Mechanism of Green Finance Awareness on Sustainable Competitiveness of Enterprises

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Abstract

One phenomenon observed during environmental problems was increased green finance in most countries. This study explores the mechanisms of green finance, sustainable competitiveness, and supply chain among SMEs. Self-administered online questionnaires were completed by 738, 314, and 210 senior managers respectively from China, Malaysia, and Singapore. SPSS and Smart PLS-SEM software were used to test the hypotheses. This study aligns with Sustainable Development Goal 11, i.e., sustainable cities and communities, and Sustainable Development Goal 13, i.e., climate action. This study echoes the China government's "double-carbon" target initiative presented in the 75th session of the United Nations General Assembly.

Keywords: green finance awareness; sustainable competitiveness; ESG, SDG

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1.0 Introduction

According to the White Paper on China's Prospects for the Next 50 Years (Frost & Sullivan Report, 2021), a series of environmental problems caused by global warming has caused substantial economic losses to society, driving countries worldwide to introduce carbon emission control measures one after another. China accounts for 27 percent of global carbon emissions. The demand for new energy drives the growth of power generation of new energy. Green finance in the economy has been growing, and enterprises are the main body of power consumption. Most studies consider green finance awareness an effective practice to help enterprises achieve sustainable development goals. However, some studies argue that environmental protection is additional costs and hurts profit. Is green finance awareness promote sustainable Competitiveness? This study constructs the conceptual model to determine whether green finance awareness is conducive to building sustainable Competitiveness. In addition, this study uses the environmental, social, and governance (ESG) model to evaluate firms' sustainability in China. This exploratory study primarily contributes to theory by exploring the mechanisms of sustainable green finance competitiveness, including green finance awareness and supply chain among SME management in China.

Furthermore, this study also examines the mediating role of green Innovation and the moderating effect of redundant resources and environmental turbulence toward sustainable Competitiveness. The study will guide enterprises to build sustainable Competitiveness in green finance awareness. This study also echoes the China government's "double-carbon" target initiative presented in the 75th session of the United Nations General Assembly that achieves a carbon peak by 2030 and carbon neutrality by 2060.

1.1 Study Objectives

Green Finance cannot be ignored as an essential driving force of the economy. This study examines whether Green finance awareness, Green Supply Chain, and Green Innovation promote Sustainable Competitiveness while describing the moderating relationship between Redundant Resources and Environmental Turbulence between Green Finance Awareness, Green Supply Chain, Green Innovation, and Sustainable Competitiveness. It aims to explore how to help enterprises build Sustainable Competitiveness in China, Malaysia, and Singapore.

2.0 Literature Review

Green finance awareness is the responsibility to balance environmental protection with the pursuit of financial gain. Green finance is the best way for corporations to achieve environmental protection and economic growth, and it also can provide enterprises with sustainable Competitiveness. Green finance assists businesses in acquiring and cultivating environmentally-focused strategic resources and capabilities. In the field of supply chain management, green supply chain integration is a crucial capability businesses use to address environmental issues (Lo, Zhang, Wang, & Zhao, 2018). Green internal integration

includes the implicit resources of enterprises, whereas green supplier integration and green customer integration include the implicit resources of social complexity. On this basis, green innovation can comprehensively utilise the resources above and make continuous improvements, thereby increasing the complexity of bundled resources and assisting businesses in enhancing their environmental sustainability.

Green innovation not only assists businesses in balancing economic growth and environmental protection objectives but also offers new opportunities for enterprise growth (Janicke, 2008; Lin et al., 2019). Green innovation is essential to the effective implementation of green finance awareness. The innovation externalities and environmental externalities generated by green Innovation not only encourage enterprises to optimize production processes and product design and provide support for enterprises to solve environmental problems innovatively but also aid enterprises in obtaining legitimacy and establishing sustainable Competitiveness via first-mover advantage and innovation compensation (Kiefer, Del Río González, & Carrillo-Hermosilla, 2019; Khan, Yang, & Waheed, 2019). In addition, businesses develop and update hardware and software associated with green products and processes, utilizing strategic resources acquired through green supply chain integration to account for economic growth and environmental protection objectives and establish sustainable Competitiveness (Kong et al., 2020).

The buffer function of redundant resources can alleviate internal resource conflicts and the pressure of external environment changes, allowing businesses to function more efficiently (Bourgeois, 1981; Fadol et al., 2015). Specifically, redundant resources can help enterprises strengthen cross-department cooperation to achieve the goal of cross-functional environmental management, but also provide resources and flexible support for enterprises to integrate supplier and customer demands, information, and other elements (Wong et al., 2015). Environmental turbulence entails technological shifts and alterations in consumer preferences, which will generate uncertainty in the firm's external environment (Dess & Beard, 1984). The ability of enterprises to adapt to their external environment determines whether environmental turbulence can create new development opportunities for businesses (Sirmon & Hitt, 2009; Baird et al., 2012).

2.1 Sustainable Competitiveness (Dependent Variable)

Competitive benefit leads to sustainable Competitiveness. Chamberlin's (1939) "monopolistic opposition concept" introduced the idea of competitive gain, defined as superior agency overall performance compared to competitors. Selznick (1957) changed into the primary benefits with abilities, and Hofer and Schendel (1978) believed that aggressive advantage derived from capabilities. They introduced the concept of competitive advantage in strategic management. This concept is defined as an organization's unique function compared to its competitors through the use of resources. Following that, Porter (1985) verified that the business's strategic objective is to establish a competitive advantage. The competitive benefit happens when the cost needed to create Competitiveness is less than those of the competitors. Competitive advantage can be

measured based on cost-leading benefit, differentiation advantage, and focusing gain (Porter, 1985).

Furthermore, Jia & Wang (2018) also contend that advanced overall performance correlates with a competitive advantage and that gaining benefits results in better performance. The notions of a helpful resource-based view have broadened the definition of Competitiveness. Competitiveness can be a much more comprehensive array of capacity benefits, including organisational capital, human capital, technological possibility, physical capital, and even institutional context (Barney, 1991; Oliver,1997; Teece,1997). Competitive advantage is a helpful resource or set of resources or abilities that outdo a competitor and should lead to a better relative overall performance (Wiggins & Ruffle, 2002). According to Nguyen (2019), sustainable Competitiveness is characterised by long-time profitability and above-common long-term performance. From this perspective, sustainable Competitiveness is defined as long-term excellence with the consideration of sustainability and creating more economic value for a prolonged time frame (Maury, 2018).

2.2 Green Finance Awareness (Independent Variable)

The concept of corporate social responsibility increases the consciousness of green finance. The definition of green finance awareness is the idea of voluntarily integrating environmental concerns in business operations and interactions with stakeholders (Williamson et al., 2006). Corson and Treich (2014) highlighted the mechanisms of green finance awareness as the environmental goods that concern the stakeholders, and organisations should provide them voluntarily. Amongst those, voluntariness emphasises that green finance should go beyond compliance with laws and should be the social responsibility of the business to embrace green finance while pursuing financial profits (Kovács, 2008; Qin et al., 2019). However, excessive corporate social responsibility usually gains more attention than green finance awareness (Rahman, 2012). In addition, there are many concepts in green finance awareness from different scholars' perspectives. For example, Corporate social responsibility refers to the obligation of enterprises to implement strategies, make decisions and follow courses of action that create value for the public; Green Finance Awareness is a Dimension of Corporate Social Responsibility (Kraus et al., 2020), Green finance awareness is the embodiment of the ability of enterprises to incorporate environmental factors into their daily operations and management (Li et al., 2020), Green finance awareness involves translating environmental awareness into action to limit adverse environmental impacts and promote positive environmental externalities (Orcadell et al., 2021).

2.3 Green supply chain (Independent Variable)

A green supply chain encompasses green purchasing, manufacturing, packaging, advertising, and reverse logistics (Zhu & Sarkis, 2004; Chan et al., 2012; Wang et al., 2020b). Within the examination of green delivery chain management, the functional paradigm focuses ordinarily on green practices, specifically practical regions, while the cooperative paradigm broadly focuses on mutually addressing environmental troubles

(Vachon & Klassen, 2006; Zhu & Sarkis, 2007; Han & Huo, 2020). To improve the efficacy of green supply chain control, researchers have proposed the integration approach of green delivery chain management (Wu, 2013; Han & Huo, 2020). Integration is the management of re-engineering sports so that related enterprise approaches are seamlessly connected, redundant methods are eliminated, and sources are allocated optimally (Chen et al., 2009;Li et al., 2020 a). Supply chain integration, that is, the strategic cooperation among companies and supply chain partners inside and between businesses (Huo, 2012; Kong et al., 2020), can offer enterprises structures that meet strategic needs and successfully utilise allotted resources (Wolf, 2011; Li et al., 2020 a).

2.4 Green Innovation (Mediating Variable)

The existing research has associated ideas, including green Innovation, environmental Innovation, ecological Innovation, and sustainable Innovation. However, most scholars believe these definitions may be substituted, whereas sustainable Innovation incorporates each environmental and social innovation dimension (Schiederig et al., 2012; Huang & Chen, 2022; Oduro et al., 2022). This study contends that "surroundings" encompasses the natural environments and social elements such as ideas and systems. This could include the ideas of Innovation. "Ecology" is derived from environmental sociology, which specialises in the relationship between natural ecology and the financial system, whereas "green" accurately displays organisational Innovation's significance and goal. Therefore, "green innovation" is selected to symbolise those types of Innovation. There are many definitions of green innovations. Wang and Juo(2021) believe that innovations that utilise improved technologies, systems, and management practices mitigate the negative environmental impact of operations. Green innovation can help businesses in generating both green and Sustainable Competitiveness (Singh, Del Giudice, Chiappetta Jabbour, Latan & Sohal, 2022). Singh et al. (2022) believe that green innovation refers to the use of environmentally friendly technologies to improve products or processes in production processes that hurt the environment.

2.5 Redundant resources (Moderating Variable)

Literature review reveals that there is no universally accepted definition of redundant resources. Existing studies have diverse interpretations of the connotation of redundant resources based on various theoretical foundations and perspectives. From the agency theory perspective, redundant resources represent managers' disregard for available resources (Leyva-de la Hiz et al., 2019). Redundant resources allow managers to engage in political or self-serving behavior, creating moral hazard (Daniel et al., 2004). In the context of a high level of redundant resources, managers will squander resources on non-productive activities, resulting in low enterprise efficiency and negatively impacting enterprise performance (Jensen, 1986). This type of research is motivated by the interests of shareholders. It focuses on the current production efficiency of businesses, while the definition of enterprise success is restricted to increased production efficiency and financial performance.

From the resource-based view and organisation theory perspective, Cyert and March (1963) rejected profit maximisation as the enterprise's only objective. They tended to view the enterprise as an entity with multiple objectives.

2.6 Environmental turbulence (Moderating Variable)

The term' turbulence' refers to the volatility or unpredictability of environmental discontinuities (Haleblian & Finkelstein, 1993). Emery and Trist (1965) introduced the concept of volatility, which refers to external changes that are uncertain and challenging for managers to plan for. On this basis, Aldrich (1979) emphasized the degree of interdependence between environmental factors. Meyer (1982) believed environmental turbulence is fleeting, unexpected, and unprecedented. Dess and Beard (1984) conceptualised environmental turbulence as the degree and frequency of changes in the external environment of enterprises over time, representing industry changes, innovation velocity, and unpredictability of market activities. Subsequent research is generally based on this definition (Ashraf et al., 2019; Lyu et al., 2020).

On the one hand, environmental turbulence can result in resource constraints, prompting businesses to view external environmental changes as threats rather than opportunities. In addition, it can increase enterprises' awareness of external orientation, Innovation, and initiative. Different response attitudes depend on enterprises' diverse strategic approaches and resource capacities (Bodlaj & Cater, 2019). On the one hand, environmental turbulence can result in resource constraints, prompting businesses to view external environmental changes as threats rather than opportunities. In addition, it can increase enterprises' awareness of external orientation, Innovation, and initiative. Different response attitudes depend on enterprises' diverse strategic approaches and resource capacities (Bodlaj & Cater, 2019). Hence, the following hypotheses were formulated.

H1: There is a significant relationship between green finance awareness and sustainable competitiveness.

H2: There is a significant relationship between green supply chain and sustainable competitiveness.

H3: There is a significant relationship between green innovation and sustainable competitiveness.

H4: Redundant resources moderates the relationship between green finance awareness and sustainable competitiveness.

H5: Redundant resources moderates the relationship between green supply chain and sustainable competitiveness.

H6: Redundant resources moderates the relationship between green innovation and sustainable competitiveness.

H7: Environmental turbulence moderates the relationship between green finance awareness and sustainable competitiveness.

H8: Environmental turbulence moderates the relationship between green supply chain and sustainable competitiveness.

H9: Environmental turbulence moderates the relationship between green innovation and sustainable competitiveness.

H10: Green innovation mediates the relationship between green finance awareness and sustainable competitiveness.

H11: Green innovation mediates the relationship between green supply chain and sustainable competitiveness.

Based on the above scholarly review guided by existing theories and empirical evidence, this study proposes the following research model with effect pathways.

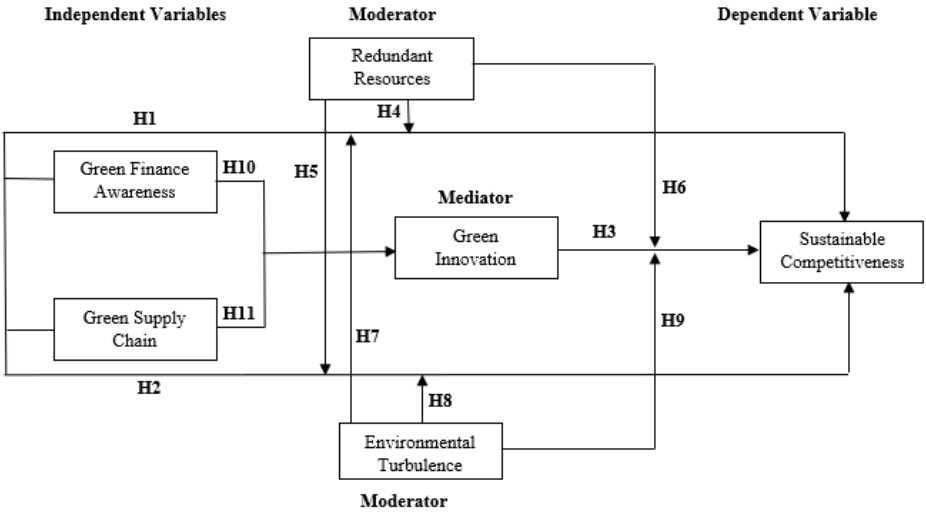

Figure 1: Research Framework
(Source: Author)

3.0 Methodology

This research adopted questionnaire survey method, collected questionnaire data from the enterprise personnel, and recovered 1,262 valid questionnaires. Of these, 738 were from China, 314 were from Malaysia, and 210 were from Singapore. This study used SPSS26.0 and SmartPLS3.3.2 statistical software to analyse the study samples. As in Table 1, six related constructs were identified. In order to improve the reliability and validity of the scale, all the scales were selected from prominent published journals.

Table 1. Constructs and their related studies

Constructs	Studies
Green finance awareness	Hart and Dowell(2011), Wu (2013), Yang Zhen et al.(2021), Kraus et al. (2020), Qin et al.(2019), Yang et al.(2019), Wu et al. (2020), Li et al. (2020b), Orcadell et al. (2021), Jung et al.(2021), Peng et al.(2021)
Green supply chain	Song et al.(2017), Qian et al.(2019), Zhou et al.(2020), Han and Huo(2020), Solar and sun(2021), Zhu et al.(2022), Wang and Feng(2022), Guo et al.(2022)
Green innovation	Huang and Li(2018), Tariq et al.(2017), Chen and Liu(2019), Kiefer et al.(2019), Guo et al.(2020), Zhou et al.(2020), Pan et al.(2021), Kong et al.(2021), Wang and Juo(2021), Khan et al., (2021), Singh et al. (2022), Oduro et al.(2022), Khanra et al.(2022), Huang and Chen(2022),
Sustainable competitiveness	Hart and Dowell(2011), Fraj et al.(2013), Forsman(2013), Mohammed and Arusha(2013), Ahmad(2015), Yu et al. (2017), Xiao Xie et al.(2019), Qiu et al.(2019), Andersen et al.(2020), Yang Miaomiao and Wang Juanru(2020), Singh et al.(2020), Mahdi and Nassar(2021), Tian Hong and Tian Jihadi(2022)
Redundant Resource	Fadol et al. (2015), Liao Zhongju et al.(2016), Shin and Konrad(2017), Hsiao et al.(2018), Xiao et al.(2018), Liao and Long(2018), Leyva-de la Hiz et al.(2019), Hu et al.(2019), Leyva-dela Hiz et al.(2019), Bai et al.(2021),
Environmental Turbulence	Silvestre(2015), Wilden and Gudergan (2015), Hartono and Sheng(2016), Cheng and Yang(2017), Ashraf et al.(2019), Bodlaj and Cater(2019), Zhou et al.(2019), Lyu et al.(2020), Wei et al.(2020), Bao et al.(2021), Clauss et al.(2021)

(Source: Author)

The population will be chair executives who have worked for more than one year in enterprises in China, Malaysia, and Singapore. such as Like CEO、CFO、COO.

3.1 Demographic Profile

Table 2. Demographic profile for China, Malaysia, and Singapore

Variables		China Frequency (%)	Singapore Frequency (%)	Malaysia Frequency (%)
Number of employees in your business	people and below	379(51.40%)	106(50.50%)	146(46.50%)
	101-300 people	236(32.00%)	80(38.10%)	113(36.00%)
	301-1000 people	118(16.00%)	22(10.50%)	53(16.90%)
	1000 people and above	5(0.70%)	2(1.00%)	2(0.60%)
Your business's industry	Food manufacturing	3(0.40%)	-	1(0.30%)
	Tobacco processing industry	3(0.40%)	-	-
	Textile processing industry	1(0.10%)	1(0.50%)	1(0.30%)
	Furniture manufacturing	2(0.30%)	1(0.50%)	-
	Petroleum processing and coking industry	1(0.10%)	-	-
	Pharmaceutical manufacturing industry	55(7.50%)	16(7.10%)	21(6.70%)
	Electronic product manufacturing industry	364(49.30%)	107(51.00%)	158(50.30%)
	Automobile and parts manufacturing industry	213(28.90%)	57(27.10%)	89(28.30%)
	Mechanical equipment manufacturing	80(10.80%)	23(11.00%)	35(11.10%)
	Other	16(2.20%)	5(2.40%)	9(2.90%)
The ownership type of your business	State-owned	78(10.60%)	20(9.50%)	36(11.50%)
	Foreign capital	7(0.90%)	1(0.50%)	1(0.30%)
	Joint venture	4(0.50%)	3(1.40%)	3(1.00%)
	Private	649(87.90%)	186(88.60%)	274(87.30%)
Your business has been in operation for [ ]year.	1-5	448(60.70%)	153(72.90%)	197(62.70%)
	6-10	268(36.30%)	55(26.20%)	110(35.00%)
	11-15	20(2.70%)	2(1.00%)	5(1.60%)
	16-20	1(0.10%)	-	2(0.60%)
	20 and above	1(0.10%)	-	-

(Source: Author)

For China, Malaysia, and Singapore, the proportion of the respondents between the number of employees, industry, type, and operation year are similar. The details are in the Table 2.

4.0 Results

As depicted in Table 3, the combined data from both countries showed that all the items except one have good loadings higher than 0.50, with composite reliability of the constructs higher than 0.70. The average variance extracted (AVE) of the constructs is higher than 0.50, showing an acceptable validity for the constructs.

GFA significantly positively affected GII (β= 0.333,0.350,0.357,p <0.001).GSC significantly positively affected GII (β= 0.353,0.346,0.155,p <0.05).GFA significantly affected SCA (β= 0.234,0.290,0.275,p <0.001), and hypothesis H1 was supported in all three countries. GSC had a significant positive effect on SCA (β=0.283, 0.291, 0.210, p <0.001), and hypothesis H2 was supported in all three countries. GII had a significant positive effect on SCA (β=0.318, 0.296, 0.252, p <0.001), and hypothesis H3 was supported in all three countries. Further, by comparing the path coefficients of the three countries, it is found that there was no significant difference (p>0.05) in the impact size of assumptions H1, H2, and H3 among the three countries.

In the path of GFA→GII→SCA, the confidence intervals of the three countries do not contain 0, so there is a mediating effect between GFA and SCA in the three countries, and the mediating effects are 0.106, 0.104, and 0.090, respectively, assuming that H10 is supported; In the path of GSC→GII→SCA, the confidence intervals of the three countries are all 0, so it shows that there is a mediating effect between GSC and SCA in the three countries. The size of the mediating effect is 0.112, 0.102, and 0.039, assuming that H11 is supported. Furthermore, the mediating effects of GII between GFA and SCA in the three countries were not significantly different (p>0.05).

The interaction between GFA and RRI had a significant positive effect on SCA in the three countries (β =0.148, 0.161, 0.150, p <0.01), so the hypothesis H4 of the three countries was supported; The interaction between GSC and RRI had a significant positive effect on SCA in the three countries (β =0.115, 0.147, 0.118, p <0.05), so the hypothesis H5 was supported in the three countries; The interaction term of GII and RRI had a significant positive effect on SCA in the three countries (β =0.119, 0.181, 0.132, p <0.01), so the hypothesis of H6 was supported in the three countries.

When RRI was low, the effect of GFA on SCA was not significant in all three countries(simple slope= 0.059,0.106,0.101, p>0.05), China GSC had a little positive effect on SCA(simple slope=0.128, p<0.01), Singapore and Malaysia GSC had no significant effect on SCA(simple slope=0.115, 0.060, p>0.05), GFA in China had a little positive effect on SCA (simple slope=0.157, p<0.001), GSC in Singapore and Malaysia had no significant effect on SCA (simple slope=0.071, 0.091, p>0.05); When RRI was high, GFA had a more significant positive impact on SCA in three countries (simple slope=0.355, 0.428, 0.401,

Table 3. Results of measurement items

	Construct	Item	Factor Loading	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
Green Finance Awareness	Green Finance Awareness	GFA1	Chi:0.737 Sin:0.704 Mal:0.788	Chi:0.923 Sin:0.929 Mal:0.926	Chi:0.934 Sin:0.939 Mal:0.937	Chi:0.541 Sin:0.566 Mal:0.552
		GFA2	Chi:0.767 Sin:0.812 Mal:0.770			
		GFA3	Chi:0.772 Sin:0.727 Mal:0.753			
		GFA4	Chi:0.724 Sin:0.728 Mal:0.748			
		GFA5	Chi:0.740 Sin:0.795 Mal:0.755			
		GFA6	Chi:0.794 Sin:0.823 Mal:0.727			
		GFA7	Chi:0.781 Sin:0.852 Mal:0.794			
		GFA8	Chi:0.753 Sin:0.834 Mal:0.765			
		GFA9	Chi:0.688 Sin:0.674 Mal:0.732			
		GFA10	Chi:0.646 Sin:0.676 Mal:0.622			
		GFA11	Chi:0.721 Sin:0.665 Mal:0.746			
		GFA12	Chi:0.691 Sin:0.701 Mal:0.703			
Green supply chain	Green interior	GSC1	Chi:0.820 Sin:0.822 Mal:0.815	Chi:0.874 Sin:0.851 Mal:0.867	Chi:0.905 Sin:0.890 Mal:0.901	Chi:0.616 Sin:0.575 Mal:0.604
		GSC2	Chi:0.795 Sin:0.818 Mal:0.817			
		GSC3	Chi:0.838 Sin:0.765 Mal:0.850			
		GSC4	Chi:0.788 Sin:0.694 Mal:0.788			
		GSC5	Chi:0.710 Sin:0.701 Mal:0.658			
		GSC6	Chi:0.750 Sin:0.737 Mal:0.718			
		GSC7	Chi:0.794 Sin:0.786 Mal:0.752			
	Green supplier	GSC8	Chi:0.724 Sin:0.832 Mal:0.780	Chi:0.851 Sin:0.877 Mal:0.85	Chi:0.890 Sin:0.907 Mal:0.889	Chi:0.574 Sin:0.62 Mal:0.572
		GSC9	Chi:0.766 Sin:0.817 Mal:0.720			

(Source: Author)

Table 3. Results of measurement items (Continuation Sheet)

	Construct	Item	Factor Loading	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
Green supply chain	Green supplier	GSC10	Chi:0.781 Sin:0.771 Mal:0.789	Chi:0.881 Sin:0.881 Mal:0.877	Chi:0.910 Sin:0.910 Mal:0.907	Chi:0.627 Sin:0.627 Mal:0.62
		GSC11	Chi:0.720 Sin:0.740 Mal:0.752			
		GSC12	Chi:0.758 Sin:0.777 Mal:0.742			
		GSC13	Chi:0.783 Sin:0.752 Mal:0.797			
	Green customer	GSC14	Chi:0.789 Sin:0.819 Mal:0.762			
		GSC15	Chi:0.779 Sin:0.773 Mal:0.792			
		GSC16	Chi:0.809 Sin:0.845 Mal:0.850			
		GSC17	Chi:0.806 Sin:0.792 Mal:0.775			
		GSC18	Chi:0.786 Sin:0.767 Mal:0.744			
Green Innovation	Green process	GII1	Chi:0.819 Sin:0.790 Mal:0.812	Chi:0.843 Sin:0.846 Mal:0.843	Chi:0.895 Sin:0.897 Mal:0.895	Chi:0.681 Sin:0.686 Mal:0.680
		GII2	Chi:0.784 Sin:0.784 Mal:0.792			
		GII3	Chi:0.818 Sin:0.856 Mal:0.82			
	Green product	GII4	Chi:0.877 Sin:0.878 Mal:0.872	Chi:0.835 Sin:0.861 Mal:0.842	Chi:0.890 Sin:0.906 Mal:0.894	Chi:0.671 Sin:0.707 Mal:0.68
		GII5	Chi:0.868 Sin:0.873 Mal:0.864			
		GII6	Chi:0.838 Sin:0.876 Mal:0.835			
		GII7	Chi:0.719 Sin:0.741 Mal:0.765			
		GII8	Chi:0.843 Sin:0.865 Mal:0.832			
Redundant Resources	Unabsorbed redundancy	RRI1	Chi:0.850 Sin:0.837 Mal:0.862	Chi:0.797 Sin:0.785 Mal:0.792	Chi:0.881 Sin:0.874 Mal:0.878	Chi:0.711 Sin:0.699 Mal:0.706
		RRI2	Chi:0.834 Sin:0.846 Mal:0.824			
		RRI3	Chi:0.845 Sin:0.825 Mal:0.835			
		RRI4	Chi:0.841 Sin:0.833 Mal:0.849			
	Absorbed redundancy	RRI5	Chi:0.869 Sin:0.880 Mal:0.841	Chi:0.805 Sin:0.821 Mal:0.776	Chi:0.885 Sin:0.893 Mal:0.87	Chi:0.72 Sin:0.736 Mal:0.691
		RRI6	Chi:0.835 Sin:0.861 Mal:0.803			

(Source: Author)

Table 3. Results of measurement items (Continuation Sheet)

	Construct	Item	Factor Loading	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
environmental turbulence	Market turbulence	ETI1	Chi:0.853 Sin:0.882 Mal:0.86	Chi:0.798 Sin:0.843 Mal:0.797	Chi:0.881 Sin:0.905 Mal:0.881	Chi:0.712 Sin:0.761 Mal:0.712
		ETI2	Chi:0.836 Sin:0.863 Mal:0.839			
		ETI3	Chi:0.842 Sin:0.872 Mal:0.832			
	Technological turbulence	ETI4	Chi:0.859 Sin:0.842 Mal:0.865	Chi:0.824 Sin:0.832 Mal:0.811	Chi:0.895 Sin:0.899 Mal:0.888	Chi:0.740 Sin:0.749 Mal:0.726
		ETI5	Chi:0.871 Sin:0.892 Mal:0.853			
		ETI6	Chi:0.85 Sin:0.861 Mal:0.838			
Sustainable Competitiveness	Sustainable Competitiveness	SCA1	Chi:0.773 Sin:0.823 Mal:0.766	Chi:0.930 Sin:0.936 Mal:0.910	Chi:0.940 Sin:0.945 Mal:0.924	Chi:0.567 Sin:0.589 Mal:0.505
		SCA2	Chi:0.689 Sin:0.641 Mal:0.650			
		SCA3	Chi:0.709 Sin:0.741 Mal:0.615			
		SCA4	Chi:0.740 Sin:0.764 Mal:0.764			
		SCA5	Chi:0.782 Sin:0.793 Mal:0.712			
		SCA6	Chi:0.706 Sin:0.772 Mal:0.720			
		SCA7	Chi:0.724 Sin:0.762 Mal:0.698			
		SCA8	Chi:0.821 Sin:0.817 Mal:0.808			
		SCA9	Chi:0.834 Sin:0.836 Mal:0.748			
		SCA10	Chi:0.765 Sin:0.741 Mal:0.656			
		SCA11	Chi:0.743 Sin:0.781 Mal:0.692			
		SCA12	Chi:0.736 Sin:0.718 Mal:0.679			

(Source: Author)

p<0.001), GSC had a more significant positive impact on SCA in three countries (simple slope=0.358, 0.409, 0.296, p<0.01), and GII had a more significant positive impact on SCA in three countries (simple slope=0.395, 0.433, 0.355, p<0.001).In the three countries, the positive effects of GFA, GSC, and GII on SCA increased with the increase of RRI, which indicated that RRI had a positive regulatory effect among GFA, GSC, GII, and SCA.

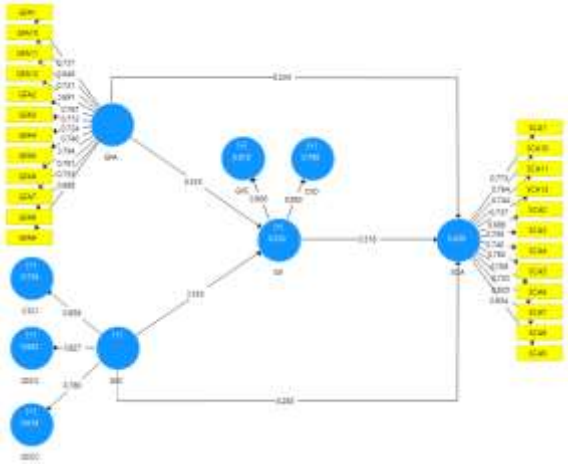

Figure 2: Mediation model results of the path analysis: China
(Source: Author)

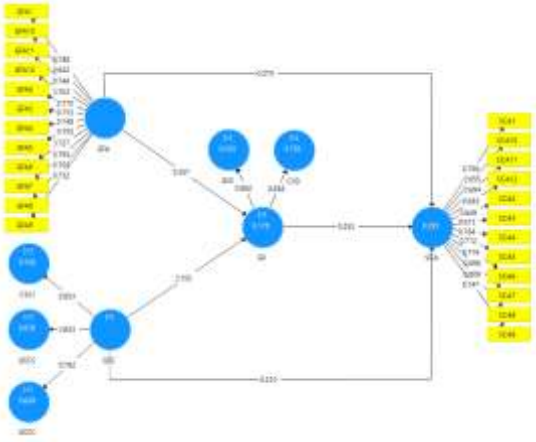

Figure 3: Mediation model results of the path analysis: Malaysia
(Source: Author)

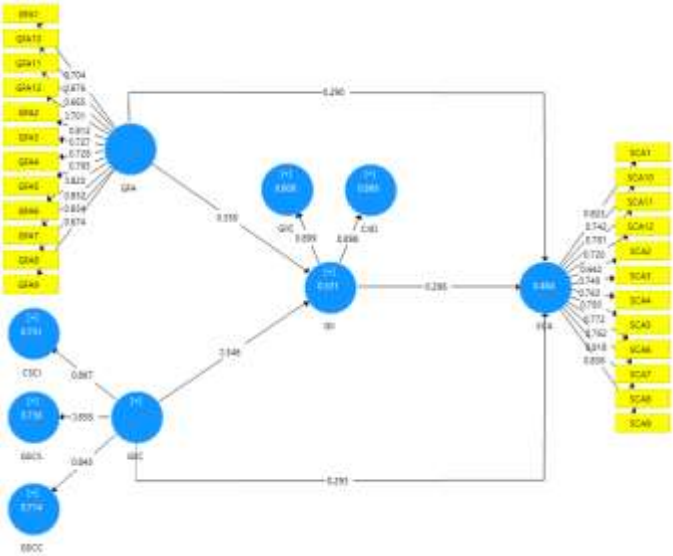

Figure 4: Mediation model results of the path analysis: Singapore
(Source: Author)

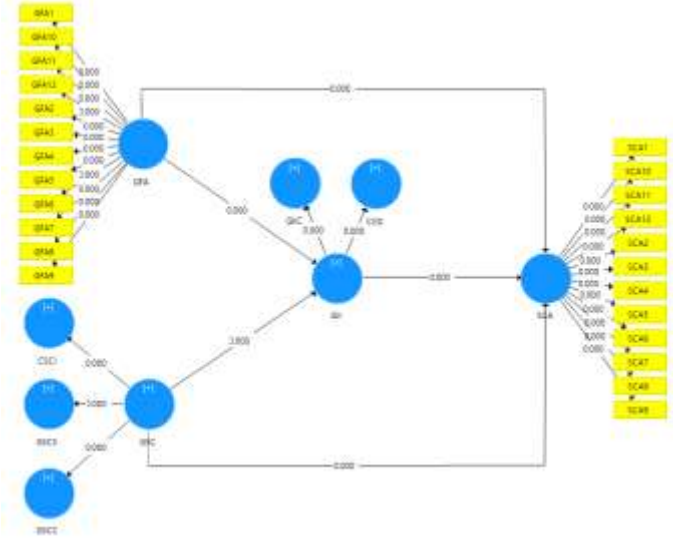

Figure 5: Mediation model results of Bootstrapping: China
(Source: Author)

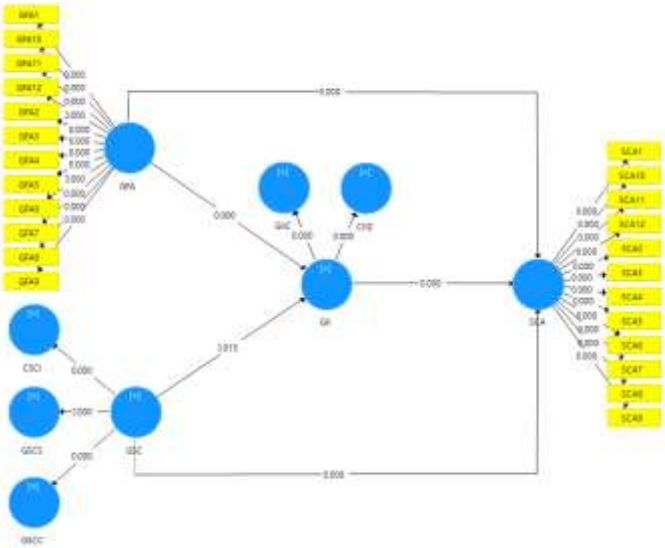

Figure 6: Mediation model results of Bootstrapping: Malaysia
(Source: Author)

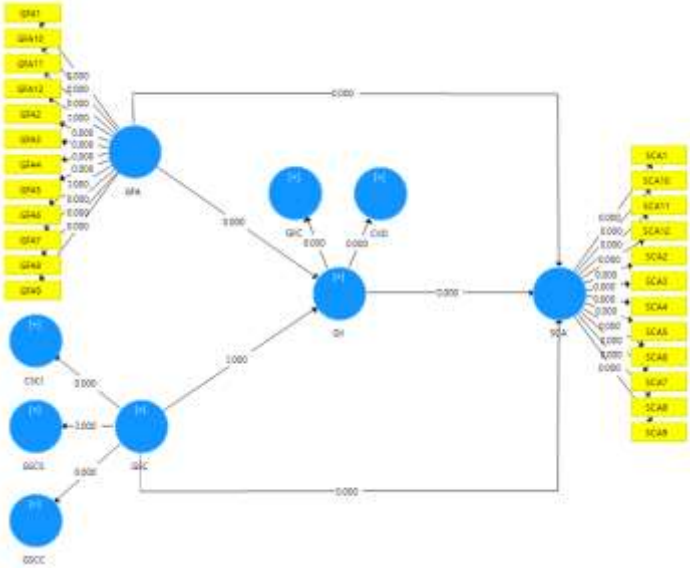

Figure 7: Mediation model results of Bootstrapping: Singapore
(Source: Author)

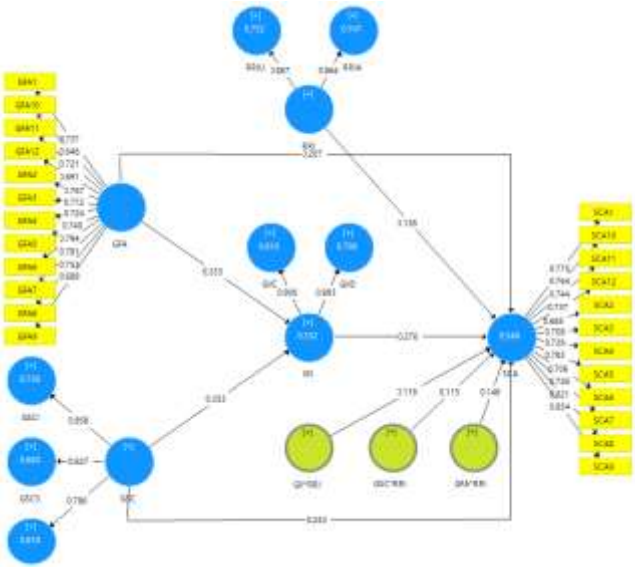

Figure 8: Redundant resource results of the path analysis: China
(Source: Author)

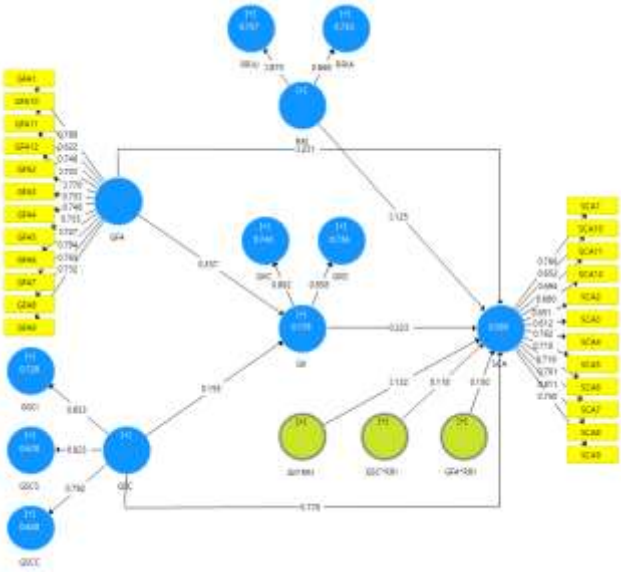

Figure 9: Redundant resource results of the path analysis: Malaysia
(Source: Author)

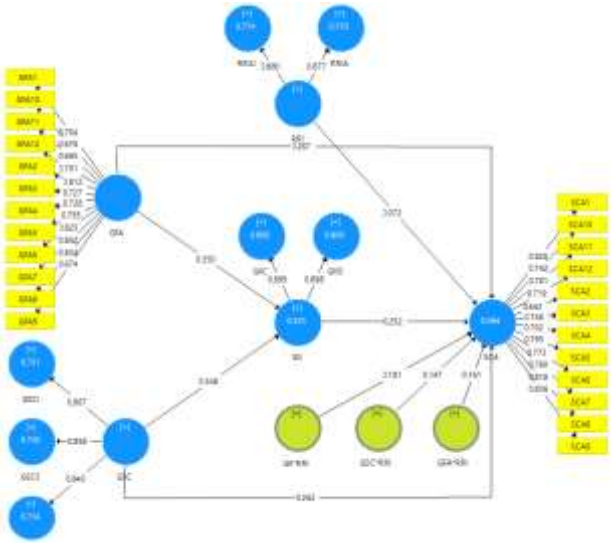

Figure 10: Redundant resource results of the path analysis: Singapore
(Source: Author)

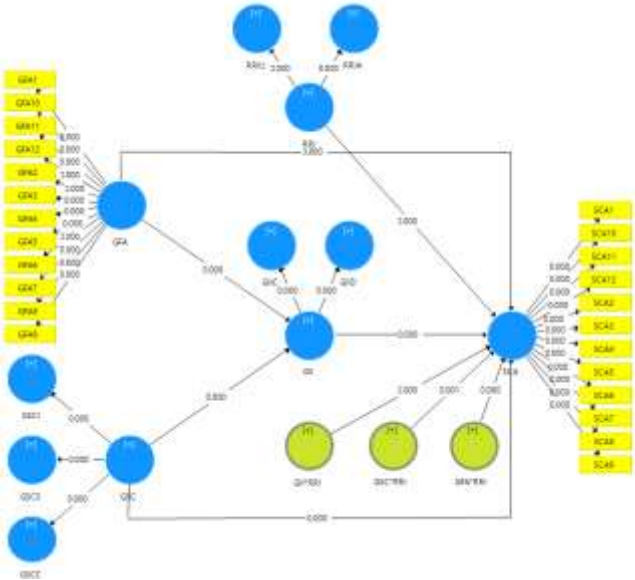

Figure 11: Redundant resource results of Bootstrapping: China
(Source: Author)

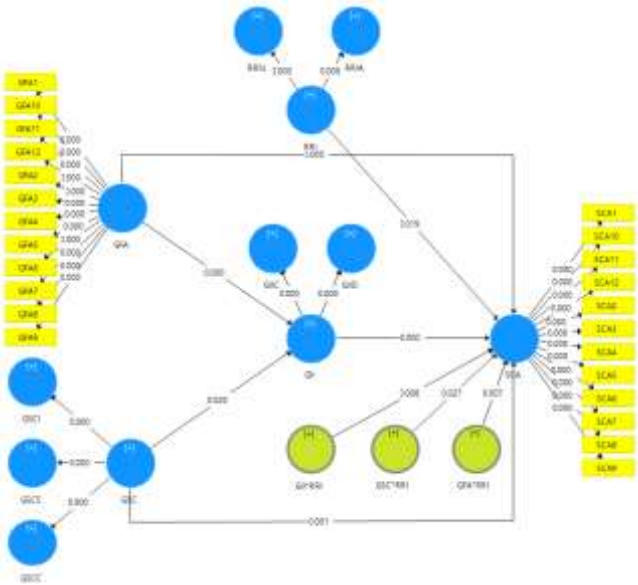

Figure 12: Redundant resource results of Bootstrapping: Malaysia
(Source: Author)

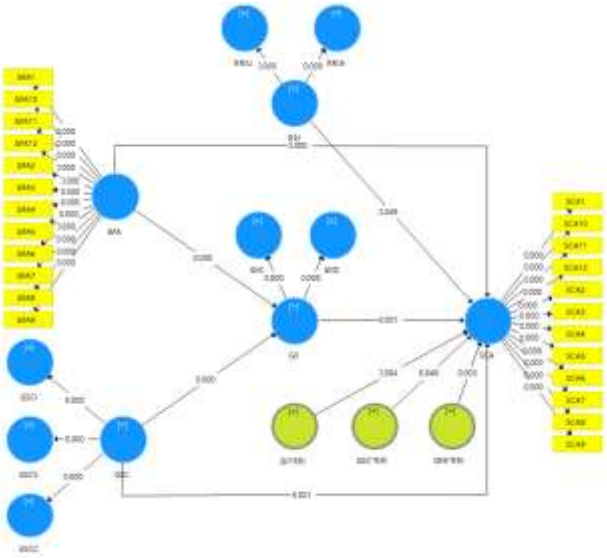

Figure 13: Redundant resource results of Bootstrapping: Singapore
(Source: Author)

The interaction between GFA and ETI had a significant positive effect on SCA in the three countries (β =0.097, 0.122, 0.149, p <0.05), so hypothesis H7 of the three countries was supported; The interaction between GSC and RRI in China had a significant positive effect on SCA (β =0.158,p<0.001), but the interaction between GSC and RRI in Singapore and Malaysia had no significant effect on SCA (β = -0.057,0.071,p>0.05), so the hypothesis H8 in China was supported, while the hypothesis H8 in Singapore and Malaysia was not supported. The interaction between GII and RRI in China and Singapore significantly positively affected SCA (β =0.181, 0.204, p <0.01). In contrast, the interaction between GII and RRI in Malaysia had no significant effect on SCA (β = 0.027, p>0.05). Therefore, hypothesis H9 of China and Singapore was supported, while that of Malaysia was not supported.

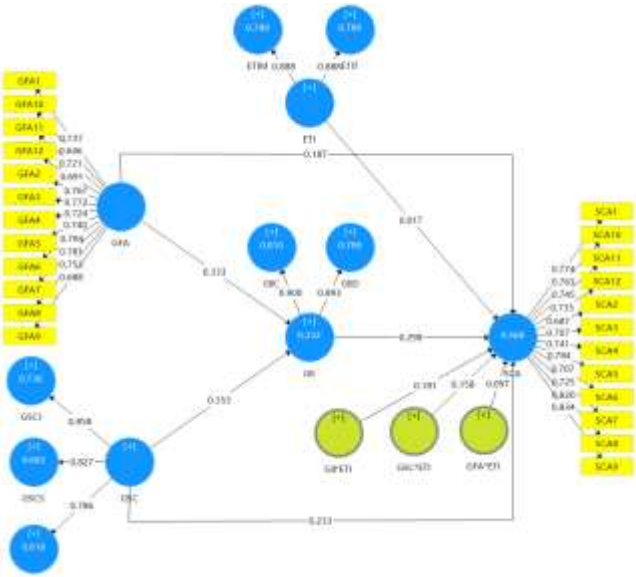

Figure 14: Redundant resource results of the path analysis: China
(Source: Author)

When ETI is low, GFA in China and Singapore have a little positive effect on SCA(simple slope= 0.090,0.186, p<0.01), GFA in Malaysia had no significant effect on SCA(simple slope=0.129, p>0.05), China GSC had no significant effect on SCA(simple slope=0.075, p>0.05), China GII had a little positive effect on SCA (simple slope=0.117, p<0.01), Singapore GII had no significant effect on SCA (simple slope=0.144, p>0.01); When ETI was high, GFA in China, Singapore, and Malaysia had a more significant positive effect on SCA (simple slope=0.284, 0.430, 0.427, p<0.001), GSC in China had a more significant positive effect on SCA (simple slope=0.391, p<0.001), and GII in China and

Singapore had a more significant positive effect on SCA (simple slope=0.479, 0.552, p<0.001).

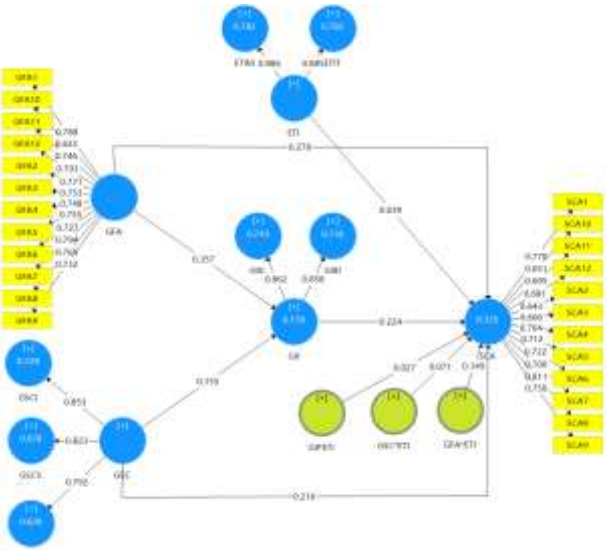

Figure 15: Redundant resource results of the path analysis: Malaysia
(Source: Author)

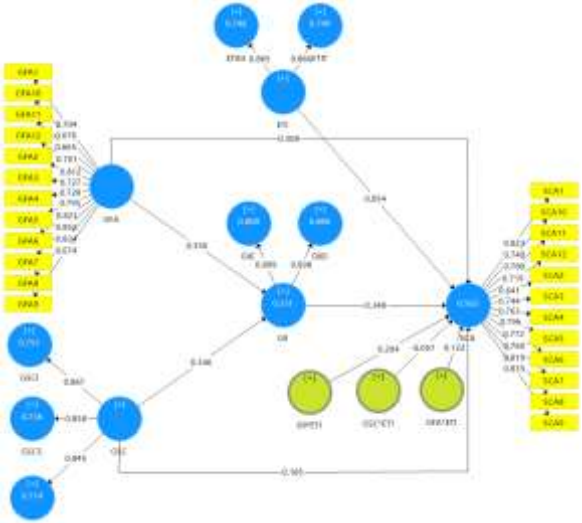

Figure 16: Redundant resource results of the path analysis: Singapore
(Source: Author)

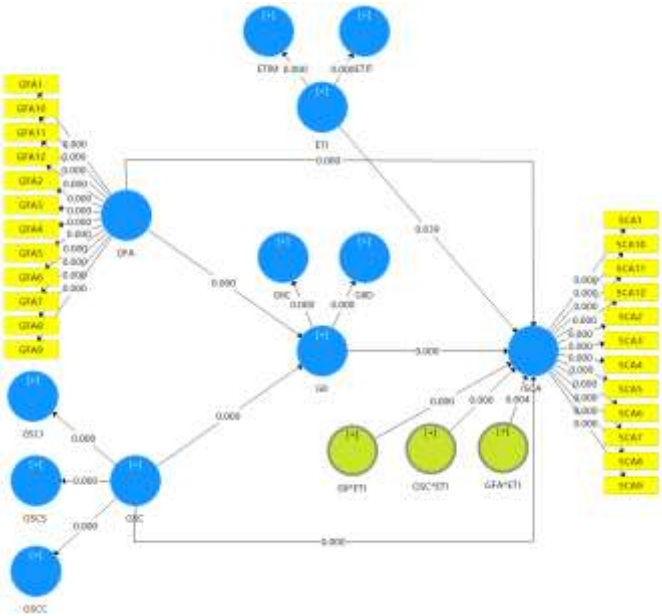

Figure 17: Redundant resource results of Bootstrapping: China
(Source: Author)

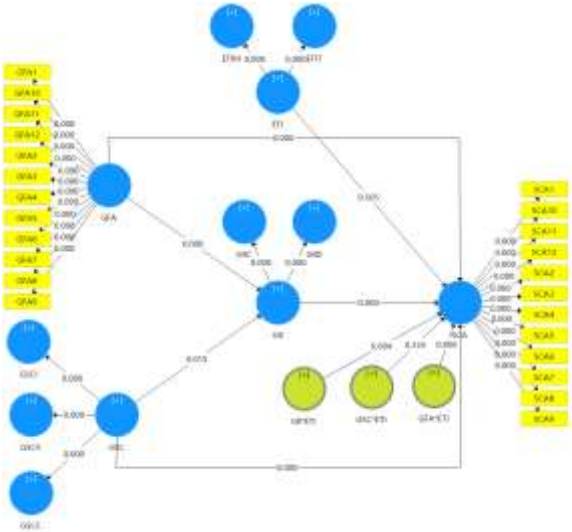

Figure 18: Redundant resource results of Bootstrapping: Malaysia
(Source: Author)

Therefore, with the increase of ETI, the positive effects of China GFA, GSC, and GII on SCA increased gradually, indicating a positive regulatory effect between GFA, GSC, GII, and SCA in China. That is to say, with the increase of ETI, the positive effects of Singapore GFA and GII on SCA also increased gradually, indicating that Singapore ETI has a positive regulatory effect among GFA, GII, and SCA; That is to say, with the increase of ETI, the positive effect of GFA on SCA in Malaysia also increases gradually, indicating that there is a positive moderating effect between GFA and SCA in Malaysia.

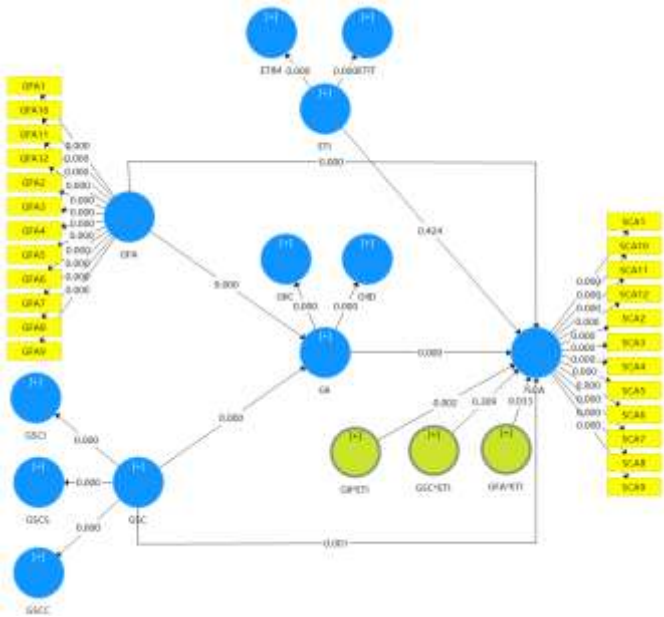

Figure 19: Redundant resource results of Bootstrapping: Singapore
(Source: Author)

The hypothesis testing was fully established from the above verification results. See Table 4 for specific relevant hypothesis verification results.

Most of the study hypotheses of multi-group analysis were confirmed, but some of the study hypotheses were not established. However, hypotheses H8 assumption is not significant in Malaysia and Singapore. The H9 assumption is not significant in Malaysia.

Table 4. Results of hypothesis testing for China, Malaysia, and Singapore (combined)

Hypothesis	Path	Beta	SE	t-value	p	Results
		Chi:0.234	Chi:0.035	Chi:6.627	Chi:0.000	Chi:Accepted
H1	GFA→SCA	Sin:0.290	Sin:0.062	Sin:4.659	Sin:0.000	Sin:Accepted
		Mal:0.275	Mal:0.056	Mal:4.897	Mal:0.000	Mal:Accepted
		Chi:0.283	Chi:0.037	Chi:7.612	Chi:0.000	Chi:Accepted
H2	GSC→SCA	Sin:0.293	Sin:0.077	Sin:3.804	Sin:0.000	Sin:Accepted
		Mal:0.210	Mal:0.056	Mal:3.719	Mal:0.000	Mal:Accepted
		Chi:0.318	Chi:0.037	Chi:8.500	Chi:0.000	Chi:Accepted
H3	GII→SCA	Sin:0.296	Sin:0.077	Sin:3.857	Sin:0.000	Sin:Accepted
		Mal:0.252	Mal:0.058	Mal:4.378	Mal:0.000	Mal:Accepted
		Chi:0.148	Chi:0.033	Chi:4.553	Chi:0.000	Chi:Accepted
H4	GFA*RRI→SCA	Sin:0.161	Sin:0.055	Sin:2.932	Sin:0.003	Sin:Accepted
		Mal:0.150	Mal:0.055	Mal:2.726	Mal:0.007	Mal:Accepted
		Chi:0.115	Chi:0.034	Chi:3.373	Chi:0.001	Chi:Accepted
H5	GSC*RRI→SCA	Sin:0.147	Sin:0.074	Sin:1.980	Sin:0.048	Sin:Accepted
		Mal:0.118	Mal:0.053	Mal:2.22	Mal:0.027	Mal:Accepted
		Chi:0.119	Chi:0.034	Chi:3.502	Chi:0.000	Chi:Accepted
H6	GII*RRI→SCA	Sin:0.181	Sin:0.063	Sin:2.866	Sin:0.004	Sin:Accepted
		Mal:0.132	Mal:0.05	Mal:2.659	Mal:0.008	Mal:Accepted
		Chi:0.097	Chi:0.033	Chi:2.947	Chi:0.003	Chi:Accepted
H7	GFA*ETI→SCA	Sin:0.122	Sin:0.058	Sin:2.120	Sin:0.034	Sin:Accepted
		Mal:0.149	Mal:0.053	Mal:2.819	Mal:0.005	Mal:Accepted
		Chi:0.158	Chi:0.031	Chi:5.073	Chi:0.000	Chi:Accepted
H8	GSC*ETI→SCA	Sin:-0.057	Sin:0.054	Sin:1.048	Sin:0.295	Sin:Rejected
		Mal:0.071	Mal:0.070	Mal:1.013	Mal:0.311	Mal:Rejected
		Chi:0.181	Chi:0.031	Chi:5.784	Chi:0.000	Chi:Accepted
H9	GII*ETI→SCA	Sin:0.204	Sin:0.067	Sin:3.031	Sin:0.003	Sin:Accepted
		Mal:0.027	Mal:0.057	Mal:0.473	Mal:0.636	Mal:Rejected
		Chi:0.106	Chi:0.018	Chi:6.023	Chi:0.000	Chi:Accepted
H10	GFA→GII→SCA	Sin:0.104	Sin:0.028	Sin:3.724	Sin:0.000	Sin:Accepted
		Mal:0.090	Mal:0.027	Mal:3.312	Mal:0.001	Mal:Accepted
		Chi:0.112	Chi:0.017	Chi:6.581	Chi:0.000	Chi:Accepted
H11	GSC→GII→SCA	Sin:0.102	Sin:0.039	Sin:2.661	Sin:0.008	Sin:Accepted
		Mal:0.039	Mal:0.019	Mal:2.116	Mal:0.035	Mal:Accepted

5.0 Discussion

There are similar significant positive effects for most hypotheses across the three countries. This study reveals the critical role of rational allocation of resources with environmental sustainability orientation in building sustainable competitiveness of enterprises, which is consistent with Hart's (1995) natural resource-based view and with the findings of Chuang and Huang(2018) and Singh et al. (2019). The positive impact of green supply chain integration on enterprises has also been confirmed (Wong et al., 2020; Zhou et al., 2020). Therefore, green finance awareness and a green supply chain are crucial for enterprises to build sustainable competitiveness. The findings are consistent with the research results of Kraus et al. (2020), Li et al. (2020b), and Wu et al. (2020) that green finance awareness and supply chain can promote enterprise innovation and verify the positive impact of green innovation on the long-term development of enterprises (Huang & Li, 2017; Bhatia & Jakhar, 2021; Wang & Juo, 2021). This study responds to Penrose's (1959) and Daniel et al. (2004) views that redundant resources can help enterprises adapt to and grasp the rapid

changes in the internal and external environment, thus triggering enterprises to innovate to take advantage of environmental opportunities.

However, hypotheses H8 assumption is not significant in Malaysia and Singapore. The H9 assumption is not significant in Malaysia. The results of this study are consistent with the research results on environmental turbulence. Through internal cross-functional collaboration and continuous improvement learning, companies have improved their responsiveness to green value propositions, thereby better leveraging the growth opportunities presented by market turbulence (Wu, 2013). However, it will also shorten the technology cycle of incumbent dominant enterprises, shortening the window of technological advantage opportunity that can bring competitive advantage (Zhou et al., 2019; Xu Zhi et al., 2020). This will weaken the positive impact of technological turbulence, resulting in the moderating effect of technological turbulence not being significant. For firms with weak technical knowledge and limited innovation capabilities, market opportunities in a technologically volatile environment are difficult to capture and exploit (Tariq et al., 2019).

This result also reflects that China attaches importance to the Belt and Road Initiative and the supply chain. China has the ability and willingness to lead other countries, so hypotheses H8 is significant in China and not significant in Malaysia and Singapore. China is an economic power, Singapore is a developed country, and Malaysia is a developing country; the green innovation capacity of the economy needs to be strengthened, so hypotheses H9 is significant in China and Singapore but not significant in Malaysia. (Chong, et al., 2023).

6.0 Conclusion

This paper contributes to both theory and practice. In theory, First examines the mechanism of green finance awareness on sustainable Competitiveness from the practical perspective. Secondly, it offers theoretical suggestions for enhancing the level of green cost among organisations, accelerating the greening of the supply chain and value chain, and building sustainable Competitiveness by examining the green supply chain's function in forming sustainable Competitiveness. Thirdly, it clarifies the connection between green economic recognition and sustainable Competitiveness, introduces the mediating effect of green supply chain and green Innovation, and deepens the theoretical research of green Innovation. Fourthly, it combines internal resource conditions and external environmental factors and explores the contingency effect of redundant resources and environmental turbulence.

This study has practical implications and recommendations for enterprise chair executives, such as the CEO, CFO, and COO. For example, the findings show that organisations are changing the traditional concept that environmental protection will add cost and hurt profits. Secondly, practical implications for promoting the supply and price chain greening. Thirdly, it helps boost green Innovation and inspires enthusiasm for green product and process innovation. Fourthly, It will also guide enterprises in paying attention to the internal constraints represented by redundant resources and the external

environmental factors represented by environmental turbulence, which play an essential roles in constructing sustainable Competitiveness.

However, this study is limited by the influence of time, cost, workforce, and other factors. The external factors, such as the economic level of the city where the enterprise is located, the local environmental protection regulations, and the internal factors. Such as Firstly, the limitations of data sources. The industrial environment where enterprises are located is very different for different industries; Secondly, the limitations of research methods. There are limitations that cross-sectional data cannot fully depict the long-term and dynamic nature of green finance awareness affecting sustainable competitiveness; Thirdly, the limitations of control variables. the enterprise management's level and the enterprise's main business, will affect the implementation of the green finance consciousness, as such, future studies should consider incorporating more control variables into the study to improve the reliability of hypothesis testing.

The recommendation for future research in this study is to explore the role of environmentally sustainable resources in building sustainable Competitiveness from the enterprise-level perspective. Leaders at the organisational level and employees at the individual level also play an essential role in implementing and enforcing green finance awareness. Therefore, future research needs to combine various theoretical perspectives to construct the theoretical framework of the mechanism of green finance consciousness on sustainable Competitiveness from multi-level and multi-angle.

In the future, a dynamic measurement model or simulation can be introduced to analyse and predict the long-term dynamic impact to provide a reference for improving the efficiency of enterprise green value.

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Article Contribution to Related Field of Study

More studies on agencies' energetic environmental obligations are needed strategically. The scope of the study expands the impact of green financial concepts from a long-term and natural resource-based perspective. The theoretical version of green finance awareness promoting sustainable competitiveness has no longer been formed. This paper: constructs the theoretical model. The current research does not comprehensively consider internal regulations and the external environment. This paper: introduces two moderating and broadens the scope of ecological modernization theory studies.

Authors Declaration

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