Environmental factors and sustainable investment behaviour: Moderating role of financial literacy

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Abstract

Climate change significantly influences investment decisions by creating substantial investment opportunities. The study stems from the fact that emerging economies like Pakistan are heavily reliant on energy intensive sectors (cement, textile, transport, fertilizers, steel, etc.). This study put forwards that the investment behavior and the decisions made under such conditions have now been transformed into a complex relationship. The data was collected from the large retail sector of Pakistan registered with the Pakistan Stock Exchange (PSX). Investors with the last two years were approached for a useable sample of 243 responses. It was found that Perceived climate risk level by investors plays an important role in shaping the overall investment behavior of the investors. This role was mediated by the attitudinal and behavioral constructs like pro-environmental attitude. While researchers have done a lot of work on climate finance, a significant gap exited in evaluating simultaneously, the impact of attitudinal and knowledge factors namely financial literacy in shaping Sustainable investment behavior which found to be a boundary condition of the relationship. Implications for managers have been discussed.

Introduction

Over the past few years, countries throughout the world have experienced severe climatic conditions leading to a climatic emergency. This climate crisis has an influence on many sectors and industries. One of the most important sectors that the changing climatic conditions are impacting is the investment and financing sector. Climate change significantly influences investment decisions by creating substantial investment opportunities. Investors throughout the world are reconsidering their preferences and re-evaluating of specific assets in their portfolios.

Climate risk can be further classified into two main types of material risks i.e. the physical risk and the transition risk. Physical risks are the direct risks associated with the changing climate itself. These can be acute such as hurricanes, floods, rainstorms, wildfires, heat waves, droughts, etc. Or, they can be chronic such as rising sea levels, rising temperatures, ocean acidification etc. Transition risks, on the other hand, are the sorts of risks we take when moving to a low-carbon economy. While governments around the globe put in place policies, technologies and consumer trends to counteract climate change some industries and businesses are made vulnerable financially or operationally. Therefore, in broader terms, it can be said that climate risk is the negative effect of climate change on several aspects of the environment, society and business.

Physical risk, while catastrophic, often translates into uninsured losses or localized damages, which can be diversified or factored into short-term operational expenses. Transition risk on the other hand is driven by international forces such as policy shifts (e.g. carbon pricing) and technological disruptions. It suggests a fundamental and system-wide revaluation of assets. Transition risk for an organization is associated with changes aimed at reducing greenhouse gas emissions and switching to renewable energy sources. The transition is driven by political, legal, technological, and market changes necessary to address the mitigation and adaptation requirements related to the mutations resulting from climate change (Di Febo, 2025).

While the society, particularly the investors recognize climate change as a systemic threat, categorized into two categories (physical and transition), it is the latter the poses the most immediate and quantifiable threat to asset valuation in emerging markets like Pakistan.

Significance of research:

The significance of this study stems from the fact that emerging economies like Pakistan are heavily reliant on energy intensive sectors (cement, textile, transport, fertilizers, steel, etc.). This makes such economies vulnerable to global policy shocks (carbon taxes, de-carbonization, etc.). Not only this, the investors have to reconsider their investment choices and may have to stop investing in activities that further damage the environment leading to excessive climate shocks in the future.

This study put forwards that the investment behavior and the decisions made under such conditions have now been transformed into a complex relationship. The Perceived climate risk level by investors plays an important role in shaping the overall investment behavior of the investors. This role could be mediated by the attitudinal and behavioral constructs like pro-environmental attitude. This attitudinal construct is namely the pro-environmental attitude.

While researchers have done a lot of work on climate finance, a significant gap exits in evaluating simultaneously, the impact of attitudinal and knowledge factors namely financial literacy in shaping Sustainable investment behavior.

Problem Statement

The changing climatic conditions have put the industries throughout the world at a stake. The intensifying climatic crisis creates sever financial risk for companies in emerging markets like Pakistan. Sectors like textile, agriculture, construction and transportation are facing newer problems like carbon taxes and other policy pressures. The problem arises when these companies find the need to finance their business. Investors can either perceive this transition risk as very severe and a complete threat to our environment or stop investing in these sectors at all. Or, if their perceptions are week and pro-environmental attitude is not strong enough, they may continue investing in such sectors as mentioned above.

In current years, as the severity of climate change influences various sectors and regions, a large number of researchers around the globe have started to pay attention towards the effects of these risks on finance, economy and risk assessment (Campiglio, 2016; Sun et al., 2023). Studies on financial and economic impacts of climate change are well established. A rich literature can be found on the severe impacts of climate risk and the approach of companies towards mitigating, reporting and pricing that risk but there is a little focus on investors' behavior and decisions in the light of these risks.

Some studies show how global climatic emergency has changed firms' value and investment efficiency (al, 2022). According to the research by the Intergovernmental Panel on Climate Change (IPCC), global temperatures have risen by 1.1 °C above pre-industrial levels due to fossil fuel combustion and unsustainable energy and land use practices in industrial activities. These events have presented regulatory and policy changes on various industries (Gu et al., 2023; li et al., 2023). In this context, companies reliant on heavy manufacturing and otherwise climate vulnerable companies face greater challenges. Investors funding such companies also face a dual problem; should they continue investing in such companies, or should the shift to other less vulnerable assets/companies that support less carbon emission, less pollution and circular economy as well.

The existing literature, although provides a ground for establishing this "investor dilemma", but it fails to integrate the simultaneous forces driving the choice. Therefore, in order to understand which outcome prevails i.e. the decision of investors to continue investing in climate exposed and environment polluting companies, or considering companies instead that focus on environmental, social and governance perspectives to save the environment, major theories have been discussed in the subsequent sections.

The study falls under the domain of the following theories:

a) Capital Asset Pricing Model (CAPM) and the broader Efficient Market Hypothesis (EMH)
b) Ambiguity Aversion (Knightian Uncertainty)
c) Prospect Theory

Underlying Theories

The following theories play a significant role in building the basis of this study:

Capital Asset Pricing Model (CAPM):

The model was proposed in early 1960s by economists including William Sharpe, John Linter and Jack Treynor. The capital Asset Pricing Model is the foundational model that links risk and expected returns. It describes the relationship between systematic risk and expected returns for assets, specifically stocks. It suggests that investors are only compensated for the non-diversifiable/systematic/market risk which cannot be eliminated through diversification. The market does not reward the investors for holding the risk which can be diversified (company-specific risk) by dropping that asset and investing in some other.

This study aims to utilize the CAPM's logic to establish a rational benchmark. Climate risk is now a new systematic risk. Established in December 2017, the Network for Greening the Financial System (NGFS) which represents a consortium of central banks and financial institutions, claims that climate change is to be considered as a systemic risk because it has the potential to destabilize the entire financial system through its physical and transitional impacts.

Regulators globally are challenging the idea that climate change is merely a firm-specific risk. The consensus among central banks and financial bodies is that climate change must be viewed as a systemic risk with the potential to destabilize the entire financial system and ultimately the environment (NGFS, 2020).

This consensus among authorities is crucial to the model under study. Since climate risk impacts core macro-economic activities and function such as inflation, energy stability, policies, taxation and national supply chains, it becomes a non-diversifiable systematic risk (climate beta) that affects the stocks. Therefore it would not be wrong to propose that investors under such conditions, theories and research may develop strong attitudinal choices, wither favoring the stance of exposed industries and continue investing in them, or completely taking a safe flight to highly ESG contributing companies.

Prospect Theory

It is a behavioral economics model developed by Daniel Kahneman and Amos Tversky in 1979. Prospect theory has emerged as a leading alternative to expected utility as a theory of decision under risk. Prospect theory posits that individuals evaluate outcomes with respect to deviations from a reference point rather than with respect to net asset levels, that their identification of this reference point is a critical variable, that they give more weight to losses than to comparable gains, and that they are generally risk-averse with respect to gains and risk-acceptant with respect to losses (Jack S. Levy, 1992).

The concept of loss aversion is central to understanding investor behavior during a climate crisis. Since the investors feel the pain of potential losses, such as the total devaluation of their assets/portfolios due to an irreversible flood or a policy change, far more intensely than the pleasure of a comparable return, they are compelled to prioritize avoidance. This theoretical framework and concept directly supports the proposed idea of "safety flight" towards ESG high companies' side of the investor dilemma discussed earlier. The logic here is that exposed companies, primarily because of carbon taxes and other restrictions might pay less returns/dividends to investor which is another disadvantage apart from their contribution towards pollution.

Combining this argument with the logic established through CAPM and the one discussed in earlier sections, it would not be wrong to suggest that climate risk is a severe risk as of 2026 and based on the perceptions people develop regarding this risk, they will either perceive climate risk as a severe threat to not only the financial system but also the environment and develop a more Sustainable investment behavior or they will perceive climate risk as something that is not a severe threat to the environment and maintain their original investment behavior, the one including investments in polluting companies.

Ambiguity Aversion

Proposed by Daniel Ellsberg in 1961, the ambiguity aversion bias is a behavioral bias where individuals tend to prefer known outcomes over the unknown outcomes even if the potential gains on the unknown outcomes are greater than (but not guaranteed) the potential returns on known outcomes. It is

the inherent nature of individuals that they prefer certainty over uncertainty. Uncertainty and time increase the complexity of monetary benefit evaluation of environmental investments (Maria Sandsmark, 2007).

In behavioral finance, this bias can lead the investors to drop risky investments and shift towards less risky ones that offer clear potential returns, potentially missing out higher-growth opportunities. When investors find a signal that the climate-exposed assets in their portfolios, though offering higher returns, can face policy issues, additional taxes, destructive impacts of weather, technological risks, and market and reputational risks, they will take a safe flight towards alternatives. This can guarantee the investors a certain amount of return without any fear of loss.

It is also important to take into account the concept that in the case being discussed, climate risk often shifts from quantifiable risk to Knightian Uncertainty when a firm provides low disclosure. For instance, investors know that the consequences of flood can be severe and their investment in related sectors is at stake but they have no basis to estimate the financial probability for a specific company.

Hypotheses Development

Climate Risk Perception (CRP)

Climate risk perception refers to the perceived prominence of climate related risks when making decisions. In broader context, risk perception is the degree to which investors consider a particular risk and rank it as a major threat that requires urgent change of plans or a minor/emerging issue that does not require urgent threat at the exact moment.

Conceptual Definition

The idea of climate risk salience or climate risk perception comes from the salience theory proposed by Pedro Bordalo, Nicola Gennaioli and Andrei Sheifer in 2012. It is the degree to which climate related risks, both physical and transition are perceived as relevant and important by various stakeholders, particularly by investors, corporations and policy makers. When climate risks are salient, investors are more likely to pay attention towards mitigating strategies, either adjusting their portfolios or demanding a higher return for holding onto that risk.

Operational Definition

The construct Climate Risk Perceptions is measured through a set of 4 items.

Evolution of work on Climate Risk Salience:

Extreme weather and climate events such as heat waves and visibility have become more frequent over the past decade. Climate experts find no end to this and only see this as an irreversible damage globally (Hansen et al., 2019, Rao et al.,2022). High humidity levels can increase the likelihood of natural disasters such as rapid melting of glaciers, floods, wildfires and much more. This will ultimately impact investors throughout major industries reliant on temperature patterns such as agriculture, forestry, textile and renewable energy industries (Agovino et al.2019, Rao et al.,2022).

Climate experts have conducted a lot of research based on the recent visibility issues. Poor visibility, smog and cloudy weather for a prolonged period of time can lead to reduced crop yields, lower timber production, increased food prices which will ultimately impact the economy in broader terms. According to Rizwan Ahmed, Xihui Haviour Chen, Yen Hai Hoang and Chi Do-Linh, extreme weather conditions have a greater impact on stock market dynamics, making the returns more volatile.

The direct effect

Extreme weather conditions of various forms impact investor behavior. In today's world, investors find it impossible to neglect such risks. These conditions regularly impact stock index returns and volatility apart from environmental effects discussed in the paragraph above. As a result, investors may decide to adjust their portfolios to reduce possible risks and adopt a more sustainable approach. Similarly, investors may seek opportunities to invest in sectors or businesses that are likely to profit from these circumstances if consistently low temperatures are linked to higher stock returns.

Accordingly, it would not be wrong to hypothesize that:

H1: Following a climate risk salience shock, investors develop strong climate risk perceptions and engage in sustainable investment behavior.

Sustainable Investment Behavior (SIB)

Sustainable investment behavior refers to the practice by investors to incorporate environmental, social and governance dimensions in their investing activities.

Conceptual Definition

From the environmental dimension, companies engaged in sustainable finance promote practices that require low resource input thus promoting less resource exhaustion.

From the social dimension, sustainable investment focuses on inclusivity and accessibility, directly targeting low income groups, distant people and SMEs, especially the small enterprises that lacked access previously.

Finally, from the governance dimension, sustainable finance promotes transparency, disclosure and traceability to reduce information asymmetry between investors/shareholders and the management of the company.

Operational Definition

The construct Sustainable investment behavior is measured through a set of 4 items.

Evolution of work on Sustainable investment behavior:

The concept of sustainable investment finds its roots in ethical, moral and religious values and the studies based on these values that date back to 1500s and 1600s, when people considered investing in tobacco and alcohol companies as morally and religiously wrong and these were categorized as sin stocks.

Evolving from purely religious and moral grounds, the concept revolutionized till 1990s, where negative screening for ethical reasons was done. This evolved from purely religious to social justice issues.

Work on mainstream ESG and Sustainability, including sustainable investment behavior started in late 1990s and is continued till now. Sustainability is no longer regarded as merely an optional thing; it is regarded as tool for identifying material risk and generating alpha values for investors.

The United Nations Global Compact devised the ESG framework in 2004. Based on this framework, Impact investment picked pace after 2010. Current era focuses on Socially responsible investments.

Sustainable Investment behavior is more of a recently discovered variable. This particular concept emerged in response of climate risks and climate shocks and other governance related problems that intensified with time in severity. As a result, big investors or more appropriately, institutional investors had to reconsider their investing activities and preferences. This reconsideration translated in retail investors over time.

Sustainable investment behavior in 2026 is characterized by incorporation of environmental, social and governance dimensions into investment as discussed above. The importance of sustainability in finance is evident from the fact shared by a study published in International Review of Economics and Finance journal which stated that the size of ESG funds as of mid-2025 was reported to be 3.5 trillion dollars. This size was expected to increase by many folds in the near future.

Overall, the evolution of work on Sustainable investment behavior reflects a move from a static, idealized agent to a more complex, dynamic model that incorporates changing economic conditions, psychological factors, and market interactions.

Under the Task force on Climate-related Financial Disclosures (TCFD), companies are increasingly pressured to disclose climate-related risks and opportunities, and consultancies like KPMG Pakistan and organizations like the Ministry of Climate Change and Environmental Coordination are guiding businesses on how to adapt and comply with these growing international and local expectations for climate action and financial reporting. TCFD has 4 core pillars which will form the basis of the index:

1) Governance
2) Strategy
3) Risk management
4) Metrics and Targets

BASIS	CRITERIA
Governance	1) Does the report describe the board's oversight of climate-related risk? 2) Does the report describe management's efforts in assessing climate related risk?
Strategy	1) Are transition risks (carbon taxes, policies etc.) identified? 2) Are physical risks (floods, rainfalls, draughts) identified? 3) Is there a description of impact of these risks? 4) Does the firm describe its strategy for overcoming these risks?
Risk Management	1) Does the firm describe its processes for identifying climate risks?
Metrics and Targets	1) Are climate-related targets (net-zero etc.) disclosed. 2) Are the metrics used to assess climate risks against targets disclosed?

Exploring Interconnections: Relationship between climate risk salience and Sustainable investment behavior:

Investors in the market are quick to adjust their portfolios based on either rationality or behavior. Based on the salience theory, it can be seen that businesses whose operational and financial performance is vulnerable to extreme climate and weather events need to shift towards a distinct climate change corporate investment strategy. The same mechanism goes for investors as well. As the climate risk becomes more salient, investors become more averse to assets exposed to those risks.

Mediation

Pro-Environmental Attitude:

Pro-environmental attitude refers to adopting a responsible behavior that positively impacts the environment. It is a positive, conscious and purposeful disposition towards nature guided by the motive to protect the environment from long-term damage.

Conceptual Definition

In context of this research, Pro-environmental attitude refers to the shift in behavior of investors towards considering environmentally responsible investments. These include investments that have high green innovation index, high sustainability scores and good general perception regarding their compliance in the investing community.

Operational Definition

The construct Pro-environmental attitude is measured through a set of 4 items.

Evolution of Work on Pro-environmental attitude

The concept of pro-environmental attitude dates back to early 1970s when people focused on ecological issues and considerations. Slowly, people gained more knowledge and realized that such environmental attitudes may originate from developing a consideration for eological systems, but it is actually deeper than that. It requires the understanding of complex models that involve interactions of concepts from psychology, social norms and situational factors.

Exploring interconnections

The mediator (Pro-environmental attitude) explains the process through which the independent variable (Climate risk perception) affects the dependent variable (Sustainable investment behavior). In

essence, it answers the question how exactly does the climate shock lead to people changing their investment activities and reconsidering the sustainability of their portfolios as well.

When a climate shock hits the market, and the perceived climate related risk is high, it translates its effects in financial and environmental losses is high and the investors flee towards safety. Conversely, when a climate shock hits the market followed by a perception that the risk is not severe, people continue with their usual investment behavior and do not consider sustainability issues.

Under these assumptions, the following hypothesis can be stated:

H2: Following a climate risk salience shock, investors develop strong climate risk perceptions and engage in sustainable investment behavior that is amplified further through pro-environmental attitude.

Moderation

Financial Literacy

Financial literacy refers to the ability of individuals to understand financial methods, tools and terminologies and apply this knowledge to make informed decisions.

Conceptual Definition:

In the context of this particular study, financial literacy specifically refers to the ability of the investors to understand financial risks of investing in exposed companies or the companies that have low green innovation indices.

Operational Definition

The construct financial literacy is measured through a set of 4 items.

Evolution of Work on Financial Literacy:

The importance of financial literacy as a study variable is confirmed by the fact that financial literacy emerged as a niche topic in 2007 and since then, hundreds and thousands of research articles in behavioral finance have used it as a study variable.

In today's world, it is a critical and important global policy priority. It is prioritized by central governments and central banks or majority of the countries throughout the world since the 2007 financial crisis.

Exploring Interconnections

Based on the rationale presented in the conceptual definition, the following hypothesis can be stated:

H3: Following a climate risk salience shock, investors develop strong climate risk perceptions and engage in sustainable investment behavior that is amplified further through higher financial literacy.

The Integrated Model

Moderated mediation

The combine (moderated mediation) model answers the critical and the most important part of this study i.e. how and under what conditions Climate risk perceptions among investors influence sustainable investment behavior.

This is the most unique and distinctive part of the study which focuses on the complex interplay between Pro-environmental attitude and financial literacy i.e. the attitudinal and knowledge based variables respectively.

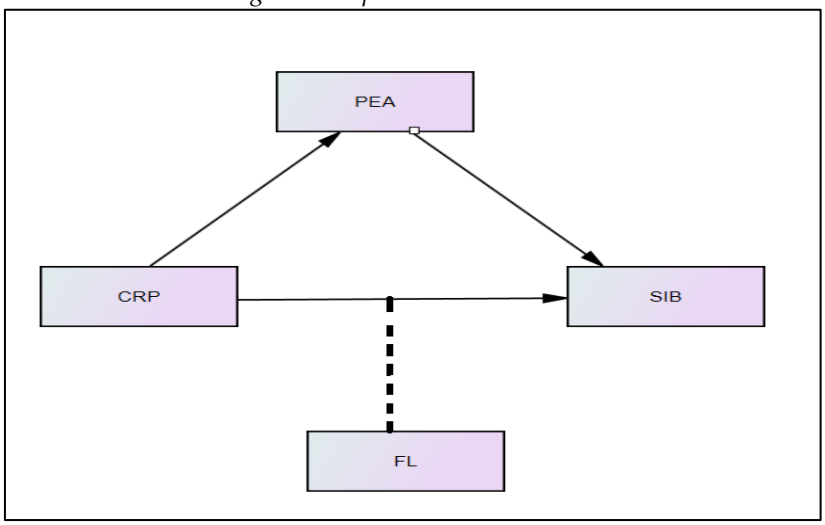
Conceptual Definition

While the previous sections measured the effect of moderator and mediator in isolation, this section combines the effect of both to test the complete theoretical model. Moderated mediation occurs when the strength of the mediation mechanism (the pathway through Pro-environemtal attitude) itself depends on the level of the moderator (financial literacy).

Operational Definition

Having established the moderation and mediation effects in isolation, the combined effects can be measured through AMOS. The model will simultaneously estimate the effect of both.

Fig 1: Conceptual Framework



Where, CRP refers to the Climate Risk Prescriptions and is the independent construct.
SIB refers to the Sustainable Investment Behavior and is the dependent construct.
FL refers to Financial literacy and it is the proposed moderator.
PEA refers to the Pro-environmental attitude and it is the proposed mediator.
The dotted line measures the impact of moderator in the proposed model.

Methodology

This section will outline the systematic approach that will be used to investigate the impact of climate risk perception on investor behavior in emerging economies like Pakistan. The methodology is designed to test the two moving forces of moderation and mediation, the effect of which is captured at a later stage through the moderated mediation model analyzed in AMOS.

The section also sheds light on the measurement of each variable and various proxies and scales used for this.

Research Setting

This research was conducted among retail investors in Pakistan. They represent a diverse segment of investment professionals engaged in the financial system of Pakistan. For this particular study, retail investors were specifically chosen for two main reasons.

Firstly, they constitute a very large segment of investors in Pakistan apart from the large scale institutional investors and their investment decisions are often guided by behavioral and attitudinal dimensions similar to the ones discussed above.

Secondly, this segment was much easier to approach based on connections in the corporate sector.

The research is set within the large retail sector of Pakistan registered with the Pakistan Stock Exchange (PSX). Specifically, the investors showed varying attributes in three major domains:

1) Age
2) Education
3) Years of investing experience

A filter question was applied in the very beginning of the questionnaire regarding whether they were active investors and have made at least 1 investment in the past 2 years or not. The responses that signaled a NO (which were very few) were filtered out and a sample of 243 responses was obtained.

Research Paradigm

The study adopts a Positivist research paradigm.

The assumption here is that reality exists externally and it can be measured. To operate in this particular paradigm, various frameworks have been used to collect primary data. The philosophy is selected because of the following important considerations:

- Objectivity:

Quantifiable data has been used.

- General to specific approach:

The research is built on a deductive approach. For that, 3 hypotheses have been established through already existing frameworks like the CAPM, Prospect theory, Ambiguity aversion theory and other logics established through examination of previous literature.

- Quantifiable:

For every Construct, 4 items were included. Each item set was composed of a 5-point likert scale based on the following pattern: 1=Strongly Disagree, 2= Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree

Research Design

The study uses a quantitative, causal research design based on questionnaire methodology. The event is the climate shock which shapes the investors' perceptions regarding climate risks and triggers the investors' financial behavior pushing them to choose between a continuing investing in their regular portfolio firms or transforming their portfolio to make it more green.

- Moderated Mediation Model: The simultaneous testing of Pro-environmental attitude mediates the relationship between risk perception and investor behavior and whether the shock translates into a strong perception or not.

Population, Sampling and Sampling Technique:

To evaluate the investor's dilemma, the data collection follows a structured approach:

Population:

The target population consists of retail investors working in corporate sector of Pakistan. These investors belong to various companies, major ones of which include Finca microfinance bank, Faletti's hotel, Arif Habib ltd, Avari Hotel, etc. However, it was not limited to the employees in these companies only. For instance, a female investors who were housewives and had primarily mad small scale investments through their savings also filled the questionnaire.

Sampling Technique

Purposive (judgmental) sampling technique and Snowball sampling technique have been employed here. This non-probability sampling approach has been used to ensure maximum participation. Based on limited contacts, the purposive technique had to be employed along with snowball technique to ensure that the questionnaire reached maximum targeted respondents.

Sampling

After the exclusion of non-active investors and only including active investors who had made at least 1 investment in the past 2 years, the sample reached a total of 243 responses.

Time period

Sampling was done for about 6 weeks. Data collection in the first 2 weeks was slow, however, after the incorporation of snowball sampling technique, it picked pace and the final 243 responses were collected approximately by the end of the sixth week on google forms.

Measurement instruments

To empirically test the integrated model, various frameworks have been used. These instruments translate the effects of climate risk and investor behavior into quantifiable metrics.

Independent Variable

The measurement of climate risk was done with 4 item construct. Each item was based on a question with 5 point Likert scale which was developed by Bohm and Mader (2009).

Mediating Variable

The measurement of Pro-environmental attitude consists of 4 item construct. Each item was based on a question with 5 point likert scale developed by Dunlap et al. (2000).

Moderating Variable

The measurement of financial literacy was carried out with 4 item construct. Each item was based on a question with 5 point likert scale.It was Adapted from Lusardi and Mitchell (2011).

Dependent Variable

The measurement of financial literacy is explained as follows: 4 item construct. Each item was based on a question with 5 point likert scale.by Riedl, and Smeets (2017).

Sample analysis

This study is conducted using primary data collected through questionnaires. Since the research question is centered on the behavior of investors in emerging economies like Pakistan, the questionnaires were filled by investors belonging to different age groups and different portfolio sizes. The sample had young investors such as university students who had just opened their accounts with the Pakistan Stock Exchange and had less than 2 years of investing experience. At the other extreme, the investors belonged to the 55+ age group who had more than 10 years of investing experience.

The analysis was done using SPSS and AMOS to investigate the hypothesized relationship between the variables.

The following outcomes were obtained:

Descriptive statistics:

This section is further divided into two parts. One deals with the demographics of the study. For that, Age groups, years of investing experience and Education level have been considered. Simple size corresponds to 243 respondents. Analysis revealed the following results:

The results depict that maximum percentage of the questionnaire belonged to people falling within the 31-45 age bracket, followed by the 45-60 age bracket. Results for years of investing experience indicate that most of the people had moderate experience ranging from 2 to 5 years. They were neither under-experienced nor overly experienced to show various kinds of biases. Finally we could conclude that educational barriers in this particular study do not exist since most of the people who filled the sample at least hold a master's degree, followed by a graduate degree.

Table 1: Demographics

Characteristic	Classification	Frequency	Percentage
AGE	18-30	37	15.2%
	31-45	112	46.1%
	45-60	91	37.4%
	60+	3	1.2%
Years of Investing Experience	Less than 2	48	19.8%
	2-5 years	108	44.4%
	6-10 years	69	28.4%
	More than 10 years	18	7.4%
Education	Under-graduate	12	4.9%
	Graduate	46	18.9%
	MS/M.Phil.	178	73.3%
	PHD	7	2.9%

Data Normality Analysis

The second part of descriptive analysis deals with data normality analysis. For this, the data file in SPSS was subjected to descriptive analysis where mean, standard deviation, skewness and kurtosis were checked. For the data to be normal, we follow the rule devised by Blumer in 1979. According to this rule, skewness estimated values must lie between -1 and +1, while kurtosis estimates should lie between -2 and +2. Skewness and kurtosis values for each item were checked, the following values were reported:

Table 2: Descriptive Statistics

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
CRP1	243	3.527	.9194	-.111	.156	-.521	.311
CRP2	243	3.428	.8708	-.156	.156	-.205	.311
CRP3	243	3.638	.8483	-.254	.156	-.298	.311
CRP4	243	3.284	.8706	.020	.156	-.463	.311
PEA1	243	3.593	.8496	-.293	.156	.086	.311
PEA2	243	3.494	.8301	-.046	.156	-.539	.311
PEA3	243	3.741	.8447	-.390	.156	-.144	.311
PEA4	243	3.416	.8838	-.194	.156	-.307	.311
FL1	243	3.259	.8830	-.097	.156	-.359	.311
FL2	243	3.214	.8102	-.269	.156	.258	.311
FL3	243	3.424	.8414	-.471	.156	.247	.311
FL4	243	3.053	.8487	-.307	.156	-.085	.311
SIB1	243	3.510	.8737	-.219	.156	-.140	.311
SIB2	243	3.440	.8279	-.139	.156	-.152	.311
SIB3	243	3.621	.8652	-.264	.156	-.188	.311
SIB4	243	3.329	.9263	.022	.156	-.239	.311
Valid N (listwise)	243						

All of the above values indicate that the data is normally distributed and the values are well within the range.

Reliability Analysis

An internal consistency analysis was conducting using Cronbach's alpha as the benchmark for this analysis. The corrected item-total values ranged from 0.544 to 0.684. This indicates that all items contribute significantly towards the overall construct. These values further depict that each item is significantly correlated with the total scale score.

According to Nunnally and Bernstein (1994) in their Psychometric Theory, inter-item correlations should be at least 0.3 to prove that they contribute towards the scale (Nunnally and Bernstein, 1994).

The Cronbach's alpha values if item deleted ranged from 0.889 to 0.896, suggesting that removal of any specific item would not significantly lead to the improvement in of overall scale. This suggests that the all the items belonging to four variables i.e. Climate risk perception, Sustainable Investment Behavior, Financial Literacy and Pro-environmental Attitude are all internally consistent and stable.

Table 3: item-total statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
CRP1	37.543	42.266	.638	.892
CRP2	37.642	42.305	.678	.890
CRP3	37.432	43.122	.619	.893
CRP4	37.786	43.218	.591	.894
PEA1	37.477	42.449	.684	.889
PEA2	37.576	43.138	.634	.892
PEA3	37.329	43.230	.612	.893
PEA4	37.654	43.161	.586	.894
FL1	37.811	42.633	.636	.892
FL2	37.856	43.454	.621	.893
FL3	37.646	43.403	.598	.894
FL4	38.016	43.901	.544	.896

Although the item in financial literacy scale (FL4) showed the lowest values for cronbach's alpha compared to other items, and its deletion could increase the cronbach's alpha to 0.896, but, this improvement is negligible. Therefore, FL4 could be retained. The instrument is therefore reliable for subsequent analyses.

Table 4: Correlations

		AVG_CRP	AVG_PEA	AVG_FL	AVG_SIB
AVG_CRP		1	.422**	.388**	.479**
			.000	.000	.000
		243	243	243	243
AVG_PEA		.422**	1	.406**	.592**
		.000		.000	.000
		243	243	243	243
AVG_FL		.388**	.406**	1	.226**
		.000	.000		.000
		243	243	243	243
AVG_SIB		.479**	.592**	.226**	1
		.000	.000	.000	
		243	243	243	243

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4 shows the relationship corresponding to the Pearson Correlation Coefficients between the four constructs namely

- Climate Risk Perception (CRP)
- Sustainable Investment Behavior (SIB)
- Financial Literacy (FL)
- Pro-environmental Attitude (PEA)

It shows the association between attitudinal and psychological factors and the importance of the factors in shaping the overall investment behavior of individuals.

All correlations are significant at 0.01 level (1%) indicating robust associations across the constructs.

The correlation between Climate Risk Perception (CRP) and Sustainable Investment Behavior (SIB) is 0.479, which is positively significant. This means that people with a higher climate risk perception, or more specifically, people with the ability to perceive climate risk are more likely to engage in sustainable investment behavior. For CRP and PEA, the correlation is again positively significant and demonstrates a value of 0.422. This indicates that stronger climate risk perception is associated with stronger pro-environmental attitude. People in such a case are more likely to engage in ESG initiatives and attitudes that promote low carbon emission, low pollution and ethical behavior. For CRP and FL, the correlation value is 0.388, which is again positively significant. This indicates a moderate linkage. Greater financial literacy is associated with greater awareness regarding climate risk and people are more likely to shape their climate risk perceptions in a better and educated way when they possess the necessary and required financial education.

Pro-environmental attitude and Sustainable Investment Behavior show the strongest correlation in the table. There is a strong positive relationship between these two variables suggesting that individuals with stronger Pro-environmental attitude are more likely to adopt Sustainable Investment Behavior. Financial literacy also tends to support Pro-environmental attitude. A correlation between these two of 0.406 again shows a positively significant correlation. Finally, FL and SIB also show a weak (0.226) but positive and significant correlation. This confirms that FL does predict SIB but in a weaker way compared to the other attitudinal variables.

Hence, the correlation matrix confirms that attitudinal variables are more strongly related to sustainable investment behavior. This could be confirmed from the fact that Pro-environmental attitude (PEA) appears as the strongest and most influential predictor. Literature on Financial literacy suggests that while financial knowledge is important and significant but it may not drive sustainable investment behavior alone in a strong way unless accompanied by strong attitudes. This is because people do possess

the knowledge but implying that knowledge in investing behavior takes more than just education. It requires people to evaluate their attitudes and perceptions as well.

Multicollinearity Analysis:

Multi-collinearity occurs when the predicting variables are highly associated with each other in simple linear regression, meaning, that one variable could be easily predicted by the other variable with great accuracy. Multicollinearity is specifically analyzed to check the importance of each single variable and that its importance is not obscured by other predictors in the model.

Table 5:

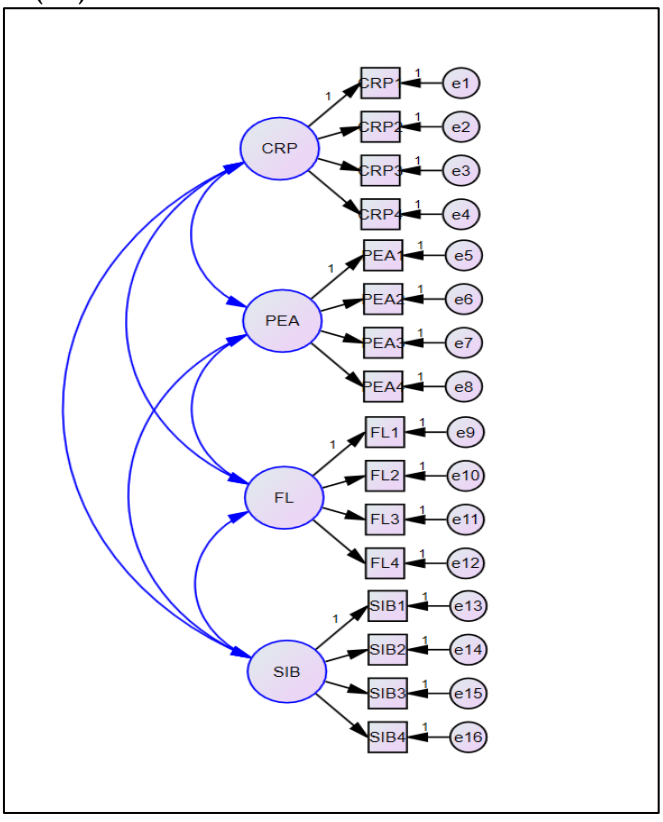
Variable	VIF
Climate Risk Perception	1.306
Pro-environmental Attitude	1.328
Financial literacy	1.286

To analyze multicollenarity, we look at the VIF values of each of the predicting variables. In SPSS, the results were obtained using linear regression, treating SIB as dependent variable while CRP, FL and PEA as the predictors. The requirement for collinearity was checked and the results obtained are depicted in table 5.

According to Hair et al. in their book Multivariate data analysis, the threshold value for VIF is 10. All of the values for the variables in table 5 are value below the cutoff value of 10. This indicates that variables are not highly correlated with each other. Multicollinearity is not a concern in this regression model and the variables retain their unique essence. All variables contribute unique explanatory power to the model.

The analysis confirms that the regression model is free from multicollenarity concerns. This strengthens the validity of regression analysis ensuring that the variables namely Climate Risk Perception, Pro-environmental Attitude and Financial literacy could be analyzed and interpreted reliably.

Confirmatory factor analysis (cfa)



Confirmatory factor analysis is a specific technique within structural equation modeling that is used to validate a specific measurement model. To check whether the observed items correctly validate the

latent constructs, confirmatory factor analysis is used. AMOS Graphics has been specifically used for this technique.

Firstly, the model demonstrated in the figure depicts the following factor loadings:

Table 6:

			Estimate
CRP1	<---	CRP	.846
CRP2	<---	CRP	.871
CRP3	<---	CRP	.874
CRP4	<---	CRP	.845
PEA1	<---	PEA	.864
PEA2	<---	PEA	.845
PEA3	<---	PEA	.852
PEA4	<---	PEA	.848
FL1	<---	FL	.854
FL2	<---	FL	.834
FL3	<---	FL	.841
FL4	<---	FL	.823
SIB1	<---	SIB	.874
SIB2	<---	SIB	.826
SIB3	<---	SIB	.885
SIB4	<---	SIB	.850

The recommended threshold for factor loadings is generally >0.4 (hair et al., 1998, 2010, 2014). The factor loadings for all of the items are well above this threshold, depicting a strong model and confirming good convergent validity.

Table 7:

Parameter	Value Obtained	Cutoff Value
CMIN/DF	1.158	<3
RMR	0.027	Closer to 0
GFI	0.947	≥0.9
AGFI	0.927	≥0.8
CFI	0.995	≥0.9
RMSEA	0.026	<0.08

To evaluate the overall model fitness, 6 major parameters have been discussed in table 7.

Firstly, CMIN/DF is a structural equation modeling model fit index. It refers to the minimum sample discrepancy ratio. To check how well the observed data fits the theoretical model, we look at this parameter. A model with the ratio of 3.0 or less is an acceptable model.

Secondly, the root mean square residual (RMR) is very close to zero, which means that the residuals between the observed and predicted correlations are minimal.

Thirdly, the GFI and AGFI i.e. goodness-of-fit and adjusted goodness-of-fit are also important parameters to check model fitness. Higher values depict a better fit. For both the parameters, the values are above the minimum required value, depicting strong model fit and adjustment for model complexity.

Fourthly, the CFI i.e. comparative Fit Index is again far above the cutoff value of 0.9. This indicates that the proposed model is explaining the data better than the null model.

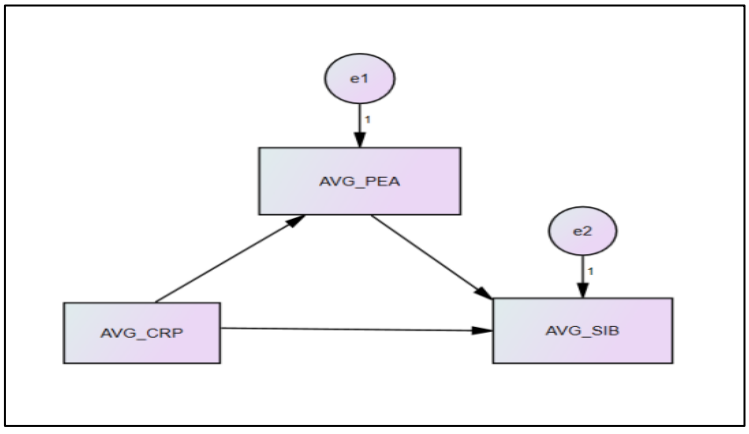
Lastly, the RMSEA values are well below the cutoff value again. This suggests that the proposed model has a very close fit to the population covariance structure.

Testing the hypothesized model

The hypothesized model has including the four variables have been tested using through 2 steps.

1. In the first step, simple the effect of mediator is tested in AMOS.
2. In the second step, a moderated mediation model has been used. This model is tested to understand the impact of Pro-environmental attitude as mediator while simultaneously investing under what conditions the moderation exists.

Evidence for Partial Mediation:



For this, the following mediation model has been tested in AMOS:

The analysis reported the following findings

Path	Direct Effect (β)	Indirect Effect (β)	Total Effect (β)	Significance
CRP → PEA	0.346 (0.339 std.)	–	–	$p < 0.001$
PEA → SIB	0.325 (0.316 std.)	–	–	$p < 0.001$
CRP → SIB	0.161 (0.153 std.)	0.112 (0.107 std.)	0.274 (0.261 std.)	Direct: $p = 0.014$; Indirect: $p < 0.01$

The findings report that the model supports Partial Mediation.

The climate risk perception (IV) directly predicts pro-environmental attitude ($\beta=0.339$, $p<0.001$), which in turn significantly predicted sustainable investment behavior ($\beta=0.316$, $p<0.001$). Climate Risk Perception also had a direct effect on Sustainable investment behavior ($\beta=0.153$, $p<0.014$).

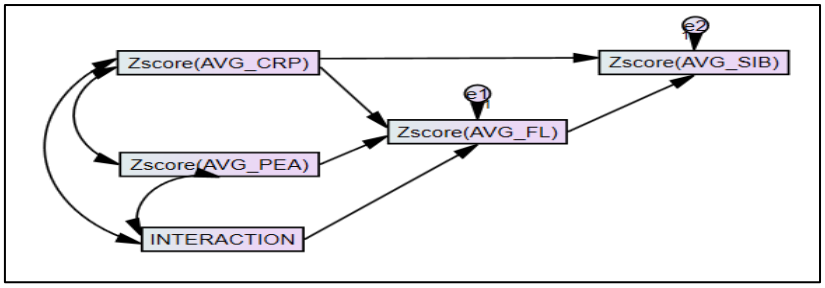
The analysis also reported indirect effects of Climate risk perception on sustainable investment behavior. The indirect effect or CRP on SIB was ($\beta=0.107$, $p<0.01$). Hence, these results report partial mediation, suggesting that Pro-environmental Attitude partially explains the relationship between Climate Risk Perceptions and Sustainable Investment Behavior.

Testing Moderated Mediation

In the second test, a moderated mediation model has been used. This model is tested to understand the impact of Pro-environmental attitude as mediator while simultaneously investing under what conditions the moderation exists.

To run this model, the Z scores of respective variables have been used. These Z scores were created in SPSS. The interaction term (CRP x FL) was also created in SPSS.

The following model was created



Mediation Model

The moderated mediation model was tested with Climate risk perceptions as the independent variable, Sustainable investment behavior as the dependent variable, financial literacy as the moderator and Pro-environmental attitude as the mediator.

The results revealed that Climate risk perception had a significant positive impact on Sustainable investment behavior (β=0.266, p<0.001). This finding confirms the fact that people who perceive climate risk strongly are more likely to engage in investment activities that support environmental, social and governance perspectives to contribute towards sustainable finance and vice versa. The moderator itself i.e. financial literacy did not directly predict sustainable investment behavior, but it mainly played its role by moderating the strength of the independent variable. This is confirmed by the fact reported by the analysis that the interaction is significant. The interaction term significantly predicted the relationship (β=0.150). This confirms that moderation was present. The relationship between CRP and FL was conditional on the interaction effect.

PATH	STANDARDIZED β	SIGNIFICANCE
CRP→SIB	0.266	P<0.001
Interaction term → FL	0.150	P=0.018
CRP → SIB (Total Effect)	0.262	P<0.001

Discussion:

The findings of this study reflect a complex interplay and interaction between attitudinal and psychological variables namely, pro-environmental attitude, financial literacy and climate risk perceptions. Together they play an important role in predicting and shaping the sustainable investment behavior of retail investors.

Consistent with hypothesis 1, climate risk perceptions shaped investors sustainable investment behavior. The coefficient was significant and positive confirming that the more risk the investors perceived; the more likely they were to engage in sustainable investment behavior. This also confirmed the fact that investors were sensitive to both physical and transition climate related risks. This also aligns with the previous studies in literature that climate risk has transformed into a systematic risk that needs immediate attention, comparable to the traditional market risks measured under the Capital Asset Pricing Model framework (CAPM). This evidence also supports the fact that climate risk is not firm specific but an important macro-economic factor influencing asset prices and portfolio strategies.

Mediation through Pro-environmental Attitude

The mediation pathway was validated successfully, confirming the fact that climate risk perceptions not only directly influenced the sustainable investment behavior of investor, but it also played it role by environmental attitude. The findings confirm that pro-environmental attitude amplified investors' perceptions. Investors who perceived climate risk more strongly due to pro-environmental attitude i.e. attitude involving ecological considerations strongly engage in a more sustainable investment behavior.

This mediation pathway confirms that attitude serves as a pathway and bridge between risk perceptions and actual behavior, reinforcing the importance of behavioral dimensions in financial decision making.

Moderation through Financial Literacy

The moderated-mediation framework analyzed in AMOS revealed that the interaction term for financial literacy was significant and positive, confirming that financial literacy strengthens the pathway from climate risk perceptions to sustainable investment behavior. Investors with higher financial literacy are better equipped to interpret climate related disclosures, assess transition risks such as carbon taxes, government regulations and policies. These investors were also capable of assessing the long-term viability of green investments.

Integrated Model and Investor Dilemma

The combined moderated mediation model reveals that sustainable investment behavior is most evident and pronounced when both "attitudinal" and "knowledge" factors are strong i.e. pro-environmental attitude and financial literacy respectively. This integrated model addresses the investor dilemma in existing research: "whether to continue investing in traditional, climate exposed stocks or to adopt a green approach and shift towards sustainable investment.

Implications

For emerging economies like Pakistan, these results hold considerable importance and significance. Retail investors represent a very large portion of financial and investment sector in such economies and their collective behavior could influence capital allocation towards sustainable investment. Such countries must strengthen and pay attention towards financial literacy programs for youth specifically and generally for the entire population to accelerate the transition towards green investment.

Limitations

Despite the valuable insights generated, this study is subject to several limitations that should be acknowledged:

Sample Scope: The research was conducted among retail investors in Pakistan. While this group represents a significant segment of the financial system, the findings may not fully capture the perspectives of institutional investors or policymakers whose decisions often shape broader market dynamics.

Geographical Context: The study is limited to an emerging economy context. Climate risk perceptions and sustainable investment behavior may differ substantially in developed markets where regulatory frameworks, disclosure standards, and investor awareness are more advanced.

Measurement Constraints: The constructs of climate risk perception, pro-environmental attitude, financial literacy, and sustainable investment behavior were measured using self-reported survey items. Such measures are prone to biases, including social desirability bias and subjective interpretation of questions.

Cross-Sectional Design: The research design is cross-sectional, capturing investor perceptions and behaviors at a single point in time. This limits the ability to establish causality or observe how perceptions and behaviors evolve in response to ongoing climate shocks or policy changes.

Moderated Mediation Complexity: While AMOS modeling allowed for testing moderated mediation, the complexity of real-world investor decision-making may involve additional variables not captured in this study, such as cultural values, political trust, or access to green financial products.

Disclosure and Data Availability: Climate-related disclosures in Pakistan remain limited compared to international standards. This lack of transparency may have influenced investor perceptions and constrained the accuracy of responses regarding sustainable investment behavior.

References

Agovino, M., Casaccia, M., Ciommi, M., Ferrara, M. and Marchesano, K. (2019) 'Agriculture, climate change and sustainability: The case of EU-28', Ecological Indicators, 105, pp.525–543.

Ahmed, R., Chen, X.H., Hoang, Y.H. and Do-Linh, C. (2024) 'Climate change effects and their implications for the financial markets: Evidence from the United Kingdom', Journal of Environmental Management, 366, p.121782.

Andersson, M.B. (2022) Analysis of climate- and financial volatility measures and their relation. Master's thesis (Mathematics-Economics). Aalborg University, Denmark.

Bender, J., Bridges, T.A. and Shah, K. (2019) 'Reinventing climate investing: Building equity portfolios for climate risk mitigation and adaptation', Journal of Sustainable Finance and Investment, 9(3), pp.191–213.

Blyth, W., Bradley, R., Bunn, D., Clarke, C., Wilson, T. and Yang, M. (2007) 'Investment risks under uncertain climate change policy', Energy Policy, 35(11), pp.5766–5773.

Bohm, G. and Mader, S. (2009) 'Emotional reactions to environmental risks: Consequentialism-based appraisals and ethical concerns', Journal of Environmental Psychology, 29(4), pp.452–461.

Campiglio, E. (2016) 'Beyond carbon pricing: The role of banking and monetary policy in financing the transition to a low-carbon economy', Ecological Economics, 121, pp.220–230.

De Jong, M. and Nguyen, A. (2016) 'Weathered for climate risk: A bond investment proposition', Financial Analysts Journal, 72(3), pp.34–39.

Di Febo, E. and Angelini, E. (2025) 'Transition risk in climate change: A literature review', Risks, 13(4), p.66.

Dunlap, R.E., Van Liere, K.D., Mertig, A.G. and Jones, R.E. (2000) 'New trends in measuring environmental attitudes: Measuring endorsement of the New Ecological Paradigm', Journal of Social Issues, 56(3), pp.425–442.

Dutta, A., Bouri, E., Rothovius, T. and Uddin, G.S. (2023) 'Climate risk and green investments: New evidence', Energy, 265, p.126376.

Ellsberg, D. (1961) 'Risk, ambiguity, and the Savage axioms', Quarterly Journal of Economics, 75(4), pp.643–669.

Hansen, L.P., Roberds, W. and Sargent, T.J. (2019) 'Time series implications of present value budget balance and of martingale models of consumption and taxes', in Hansen, L.P. and Sargent, T.J. (eds.) Rational Expectations Econometrics. Boca Raton, FL: CRC Press, pp.121–161.

Ibrahim, M.R. (2022) 'Climate risk, financial stability, and global capital allocation: A predictive analytics approach to assessing climate-related financial risk in international investment markets', Journal of Business and Management Studies, 4(4), pp.264–276.

Kahneman, D. and Tversky, A. (1979) 'Prospect theory: An analysis of decision under risk', Econometrica, 47(2), pp.263–291.

Krueger, P., Sautner, Z. and Starks, L.T. (2020) 'The importance of climate risks for institutional investors', Review of Financial Studies, 33(3), pp.1067–1111.

Levy, J.S. (1992) 'An introduction to prospect theory', Political Psychology, 13(2), pp.171–186.

Li, W., Qiao, Y., Li, X. and Wang, Y. (2022) 'Energy consumption, pollution haven hypothesis, and Environmental Kuznets Curve: Examining the environment–economy link in Belt and Road Initiative countries', Energy, 239, p.122559.

Lusardi, A. and Mitchell, O.S. (2011) 'Financial literacy around the world: An overview', Journal of Pension Economics and Finance, 10(4), pp.497–508.

Marshall, B.R., Nguyen, H.T., Nguyen, N.H., Visaltanachoti, N. and Young, M. (2021) 'Do climate risks matter for green investment?', Journal of International Financial Markets, Institutions and Money, 75, p.101438.

NGFS (2020) Guide for Supervisors: Integrating Climate-Related and Environmental Risks into Prudential Supervision. Paris: Network for Greening the Financial System / Banque de France.

Nunnally, J.C. and Bernstein, I.H. (1994) Psychometric Theory. 3rd edn. New York: McGraw-Hill.

Rao, A. and Kumar, S. (2025) 'Climate resilience through finance: The divergent roles of institutions and markets', Finance Research Letters, p.108008.

Riedl, A. and Smeets, P. (2017) 'Why do investors hold socially responsible mutual funds?', Journal of Finance, 72(6), pp.2505–2550.

Sandsmark, M. and Vennemo, H. (2007) 'A portfolio approach to climate investments: CAPM and endogenous risk', Environmental and Resource Economics, 37(4), pp.681–695.

Sharpe, W.F. (1964) 'Capital asset prices: A theory of market equilibrium under conditions of risk', Journal of Finance, 19(3), pp.425–442.

Sun, L. et al. (2024) 'State of China's climate in 2023', Atmospheric and Oceanic Science Letters, 17(5), p.100519.

Treynor, J.L. (1962) Toward a Theory of Market Value of Risky Assets. Unpublished manuscript.

Van Dijk, M. (2020) Assessing Climate Risk for Investment Portfolios. Rotterdam: Erasmus Platform for Sustainable Value Creation.

Xing, Z. and Wang, Y. (2023) 'Climate risk, climate risk distance and foreign direct investment', International Journal of Climate Change Strategies and Management, 15(1), pp.41–57.

Xu, W., Huang, W. and Li, D. (2024) 'Climate risk and investment efficiency', Journal of International Financial Markets, Institutions and Money, 92, p.101965.