Sam, Aloysius; Appiah, Michael Karikari; Ameko, Elikplim et al.

Article

Smart initiatives to drive solar energy investments under environmental uncertainty : exploring linear and quadratic relationships

International Journal of Energy Economics and Policy

Provided in Cooperation with:
International Journal of Energy Economics and Policy (IJEEP)

Reference: Sam, Aloysius/Appiah, Michael Karikari et. al. (2024). Smart initiatives to drive solar energy investments under environmental uncertainty : exploring linear and quadratic relationships. In: International Journal of Energy Economics and Policy 14 (4), S. 550 - 561. https://www.econjournals.com/index.php/ijeep/article/download/16331/8053/37994. doi:10.32479/ijeep.16331.

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2024, 14(4), 550-561.

Smart Initiatives to Drive Solar Energy Investments under Environmental Uncertainty: Exploring Linear and Quadratic Relationships

Aloysius Sam[1], Michael Karikari Appiah[2]*, Elikplim Ameko[3], Beverly Akomea Bonsu[4]

[1]Kumasi Technical University, Kumasi, Ghana, [2]Department of Sustainable Energy and Resources, University of Environment and Sustainable Development, Ghana, [3]Department of Sustainable Energy and Resources, University of Environment and Sustainable Development, Ghana, [4]Department of Estate Management, Kumasi Technical University, Kumasi, Ghana.

*Email: kofikarikari@ yahoo.com

Received: 04 March 2024 **Accepted:** 10 June 2024 **DOI:** https://doi.org/10.32479/ijeep.16331

ABSTRACT

Solar energy is an environmentally friendly and reliable source of electricity and contributes immensely towards achieving Sustainable Development Goal (SDG) 7. The quantity of solar radiation reaching the earth's surface offers enough prospects for solar and green energy investments. This study aims to develop an integrated model to explain the effects of sustainability-enabled initiatives on sustainable investment adoption and solar energy investment and to ascertain whether the relationship between solar energy investment and environmental uncertainty is parabolic (quadratic) or linear. Cross-sectional survey data from private companies in Ghana has been used. SMART-PLS version 3.3.9 has been used to analyse and confirm our hypotheses. The results showed that sustainability initiatives (e.g., supply chain integration, institutionalization, supply chain resilience, innovativeness, climate literacy, and justice) were found to be linear. Moreover, sustainable investment adoption moderates the relationships between various factors identified and solar energy investment. Again, environmental uncertainty confirmed a quadratic relationship with solar energy investment. By implications, this paper is the first of its kind to uniquely apply quadratic analysis in the context of renewable energy investment and sustainable energy in Ghana. The newly developed integrated model could be used to explain the drivers of sustainable investment adoption and solar energy investment in Ghana and beyond. Besides, the results will stimulate and re-enforce Ghana's renewable energy policies (Act 832 and Act 1045) towards the realisation of SDGs 7 and 13.

Keywords: Solar Energy Investments; Sustainability, Environmental Uncertainty, Quadratic Analyses, Ghana
JEL Classifications: B21, B16, G11, G18, N5

1. INTRODUCTION

One of the most significant forms of renewable and ecologically friendly energy is solar energy, which is also a reliable source of electricity. It makes a substantial contribution to the search for sustainable energy solutions (Saari, 2023). Solar energy is a particularly appealing resource for power generation because of the enormous amount that may be produced each day. To meet our energy demands, solar photovoltaics and concentrated solar power applications are continually being enhanced (Kipkoech et al., 2022; Zulu et al., 2022; Appiah et al., 2023). Therefore, in this context, a large installed capacity of solar energy applications supports the energy sector and meets the demands of the development of the labour market. Compared to energy sources based on fossil fuels, solar energy is intrinsically more sustainable. Solar panels turn solar energy—the greatest renewable resource on earth—into electrical energy by utilising the sun's light. Sustainable development, according to the United Nations, is growth that satisfies present demands without jeopardising the capacity of future generations to satiate their own needs (Hunter et al., 2021; World Health Organization, 2021). Solar energy epitomises this generally acknowledged idea of sustainability since it may be used indefinitely without affecting its future supply. The sun is the most important source of renewable energy, according to earlier researchers (Bukari et al., 2021; Amo-Aidoo et al., 2022; Awuku et al., 2022; Matana Júnior et al., 2023).

Solar energy is a renewable resource as opposed to finite energy sources like fossil fuels. Solar energy will be a vital tool in the battle against climate change even if the Earth's population and energy consumption keep expanding (Egli, 2020). Solar energy will be more than sufficient to fulfil all of the planet's energy demands. The COP26 Climate Change Conference was held in Glasgow, United Kingdom, in 2021, and consideration was given to the UN's proposals. The 197 nations' representatives came to a consensus and decided to lessen their dependency on coal and other fossil fuels. The conference also discussed ways that governments should emphasise equity and health within the framework of the fight against climate change and the sustainable development goal. Another sign is the directive to develop energy systems that safeguard and enhance both the environment and human health (UNFCCC, 2021; Sun et al., 2020; Hunter et al., 2021; Kukah et al., 2022). A worldwide climate change pact reached in 2015, the Paris Climate Accords, addressed adaptation, funding, and climate change mitigation. Delegates from 196 nations consequently decided to lower greenhouse gas emissions. For both present and future generations to achieve a more safe and stable environment, the Paris Agreement is crucial. In essence, the Paris Agreement aims to guarantee that everyone has the right to live in an environment that is free from pollution and unaffected by climate change. Additionally, it has been about protecting people from a riskier and more turbulent world. The need for sustainable energy sources has increased over the past few decades. On this basis, decision-makers have developed long-term plans that rely on renewable energy sources. As a result, these initiatives increase the use of alternative energy technology while decreasing dependency on traditional energy sources. As a result, the traditional use of fossil fuels is being replaced by the use of renewable energy sources in modern civilisation (UNFCCC, 2016; World Health Organization, 2021; Warris et al., 2022).

In Ghana, the Renewable Energy Master Plan (REMP) was enacted as an amendment to the Renewable Energy Act, 2011 (Act 832) in order to fulfil the objective of having renewable energy account for 10 percent of the country's power output by 2030. Some scholars (Amoah et al., 2020; Sackey et al., 2020) have attributed the slow pace of development of the renewable energy sector in the country to corruption and political interference. While others have focused on policy inadequacy (Sommerfeldt et al., 2022; Appiah, 2022a; Salim and Abu, 2023), Meanwhile, private sector investment in the renewable energy sector in Ghana continues to dwindle, obviously due to a lack of a baseline model to guide investors (Appiah et al., 2023). As a result, the following gaps largely remained unaddressed in the empirical literature: The need to test the mediating role of sustainable investment adoption on solar energy investment; the need to re-examine the relationship between environmental uncertainty and solar energy investment to determine whether it's linear or a parabola. Besides, there has never been any study that has assessed the quadratic effect of environmental uncertainty on solar energy investment using structural equation modelling (SEM). There is an urgent need to develop an integrated model to explain the extent to which sustainability-enabled initiatives drive sustainable investment adoption and solar energy investment and to ascertain whether the relationship between solar energy investment and environmental uncertainty is parabola or linear in order to map strategies to expedite the realisation of Sustainable Development Goals 7 and 13. This paper has therefore integrated four competing theories (dynamic capability theory, theory of innovation, institutional theory, and natural resources-based view) in addition to climate literacy and justice to formulate a new baseline model that is sustainable in nature to drive solar energy investment in Ghana.

Inferring from the aforementioned theories, this paper aims to develop an integrated model to explain the extent to which sustainability-enabled initiatives drive sustainable investment adoption and solar energy investment and to ascertain whether the relationship between solar energy investment and environmental uncertainty is parabolic (quadratic) or linear. The contributions to the paper are enormous. First, the paper makes a big contribution to sustainability efforts by combining different theories, like the institutional theory, the dynamic capability theory, the innovation theory, and a natural resources-based perspective. It also includes climate literacy and climate justice as important factors in the adoption of sustainable investment. Second, the paper makes original contributions to our comprehension of the relationship between institutionalization, supply chain integration, supply chain resilience, innovation, climate literacy, justice, and solar energy investment in a single model. Furthermore, this is the first study of its kind to employ quadratic analysis in the context of renewable energy and sustainable energy investments in Ghana. Using the newly constructed integrated model, sustainable investment adoption and solar energy investment in Ghana can be better understood. In conclusion, the article demonstrated that policy design alone is not a sustainable driver of solar energy investment, demonstrating the need to take into consideration additional factors such as those outlined above in order to increase local participation in the industry. This paper consists of the five sections listed below: The first section introduces the subject at hand, while the second section discusses pertinent literature; the third section describes the study's methodology; the fourth section presents the study's findings; and the fifth section derives the necessary conclusions and discusses their significance.

2. RESEARCH FRAMEWORK AND THE UNDERLYING THEORIES

This paper has integrated the following theories: institutional theory, a natural resources-based approach, and the theory of innovation and dynamic capacity theory to develop a baseline model to enhance solar energy investment in Ghana. Teece et al. (1997) define "dynamic capabilities" as a company's capacity to "integrate, create, and adapt internal and external resources and capabilities to cope with and shape a rapidly changing business environment." Targeting unreasonable profit margins. Management actions to activate opportunities include mapping, exploitation, and transformation. Innovation theory is a popular economic theory. Schumpeter started it in 1991. Schumpeter believes that creativity is the most significant aspect of an entrepreneur's ability to specialize. He believed education alone could make a business successful. Schumpeter believed that fresh information and creativity were the most important factors in corporate success. Today's competitive business climate requires innovation. New products, production methods, markets, fundamental materials, and organisational structures are introduced during the innovation process. Schumpeter combines business philosophies. Institutional theory studies the foundations of social order. The essence of the natural resource-based view is to ensure that for firms to adopt sustainable investment, they should adhere to pollution avoidance, appropriate product usage, and long-term sustainability. Institutional theory provides the supporting framework to set the rules and regulations for sustainable investment. Existing studies (Kraaijenbrink et al., 2010; Appiah et al., 2023). have used these theories in isolation. This paper aims to design an integrated model to explain the extent to which sustainability-enabled initiatives drive sustainable investment adoption and solar energy investment, and to ascertain whether the relationship between solar energy investment and environmental uncertainty is linear or not. Therefore, the paper is guided by the research frameworks as shown in Figure 1.

3. HYPOTHESES DEVELOPMENT

3.1. Supply Chain Integration and Sustainable Investment Adoption

The research assumes sustainable investment uptake and supply chain integration. (Afum et al., 2020; Shukor et al., 2021; Tiwari, 2021). Supply chain integration integrates, aligns, and coordinates people, information, processes, and communication across the value chain (Stevens and Johnson, 2016). Supply chain integration efficiently moves customer-required commodities, information, cash, and knowledge. SCI comprises operations, product development, marketing, financing, distribution, and customer service. Additionally, two or more organisations actively coordinate upstream and downstream actions from source to client (Hassan and Abbasi, 2021). Rahman et al., 2022). Beheshti et al. (2014) define supply chain integration as the synergy between an organisation's internal operations and external activities across its supply chain, which improves performance. Supply chain integration has been studied, but sustainable investment acceptance has not. The paper suggests:

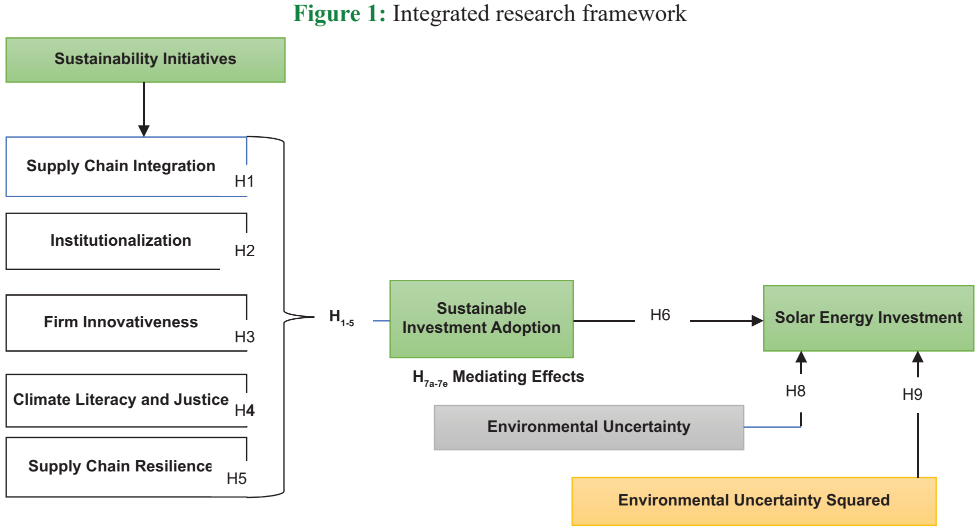
H1: Supply Chain Integration and Sustainable Investment Adoption are positively and significantly related.

3.2. Institutionalisation and Sustainable Investment Adoption

While institutionalisation has been adequately investigated in prior studies (Aaltonen and Turkulainen, 2022; Choo and Fergnani, 2022; Magnagnagno et al., 2022; Porter and Hunter, 2022), very little is known from the perspective of sustainable investment adoption. Osho (2016) defines institutionalisation as combining an organisation's code of conduct, purpose, policies, vision, and strategic objectives into an action template relevant to workers' everyday tasks. Osho et al. (2017) describe institutionalisation as an organisation's purposeful activity to integrate core values and goals into its culture and structure. Demir and Tavacioglu (2021) define institutionalisation as "the set of rules that must be followed" or 'the standardisation of repetitive actions and habits within communities." Institutionalisation involves having rules, standards, and procedures that are independent of individuals, establishing systems that follow changing environmental conditions, establishing an organisational structure that is suitable for development, and transforming its own communication and business methods into a culture, giving it a distinct identity from other businesses (Demir and Tavacioglu, 2021; Turhaner and Nas, 2021). Demir and Tavacioglu, 2021. "The process of establishing the rules, policies, procedures, and practices that result from this system" is institutionalisation, according to Turhaner and Nas (2021). Institutionalisation has been studied, but sustainable investment uptake has not. The paper suggests:

H2: Institutionalisation and sustainable investment adoption are positively and significantly related.

Figure 1: Integrated research framework



3.3. Firm Innovativeness and Sustainable Investment Adoption

Prior studies have argued vehemently that innovation is the foundation of sustainable investment (e.g., Dambiski et al., 2017; Prima Lita et al., 2020; Das, 2021; Maziriri et al., 2022; Vătămănescu et al., 2022). Rubera and Kirca (2012) suggested that a company's innovativeness is characterised by its openness to new ideas and readiness to execute them, which leads to new product development and distribution. Keklik (2018) defined innovativeness as using one's creativity in a business's technical, marketing, and organisational tasks to create new products and services for profit (Kraaijbrink et al., 2010; Zawawi et al., 2016). Tsai and Yang (2013) also said that business innovation involves both a company's cultural openness to new ideas and its ambition to produce and promote new goods from those ideas. It symbolises the company's culture, which inspires innovation (Yang, 2012). Although firm innovation has been adequately investigated in prior studies, very little is known from the perspective of sustainable investment adoption in the context of solar energy. Therefore, the paper proposes that:

H3: Firm innovation and sustainable investment adoption are positively and significantly related.

3.4. Climate Literacy, Climate Justice, and Sustainable Investment Adoption

Climate literacy and justice have been widely studied and reported (e.g., Alves and Mariano, 2018; Ali and Abdullah, 2021; Corrochano et al., 2022; Madhanagopal et al., 2022; Suhaimi and Mahmud, 2022; Tang, 2022; Huq et al., 2023). Selormey et al. (2019) defined climate literacy as understanding climate change's causes, effects, and remedies. The journey must be taken step-by-step. After being aware of the situation, the next step is to comprehend how people cause climate change, its harmful impacts, and how effective acting against it is. Miléř and Sládek (2011) suggested that it entails giving people a comprehensive worldview that includes information and a sense of duty to act. Climate literacy includes understanding climate change, assessing climate data, and practicing self-reflection (Neumann et al., 2013; Duit, 2014; Sahebi et al., 2023). Climate justice entails representing, including, and protecting the most vulnerable to climate change. Climate justice requires fairness, access to basic resources, and a healthy, clean environment for young people to live, learn, play, and work. It ensures that environmental transitions, typically on the scale of a country, region, or sector (such as the elimination of coal mining), promote socioeconomic fairness, minimise harm to affected individuals and communities, and ensure the benefits of change, such as new jobs and opportunities (Damico et al., 2020). Climate knowledge and justice will drive sustainable investment. The paper suggests:

H4: Climate knowledge and justice positively and significantly affect sustainable investment adoption.

3.5. Supply Chain Resilience and Sustainable Investment Adoption

Supply chain resilience has been extensively argued to have a relationship with organisational outcome (Ali and Gölgeci, 2019; Mubarik et al., 2022; Song et al., 2022; Castillo, 2023). Resilience is the ability to recover swiftly and effectively from disruptions. Supply chain resilience is the ability to bounce back from interruptions. Supply chain resilience is the adaptive capacity of a supply chain to prepare for unanticipated events, respond to disruptions, and recover from them while maintaining operations continuity within expected levels of connectivity and control of structure and function (Gupta et al., 2015; Behzadi et al., 2018; Ekanayake et al., 2020). It's also a supply chain network's ability to avoid or recover from disturbances. Sustainable investment uptake has been studied less than supply chain resilience (Brusset and Teller, 2017; Behzadi et al., 2017; Lohmer et al., 2020). The paper argues that supply chain resilience has a symbiotic relationship with sustainable investment adoption. Therefore, the paper proposes that:

H5: Supply chain resilience and sustainable investment adoption are positively and significantly related.

3.6. Sustainable Investment Adoption and Solar Energy Investment

The adoption of sustainable investments has been the subject of numerous studies (such as those by Talan and Sharma in 2019; Alshubiri in 2021; Caferra and Falcone in 2022; Ferrat et al. in 2022; Katelouzou and Micheler in 2022; Lin in 2022; Poursoleyman et al. in 2022; Rampini and Re Cecconi in 2022; and Shaikh in 2022). Sustainable investment integrates and achieves an organisation's social, environmental, and economic goals strategically and openly. Methodically managing important internal activities improves each organisation's and supply chain's long-term financial success. Koksal et al. (2017) say companies are inspired to use sustainable supply chain practices to boost sustainable investment. Chand et al. (2022) define sustainable investment as organisational pressures to implement sustainability initiatives. Chand et al. (2022) define sustainable investment as organisational pressures to implement sustainability initiatives. SSCM drivers motivate or coerce firms to undertake sustainability measures in their supply chains. However, several factors affect supply chain decision-making (Aray et al., 2021; Kipkoech et al., 2022). Though sustainable investment adoption has been adequately investigated in prior studies, very little is known from the perspective of solar energy investment. Therefore, the paper proposes that:

H6: Sustainable investment adoption and solar energy investment are positively and significantly related.

H7a-e: Sustainable investment adoption significantly mediates the relationships between sustainability initiatives (supply chain integration, institutionalisation, firm innovativeness, supply chain resilience, climate literacy, and justice) and solar energy investment.

3.7. Environmental Uncertainty and Solar Investment Adoption

Environmental unpredictability affects investment. Rasi et al. (2019) define environmental uncertainty as the inability to anticipate decision-making unit success or failure due to environmental factors. Huo et al. (2018) verified that uncertainty is the feeling of being unable to foresee something predictable. Environmental uncertainty is the apparent lack of understanding about critical environmental issues that affect firm performance (Chen, 2013). This apparent lack of knowledge may include the environment's unpredictability, environmental change's effects, and reaction choices' consequences. Environmental uncertainty also means unpredictability. Adhikara et al. (2022) said that environmental uncertainty is the inability of people to precisely foresee whether their actions will succeed or fail. This is because it is impossible to predict the potential outcomes. Though environmental uncertainty has been adequately investigated in prior studies, very little is known from the perspective of solar energy investment. Therefore, the paper proposes that:

H8: Environmental uncertainty and solar energy investment are negatively and significantly related.

H9: There is a U- shaped relationship between environmental uncertainty and solar energy investment. Business environment with high levels of environmental uncertainty will have low solar energy investment than those with moderate uncertainty.

4. MATERIALS AND METHODS

4.1. Research Paradigm and Approach

This paper aims to develop an integrated model to explain the extent to which sustainability-enabled initiatives drive sustainable investment adoption and solar energy investment and to ascertain whether the relationship between solar energy investment and environmental uncertainty is parabolic (quadratic) or linear. To successfully address these objectives, the paper is anchored to the following research paradigms: objectivism ontology, positivism epistemology, quantitative research approach, deductive reasoning, and survey instrument. The quantitative research approach has been employed because it is based on mathematical and statistical approaches that focus on quantifying the frequency of occurrence through the use of numerical measures. Again, quantitative design was chosen because it is consistent with positivism and objectivism when applied to real-world social circumstances (Appiah et al., 2022a; 2022b). Additionally, based on the purpose of the paper, an explanatory research design was used to explain the relationship between the variables' causes and effects. In order to obtain an exhaustive representation of people's thoughts, beliefs, and perspectives, the researchers decided to employ a survey for their investigation. The paper employed these techniques because they were consistent with the ontology and epistemology held by this school of thought.

4.2. Population and Sampling Procedures

The population of the study comprises private companies in Ghana, including manufacturing, construction, transportation, consultancy, food processing, and hospitality, among others. *The target population includes* small and medium-sized enterprises (SMEs) that have been enrolled with the Ghana Enterprise Agency, the Association of Ghana Industries, and the Ghana Chamber of Commerce and Industry for at least 5 years and maintained an active membership. This is due to the fact that the overwhelming majority of small and medium-sized enterprises fail within their first 5 years of existence, according to Ghana's Registrar General's report. The reminder of the inclusion criteria is that only small and medium-sized enterprises in the cities of Kumasi and Accra were chosen due to their unique administrative and economic functions. According to Ghana Enterprise Agency statistical records, the vast majority of registered SME businesses are located in metropolitan areas. This is likely the result of a large market, a variety of ethical traditions, and a varied consumer base. Again, the participating SMEs should be certified by the Ghana Environmental Protection Agency (EPA) or the International Organisation for Standardisation (ISO) (ISO 9001, ISO 16001, ISO 50001). The sample size was determined by inverting the rule of ten criteria proposed by Hair et al. (2017) and recommended for structural equation modelling (SEM). It is estimated by multiplying the total paths (number of hypotheses) by ten ($10 \times 13 = 130$). Although the sampling estimation revealed that a minimum of 130 participants should be okay for the study, the survey covered 300 participants with 275 usable responses, recording a 91.7% response rate. It has been demonstrated that sample size influences the results, with larger samples yielding more accurate results. The participants were chosen using stratified and simple random sampling techniques. The sub-sectors served as the strata, and then participants were randomly selected from each stratum. Adopting this sampling technique reduced the number of sample errors and increased the level of representativeness.

4.3. Constructs Measurements and Data Collection

This section presents construct measurements and their sources as presented in Table 1. The constructs were adopted on the bases of theoretical and empirical reviews and modified to reflect the current study.

A structured questionnaire served as the primary data collection instrument. The paper employed a structured questionnaire to collect data through a survey. The effectiveness of the questionnaire instrument in saving both money and labour led to its eventual adoption. To address the issue of non-response, approximately 300 questionnaires were disseminated to prospective participants, of which 275 were subsequently returned. In order to generate dependable results, it was necessary to remove from the original data any responses that raised suspicion. This strategy led to the elimination of 25 responses. In total, 275 relevant questionnaires were received. The questionnaire was structured into two main

Table 1: Constructs measurements and sources

Constructs	No of Items	Measurement scale	Sources
Supply Chain Integration	10 items	Likert-type Scale	Aray et al. (2021)
Supply Chain Resilience	5 items	Likert-type Scale	Wang et al. (2020)
Institutionalization	9 items	Likert-type Scale	Aray et al. (2021)
Innovativeness	7 items	Likert-type Scale	Aray et al. (2021)
Climate Literacy and Justice	5 items	Likert-type Scale	Neumann et al. (2013) and Duit (2014)
Environmental Uncertainty	10 items	Likert-type Scale	Foss et al. (2019)
Sustainable Investment Adoption	7 items	Likert-type Scale	Appiah et al. (2023)
Solar Energy Investment	6 items	Likert-type Scale	Appiah et al. (2023)

sections, covering the main issues and demographic profile. The main issues covered in the study include sustainability initiatives, climate literacy and justice, sustainable investment adoption, and solar energy investment. Regarding the demographic information, the paper covered geographic location, legal status, business type, firm age, and firm size. While a 5-point Likert-type scale was used to measure the main issues, a categorical-type scale was used to measure the demographic information.

4.4. Data Analysis

Because of the research approach underlying this paper, variance-based SEM was used to analyse the collected data (using SMART-PLS, version 3.3.8). There is no question that the SEM is a potent variation on the traditional regression analysis (1st Generational Analysis). The data from the field was checked for errors as part of the study's quality assurance procedures. Prior to the analysis of the data, Field data was examined for errors such as duplications and gaps in coverage. There are now two separate analyses available. In particular, the model of structure and the model of measurement. The measuring strategy put a heavy focus on ensuring the validity of the scales they used, particularly their discriminant and convenience validity. The second part of the study focused on the path coefficients and the structural model. 500 bootstrap resamples from the original sample were used to compute T-values and path coefficients for the study's hypothesis testing. Hair et al. (2014) presented these methods for evaluating the structure. In 2014, Hair et al. proposed using structural equation modelling (SEM) to examine mediation. It has been stated that SEM is superior to other kinds of traditional regression analysis (first-generation analysis) due to its ability to examine several exogenous mediator factors and endogenous outcome variables at once. The Figure 2 shows a quadratic relationship between environmental uncertainty and solar energy investment while the Figure 3 depicts a quadratic relationship between environmental uncertainty and solar energy investment.

5. RESULTS

5.1. Scale Validity – Convergent and Discriminants Validities

The first part of SEM analysis is the model measurement, or scale validity. According to Fornell and Larcker's (1981) criteria, the results for convergent and discriminant validities are shown in Tables 2 and 3, respectively. Henseler et al. (2015) asserted that the heterotrait-monotrait (HTMT) ratio provides a robust assessment of the discriminant validity of a model, as depicted in Table 4. Composite Reliability (CR), Average Variance Extracted (AVE), Cronbach Alpha (CA), and Factor Loadings (FL) were employed to evaluate the model's convergent validity. According to Table 2, CR scores ranged between 0.931 and 0.977, AVE scores ranged between 0.716 and 0.787, and CA scores ranged between 0.908 and 0.974. In addition, as shown in Figure 4, the item loadings were >0.70. These findings demonstrate the model's acknowledged convergent validity. For the evaluation of discriminant validity, both Fornell and Larker's (1981) and Henseler et al.'s (2015) criteria were applied. According to Table 3, the square root of AVEs exceeded correlation values. In addition, the HTMT ratio revealed that none of the inter-construct correlations exceeded 0.90, indicating that the model's discriminant validity is adequate.

Figure 2: A linear relationship between sustainable investment adoption and solar energy investment

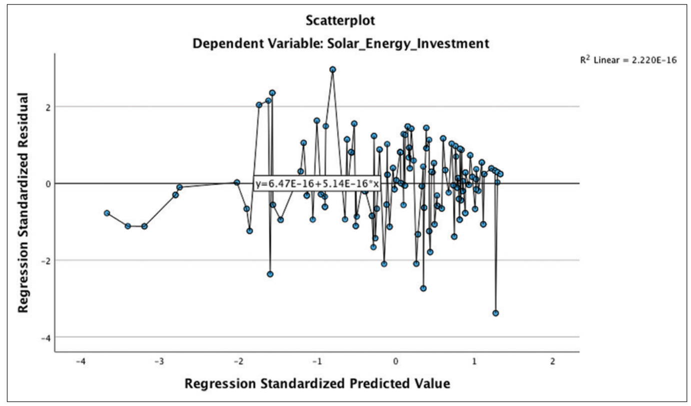


Figure 3: A quadratic relationship between environmental uncertainty and solar energy investment

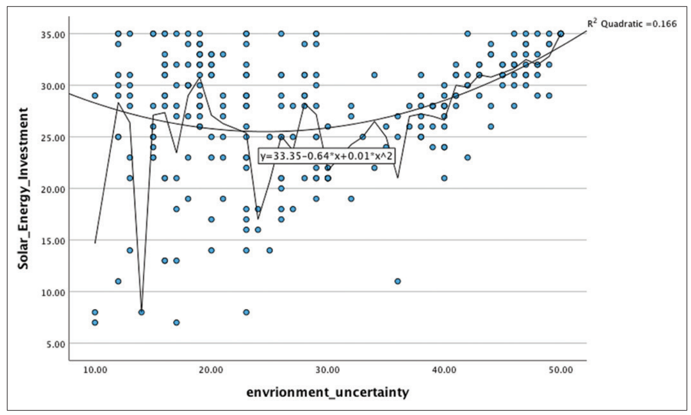


Table 2: Construct reliability and validity

Constructs' Names	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
CLJ	0.908	0.917	0.931	0.731
EU	0.974	0.980	0.977	0.810
INNO	0.953	0.955	0.962	0.781
INT	0.950	0.955	0.958	0.716
SEI	0.939	0.940	0.952	0.766
SCI	0.968	0.969	0.972	0.775
SCR	0.932	0.942	0.948	0.787
SIA	0.944	0.944	0.954	0.749

SCI: Supply chain integration, INT: Institutionalization, CLJ: Climate Literacy and Justice, INNO: Firms' Innovativeness, SCR: Supply chain resilience, SIA: Sustainable Investment Adoption, SEI: Solar Energy Investment, EU: Environmental Uncertainty

Table 3: Discriminants validity Fornell-Larcker criterion

Constructs' names	CLJ	EU	INNO	INT	SEI	SCI	SCR	SIA
CLJ	0.855							
EU	0.253	0.900						
INNO	0.743	0.217	0.884					
INT	0.646	0.175	0.596	0.846				
SEI	0.763	0.336	0.692	0.634	0.875			
SCI	0.711	0.277	0.747	0.569	0.709	0.880		
SCR	0.878	0.253	0.738	0.607	0.739	0.676	0.887	
SIA	0.786	0.320	0.732	0.666	0.921	0.725	0.764	0.865

SCI: Supply chain integration, INT: Institutionalization, CLJ: Climate Literacy and Justice, INNO: Firms' Innovativeness, SCR: Supply chain resilience, SIA: Sustainable investment adoption, SEI: Solar energy investment, EU: Environmental uncertainty

5.2. Structural Model

5.2.1. Construct crossvalidated redundancy- R-square (R^2) and Q-square (Q^2)

As shown in Figure 5, the R-square (R2) and construct cross-validated redundancy (Q2) values have been calculated. The R-square scores indicate that our baseline integrated model has a predictive power spanning from 0.713 to 0.849. These results suggest that sustainability initiatives and climate literacy and justice explained 71.4% of changes in sustainable investment adoption. While sustainable investment adoption explained 84.9% of changes in solar energy investment, The results indicate that sustainability initiatives are significant predictors of sustainable investment adoption and, subsequently, solar energy investment. As a means of validating the R-square scores, the construct of cross-validated redundancy (Q2) has been conducted. As shown in Table 5, Q2 results ranged from 0.530 to 0.645, which is greater than zero (0), indicating the model has predictive value. The subsequent section presents the path coefficient and hypotheses results as detailed in Table 6.

Table 4: Heterotrait-Monotrait Ratio (HTMT)

Constructs' names	CLJ	EU	INNO	INT	SEI	SCI	SCR	SIA
CLJ								
EU	0.253							
INNO	0.796	0.220						
INT	0.679	0.175	0.624					
SEI	0.802	0.343	0.730	0.665				
SCI	0.751	0.279	0.777	0.590	0.743			
SCR	0.690	0.251	0.771	0.626	0.771	0.699		
SIA	0.821	0.328	0.770	0.697	0.678	0.758	0.787	

SCI: Supply chain integration, INT: Institutionalization, CLJ: Climate Literacy and Justice, INNO: Firms' Innovativeness, SCR: Supply chain resilience, SIA: Sustainable investment adoption, SEI: Solar energy investment, EU: Environmental uncertainty

5.2.2. Path coefficients and hypotheses testing

As showed in Table 6, the results have showed that sustainability initiatives e.g., institutionalization (B = 0.190, T-value = 3.874), supply chain integration (B = 0.212, T-value = 3.789), supply chain resilience (B = 0.190, T-value = 2.682), firm innovativeness (B = 0.143, T-value = 2.026), climate literacy and justice (B = 0.239, T-value = 3.089) have significant effects on sustainable investment adoption. Again, environmental uncertainty (B = −0.135, T-value = 4.518), environmental uncertainty squared (B = 0.055, T-value = 2.448) and sustainable investment adoption (B = 0.914, T-value = 60.773) have significant effects on solar energy investment. The study has further revealed that sustainable investment adoption significantly mediated the relationships between sustainability initiatives and solar energy investment. Overall, 13 hypotheses have been tested and supported, comprising 8 direct relationships and 5 indirect (mediating relationships).

As can be seen in Table 7, the values of SRMR ranged anywhere from 0.060 to 0.62 for saturated and estimated models, respectively. The findings of the NFI were somewhere between 0.719 and 0.721. According to the findings of Hu and Bentler (1999), the recommended value for SRMR should be 0.08 or less, and the recommended range for NFI should be between 0 and 1. Given the findings of the model, it is possible to assert that the model provides an adequate fit for the data.

6. DISCUSSION

The results showed that sustainability initiatives, climate literacy, and justice significantly influence sustainable investment adoption.

Figure 4: Factor loadings

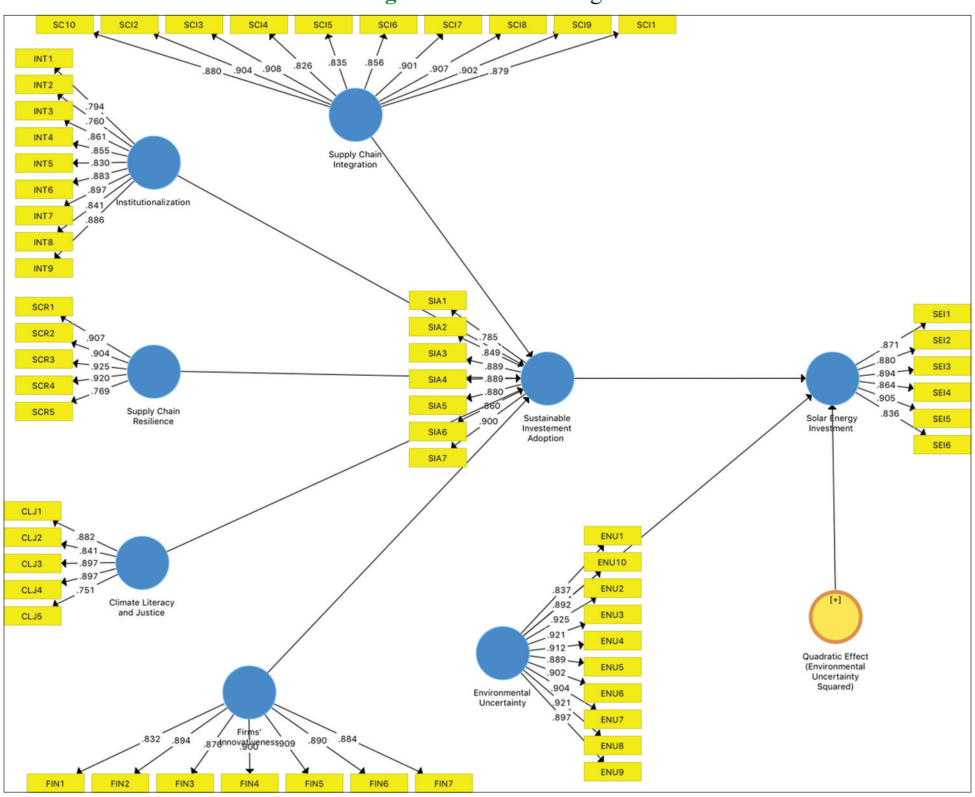


Figure 5: R-square values

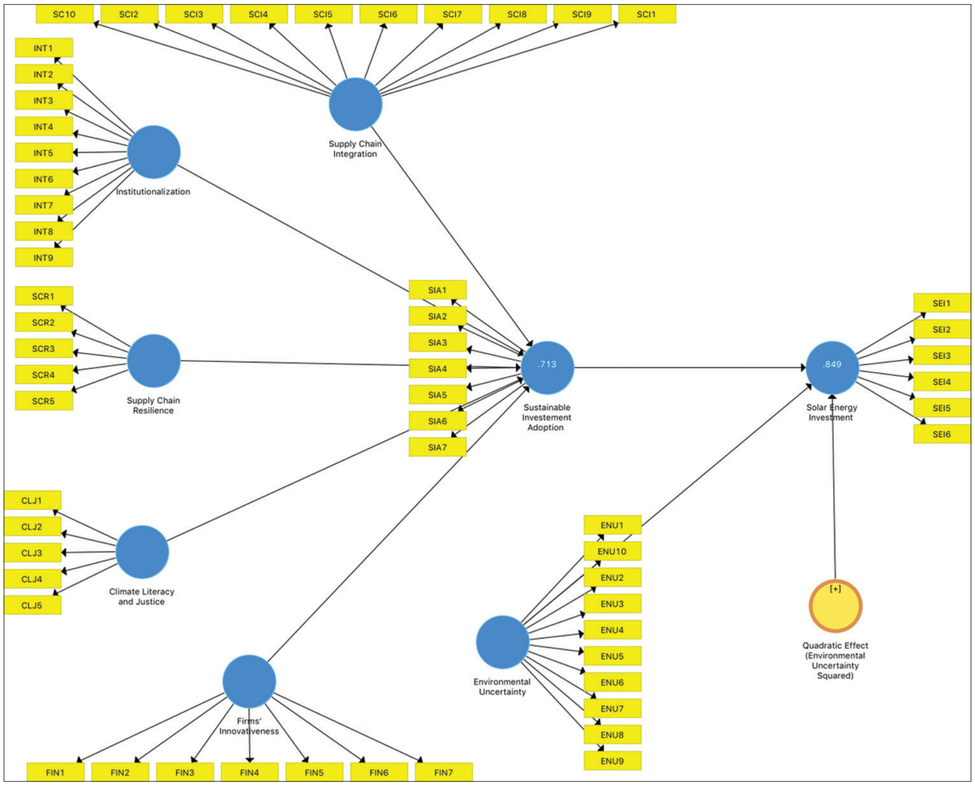


Table 5: Construct crossvalidated redundancy

Constructs' names	SSO	SSE	Q² (=1-SSE/SSO)
CLJ	1375.000	1375.000	
EU	2750.000	2750.000	
INNO	1925.000	1925.000	
INT	2475.000	2475.000	
SEI	1650.000	586.451	0.645
SCI	2750.000	2750.000	
SCR	1375.000	1375.000	
SIA	1925.000	904.502	0.530

SCI: Supply chain integration, INT: Institutionalization, CLJ: Climate literacy and justice, INNO: Firms' Innovativeness, SCR: Supply chain resilience, SIA: Sustainable investment adoption, SEI: Solar energy investment, EU: Environmental uncertainty

These results are consistent with existing theoretical assumptions and prior studies (Zhu et al., 2018; Afum et al., 2020; Shukor et al., 2021; Tiwari., 2021; Suhaimi and Mahmud, 2022; Tang, 2022; Huq et al., 2023). Supply chain integration also refers to the process of efficiently and effectively moving customer-required materials, information, funds, and knowledge. It has been affirmed that SCI includes operations, the creation of new products, marketing, finances, distribution, and customer support. Besides, it is a collection of two or more organisations directly involved in the coordination of upstream and downstream activities from source to customer (Chopra and Meindl, 2007; Hassan and Abbasi, 2021). Rahman et al., 2022). Supply chain integration includes the process of efficiently and effectively moving customer-required materials, information, funds, and knowledge with the aim of improving production efficiency (Hassan and Abbasi, 2021; Appiah et al., 2022c). Also, institutionalization presents the process of incorporating an organisation's regulations and working principles into an action template that is pertinent to the daily activities of its employees. Meanwhile, Keklik (2018) argued innovativeness incorporates the concept of employing one's inventive abilities in the technical, marketing, and organisational tasks of a business in order to generate new products and services for the purpose of making money. Selormey et al. (2019) postulated that climate literacy presents knowledge or the ability to comprehend climate change in terms of its causes, consequences, and potential solutions.

The study has revealed that sustainable investment adoption has a positive and significant relationship with solar energy investment. Moreover, sustainable investment adoption partially mediates the relationships between sustainability initiatives and solar energy investment (Caferra and Falcone, 2022; Ferrat et al., 2022; Katelouzou and Micheler, 2022; Lin, 2022; Poursoleyman et al., 2022; Rampini and Re Cecconi, 2022; and Shaikh, 2022). Sustainable investment entails the strategic coordination and integration of socio-economic and environmental issues. This is achieved by methodically coordinating critical internal operations to enhance each organization's and its supply chain's long-term financial performance. Chand et al. (2022) asserted that sustainable investment incorporates the pressures that push organisations to adopt particular sustainability measures. The phrase motivating or influencing factors that encourage or compel organisations to implement sustainability initiatives in their supply chains is sustainability initiative. This is consistent with NRBV theory.

The study has found that environmental uncertainty has a quadratic relationship with solar energy investment. The study has revealed a u-shaped relationship between environmental uncertainty and solar energy investment. Huo et al. (2018) posited that uncertainty

Table 6: Path coefficients and hypotheses testing

Hypothesized Paths	Original Sample (Beta)	Sample Mean	Standard Deviation	T-Statistics	Hypotheses confirmation
Direct Effects					
H1: Supply Chain Integration -> SIA	0.212	0.217	0.056	3.789	Yes
H2: Institutionalization -> SIA	0.190	0.182	0.049	3.874	Yes
H3: Firms' Innovativeness -> SIA	0.143	0.142	0.070	2.026	Yes
H4: Climate Literacy and Justice -> SIA	0.239	0.231	0.077	3.089	Yes
H5: Supply Chain Resilience -> SIA	0.190	0.202	0.071	2.682	Yes
H6: Sust. Investment Adoption -> SEI	0.914	0.915	0.015	60.773	Yes
Quadratic Effects					
H8: Environmental Uncertainty -> SEI	−0.135	−0.034	0.030	4.518	Yes
H9: Env. Uncertainty Squared -> SEI	0.055	0.054	0.022	2.448	Yes
Mediating Effects					
H7a: CLJ -> SIA -> SEI	0.219	0.211	0.071	3.086	Yes
H7b: SCI -> SIA -> SEI	0.194	0.199	0.051	3.787	Yes
H7c: INNO -> SIA -> SEI	0.130	0.130	0.065	2.016	Yes
H7d: SCR -> SIA -> SEI	0.174	0.185	0.065	2.672	Yes
H7e: INT -> SIA -> SEI	0.174	0.166	0.045	3.902	Yes

SCI: Supply chain integration, INT: Institutionalization, CLJ: Climate literacy and justice, INNO: Firms' innovativeness, SCR: Supply chain resilience, SIA: Sustainable investment adoption, SEI: Solar energy investment, EU: Environmental uncertainty

Table 7: Table fit summary

CFA-Tests	Saturated Model	Estimated Model
SRMR	0.060	0.062
NFI	0.719	0.721

SRMR: Standardized root mean square residual, NFI: Normed fit index

is the perception of being unable to anticipate something that can be predicted. Environmental uncertainty is the perceived absence of information about crucial environmental factors that influence the performance of a company (Chen, 2013). According to Adhikara et al. (2022), environmental uncertainty is the inability of humans to accurately predict whether the decisions they have implemented will be successful or unsuccessful. This result debunks most previous reports (Chen, 2013; Rasi et al., 2019; Adhikara et al., 2022).

7. CONCLUSIONS AND IMPLICATIONS

7.1. Conclusions

The low level of investment in renewable energy in Ghana could be attributed to a lack of sustainability initiatives such as strong innovation, strong institutions, robust supply chains, supply chain integration, climate literacy, and justice. This gap has been addressed in this study by developing a sustainability-enabled baseline model to enhance solar energy investment in Ghana that treats environmental uncertainty as a parabola (U-sharped) rather than a linear model as claimed by most existing studies. This paper is the first of its kind to uniquely apply quadratic analysis in the context of renewable energy investment and sustainable energy in Ghana. The paper has revealed that sustainability initiatives, climate literacy, and justice were found to be linear. Moreover, sustainable investment adoption moderates the relationships between various factors identified and solar energy investment. Again, environmental uncertainty confirmed a quadratic relationship with solar energy investment. The paper concludes that for a successful investment in the solar energy sector in a developing economy like Ghana, these two assumptions are imperative: i) prospective investors in solar energy must first adopt sustainable investment ii) Environmental uncertainty exerts a negative effect in the initial stage of investment but subsequently turns positive, making it a parabola (U-sharped). Finally, this paper employed methods and techniques that could be readily replicated in related studies in other emerging economies.

7.2. Implications: Theoretical, Practical, and Policy

This paper is the first of its kind to uniquely apply quadratic analysis in the context of renewable energy investment and sustainable energy in Ghana. The results showed that sustainability initiatives, climate literacy, and justice significantly influence SIA. These results are consistent with existing theoretical assumptions and prior studies (Amoah et al., 2020; Amo-Aidoo et al., 2022). The study has revealed that sustainable investment adoption has a positive and significant relationship with solar energy investment. Moreover, sustainable investment adoption partially mediates the relationship between sustainability initiatives and solar energy investment. This is consistent with NRBV theory and Appiah et al. (2022b; 2023). The study has found that environmental uncertainty has a quadratic relationship with solar energy investment. The results have found a u-shaped association between environmental uncertainty and solar energy investment. This result debunks most previous reports (Chen, 2013; Rasi et al., 2019; Adhikara et al., 2022). The newly developed integrated model could be used to explain the drivers of sustainable investment adoption and solar energy investment in Ghana and the rest of Sub-Saharan African countries. The findings of the study will stimulate and re-enforce Ghana's Renewable Energy Policies (Act 832 and Act 1045) towards the realisation of Sustainable Development Goals 7 (sustainable energy) and 13 (climate action). The findings also have implications for local content policy enforcement as well as the energy agenda of youth. The emergence of a winning integrated model could be used as a guide by investors and trade facilitators to better understand the drivers of sustainable investment adoption and solar energy investment in a volatile environment.

7.3. Limitations and Suggestions for Future Studies

This study has a few limitations that need to be addressed in future studies. The paper adopted a cross-sectional strategy; given the nature of the study, a longitudinal study would have been more suitable, but there was a lack of longitudinal data. Therefore, it is suggested that future studies should consider using longitudinal data to be able to understand the trends in solar energy investment in Ghana. Secondly, the paper focused on broad sectors, e.g., SMEs in Greater Kumasi and Accra Metropolitan Areas. It is suggested that future studies should be limited to one specific sector or comparative studies of two or more sectors, e.g., manufacturing, transportation, etc. Finally, the current paper did not consider the role of local content in renewable energy investments, such as solar energy. It is suggested that future studies should consider assessing the role of local content policy and how it facilitates investment in solar energy.

REFERENCES

Aaltonen, K., Turkulainen, V. (2022), Institutionalization of a collaborative governance model to deliver large, inter-organizational projects. International Journal of Operations and Production Management, 42(8), 1294-1328.

Adhikara, A., Maslichah, M., Diana, N., Basjir, M. (2022), Organizational performance in environmental uncertainty on the Indonesian healthcare industry: A path analysis. Academic Journal of Interdisciplinary Studies, 11(2), 365-377.

Afum, E., Osei-Ahenkan, V.Y., Agyabeng-Mensah, Y., Amponsah Owusu, J., Kusi, L.Y., Ankomah, J. (2020), Green manufacturing practices and sustainable performance among Ghanaian manufacturing SMEs: The explanatory link of green supply chain integration. Management of Environmental Quality, 31(6), 1457-1475.

Ali, I., Gölgeci, I. (2019), Where is supply chain resilience research heading? A systematic and co-occurrence analysis. International Journal of Physical Distribution and Logistics Management, 49(8), 793-815.

Ali, W.S.N.W., Abdullah, L.N. (2021), Climate change: Climate literacy and response among USM students. Turkish Journal of Computer and Mathematics Education, 12(3), 2205-2210.

Alshubiri, F. (2021), Investment obstacles to sustainable development and competitiveness index. Marketing Intelligence and Planning, 39(2), 234-248.

Alves, F.W.M., Mariano, B.E. (2018), Climate justice and human development: A systematic literature review. Journal of Cleaner Production, 202, 360-375.

Amoah, A., Kwablah, E., Korle, K., Offei, D. (2020), Renewable energy consumption in Africa: The role of economic well-being and economic freedom. Energy, Sustainability and Society, 10, 32.

Amo-Aidoo, A., Kumi, E.N., Hensel, O., Korese, J.K., Sturm, B. (2022), Solar energy policy implementation in Ghana: A LEAP model analysis. Scientific African, 16, e01162.

Appiah, M.K., Toseafa, E., Sam, A., Danso, F., Nsowah, A. (2023), Implications of sustainability initiatives on African Continental Free Trade adoption by firms under environmental uncertainty. International Journal of Development Issues, 22, 255-277.

Appiah, K.M., Boateng, F., Abugri, A., Barnes, S. (2022a), Modeling the implications of sustainable supply chain practices on sustainable performance in Ghana's petroleum industry: The role of stakeholders' pressure. International Journal of Sustainable Engineering, 15(1), 314-324.

Appiah, K.M., Tettevi, P.K., Amaning, N., Opoku Ware, E. (2022b), Modeling the implications of internal audit effectiveness on value for money and sustainable procurement performance: An application of structural equation modeling. Cogent Business and Management, 9(1), 210127.

Appiah, M.K., Odei, S.A., Kumi-Amoah, G., Yeboah, S.A. (2022c), Modeling the impact of green supply chain practices on environmental performance: The mediating role of ecocentricity. African Journal of Economic and Management Studies, 13(4), 551-567.

Appiah, M.K., Toseafa, E., Sam, A., Danso, F., Nsowah, A. (2023), Implications of sustainability initiatives on African Continental Free Trade adoption by firms under environmental uncertainty. International Journal of Development Issues, 22, 255-277.

Aray, Y., Veselova, A., Knatko, D., Levchenko, A. (2021), Drivers for adoption of sustainability initiatives in supply chains of large Russian firms under environmental uncertainty. Corporate Governance, 21(2), 322-338.

Awuku, A.S., Bennadji, A., Muhammad-Sukki, F., Sellami, N. (2022), Public-private partnership in Ghana's solar energy industry: The history, current state, challenges, prospects and theoretical perspective. Energy Nexus, 6(16), 100058.

Beheshti, M.H., Oghazi, P., Mostaghel, R., Hultman, M. (2014), Supply chain integration and firm performance: An empirical study of Swedish manufacturing firms. Competitiveness Review, 24(1), 20-31.

Behzadi, G., O'Sullivan, M.J., Olsen, T.L., Scrimgeour, F., Zhang, A. (2017), Robust and resilient strategies for managing supply disruptions in an agribusiness supply chain. International Journal of Production Economics, 191, 207-220.

Behzadi, G., O'Sullivan, M.J., Olsen, T.L., Zhang, A. (2018), Agribusiness supply chain risk management: A review of quantitative decision models. Omega, 79, 21-42.

Brusset, X., Teller, C. (2017), Supply chain capabilities, risks, and resilience. International Journal of Production Economics, 184, 59-68.

Bukari, D., Kemausuor, F., Quansah, D.A., Adaramola, M.S. (2021), Towards accelerating the deployment of decentralised renewable energy mini-grids in Ghana: Review and analysis of barriers. Renewable and Sustainable Energy Reviews, 135(C), 110408.

Bukari, D., Tuokuu, F.X.D., Suleman, S., Ackah, I., Apenu, G. (2021), Ghana's energy access journey so far: A review of key strategies. International Journal of Energy Sector Management, 15(1), 139-156.

Caferra, R., Falcone, P.M. (2022), From the "age of instability" to the "age of responsibility": Economic uncertainty and sustainable investments. Journal of Economic Studies, 50, 1297-1316.

Castillo, C. (2023), Is there a theory of supply chain resilience? A bibliometric analysis of the literature. International Journal of Operations and Production Management, 43(1), 22-47.

Chand, P., Kumar, A., Thakkar, J., Ghosh, K.K. (2022), Direct and mediation effect of supply chain complexity drivers on supply chain performance: An empirical evidence of organizational complexity theory. International Journal of Operations and Production Management, 42(6), 797-825.

Chen, J. (2013), Environmental uncertainty. In: Kessler, E.H., editor. Encyclopedia of Management Theory. United States: Sage. p245-249.

Choo, E., Fergnani, A. (2022), The adoption and institutionalization of governmental foresight practices in Singapore. Foresight, 24(1), 19-36.

Corrochano, D., Ferrari, E., López-Luengo, M.A., Ortega-Quevedo, V. (2022), Educational gardens and climate change education: An analysis of Spanish pre-service teachers' perceptions. Education Sciences, 12, 275.

Dambiski, G.C.G., Alisson, W.C.J., Gomes de Carvalho, H., Carlos Duclós, L., de Fátima Stankowitz, R. (2017), Innovativeness measures: A bibliometric review and a classification proposal. International Journal of Innovation Science, 9(1), 81-101.

Damico, S.J., Baildon, M., Panos, A. (2020), Climate justice literacy:

Stories-we-live-by, ecolinguistics, and classroom practice. Journal of Adolescent and Adult Literacy, 63, 1-9.

Das, R. (2021), Followership practices as determinants of national innovativeness: A study across 56 cultures. Leadership and Organization Development Journal, 42(8), 1282-1294.

Demir, B., Tavacioglu, L. (2021), Developing a scale to measure the institutionalization level of maritime family businesses. Journal of ETA Maritime Science, 9(4), 243-255.

Duit, R. (2014), Teaching and learning the physics energy concept. In: Chen, R.F., Eisenkraft, A., Fortus, D., Krajcik, J., Neumann, K., Nordine, J., Scheff, A., editors. Teaching and Learning of Energy in K - 12 Education. Switzerland: Springer International Publishing

Egli, F. (2020), Renewable energy investment risk: An investigation of changes over time and the underlying drivers. Energy Policy, 140, 111428.

Ekanayake, E.M.A.C., Shen, G.Q.P., Kumaraswamy, M.M. (2020), Identifying supply chain capabilities of construction firms in industrialized construction. Production Planning and Control, 32(4), 303-321.

Ferrat, Y., Daty, F., Burlacu, R. (2022), Short- and long-term effects of responsible investment growth on equity returns. Journal of Risk Finance, 23(1), 1-13.

Foss, N.J., Klein, P.G., Bjørnskov, C. (2019), The context of entrepreneurial judgment: Organizations, markets, and institutions. Journal of Management Studies, 56, 1197-1213.

Fornell, C., Larcker, D.F. (1981), Structural equation models with unobservable variables and measurement error: Algebra and statistics. Journal of Marketing Research, 18, 382-388.

Gupta, V., He, B., Sethi, S.P. (2014), Contingent sourcing under supply disruption and competition. International Journal of Production Research, 53(10), 3006-3027.

Hair, J.F., Hult, G.T.M., Ringle, C.M., Sarstedt, M. (2017), A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM). 2nd ed. Thousand Oaks, CA: Sage Publications Inc.

Hair, J.F., Risher, J.J., Sarstedt, M., Ringle, C.M. (2019), When to use and how to report the results of PLS- SEM. European Business Review, 31, 2-24.

Hassan, M.N., Abbasi, N.M. (2021), A review of supply chain integration extents, contingencies and performance: A post Covid-19 review. Operations Research Perspectives, 8, 1-10.

Henseler, J., Ringle, C.M., Sarstedt, M. (2015), A new criterion for assessing discriminant validity in variance-based structural equation modeling. Journal of the Academy of Marketing Science, 43, 115-135.

Hunter, D.B., Salzman, J.E., Zaelke, D. (2021), Glasgow Climate Summit: COP26. UCLA School of Law, Public Law Research Paper No. 22-02.

Huo, B., Ye, Y., Zhao, X., Wei, J., Hua, Z. (2018), Environmental uncertainty, specific assets, and opportunism in 3PL relationships: A transaction cost economics perspective. International Journal of Production Economics, 203, 154-163

Huq, M., English, S., Nagginda, P.H., Bonifacio, J., Deivanayagam, A.T., Issa, R., Chobhthaigh, N.S., Sato, M.P., Mulindwa, H., Devakumar, D., (2023), Developing a guide to climate and health justice education: Process and content. The Journal of Climate Change and Health, 9, 100-188.

Katelouzou, D., Micheler, E. (2022), Investor capitalism, sustainable investment and the role of tax relief. European Business Organization Law Review, 23, 217-239.

Keklik, M. (2018), Schumpeter, Innovation and Growth: Long-Cycle Dynamics in the Post-WWII American Manufacturing Industries. London: Routledge.

Kipkoech, R., Takase, M., Afrifa, A.K.E. (2022), Renewable energies in Ghana in relation to market condition, the environment, and food security. Journal of Renewable Energy, 2022, 1-8.

Köksal, D., Strähle, J., Müller, M., Freise, M. (2017), Social sustainable supply chain management in the textile and apparel industry-A literature review. Sustainability, 9, 100.

Kraaijenbrink, J., Spender, J., Groen, J.A. (2010), The resource-based view: A review and assessment of its critiques. Journal of Management, 10(36), 349-362.

Kukah, A.S., Anafo, A., Kukah, R.M.K., Blay Jnr, A.V.K., Sinsa, D.B., Asamoah, E., Korda, D.N. (2022), Exploring innovative energy infrastructure financing in Ghana: Benefits, challenges and strategies. International Journal of Energy Sector Management, 16(2), 248-264.

Lin, L. (2022), Venture capital in the rise of sustainable investment. European Business Organization Law Review, 23, 187-216.

Lohmer, J., Bugert, N., Lasch, R. (2020), Analysis of resilience strategies and ripple effect in block-chain coordinated supply chains: An agent-based simulation study. International Journal of Production Economics, 228, 107882.

Madhanagopal, D., Beer, C.T., Nikku, B.R., Pelser, A.J., editors. (2022), Environment, Climate, and Social Justice. In: Environment, Climate, and Social Justice: Interdisciplinary Voices from the Global South. Singapore: Springer.

Magnagnagno, O.A., Luciano, E.M., Wiedenhöft, G. (2022), Impact of information system institutionalization on corruption in the Brazilian public health system. Transforming Government: People, Process and Policy, 16 (4), 540-553.

Matana Júnior, S., Antonio Leite Frandoloso, M., Barbosa Brião, V. (2023), The role of HEIs to achieve SDG7 goals from Netzero campuses: Case studies and possibilities in Brazil. International Journal of Sustainability in Higher Education, 24 (2), 462-480.

Maziriri, E.T., Nyagadza, B., Chuchu, T. (2022), Innovation conviction, innovation mindset and innovation creed as precursors for the need for achievement and women's entrepreneurial success in South Africa: Entrepreneurial education as a moderator. European Journal of Innovation Management, 27, 1225-1248.

Miléř, T., Sládek, P. (2011), The climate literacy challenge. Procedia Social and Behavioral Sciences, 12, 150-156.

Mubarik, M.S., Bontis, N., Mubarik, M., Mahmood, T. (2022), Intellectual capital and supply chain resilience. Journal of Intellectual Capital, 23 (3), 713-738.

Neumann, K., Viering, T., Boone, W.J., Fischer, H.E. (2013), Towards a learning progression of energy. Journal of Research in Science Teaching, 50(2), 162-188.

Osho, A., Essien-Abasi, I., Ekweli, F. (2017), Institutionalization: A contemporary perspective of the old and new institutionalism for managers. International Journal of Social Science and Humanities Research, 5(4), 447-453.

Osho, A.A (2016), Strategy Implementation and Organizational Growth of Deposit Money Banks in Port Harcourt. An Unpublished MSc Dissertation Submitted to the Post Graduate School, Rivers State University Port Harcourt.

Porter, S., Hunter, T. (2022), Boards and social media: the institutionalization of corporate social media policy. Journal of Communication Management, 26 (3), 254-270.

Poursoleyman, E., Mansourfar, G., Homayoun, S., Rezaee, Z. (2022), Business sustainability performance and corporate financial performance: The mediating role of optimal investment. Managerial Finance, 48(2), 348-369.

Prima Lita, R., Fitriana Faisal, R., Meuthia, M. (2020), Enhancing small and medium enterprises performance through innovation in Indonesia: A framework for creative industries supporting tourism. Journal of Hospitality and Tourism Technology, 11(1), 155-176.

Rahman, T., Paulm K.S., Shukla, N., Agarwal, R., Taghikhah, F. (2022),

Supply chain resilience initiatives and strategies: A systematic review. Computers and Industrial Engineering, 170, 108317.
Rampini, L., Re Cecconi, F. (2022), Artificial intelligence algorithms to predict Italian real estate market prices. Journal of Property Investment and Finance, 40(6), 588-611.
Rasi, R.E., Abbasi, R., Hatami, D. (2019), The effect of supply chain agility based on supplier innovation and environmental uncertainty. International Journal of Supply and Operations Management, 6, 94-109.
Rubera, G., Kirca, A.H. (2012), Firm innovativeness and its performance outcomes: A meta-analytic review and theoretical integration. Journal of Marketing, 76(3), 130-147.
Saari, S. (2023), Enhancing the environmental sustainability of emergency humanitarian medical cold chains with renewable energy sources. Journal of Humanitarian Logistics and Supply Chain Management, 13, 152-172.
Sackey, D.M., Owusu-Manu, D.G., Asiedu, R.O., Jehuri, A.B. (2020), Analysis of latent impeding factors to solar photovoltaic investments in Ghana. International Journal of Energy Sector Management, 14(4), 669-682.
Sahebi, I., Toufighi, S.P., Azzavi, M., Masoomi, B., Maleki, M.H. (2023), Fuzzy ISM-DEMATEL modeling for the sustainable development hindrances in the renewable energy supply chain. International Journal of Energy Sector Management, 18, 43-70.
Salim, A.M., Abu Dabous, S. (2023), A review of critical success factors for solar home system implementation in public housing. International Journal of Energy Sector Management, 17(2), 352-370.
Selormey, E.E., Dome, M.Z., Osse, L., Logan, C. (2019), Change Ahead. Experience and Awareness of Climate Change in Africa, (Accra: Afrobarometer Policy Paper No 60).
Shaikh, I. (2022), On the relationship between policy uncertainty and sustainable investing. Journal of Modelling in Management, 17(4), 1504-1523.
Shukor, A.A.A., Newaz, M.S., Rahman, M.K., Taha, A.Z. (2021), Supply chain integration and its impact on supply chain agility and organizational flexibility in manufacturing firms. International Journal of Emerging Markets, 16(8), 1721-1744.
Sommerfeldt, N. Lemoine, I., Madani, H. (2022), Hide and seek: The supply and demand of information for household solar photovoltaic investment. Energy Policy, 161, 112726.
Song, M., Ma, X., Zhao, X., Zhang, L. (2022), How to enhance supply chain resilience: A logistics approach. The International Journal of Logistics Management, 33(4), 1408-1436.
Stevens, G.C., Johnson, M. (2016), Integrating the supply …chain 25 years on. International Journal of Physical Distribution and Logistics Management, 46(1), 19-42.
Suhaimi, N., Mahmud, S.N.D. (2022), A bibliometric analysis of climate change literacy between 2001 and 2021. Sustainability, 14, 11940.
Sun, H., Khan, R.A., Bashir, A., Alemzero, A.D., Abbas, Q., Abudu, H. (2020), Energy insecurity, pollution mitigation, and renewable energy integration: Prospective of wind energy in Ghana. Environmental Science and Pollution Research, 27, 38259-38275.
Talan, G., Sharma, D.G. (2019), Doing well by doing good: A systematic review and research agenda for sustainable investment. Sustainability, 11, 353.
Tang, K.H.D. (2022), Climate change education in China: A pioneering case of its implementation in tertiary education and its effects on students' beliefs and attitudes. International Journal of Sustainability in Higher Education, 24, 1058-1081.
Tiwari, S. (2021), Supply chain integration and Industry 4.0: A systematic literature review. Benchmarking: An International Journal, 28(3), 990-1030.
Teece, D.J., Pisano, G., Shuen, A. (1997), Dynamic capabilities and strategic management. Strategic Management Journal, 18, 509-533.
Tsai, K.H., Yang, S.Y. (2013), Firm innovativeness and business performance: The joint moderating effects of market turbulence and competition. Industrial Marketing Management, 42(8), 1279-1294.
Turhaner, K.O., Nas, S. (2021), Determining the level of institutionalization in family-owned shipping businesses. Journal of ETA Maritime Science, 9, 138-153.
United Nations Framework Convention on Climate Change (UNFCCC). (2016), Paris Agreement-Status of Ratification, United Nations Framework Convention on Climate. Available from: https://unfccc.int/process/the-paris-agreement/status-of-ratification [Last accessed on 2023 May 05].
United Nations Framework Convention on Climate Change (UNFCCC). (2021), The Paris Agreement. Available from: https://unfccc.int/sites/default/files/resource/parisagreement_publication.pdf [Last accessed on 2023 May 05].
Vătămănescu, E.M., Mitan, A., Andrei, A.G., Ghigiu, A.M. (2022), Linking coopetition benefits and innovative performance within small and medium-sized enterprises networks: A strategic approach on knowledge sharing and direct collaboration. Kybernetes, 51(7), 2193-2214.
Wang, Y., Yan, F., Jia, F., Chen, L. (2021), Building supply chain resilience through ambidexterity: an information processing perspective. International Journal of Logistics Research and Applications, 26, 1-18.
Warris, I., Hameed, I., Ali, R. (2022), Predicting household sign up for solar energy: An empirical study based on the extended theory of planned behavior. International Journal of Energy Sector Management, 17, 455-473.
World Health Organization. (2021), COP26 Special Report on Climate Change and Health: The Health Argument for Climate Action. Geneva: World Health Organization. Available from; https://www.who.int/publications-detail-redirect/9789240036727 [Last accessed on 2023 May 05].
Yang, C.C. (2012), Assessing the moderating effect of innovation capability on the relationship between logistics service capability and firm performance for ocean freight forwarders. International Journal of Logistics Research and Applications, 15(1), 53-69.
Zawawi, M.F.N., Wahab, A.S., Al-Mamun, A., Yaacob, S.A., Samy, N.K., Fazal, A.S. (2016), Defining the concept of innovation and firm innovativeness: A critical analysis from resource-based view perspective. International Journal of Business and Management, 11(6), 87-94.
Zhu, Q., Krikke, H., and Caniëls, M.C.J. (2018), Supply chain integration: Value creation through managing inter-organizational learning. International Journal of Operations and Production Management, 38(1), 211-229.
Zulu, S., Zulu, E., Chabala, M. (2022), Factors influencing households' intention to adopt solar energy solutions in Zambia: Insights from the theory of planned behaviour. Smart and Sustainable Built Environment, 11(4), 951-971.