on analysis of current practices, this study recommends optimized management processes, enhanced quality monitoring mechanisms, improved faculty training and support systems, and strategies to increase student engagement. These evidence-based proposals aim to improve institutional efficiency and academic rigor.

### 1.2.2 Examining the Impact of Student Engagement on Thesis/Dissertation Quality

This research investigates the correlation between students' proactive participation and the academic quality of final projects. Through empirical analysis, it identifies engagement patterns and proposes targeted interventions to strengthen student motivation and ownership of research outcomes.

### 1.2.3 Sustainability Analysis of Quality Assurance Systems in Private Higher Education

The study evaluates the adaptability, feasibility, and continuous improvement capabilities of current quality management frameworks. It develops sustainability indicators and recommends institutional mechanisms for maintaining long-term effectiveness amid evolving educational landscapes.

### 1.2.4 Internationalization Strategies for Thesis Supervision and Quality Management

Through comparative analysis of global best practices, this work identifies internationalization pathways for private universities. It proposes adaptive frameworks that integrate transnational quality standards while addressing localized institutional contexts, with particular attention to emerging trends in cross-border education.

### 1.2.5 Innovative Approaches to Enhance Practical Value in Academic Research

This exploration focuses on paradigm-shifting strategies including digital management platforms, industry-academia collaboration models, and technology-enhanced supervision. The proposed methodology emphasizes bridging theoretical research with real-world applications through systemic innovation.

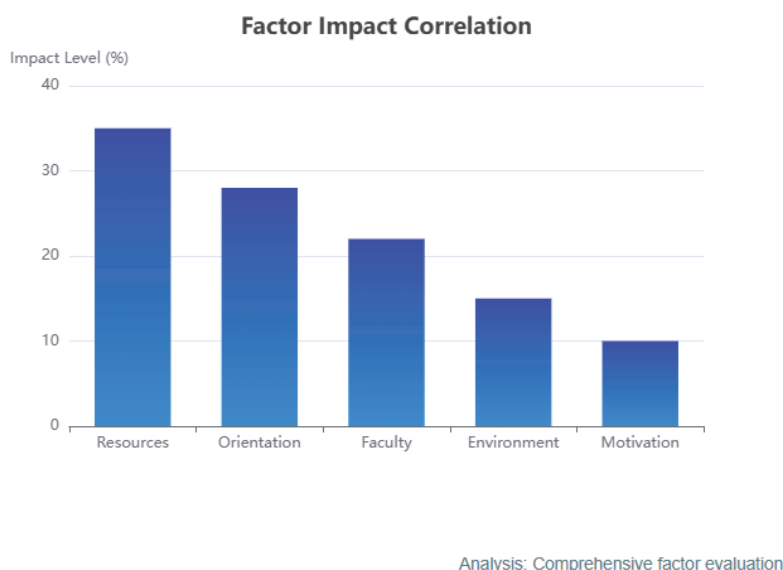
## 2. Current Challenges in Thesis Management and Quality Assurance

### 2.1 Management Issues

In the topic selection phase, some private undergraduate institutions face challenges such as students' significant randomness and blindness in choosing research topics, coupled with low alignment between selected topics and their academic disciplines. When selecting topics, a portion of students fail to adequately consider their academic strengths and personal interests, leading to excessively broad or professionally irrelevant topics. This mismatch negatively impacts both the quality of subsequent thesis writing and student motivation. These issues highlight the need for improved guidance mechanisms to enhance topic relevance and foster scholarly engagement.

**Guidance Phase:** A prevalent issue in private undergraduate institutions is the insufficient number of faculty supervisors, leading to an imbalanced student-to-faculty ratio. This imbalance often forces supervisors to provide only broad oversight rather than in-depth and detailed guidance for individual students. Consequently, specific challenges encountered during thesis writing may go unnoticed and unresolved. Furthermore, some supervisors exhibit limited mentoring capabilities and a lack of professional commitment, resulting in inadequate patience and expertise during student consultations. These shortcomings negatively affect both the quality of student theses and their academic engagement.

**Evaluation and Defense Phase:** The absence of standardized and scientifically rigorous evaluation criteria creates inconsistencies in assessment practices across reviewers, undermining the fairness and objectivity of evaluation outcomes. During thesis defenses, lax quality control measures and overly formalistic adherence to procedural requirements are common. Some examiners focus excessively on superficial aspects rather than critically evaluating the substantive content of theses or students' research competencies. As a result, the defense process often fails to fulfill its intended role as a critical quality control mechanism. These systemic gaps highlight the urgent need to refine evaluation protocols and strengthen accountability in academic oversight processes.



## 2.2 Quality Assurance Deficiencies

### 2.2.1 Faculty Challenges

The teaching faculty in private undergraduate institutions exhibits significant heterogeneity in professional quality. A proportion of instructors demonstrate limited teaching experience and academic proficiency, thereby compromising their capacity to provide effective guidance for high-quality undergraduate theses (designs). Furthermore, frequent faculty turnover and insufficient workforce stability introduce unpredictability into the supervision process, adversely affecting both the consistency of student mentorship and the academic continuity essential for rigorous research outcomes.

### 2.2.2 Student-Related Issues

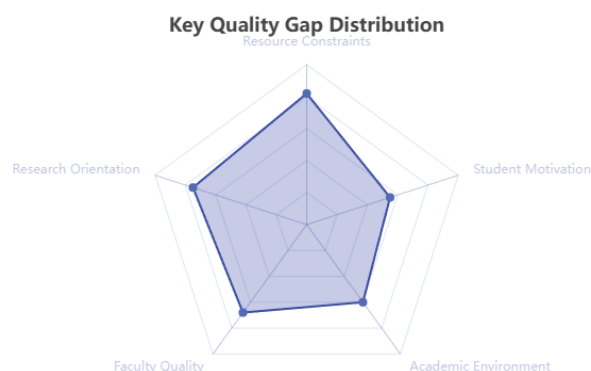
Substantial disparities exist in students' academic attitudes and research competencies. A notable subset of students displays inadequate commitment to thesis (design) requirements, manifesting deficiencies in fundamental academic literacy and research skills. This deficiency often leads to problematic practices such as plagiarism and fragmented content synthesis, substantially undermining the overall quality of scholarly output. Moreover, many students exhibit limited capacity for self-

directed learning and innovative thinking during the writing process, approaching the task as a perfunctory requirement rather than an intellectual exploration. Consequently, their work frequently lacks analytical depth and originality.

### 2.2.3 Institutional Limitations

While most private institutions have established regulatory frameworks for thesis (design) management, significant implementation gaps persist. Inadequate supervision mechanisms and lax enforcement of quality control protocols result in insufficient monitoring of student progress and output standards. This institutional leniency enables chronic procrastination and superficial engagement among some students. Furthermore, the absence of systematic punitive measures for academic misconduct and substandard work quality diminishes the deterrent effect of existing policies, allowing recurrent quality issues to remain unaddressed.

This tripartite analysis of faculty capabilities, student engagement, and institutional governance reveals systemic barriers to academic excellence in private undergraduate education. Addressing these interconnected challenges requires comprehensive reforms in faculty development, student research training, and quality assurance mechanisms.



Data: Synthetic metrics based on institutional reports

## 3. Proposed Strategies and Framework

### 3.1 Process Monitoring and Supervision

#### 3.1.1 Strengthening Mid-Term Evaluation Mechanisms

The mid-term evaluation constitutes a pivotal phase in ensuring the quality of undergraduate theses (designs). Private undergraduate institutions must prioritize this stage by establishing well-defined evaluation criteria and procedural requirements to prevent superficial implementation. A structured feedback mechanism should be implemented to promptly communicate identified deficiencies to both students and supervisors, mandating corrective actions within specified timelines. This dual approach—rigorous assessment coupled with actionable feedback—ensures continuous quality improvement while fostering accountability among stakeholders. To optimize efficacy, institutions may integrate digital tracking systems to monitor compliance with revision requirements and standardize documentation of the evaluation process.

#### 3.1.2 Implementation of Pre-Defense Review Protocols

To address lax quality control in thesis defense procedures, a pre-defense review system should be formally instituted. This protocol involves forming evaluation panels composed of disciplinary experts or academic committee members to conduct preliminary assessments of theses prior to formal defenses. Only those meeting established scholarly and methodological standards would advance to the oral defense stage, while substandard submissions would be required to undertake substantive revisions. This tiered evaluation framework enhances academic rigor by filtering deficient works at the pre-defense phase, thereby optimizing defense session efficiency and ensuring baseline quality across all presented research.

#### 3.1.3 Development of a Thesis Management Information System

Leveraging digital platforms, institutions should deploy a comprehensive thesis management information system to streamline workflow oversight. This system would integrate modular functionalities for online topic approval, proposal submission, mid-term progress tracking, and final manuscript archiving. Advanced features such as algorithmic monitoring

of writing patterns, plagiarism detection interfaces, and predictive analytics for at-risk submissions could further enhance proactive quality assurance. By centralizing data flows and automating administrative tasks, the system reduces bureaucratic redundancies while enabling real-time identification of procedural bottlenecks or academic integrity violations. Such technological integration not only standardizes supervision processes but also generates actionable metrics for continuous improvement of institutional research governance.

### **3.2 Faculty Development and Incentivization**

#### **3.2.1 Strengthening Supervisor Selection and Training**

Private undergraduate institutions should implement rigorous supervisor selection mechanisms to appoint faculty with substantial teaching experience and research expertise as thesis advisors. Concurrently, institutions must prioritize supervisor training and professional development to enhance pedagogical competencies and accountability. Regular participation in academic seminars, mentorship workshops, and collaborative forums should be institutionalized to foster knowledge exchange and interdisciplinary cooperation among supervisors.

#### **3.2.2 Establishing Incentive Structures for Supervisors**

To motivate supervisors and cultivate innovation in mentorship, private institutions should develop comprehensive incentive systems. Exemplary measures include instituting “Outstanding Supervisor Awards” to confer public recognition and material rewards for supervisors demonstrating exceptional performance in thesis guidance. Additionally, integrating thesis supervision outcomes into performance evaluations and professional promotion assessments will create a merit-based incentive framework. Such strategies align institutional goals with individual career advancement, thereby enhancing sustained engagement in mentorship quality.

#### **3.2.3 Clarifying Supervisory Responsibilities and Rights**

A clear delineation of supervisors’ responsibilities and entitlements is imperative for effective thesis guidance. Supervisors are obligated to provide systematic support in topic selection, research design, and manuscript development, while bearing primary accountability for the academic rigor of student outputs. Correspondingly, supervisors should retain formal rights, including evaluation authority over student theses and recommendation privileges for defense eligibility. This dual emphasis on accountability and authority ensures supervisors’ professional autonomy while reinforcing their commitment to ethical and scholarly mentorship standards.

### **3.3 Process Monitoring and Evaluation**

#### **3.3.1 Implementation of Refined Process Management**

To enhance oversight of thesis development, private undergraduate institutions should adopt a refined process management system. This involves creating detailed timelines for students, with clearly defined tasks and objectives for each research phase. For instance, students should adhere to structured milestones—from topic selection to literature review, data collection, analysis, and draft completion—to ensure systematic progress. Such granular management not only aids students in organizing their workflow but also enables supervisors to monitor advancements effectively, thereby facilitating targeted guidance.

A dynamic monitoring mechanism should be institutionalized, incorporating regular progress reviews, mid-term evaluations, and random inspections. These measures allow institutions to promptly identify and address challenges during the research process, ensuring timely completion of high-quality theses. Digital tracking tools could further enhance transparency by providing real-time updates on student progress and supervisor interventions.

#### **3.3.2 Development of a Diversified Assessment Framework**

Complementing process monitoring, a diversified assessment framework is critical for elevating thesis quality. Traditional evaluation models, which disproportionately emphasize final outputs, often overlook students’ incremental efforts and developmental progress. Private institutions should instead adopt a hybrid evaluation system integrating process-oriented assessment (e.g., research diligence, collaboration skills, innovation) and outcome-based metrics (e.g., academic rigor, structural coherence).

## **4. Anticipated Outcomes and Impact Assessment**

## 4.1 Expected Outcomes and Evaluation of Target Attainment

Following the implementation of quality assurance measures, a series of positive transformations and outcomes are anticipated. First, through institutional refinement and standardization, private undergraduate institutions will establish a more scientific and rational thesis management system, ensuring that the entire process—from topic selection to final evaluation—adheres to standardized and transparent protocols. This institutional optimization will significantly enhance administrative efficiency, reduce resource redundancies, and provide students with clearer, more targeted guidance.

Second, strengthened process monitoring and evaluation mechanisms will enable students to receive timely and actionable feedback during thesis development. Regular progress reviews and milestone assessments will allow institutions to promptly identify and address challenges in students' research workflows, ensuring incremental improvements in thesis quality. The introduction of third-party evaluation bodies will further enhance the objectivity and impartiality of quality assessments, offering authoritative and professional insights to both institutions and students.

Third, enhancements to faculty development—including rigorous supervisor training and optimized resource allocation—are expected to elevate the overall competence of mentorship teams. Supervisors will gain updated knowledge of academic frontiers and advanced research methodologies, enabling them to deliver higher-quality, discipline-specific guidance. Optimized faculty-student ratios will ensure equitable access to personalized supervision, thereby improving both the academic rigor of theses and students' scholarly capabilities.

To comprehensively evaluate implementation efficacy and target attainment, a multidimensional assessment framework will be established. This system will encompass qualitative and quantitative metrics across critical dimensions:

Thesis quality (e.g., originality, methodological soundness, compliance with academic norms)

Administrative efficiency (e.g., timeline adherence, resource utilization rates)

Student satisfaction (e.g., perceived support quality, skill development outcomes)

Faculty performance (e.g., mentorship effectiveness, professional development engagement)

Periodic evaluations using this framework will identify implementation gaps and inform iterative refinements to strategies, ensuring alignment with institutional goals.

### Projected Impact

The systematic execution of these quality assurance measures is expected to yield transformative outcomes in thesis management at private undergraduate institutions. Standardized processes, enhanced supervision, and robust evaluation mechanisms will collectively elevate thesis quality while fostering students' academic competencies and critical thinking skills. These advancements will serve as a cornerstone for the connotative development of private institutions, strengthening their academic reputation and societal relevance. Long-term benefits include improved graduate employability, increased research output visibility, and alignment with national standards for higher education excellence. By anchoring reforms in evidence-based monitoring and adaptive evaluation, private institutions can transition from compliance-driven practices to a culture of sustained academic improvement. This strategic approach not only addresses existing challenges but also positions these institutions as competitive contributors to the global academic landscape.

## 4.2 Anticipated Outcomes and Objectives

### 4.2.1 Elevating Overall Thesis Quality

The implementation of the proposed quality assurance measures is anticipated to significantly enhance the overall quality of undergraduate theses at private institutions. This improvement will encompass not only theoretical depth and empirical rigor but also originality, practical relevance, and adherence to academic standards. Through these measures, students are expected to select research topics with greater foresight and societal applicability, employ more systematic and rigorous methodologies, and demonstrate marked progress in academic writing and communication skills.

Post-implementation outcomes may include:

**Advanced Research Competence:** Students will adeptly integrate disciplinary knowledge with practical inquiry, producing innovative and insightful scholarly work.

**Structural Coherence:** Theses will exhibit logically organized frameworks, robust argumentation, and precise language,



elevating their academic and practical value.

**Methodological Sophistication:** Increased adoption of data-driven approaches and interdisciplinary perspectives in addressing real-world challenges.

#### **4.2.2 Strengthening Institutional Reputation**

Elevating thesis quality serves dual purposes: advancing students' academic and professional trajectories while amplifying the institutional brand. High-caliber theses function as tangible evidence of educational excellence, showcasing an institution's capacity to nurture talent and produce impactful research. Improved thesis quality will bolster public trust and attract high-potential students and distinguished faculty, creating a virtuous cycle of academic excellence. A strengthened reputation will position institutions favorably in accreditation assessments and rankings, facilitating sustainable development and connotative growth. Employers and graduate schools will recognize the enhanced rigor of thesis training, improving alumni employability and postgraduate admission rates.

#### **4.2.3 Fostering Holistic Student Development**

The thesis process is designed to cultivate multidimensional competencies beyond academic achievement. By engaging in rigorous research, students will:

- Integrate Knowledge and Practice:** Synthesize classroom learning with real-world problem-solving, bridging theory and application.
- Develop Critical Capacities:** Strengthen independent thinking, analytical reasoning, and innovative problem-solving through iterative research cycles.
- Build Professional Readiness:** Acquire transferable skills in project management, ethical decision-making, and scholarly communication, preparing for dynamic career landscapes.

These interrelated objectives—quality enhancement, institutional branding, and student empowerment—collectively redefine the role of thesis education in private undergraduate institutions. By aligning academic rigor with societal needs, the proposed measures aim to transform thesis supervision into a strategic asset for institutional differentiation and student career readiness in an increasingly competitive global environment.

### **4.3 Evaluation Methods and Criteria**

#### **4.3.1 Establishment of Evaluation Metrics**

To ensure objective assessment of the implemented strategies, a scientifically grounded set of evaluation metrics must be established. These metrics should holistically reflect thesis quality while incorporating critical dimensions such as student satisfaction and supervisory effectiveness. Specifically, evaluation indicators will be structured as follows:

##### **1. Thesis Quality Metrics:**

**Originality:** Novelty of research questions and contributions.

**Practical Relevance:** Applicability of findings to real-world challenges.

**Academic Rigor:** Comprehensiveness of literature reviews, methodological validity, and accuracy of data analysis.

**Structural Integrity:** Logical organization, coherence of arguments, and adherence to academic writing standards.

##### **2. Student Satisfaction Metrics:**

Perceived adequacy of supervisory support, resource accessibility, and procedural transparency, measured via Likert-scale surveys. Qualitative feedback on challenges encountered during topic selection, data collection, and revision processes.

##### **3. Supervisory Quality Metrics:**

**Frequency and Diversity of Guidance:** Regularity of supervisor-student interactions and adaptability of mentoring approaches.

**Professional Competence:** Alignment of supervisory expertise with student research topics, assessed through peer reviews and student evaluations.

**Accountability:** Timeliness and constructiveness of feedback, tracked via institutional oversight mechanisms.

#### **4.3.2 Application of Multimodal Evaluation Methods**

A triangulated evaluation approach will be adopted to capture multifaceted insights into strategy efficacy:

**1. Quantitative Surveys:** Standardized questionnaires distributed to students and supervisors to quantify satisfaction levels, perceived barriers, and resource utilization efficiency. Statistical analysis of thesis quality indicators (e.g., plagiarism detection rates, defense pass rates) pre- and post-implementation.

**2. Qualitative Interviews:** Semi-structured interviews with purposively sampled stakeholders (students, supervisors,

administrators) to explore nuanced experiences, including: Challenges in interdisciplinary research design. Effectiveness of digital management platforms. Perceptions of institutional support systems.

3. Expert Peer Review: Double-blind evaluations by external academic experts to assess theses against national accreditation benchmarks. Rubric-based scoring of originality, methodological soundness, and contribution to disciplinary knowledge.

4. Longitudinal Tracking: Monitoring of alumni career trajectories and postgraduate research performance to evaluate the sustained impact of thesis training.

By integrating these metrics and methods, institutions can generate actionable insights to refine thesis supervision frameworks. This evidence-based approach ensures alignment with global standards for undergraduate research while addressing the unique challenges faced by private institutions. Future iterations should leverage machine learning tools to automate metric analysis, enabling real-time quality interventions and dynamic policy adaptations.

## 5. Conclusion

The standardization and regulation of thesis management processes in private undergraduate institutions are imperative for academic excellence. By establishing unified administrative protocols and robust quality control mechanisms, institutions can ensure effective supervision and monitoring across all stages of thesis development. This systematic approach not only enhances students' academic writing proficiency and scholarly competencies but also institutionalizes pedagogical governance, thereby elevating overall educational quality.

Process monitoring and evaluation play a pivotal role in safeguarding thesis integrity. Rigorous oversight enables the timely identification and correction of deviations in students' research trajectories, ensuring adherence to academic timelines and methodological standards. Furthermore, the introduction of third-party evaluation bodies for impartial assessments provides institutions and students with professional, evidence-based feedback, driving continuous improvement in thesis outcomes.

The strategies proposed in this study hold significant practical significance and scalability for private undergraduate institutions. Implementation is projected to yield measurable enhancements in thesis quality, which in turn will strengthen institutional credibility and competitiveness. Such advancements align with national objectives to cultivate high-caliber professionals equipped with critical research skills. Additionally, these findings may serve as a valuable reference for other higher education institutions seeking to optimize thesis management frameworks and quality assurance systems. Future research should explore technological integrations (e.g., AI-driven plagiarism detection, blockchain-based credentialing) to further modernize academic supervision in alignment with global educational trends.

While this study proposes targeted quality assurance strategies for thesis management in private undergraduate institutions, the implementation efficacy of these measures remains empirically unverified. In subsequent phases, we will prioritize longitudinal tracking of their operational impact within institutional contexts. Through systematic collection of stakeholder feedback (students, supervisors, administrators) and outcome metrics (thesis quality benchmarks, defense success rates), a robust empirical evaluation framework will be applied to assess strategy effectiveness.

This evidence-driven approach will enable iterative refinement of the proposed measures, ensuring their alignment with the operational realities and resource constraints characteristic of private institutions. Furthermore, comparative analyses across disciplines and institutional tiers will be conducted to identify context-specific adaptations. Future research should also explore the integration of predictive analytics and machine learning models to anticipate implementation challenges and optimize resource allocation dynamically. Such methodological advancements will strengthen the generalizability of quality assurance frameworks while addressing the evolving demands of undergraduate research education.

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The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

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# Study on the Financial Performance Evaluation Based on EVA Model of BYD Auto

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**Abstract:** By analysing the financial data of it is found that BYD Auto, the traditional financial performance evaluation method may not be able to show the enterprise's operation status and value creation ability in a comprehensive way, based on which, the adopted economic value added (EVA) is as the evaluation index to make up for the shortcomings of method the traditional. The EVA theory is applied to the financial performance evaluation of BYD Auto, calculating the company's EVA and analysing its problems, making suggestions the future development of for BYD Auto, and further for providing certain the development of the automobile manufacturing industry reference and help.

**Keywords:** BYD Auto; EVA; Financial Performance Evaluation

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## Introduction

In recent years, with the the real estate downward of , automobiles, as the second largest consumer product for all people, are in trend economy a higher and higher position, carrying an important after real estate economic and strategic consumer pressure . The automotive industry has also ushered in unprecedented development opportunities. On the one hand, the continuous innovation of battery technology and progress; on the other hand, the increasing support of the national policy, new energy have provided a favourable soil for the development of the automotive industry. In this context, how automotive companies can seize the opportunity to move towards the top of the industry is a question worth pondering. In the face of fierce market competition, enterprises need to maintain their competitiveness through a more accurate and effective financial performance evaluation system. Traditional financial performance evaluation methods, such as net profit, return on net assets, etc., although to a certain extent, can reflect the profitability of enterprises, but often ignore the cost of capital, and cannot fully reflect the real value creation ability of enterprises. Economic value added (EVA), as an emerging financial evaluation tool, can more accurately measure the real of enterprises by considering the cost of capital profitability and value creation ability. Ma Jing (2017) argued that the analysis of EVA value can be targeted to to suggest improvements, such as it can be proposed to increase the company's economic profit and improve the value of the company by improving the efficiency of the use of assets the company <sup>[1]</sup>. Yao Jinyuan (2018) studied how to improve the economic value added of the enterprise by decomposing the EVA driving indicators to construct a system of its driving indicators, which helps the enterprise can quickly shift from the core of the net profit evaluation to the economic value added, so as to realise the value added of the enterprise <sup>[2]</sup>. In this paper, the introduction of EVA performance evaluation method can evaluate the actual value created by the enterprise, and can find its deficiencies in the operation process, can effectively solve the defects due to the statement whitewash and

can not accurately analyse the profit and loss situation of the enterprise, as well as for enterprise stakeholders to provide a more reasonable basis for business decision-making, for the relevant enterprises to further enhance the competitiveness of the occupation of a larger market share to provide a guarantee, and at the same time for the other automotive manufacturing enterprises in China to provide a new evaluation idea. At other in China the same time, it provides a new for the performance evaluation of enterprises evaluation idea automobile manufacturing

## 1. Case study

### 1.1 BYD Auto Company Background

BYD Auto, as a global leader in new energy vehicles, has taken technological innovation as its core driving force since its establishment in 1995, and has achieved leapfrog development in recent years: it won the global championship with 1.86 million new energy vehicles sold in 2022, and was ranked No. 1 in the world with sales exceeding 3.02 million in 2023, and historically won the crown of the whole-brand sales in China's automobile market, breaking the monopoly pattern of joint venture brands; it has continued to make breakthroughs in the field of technology, with self-developed technologies such as blade batteries and DM-i super hybrid systems setting industry benchmarks. The brand's monopoly pattern; continuous breakthroughs in the field of technology, blade batteries, DM-i super hybrid system and other self-developed technologies to set the industry benchmark. 2024, the first half of the cumulative sales of new energy vehicles exceeded 1.6 million units, an increase of 28%, and accelerated the globalisation of the layout of the product coverage of Europe, East South Asia, South America and other 78 countries, a surge in overseas sales of 174% year-on-year, Thailand and Brazil, such as the imminent commissioning of the overseas bases. In addition, the company has demonstrated its strong progress from "Chinese Champion" to "Global Leader", and continues to promote the sustainable development of global transport with green technology.

## 2. Analysis of Traditional Financial Indicators BYD Auto'

### 2.1 Evaluation of 's Current Financial Performance BYD Auto

The financial performance evaluation of is based on BYD Auto net profit as the main assessment and evaluation index, and by analysing the financial data of for the years can be BYD Auto 2018-2023 (see Table 1), the company's profitability, operating ability, development ability and solvency evaluated comprehensively , and problems can be found.

Table 1: BYD Auto Financials 2014-2023

sports event	Indicator/year	2018	2019	2020	2021	2022	2023
profitability	Net sales margin (%)	2.73	1.66	3.84	1.84	4.18	5.2
	Return on net assets (average) (%)	5.05	2.88	7.45	4.01	16.13	24.05
operating ability	Inventory turnover	4.14	3.28	3.64	4.24	4.87	5.25
	Total asset turnover	0.7	0.65	0.79	0.87	1.07	1.03
solvency	Gearing ratio (%)	68.81	68.00	67.94	64.76	75.42	77.86
	current ratio	0.99	0.99	1.05	0.97	0.72	0.67
Development capacity	Earnings per share year-on-year growth rate (%)	-33.57	-46.24	194.00	-27.89	438.68	80.74
	Year-on-year growth rate of operating income (%)	22.79	-1.78	22.59	38.02	96.20	42.04
earnings per share	Earnings per share EPS (yuan)	0.93	0.50	1.47	1.06	5.71	1.03

Data source: Oriental Wealth Choice data

#### 2.1.1 Profitability

The company's profitability is showing a volatile upward trend. Net sales margin increased from 2.73% in 2018 to 5.2% in 2023, and ROE even jumped from 5.05% to 24.05%. This improvement is mainly attributed to the scale effect and

technological dividend brought about by the outbreak of the new energy vehicle market after 2020. For example, ROE in 2022 is as high as 16.13%, while net sales margin for the same period is 4.18% and total asset turnover reaches 1.07, showing synergistic improvement in profitability and operational efficiency. However, it should be noted that the net sales interest rate in 2023 does not match the ROE growth rate, and the ROE increase is significantly higher than the net sales interest rate, which may stem from the further amplification of financial leverage.

### 2.1.2 Operational capacity

Among the operating capacity indicators, the total asset turnover ratio improved from 0.7 in 2018 to 1.07 in 2022, and slightly decreased to 1.03 in 2023; the inventory turnover ratio increased from 4.14 to 5.25. This indicates that the company's asset use efficiency continues to be optimised and the supply chain management capability has been enhanced, especially against the backdrop of the surge in demand for new-energy vehicles after 2021, with the acceleration of inventory turnover and the capacity utilisation rate Improvement. However, the slight decline in total asset turnover ratio in 2023 may reflect intensified market competition or digestion pressure after capacity expansion.

### 2.1.3 Solvency

BYD Auto's solvency indicators show that the gearing ratio continues to climb from 68.81% to 77.86% from 2018-2023, while the current ratio falls from 0.99 to 0.67. This indicates the company's long-term reliance on debt financing and a significant increase in short-term debt-servicing pressure. In particular, the gearing ratio exceeds 75% after 2022 and the current ratio is below 1, reflecting the lack of asset liquidity and possible short-term debt service risk. Although high leverage can amplify shareholders' returns, such as ROE of 24.05% in 2023, it also increases financial vulnerability and requires vigilance against debt servicing crisis triggered by interest rate fluctuations or economic downturn.

### 2.1.4 Developing capacity

In terms of development capability, the year-on-year growth rate of operating income peaks at 96.2% in 2022 and falls back to 42.04% in 2023, but remains high. The year-on-year growth rate of earnings per share fluctuates sharply, reaching a high of 438.68% in 2022 and falling to 80.74% in 2023. This high growth rate is mainly benefited from the new energy vehicle penetration rate and policy support, but the decline in growth rate also indicates that the industry is gradually entering a mature period, the future need to rely on technological innovation or international expansion to maintain growth momentum .

## 2.2 Shortcomings of traditional financial performance evaluation

Ignoring cash flow and non-financial factors. DuPont analyses rely on the income statement and balance sheet, and do not address factors that affect long-term competitiveness, such as cash flow, R&D investment or brand value.

Strong dependence on historical data. Based on past data, it is difficult to predict future trends, such as the effect of 's new energy transformation needs to be combined with industry forward-looking analysis BYD Auto.

Accounting profits are susceptible to manipulation. automobile The business scope of an enterprise includes complete automobiles manufacturing the manufacture of , the production and manufacture of automobile parts and components and automobile trading. Year-end inventory of internal assets of the enterprise requires asset impairment provision and depreciation of used parts and equipment, and the enterprise may exist by reducing the amount of current provision or reversal of previous accounting period's provision, which provides an opportunity for managers to whitewash the financial statements. Such behaviour may make managers more focused on enhancing their personal earnings rather than on the development of the business and the interests of shareholders. The falsification of financial data can lead to short-term false growth in , and shareholders financial performance and investors will not be able to accurately understand the true state of the enterprise's earnings and revenues, which affects decision-making and is detrimental to the long-term development of the enterprise.

## 3.Evaluation under EVA of Financial Performance BYD Auto's

EVA (Economic Value Added, Economic Value Added) is a method of measuring the economic performance of an enterprise, proposed by Stern Stewart & Co. in 1982.The formula for calculating EVA is:  $EVA = \text{Net Operating Profit (NOPAT)} - \text{Cost of Capital (Capital} \times \text{Expected Return on Capital)}$ . The core idea of EVA is to measure the actual profit generated by a company after deducting all the costs of capital, which reflects the value created by the company for its shareholders.



The main advantage of EVA over traditional financial performance evaluation methods is that it provides a more comprehensive and in-depth reflection of an enterprise's actual profitability; EVA takes into account not only the cost of debt, but also the cost of equity, fully reflecting the cost of capital used by the enterprise; at the same time, EVA focuses on the creation of shareholder value and avoids the distortions that may be associated with traditional metrics. In addition, EVA can incentivise management to focus on capital efficiency and long-term value creation rather than short-term profits, and it is applicable to companies of different sizes and industries, providing a more uniform performance assessment standard.

### 3.1 Calculate the EVA of BYD Auto

#### 3.1.1 Calculation of net operating profit after tax

The formula for calculating operating profit after tax is as follows:

Net operating profit after tax (NOPAT) = net profit + (interest expense + R&D expenses - non-recurring gains and losses x 50%) x (1 - income tax rate).

The net operating profit after tax (NOPAT) of BYD Auto for 2018-2023 calculated based on the above formula is shown in Table 2.

Table 2: Calculation of BYD Auto's net operating profit after tax, 2018-2023 (in millions)

Project/year	2018	2019	2020	2021	2022	2023
net profit	355619.30	211885.70	601396.30	396726.60	1771310.40	3134407.00
Add: Interest expense *(1-25 per cent)	224782.58	226052.40	282195.75	134019.53	-121346.78	-110617.05
R&D costs* (1-25 per cent)	374202.00	422202.90	559864.58	599323.05	1399083.98	2968120.88
Less: Non-recurring gains and losses *50 per cent *(1-25 per cent)	5395.50	4456.61	-7619.48	-4274.59	-17328.38	-31292.18
Net operating profit after tax	949208.38	855684.39	1451076.10	1134343.76	3066375.98	6023203.00

Data source: BYD Auto 2018-2023 financial report

#### 3.1.2 Calculation of total capital

In order to ensure the accuracy of the results, a series of corresponding adjustments are also made to the total capital of the company when calculating the total capital. The formula for calculating the adjusted total capital is as follows:

Total capital = owners' equity + short-term borrowings + long-term borrowings + bonds payable + non-current liabilities due within one year - construction in progress

Table 3: BYD Auto's Total Capital Calculation 2018-2023 (in millions)

Project/Year	2018	2019	2020	2021	2022	2023
owners' equity	6069397.90	6260142.00	6445391.20	10424420.90	12138983.70	15046211.30
Add: short-term loans	3778897.70	4033236.50	1640069.00	1020435.80	515309.80	1832321.60
long term loan	684760.30	1194793.20	1474549.50	874351.90	759359.60	1197513.90
Non-current liabilities due within one year	748263.40	874744.80	1141246.00	1298341.60	646482.80	774049.10
Less: Construction in progress	968377.30	1067484.70	611176.70	2027730.90	4462193.50	3472619.60
Total capital	10312942.00	11295431.80	10090079.00	11589819.30	9597942.40	15377476.30

Data source: BYD Auto 2018-2023 financial report

The total capital of BYD Auto for the years 2018-2023 calculated based on the above formula is shown in Table 3.

#### 3.1.3 Calculation of the weighted average cost of capital ratio

The formula for calculating WACC is:  $WACC = \text{debt capital ratio} \times \text{debt capital cost rate} \times (1-25\%) + \text{equity capital ratio} \times \text{equity capital cost rate}$ . In this paper, published by the People's Bank of China (PBOC) for the last 6 selected the lending

rate (4.75%) as years was the debt cost of capital ratio of Auto. The cost of equity capital ratio is derived from the capital asset pricing model (cost of equity capital ratio = risk-free interest rate + beta coefficient  $\times$  market risk premium), the risk-free interest rate is based on until 2024BYD calculated the one-year time deposit rate of 1.5% published by , the market risk premium is by the the People's Bank of China expressed GDP growth rate , and published by the National Bureau of Statistics the beta coefficient of Auto is found from the Rexis database BYD. In summary, the weighted average cost of capital ratio for BYD Auto is derived as shown in the table below.

*Table 4: Calculation of Weighted Average Cost of Capital Ratio for BYD Auto 2018-2023*

Indicator/year	2018	2019	2020	2021	2022	2023
Debt capital ratio/per cent	0.69	0.68	0.68	0.65	0.75	0.78
Equity capital ratio/per cent	0.31	0.32	0.32	0.35	0.25	0.22
Risk-free rate/per cent	1.50	1.50	1.50	1.50	1.50	1.50
Beta coefficient	0.89	0.72	0.72	0.43	0.90	1.18
Market risk premium/per cent	6.75	5.95	2.24	8.45	3.00	5.20
Debt cost of capital ratio/per cent	4.75	4.75	4.75	4.75	4.75	4.75
Cost of equity capital ratio/per cent	7.51	5.78	3.11	5.13	4.20	7.64
Weighted average cost of capital ratio/per cent	4.79	4.27	3.42	4.12	3.72	4.46

Data source: BYD Auto 2018-2023 financial report

### 3.1.4 Calculation of EVA

The EVA value is calculated as EVA = Net Operating Profit After Tax (NOPAT) -Total Capital (TC) at the beginning of the period  $\times$  Weighted Average Cost of Capital (WACC). The results of BYD Auto's EVA value calculation are shown in 5 Table. BYD Auto's overall EVA value for 2018-2023 shows a significant growth trend, reflecting the company's continuous optimisation in value creation and capital efficiency. From the data, EVA from 4,in 2018 jumped .9 million yuan to 53,367 million yuan in 2023, a six-year growth of more than 10 times, especially in 2022 and 2023, the growth rate is the most rapid, reaching 27,094 million yuan and 53,367 million yuan, respectively, which reflects the company's strong profitability in the period of new energy automobile market outbreak.<sup>540</sup>

Specifically, EVA briefly declined to \$3.730 billion in 2019, likely related to the decline in net operating profit after tax (from \$9.492 billion to \$8.557 billion) and the rising cost of capital in that year. However, after 2020, EVA began to rebound sharply, exceeding \$11.062 billion in 2020, mainly thanks to the nearly 70% growth in net operating profit after tax to \$14.511 billion and the WACC effective control of to 3.42%. 2021, although EVA fell back to \$6.573 billion due to the impact of the increase in total capital and the rise in the cost of capital, the following two years by virtue of the net operating profit after tax. In 2021, EVA dropped back to \$6.573 billion due to the increase in capital stock and rising cost of capital. It is worth noting that despite the increase in total capital to RMB153.775bn in 2023 and a rise in WACC to 4.46%, high profits still drove EVA to break through historical peaks, reflecting BYD in technological innovations (e.g., blade batteries, 's success hybrid system) and large-scale production. going forward DM-i The impact of capital cost volatility on long-term value creation will need to be watched, but overall, BYD has demonstrated industry-leading profitability and strategic execution.

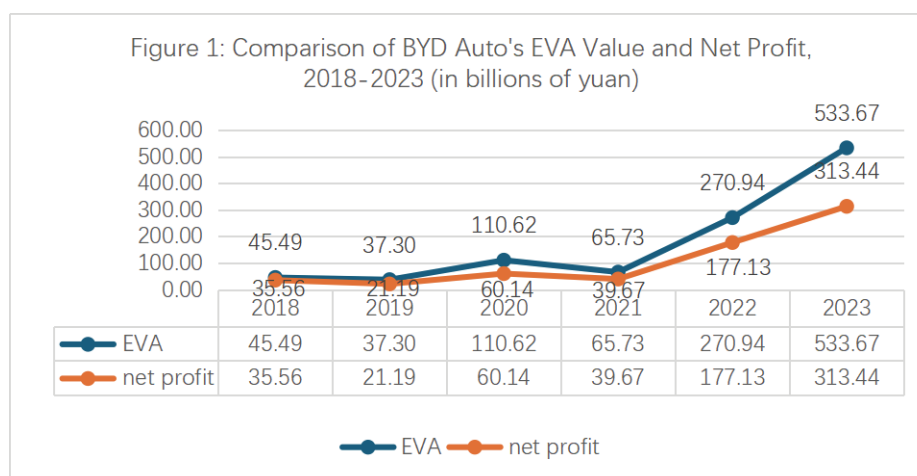
*Table 5: EVA Value of BYD Auto, 2018-2023 (in million yuan)*

Indicator/year	2018	2019	2020	2021	2022	2023
Net operating profit after tax	949208.38	855684.39	1451076.10	1134343.76	3066375.98	6023203.00
Total capital	10312942.00	11295431.80	10090079.00	11589819.30	9597942.40	15377476.30
Weighted average cost of capital	0.05	0.04	0.03	0.04	0.04	0.04
EVA	454899.51	372992.66	1106166.04	657285.90	2709409.68	5336685.66

Source: BYD Auto Annual Report

### 3.1.5 Comparison of EVA and Net Profit

Comparison of EVA and net profit As shown in Figure 1, BYD Auto's from 2018-2023 BYD Auto's EVA is higher than net profit in all cases, which implies that BYD Auto's actual operation is better than the net profit in the statement, and the company can really create value for shareholders. Since 2021, EVA has rebounded strongly, and its growth rate exceeds the growth rate of net profit in the same period, a phenomenon which suggests that BYD has made a capital allocation efficiency, cost control or high value-added business expansion to make breakthroughs, which effectively enhance the economic value added. In addition, the difference of EVA consistently higher than net profit may stem from the effective management of capital cost, which has enabled the company to create a continuous expansion of excess profit. Overall, despite short-term fluctuations, BYD's EVA performance highlights its enhanced long-term value creation ability and optimised financial health.



## 4. Suggestions for Improving the Financial Performance Evaluation Methodology of BYD Auto

### 4.1 Integration of the cost of capital into the evaluation system and comprehensive measurement of value creation capacity

Traditional financial indicators (e.g., net profit, ROE) do not take into account the cost of equity capital, which may overestimate the real profitability of the enterprise, while EVA reflects more accurately the actual economic profit created by the enterprise for shareholders by deducting the full cost of capital (including debt and equity). It is recommended that BYD in its performance evaluation continue to deepen EVA the application of , and incorporate cost of capital management into its assessment objectives, for example, by setting a threshold for return on capital (ROIC), to incentivise the management to optimise the allocation of capital, to reduce the occupation of inefficient assets, and to avoid wastage of capital due to blind expansion, so as to enhance the overall efficiency of value creation.

### 4.2 Strengthen long-term orientation and promote synergy between strategy and performance evaluation

Traditional methods are susceptible to short-term profit manipulation, while EVA emphasises long-term value accumulation and can guide companies to balance short-term earnings and long-term investment. It is recommended that BYD link EVA to strategic objectives such as technological innovation and globalisation, for example, by incorporating non-financial indicators such as R&D investment and overseas market penetration into the analysis of EVA drivers, and evaluating the effect of releasing technological dividends by extending the assessment cycle. At the same time, long-term incentive mechanisms based on EVA, such as equity incentive plans, can be designed to prompt management to focus on technology research and development, brand building and other long-term value drivers, to avoid the pursuit of short-term profits at the expense of core competitiveness.

### 4.3 Improving data transparency and adjustment mechanisms to enhance evaluation objectivity

Traditional accounting profits are easily affected by standard adjustments or management's subjective judgement, while EVA reduces the room for financial whitewash by adjusting accounting items such as non-recurring gains and losses and

capitalised R&D costs. It is recommended that BYD further refine its EVA calculation rules, such as clarifying the criteria for capitalising R&D costs, standardising the process of adjusting non-recurring gains and losses, and regularly disclosing the details of EVA calculation and the basis for adjustment. At the same time, an independent third party can be introduced to audit the EVA data to enhance external stakeholders the trust of (e.g., investors and regulators) in the evaluation results, so as to build a more transparent and credible performance evaluation system to support the sustainable development of the enterprise.

## **5.concluding remarks**

This study evaluates BYD Auto's financial performance through the EVA model and finds a significant increase in its EVA value, reflecting the company's strong value creation capability driven by new energy technologies. Compared with traditional indicators, EVA measures the cost of capital more comprehensively, revealing the effectiveness of BYD's capital efficiency optimisation and long-term strategy execution. However, high leverage and short-term debt servicing pressure still need to be guarded against. It is recommended that BYD continue to optimise its capital structure, deepen its technological innovation, and strengthen its globalisation to consolidate its competitive advantage. This study provides a practical reference for EVA performance evaluation in the automotive industry, helping companies balance profitability and sustainable development, and promoting the industry's transition to a value-driven model.

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# Research on the Construction of Agricultural and Rural Joint Audit System under the Background of Comprehensive Rural Revitalization

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**Abstract:** In the context of advancing national rural development strategies and accelerating agricultural modernization, a multi-dimensional rural development framework has emerged. Policy documents emphasize that “the most challenging task in national modernization lies in rural areas,” highlighting the critical role of rural transformation in overall development. National policy frameworks have outlined specific measures to promote rural revitalization, including learning from successful rural development programs. This paper focuses on establishing an integrated agricultural audit system within the broader rural revitalization context. By examining current audit practices, identifying emerging demands, and addressing challenges, it proposes a collaborative audit mechanism tailored to agricultural modernization. The goal is to enhance audit efficiency and support sustainable rural development through systematic oversight and innovation.

**Keywords:** Agricultural and Rural Audit; Rural Revitalization; Joint Audit; Institutional Construction

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## 1.Introduction

The report of the 20th National Congress of the Communist Party of China clearly states that “the most arduous and onerous task in building a modern socialist country in all respects remains in rural areas,” emphasizing that continuously deepening the rural revitalization strategy remains a crucial component in China’s high-quality economic development process. It highlights the vital position of comprehensively advancing rural revitalization in China’s socialist modernization drive. Since the 20th National Congress, the Central Committee’s No.1 documents have all focused on “rural revitalization.” In January 2024, the “Opinions of the Central Committee of the Communist Party of China and the State Council on Learning and Applying the Experience of the ‘Thousands of Villages Demonstration and Ten Thousands of Villages Renovation’ Project to Effectively Promote Comprehensive Rural Revitalization” emphasized that advancing Chinese-style modernization requires unremitting efforts to consolidate the agricultural foundation and promote comprehensive rural revitalization. It specifically pointed out that promoting comprehensive rural revitalization should serve as the overall grasp for “agriculture, rural areas, and farmers” work in the new era and new journey, with a greater emphasis on all-round rural development and the introduction of more detailed plans such as “one strengthening, two ensuring, three enhancing.” The shift from “comprehensively promoting rural revitalization” to “promoting comprehensive rural revitalization” indicates a progression from achieving overall rural revitalization to comprehensive development and modernization across specific rural aspects.

The “Opinions of the National Audit Office on Strengthening Audit Supervision in the Implementation of the Rural Revitalization Strategy” sets requirements for audit work in agricultural and rural development, including enhancing coordination, innovating audit techniques, and ensuring resource, information, and result sharing among special audits to achieve deep cross-departmental collaborative audits. According to the characteristics of agricultural and rural work and rural audit, it further explores digital audit models. The “14th Five-Year Plan for National Audit Development” for the first time separately lists agricultural and rural audits, reflecting the significance of agricultural and rural development in the national master plan. It emphasizes the new responsibilities and missions of audit work in the new era, calling for continuous innovation in audit concepts, approaches, methods, systems, and mechanisms, improving centralized audit systems, building a full audit coverage framework, and establishing authoritative and efficient audit operational mechanisms.

Facing the comprehensive rural revitalization plan, policies and systems related to agricultural modernization construction feature wide coverage, extensive influence, high specialization, and development tailored to local conditions, leading to differentiated approaches and policy priorities in rural revitalization across regions. However, current rural revitalization audits remain confined to the scope of rural audits, essentially a single audit model derived from national audit focusing on rural fund management and supervision. The existing rural audit system has not been constructed based on the development characteristics of rural revitalization in different regions. With the more specific measures for comprehensive rural revitalization, conducting rural joint audits allows audit institutions to better identify policy constraints, development obstacles, and institutional flaws in rural revitalization, providing decision-making recommendations and ensuring the smooth progress for the next phase of rural revitalization. Therefore, analyzing the current status and issues of agricultural and rural audits, systematically combing China’s audit system to align with the new requirements of comprehensive rural revitalization, and constructing a rural joint audit model are of significant practical and theoretical importance for the high-quality development of rural revitalization.

## **2. Development Achievements of Agricultural and Rural Audits**

Under the strategy of comprehensively advancing rural revitalization, the state has set more comprehensive, specific, and high-level construction goals for agricultural and rural development. Agricultural and rural audits, as important tools for verification, supervision, and evaluation, serve as indispensable guarantees for implementing pro-farmer policies, safeguarding farmers’ fundamental interests, and establishing agricultural and rural modernization. However, current agricultural and rural audits are merely conducted under the overall coordination of national audits.<sup>[1]</sup> Facing the extremely complex and cumbersome audit environment in rural revitalization, the traditional agricultural and rural audit system cannot adapt to new rural revitalization policies, fails to comprehensively and effectively focus on the implementation of policies, subsidies, pro-farmer policy enforcement, agricultural infrastructure construction, and other complex scenarios under the comprehensive rural revitalization strategy. This may even have adverse effects on the overall implementation of policies.

### **2.1 Continuous Strengthening of Agricultural and Rural Audit Laws**

With the vigorous development of China’s rural economy and the comprehensive implementation of the rural revitalization strategy, the importance of rural audits has become increasingly prominent. However, China’s rural audit legal system remains incomplete, primarily dominated by the Audit Law of the People’s Republic of China. At the local level, agricultural departments in provinces, municipalities, and autonomous regions formulate corresponding implementation measures and regulations based on local conditions and the Regulations on Audits of Rural Collective Economic Organizations promulgated by the Ministry of Agriculture and Rural Affairs to standardize agricultural and rural audit work. To strengthen the construction of internal audit teams in agriculture and rural areas and improve the quality of internal audit work, the Ministry of Agriculture and Rural Affairs has formulated the Administrative Measures for Specially-Employed Auditors of the Ministry of Agriculture and Rural Affairs.

### **2.2 Enhanced Exploration of Agricultural and Rural Audit Models**

Currently, China’s traditional rural audit models mainly include three types: internal audit departments established in township governments, rural audit stations, and entrusted third-party social audits. Among them, the most widely applied in practice is the rural audit station model, which is essentially an internal audit established under the leadership of county



governments, relying on rural township economic management stations. Although it can directly face grassroots levels, penetrate the core of township economic activities, and provide real-time and effective supervision over the revenue and expenditure of fiscal funds, it plays an indispensable role in standardizing rural financial management, safeguarding rural collective economies, improving rural economic returns, and maintaining stable rural development. Facing the development of agricultural and rural modernization, provinces are actively exploring audit models tailored to local conditions. For example, Zhejiang Province has accelerated the construction of the “131” audit framework system and internal audit village resident guidance stations, while the Chongqing Audit Bureau has established the “1+39+N” agricultural and rural audit model.<sup>[2]</sup>

## **2.3 Increasing Professionalization of Agricultural and Rural Audits**

China’s rural economic management system is relatively complex, reflected not only in the diversity of policies and regulations and the complexity of implementation but also in complex relationships related to resource allocation, industrial structure, and land use. At the critical stage of comprehensive rural revitalization, as the government continues to increase support for rural economic development, the categories of project funds involved have become more diverse, covering multiple fields such as agricultural production, rural infrastructure construction, and rural industrial development. The large volume of funds and long project cycles have increased the difficulty and complexity of audit work. On the other hand, agricultural departments in provinces, municipalities, and autonomous regions are accelerating cooperation with audit departments to carry out regular cultivation of more professional auditors. The Ministry of Agriculture and Rural Affairs has issued the Administrative Measures for Specially-Employed Auditors of the Ministry of Agriculture and Rural Affairs in accordance with the Audit Law of the People’s Republic of China, the Regulations for the Implementation of the Audit Law of the People’s Republic of China, and the Regulations of the National Audit Office on Internal Audit Work to further exert the role of internal audits, strengthen internal audit team construction, and promote the improvement of the quality and efficiency of internal audit work in agriculture and rural areas.

## **2.4 Regional Characteristics of Agricultural and Rural Audits**

By the end of 2022, there were 2,843 county-level divisions and 38,602 township-level divisions nationwide, including 21,389 towns, 8,227 townships, and 8,984 subdistricts [National Bureau of Statistics]. Evidently, rural areas at the county and township levels account for a large proportion in China, and the tasks of the rural revitalization strategy are extensive, multi-layered, and subject to diverse environmental changes. Notably, rural areas in China are home to diverse ethnic groups, each with distinct ethnic characteristics and cultural environments. During audits, different regions may face the same development goals but require different development paths. This situation demands flexible audit approaches and methods tailored to local conditions to efficiently complete audit tasks and provide targeted audit recommendations. However, the current rural audit system primarily follows traditional government audit methods and fails to fully recognize the gaps and characteristics among rural regions. The failure to adapt traditional audit methods to local conditions has significantly reduced audit efficiency.

## **3. Policy Demands for Constructing Agricultural and Rural Joint Audits under the Background of Comprehensive Rural Revitalization**

In 2017, the national rural revitalization strategy was formally put forward. Subsequently, the No.1 documents of relevant central authorities for five consecutive years focused on the “rural revitalization strategy”. It has been continuously emphasized that the most arduous and challenging task in comprehensively building a modern country lies in rural areas, and it is necessary to adhere to giving priority to the development of agriculture and rural areas. The 2024 Central Committee’s No.1 document put forward specific plans of “one strengthening, two ensuring, three enhancing,”<sup>[3]</sup> which not only charted new development paths and task priorities for rural revitalization but also posed a series of new requirements for the construction of agricultural and rural audit systems. Therefore, it is essential to systematically and scientifically grasp these requirements to construct a development path for agricultural and rural joint audits that align with the needs of the new era.

### **3.1 New Requirements for Strengthening the Party’s Comprehensive Leadership over “Agriculture, Rural Areas, and Farmers” Work**

Under the background of comprehensively advancing rural revitalization, the focus lies in improving the Party’s institutional

mechanisms for leading agricultural and rural work and strengthening rural reform and innovation. Previous agricultural and rural work systems were incomplete, with insufficient implementation of rural revitalization responsibilities and a lack of development methods tailored to local conditions. Over-reliance on urban audit mechanisms extended to rural management, leading to unclear accountability directions for the “five-level secretaries” (provincial, municipal, county, township, and village Party secretaries) in rural revitalization and slow progress in Party organizations’ promotion of rural revitalization. The system four approaches to the grassroots: visiting villages, solving problems, conducting research, and promoting development was not effectively implemented, with insufficient in-depth investigations failing to resolve issues strongly reflected by farmers. Regular supervision, inspections, and assessments related to agriculture were not institutionalized, placing heavy burdens on grassroots units during inspections. Currently, improving agricultural and rural work systems, implementing rural revitalization accountability, solidly advancing comprehensive rural revitalization, and strengthening the Party committee’s agricultural and rural work system construction require strengthened coordination responsibilities for rural revitalization. However, the existing agricultural and rural audit models, constrained by institutional flaws, single approaches, and a lack of comprehensive policy coverage across all aspects of agricultural development, cannot serve as robust supervisory tools for the Party’s comprehensive leadership over “agriculture, rural areas, and farmers” work, thus generating new demands for constructing agricultural and rural joint audit systems. In the context of strengthening agricultural and rural reform and innovation, while adhering to principles and bottom lines, encouraging local practice-based explorations and institutional innovations, improving land transfer pricing mechanisms, deepening reforms of rural collective property rights, collective forest rights, agricultural water pricing, state farms, and supply and marketing cooperatives all require utilizing the supervisory and verification roles of agricultural and rural joint audits. However, current agricultural and rural audits are limited to ex-post audits of fund usage and policy implementation, unable to meet the new requirements for agricultural and rural reform and innovation. Therefore, it is urgent to establish a new adaptive agricultural and rural joint audit system.

### **3.2 New Requirements for Ensuring National Food Security and Preventing Large-Scale Poverty Reoccurrence**

Under comprehensive rural revitalization, ensuring national food security and preventing large-scale poverty reoccurrence are fundamental. National food security is of utmost importance, serving as the bedrock of national development. Food originates in rural areas, where agricultural cultivated land is the primary base for grain planting and supports most agricultural product planting-production-marketing chains. Rural areas also host major meat product breeding bases, underscoring their critical role in agricultural production. In the process of socialist modernization, agricultural and rural food production must keep pace with the times. Measures include promoting grain and key agricultural product production, implementing the grain yield improvement project, integrating and promoting high-quality farmland, seeds, machinery, and techniques, improving mechanisms for ensuring agricultural input supply and price stability, and exploring the establishment of inter-provincial horizontal interest compensation mechanisms between grain production and sales regions. Strict implementation of the cultivated land protection system involves establishing a “three-in-one” protection system for cultivated land quantity, quality, and ecology, improving quality acceptance systems for supplementary cultivated land, and enhancing post-construction management and re-evaluation mechanisms. Strengthening agricultural infrastructure construction requires converting cultivated land in plain areas with irrigation conditions into high-standard farmland, strengthening full-process supervision of high-standard farmland projects, promoting the construction and modernization of key water sources, irrigation districts, and flood storage areas, and accelerating post-disaster reconstruction. Improving monitoring and early-warning mechanisms for the entire agricultural product industrial chain, promoting food loss reduction across the entire supply chain, and establishing regular and long-term operational mechanisms are also essential.<sup>[4]</sup> Facing numerous grain subsidy policies and the establishment of modern agricultural mechanisms, agricultural and rural audits are characterized by complexity, and diversity. The existing rural audit station model cannot adapt to the increasingly complex agricultural and rural development environment, necessitating the establishment of an all-round, joint audit model. To ensure no large-scale poverty reoccurrence, constructing an agricultural and rural joint audit system is crucial, requiring “retrospective checks” to verify genuine poverty alleviation rather than symbolic achievements. Implementing poverty reoccurrence prevention and assistance

mechanisms demands that agricultural and rural joint audits parallelly supervise the effectiveness and regularity of poverty monitoring and assistance, raising requirements for auditors' professional competencies and enhancing the resilience of the joint audit system.

### **3.3 New Requirements for Enhancing Rural Industrial Development, Construction, and Governance Levels Under the comprehensive rural revitalization strategy, enhancing rural industrial development, construction, and governance levels is key.**

First, enhancing rural industrial development. This involves promoting the integrated development of rural primary, secondary, and tertiary industries, constructing a modern rural industrial system integrating agriculture, culture, and tourism, and transforming agriculture into a modern large-scale industry. Local characteristic industries should be developed based on regional conditions, building local brands, promoting rural tourism clusters, and fostering high-quality homestays and agricultural industrialization consortia. Accelerating the optimization of agricultural product processing requires coordinated development of primary and intensive processing, creating rural characteristic industrial clusters. Promoting high-quality rural circulation development involves improving rural logistics support systems and expanding county-level e-commerce live-streaming platforms. Linking support policies for new agricultural operators and agriculture-related enterprises to mechanisms for increasing farmers' incomes and strengthening dynamic monitoring of migrant worker employment are also critical. Enhancing rural industrial development relies on agricultural and rural joint audit results to optimize future pathways, necessitating sound joint audit systems to ensure the accuracy and Diversified of audit recommendations.

Second, enhancing rural construction. This requires professional demands in areas such as strengthening rural planning guidance, optimizing public service layouts, implementing rural living environment improvement initiatives, and ecological civilization construction. Audit plans must involve experts in township planning, ecology, and environmental science to fulfill audit verification roles and provide valuable rectification suggestions. Policies related to rural infrastructure filling gaps and improving public service systems are characterized by periodicity, permanence, and regularity, requiring agricultural and rural joint audits to adopt continuous and regular follow-up audits rather than focusing solely on post-implementation outcomes.

Third, enhancing rural governance. Promoting rural cultural prosperity involves integrating agricultural civilization with modern civilization elements, strengthening the excavation, collation, and protection of agricultural cultural heritage and rural intangible cultural heritage, and implementing rural cultural relic protection projects. This requires agricultural and rural joint audits to avoid one-size-fits-all rectification supervision and instead provide culturally adapted audit suggestions, necessitating auditors to deepen their understanding of local customs and cultural heritage in addition to professional knowledge. In rural governance, promoting cultural transformation requires agricultural and rural joint audit institutions to strengthen audit supervision over comprehensive management of issues such as exorbitant betrothal gifts, extravagant ceremonies, and improper burials.

## **4. Analysis of Issues in the Construction of Agricultural and Rural Joint Audit System under the Background of Comprehensive Rural Revitalization**

Under the new era's strategy of comprehensive rural revitalization, while new requirements arise, the construction of the agricultural and rural joint audit system faces numerous pressing challenges. These issues stem from both the lagging nature of the traditional rural audit system in adapting to new developments and emerging problems accompanying the new demands of comprehensive rural revitalization. The following four aspects are summarized:

### **4.1 Incomplete Legal Framework for Agricultural and Rural Audits**

Currently, China's agricultural and rural audits are primarily governed by the Audit Law of the People's Republic of China and local implementation measures and regulations formulated by provinces based on the Regulations on Audits of Rural Collective Economic Organizations issued by the Ministry of Agriculture and Rural Affairs. However, the Regulations on Audits of Rural Collective Economic Organizations was promulgated in 2008, suffering from severe obsolescence.<sup>[5]</sup> Facing the new journey of rural and agricultural development in the new era, these laws are insufficient to address emerging issues. The unsound supervision mechanism in the agricultural and rural joint audit legal system increases the risk of audit abuses and misconduct, such as "monetary" and "interest" temptations during comprehensive rural revitalization.

This ultimately elevates audit risks, calls into question the authenticity of audit opinions, and hinders rural revitalization. Ambiguities in legal bases for rural audits persist, as diverse rural industries and policy implementations—unique to rural regional characteristics—lack clear guidance. This leads to uncertainties and conceptual confusion in audit practices. Traditional agricultural and rural audits focus solely on verifying the authenticity of fund usage, whereas modern rural revitalization requires audits of industrial rationality, policy effectiveness, and other specifics. Current laws provide vague scope definitions for rural audits, failing to clearly specify audit objects, contents, and procedures, resulting in unclear guidance. Rural development diversity and distinct regional features are inadequately reflected in audit standards and guidelines, reducing audit relevance and effectiveness.

#### **4.2 Unreasonable Agricultural and Rural Audit Models**

The past single audit station model or audit points established within rural economic management stations cannot adapt to the diversified, regionalized, professionalized development of modern agriculture and rural areas. Existing rural audit models lack standardized operational procedures and work criteria, leading to inconsistent results and poor comparability, undermining audit scientificity and accuracy. Rural modernization, such as industrial clusters, technology-driven agriculture, and big data applications, demands higher IT capabilities. However, traditional audits rely on manual operations and paper documentation for data collection, analysis, and reporting, causing inefficiencies. There is no pre-audit prevention or mid-audit correction mechanism, and traditional models lack tailored approaches to rural specifics, reducing practicality and effectiveness.<sup>[6]</sup>

#### **4.3 Weak Talent Pool in Agricultural and Rural Audits**

Talent is critical to the construction and effective operation of the agricultural and rural audit system. Despite policy, model, and mechanism changes, auditors remain the core of the audit process. However, there is a shortage of agricultural and rural auditors nationwide, especially in remote or underdeveloped regions, hindering audit implementation and rural revitalization evaluation. The comprehensive rural revitalization requires higher professionalism, yet many rural auditors are transferred from economic management stations, lacking systematic audit training and practical experience. This leads to difficulties in risk identification and assessment, undermining audit quality and efficiency. Additionally, auditors often have narrow disciplinary backgrounds, struggling to meet complex audit demands in modern agriculture and technology-driven sectors. There is a lack of talent cultivation planning, with personnel often assigned without localized training.

#### **4.4 Issues of Independence in Agricultural and Rural Audits**

Weak independence is inherent in traditional rural audit station models, which are essentially internal audits under superior government leadership.<sup>[7]</sup> Internal audits face multiple independence constraints: they are influenced by organizational management and prioritize fiduciary responsibility over pure supervisory functions. Firstly, as internal departments, audit stations are subject to leadership interference. When audit results conflict with management interests, independence and impartiality are compromised. Secondly, internal audits focus on organizational efficiency and risk reduction, potentially neglecting external stakeholders. This limits their independence and objectivity. Thirdly, resource and authority limitations—including funding and manpower—restrict rural audit stations from conducting thorough, independent audits. Information and evidence collection may also face obstacles, impeding problem identification.

### **5. Construction of Agricultural and Rural Joint Audit System under the Background of Comprehensive Rural Revitalization**

The construction of an agricultural and rural joint audit system is a comprehensive and systematic project. It requires focusing on the overall framework, including legal support for agricultural and rural audits, the application of specific joint audit models, and the establishment of new talent cultivation mechanisms. Guided by three major audit types, it integrates relevant departments to precisely address diverse issues in comprehensive rural revitalization.

#### **5.1 Establishing and Perfecting Agricultural and Rural Joint Audit Laws**

As the key and most arduous area for socialist modernization, rural development relies heavily on agricultural and rural audits to drive rural revitalization. Under the guidance of the Audit Law of the People's Republic of China, formulating a "Law on Agricultural and Rural Joint Audits" is imperative for the new agricultural era. First, by integrating the Regulations on Audits of Rural Collective Economic Organizations and other rural-related regulations, a unified legal framework will

be established to avoid contradictions, clarify legislative objectives, and define basic principles. Second, audit objects (e.g., rural collective economic organizations, farmer cooperatives, rural enterprises) and scope (e.g., financial transactions, village cadre departures, asset-liability assessments, policy implementation, industrial performance) will be clearly defined to ensure comprehensiveness. Finally, the law will specify audit institutions' establishment, organizational structures, and personnel configurations to guarantee professionalism and independence, while also regulating audit procedures, powers, obligations, and penalties.<sup>[8]</sup>

## 5.2 Constructing the “1+3+N” Agricultural and Rural Joint Audit Model

According to the Audit Law, county-level audit institutions operate under dual leadership, with supervision primarily from higher-level audit authorities. To adapt to rural revitalization, county-level rural joint audit centers will be established. Drawing from “national governance theory” and “immune system theory,” stationing township auditors directly addresses rural complexity,<sup>[9]</sup> enabling effective supervision and constraint of rural power operations. Professional social audit agencies will be introduced to supplement government audits, forming a support model where the government stabilizes their market presence. Township internal audit committees, led by dual county-socially appointed auditors and village representatives, will implement regular audit training and the “Fengqiao Experience” for grassroots prevention and oversight. The model integrates joint audit centers with government, internal, and social audits, supported by cross-departmental collaboration (e.g., finance, transportation, ecology), creating a “1+3+N” framework.

## 5.3 Building a New Agricultural and Rural Joint Audit Talent Team

Scientific talent recruitment and incentives will foster professionalism. Region-specific training programs will emphasize practical case studies and on-the-job learning, incorporating special training for rural revitalization challenges. tracking mechanism will monitor talent development, evaluate outcomes, and adjust strategies to enhance professional competency.

## 5.4 Establishing a Smart Data-Driven Agricultural and Rural Joint Audit Database

Leveraging smart data technologies, a county-level database managed by provincial agricultural departments and supervised by the Ministry of Agriculture will store audit cases and use AI for analysis, improving efficiency. A national network will integrate data from diverse departments, enabling machine learning for predictive analytics and detection of irregularities.<sup>[10]</sup>

## 5.5 Enhancing Independence and Transparency of Agricultural and Rural Joint Audits

Independence will be ensured through cross-departmental coordination while maintaining autonomy, strengthening independence awareness via ethics training and quantitative assessments.<sup>[11]</sup> Audit personnel will sign independence declarations, and whistleblower mechanisms will protect informants. Village resident supervisory committees will monitor audit integrity. Transparency will be enhanced through public audit plans/reports, public bulletins, and information disclosure systems to address villagers' concerns.

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# Unmasking Exploitative Leadership's Dual Pathways: An FsQCA and PLS-SEM Comparison Analysis of Emotional Exhaustion and Job Satisfaction in Workplace Procrastination

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**Abstract:** This study investigates how exploitative leadership(EL) exacerbates employee work procrastination(WP) through the chain mediation of emotional exhaustion(EE) and job satisfaction(JS), while examining psychological resilience(PR) as a critical moderator. Grounded in affective events theory and conservation of resources theory, this study collected data from 450 employees of Chinese companies. Structural equation modeling (PLS-SEM) revealed that EL significantly increases WP ( $\beta = 0.340$ ,  $p < 0.001$ ), with EE ( $\beta = 0.306$ ) and JS ( $\beta = -0.188$ ) serving as partial mediators (VAF = 63.3% and 30.5%, respectively). Furthermore, PR attenuates EL's adverse effects, weakening its association with EE ( $\beta = -0.302$ ) and buffering JS decline ( $\beta = 0.161$ ). Fuzzy-set qualitative comparative analysis (fsQCA) identified three causal configurations, with the EL  $\times$  EE pathway showing the highest explanatory power (raw coverage = 0.756). These findings advance understanding of the dynamic interplay between destructive leadership and procrastination, emphasizing the role of emotional and cognitive depletion. Practically, the study advocates for institutional transparency and resilience-building interventions to mitigate EL's covert harm. By integrating symmetric and asymmetric methodologies, this research bridges theoretical gaps and offers a nuanced framework for fostering healthier workplaces.

**Keywords:** Exploitative Leadership; Employee Work Procrastination; Affective Events Theory; FsQCA; Psychological Resilience

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## 1.Introduction

In recent years, researchers have shifted from focusing on the positive aspects of leadership to studying the negative aspects of leadership <sup>[1]</sup>. A substantial corpus of research has been dedicated to the exploration of various manifestations of destructive leadership, including exploitative leadership <sup>[2]</sup>, despotic leadership <sup>[3]</sup>, and hubristic leadership <sup>[4]</sup>. Exploitative leadership is characterized primarily by appropriating the results of the work of followers, pressuring and manipulating them, increasing their workload and undermining their personal development <sup>[5]</sup>. Exploitative leadership is one of the more prevalent and self-serving leadership behaviors, but it is so insidious that research has paid less attention to it <sup>[5]</sup>. Previous research has shown that exploitative behavior is often presented in the form of ambiguous transgressions <sup>[6]</sup>. Its harming process is

naturally obscured by power asymmetry, leading to short-term difficulties for employees to identify the causal link between leadership behavior and personal development<sup>[7, 8]</sup>. This causal ambiguity is further exacerbated by the information gap when exploitative leaders use progressive strategies (e.g., implicit resource appropriation or responsibility shifting), allowing the exploitative nature to be rationalized in the power structure<sup>[9]</sup>. Therefore, this study focuses on: how do employees dynamically deconstruct the implicit harm mechanisms of exploitative leadership under the structural constraint of status inequality? What factors shape their cognitive evolutionary paths and behavioral response boundaries? Revealing the hidden nature of exploitative leadership exploitation and employees' procrastination behavior is worth studying.

Leaders represent their organizations and their activities are often related to the actions of their employees<sup>[10, 11]</sup>. Previous affective event theory theoretical studies have emphasized that characteristics of the work environment can trigger certain events that affect employees' emotional and attitudinal responses, which in turn affect their work behaviors<sup>[12]</sup>. Exploitative leadership often leads to negative work events<sup>[5]</sup>, which involve emotional and state reactions<sup>[13]</sup>. Depending on the differentiation of employees' personalities, their perceived stress can present different levels of psychological resilience responses<sup>[8]</sup>. Specifically, factors such as work environment characteristics, events, and employee personality affect employee mood and satisfaction, and ultimately emotionally driven behavior<sup>[14]</sup>. Although a few studies have investigated the potential relationship between leadership style and employee behavior. However, the full underlying mechanisms and the internal logic of regulation between exploitative leadership and employee procrastination have not yet been theoretically elucidated or empirically investigated<sup>[15]</sup>. Therefore, this study is based on the affective event theoretical framework to reveal how exploitative leadership as a negative work event affects employees' behaviors. Filling a gap in empirical research on the mechanisms of dynamic emotional and attitudinal evolution between negative leadership behaviors and employee procrastination.

Despite numerous studies linking academic procrastination with stress, there is little research on the correlation between workplace procrastination<sup>[16-18]</sup>. Workplace stress is considered an excessive demand on employees that exceeds their coping resources, which can have a negative impact on job satisfaction<sup>[19, 20]</sup>. And cross-cultural studies have emphasized the inverse relationship between work-related stress and satisfaction (Mohsin & Ayub, 2014; Wilson, 2016). According to conservation of resources theory, individual emotional resource depletion exacerbates job dissatisfaction when employees are under stressful situations<sup>[21]</sup>. Emotional suppression of employees in a high-pressure work environment leads to dissatisfaction with work and spitting in the face of leaders<sup>[22, 23]</sup>. Therefore, by integrating affective event theory and conservation of resources theory to construct a chain transmission model of "stressful event-emotional depletion-cognitive appraisal-behavioral response", the present study not only breaks through the traditional single mediator pathway explanation, but also provides micro-mechanism evidence to understand how individual differences shape the threshold of exploitation tolerance. This study not only breaks through the limitations of the traditional single mediator pathway, but also reveals the boundary role of psychological resilience in resource compensation (e.g., emotion regulation, cognitive reappraisal), and provides micro-mechanisms evidence to understand how individual differences shape the threshold of tolerance to exploitation.

Inspired by the concept of "personality differentiation" in organizational behavior. This study aims to reveal the hidden mechanisms by which exploitative leaders exacerbate employees' procrastination behaviors through the chain-mediated path of emotional exhaustion and job satisfaction, to test the moderating effects of psychological resilience between stress perception, emotional exhaustion, and job satisfaction, to construct an integrative explanatory model of the dynamic evolution of implicit exploitation and the interaction of resources-stress in the context of power asymmetry, and to fill the gap in the theory of dynamic cognitive paths and cultural boundary conditions between destructive leadership and workplace procrastination. the theoretical gap of cultural boundary conditions. In order to address the above research gaps, this study adopts a progressive structure: (1) the theoretical foundation integrates the affective event theory and conservation of resources theory, and constructs a theoretical model of exploitative leadership influencing procrastination behaviors through the chain mediation of emotional depletion-job satisfaction; (2) the hypothesis of the moderating effect of psychological resilience on the stress-satisfaction pathway is proposed. Satisfaction pathway; (3) examine the strength of the chain mediation effect and the moderating effect of psychological resilience through symmetric PLS-SEM, and introduce fsQCA

to reveal the multiple concurrent causal conditions; (4) reveal the dynamic game mechanism between the masking effect of the organizational leadership and the individual's mental resources, and put forward the dual-path governance framework of "institutional transparency and cultivation of resilience". Therefore, this study not only fills the theoretical gap of the dynamic cognitive path between destructive leadership and procrastination, but also provides an integrative explanatory model for the design of organizational intervention strategies in cross-cultural contexts.

## 2. Literature review and hypothesis development

### 2.1 Affective events theory

Affective event theory was first proposed and defined by Weiss and Cropanzano<sup>[12]</sup>, where the work environment is an important source of various work events that in turn influence individuals' affective responses and attitudes and trigger their work behaviors. Affective event theory suggests that specific events in the workplace, known as "affective events," can trigger positive or negative emotional responses<sup>[24]</sup>. These emotional reactions affect the relationship between work events and outcomes<sup>[12, 14, 25]</sup>. Leadership style is one of the key characteristics of the work environment, and exploitative leadership is a negative force in the work environment and a source of becoming negative work events<sup>[15]</sup>. Bajaba, Al-Judibi<sup>[26]</sup> showed that exploitative leaders prioritize self-interest at the expense of their subordinates' well-being and undermine organizational development. These behaviors constitute negative events that lead to mental internal depletion and emotional exhaustion of employees<sup>[27]</sup>.

Previous research has shown several negative consequences of exploitative leadership, including increased burnout, willingness to leave, and imbalance in social exchanges, among other deviations<sup>[28, 29]</sup>. Ghanbari, Majooni and Taajobi<sup>[30]</sup> showed that negative emotions triggered by exploitative leaders not only affect employees' work attitudes, but also affect the overall emotional climate of the team through the emotional contagion effect, which reduces team performance. Bonanno and Burton<sup>[31]</sup> investigated the role of individual psychological differences, such as personality traits and psychological responses, in regulating the impact of emotional events. For example, people with high psychological resilience may be more capable of regulating their emotional responses, thereby reducing the negative impact of stressful events<sup>[32]</sup>. In addition, Rodell and Judge<sup>[33]</sup> showed that an individual's emotions are the result of various work events which in turn affect their behavior. Humble leadership enhances employees' positive emotions, which promotes improvisation<sup>[34]</sup>. Whereas, destructive leadership weakens employees' work ethic and undermines the development of the organization<sup>[27]</sup>.

According to affective event theory, characteristics of the work environment trigger certain events that in turn affect employees' emotions and work attitudes, leading to relevant work behaviors<sup>[12]</sup>. Specifically, exploitative leaders' behaviors as negative affective events trigger negative emotional responses (e.g., emotional exhaustion, anger, sadness), which further affect employees' attitudes (e.g., decreased job satisfaction) and ultimately lead to negative work behaviors such as procrastination. The affective event theory explains the key role of personal affective responses between work events and behavioral outcomes through this chain, revealing the function of emotions as a bridge between leadership style and employee behavior. As such, it is a suitable framework for exploring the influences between leadership style and employee behavior to understand the antecedents and consequences of specific employee behaviors.

### 2.2 The impact of exploitative leadership on employee work procrastination

Exploitative leadership is a destructive leadership style characterized by leaders prioritizing self-interest at the expense of the well-being of subordinates and the goals of the organization<sup>[5]</sup>. Exploitative leadership behavior can be deconstructed into five dimensions<sup>[5]</sup>: Egoistic behavior, manifested in the leader's placing his personal goals above those of his subordinates and instrumentalizing his subordinates as a vehicle for achieving his personal interests; Results-appropriating behavior, where the leader appropriates the results of the subordinate's work for himself or herself; Pressure shifting behavior, which refers to a leader's ability to gain personal advantage by exerting excessive pressure on subordinates; Developmentally destructive behaviors, manifested by leaders limiting their subordinates' room for career advancement by assigning repetitive, low-value work tasks; Relationship manipulation, in which a leader deliberately provokes relationships between subordinates for personal gain<sup>[27]</sup>. Similarly destructive leaders such as narcissistic, manipulative, and authoritarian leaders exhibit manipulative, exploitative, and selfish behaviors, but their negative behaviors are obvious<sup>[1, 35]</sup>. Exploitative leadership differs

from other destructive leadership styles in that leaders use “overly friendly” and “extremely pleasant” behaviors to achieve their personal goals, and do not display their exploitative behaviors in a hostile manner <sup>[5, 36, 37]</sup>. Research has shown that exploitative leadership as a consumptive stressor <sup>[27]</sup> can have significant negative impacts on employees, such as increased turnover intentions <sup>[38]</sup> and decreased job satisfaction <sup>[39]</sup>.

Work procrastination is the intentional delaying of work tasks that need to be completed <sup>[40]</sup>, which is usually a maladaptive coping mechanism to cope with a stressful work environment. Work procrastination can be recognized by two dimensions, namely soldiering and cyberslacking <sup>[41-43]</sup>. Metin, Taris and Peeters <sup>[42]</sup> indicate that although work theoretically distinguishes between these two dimensions of procrastination, it is difficult to distinguish them in practice. Paulsen <sup>[44]</sup> defined “work avoidance” as avoiding work for more than one day without harming others or transferring work to colleagues. Therefore, high levels of stress are associated with an increase in work procrastination and a decrease in work engagement <sup>[41]</sup>. According to affective event theory <sup>[12]</sup>, factors such as workplace characteristics, work events, and employee personality influence employees' affective responses and attitudes, and ultimately emotionally driven behavior <sup>[45]</sup>. Majeed, Fatima and Irshad <sup>[1]</sup> argued that when employees perceive that their leaders are exploiting them, they experience higher levels of emotional exhaustion and diminished motivation, decreasing their ability to effectively engage in tasks. This process of emotional exhaustion not only weakens employees' task performance, but also leads to intentional delays in task completion as a form of psychological withdrawal <sup>[46]</sup>. If employees perceive leaders as self-serving, credit-hungry and manipulative, they tend to display negative emotions such as frustration and anger <sup>[47]</sup>. Consequently, the chronic stress and unfavorable development associated with this leadership style leads to increased psychological stress among employees <sup>[5]</sup>, which can be manifested in work delays.

H1: Exploitative leaders positively influence employees' procrastination behavior at work

### **2.3 Emotional exhaustion as a mediator between exploitative leadership and employee work procrastination**

Emotional exhaustion is defined as a state in which an employee is so overworked that he or she has no energy left to give, and involvement in the environment attributed to the feeling of emotional depression is associated with psychological discomfort <sup>[48-50]</sup>. Emotional exhaustion is the core essence of burnout <sup>[49, 51]</sup>. Emotional exhaustion involves the decline or depletion of an individual's emotional capacity <sup>[52]</sup> and is associated with work overload, time pressure, and lack of resources <sup>[53]</sup>. Emotional exhaustion occurs when there are high demands placed on the subject and there is a perceived lack of emotional and physical resources to cope with these demands <sup>[54]</sup>. Dodanwala and Shrestha <sup>[55]</sup> showed that an increase in stressors such as role ambiguity, conflict, overload, etc. can directly lead to an increase in the level of emotional exhaustion of employees. Kim and Lee <sup>[56]</sup>; Martínez-Iñigo, Totterdell <sup>[58]</sup> showed that emotional exhaustion is induced by stress. Thus, emotional depletion occurs when individuals do not have the critical traits to adapt to adversity and are not able to buffer the erosion of psychological resources from stressors.

Burnout is a long-term stress response often referred to as emotional exhaustion [59]. Burnout has become a unique syndrome in the workplace, but is distinct from depression and other forms of stress and fatigue <sup>[60, 61]</sup>. Emotional exhaustion occurs when an individual exerts too much energy and demands on his or her time <sup>[62]</sup>. Elsaied <sup>[63]</sup> showed that the relationship between exploitative leadership and organizational cynicism can be more fully explained by examining the mediating role of emotional exhaustion. Lee and Ashforth <sup>[64]</sup> showed that, other things being equal, the negative effects of job demands such as role conflict and stress on emotional exhaustion outweighed the positive effects of job resources such as coworker and supervisor support. Exploitative leaders can place excessive burdens on their subordinates by setting unrealistic deadlines and exploiting them, which can increase people's negative emotional states <sup>[5, 65]</sup>.

H2a: Exploitative leadership shows a positive correlation with employees' emotional exhaustion

Research has shown that emotional exhaustion has become a major concern for organizations and that it is directly related to employee work delays <sup>[66-68]</sup>. In previous studies, Balkis <sup>[69]</sup> observed a significant correlation between their exhaustion and deliberate academic procrastination. Krischer, Penney and Hunter <sup>[70]</sup> showed that emotionally exhausted employees are highly likely to perform counterproductive work behaviors. Çelik, Turunç and Begenirbaş <sup>[71]</sup> stated that when employees feel tired

at work, they are likely to behave abnormally in their interpersonal relationships. Ugwu, Enwereuzor<sup>[72]</sup> found that employees with high levels of exhaustion may intentionally use counterproductive behaviors that are harmful to their organizations compared to employees with low levels of exhaustion. Emotional depletion of employees positively affects transgressive behaviors because this disruption is detrimental to their ability to properly maintain normal work behaviors<sup>[73, 74]</sup>. Therefore, there is a positive correlation between employees' emotional exhaustion and procrastination behavior, and employees in an organization experiencing emotional exhaustion significantly increase negative behaviors that are harmful to the organization<sup>[75]</sup>.

H2b: Employee's emotional exhaustion positively correlates with employee's procrastination work

The combination of these arguments suggests that emotional exhaustion plays a key mediating role. Exploitative leaders continue to deplete the psychological resources of their employees through implicit resource appropriation (e.g., stealing results) and responsibility shifting (e.g., setting unreasonable deadlines)<sup>[5]</sup>, this chronic stressor forces employees into long-term emotional overload<sup>[76]</sup>, this ultimately leads to the core symptoms of emotional exhaustion-emotional exhaustion and a sudden drop in work engagement. When the continuous depletion of emotional resources exceeds the individual compensatory threshold, employees will activate self-protection mechanisms<sup>[77]</sup>, reducing immediate emotional load by delaying task progress through procrastination behavior. Empirical evidence suggests that highly emotionally exhausted employees are impaired by cognitive regulation<sup>[78]</sup>, prefer delay as a non-adaptive coping strategy<sup>[66]</sup>, creating a vicious cycle of "emotional overdraft-behavioral withdrawal".

H2: Employee emotional exhaustion mediates the relationship between exploitative leadership and work procrastination

## 2.4 Job satisfaction as a mediator between exploitative leadership and work procrastination

Job satisfaction is an employee's emotional response to his or her job, which is based on a comparison between actual results and desired results<sup>[79-81]</sup>. Job satisfaction is considered to be a multifactorial structure that includes employees' perceptions of various intrinsic and extrinsic job factors<sup>[82]</sup>. They cover specific satisfaction with working conditions, organizational practices and co-worker relations, among other things<sup>[83]</sup>, Perceived attitude towards the job and the organization in which it is located<sup>[84]</sup>. Job satisfaction is strongly influenced by factors such as work-life balance, career advancement opportunities, and type of leadership<sup>[85, 86]</sup>, is a prerequisite for predicting employee behavior<sup>[87]</sup>. Previous research has shown that job satisfaction remains one of the most studied job attitudes in organizational psychology<sup>[88]</sup>. In organizational behavior research, employees who feel appreciated, supported by colleagues and management, and have a sense of purpose show higher job satisfaction<sup>[89]</sup>. And when the sense of organizational support is insufficient, employees reinforce their negative evaluations to show dissatisfaction with their jobs<sup>[90]</sup>, which in turn promotes negative employee behavior. However, most studies have not used job satisfaction as a potential factor in job attitudes to measure leadership style and corresponding behaviors produced by employees, nor have they demonstrated the effect of employee emotional state on job satisfaction between potential factors. Therefore, this study will further explore the effect of employees' emotional exhaustion on job satisfaction by conceptualizing job satisfaction as the attitude that employees develop towards their work environment, which further influences their characteristic behaviors.

Leaders are key determinants in alleviating psychological distress and coping with negative emotions<sup>[91]</sup>. Leadership is recognized as an important predictor and plays a central role in the determinants of job satisfaction<sup>[82]</sup>. Leadership is a management function that focuses on human and social interaction and the process of influencing people to achieve organizational goals<sup>[92]</sup>. Hajiali, Kessi<sup>[93]</sup>, Naeem and Khanzada<sup>[94]</sup> showed that employees' job satisfaction depends on leadership style. Employee job satisfaction is high under humble leadership<sup>[95, 96]</sup> and lower under destructive leadership<sup>[89]</sup>. Exploitative leaders seek to exert pressure, heavy workloads, gain honor from followers, sources of psychological resource fatigue<sup>[65]</sup> and also reduce employee satisfaction<sup>[97]</sup>.

H3a: Exploitative leadership and job satisfaction show negative correlation

Employees need satisfaction and self-actualization through qualified and autonomous work<sup>[98]</sup>. Factors that motivate work are positively related to overall workplace satisfaction, such as: variety of tasks required, autonomy, importance of the task, or feedback<sup>[98]</sup>. Tudose and Pavalache-Ilie<sup>[99]</sup> showed that job satisfaction affects employee productivity, absenteeism, business turnover and overall organizational efficiency. Procrastination is recognized as a significant predictor of job stress,



which in turn is a significant predictor of job satisfaction<sup>[99]</sup>. Several studies on employee job satisfaction have found that procrastination is negatively related to job satisfaction<sup>[18]</sup>. Workplace satisfaction is lower when procrastination and job stress overlap<sup>[18]</sup>. Job dissatisfaction can lead to counterproductive work behaviors<sup>[100]</sup>. As a result, dissatisfied employees will leave the workplace more often than satisfied employees<sup>[101-103]</sup>.

H3b: Employee job satisfaction and procrastination show negative correlation

The combination of these arguments suggests that job satisfaction plays a key mediating role. Exploitative leaders erode employees' fundamental trust in organizational fairness by undermining norms of reciprocity and distorting boundaries of responsibility<sup>[73]</sup>, and this systemic resource imbalance triggers negative reappraisal of employees' psychological contracts<sup>[104]</sup>. As a result, employees' intrinsically motivated need for autonomy is blocked and their extrinsically motivated perception of instrumental value is weakened. Empirical evidence suggests that low job satisfaction employees are more inclined to adopt procrastination as a passive workplace alienation strategy due to goal commitment decoupling<sup>[105]</sup> with prospective cognitive control deficits<sup>[106]</sup>. Affective event theory<sup>[12]</sup> further reveals that decreased satisfaction significantly raises the activation threshold for procrastination as an emotionally driven coping strategy by enhancing the salience of negative affective events versus weakening positive affect regulation.

H3: Job satisfaction mediates the relationship between exploitative leadership and work procrastination

Emotional exhaustion has been directly associated with job satisfaction in most burnout studies<sup>[107]</sup>. Many researchers have confirmed that emotional exhaustion has a negative impact on job satisfaction<sup>[108]</sup>. As emotional exhaustion increases, job satisfaction decreases<sup>[49]</sup>. Emotional exhaustion also negatively affects employee job satisfaction<sup>[109-111]</sup>. Pu, Sang<sup>[112]</sup> showed a negative correlation between emotional exhaustion and job satisfaction among hotel workers. Kara<sup>[113]</sup> revealed that emotional burnout showed a negative correlation with job satisfaction in a work study of Turkish teachers. Thus, higher emotional exhaustion is associated with lower job satisfaction<sup>[114]</sup>.

H4: Emotional exhaustion and job satisfaction show negative correlation

## 2.5 Psychological resilience as moderator between exploitative leadership, employee emotional exhaustion and work procrastination

As a core element of stable psychological traits, psychological resilience is the ability of individuals to overcome obstacles and adapt to difficult situations<sup>[115, 116]</sup>. Psychological resilience, a key trait for individuals to adapt to adversity, buffers the erosion of psychological resources by stressors<sup>[117]</sup>. According to conservation of resources theory, employees' responses to the loss of resources caused by workplace stressors depend on personal resources<sup>[118]</sup>. Resilience is an important personal resource for coping with stressful situations<sup>[119]</sup>. Guo, Cheng and Luo<sup>[27]</sup> showed that all employees react differently when they encounter exploitative leaders. High resilience gives individuals the ability to cope with challenges in a well-adapted and productive manner, whereas low resilience impairs the ability of individuals in dealing with environmental problems<sup>[120-122]</sup>. Therefore, this study used psychological resilience as a moderating variable to reveal the effects of employees' psychological individual differences in responding differently to exploitative leadership both on self-emotional and work attitude changes.

Exploitative leaders can accelerate the loss of employees' psychological resources through persistent resource solicitation (e.g., excessive work demands) and emotional indifference (e.g., lack of supportive behaviors), which in turn leads to emotional exhaustion<sup>[5]</sup>. The conservation of resources theory suggests that when individuals are consistently confronted with a resource imbalance (resources given > resources received), this triggers an accelerated depletion of emotional resources<sup>[123]</sup>. Exploitative leaders continue to deplete employees' resources through behaviors such as unreasonable shifting of responsibility, while suppressing avenues for replenishing their resources (e.g., denying emotional support or development opportunities)<sup>[27]</sup>. Together, this impeded access to resources and increased resource loss constitute a dual-path formation mechanism for emotional depletion<sup>[124]</sup>. Psychological resilience, a core competency of individuals to adapt to adversity, moderates the impact of stressors through cognitive reappraisal and resource substitution mechanisms<sup>[119]</sup>. Specifically, low psychological resilience employees faced with exploitative behaviors: are more likely to develop uncontrollable threat appraisals and activate strong stress responses<sup>[125]</sup> and lack an effective arsenal of coping strategies, leading to inefficient resource recovery<sup>[126]</sup>. As a result, this dual vulnerability magnifies the negative effects of exploitative leadership.



H5a: The positive relationship between exploitative leadership and emotional exhaustion is moderated by psychological resilience, i.e., the higher the psychological resilience, the weaker the relationship between exploitative leadership and emotional exhaustion.

The protective effects of psychological resilience are particularly significant in organizational contexts<sup>[127]</sup>. Good psychological resilience has been described as a way for individuals to overcome obstacles, to self-regulate and to have the flexibility to accept change<sup>[121, 128]</sup>. Research has shown that resilient people tend to exhibit optimism, creative problem-solving skills, and positive emotions, which enhance their ability to cope with stress<sup>[129, 130]</sup>. This positive mindset enables them to maintain positive social interactions and a sense of personal professional fulfillment, mitigating the negative effects of exploitative behaviors<sup>[131]</sup>. In addition, resilience can minimize resource loss in stressful work environments<sup>[132]</sup> and help individuals maintain well-being under exploitative leadership<sup>[133]</sup>. Highly psychologically resilient employees possess greater emotional regulation<sup>[134]</sup> and are more inclined to employ cognitive reappraisal strategies to reinterpret exploitative leadership behaviors as manageable challenges rather than uncontrollable threats<sup>[135]</sup>. As a result, exploitative leadership may have a greater impact on employees who are less psychologically resilient, thereby maintaining lower job satisfaction.

H5b: The negative relationship between exploitative leadership and job satisfaction is moderated by psychological resilience, i.e., the higher the psychological resilience, the stronger the relationship between exploitative leadership and job satisfaction.

### 3.Methods

This study integrates symmetric and asymmetric analysis methods to systematically examine the formation mechanisms of employees' procrastination behavior at work. At the symmetric level of analysis, PLS-SEM (Smart PLS 4.0) was used to conduct multicenter components<sup>[136]</sup> to validate the predictive effects of antecedent variables on outcome variables<sup>[137]</sup>. At the asymmetric level of analysis, fsQCA 3.0 was applied to identify multivariate causal combinations that lead to work delays, revealing complex paths of action through the sufficiency configuration solution and necessary conditions analysis<sup>[138]</sup>. Based on the validation of the two-party method, this study deeply analyzes the direct effect and mediating mechanism of exploitative leadership on work procrastination to provide more robust empirical evidence for theory construction.

#### 3.1 Participants and procedures

This study obtains research data by means of questionnaire survey. The top 500 companies in the service sector included in the White Paper on Chinese Enterprises 2024 were selected and 50 companies were selected from them using random sampling method. The specific sampling operation is to number all enterprises and then use a random number generator to complete the sample selection. After identifying the sample enterprises, the research team contacted their managers and sent out invitations for research. In the end, a total of 43 enterprises agreed to participate in the survey and provided valid data, and all enterprises participated in the research on a voluntary basis.

The academic nature of the study was explained in detail to the participants prior to the formalization of the survey and a promise was made to maintain strict confidentiality of the data, while support was obtained from the heads of the departments. The questionnaire based on the mature scale design was pre-tested and participants gave positive feedback on the clarity and relevance of the questions. The content validity of the questionnaire was ensured after adjustments were made based on input from domain experts, and all items were eventually retained to ensure reliability. Through the assistance of the human resources department, we finalized 521 voluntary participants from 607 candidates using random sampling matched to employee job numbers. The research team explained the purpose of the study in detail to the selected employees by phone or email and obtained their informed consent. To minimize the effect of common method bias<sup>[139, 140]</sup>, this study used a three-stage time-point separation method to collect data. In the first phase of the survey, 521 employees completed questionnaires containing demographic variables, psychological resilience, and perceptions of exploitative leadership, and 500 valid questionnaires were returned (95.96% return rate). The second phase of the survey was conducted after a one-month interval, in which the aforementioned 500 employees were asked to report on their emotional exhaustion and job satisfaction status, and 480 valid responses were obtained (96.00% recovery rate). In the third phase of the survey, conducted at a further one-month interval, 480 continuing participants completed the work delay assessment, and 466 valid questionnaires were recovered (97.08% recovery rate). After rigorous data cleaning (excluding invalid questionnaires such as abnormal response

times and regular responses), a final sample of 450 valid samples was obtained, with an overall validity rate of 86.37%. Among them, 52% were male ( $SD=0.50$ ), the mean age was 38.26 years ( $SD=10.67$ ), and the mean tenure was 5.71 years ( $SD=3.15$ ); 47% had a bachelor's degree.

Table 1. Sample characteristics ( $n=450$ )

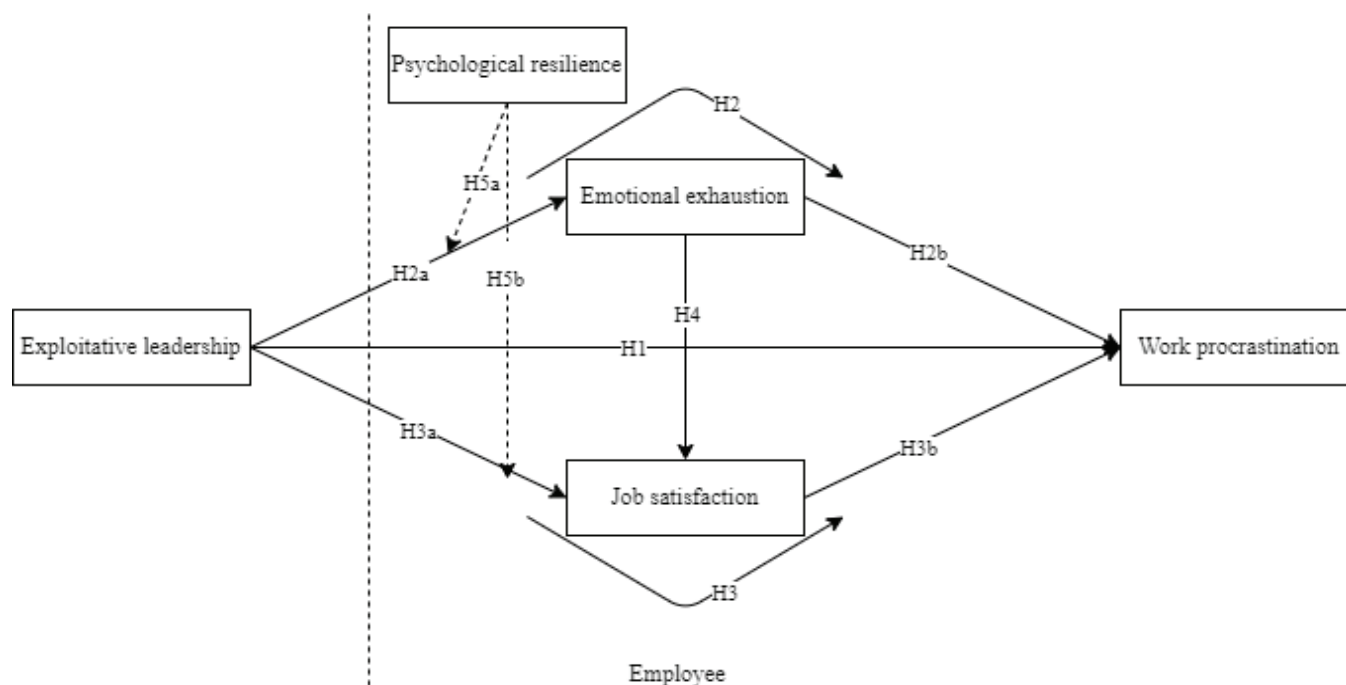
		Total (450)	
		Frequency %	
Gender	Male	234	52.0%
	Female	216	48.0%
Age	18-25	53	11.78%
	26-35	153	34.00%
	36-45	107	23.77%
	46-55	124	27.55%
	56-65	10	2.22%
	$\geq 65$	3	0.68%
Education	Below High School	6	0.20%
	High school or technical secondary school	15	3.20%
	Undergraduate or junior college	301	67.80%
	Master degree or above	128	28.80%
Work years	1-2years	90	20.00%
	3-5years	201	44.67%
	6-9years	126	28.00%
	10-15years	25	5.56%
	>15years	8	1.77%

Note(s): SD – Standard deviation

### 3.2 Measures

Following the reverse translation procedure <sup>[141]</sup>, all English questionnaire entries were translated into Chinese. To avoid language bias, two language experts were invited to proofread the scales. The sample items measuring “exploitative leadership” were adapted from Schmid, Pircher Verdorfer and Peus <sup>[5]</sup>; Sample items measuring “psychological resilience” adapted from Smith, Dalen <sup>[142]</sup>; Sample items measuring “emotional exhaustion” adapted from Maslach, Jackson and Leiter <sup>[59]</sup>; Sample items measuring ‘job satisfaction’ adapted from De Simone, Lampis <sup>[84]</sup>, which is based on the originally developed <sup>[143]</sup> scale; The sample item measuring “work delays” was adapted from the scale assessed by He et al. (2021). A seven-point Likert scale ranging from 1 “completely disagree” to 7 “completely agree” was used in this study.

Figure 1. Proposed research framework.



## 4. Results

### 4.1 Control of confounding variables and assessment of common method variance

The study sample was limited to individuals who had worked full-time for their current business for 1 year or more, and sample characteristics were matched to minimize the impact of potential confounding variables (internships or part-time employees) on the results of the study. In order to control, eliminate, and detect extraneous variables such as sample characteristics<sup>[144]</sup>, the effect of demographic characteristics (e.g., age, gender, etc.) on each construct was examined through an analysis of covariance<sup>[145]</sup>. The data showed that these factors had no effect on any of the structures of the research model. To check for common method bias, two tests of one-factor methods as well as tests of simple and complex model comparison methods were conducted, which showed that common method variance was not an issue in this study (see Table 2).

Table 2. Common method bias tests

Test method	Test	Result
Harmon single-factor test	Fourth factors appeared (the total 64.4% variance explained) First factor: 38.4% Second factor: 12.0% Third factor: 7.1% Fourth factor: 6.9%	Since more than one factor appears, and the first factor has less than 40% variance, common method bias is not an issue <sup>[139]</sup> .
Comparing single factor model (simple model; all independent factors considered one variable) and hypotheses model (complex)	Simple model: AVE: 0.698 (the larger the better) R2: 37.3% (the larger the better)	Since the complex model is superior to the simple model, common method bias is not an issue in this study <sup>[146]</sup> .
	Research model: AVE: 0.699 R2: 48.2%	

Note: All tests show that common method bias is not problem in this study.

### 4.2 PLS-SEM

#### 4.2.1 Reliability and validity

The results of data analysis showed (Tables 3 and 4) that the factor loadings of all measures were higher than 0.7, while the composite reliability (CR) and Cronbach's alpha coefficients exceeded 0.7, and the average variance extracted (AVE) was

greater than 0.5. These results fully demonstrated that the scales had high reliability with good convergent validity<sup>[147]</sup>. In addition, all heterogeneous trait ratios (HTMT) were less than 0.8, and the square root of the AVE of each latent variable was greater than its correlation coefficient with the other latent variables (based on the Fornell-Larcker criterion, see Table 4), which further verified that the scale had desirable discriminant validity<sup>[147]</sup>.

Table 3. Measurement items.

Construct	Measurement Item	Factor Loading	Mean	Standard Deviation	Kurtosis	Skewness	VIF
Exploitative Leadership	My supervisor used my work product for personal gain	0.832	4.013	1.238	-0.172	0.052	2.165
	My supervisor thinks my work product can be used for his/her personal gain	0.812	3.987	1.213	-0.256	0.191	2.004
	My supervisor increases my workload to achieve his/her goals without considering my needs	0.833	3.964	1.209	-0.145	0.015	2.123
	My supervisor gives me boring daily tasks so he/she can profit from them	0.807	4.024	1.186	-0.141	0.073	2.000
	My supervisor picks on my coworkers for his/her own purposes	0.859	3.998	1.234	-0.377	0.047	2.370
Emotional Exhaustion	I feel depressed at work	0.782	4.018	1.211	-0.028	0.071	1.559
	I woke up in the morning feeling tired and had to face a new day at work!	0.821	4.031	1.211	0.002	-0.015	1.797
	I'm frustrated with my job	0.832	3.989	1.232	-0.211	0.014	1.868
	I feel like dealing directly with people puts too much pressure on me	0.771	4.009	1.215	0.028	0.095	1.585
Job Satisfaction	I'm quite happy with my current job	0.884	4.013	1.215	-0.117	-0.018	1.997
	I'm quite unhappy with my current job R	0.835	3.962	1.228	0.123	0.034	1.728
	I'm passionate about what I'm doing	0.842	3.998	1.246	-0.436	-0.058	1.754
	I feel as if each day's work never ends R	0.831	3.875	1.238	0.329	0.046	1.679
	I really like my job	0.846	3.951	1.173	-0.131	-0.021	1.811
Work Procrastination	I promise myself I'll do something, but I keep putting it off because of pressure	0.785	4.033	1.176	-0.001	-0.081	1.508
	I usually delay the start of a job	0.862	3.987	1.229	-0.337	0.155	1.801
	I will postpone work that is not needed at the moment	0.858	4.016	1.260	-0.398	0.011	1.696
Psychological Resilience	I recover quickly from stressful events	0.838	3.956	1.248	-0.463	-0.046	1.663
	I have a hard time with stressful events R	0.831	3.942	1.253	0.315	0.028	1.570
	I tend to recover quickly after tough times	0.856	3.971	1.226	-0.187	0.048	1.801
	When bad things happen, it's hard for me to pull myself together R	0.851	3.867	1.221	0.172	-0.036	1.792
	I usually get in a little trouble when times are tough	0.828	3.971	1.210	-0.024	0.048	1.602

Note: Exploitative Leadership(EL), Emotional Exhaustion(EE), Job Satisfaction(JS), Work Procrastination(WP), Psychological Resilience(PR) ; "R" representing reverse-coded items

Table 4. Reliability and validity

	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)	Fornell-Larcker Criterion					Heterotrait-Monotrait Ratio (HTMT)					
				EE	EL	JS	PR	WP	EE	EL	JS	PR	WP	PR x EL
EE	0.815	0.878	0.643	0.802										
EL	0.886	0.916	0.687	0.553	0.829				0.648					
JS	0.821	0.893	0.736	-0.468	-0.528	0.858			0.571	0.617				
PR	0.793	0.879	0.707	-0.174	-0.057	0.120	0.841		0.217	0.071	0.147			
WP	0.785	0.874	0.699	0.582	0.609	-0.511	-0.129	0.836	0.722	0.721	0.635	0.164		
PR x EL									0.294	0.079	0.193	0.047	0.058	

#### 4.2.2 Structural model analysis

In this study, PLS-SEM was used to analyze the subsample and the results are presented in Figure 2. Exploitative leadership has a significant positive effect on employee procrastination (H1:  $\beta = 0.340$ ,  $p < 0.001$ ), and hypothesis H1 is valid. Exploitative leadership has a significant positive effect on employee emotional exhaustion (H2a:  $\beta = 0.567$ ,  $p < 0.001$ ), and emotional exhaustion has a significant positive effect on employee work procrastination (H2b:  $\beta = 0.306$ ,  $p < 0.001$ ), Hypotheses H2a and b hold. Exploitative leadership has a significant negative effect on employee job satisfaction (H3a:  $\beta = -0.444$ ,  $p < 0.001$ ) and employee job satisfaction has a significant negative effect on job procrastination (H3b:  $\beta = -0.188$ ,  $p < 0.001$ ), hypotheses H3a, b hold. Employees' emotional exhaustion has a significant negative effect on job satisfaction (H4:  $\beta = -0.168$ ,  $p = 0.002$ ) and hypothesis H4 holds. High psychological resilience employees showed attenuated emotional exhaustion and mitigated decrease in job satisfaction when faced with exploitative leaders (H5a:  $\beta = -0.302$ ,  $p < 0.001$ ; H5b:  $\beta = 0.161$ ,  $p < 0.001$ ), Hypotheses H5a, b hold.

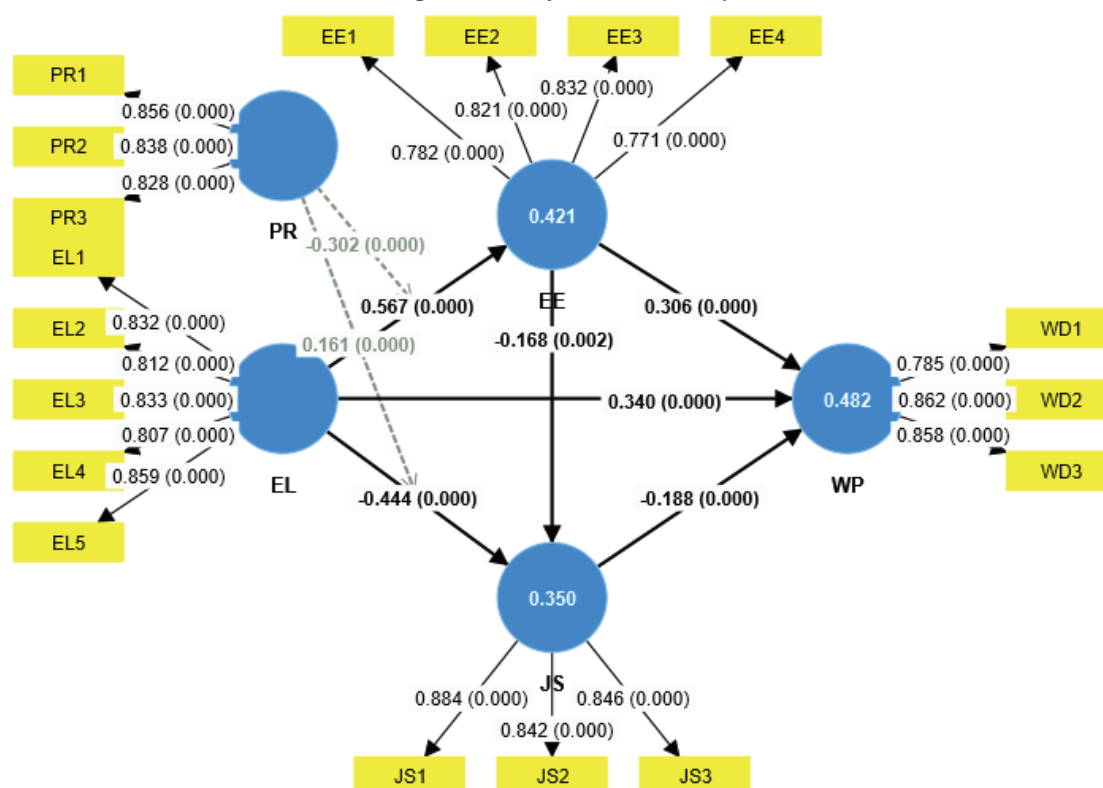
In order to test the indirect effects of employees' emotional exhaustion and job satisfaction, this study used the PLS-SEM bootstrapping method with 5000 bootstrapping sessions. employees' procrastination was indirectly affected by emotional exhaustion and job satisfaction (H2:  $\beta = 0.084$ ,  $p < 0.001$ ; H3:  $\beta = 0.174$ ,  $p < 0.001$ ), and it was hypothesized that H2 and 3 would be affected by emotional exhaustion and job satisfaction (H2:  $\beta = 0.084$ ,  $p < 0.001$ ; H3:  $\beta = 0.174$ ,  $p < 0.001$ ). were established. Therefore, emotional exhaustion and job satisfaction played a mediating role in this study. Table 5 reports the results of the data analysis of indirect effects, full mediation and partial mediation of the research model. Variance accounted for value in PLS is a process of calculating the strength of mediation, and also the ratio of indirect effects to the total effect, VAF is less than 20% no mediation, 20%-80% belongs to partial mediation, and greater than 80% belongs to full The VAF was calculated as  $VAF = \text{Indirect effect} / \text{Total effect} \%$  (Hair Jr, Hult, Ringle, Sarstedt, Danks, & Ray, 2021). The data results indicated that EL-JS-WP, EL-EE-WP were all partial mediators. Hair Jr, Hult, Ringle, Sarstedt, Danks, et al. (2021) showed that 0.005, 0.01, and 0.025 were used as realistic criteria for small, medium, and large effects, respectively, and the data results indicated that all but the PR  $\rightarrow$  JS small effect was the large effects.

Table 5. VAF and effect size

	Indirect effect	Total effect	T statistic	2.50%	97.50%	VAF(Result)	$f^2$
EL $\rightarrow$ JS $\rightarrow$ WP	0.084***		3.988	0.045	0.127	30.50%(Partial mediation)	
EL $\rightarrow$ EE $\rightarrow$ WP	0.174***		6.825	0.125	0.224	63.30%(Partial mediation)	
EL $\rightarrow$ WP		0.275***	9.486	0.219	0.332		0.134
EE $\rightarrow$ JS							0.025
EE $\rightarrow$ WP							0.118
EL $\rightarrow$ EE							0.551
JS $\rightarrow$ WP							0.046
EL $\rightarrow$ JS							0.194
PR $\rightarrow$ EE							0.038
PR $\rightarrow$ JS							0.007

Note: \*\*\* $p < 0.001$ ; \*\* $p < 0.01$ ; \* $p < 0.05$ .

*Fig 2 Results of PLS-SEM analy*



### 4.3 fsQCA

#### 4.3.1 Variable calibration

This study uses fuzzy set qualitative comparative analysis (fsQCA) in order to reveal the multiple causative factors and grouping paths of employees' procrastination triggered by exploitative leadership. By integrating qualitative and quantitative logics, this method can resolve the nonlinear interaction mechanism between emotional and attitudinal factors and compensate for the limitations of traditional linear models. Most of the studies used the direct method to transform the Likert scale data into 0-1 fuzzy set affiliation scores during the data calibration stage. The extremes were set as full affiliation (0.95) versus non-affiliation (0.05), with (0.5) as the intersection point <sup>[148, 149]</sup>. This study followed Pappas and Woodside <sup>[150]</sup> to ensure standardization and operationalization of the analytical framework by marking the actual maximum and minimum values of each variable as calibrated values for full affiliation and full non-affiliation. The mean and median values of the variables are close to each other, and choosing the mean as a calibration benchmark helps to retain more valid cases <sup>[151]</sup>.

Table 6. Calibration points of variables

Variables	Full membership	Crossover	Full non-membership
Exploitative Leadership	6.80	4.00	1.40
Emotional Exhaustion	7	4.01	1.50
Job Satisfaction	7	3.99	1.00
Work Procrastination	7	4.01	1.33
Psychological Resilience	7	3.97	1.00

### 4.3.2 Necessity analysis

According to Schneider and Wagemann <sup>[152]</sup>, necessity conditions are prerequisites for the occurrence of an outcome but alone do not necessarily lead to the outcome and are recognized as necessary when the consistency of the condition reaches 0.9. This study examined the necessity of each individual condition (including its non-setting values) for employee work delays and non-employee work delays. The results showed (Table 6) that the consistency of the conditions ranged from 0.663 to 0.841



for employee work procrastination and from 0.646 to 0.848 for non-employee work procrastination. All values were below the criterion of 0.9, indicating that no single condition was necessary for employee work procrastination or non-employee work procrastination.

Table 7. Analysis results of necessary conditions

Variables	Outcome: Work Procrastination		Outcome: ~Work Procrastination	
	Consistency	Coverage	Consistency	Coverage
Exploitative Leadership	0.841	0.843	0.646	0.662
~Exploitative Leadership	0.663	0.647	0.847	0.845
Emotional Exhaustion	0.831	0.842	0.656	0.680
~Emotional Exhaustion	0.684	0.660	0.848	0.837
Job Satisfaction	0.686	0.680	0.817	0.829
~Job Satisfaction	0.828	0.816	0.685	0.690
Psychological Resilience	0.731	0.725	0.760	0.771
~Psychological Resilience	0.769	0.758	0.729	0.735

Note: ~ represents the absent of the condition.

### 4.3.3 Sufficiency analysis

In previous research, we set the threshold for raw consistency at 0.8, the threshold for proportional reduction inconsistency (PRI) at 0.5, and the case frequency threshold for configurational adequacy analysis at 10<sup>[150]</sup>. This study is based on affective event theory, so for the causal conditions of employee procrastination emotional exhaustion and job satisfaction were indicated as present, and for psychological resilience as present or uncertain. Therefore, by comparing the intermediate and parsimonious solutions, the core condition (present in both solutions) and the peripheral condition (seen only in the intermediate solution) can be identified. Results are presented strictly following Ragin<sup>[153]</sup> canonical format to clarify the relative importance of each condition. Specifically, ● core condition present, ● peripheral condition present, ⊗ core condition missing, ⊗ peripheral condition missing, and “blank” indicate no concern.

Table 7 presents three typical path patterns that lead to employee procrastination, each representing a specific set of condition combinations. The results show that the consistency index for each path exceeds the threshold of 0.9, while the overall solution has a consistency of 0.88, which means that 88% of the respondents in cases that meet these condition combinations experience procrastination behaviors in exploitative leadership environments. In terms of explanatory power, the overall solution coverage of 0.827 suggests that these condition combinations explain 82.7% of the observed cases<sup>[153]</sup>. Notably, the overall solution consistency and coverage were significantly higher than the benchmark value of 0.75<sup>[153]</sup>, fully confirming the validity of these condition combinations as sufficient conditions. The findings corroborate the causal effect of multifactorial combinations, i.e., work procrastination is often not caused by a single factor, but is the result of a combination of specific conditions.

Differential antecedent conditioning analyses revealed that different combinations of factors had significantly different effects on employees' work procrastination behaviors. Specifically, Solution 1 (Exploitative Leadership x Emotional Exhaustion) the combination has a raw coverage of 0.756 and a consistency of 0.912 suggesting that the combined effect of exploitative leadership and emotional exhaustion constitutes a highly consistent path to work procrastination. This suggests that employees are highly susceptible to procrastination when they are subjected to both exploitative management and emotional exhaustion. The unique coverage (0.077) shows that this combination explains some of the cases not covered by the other solutions; Solution 2 (Emotional exhaustion × low psychological resilience × low job satisfaction) has an original coverage of 0.642 and a consistency of 0.928 reveals that emotional exhaustion superimposed on the absence of psychological resilience and job satisfaction still leads to procrastination even in the absence of exploitative leadership. The lower unique coverage (0.03) suggests that there is a partial overlap between this path and the other solutions; Solution 3 (exploitative leadership x

low psychological resilience x low job satisfaction) has a raw coverage = of 0.6 with a consistency of 0.918 confirming that exploitative leadership with the same lack of psychological resources and job satisfaction triggers procrastination. This result highlights the interaction of leadership behavior with employees' psychological and job resources. In this study all three paths have raw coverage of more than 0.6 but path 1 has raw coverage of 0.756. hence path 1 is the best path.

Table 8. Analysis results of sufficient conditions

Solutions of work procrastination			
	Exploitative Leadership - Emotional Exhaustion	Emotional Exhaustion - Psychological Resilience - Job Satisfaction	Exploitative Leadership - Psychological Resilience - Job Satisfaction
	1	2	3
Exploitative Leadership	●		●
Emotional Exhaustion	●	●	
Job Satisfaction		⊗	⊗
Psychological Resilience		⊗	●
Raw coverage	0.756	0.642	0.600
Unique coverage	0.077	0.030	0.041
Consistency	0.912	0.928	0.918
Overall solution coverage	0.827		
Overall solution consistency	0.880		

Note: ● indicates the presence of core conditions, ⊗ indicates the absence of core conditions, ● indicates the presence of peripheral conditions, ⊗ indicates the absence of peripheral conditions and blank spaces for 'don't care'

#### 4.3.4 Robustness test

In configurational analysis, robustness testing is essential to ensure the reliability of research findings<sup>[152]</sup>. According to methodological studies, if the research findings remain stable after parameter adjustment or show only a subset of relationships rather than essential changes, the results are shown to be robust. It has been established in the literature that the robustness of the results can be effectively verified by adjusting the consistency threshold and frequency threshold<sup>[151, 152]</sup>. As shown in Table 8, this study verifies robustness in two ways: after raising the consistency threshold from 0.80 to 0.85 while keeping the PRI and frequency thresholds unchanged, the three resulting configurations (B1~B3) are completely consistent with the initial solution; when fixing the consistency thresholds and PRI thresholds, and adjusting the frequency thresholds from 10 to 5, of the three newly generated conditional configurations, B4 and B5, respectively, are consistent with the initial solutions of scenarios 1 and 2 correspond to each other, while B6 constitutes a subset relationship of scenario 3. These test results verify the robustness of the research conclusions from different perspectives.

Table 9. Robustness test results

Threshold	configurations	Set theoretic representation
Baseline model	1	EL1*EE1
10a/0.80b/0.5c	2	EE1*~JS1*~PR1
	3	EL1*~JS1*PR1
10a/0.85b/0.5c	B1	EL1*EE1
	B2	EE1*~JS1*~PR1
	B3	EL1*~JS1*PR1
5a/0.80b/0.5c	B4	EL1*EE1
	B5	EE1*~JS1*~PR1
	B6	EL1*~JS1

## 5. Discussion and Conclusion

### 5.1 Discussion of results

This study deepens our understanding of how exploitative leadership exacerbates employee procrastination through the dual mediating pathways of emotional exhaustion and job satisfaction, while emphasizing the critical moderating role of psychological resilience. Consistent with affective event theory, our findings suggest that exploitative leadership acts as a chronic stressor that triggers negative affective responses (e.g., emotional exhaustion) and worsens cognitive appraisals of work (e.g., job satisfaction), ultimately leading to procrastination as a maladaptive coping mechanism. Specifically, exploitative leaders show significant direct effects on employee procrastination, confirming previous evidence that destructive leadership styles weaken employees' task engagement and self-regulation <sup>[1, 5]</sup>.

The chain mediator model reveals that exploitative leadership depletes employees' emotional resources, which in turn amplifies procrastination. This is consistent with the Conservation of resources theory, as chronic exposure to exploitative behaviors (e.g., outcome plagiarism, responsibility shifting) results in a loss of resources, leaving employees emotionally drained and cognitively disconnected <sup>[27, 123]</sup>. At the same time, exploitative leadership undermines job satisfaction, and lower satisfaction further predicts work procrastination. This dual-path mechanism emphasizes the interplay of emotional exhaustion and attitudinal disengagement in shaping behavioral outcomes.

Notably, psychological resilience is a critical buffer. High psychological resilience employees exhibit attenuated emotional exhaustion and mitigated job satisfaction decline when confronted with exploitative leadership. fsQCA results further validate this by identifying different configurations: exploitative leadership-induced procrastination is most pronounced in the low psychological resilience and high emotional exhaustion conditions (raw coverage = .756), whereas high psychological resilience, even in the context of impaired job satisfaction, can undermine this pathway. These findings resonate with research that emphasizes resilience as a dynamic ability to reframe stressors and mobilize compensatory resources <sup>[119]</sup>.

### 5.2 Theoretical implications

This study advances the organizational behavior literature by integrating and extending theoretical frameworks to reveal the subtle mechanisms by which exploitative leadership shapes employee procrastination. Our findings yield three key theoretical contributions that address critical gaps in destructive leadership research. First, we extend affective event theory (AET) by embedding conservation of resources theory (COR) to elucidate how chronic leadership stressors function through continuous affective and cognitive pathways. Although AET has traditionally emphasized discrete emotional triggers <sup>[12]</sup>, our dual-mediation model suggests that prolonged exposure to leadership stressors (e.g., resource depletion) leads to cumulative affective exhaustion, which in turn leads to diminished job satisfaction and ultimately procrastination. This continuous mediating effect (EL → EE → JS → WP) challenges previous views of the role of EE and JS as parallel mediators <sup>[49, 112]</sup>. By viewing EE as a proximal affective response that precedes cognitive reappraisal, the present study reconciles micro-level affective processes with macro-level behavioral outcomes, providing a dynamic perspective to understand how persistent harmful leadership erodes psychological resources and attitudinal engagement over time.

Second, we redefine psychological resilience as a key boundary condition that redefines the interaction between leadership toxicity and employee outcomes. While existing research has primarily focused on leader-centered traits (e.g., humility) <sup>[95]</sup>, the moderated mediation analysis in this study revealed that psychological resilience serves as a dynamic personal resource that buffers against the adverse effects of destructive leadership. Employees with high psychological resilience mitigated emotional exhaustion and alleviated declines in satisfaction by reframing leadership toxicity-induced stressors as manageable challenges through cognitive reappraisal. This is consistent with the COR principle that resilience facilitates resource substitution <sup>[123]</sup>, but we provide further evidence of its asymmetric efficacy: fsQCA results suggest that low psychological resilience amplifies the effects of leadership toxicity (raw coverage of 0.756), whereas high mental resilience breaks the path of the association between leadership toxicity and job stress even in the presence of inadequate satisfaction under satisfaction as well. These findings contribute to a contingent perspective in leadership research by emphasizing employee agency in neutralizing toxic environments, which differs from trait-centered paradigms.

Third, we bridge the methodological divide by combining symmetric (PLS-SEM) and asymmetric (fsQCA) approaches to

capture the complexity of delay drivers. In SEM, the EE-JS chain mediation dominates ( $VAF = 63.3\%$ ), whereas in fsQCA, three equivalent final configurations are revealed—such as  $EL \times EE$  and  $Low\ PR \times Low\ JS$ —which together explain 82.7% of the cases. This dual methodological rigor not only validates the robustness of our theoretical model, but also challenges the linear assumptions by revealing nonlinear interactions (e.g., the effect of EL shifts from destructive to neutral with increasing PR). This methodological plurality enriches leadership research by advocating the adoption of a configurational framework to complement variance-based models <sup>[149]</sup>.

Overall, this study redefines the field of disruptive leadership research by (1) viewing exploitative leadership (EL) as a chronic stressor that sequentially depletes emotional and cognitive resources, (2) positioning resilience as a transformative buffer capable of recalibrating the assessment of the stressor, and (3) demonstrating the value of integrative approaches in capturing workplace dynamics. These contributions pave the way for future research to explore temporally and culturally conditioned variables and provide actionable insights for promoting resilient and equitable work systems.

### 5.3 Practical implications

Organizations must adopt a dual strategy to counteract the negative effects of EL. First, institutional transparency mechanisms—such as anonymous feedback systems and ethics audits—may reduce the opportunities for leaders to be exploited in secret. Clear accountability frameworks for credit allocation and task delegation may also reduce the ambiguity of EL by enabling employees to recognize and report exploitative behavior. Resilience building interventions should be prioritized. Training programs in cognitive reassessment, stress management, and social support mobilization can improve employees' ability to withstand resource depletion <sup>[135]</sup>. For example, positive thinking-based practices and peer mentoring networks can help high-risk employees reframe EL-induced stress as a manageable challenge.

### 5.4 Suggestions for future research and Limitations

Despite its contributions, this study has limitations. First, the cross-sectional design precludes causal inferences. Future longitudinal studies could track the dynamic evolution of EL effects over time, especially during critical periods such as organizational restructuring. Second, the sample is limited to Chinese firms. Cross-cultural comparisons can be made, especially in low power distance cultures, which can reveal how cultural values moderate the effects of EL. Finally, reliance on self-reported work procrastination may be subject to common methodological biases, although our robustness checks (e.g., Harman test, fsQCA) mitigated this concern. Future research could incorporate objective indicators (e.g., task completion logs) or supervisor ratings to triangulate results. In addition, exploring alternative mediators (e.g., psychological contract violations) and moderators (e.g., organizational justice) could deepen our understanding of EL boundary conditions. Qualitative methods may also reveal subtle employee coping strategies in exploitative systems. By revealing the affective and cognitive pathways through which exploitative leadership contributes to procrastination, this study emphasizes the need to address systemic leadership deficits and personal resilience. Our integrative model not only advances the theoretical discourse on destructive leadership, but also provides actionable insights for fostering healthier and more equitable workplaces.

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The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

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