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The impact of green innovations accounting on firm value: Moderating role of intangible assets in Saudi industrial sector

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Abstract

The purpose of this study is to close the gap in the literature and offer new perspectives on the relationship between business value, green innovation, accounting, and intangible assets. This study seeks to increase our knowledge of how intangible assets mediate the relationship between company value and green innovation accounting. The study sample is composed of manufacturing businesses from 13 Saudi Arabian industrial locations. The total final sample collected consists of 727 industrial firms in the Saudi environment for the year ended in 2023. Results indicate that green innovation accounting has a positive effect on firm value, and intangible assets also positively affect firm value. Increasing the components of intangible assets leads to a greater increase in firm value, and the interaction between the total green innovation index and the logarithm of capitalized intangibles results in a further increase in firm value. The results also show that the interaction between green innovation, measured by the natural logarithm of R&D, and the components of intangible assets positively affects firm value. Increasing the interaction between green innovation, measured by the natural logarithm of R&D, and intangible assets leads to a further increase in firm value.

Keywords: Firm value (FV), Green innovations accounting (GIA), Intangible assets (IA).

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1. Introduction

Considering how operations impact environmental hazards has changed the manufacturing process through green innovation (GI) and other business innovations brought about by the adoption of sustainability models [1]. Inextricably linked to the argument over GI implementation is the industrialization issue, which is positively associated with both climate change and environmental pollution rates by variables including the increasing use of hazardous chemicals, carbon gas emissions, pollution, and waste that isn't useful [2].

One of the methods for assessing long-term sustainability is green innovation, which helps businesses boost productivity, enhance financial performance, profitability, and competitive advantage; lessen social and governmental pressures (El-Kassar and Singh [3]; Li, et al. [4] and Sangwan and Choudhary [5]) and relate to adherence to government-issued or approved institutional standards (Husnaini and Tjahjadi [6]).

In accordance with agency theory, participants have the same rights as investors to learn about green intellectual properties, advance renewable energy and technology to reduce pollution, and regulate emissions and pollutants to boost business success and profits and build corporate value. When the company discloses information about its green innovation property, it sends a signal to potential investors that it has promising future prospects. The market will respond by raising stock prices, which will increase the value of the business [7].

Therefore, businesses that use green innovation must constantly improve their efficiency and effectiveness to maintain a competitive edge that can raise their value. They also need to change their business strategy from one that initially used labor-based methods to one that is knowledge-based [8]. An intangible asset is created when knowledge is transformed and capitalized into assets for the business [9]. Information and expertise are examples of intangible assets that need to be well managed in order to generate a competitive advantage [8].

Even though organizations like the IRFS Foundation and the IASB have released guidelines that largely satisfy the requirements of investors, the capital markets, multinational corporations, and institutions like the World Bank, other initiatives, like the GRI and the EU Directive on Non-Financial Reporting, have learned more about sustainability and investor impact issues. In order to assess the potential value of their significant investments, such as advertising and R&D, businesses typically try to account for intangibles.

The definitions given by IFRS and US GAAP state that intangible assets are not tangible but nonetheless qualify as assets since they must create future financial gains for the company. In accordance with the revised standard, which considers "the future economic benefits gathered as a result of past transactions," distinct recognized intangibles must be regarded as a component of the exchange between the buyer and the acquired business in a merger rather than the result of distinct transactions. For instance, copyrights, trademarks, and patents are examples of intangible assets. According to Mazzi, et al. [10], goodwill is another intangible asset that can be identified when purchasing a corporation. A distortion of accounting information results from the neglect of intangible assets in pertinent corporate characteristics, such as book values [11].

Park [12] contends that changes in accounting regulations pertaining to intangible assets over the past few decades have reduced the explanatory power of the widely used B/M ratio. One possible approach has been to incorporate intangible assets into a company's book value in order to better represent the fundamental underpinning needed by value investment. Existing research demonstrates how an intangible-adjusted B/M factor performs noticeably better than its standard counterpart for U.S. markets. The intangible-adjusted value factor has performed significantly better than the standard value factor, particularly in the last ten years.

Theoretically, green innovation, which aims to improve sustainability and lessen its influence on the environment, should raise the company's market value. However, little research has been done on these phenomena [13]. Accounting figures are particularly significant as summaries of business success since they ought to represent the economic substance of a company's operations and profits [14]. Thus, we concentrate on how the results of green innovation impact the value of businesses.

Although this subject has been briefly discussed in previous studies, none have particularly examined the role of intangible assets as a mediating variable between business value and green innovation accounting. This leads to a knowledge gap that this study attempts to close, providing a fresh avenue for investigation. The objective of this study is to close the gap in the literature and offer new perspectives on the relationship between firm value, green innovation, accounting, and intangible assets. Thus, the study seeks to increase our knowledge of how intangible assets mediate the relationship between firm value and green innovation accounting.

The remainder of this work is arranged as follows. The next section contains a review of the literature and conceptual presumptions. Section 3 describes in detail the approach, data sources, and important variables' construction. Section 4 summarizes the empirical findings and reports on the robustness tests. Section 5 contains the final results and policy recommendations.

2. Literature Review and Hypotheses Development

2.1. Green Innovation Accounting

Green accounting is described as "systematic documentation and analysis, sustaining a positive relationship among businesses and the environment, and promoting effective and efficient environmental initiatives to attain sustainable growth." It is further described as a "quantitative assessment of the expenditures and advantages of environmental protection initiatives." Businesses must internalize the external costs of manufacturing operations once green accounting is implemented, which raises production and operating expenses. Therefore, businesses need to improve product design, including green innovation, to maintain current earnings or reduce expenses [15].

According to Huang and Li [16] "GI" refers to a form of innovation that a company carries out with the intention of lowering the risk of adverse environmental effects while simultaneously offering advantages to the environment [2, 6]. Innovation in hardware or software that is linked to green products or green processes includes technological advancements that have led to energy savings, waste reduction, pollution prevention, environmentally friendly product design, or environmental management by a company that aims to shield the environment from dangerous substances.

GI which encompasses all the words pertinent to environmental innovation activities, was described by Zhang, et al. [17] using a broader perspective. Therefore, businesses must make large resource investments and pay high opportunity costs in

order to implement GI. It puts businesses in a comparatively disadvantageous position in the market and consumes resources that may be used for other value-added operations [18].

In particular, green innovation damages current production and sales by consuming resources that could be employed for other investment activities or daily operations [19, 20]. The return on investments made in green innovation initiatives is uncertain and takes a long time [21]. Green innovation has also been the subject of extensive research by numerous academics. They discovered that the green innovation of businesses will be impacted by the digitization of businesses, the term of the CEO, green finance, and foreign ownership [22].

2.2. Firm's Value and Green Innovation Accounting

The company's objective is to fulfill the interests of other stakeholders in addition to the owners' interests as shareholders. Businesses meet their social and environmental responsibilities as well as their economic ones by creating eco-friendly company innovations that align with the sustainable development goals (SDGs) [23]. Increasing the transparency of green innovation information in the social responsibility report is one way that businesses worldwide are responding to stakeholder pressure by providing non-financial information to stakeholders in addition to traditional financial reports [24].

In addition to lowering the risks of information asymmetry and adverse selection, increasing the level of green innovation accounting can highlight businesses' social responsibility initiatives and give stakeholders useful data to aid in decision-making [18]. GI has been shown to improve corporate performance in a number of empirical investigations. According to this study, firms worth will be greatly impacted by how creatively it fulfills its social responsibilities. According to this research, environmental innovation may boost the company's expansion [21].

Additionally, research by Agustia, et al. [25] using samples of manufacturing firms listed in Indonesia demonstrates that green innovation techniques increase firm value. Businesses that embrace green innovation can save money increase the efficiency of their use of raw materials, and lower the costs associated with environmental penalties.

As a result, they can make more money by creating green innovations that will help them develop a green reputation, diversify their product offerings, and increase their market share in the future [23]. However, because green innovation has a high reputation, it is possible to get financing at a reasonable cost. This cash can then be used by businesses to improve the efficiency of their production departments and, ultimately, increase their value [18].

Tu and Huang [15] assert that innovation can cut costs related to environmental improvement while simultaneously incentivizing companies to use more productive labor, resources, and raw materials. By doing this, businesses can become more competitive and productive with their resources. Corporate competitiveness is positively impacted by businesses' green innovation performances. Complete control over environmental financial data can help reduce waste, cut costs, and prevent dangers by improving production and design processes that are harmful to environmental protection.

According to the results of their study, Vargas, et al. [26] found that green innovation has a positive moderating effect on green accounting and a business's financial performance, which may reflect profitability. This suggests that by providing more indications of a business's dedication to sustainability and green innovation, the correlation between profitability and green accounting can be improved, which in turn affects firm value.

It is anticipated that green innovation would address global concerns regarding techniques, procedures, technologies, and goods that negatively affect the environment, thereby enhancing the company's performance through higher income. Lastly, the company's quality and performance in terms of efficiency and sales are also enhanced by green innovation [24].

The connection between FV and GI can be explained by the NRBV theory. According to the NRBV hypothesis, a company's competitive advantage stems from both non-technological and technological resources that are based on environmentally friendly regulations. By utilizing resources more effectively, environmentally friendly policies can boost business productivity, lower operational costs, and improve financial performance [27, 28]. Therefore, it can be explained by the NRBV hypothesis that green innovation is a company resource that will result in superior financial performance and contribute to environmental sustainability. Similarly, green innovation can lower manufacturing costs and boost company value when implemented in accordance with relevant environmental requirements [29].

Two key concerns are how to quantify GI and quantify its accounting impact. First, empirical research frequently uses green patent data as a stand-in indicator of GI [30-32]. Businesses' patent data efficiently tell financial markets about their innovation output and R&D skills and directly represent the results of their R&D efforts [33]. Furthermore, when it comes to gauging green innovation, the green patent ratio might be a more accurate indicator than green patent counts. It can successfully get rid of other invisible elements, like an innovation subsidy program, that promote green innovation.

Alternatively, the percentage of green patent applications relative to all patent applications, for instance, might be used to illustrate the direction of corporate innovation efforts. as well as the shift in green innovation output. Second, Tobin's q has been extensively employed in empirical research as a stand-in measure of business value [34]. It is a thorough representation of capital market performance and corporate accounting data that skillfully accounts for a business's activities and potential expansion. Furthermore, Tobin's q is more resistant to management manipulation than financial measures like ROE and ROA.

The following related H1 is therefore proposed:

H_1: Green innovation accounting has a positive effect on firm value.

2.3. Intangible Assets and Firm Value

Intangible assets, which are non-monetary assets without a physical form that are uniquely identifiable (either by being separable or originating from contractual or other legal rights), are subject to the accounting principles specified in IAS 38. Before being systematically amortized over the course of their useful lives (unless the asset has an infinite useful life, in

which case it is not amortized), intangible assets that meet the required recognition criteria are first valued at cost and then valued at cost or using the revaluation model [35, 36].

The IASB [36] and Georgiou [35] state that there is a comparatively wide range of intangible assets. Patented technological advances, software for computers, databases, and trade secrets are among them; trademarks, trade dress, newspaper mastheads, internet domains, and video and visual content; client lists; mortgage-providing rights; licenses, rulings, and standstill deals; import limits; franchise agreements; and customer and supplier relationships.

Intangible assets come in many forms, such as the form of databases, goodwill, green human resources, sustainable design, green exploration for minerals, sustainable brands, green programs, emphasized green R&D, green management, sustainable advertising, sustainable goods, sustainable manufacturing, and green national accounting, according to Hasanudin, et al. [37].

Numerous studies examine how certain forms of intangible assets (such patents, trademarks, and research and development) or their sub-components affect company performance, firm value, and productivity at the firm and national levels. In recent times, some academics have concentrated on the relationship between IA and FV, as well as the sub-components of intangible assets Hasanudin, et al. [37].

The impact of IA and their subcomponents on business value and sustainable growth in Turkey is examined in a study Ocak and Fındık [38]. In this study, test variables included the cumulative (i.e., aggregative) value of enterprises' intangible assets as well as sub-components of those assets. The overall value of IA has a favorable impact on FV and the rates of sustainable development of enterprises, according to estimation results from the OLS and Heckman two-stage methodologies. When the total value of IA is broken down into three smaller parts, databases, computerized information, and economic skill all have an impact on the firm value and sustainable development rates of businesses.

De Boer [39] incorporates intangible assets into the ratio of total assets to enterprise value and discovers a strong relationship between the ratio and anticipated stock performance in the future. Gulen, et al. [40] demonstrate the benefits of accounting for intangibles in terms of value, investment, and profitability. Thus, we can conclude that the importance of accounting for intangibles is examined throughout a broader range in addition to being emphasized by the beneficial effect on the value factor.

More than half of a company's total capital may come from domestically generated intangible assets, which can be acquired or created internally (e.g. patents, copyrights, intellectual property, brands), according to recent U.S. study [41, 42]. Internally generated IA have grown in importance as a component of a company's worth, particularly in the past ten years.

Researchers are better able to explain the connection between business value and intangible assets. Because they incur greater adjustment costs, businesses with high levels of intangibles are able to adapt their operations to shifting economic conditions. Even with long-only limits, investors can receive a bigger risk premium by adjusting HML by intangible assets. Ineffective accounting-based representations of intangible assets can impact quality, investment, and value, among other aspects Vincenz [43].

Vincenz [43] developed an intangible-adjusted value factor, hence the term "intangible value factor" or simply HMLINT, to analyze the impact of intangible-adjusted book values on the value factor in foreign markets. Although the approach of Fama and French's value factor is closely followed in the construction of HMLINT, goodwill is subtracted from the book value, and the stated proxy for intangible assets is added. The intangible-adjusted book-to-market ratio, which results from sorting a company's book value by internally created intangible assets, performs noticeably better than the traditional value factor. The following related H2 is therefore proposed.

H_2: Intangible Assets has a positive effect on firm value.

2.4. Intangible Assets on relation between Green Innovations Accounting and Firm Value

An important intangible asset that influences firm value is green innovation, which helps businesses turn the objective of environmental sustainability into a lucrative investment opportunity. We were the first to connect the accounting effects of GI with the literature on innovation and firm value. According to this paradigm [33], the financial market will value the bundle of an organization's assets at the current discounted value of every future revenue that the assets will generate. The observed market value of the company should represent the value of intangible assets if they are anticipated to have an impact on future cash flow.

According to this theory, the financial market will be impacted when determining an organization's worth if GI is anticipated to impact future cash flows through production management, marketing, reputation, and other factors [21]. A company's success is impacted by intangible assets in two different ways: It lowers overall costs, to start. Secondly, it boosts the market worth of the goods and services the company sells. Both production and service delivery efficiency are increased when intangible assets are at higher levels. In order to increase their competitiveness, the majority of businesses have recently shown a strong interest in intangible assets rather than monetary and tangible capital [44].

Businesses with significant intangible assets have proven to investors their prowess in corporate governance, social responsibility, and environmental preservation. Their credit standing in the financial sector is improved as a result of Kong [45] which makes it easier to win over investors and provide ongoing funding for tenacious green innovation projects. Businesses are now under less financial strain thanks to the money infusion from green investors, which encourages them to continue their GI efforts [22, 46].

A study by Liao [47]. reveals that GI methods are seen as an essential strategy for organizations to achieve environmentally friendly development and acquire funding. Therefore, in order to preserve a competitive edge that might raise the value of the company, businesses that use green innovation must constantly enhance their efficiency and effectiveness. According to Wang, et al. [48] sustained green innovation necessitates significant financial resources for

research and development, which involves laborious procedures and significant risks. As a result, a lot of investors can voice worries about possible hazards and put stricter restrictions on related investments [18].

2.4.1. The Value Relevance of Intangibles Assets

The importance of investing in intangibles like stock returns and future earnings, can be demonstrated empirically. This is especially true when it comes to R&D, advertising, and patents on green innovation and business value. Compared to the benefits of investing in tangible assets, the future returns on R&D green investments are less guaranteed [49]. Furthermore, even when a company's R&D assets are conservatively stated on the balance sheet, market analysts frequently attempt to ascertain a reasonable value for these assets [50].

These valuations may be especially important for businesses getting ready for IPOs or mergers and acquisitions (M&As) [51]. Furthermore, funding R&D could lead to less information asymmetry, cheaper loan costs Kreß, et al. [52] and more effective tax allocations [14, 53].

Some post-2000 studies have focused on the long-term effects of effective advertising on current and potential clients, as well as the favorable correlation between it and future stock performance. For instance, high advertising costs typically do not help predict stock prices, according to Hodgson, et al. [54]. However, in the case of M&A, they typically lead to greater profits. When predicting stock prices, investors should take into account additional non-accounting-based intangible information, even though accruals for advertising expenses are favorably correlated with abnormal returns.

Another intangible that is still being closely examined is green patents. It is generally agreed that during an initial public offering (IPO), providing information about patent-protected products to prospective investors lessens information asymmetry. For instance, there are fewer forecasting mistakes for future earnings the more R&D expenditures are covered by patents. It goes without saying that this facilitates decision-making for potential investors. The number of patents held and patent citations obtained are positively correlated with an institution's investment horizons, according to Kim, et al. [55] examination of US corporations' patent holdings.

The connection between R&D accounting, patents, and management practices has also been examined by a number of writers (e.g. [56, 57]). Here, the empirical data indicates that when a company's working horizon is limited, managers file more patents per dollar of R&D expenses [56]. As a result, investors are influenced to depreciate a company's value more when they think a manager's stay is or will be brief. Therefore, managers must choose between the company's worth and the duration of their managerial horizon [58]. Thus, the H3 that is put out is.

H_3: Intangible Assets supported the relationship between the GIA and the firm value.

3. Research Design

3.1. Data and Sample

The research sample consists of manufacturing businesses. Out of 13 industrial locations in Saudi Arabia, the sample data tracing results were shown. Taking into consideration a variety of variables, such as the availability of balanced full panel data reflecting the indicators used as proxies for the previous year, 11,898 firm-years of observations were made using panel data. Meanwhile, content analysis, which is carried out manually through public reports, is employed for data on green innovation.

Consequently, according to the above considerations, the total final sample that managed to be collected is 727 industrial firms in the Saudi environment for the year ended in 2023. In this regard study sample can be distributed as follows.

Table 1.
Distribution of sample &quantity of observations.

No	Industrial area	Population of manufacturing firm	Σ Sample	% Sample distribution
1	Riyadh	4626	282	38.79%
2	Eastern Region	2696	165	22.70%
3	Al-Qassim	578	35	4.81%
4	Mecca	2257	137	18.84%
5	Jizan	205	13	1.79%
6	Al-Baha	52	4	0.55%
7	Hail	148	9	1.24%
8	Tabuk	119	7	0.96%
9	Northern Borders	61	4	0.55%
10	Al-Jawf	90	6	0.83%
11	Asir	406	24	3.30%
12	Najran	90	6	0.83%
13	AL Madinah	570	35	4.81%
Σ (Total Count)		11898	727	100%

3.2. Variables

3.2.1. Green Innovation (GI)

Is measured using eight items, four of which are for product innovation and four of which are for process innovation. The GI measuring items were developed from the content analysis of companies' public reports, in accordance with earlier research [21, 25, 34]. Accordingly, each measurement item is assigned a degree between 0 and 2 [21] with 0 denoting firms with no description, 1 denoting a simple description without implementation details (e.g., a detailed plan or implementation procedure relating to green innovation), and 2 denoting a full description with details (numerical indicators and the type of product/process innovation are examples of proper environmental practices). In order to create the final data that represented GI, then computed a total for each component and used the item average. Each item is described in greater detail in the table below.

Table 2.
GI index.

No.	Sub Dimension	Item
(1)	Process innovation	Strives to use less energy, water, and resources.
(2)		Make use of environmental technologies, recycling methods, and recycled materials.
(3)		Organizing environmental campaigns.
(4)		Utilize or modify technology and equipment to cut down on waste, water, and energy.
(5)	Product innovation	Change the product's design to avoid using hazardous materials or causing pollution during manufacture.
(6)		Enhance and create eco-friendly packaging for both new and current items.
(7)		Design new products or alter existing ones to increase energy efficiency while in use.
(8)		Less harmful or polluting components are used in this product.

3.2.2. Firm Value

It is can be measured by Tobin's Q, which is calculated as the sum of an equity' market value and liabilities' book value divided by total assets [59].

3.2.3. Intangible Asset

The company's ability to create intangible assets is measured by its capacity to increase goodwill, patents, advertising costs, and capitalized intangibles. Consequently, this research depended on a numerical scale based on the logarithm of each item from the intangible assets to all disclosed intangible assets in the financial statements.

3.2.4. Control Variables

This study depends on the most influential variables on the dependent variable of this study, which is the firm value. Consequently, the current study follows Shan, et al. [22] and Zaid, et al. [60] in determining the most suitable control variables, which are: firm revenue growth, measured by the percentage change in annual revenue; financial leverage, determined by dividing total liabilities by total assets; firm size, determined by taking the natural logarithm of total assets; cash flow efficiency, determined by dividing operating cash flow by total assets; and profitability, determined by dividing earnings before interest and taxes by total assets.

3.3. Empirical Models

Testing the primary hypotheses of this research necessitates developing empirical models for each hypothesis separately. In this regard, testing the first hypothesis for the relationship between the GI and FV requires running the following empirical model from (1) to (3):

$$Tobin's\ Q = \alpha + \beta 1\ Process\_GI + \beta 2\ Rev\% + \beta 3\ Lev + \beta 4\ Size + \beta 5\ CFO + \beta 6\ ROA + \varepsilon \quad (1)$$

$$Tobin's\ Q = \alpha + \beta 1\ Product\_GI + \beta 2\ Rev\% + \beta 3\ Lev + \beta 4\ Size + \beta 5\ CFO + \beta 6\ ROA + \varepsilon \quad (2)$$

$$Tobin's\ Q = \alpha + \beta 1\ Total\_GI + \beta 2\ Rev\% + \beta 3\ Lev + \beta 4\ Size + \beta 5\ CFO + \beta 6\ ROA + \varepsilon \quad (3)$$

Equations from (4) to (7) relate to the relationship between intangible assets (IA) and the FV. This relationship is of interest to the second hypothesis; consequently, these equations must be run to test the hypothesis.

$$Tobin's\ Q = \alpha + \beta 1\ GWI + \beta 2\ Rev\% + \beta 3\ Lev + \beta 4\ Size + \beta 5\ CFO + \beta 6\ ROA + \varepsilon \quad (4)$$

$$Tobin's\ Q = \alpha + \beta 1\ PTI + \beta 2\ Rev\% + \beta 3\ Lev + \beta 4\ Size + \beta 5\ CFO + \beta 6\ ROA + \varepsilon \quad (5)$$

$$Tobin's\ Q = \alpha + \beta 1\ ACI + \beta 2\ Rev\% + \beta 3\ Lev + \beta 4\ Size + \beta 5\ CFO + \beta 6\ ROA + \varepsilon \quad (6)$$

$$Tobin's\ Q = \alpha + \beta 1\ CI + \beta 2\ Rev\% + \beta 3\ Lev + \beta 4\ Size + \beta 5\ CFO + \beta 6\ ROA + \varepsilon \quad (7)$$

Equations from (8) to (19) related to the relationship between the interaction of GI index with IA index and the FV. This relationship is of interest of the third main hypothesis, consequently these equations must be running for testing the third hypothesis.

$$Tobin's\ Q = \alpha + \beta 1\ Process\_GI \times GWI + \beta 2\ Rev\% + \beta 3\ Lev + \beta 4\ Size + \beta 5\ CFO + \beta 6\ ROA + \varepsilon \quad (8)$$

$$Tobin's\ Q = \alpha + \beta 1\ Product\_GI \times GWI + \beta 2\ Rev\% + \beta 3\ Lev + \beta 4\ Size + \beta 5\ CFO + \beta 6\ ROA + \varepsilon \quad (9)$$

$$Tobin's\ Q = \alpha + \beta 1\ Total\_GI \times GWI + \beta 2\ Rev\% + \beta 3\ Lev + \beta 4\ Size + \beta 5\ CFO + \beta 6\ ROA + \varepsilon \quad (10)$$

$$Tobin's\ Q = \alpha + \beta 1\ Process\_GI \times PTI + \beta 2\ Rev\% + \beta 3\ Lev + \beta 4\ Size + \beta 5\ CFO + \beta 6\ ROA + \varepsilon \quad (11)$$

$$Tobin's\ Q = \alpha + \beta 1\ Product\_GI \times PTI + \beta 2\ Rev\% + \beta 3\ Lev + \beta 4\ Size + \beta 5\ CFO + \beta 6\ ROA + \varepsilon \quad (12)$$
$$Tobin's\ Q = \alpha + \beta 1\ Total\_GI \times PTI + \beta 2\ Rev\% + \beta 3\ Lev + \beta 4\ Size + \beta 5\ CFO + \beta 6\ ROA + \varepsilon \quad (13)$$
$$Tobin's\ Q = \alpha + \beta 1\ Process\_GI \times ACI + \beta 2\ Rev\% + \beta 3\ Lev + \beta 4\ Size + \beta 5\ CFO + \beta 6\ ROA + \varepsilon \quad (14)$$
$$Tobin's\ Q = \alpha + \beta 1\ Product\_GI \times ACI + \beta 2\ Rev\% + \beta 3\ Lev + \beta 4\ Size + \beta 5\ CFO + \beta 6\ ROA + \varepsilon \quad (15)$$
$$Tobin's\ Q = \alpha + \beta 1\ Total\_GI \times ACI + \beta 2\ Rev\% + \beta 3\ Lev + \beta 4\ Size + \beta 5\ CFO + \beta 6\ ROA + \varepsilon \quad (16)$$
$$Tobin's\ Q = \alpha + \beta 1\ Process\_GI \times CI + \beta 2\ Rev\% + \beta 3\ Lev + \beta 4\ Size + \beta 5\ CFO + \beta 6\ ROA + \varepsilon \quad (17)$$
$$Tobin's\ Q = \alpha + \beta 1\ Product\_GI \times CI + \beta 2\ Rev\% + \beta 3\ Lev + \beta 4\ Size + \beta 5\ CFO + \beta 6\ ROA + \varepsilon \quad (18)$$
$$Tobin's\ Q = \alpha + \beta 1\ Total\_GI \times CI + \beta 2\ Rev\% + \beta 3\ Lev + \beta 4\ Size + \beta 5\ CFO + \beta 6\ ROA + \varepsilon \quad (19)$$

Finally, all variables mentioned in the above empirical models can be explained according to Table 3 as follow:

Table 3.
Variables definition.

Abbreviation	Variables
Tobin's Q	Firm Value;
Process_GI	Process innovation from the green innovation index;
Product_GI	Product innovation from the green innovation index;
Total_GI	Total green innovation index;
GWI	Logarithm Goodwill value from the total intangible assets;
PTI	Logarithm Patents value from the total intangible assets;
ACI	Logarithm Advertising costs value from the total intangible assets;
CI	Logarithm Capitalised intangibles value from the total intangible assets;
Rev%	Revenue Growth;
Lev	Financial Leverage;
Size	Firm Size;
CFO	Cash Flow ratio
ROA	Profitability Ratio

Table 4.
Descriptive statistics of main variables.

Variables	Obs.	Mean	Std. dev.	Min.	Max.
Tobin's Q	727	1.063	0.098	0.815	1.148
Process_GI	727	0.992	0.813	0.000	2.000
Product_GI	727	0.990	0.816	0.000	2.000
Total_GI	727	0.991	0.682	0.000	2.000
GWI	727	3.094	1.408	1.000	5.000
PTI	727	4.223	2.028	1.000	7.000
ACI	727	3.092	1.385	1.000	5.000
CI	727	3.470	1.226	1.000	5.667
Rev%	727	0.054	0.061	-0.055	0.155
Lev	727	0.049	0.175	-0.255	0.355
Size	727	5.679	1.190	3.615	7.733
CFO	727	0.053	0.099	-0.115	0.226
ROA	727	0.114	0.130	-0.115	0.337

4. Data Analysis, Results and Discussion

4.1. Summary Statistics

Table 4 shows that Tobin's Q mean is equal to 1.063, which is greater than 1, indicating that the firms listed in the research sample are capable of creating value, and the sample mean is approximately at the maximum level. In the same vein, the means of green innovation at the product and process levels are equal to 0.992 and 0.990, respectively. Thus, the current study can assure that the majority of the firms tend to disclose information about green innovation without providing more details, and this result agrees with other previous studies.

The means of intangible asset components in my sample are highly expressed because all means are close to the maximum level; here they are equal to 3.094, 4.223, and 3.092 respectively for goodwill, patents, advertising costs, and capitalized intangibles.

4.2. Correlation Matrix

The correlation coefficients between the primary research variables are shown in Table 5. As a result, there is a positive and significant relationship between the firm value, as determined by Tobin's Q, and the green innovation dimensions related to the product and process. This suggests that increasing the green innovation dimensions raises the firm value. Furthermore, there is a positive correlation between the dimensions of intangible assets and the business value, as determined by Tobin's Q, meaning that an increase in these dimensions results in a greater capacity to create value.

Table 5.
Correlation Matrix.

	Variables	**-1**	**-2**	**-3**	**-4**	**-5**	**-6**	**-7**	**-8**	**-9**	**-10**	**-11**	**-12**	**-13**
-1	Tobin's Q	1												
-2	Process_GI	0.350**	1											
-3	Product_GI	0.311**	0.403**	1										
-4	Total_GI	0.394**	0.837**	0.838**	1									
-5	GWI	0.340**	0.381**	0.367**	0.446**	1								
-6	PTI	0.355**	0.339**	0.360**	0.418**	0.361**	1							
-7	ACI	0.339**	0.369**	0.375**	0.444**	0.380**	0.349**	1						
-8	CI	0.453**	0.472**	0.480**	0.569**	0.725**	0.821**	0.715**	1					
-9	Rev%	-0.007	0.038	-0.01	0.016	0.029	0.042	0.016	0.041	1				
-10	Lev	-0.071	0.037	0.041	0.047	-0.005	0.017	0.012	0.012	-0.028	1			
-11	Size	-0.002	0.002	0.004	0.004	0.002	0.009	0.014	0.011	0.004	0.03	1		
-12	CFO	0.014	0.013	-0.068	-0.033	-0.053	-0.039	0.063	-0.018	0.006	-0.001	-0.009	1	
-13	ROA	0.011	0.039	-0.021	0.011	0.012	-0.006	0.016	0.007	0.025	0.058	0.039	.080*	1

Note: *, **, *** denote significance levels at 10%, 5%, 1% respectively.

4.3. Baseline Results

H1 predicts the effect of GI levels on the firm value measured by Tobin's Q, consequently, the results of the equation from model (1) to model (3) can represented in the following table.

Table 6.
GI levels & FV.

Variables	Model (1)		Model (2)		Model (3)	
	Coef.	p-value	Coef.	p-value	Coef.	p-value
Constant	0.924	0.000	0.925	0.000	0.908	0.000
Process_GI	0.043	0.000				
Product_GI			0.038	0.000		
Total_GI					0.057	0.000
Rev%	-0.038	0.504	-0.012	0.835	-0.027	0.619
Lev	-0.048	0.015	-0.048	0.016	-0.051	0.008
Size	0.000	0.993	0.000	0.983	0.000	0.989
CFO	0.009	0.784	0.034	0.335	0.026	0.436
ROA	0.001	0.961	0.015	0.578	0.008	0.770
Observations	727		727		727	
Model	RE		RE		RE	
F.STAT	17.953		14.143		23.671	
Prob > F	0.000		0.000		0.000	
VIF (MAX)	1.013		1.012		1.012	
Hausman	0.000		0.000		0.000	
R-squared	0.123		0.098		0.158	

Table 6 shows that green innovation levels (Product, Process, and the total index) can explain the change in firm value by 12.3%, 9.8%, and 15.8%, respectively. In addition, model (1) results reflect that Process_GI, which is related to green innovation at the process level, can increase firm value (i.e., a positive significant relationship) where ($\beta = 0.043$, p-value < 5%). Besides, model (2) results reflect that Product_GI, which is related to green innovation at the product level, can increase firm value (i.e., a positive significant relationship) where ($\beta = 0.038$, p-value < 5%). Finally, model (3) results ensure that Total_GI, which is related to the total level of green innovation, can increase firm value (i.e., a positive significant relationship) where ($\beta = 0.057$, p-value < 5%). Consequently, all of these results support H1, which is consistent with Li, et al. [30]; Ma, et al. [31]; Scarpellini, et al. [32], and Yao, et al. [34]. Therefore, we can accept the first hypothesis as follows: green innovation accounting has a positive effect on firm value in Saudi stock-listed industrial firms.

On the other hand, the relationship between intangible assets and firm value can be tested through the equations from model (4) to model (7), and these results can be summarized in the following table.

Table 7.
Intangible assets and firm value.

Variables	Model (4)		Model (5)		Model (6)		Model (7)	
	Coef.	p-value	Coef.	p-value	Coef.	p-value	Coef.	p-value
Constant	0.891	0.000	0.893	0.000	0.894	0.000	0.841	0.000
GWI	0.024	0.000						
PTI			0.017	0.000				
ACI					0.024	0.000		
CI							0.036	0.000
Rev%	-0.032	0.571	-0.041	0.465	-0.025	0.664	-0.046	0.389
Lev	-0.039	0.044	-0.044	0.023	-0.043	0.029	-0.044	0.019
Size	0.000	0.995	0.000	0.941	0.000	0.897	0.000	0.895
CFO	0.031	0.367	0.027	0.438	-0.008	0.817	0.022	0.512
ROA	0.006	0.807	0.012	0.646	0.008	0.757	0.008	0.740
Observations	727		727		727		727	
Model	RE		RE		RE		RE	
F. STAT	16.626		18.464		16.536		32.450	
Prob > F	0.000		0.000		0.000		0.000	
VIF (MAX)	1.012		1.012		1.012		1.012	
Hausman	0.000		0.000		0.000		0.000	
R-squared	0.114		0.126		0.114		0.206	

Table 7 results indicate that the components of intangible assets (Goodwill, patents, advertising costs, and capitalized intangibles) can explain the change in firm value by 11.4%, 12.6%, 11.4%, and 20.6% respectively, which agrees with other studies [41, 42]. Moreover, the above results show that intangible assets positively affect firm value; that is, increasing the

components of intangible assets leads to a greater increase in firm value. The results of model (4) ensure that goodwill leads to a greater increase in firm value (β = 0.024, p-value < 5%), the results of model (5) ensure that patents lead to a greater increase in firm value (β = 0.017, p-value< 5%), the results of model (6) ensure that advertising costs lead to a greater increase in firm value (β = 0.024, p-value < 5%), and finally, model (7) ensures that capitalized intangibles lead to a greater increase in firm value (β = 0.036, p-value < 5%). Therefore, we can accept the second hypothesis as follows: Intangible Assets have a positive effect on firm value in Saudi stock-listed industrial firms.

In another vein, the effect of the interaction between green innovation and the components of intangible assets can be analyzed through four sub-hypotheses. H3-1 predicts the effect of the interaction between green innovation and the goodwill logarithm on firm value, which can be tested by running models from (8) to (10), and the results can be summarized in the following table.

Table 8.
Interaction between green innovation and goodwill logarithm and firm value.

Variables	Model (8)		Model (9)		Model (10)	
	Coef.	p-value	Coef.	p-value	Coef.	p-value
Constant	0.927	0.000	0.927	0.000	0.918	0.000
Process_GI × GWI	0.011	0.000				
Product_GI × GWI			0.010	0.000		
Total_GI × GWI					0.013	0.000
Rev%	-0.041	0.455	-0.021	0.711	-0.034	0.529
Lev	-0.046	0.016	-0.047	0.017	-0.048	0.012
Size	0.000	0.927	0.000	0.972	0.000	0.939
CFO	0.016	0.640	0.035	0.312	0.029	0.392
ROA	0.003	0.903	0.014	0.594	0.008	0.746
Observations	727		727		727	
Model	RE		RE		RE	
F. STAT	21.707		18.452		25.683	
Prob > F	0.000		0.000		0.000	
VIF (MAX)	1.013		1.012		1.012	
Hausman	0.000		0.000		0.000	
R-squared	0.146		0.126		0.169	

Table 8 results indicate that the interaction between green innovation and goodwill logarithm can explain the change in firm value by 14.6%, 12.6%, and 16.9%, respectively, which agrees with other studies. Moreover, the results show that the interaction between green innovation and goodwill logarithm positively affects firm value; that is, increasing the interaction between green innovation and goodwill logarithm leads to a greater increase in firm value. The results of model (8) ensure that the interaction between green innovation at the process level and goodwill logarithm leads to a greater increase in firm value (β = 0.011, p-value < 5%). The results of model (9) ensure that the interaction between green innovation at the product level and goodwill logarithm leads to a greater increase in firm value (β = 0.010, p-value < 5%). Finally, model (10) ensures that the interaction between the total green innovation index and goodwill logarithm leads to a greater increase in firm value (β = 0.013, p-value < 5%).

H3-2 predicts the effect of interaction between the green innovation and the patent intangible logarithm on the firm value, so it can be tested by running models from (11) to (13) and the results can be summarized in the following table.

Table 9.
Interaction between green innovation and patent intangible logarithm and firm value.

Variables	Model (11)		Model (12)		Model (13)	
	Coef.	p-value	Coef.	p-value	Coef.	p-value
Constant	0.925	0.000	0.928	0.000	0.918	0.000
Process_GI × PTI	0.008	0.000				
Product_GI × PTI			0.007	0.000		
Total_GI × PTI					0.010	0.000
Rev%	-0.045	0.416	-0.023	0.686	-0.037	0.494
Lev	-0.050	0.009	-0.050	0.011	-0.052	0.006
Size	0.000	0.870	0.000	0.989	0.000	0.931
CFO	0.017	0.611	0.034	0.321	0.029	0.385
ROA	0.009	0.719	0.014	0.580	0.012	0.629
Observations	727		727		727	
Model	RE		RE		RE	
F. STAT	23.767		19.165		27.096	
Prob > F	0.000		0.000		0.000	
VIF (MAX)	1.012		1.012		1.012	
Hausman	0.000		0.000		0.000	
R-squared	0.158		0.131		0.177	

Table 9 results indicate that the interaction between green innovation and patent intangible logarithm can explain the change in firm value by 15.8%, 13.1%, and 17.7%, respectively, which agrees with other studies. Moreover, the above results show that the interaction between green innovation and patent intangible logarithm positively affects firm value; that is, increasing the interaction between green innovation and patent intangible logarithm leads to a greater increase in firm value. The results of model (11) ensure that the interaction between green innovation at the process level and patent intangible logarithm leads to a greater increase in firm value ($\beta = 0.008$, p-value < 5%). The results of model (12) ensure that the interaction between green innovation at the product level and patent intangible logarithm leads to a greater increase in firm value ($\beta = 0.007$, p-value < 5%). Finally, model (13) ensures that the interaction between the total green innovation index and patent intangible logarithm leads to a greater increase in firm value ($\beta = 0.010$, p-value < 5%).

H3-3 predicts the effect of interaction between the green innovation and the advertising costs intangible logarithm on the firm value, so it can be tested by running models from (14) to (16) and the results can be summarized in the following table.

Table 10.
Interaction between green innovation and advertising costs intangible logarithm and firm value.

Variables	Model (14)		Model (15)		Model (16)	
	Coef.	p-value	Coef.	p-value	Coef.	p-value
Constant	0.929	0.000	0.923	0.000	0.917	0.000
Process_GI × ACI	0.011	0.000				
Product_GI × ACI			0.011	0.000		
Total_GI × ACI					0.013	0.000
Rev%	-0.037	0.505	-0.009	0.875	-0.024	0.663
Lev	-0.045	0.019	-0.044	0.022	-0.046	0.016
Size	0.000	0.965	0.000	0.867	0.000	0.937
CFO	-0.006	0.853	0.023	0.505	0.008	0.816
ROA	0.005	0.856	0.018	0.502	0.011	0.654
Observations	727		727		727	
Model	RE		RE		RE	
F. STAT	22.672		20.039		26.706	
Prob > F	0.000		0.000		0.000	
VIF (MAX)	1.012		1.012		1.012	
Hausman	0.000		0.000		0.000	
R-squared	0.152		0.136		0.175	

Table 10 results indicate that the interaction between green innovation and advertising costs intangible logarithm can explain the change in firm value by 15.2%, 13.6%, and 17.5%, respectively, which agrees with other studies. Moreover, the above results show that the interaction between green innovation and advertising costs intangible logarithm positively affected firm value; that is, increasing the interaction between green innovations and advertising costs intangible logarithm leads to a greater increase in firm value. The results of model (14) ensure that the interaction between green innovation at the process level and advertising costs intangible logarithm leads to a greater increase in firm value ($\beta = 0.011$, p-value < 5%). The results of model (15) ensure that the interaction between green innovation at the product level and advertising costs intangible logarithm leads to a greater increase in firm value ($\beta = 0.011$, p-value < 5%). Finally, model (16) ensures that the interaction between the total green innovation index and advertising costs intangible logarithm leads to a greater increase in firm value ($\beta = 0.013$, p-value < 5%).

H3-4 predicts the effect of interaction between the green innovation and the logarithm capitalized intangibles on the firm value, so it can be tested by running models from (17) to (19) and the results can be summarized in the Table 11.

Table 11 results indicate that the interaction between green innovation and logarithm capitalized intangibles can explain the change in firm value by 17.3%, 14.8%, and 19.8% respectively, which agrees with other studies. Moreover, the above results show that the interaction between green innovation and logarithm capitalized intangibles positively affected firm value; that is, increasing the interaction between green innovation and logarithm capitalized intangibles leads to a greater increase in firm value. The results of model (17) ensure that the interaction between green innovation at the process level and logarithm capitalized intangibles leads to a greater increase in firm value ($\beta = 0.011$, p-value < 5%). The results of model (18) ensure that the interaction between green innovation at the product level and logarithm capitalized intangibles leads to a greater increase in firm value ($\beta = 0.010$, p-value < 5%). Finally, model (19) ensures that the interaction between the total green innovation index and logarithm capitalized intangibles leads to a greater increase in firm value ($\beta = 0.013$, p-value < 5%). Therefore, we can accept the third hypothesis as follows: Intangible Assets supported the relationship between the GIA and firm value in Saudi stock-listed industrial firms.

Table 11.
Interaction between green innovation and logarithm capitalized intangibles and firm value.

Variables	Model (17)		Model (18)		Model (19)	
	Coef.	p-value	Coef.	p-value	Coef.	p-value
Constant	0.922	0.000	0.921	0.000	0.912	0.000
Process_GI × CI	0.011	0.000				
Product_GI × CI			0.010	0.000		
Total_GI × CI					0.013	0.000
Rev%	-0.045	0.411	-0.018	0.741	-0.035	0.520
Lev	-0.048	0.011	-0.048	0.013	-0.050	0.008
Size	0.000	0.927	0.000	0.953	0.000	0.926
CFO	0.010	0.775	0.034	0.326	0.024	0.467
ROA	0.005	0.830	0.016	0.542	0.011	0.665
Observations	727		727		727	
Model	RE		RE		RE	
F. STAT	26.384		22.005		30.785	
Prob > F	0.000		0.000		0.000	
VIF (MAX)	1.012		1.012		1.012	
Hausman	0.000		0.000		0.000	
R-squared	0.173		0.148		0.198	

4.4. Robustness Results

The robustness tests in this section are conducted in two stages: the first relates to the alternative measurements of the independent variable, and the second pertains to the moderating function of the independent variable's alternative measure, which is GI.

4.4.1. Robustness Checks by Alternative Measure of Green Innovation

This section of the current analysis uses the natural logarithm of the total amount spent on research and development across the study period. As a result, Table 12 shows how firm value using Tobin's Q and green innovation using the natural logarithm of R&D are related.

Table 12.
GI using natural logarithm of R&D & FV.

Variables	Baseline model	
	Coef.	p-value
Constant	0.751	0.000
GI%	0.022	0.000
Rev%	-0.021	0.690
Lev	-0.036	0.056
Size	0.000	0.930
CFO	0.005	0.877
ROA	0.019	0.448
Observations	727	
Model	RE	
F. STAT	30.281	
Prob > F	0.000	
VIF (MAX)	1.013	
Hausman	0.000	
R-squared	0.195	

According to the presented results in table no. (12), it is evident that green innovation, using the natural logarithm of the sum allocated for R&D, can explain the change in firm value by 19.5%, which is close to the basic model and aligns with other studies. Moreover, the results indicate that green innovation positively affects firm value; that is, an increase in green innovation leads to a greater increase in firm value. The results confirm that green innovation, utilizing the natural logarithm of R&D, leads to a more significant increase in firm value ($\beta = 0.022$, p-value < 5%). Consequently, the H1 results are supported again using alternative measures.

4.4.2. Robustness Checks by Moderating Effect of Alternative Measure of Green Innovation

Current study used the alternative measure of the green innovation in the moderated models for the three sub hypotheses of the third main hypothesis. Consequently, the results of Table 12 represent the relationship between the moderated variables by the alternative measure of the independent variable as follow.

Table 13.
Moderated model results using a green innovation alternative measure.

Variables	Moderated model (1)		Moderated model (2)		Moderated model (3)		Moderated model (4)	
	Coef.	p-value	Coef.	p-value	Coef.	p-value	Coef.	p-value
Constant	0.889	0.000	0.895	0.000	0.890	0.000	0.863	0.000
GI% × GWI	0.002	0.000						
GI% × PTI			0.002	0.000				
GI% × ACI					0.002	0.000		
GI% × CI							0.003	0.000
Rev%	-0.032	0.563	-0.045	0.410	-0.026	0.638	-0.043	0.406
Lev	-0.040	0.035	-0.043	0.023	-0.043	0.024	-0.043	0.018
Size	0.000	0.967	0.000	0.968	0.000	0.961	0.000	0.947
CFO	0.030	0.379	0.023	0.502	-0.008	0.808	0.017	0.597
ROA	0.011	0.666	0.013	0.605	0.012	0.651	0.013	0.603
Observations	727		727		727		727	
Model	RE		RE		RE		RE	
F. STAT	26.594		26.521		26.856		40.486	
Prob > F	0.000		0.000		0.000		0.000	
VIF (Max.)	1.012		1.012		1.012		1.012	
Hausman	0.000		0.000		0.000		0.000	
R-squared	0.175		0.174		0.176		0.246	

Table 13 results indicate that the interaction between green innovation, measured by the natural logarithm of R&D, and intangible asset components (i.e., goodwill, patent, advertising cost, and capitalized intangibles) can explain the change in firm value by 17.5%, 17.4%, 17.6%, and 24.6%, respectively, which agrees with other studies. Moreover, the above results show that the interaction between green innovation, measured by the natural logarithm of R&D, and intangible asset components positively affects firm value; that is, increasing the interaction between green innovation, measured by the natural logarithm of R&D, and intangible assets leads to a greater increase in firm value. The results of the moderated model (1) ensure that the interaction between green innovation, measured by the natural logarithm of R&D, and the goodwill intangible logarithm leads to a greater increase in firm value ($\beta = 0.022$, p-value < 5%). The results of the moderated model (2) ensure that the interaction between green innovation, measured by the natural logarithm of R&D, and the patent logarithm leads to a greater increase in firm value ($\beta = 0.002$, p-value < 5%). The results of the moderated model (3) ensure that the interaction between green innovation, measured by the natural logarithm of R&D, and advertising cost leads to a greater increase in firm value ($\beta = 0.002$, p-value < 5%). Finally, the results of the moderated model (4) ensure that the interaction between green innovation, measured by the natural logarithm of R&D, and capitalized intangibles leads to a greater increase in firm value ($\beta = 0.003$, p-value < 5%). Based on the above discussion, the results of Tables 12 & 13 are consistent with the main fundamental results of the relationship between green innovation and firm value, highlighting the moderating role of intangible assets.

5. Conclusions

The purpose of this study is to close the gap in the literature and offer new perspectives on the relationship between business value, green innovation, accounting, and intangible assets. This study seeks to increase our knowledge of how intangible assets mediate the relationship between company value and green innovation accounting. Theoretical results indicate that green innovation aims to improve sustainability and has an influence on the environment, thereby raising the company's market value.

According to the results, Green Innovation has a positive moderating effect on the impact of Green Accounting on a business's financial performance, which may reflect profitability. This suggests that by offering more indications of a business's dedication to sustainability and green innovation, Green Innovation can enhance the correlation between profitability and Green Accounting, which in turn affects firm value. The importance of investing in intangibles like stock returns and future earnings can be demonstrated empirically. This is especially true regarding R&D, advertising, and patents related to green innovation and business value.

Results ensure that Total_GI, which is related to the total level of green innovation, can increase firm value (i.e., a positive significant relationship) where ($\beta = 0.057$, p-value < 5%). Consequently, all of these results support H1, which is consistent with Li, et al. [30]; Ma, et al. [31]; Scarpellini, et al. [32] and Yao, et al. [34]. Thus, green innovation accounting has a positive effect on firm value.

The results show that intangible assets positively affect firm value; that is, increasing the components of intangible assets leads to a greater increase in firm value. The results indicate that goodwill leads to a greater increase in firm value ($\beta = 0.024$, p-value < 5%), that patents lead to a greater increase in firm value ($\beta = 0.017$, p-value < 5%), that advertising costs lead to a greater increase in firm value ($\beta = 0.024$, p-value < 5%), and that capitalized intangibles lead to a greater increase in firm value ($\beta = 0.036$, p-value < 5%).

The results ensure that the interaction between the total green innovation index and goodwill logarithm leads to a greater increase in firm value ($\beta = 0.013$, p-value < 5%). The interaction between the total green innovation index and patent

intangible logarithm also leads to a greater increase in firm value (β = 0.010, p-value < 5%). Additionally, the interaction between the total green innovation index and advertising costs intangible logarithm results in a greater increase in firm value (β = 0.013, p-value < 5%). Finally, the interaction between the total green innovation index and logarithm capitalized intangibles leads to a greater increase in firm value (β = 0.013, p-value < 5%).

The robustness results show that the interaction between green innovation, measured by the natural logarithm of R&D and intangible asset components, positively affects firm value. Specifically, increasing the interaction between green innovation, measured by the natural logarithm of R&D and intangible assets, leads to a greater increase in firm value. The results confirm that the interaction between green innovation, measured by the natural logarithm of R&D and capitalized intangibles, also leads to a more significant increase in firm value (β = 0.003, p-value < 5%).

The current study recommends paying attention to green innovations within Saudi industrial organizations in general and highly polluting organizations in particular, along with updating accounting standards regarding green innovations from an accounting perspective. The study recommends conducting more research on green innovations and tangible assets.

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