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The relationship between firm digital transformation, green transformation and risk taking: A review of the underpinning theories

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Abstract: The growth of the green and digital economy has encouraged businesses to undergo both green and digital transformations. Consistently, research on how risk-taking is affected by a firm's digital and green transformations has grown significantly. This paper analyzes the relevant theories that explain how digital transformation and green transformation affect firm risk-taking. A review of the literature highlighted that agency theory, information asymmetry theory, and resource-based theory are the three main theories used in existing research to explain the relationship between firm digital and green transformations and firm risk-taking. According to agency theory, firm digital transformation and green transformation can alleviate agency problems and promote firm risk-taking. The information asymmetry theory states that digital and green transformation increases a firm's information transmission efficiency, which encourages firm risk-taking. The resource-based theory asserts that digital transformation and green transformation provide firms with effective resources and promote risk-taking. These three theories have examined the relationship between risk-taking, green transformation, and firm digital transformation from various angles, offering concepts and insights into the financial effects of these changes, as well as theoretical support for future studies.

Keywords: *Agency theory, Firm digital transformation, Firm green transformation, Firm risk taking, Information asymmetry theory, Resource-based theory.*

1. Introduction

Firm risk taking has gained popularity in contemporary studies. Wright, et al. [1] put forward that firm risk taking is a behavior that firms pursue to maximize shareholder wealth. Firms obtain excess returns for shareholders through high risk investments, and these investment behaviors can also contribute to capital accumulation as well as economic and social development [2]. Therefore, studies on the determinants of firm risk have attracted a significant amount of attention from researchers. From the internal perspective of firms, optimized ownership structure [3, 4] and improved incentive mechanism [5] are among the factors that increase firm attitude towards risk taking [6] which consequently help improve the performance, competitiveness, and sustainable development of firms.

The growth of the green and digital economies is now a significant element influencing how businesses evolve. Firstly, the digital economy has become the foundation of the economy and propels the quick development of several sectors [7]. In the context of the digital economy, businesses actively take advantage of development possibilities to implement digital transformation [8]. Following the digital transformation, business competitiveness and business models have demonstrated significant changes [9, 10]. Digital investment can help create better prospects for firms and increase the level of firm risk taking. Secondly, businesses are encouraged to adopt low-pollution, low-energy, and low-emission production methods as the green economy expands. Businesses may increase their capacity to

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adapt to the green economy and support the high quality and environmentally friendly growth of the economy by lowering ecological and environmental expenses. Consequently, the market position of the firm and the level of product manufacturing improve [11] as well as the firm risk taking. Hence, this paper examines how agency theory, information asymmetry theory, and resource-based theory explain the relationship between firm digital transformation, green transformation, and risk taking, and offers concepts and recommendations for further research in this area.

2. Literature Review

2.1. Firm Digital Transformation

There is a lack of consensus among experts about the notion and extent of firm digital transformation [12]. From a strategic standpoint, the growth of the digital economy has established a solid basis for strategy development, which alters company procedures and the manner of value generation [13]. According to Zammuto, et al. [14] and Singh, et al. [15] the advancement of digital technology is represented in a new understanding of strategy. According to Westerman, et al. [16] a firm going through digital transformation would leverage digital technology to accomplish notable commercial progress. However, researchers have different views on how technology can be used to achieve digital transformation. For example, Legner, et al. [17] state that informatization can be used to accomplish digital transformation, while others think that the new generation of digital technology is the key to achieve digital transformation [18]. Moving forward, a firm digital transformation is the use of technologies to accomplish a complete transformation [19]. From the perspective of organizational structure, after the digital transformation, the firm organizational system is faced with a comprehensive upgrade [12, 20]. The process of organizational change is mainly completed through digital tools and platforms [21] which is mainly reflected in the process automation of business processes [22]. From the perspective of digital outcomes, digital transformation is based on digital technology innovation [19, 23]. The application of new technologies can promote improvements in business models and organizational processes to achieve digital transformation [24]. According to Fischer, et al. [10] digital transformation ought to be executed from a variety of angles, including the strategy, organization, operation, and culture. In addition, Gurbaxani and Dunkle [25] point out that vision and capability are also important aspects of digital transformation. In short, firm digital transformation is a comprehensive improvement process.

Firm behavior is significantly impacted by digital transformation. Digital transformation helps firms reaggregate production factors and improve resource allocation efficiency [26, 27]. According to Li, et al. [28] following the digital revolution, businesses' goods and services generate new consumption scenes and methods that better satisfy customer demands. Businesses utilize digital platforms to better and more rapidly understand the demands of their customers and to continually improve their goods and services [29, 30]. Additionally, Abrell, et al. [31] noted that digital transformation increase the efficacy of marketing initiatives and offer customers individualized and focused services. Firm digital transformation can promote innovation. Through digital transformation, firms use digital tools to evaluate, utilize and absorb new information, which helps to promote innovation [32]. The aforementioned opinions are also supported by empirical evidence from Liu, et al. [33] utilizing data from Chinese listed businesses. The effect of firm digital transformation on performance is well supported by empirical data. It is generally believed that firm digital transformation can promote performance, which has evidences from capital market by Zhang and Yang [34]. There is also evidence from questionnaires by Wang, et al. [35]. However, some scholars believe that after digital transformation, if there is no good organizational structure transformation, the financial performance will be reduced [36].

2.2. Firm Green Transformation

Scholars have turned their attention to the green transition as a result of the global community's influence on environmental conservation. They have different views on what constitutes firm green

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transformation. Ferguson [37] pointed out that firms carry out green investment activities based on improving resource utilization efficiency to achieve sustainable development and green development. Ghisetti and Rennings [38] and Xie, et al. [39] analyzed the green transformation from the perspective of green innovation.

More and more academics are focusing on the effects of firm green transformation. Green transformation contributes to the mitigation of carbon emissions [40] promotes environmental productivity [41] and total factor productivity [42]. Moreover, green transformation helps firms to establish unique competitive advantages. For example, differentiated green management can promote the sustainable development of firms [43, 44]. These studies provide a good foundation for the related research on firm green transformation.

2.3. Firm Risk Taking

Academics have long found that companies' pursuit of super profits drives economic growth. In order to obtain high returns, firms take the initiative to choose high-risk projects Amihud and Lev [45]. Bromiley [46] believed that risk taking is a choice, which affect high-return investment decisions. The most classic definition was proposed by Wright, et al. [1]. He pointed out that firm risk taking refers to the choice of high-cash flow and high-risk projects in the course of business operation. According to later researchers, companies are more likely to pick investment projects with higher risks and better returns when they are prepared to take on more risk. This results in increased investment, [47] as well as research and development expenditures [6].

The expansion of company investment encourages firm risk taking and vice versa [48, 49]. According to Vural-Yavaş [50] who evaluates macroeconomic policy uncertainty in 15 European nations, economic policy uncertainty have a significant negative impact on firm risk taking. Firm risk taking is influenced by institutional considerations, and risk is decreased by the degree of investor protection [47, 51]. Some scholars have also shown that debt contracts have a strong protective effect on creditors and reduce firm venture capital [52, 53] reducing firm risk taking [54]. Scholars also found that investor sentiment [49, 55] culture [56] tax policy [57, 58] affect risk taking.

There is more and more research on the influence of internal factors on firm risk taking. According to corporate governance theory, risk taking decreases with increasing ownership concentration [3, 59]. Businesses are more inclined to engage in initiatives with long-term returns if key shareholders have a variety of investment demands [60, 61] which encourages risk taking. The board of directors also influences firm risk taking. According to Cheng [62] and Wang [63] the level of risk taking decreases with the size of the board. According to Akbar, et al. [57] a strong CEO who is a non-executive director lowers firm risk taking, but the size of the board of directors has little effect on this. The impact of executive traits on firm risk taking has been extensively studied. Management gender [64, 65] educational background [65] manager overconfidence [66] and manager social capital [67] have an impact on firm risk taking. According to [68] and Jiraporn, et al. [69] management incentives have an incentive effect on the long-term production of businesses, which serves to improve company risk taking and decrease risk avoidance behavior.

3. Theoretical Explanation

There is currently no accepted theoretical framework to describe the relationship between firm risk taking, green transformation, and digital transformation. This study examines the potential of agency theory, information asymmetry theory, and resource-based theory to explain the connection between firm risk taking, green transformation, and digital transformation. Figure 1 depicts the relationship between firm risk taking, green transformation, and digital transformation and the three theories that explain the relationship. The next three sections further explain about the agency theory, information asymmetry theory, and resource-based theory.

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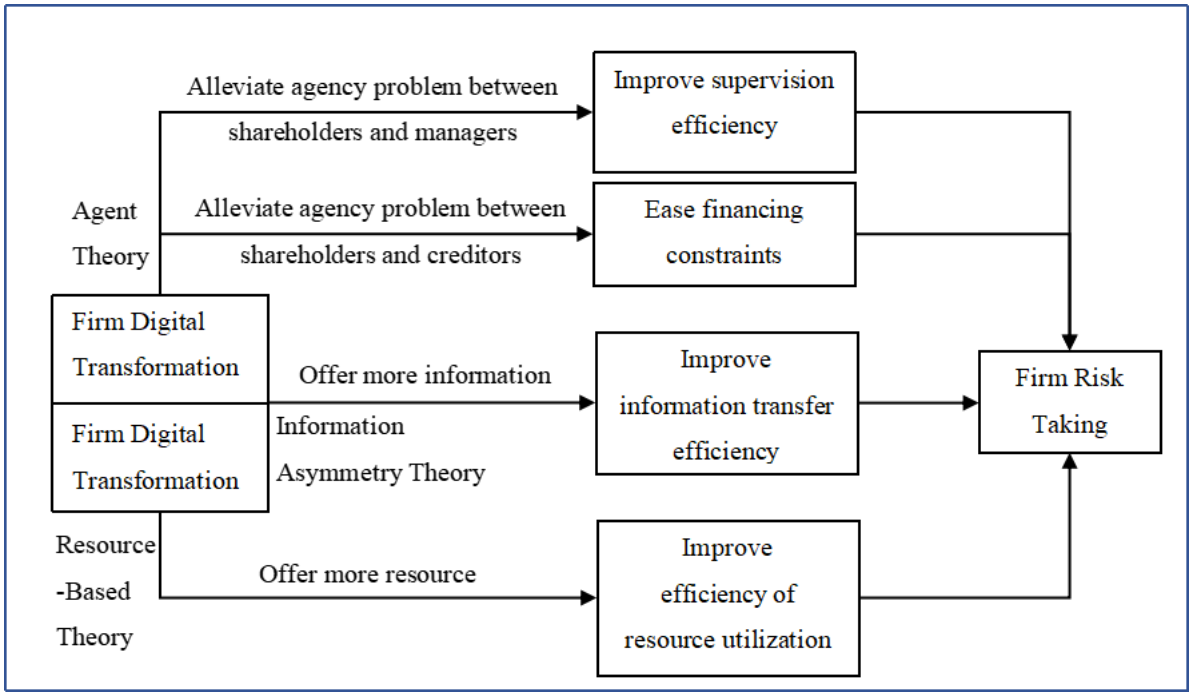

Figure 1.
Theoretical Framework.

3.1. Agency Theory

In the 1930s, American economist Berle [70] introduced the agency theory. Later, researchers developed the agency theory from three perspectives. The early agency theory's main focus on the agency dilemma between managers and shareholders. In firms with separate ownership and control, agency problem arise due to conflict of interest between managers and shareholders, where there is a likelihood that managers would pursue their own interests at the expense of shareholders' objectives Alchian and Demsetz [71]. Jensen and Meckling [72] stated that shareholders as principals entrust managers as agents to execute certain decisions on their behalf. However, the management may result in issues with moral hazard and adverse selection as the two have conflicting objectives. How to solve the agency problem has become an important issue in later research. Supervision [73, 74] and incentives [75] have become important ways to solve the agency problem between shareholders and management. The conflict between creditors and stockholders was first put up by Jensen and Meckling [72]. In addition to having infinite liability for the bankruptcy risk, creditors can only get fixed principal and interest. Therefore, shareholders are likely to use creditors' funds to make high-risk investments, where losses are likely to be borne by creditors. How to solve the agency problem caused by the two has become an important issue that scholars pay attention to. Restrictive provisions in bond contracts, according to Smith [76] may help resolve agency issues between creditors and owners. Shleifer and Vishny [77] pointed out that the governance of major shareholders has a great impact on the operation and management of firms, which may be positive or negative. In their initial analysis of the agency dilemma between major and minor owners, La Porta, et al. [78] suggested that regulation be used to mitigate the issue. Subsequent researchers examined the impact of significant shareholders on management choices [79] and the board of directors [80]. These three aspects of agency problems become an important theory to analyze firm problems.

According to Westerman, et al. [16] firm digital transformation results in significant organizational structure changes. Firm digital and green transformation causes revolutionary innovation of firm operation and management style, which significantly improves organizational

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efficiency, and has a huge impact on firm risk taking. First, digital and green transformations alleviate the agency issue between managers and shareholders and increase firm risk taking. Nambisan, et al. [21] stated that technological innovation brings changes in organizational structure and makes information transmission more transparent and convenient. The effectiveness of shareholders' oversight of management can be improved by increasing the efficiency of information transmission. In the face of investment opportunities with long-term returns, managers are less likely to deviate from shareholders' financial goals and make financial decisions that better reflect shareholders' wealth maximization. The establishment of digital platforms reduces the constraints of shareholders on management. The foundation of firm digital transformation is its management and shareholder goals. Firm digital transformation means product upgrading [81] and business model reconstruction [8]. Firm digital transformation helps reduce agency costs. Managers can conduct investment activities with minimal agency costs by assembling efficient internal and external resources [27]. An increase in investment efficiency may encourage a corporation to take on more risk. For example, China has implemented a number of green financial regulations in recent years to encourage the growth of the green economy [82]. The implementation of these policies provides a good external environment for the internal and external supervision of firms [83]. Firms are encouraged to invest more money in green initiatives as the green economy grows [84]. With the development of green economy, external stakeholders are more willing to supervise and constrain firms green innovation and investment behavior [85]. This enhances the effectiveness of green investments, which raises firm risk taking. Second, firm risk taking may be decreased by eliminating agency issues between creditors and shareholders via the use of digital and green transformation. Warner and Wäger [18] pointed out that firm digital transformation means the construction of large databases and the use of related hardware and software to improve firm informatization.The digital transformation contributes to increased information transmission efficiency and transparency. More efficient information transfer makes it possible to give creditors more useful and handy information [86]. The financial limitations that businesses encounter is lessened by these recent advancements. When a business's investment operations necessitate a significant amount of ongoing capital expenditure, firms may more easily secure the necessary financial backing, which in turn increases firm risk taking.

3.2. Information Asymmetry Theory

Hayek [87] pointed out that market participants make decisions on investment activities according to their own information mastery. Each market participant has different information and makes different decisions. Complete information facilitates optimal allocation of resources [88] while lack of information leads to loss of trading information for market participants [89]. Therefore, market participants expand their sources of information as soon as possible to reduce transaction costs [90]. In order to increase the effectiveness of their decision-making, market traders who lack knowledge take certain steps to get it. Information, especially price information, plays an important role in the allocation of social resources and plays an important role in the operation of market economy [91]. It is clear from the study above that information can increase decision-making effectiveness and that information asymmetry has a significant impact on decision-making effectiveness.

In the study of financial decision-making, researchers use the theory of information asymmetry to explain the financial behavior. Firm digital transformation and firm green transformation can help create a good internal and external environment for firms, improve the efficiency of information transmission, and promote firm risk taking. After firm digital transformation, strategic planning [13, 15] organizational structure [20] and profit model [92] underwent significant improvements. From the internal perspective, in order to reform the existing business processes, operational processes, and organizational processes, firms need to establish digital platforms to achieve digital transformation [28]. From the internal perspective, first of all, firm digital transformation makes it more convenient and efficient for firms to communicate with the outside world. In this instance, the firm's information interchange runs more smoothly, which offers a solid basis for the firm green transformation and digital

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transformation. Secondly, firm digital transformation provides more and more convenient information channels for digital investment, green investment and other decisions, alleviating the information asymmetry faced by firms [93]. Moreover, digital technology tools provide more effective estimation models and more effective information for investment decisions. It is helpful to improve the quality and effect of firm investment and change firm risk taking. Green transformation and firm digitization can help businesses project a positive image [94]. These images provide external information users with the information that firms adapt to the macro-economic development. External investors are more inclined to lend money to firms that are undergoing green and digital transformation. In other words, firm digital and green transformation may enable firms to take more risks, increase the efficiency of associated investments, and alleviate the financial limitations that firms experience when investing in digital and green projects.

3.3. Resource-Based Theory

A resource-based theory of the firm was proposed by Wernerfelt [95]. The theory emphasizes that firms should not only focus on the market and products, but also build competitive advantages by identifying and accumulating internal and external resources. The resource-based theory was later extended by other researchers. For instance, Barney [96] noted that firm require valuable, diverse, illiquid, and imitable resources in order to develop competitiveness. It is evident that both external and internal resources have a significant influence on how businesses flourish. Further, effective resource integration can enhance the competitiveness [97]. This idea was further extended by Grant [98] which assert that all of the resources used in production are crucial. In order to keep a competitive edge, these resources must be paired with the company's core competencies. Based on the resource-based theory, Teece, et al. [99] introduced the dynamic capacity theory. This idea highlights how businesses may swiftly modify their resources and skills to meet environmental opportunities and challenges when the external environment undergoes dynamic changes. It is evident that the resource-based theory's progression from internal to external and from static to external offers a solid basis for future research on firm behavior.

In the study of firm financial behavior, resource-based theory is widely used. Firms are speeding up their digital and green transformations due to the effect of the digital and green economies. Firms' internal and external resources fluctuate as a result of changes in the internal and external environment, which influences financial decisions. Information technology resources are the resources that firms can obtain and are difficult to copy at the present stage, which can promote the improvement of firm information technology [100]. By combining existing resources with information technology resources, firms can develop unique capabilities to achieve sustainable development. Vendrell-Herrero, et al. [101] pointed out that resources can help firms establish effective information technology platforms and improve internal communication efficiency, which consequently enhances the firms competitiveness. Performance enhancement and the development of information technology skills are facilitated by the creation of information platforms [102]. However, some scholars pointed out that information technology, as an important resource of firms, can promote firm value and innovation activities only if it is consistent with strategy [103]. As a result, the growth of the digital and green economies has altered businesses' internal and external resources, promoting overall company performance [104].

Firm digital transformation can help promote risk taking. The advancement of digital technology has an impact on risk taking because it speeds up the flow of innovative elements like money, information, and technology, increases internal resource allocation efficiency, and brings about the digital transformation [105, 106]. Firm digital transformation optimizes the use of internal resources and modifies the flow of internal information. Firms set up digital platforms to adjust to the growth of the digital economy. The digital platform provides firms with a mechanism of information exchange across time and space, and provides firms with abundant and inexpensive data information and resources for investment decision-making [107]. In this case, firms transform data elements into actual firm productivity, and the direction of firm product and business model innovation becomes clearer [108].

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Additionally, as the digital economy grows, more outside resources are available for businesses to advance technologically. The quick growth of digital industrialization lessens the detrimental effects of technical communication barriers on business development and creates a favorable external environment for cross-platform, cross-field, and real-time technological innovation. In turn, such development will promote green technology innovation, and produce neighborhood effect [109] which also has a significant promoting effect on innovation performance [110] and environment performance [111].The advancement of internet technology fosters investment, increases operational efficiency, and boosts performance [108, 112]. The change of financial performance further changes corporate risk taking.

The vigorous development of green economy has changed the internal and external environment faced by firms such as consumer demand, competitor strategy and other stakeholders' demand for green products. The changes in demands bring transformation in capital, information, technology, and other external resources, which promotes green transformation. Green transformation means that firms make reasonable use of internal and external advantageous resources to carry out green investment, green innovation, and other activities, and create new investment opportunities for firms [113]. These investment opportunities are an important way to improve the resource allocation and market position of firms [44] and enhance the market competitiveness of products [11]. This helps improve corporate performance, which in turn increases risk taking.

4. Conclusion

The theories discussed in this paper are agency theory, information asymmetry theory and resource-based theory. These are the main theories used in existing research to explain the relationship between firm digital and green transformations and firm risk taking. According to agency theory, firm digital transformation and green transformation reduce agency issues between shareholders, creditors, and management. It also encourage more risk taking. According to the information asymmetry theory, firm digital transformation and green transformation can reduce information asymmetry within the company as well as between the company and its external stakeholders, hence improve risk taking. According to the resource-based theory, companies that undergo digital and green transformations offer both internal and external resources for sustainable development, which enhances their ability to take risks. These theories have examined the relationship between risk taking, green transformation, and firm digital transformation from various angles, offered concepts and insights for comprehending the financial effects of these changes, and offered theoretical support for empirical studies.

This paper provides the following actionable recommendations for managers and policymakers on how to improve firm risk taking through digital and green transformations. The policymakers should seize the opportunities of the digital economy and green economy to provide a good institutional environment for firms to implement digital and green transformations. This can be done by establishing an open platform to provide targeted services, expertise, technology, and tools for firm digital and green transformation. Hence, firms can deliver their services in a more efficient, stable, and secured manner. On the other hand, the managers of the firms should establish the concept of green development, optimize resource allocation through digital means, and improve resource utilization efficiency. In addition, the managers should promote deep integration of digital and green transformation to form a situation of mutual development. The implementation of these strategies will help firms to enhance their competitiveness and achieve sustainable development.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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