CAPITAL UNIVERSITY OF SCIENCE AND TECHNOLOGY, ISLAMABAD

Impact of Climate Risk, Economic Policy Uncertainty and Macroeconomic Factors on Stock Market Performance: Evidence from Selected Emerging Economies

by

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I want to dedicate this achievement to my parents, teachers and friends who always encourage and support me in every crucial time

CERTIFICATE OF APPROVAL

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Abstract

Despite the overwhelming consensus within the scientific community concerning the causes and effects of climate change, there is little known how climate risk influences firm's financial performance. The present study aims to examine the impact of climate change, energy consumption, economic policy uncertainty, exchange rate and economic growth on the stock market's performance of emerging countries. Further, the current study examines the interaction role of energy consumption between climate risk and stock market performance. The stock market performance is measured with stock return. The stock markets are from twelve emerging countries namely: Argentina, Brazil, China, Indonesia, India, Mexico, Poland, Russia, South Africa, South Korea, Turkey, and Pakistan. To draw empirical results, the study employed fixed effect, random effect and pooled ordinary least square models on the dataset from 2005 to 2019. The findings show that higher climate risk reduce stock market performance in terms of returns. Next, the positive significant interaction term of energy consumption with climate change suggests that the negative effect of climate risk on stock performance is moderated through energy consumption. Further, economic policy uncertainty also carries negative significant effect, suggesting that rising economic policy uncertainty diminishes emerging countries stock market performance in terms of stock return. Whereas higher industrial production improves stock market performance. Moreover, in the macroeconomic factors, local currency depreciation positively and higher policy rate adversely affect stock market performance. These empirical findings imply that policymakers and investors should consider climate risk, country-level economic policy uncertainty, energy consumption and major macroeconomic factors while devising stock market's policies and formulating portfolios.

Keywords: Climate Risk, Stock Market Performance, Energy Consumption, Economic Policy Uncertainty.

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Abbreviations

CRI	Climate Risk Index
DGSE	Dynamic General Stochastic Equilibrium
DSI	Domino Social Index
ENC	Energy Consumption
EPU	Economic Policy Uncertainty
EU	European Union
Forex	Foreign Exchange Rate
GHG	Greenhouse Gas Emissions
GSIA	Global Sustainable Investment Alliance
IEA	International Energy Agency
IIP	Index of Industrial Production
IMF	International Monetary Fund
IND	Stock Market Index
IPCC	Intergovernmental Panel on Climate Change
KSE	Karachi Stock Exchange
Kurt	Kurtosis,
Kwh	Kilowatt-hours
Max	Maximum
Min	Minimum
Norm	Normality
Obs	Observations
OCED	Organization for Economic Co-operation and Development
POLS	Pooled Ordinary Least Squares
PR	Policy Rate

ROA	Return on Assets
RT	Stock Market Returns
S&P	Standard & Poor's
Skew	Skewness
SRI	Socially Responsible Investment
Std.Dev	Standard Deviations
UNEP	United Nation Environment Program
VECM	Vector Error Correction Model
WDI	World Development Indicators
WEF	World Economic Forum
WGI	World Governance Indicators

Chapter 1

Introduction

Global climate change is considered the most pressing issue faced around the globe in the 21st century. Climate change is a global threat multiplier to business, society, and overall socioeconomic development. The changing environment with new regulations, policy changes, consumer behaviour, and technological shifts has put significant pressure on countries. The substantial economic and societal consequences of climate change have received much of the researcher's attention (Nordhaus & Yang, 1996; Alley et al., 2003; Hayhoe et al., 2004; N. Stern & Stern, 2007; Matthews, Wilby, & Murphy, 2017; He & Liu, 2018). Meanwhile, climate change also poses significant challenges to the financial markets because various financial securities are ultimately backed by the real economy (Dietz, Bowen, Dixon, & Gradwell, 2016). For instance, Antoniuk and Leirvik (2021) reported that extreme weather events and climate-related policy adjustments significantly affect stock market performance i.e., stock returns. The projected changes in earth's temperature over the next century range from 1° C to more than 4 °C, devastatingly affecting many countries and their financial markets. Therefore, the role of climate change in financial markets necessitates good investigation.

Although the changing climate's effects cannot be observed overnight and are often neglected. Investors are increasingly interested in understanding how the shift to a greener and cleaner environment affects firms' performance (He & Liu, 2018; Sarkodie, Adams, & Leirvik, 2020; Teng & He, 2020; Qian, Suryani, & Xing, 2020). For instance, Mondal and Bauri (2022) and Pankratz, Bauer, and Derwall (2019)

stated that climate change imposes greater risk on firms' operational and financial performance. Qian et al. (2020) reported that better carbon performance has led to higher market returns in Australia. Giglio, Kelly, and Stroebel (2021) believe that climate change exposes firms to different forms of risks and has substantial implications for the underlying assets. However, despite the growing attention to climate change, little is known about how climate risk affects stock markets' performance. That's why the current study attempts to examine the role of climate change in the stock market performance of emerging countries.

A negative externality is something that one party does, and other party bears the cost indirectly. The same is with climate change. The climate change might be caused by one and beard the cost by other. For instance, the recent widespread floods in Pakistan which resultant in significant economic and financial losses were due to the changing global climate. In this scenario, Pakistan bears the cost of world climate change. Climate is a long-run pattern of weather condition in a particular area. The earth's climate is affected by many natural factors such as sunlight, earth's orbital changes, land cover and human factors such as the amount of greenhouse gases (GHGs). Greenhouse gases are the gases that absorb and release solar radiation that causes the greenhouse effect. The standard greenhouse gases are carbon dioxide (CO2), methane (CH4), ozone (O3), nitrous oxide (N2O), etc. These gasses are detrimental to the ecosystem and environment. The climate risk effects are not only limited a sector, a country or a region but are widespread. Therefore, the current study is considering the climate risk role in the financial performance of firms operating in emerging economies.

According to United Nations, the main contributor to climate change is human activity and the main contributor to GHGs is burning fossil fuels such as coal, oil, and gas. Climate change affects 360 degrees of human lives, from food sources and health to going on holidays. Climate change is an environmental, economic, and social risk that is expected with long-term impacts. This can be marked by phenomena such as rise of average temperature, the rise of sea level, melting of glaciers, change of wind patterns, scarcity of clean water, and extreme weather conditions. Global Climate Risk Index (Eckstein, 2021) claimed that between 2000 and 2019, climate change cost 475000 human lives and 2.6 trillion US dollars

in economic loss as a direct consequence of 11,000 extreme weather events across the globe. In view of attaining sustainable development goals, European Union set the target to reduce greenhouse gas emissions by 40% and attain a 27% growth in energy efficiency (European, 2011). In these changing dynamics, an intelligent investor cannot therefore suppose that a sector i.e., energy sector will always depend on fossil fuels at least in the long-run and that the economic growth would be there without diminishing the use of fossil fuels. Hence, climate risk is important to be considered in the companies and financial markets perspective.

In light of the Efficient Market hypothesis of Fama (1970), financial markets efficiency lies in the prompt and sufficient price adjustments toward the new public information arrivals. That is, a change in stock prices should occur when there are climate-related extreme events and subsequent policy revisions. A large part of the empirical work exhibits that companies' disclosure mechanisms are key for giving relevant information to the market, and thus help stock prices to sufficiently adjust according to the new information (Pevzner, Xie, & Xin, 2015; Bochkay, Hales, & Chava, 2020). However, recent study proposes that existing financial indicators do not incorporate climate change, thereby misleading investors, and other key business stakeholders by claiming higher achievements and better performance (Mondal & Bauri, 2022). While, climate change reduces firms' revenue and operating income, investors often fail to fully anticipate the economic repercussions of climate change (Pankratz et al., 2019). Hence despite the importance of climate change in the 21st century, stock prices still do not fully reflect climate risk which put investors' money and policymakers' job at stake. So, it's very much important to investigate the role of climate change in stock market performance. Climate risks can be divided into (a) physical risk and (b) transition risk (Clapp, Lund, Aamaas, & Lannoo, 2017).

The former is associated with extreme weather events and resultant consequences, while the latter is linked to attributes of transition to a low-carbon economy such as technological shifts, policy regulations etc. Although all countries are suffering from the negative consequences of climate change, emerging countries are expected to be more severely affected by climate change. Recent studies reported that developed economies have decoupled their economic growth from greenhouse

gas emissions, but emerging countries are struggling to attain sustainable development (Vavrek & Chovancova, 2016; Cohen, Jalles, Loungani, & Marto, 2018; Burchardt, 2018). Emerging countries try their best to transition to low-carbon economies because of limited resources (i.e., infrastructure) and the need for retaining the growth rate. When the level of development increases, countries transition their economies to the tertiary and service sector from the secondary sector or production-based economy which makes them more energy efficient (Marinaș, Dinu, Socol, & Socol, 2018). Countries and companies, which are largely dependent on energy consumption for their bread and butter, in the developing world are more exposed to climate risk as compared to countries and firms in the developed world (Mondal & Bauri, 2022). Therefore, the current study is focusing on the climate risk effects on emerging countries' stock market performance.

According to the United Nations, the main contributor to climate change is human activity and the main contributor to greenhouse gas emissions (GHG) is burning fossil fuels such as coal, oil, and gas. In other words, human activities especially energy consumption (i.e., crude oil and coal) emit GHG emissions which are detrimental to climate change. Climate change is important to tackle because it affects 360 degrees of human lives, from food sources to health and even humans' survival on the planet. In this way, climate change is an environmental, social, and economic risk that has far-reaching long-term consequences. This can be marked by rising temperature, sea level rise, melting glaciers, change in wind patterns, water scarcity, heat strokes, and other extreme weather events. According to Global Climate Risk Index (D. Eckstein, Künzel, & Schäfer, 2021) between 2000 and 2019, climate change cost 475,000 human lives and 2.6 trillion in economic losses as a direct consequence of around 11,000 extreme weather events across the globe.

The United Nation Environment Program (UNEP) (Programme, 2016) estimated that the climate annual adaptation cost is expected to reach from 140 to 300 billion dollars. Besides, the report highlighted that the climate adaptation cost has been increasing over the years. As per the current estimates, developing countries will need approximately $290 to 580$ billion in climate finances until 2030 to cover climate-caused loss and damage Climate Risk Index, (Eckstein, 2021). In

view of attaining sustainable development goals, European Union set the target to reduce greenhouse gas emissions by 40% which will be attained by increasing by 27% energy efficiency (European, 2011). Given these prospects, an intelligent investor cannot invest without taking into consideration climate change and its resultant consequences. An intelligent investor cannot suppose that energy sector will always depend on fossil fuel rather, he will consider the transition from non-renewable to renewable and will, therefore, assign some risk premium to their investment. Similarly, it is vital for researchers and portfolio managers to take into account that changing global climate can endanger investments and so the performance of the financial markets.

In the empirical literature, Ardia, Bluteau, Boudt, and Inghelbrecht (2020) for the first time, constructed the "Media Climate Change Concerns index" that measured the climate-related coverage in the New York Times, and seven other US major newspapers, during Jan-2010 to June-2018. Firstly, they categorized companies' shares into two groups: green shares and brown shares. These green and brown shares were of the environmentally friendly and environmental unfriendly companies respectively. Secondly, emissions are divided by revenue to calculate per dollar emissions. Thirdly, they compared the constructed newspaper-based index with the returns of green and brown shares. Interestingly, the authors found when climate-related coverage increases the price of brown shares goes down compared to green shares whose prices go up. Further, "(in A Time of Climate Change, 2015)", report published by Mercer (Assets Management Company) and International Finance Corporation, proposed that climate change will divide investors between winners and losers. Investors in the non-renewable energy sector are expected to be the losers because their returns are expected to drop around 26 to 138 per cent. Whereas the investors in the renewable energy sector will be winners with an annual average return expected to rise from 4 to 97 per cent. So, rational investors can no longer neglect the climate changing impact on their portfolio's performance.

The second question is: Does energy consumption moderates the relationship between climate change and stock market performance? Climate change is triggered by the extensive consumption of non-renewable energy such as oil, gas and coal.

Increase in world population increases energy demand and ultimately energy consumption which in turn causes Greenhouse Gas Emissions, or GHGs (International Energy Agency, (IEA, 2018). IEA (2018) predicted that the world energy demand from 2017 to 2040 will grow by around 30% which will further cause climate change. Climate change is triggered by energy consumption (non-renewable), and both when interacting will affect companies' performance, and so their share prices and resultant stock market performance. Although most countries have set targets to reduce non-renewable energy consumption and GHG emissions (Bayar & Gavriletea, 2019). However, implementing policies and measures to reduce GHG emissions will be accompanied by lower economic growth. Most importantly, recent studies concluded that developed countries made their economic growth independent from carbon emissions, but emerging countries, which is the interest of this study, are not so successful in doing so and the interacting role of energy consumption and climate change is expected to be stronger in their stock markets.

The third question that the current study is attempting to answer is does economic policy uncertainty affect the stock market performance? In order to respond to climate change effectively and successfully, a legally and politically binding consistent and long-term policy architecture is needed. In other words, the given economic policy should be responsive and consistent in the long-run in order to counter the adverse effects of climate change. A higher economic policy risk (uncertainty) disturbs the country's long-term climate objectives and successful transition towards low-carbon economies. The economic and stock market performance, energy consumption and carbon emission due to energy consumption in turn depend on how the government drafts policies in a timely fashion to govern and control them all.

The government can, due to its policy instrument, influence industries with higher carbon emissions e.g., by imposing sanctions, taxes and carbon pricing and they can also decrease emissions by giving subsidies to the companies which have adopted renewable energy sources or using energy in efficient ways. Recently, Gu, Sun, Wu, and Xu (2021) documented that there is a negative association between EPU (newspaper-based measure) and stock price momentum. moreover, the study argued that uncertainty in policies leads to risk premium during volatile

situations in the market, so uncertainty in policies has a positive relationship with stock market volatility and a negative relationship with stock prices.

Despite the extensive consensus within the scientific community concerning the causes and effects of climate change, policy responses and regulations are often not consistent particularly in the emerging market. Contreras and Platania (2019) reported that the effectiveness of climate control related initiatives is sensitive to both economic and political system a country. For instance, countries often fail in implementing climate policies in times of political and economic distress which makes it difficult to achieve their long-term climate goals. When countries struggle on economic fronts, which is generally the case with emerging economies, their economic policy uncertainties (EPU) affect their climate initiatives. Economic policy consistency is of the utmost importance for the effectiveness of climate control related initiatives (Contreras & Platania, 2019). (Liu & Zhang, 2015). Arouri, Estay, Rault, and Roubaud (2016) posit that increasing economic policy uncertainty significantly reduces stock performance. Therefore, the current study also examines the role of economic policy uncertainty in the stock market performance of emerging countries.

The fourth question is: does policy rate influence the stock market performance of emerging countries? Stock prices are considered to be most sensitive to a country's economic condition. Therefore, changing monetary policy to manage the economic conditions can be directly reflected in share prices. Although monetary policy is an important tool to mitigate climate change, such monetary policy might have negative consequences on the stock market's performance. For instance, the use of monetary policy to mitigate climate change can potentially affect stock market performance. Theoretically, as per the discounted cash flow approach, share prices are the present value of expected future cash flows.

Present value is calculated by using a discount rate, so, by changing interest or policy rate, the government in a way is changing share prices or at least influencing share prices. Contractionary monetary policy is linked with lower share prices or lower market performance as in such case the interest rate would be higher to discount expected future cash flows. On the other hand, expansionary monetary

policy means lower interest rates that will make share prices rise. Hence, the argument is that there is a strong relationship between monetary policy and stock market performance.

Whenever central bank increases policy rate, it promptly uplifts companies' borrowing costs. This has a far-reaching influence on essentially any borrowing costs for organizations and shoppers in an economy. When the policy rate increases, it increases the cost of financial institutions, and in turn, they increase borrowing costs. Firstly, borrowers are affected through increments to their credit card charges and home loan financing costs, particularly if these loans have a variable financing cost. At the time when the financing cost of cards and home loans rises, buyers have to cover their bills so the amount of money that consumers can spend out of their disposable income diminishes. Secondly, those bills become costly, and families are left with less disposable income. Whenever buyers have less discretionary cash, organizations' revenues and profits decline. Finally, as the rate goes up, organizations are not only affected by higher acquiring costs, but they are also additional prone to the unfavorable impacts of decreasing buyer demand. Both of these elements can cause to diminish income and as well as stock prices. The theoretical underpinnings, therefore, suggest the role of the policy rate in the stock market performance.

The fifth question is does the exchange rate affects the stock market performance of emerging countries? The open economy model suggests a relationship between exchange rate behaviors and the stock market. The model demonstrates that variation in exchange rate affects the competitiveness of firms as it affects the value of earnings and the cost of borrowing provided that most companies borrow in foreign currencies to finance their operations so their stocks must also be affected. An appreciation in local currency makes exporting goods less profitable or more expensive for foreign consumers, consequently, firms' revenues fall and do so their share prices.

Portfolio balance method postulates that the exchange rate is determined by the supply and demand of local currency, and in turn, this supply and demand can affect stock prices because it affects companies' performance, particularly, companies

involved in import and export. Good performing stocks attract foreign investors to invest and diversify their portfolios, hence, a rise in stock prices collects more foreign currency and fosters demand for local currency which consequently appreciates the relative value of the local currency. Conversely, when stocks begin to lose their value, investors sell out and demand local currency decreases which ultimately depreciates the relative value of the currency. In a nutshell, a boom (slump) in the stock market will appreciate (depreciate) the exchange rate of the local currency. Hence, the exchange rate is an indispensable factor in the determination of stock prices. Therefore, the current study has considered the exchange rate while investigating the effect of climate risk on stock market performance.

1.1 Problem Statement

Stock market is affected by many things that happen in the economy and as well as in the global financial, economic, political and any environmental system. Climate change is one of them that is a threat multiplier to business, society, and overall ecosystem and consequently to the performance of the equity market.

Although climate change has significant impacts on financial markets, these impacts cannot be observed overnight because of its long-term nature. Financial investors are keen to know how changing climate and transition towards greener environment will influence their portfolio performance and investment returns (He & Liu, 2018; Teng & He, 2020; Qian et al., 2020). Not only investors, but also other stakeholders such as companies' management and governments are increasingly concerned about the climate risk role in firms' operational and financial performance. (Mondal & Bauri, 2022; Pankratz et al., 2019). Giglio et al. (2021) stated that climate change exposes firms to different forms of risks and has substantial implications for the underlying assets. Likewise, Qian et al. (2020) argued that better carbon performance lead to higher market returns. So, climate change and resultant policy adjustments have the potential to influence financial markets' performance. However, despite the growing concern over climate change, very little is known about how climate change will affect stock markets' performance.

The climate change effects are widespread, though less developed, and emerging countries are expected to get more adverse shocks. Various empirical studies, in the last decade, investigated that developed countries successfully detached their economic growth from traditional means and progressing to reduce greenhouse gas emissions, whereas emerging countries are struggling to meet sustainable development goals (Vavrek & Chovancova, 2016; Cohen et al., 2018; Burchardt, 2018). Emerging countries being the engines of world economic development are facing enormous challenges to keep a balance between economic growth and low carbon sustainable development (Zhang, Fan, Chen, Gao, & Liu, 2020). Countries and companies in the developing world are more exposed to climate risk as compared to countries and firms in the developed world (Mondal & Bauri, 2022). Emerging countries are struggling because of limited resources such as green technologies and green infrastructure are needed for renewable resources and the necessity to keep the current face of economic growth. According to (Marinaș et al., 2018), when level of development increases, countries transition their economies to the tertiary sector from the secondary sector, which makes them more energy efficient. Hence, climate change is expected to be more severe in emerging markets, therefore, the current study investigates the climate risk effect on the emerging countries' stock market performance.

Human activity, especially energy consumption, is the primary trigger of climate change. Rising world population, increase in the standard of living and subsequent rise in per capita energy consumption substantially increased greenhouse gas emissions (International Energy Agency, IEA, 2018). The world energy demand is expected to grow at a rate of 30% which will cause further deterioration of environment (IEA, 2018). Energy consumption when interacts with climate risk will adversely affect companies' performance and so their share prices and stock market performance. Although, countries and companies have been trying to reduce the use of non-renewable energy and adopt renewable source (Bayar & Gavriletea, 2019). However, implementing policies and procedures to reduce GHG emissions will be accompanied by substantial economic cost. As discussed, emerging countries are facing difficulties to transition to renewable energy sources because of its higher economic cost. Therefore, the current study examines the

energy consumption interaction in the relationship between climate risk and stock market performance of emerging countries.

Countries and companies need long-term and consistent economic policies to counter the adverse shocks of climate change. A higher economic policy risk or uncertainty disturbs the country's long-term climate objectives and successful transition towards low-carbon economies. Governments can draft and implement policies to reduce carbon emissions and stock market performance. The government can influence industries with higher carbon emissions e.g. by imposing sanctions or taxes or by giving subsidies energy efficient companies. The empirical literature has largely a stance of significant negative association between economic policy uncertainty and stock markets performance (Durnev & Kim, 2005; Van Binsbergen, Fernández-Villaverde, Koijen, & Rubio-Ramírez, 2012; Gulen & Ion, 2016; Boadi & Amegbe, 2017; Gu et al., 2021). Economic policy consistency is needed for the effectiveness of climate change initiatives (Contreras & Platania, 2019), because higher economic policy uncertainty leads to stock market volatility (Liu & Zhang, 2015).

Changing monetary policy to manage the economic conditions can be directly reflected in share prices. Although monetary policy is an important tool to mitigate climate change, such monetary policy might have negative consequences on the stock market's performance. For instance, a higher policy rate will increase firms' borrowing cost, as a result, lower market performance. Among the monetary policy tools, exchange rate has also the potential to influence stock market performance. As evidenced by studies that exchange rate influence stock market performance (Kwofie & Ansah, 2018; Narayan, Devpura, & Wang, 2020). In short, the current study is also considering the effect of monetary policy (policy rate and exchange rate) while investigating the role of climate risk, economic policy uncertainty, and energy consumption on the stock market performance of emerging countries.

1.2 Research Questions

From the problem statement, following seven research questions have been derived.

1. Is there any significant impact of climate change on stock market performance?
2. Does energy consumption moderate the relationship between climate change and stock market return?
3. Does economic policy uncertainty affect stock market performance?
4. Does the policy rate influence the stock market performance in emerging economies?
5. Does monetary policy affect stock market return?
6. Does exchange rate influence stock market performance?
7. Is there any impact of industrial production on stock market return?

1.3 Research Objectives

Similar to the research questions, the study outlines following seven research objectives.

1. To examine the impact of climate change on stock market performance.
2. To investigate the moderating role of energy consumption between climate change and stock market return.
3. To investigate the effect of economic policy uncertainty on stock market performance.
4. To empirically explore how monetary policy influence stock market return.
5. To identify the impact of exchange rate on stock market performance.
6. To find the impact of industrial production on stock market return.
7. To examine the impact of exchange rates on the stock market's performance of emerging economies.

1.4 Study Significance

The current study offers some important insights to policymakers, investors, academicians, and other relevant stakeholders. The study's significance is outlined as follows:

First, the current study is an important extension to the body of knowledge which takes the countries' perspectives when examining the role of climate change. It offers important insights to policymakers that how climate change can influence the performance of the financial markets, especially in emerging countries which are more vulnerable to the adverse consequences of climate change. The consideration of climate change is vital to investors while formulating their investment strategies because climate change has the potential to influence firms' performance, particularly in the energy, agriculture, and transportation sectors.

Second, the economic policy uncertainties in emerging countries have been affecting their stock markets. The role of economic policy uncertainty in the price and return dynamics of stock markets is tested which will help policymakers in understanding how policy uncertainties can affect stock market performance to improve markets stability. Further, the investors can draw insights by considering the role of economic policy uncertainty in the performance of their portfolio. Besides, the discussion of economic policy uncertainties in stock markets is an important contribution to the existing body of knowledge.

Third, the interacting role of energy consumption and climate risk in stock market performance may help policymakers to better understand how the conflicting role of energy consumption in economic growth and environmental degradation can translate into stock market profitability. Further, investors can accommodate future energy prospects such as energy transition towards renewables to better formulate their portfolios.

Lastly, the investigation of monetary policy (policy rate and exchange rate) role in stock market performance provides important insights to policymakers about how to use monetary policy tools in improving the stock market performance. More specifically, when tackling climate change with the use of monetary policy,

the policymakers will be aware about how changing monetary policy can influence stock market profitability.

To recapitulate, findings not only contribute to the existing body of knowledge but also provide important insights to policymakers and investors in policy formulation and portfolio optimization, respectively.

Chapter 2

Literature Review

Markowitz (1952) optimal portfolio theory has made people believed that there is always a direct and positive relationship between risk and reward. Proponents of this theory are convinced enough to disbelieve that a portfolio consisting of socially responsible investment (SRI) can be profitable along with the consideration of environmental risk. In other words, optimal theory suggests that a company which is investing in environmental protection initiatives will have a lower share price as the company bears the cost which will decrease its profit. Statman (2000) challenged this view by reporting higher domino social index (DSI) returns, which accounted for socially responsible behavior, as compared to the S&P 500 index. The author constructed the DSI index of various companies considering their socially responsible behavior. Thereby the study negates the optimal theory and suggests that the market reward socially responsible behaviors.

In support of socially responsible investment, (Review, 2020) (Published by Global Sustainable Investment Alliance, GSIA), documented that total sustainable investment has reached $35.3 trillion and the growth of investment by 15% between 2018 and 2020. Similarly, Delmas, Nairn-Birch, and Lim (2015) conducted a study on 1,095 US firms by collecting their greenhouse data and measuring their environmental performance with Tobin's q and financial performance with ROA during five years period (2004-2008). The authors concluded that a decline in greenhouse gas emissions improves companies' environmental performance and also financial performance suggesting that environmental-friendly behaviours pay up. Moreover,

Busch, Bassen, Lewandowski, and Sump (2022) found a significant relationship between environmental performance and companies' financial performance implying that environmental degradation will affect companies' financial performance.

The changing environment with new regulations, policy changes, consumer behaviours, and technological shifts has put significant pressure on countries. It is forecasted that the earth's temperature will increase by around 1 to 4 degrees centigrade in the next century, devastatingly affecting many countries and their financial markets. Dietz et al. (2016) documented that this changing climate poses significant pressure on the financial markets because these financial securities are finally backed by the real economy. Similarly, Antoniuk and Leirvik (2021) reported that extreme weather events and climate-related policy adjustments significantly affect stock market performance i.e., stock returns. Likewise,Mondal and Bauri (2022) and Pankratz et al. (2019) advocated that climate risk imposes a greater challenge to firms' operational and financial performance. Further, Qian et al. (2020) advocated that when carbon performance improves, meaning when carbon emissions fall, market returns increase. Moreover, Giglio et al. (2021) stated that climate risk tends to confront companies with different forms of risk, therefore, carries substantial implications for the companies' assets.

The Gerlak, Weston, McMahan, Murray, and Mills-Novoa (2018) study highlighted that although much of the emphasis has been made on the identifications of climate change and adaptation opportunities, little focus has been made on the risk assessment, climate collaboration and risk management related to climate change. Some of the sectors are expected to take more influence from climate change as compared to others. For instance, the energy sector which is mostly based on non-renewable energy sources will take transition towards renewable energy, therefore, the energy sector is one of the most exposed sectors to climate change. The more a sector is exposed to climate change the more companies in that sector will get influenced by climate change. In this way, companies in the energy sector are expected to be highly influenced by climate change.

Among other sectors, agriculture is also expected to be adversely influenced by climate change, because extreme weather events caused damage to various crops. Extreme weather events such as floods, untimely rain, sea level rise and other

events, in the recent past, have been witnessed to badly affect agriculture production. So, the financial performance of companies operating in these sectors is affected by the changing climate. As the climate is changing so the government's priorities changes, for instance, countries have been introducing climate targets to achieve in order to become carbon neutral. Abreu et al. (2021) documented that the pressure coming from governments, suppliers, competitors, customers and other stakeholders will make companies unable to resist change to low-carbon. The authors further highlighted that employees and investors may not be so committed to the transition to low-carbon, but other stakeholders are more committed to doing so. Further, the authors expressed that the media pressure sustainability reporting requirements were not sufficient to force companies to adopt low-carbon strategies, but the emerging climate risk associated with companies' performance plays an important role to adopt low-carbon strategies.

Among others, Engels, Kunkis, and Altstaedt (2020) show that energy firms are faced with an emerging risk related to the transition toward low-carbon energy-efficient systems which are directly related to their performance indicators such as profitability and long-term survival. In addition, the authors reported that an important question for energy firms is to make decisions that how these companies will do their transition and convince investors on such transition and be able to generate a sustainable return on investment in the changing global business environment. For energy firms, this transition is vital from fossil fuels to renewable energy to make their businesses sustainable in the future. As discussed, in the literature, studies reported the relationship between climate change and firms' financial performance. For instance, Delmas et al. (2015) show that a decline in carbon emissions positively affects 1,095 US firms' financial performance, from 2004 to 2008. Further, the authors documented that rising carbon emissions negatively influence firms' return on assets. The authors concluded that GHG reductions mean long-term profitability for firms.

There is no shadow of a doubt that climate change is the most pressing issue of the modern world and has severe negative consequences on the environment. Human activity, especially energy combustion, is the main driving force of climate change in the last decades (IPCC, 2018). Due to global warming, on one hand,

there is a growing concern regarding scarcity of energy and on the other hand, is a paradigm shift from non-renewable to renewable energy. The causal relationship between energy consumption, economic development, and environmental degradation has been under considerable discussion in recent studies (Stern & David, 2004; Chontanawat, Hunt, & Pierse, 2008). For instance, higher economic growth requires higher energy consumption; and higher energy consumption leads to greater carbon dioxide emissions which subsequently cause environmental degradation. As per Vo, Vo, and Le (2019), economic development requires a significant amount of energy supply which is hugely dependent on fossil fuels, and the use of fossil fuels causes significant environmental degradation.

Climate change is the biggest challenge of the current millennium to achieve economic development. A higher level of economic development requires higher energy consumption, and higher energy consumption means a higher contribution to climate risk. So, the more a country is developed the higher that country has consumed energy and the more contributed to climate change. Energy consumption is a blessing for economic development and a curse for the environment. Therefore, reducing nonrenewable energy consumption to protect the environment also slows down economic development.

Among the selected emerging countries, China is the dragon of world energy consumption, economic growth, and subsequent carbon emission which has far-reaching consequences for the environment. Among the world's total greenhouse gas emissions, China is contributing 29% of emissions making it the world's largest contributor to environmental degradation (Forum, 2019). World economic development is largely dependent on emerging countries, and they are the ones who are facing tremendous challenges to keep a balance between economic growth and green sustainable development (Zhang et al., 2020). Pakistan being the sixth largest country by population and consumer of energy is important to study. Although Pakistan's contribution to the world's total carbon emissions is only 0.8 per cent, however, the country's CO2 emissions from 1994 to 2015 have increased by 123 per cent and are expected to grow further by around 300 per cent until 2030 (Ebrahim, 2021). According to the Global Climate Risk Index (D. Eckstein et al., 2021) report published by German Watch (germanwatch.org), during 1998-2016,

Pakistan is the 8th most affected country by climate change which is witnessed by the large-scale floods in the country. Although countries have already set targets and are attempting to meet their climate goals by attaining sustainable development. The world's climate change concern is because climate change is not just an environmental or social issue but has far-reaching economic consequences such as losing crops due to floods and agricultural land due to sea level rise.

In the recent past, studies that examined the link between economic growth, energy consumption, carbon emissions, financial development, environmental degradation; and even urbanization, industrialization, and foreign direct investment are ubiquitous. These studies' findings generally yielded various discrepancies due to the application of different methodological frameworks, proxies for variables, datasets used, and country or region under consideration. For instance, Nathaniel and Khan (2020) examined the impact of economic growth, renewable and non-renewable energy consumption, and urbanization on the ecological footprint, while controlling for trade, in ASEAN countries over the period from 1990 to 2016. The authors conducted the first- and second-generation unit root and cointegration testing amidst the presence of cross-sectional dependency among cross-sectional units. Their results demonstrate that economic development, non-renewable energy consumption, and trade have contributed significantly to countries' environmental degradation. From the empirical evidence, the authors claimed that the region's economic and financial development comes at the expense of its environment.

Zhang et al. (2020) analyzed the relationship between energy consumption, CO2 emissions, and GDP in ASEAN and China from 1990 to 2014. The authors applied the log-mean Divisia index (LMDI) to examine the impact of energy intensity, carbon density, economic (GDP per capita) and population on the total changes in carbon emissions. Their results demonstrate that energy intensity has contributed significantly to the reduction of carbon emissions in most of the sample countries. While economic development in terms of GDP per capita is the dominant factor in the rise of carbon emissions. Similarly, carbon density and population also play significant roles in the increase of carbon emissions in countries under consideration. When population increases it increases the demand for

energy consumption, and higher energy consumption accelerate GHG emissions, these higher emissions are detrimental to environmental quality and global climate. The authors recommended that to decouple growth from environmental degradation, ASEAN countries and China requires to focus more on energy efficiency, use of renewable energy, and green development as the region long-term goal. Hence, countries and companies have to look for sustainable ways to transition towards sustainable development which is need of the future.

Nathaniel and Khan (2020) analyzed the link between economic growth, trade openness, renewable and non-renewable energy consumption, urbanization, and ecological footprints of the following countries: Indonesia, Vietnam, Egypt, Colombia, South-Africa, and Turkey. They applied panel cointegration, augmented mean group estimator, and causality analysis on the dataset from 1990 to 2014. The findings exhibit that renewable energy consumption and trade improve the environment while non-renewable energy consumption and urbanization deteriorate the sample countries' environment. Since the current study sample countries are emerging those mostly base on the use of non-renewable energy sources, therefore, their energy consumption is expected to adversely affect their environment and companies financial performance in terms of stock market returns. Hence, higher level of energy consumption (especially non-renewable) negatively influences emerging countries stock markets performance.

Using a sample of six industrialized countries Australia, Austria, Belarus, Belgium, Bulgaria, and Canada and a data set from 1990-2012, Ozturk (2015) found that energy consumption in the sample industrialized countries is the main contributor to climate change. From the Pooled OLS results, the author reported that a unit increase in energy consumption causes an increase of 0.124% in greenhouse gases, 0.652% in carbon emissions, and 0.123% in methane emissions. On the contrary, Rahman and Velayutham (2020) reported that a unit increase in energy consumption increases 0.10% economic growth in South Asian economies namely, Bangladesh, Nepal, India, Sri Lanka and Pakistan. Bhat (2018) reported that energy consumption positively influences economic growth but negatively affects the environment of BRICS countries. Alvarado, Ponce, Criollo, Córdova, and Khan (2018) investigated the relationship between real per capita output and carbon

emissions from a group of 151 countries for 1980-2016. The authors found a significant relationship between per capita output and carbon emissions in middle-high- and low-income countries. The relationship of globalization with carbon emissions was found positively significant in middle-high and middle-low-income countries. The globalization also requires higher level of energy consumption. Besides, the association of emissions with energy consumption and manufacturing was found positively significant in all groups of countries. When output (economic activity) increases it requires higher energy consumption and when energy consumption increases it increases economic growth but adversely affect environment particularly in emerging countries. Based on the estimated results, the authors recommended policymakers to only incentivize production activities that are using environment friendly technologies to control the damage caused by contamination and overall climate change

Islam and Ghani (2018) aimed to explore the association among carbon emissions, energy consumption, economic & population growth, FDI, poverty, and income of four South East Asian Nations (ASEAN). Their results show that economic, income and population growth have a positively significant and emissions, FDI and poverty have negatively significant impact on energy consumption in Malaysia. In Singapore, energy consumption was affected positively by poverty, income and economic growth, while negatively by emissions, population growth and foreign direct investment. In the Philippines, the significant impact on energy consumption was positive from FDI and CO2 emissions and negative from population, poverty, income, and economic growth. In Brunei, carbon emissions, income, and economic growth have a positively significant and population, poverty and FDI have a negatively significant impact on energy consumption. The authors suggested ASEAN economies to increase energy efficiency, energy conservation, and use of green energy in the energy mix to reduce energy wastage.

Apart from economic performance, financial development is also related to energy consumption. In the past empirical work, various studies have confirmed the relationship between energy consumption and financial markets performance (see, for instance, (Shahbaz & Lean, 2012; Shahbaz, Khan, & Tahir, 2013; Kakar, 2016; Shahbaz, Van Hoang, Mahalik, & Roubaud, 2017). In the context of Pakistan,

Kakar, Khilji, and Khan (2011) used the Granger causality and Johansen cointegration techniques and reported a long-term cointegration in financial development and energy consumption. That's why this study introduces energy consumption as a moderator in the relationship between climate risk and stock markets' performance in selected emerging countries.

Past studies have highlighted the nexus between energy consumption and climate change. As energy consumption helps in increasing economic activity, it also generates GHG emissions, which are detrimental to the environment. Among those studies, Rahman (2020) reported that electricity consumption hurts the environment of G7 (industrialized) countries, the author applied the FMOLS estimation method to draw results. Using the ARDL approach and dataset from 1953 to 2016, Jalil and Feridun (2011) reported that energy consumption leads to increasing environmental pollution in other words energy consumption causes environmental pollution. Similarly, with the use of a vector error correction framework and GMM, Hossain (2011) also reported that energy consumption increases industrialized countries' environmental degradation.

Moreover, other studies also highlighted the negative nexus between rising energy consumption and lower environmental performance in various countries using various statistical techniques. Shahbaz, Hye, Tiwari, and Leitão (2013) reported a negative association between energy consumption and environmental quality in Indonesia. In Turkey, Ozturk and Acaravci (2013) reported the adverse effect of energy consumption on environmental pollution. Whereas in China and India, Jayanthakumaran, Verma, and Liu (2012) reported negative shocks from energy consumption to environmental quality. Lastly, with the use of Granger Causality analysis and the Augmented MG approach, Dong, Sun, and Hochman (2017) concluded that the BRICS country's electricity consumption during 1985-2016 adversely affected their environmental quality and the bi-directional causality running from electricity consumption to CO2 emissions. Hence increasing energy consumption adversely affects environmental quality.

On the other hand, the literature highlighted that energy consumption is related to economic growth and also companies' performance. Altunbas and Kapusuzoglu (2011) used granger causality analysis and concluded that energy consumption

helps increase economic growth though in the short run. Whereas the author does not find the variables related in the long run. Other studies highlighted that renewable energy has positive and non-renewable energy hurts economic growth (Ito, 2017; Sebri & Ben-Salha, 2014). Wang, Li, and Fang (2018) reported that energy consumption (primary) positively impacts growth rate. Whereas Chakamera and Alagidede (2018) found a negative impact of energy consumption on economic growth. Chen, Chen, Hsu, and Chen (2016) used a sample of 186 countries and reported a heterogenous impact of total energy consumption on economic growth. Further, Antonakakis, Chatziantoniou, and Filis (2017) do not find any impact of energy consumption on the economic growth of 106 countries categorized based on income group. Hence, there is enough evidence to conclude that although energy consumption increases firms' financial performance, it also deteriorates environmental quality.

Apart from climate risk and energy consumption, policy uncertainties particularly economic policy uncertainty has a greater potential in influencing the performance of financial markets. The role of economic policy uncertainty becomes more crucial in times of financial crises because financial crises generate a higher degree of uncertainty which might result in herding behaviours or even stock market crashes. This is witnessed by the global financial crisis in 2008 when most of the financial markets crashed due to excessive selling behaviours partly driven by market uncertainty. The International Monetary Fund ()(2014) report and United States federal open market committee (2009) concluded that the main driving force of the 2008 global financial crisis was the U.S. and European monetary, regulatory and fiscal policies uncertainty. Hence, economic policy uncertainty is an important factor in determining the stock market performance of emerging countries.

Economic policy uncertainty is often related to global uncertainties such as the policy uncertainty in the US might translate to the policy uncertainty in Pakistan. The global policy uncertainty also sometimes triggers political or for that matter economic policy uncertainty. The EPU importance is far amount because various types of uncertainties (i.e., economic, trade, social, War etc.) often influence economic activities (Blattman & Miguel, 2010). For instance, the recent Covid-19 shocked the world in terms of higher uncertainty and a decline in overall

economic activity (Altig et al., 2020). Likewise, the Gulf War in 2003 generated enormous policy uncertainty around the globe (Rigobon & Sack, 2005). Basically, what happens, EPU affects the business environment and which in turn influences the business's decision-making and overall operations. In this way, rising EPU translates into falling companies' performance and share prices, therefore, negatively influencing companies and stock market performance. Similarly, since the business decisions influence their climate objectives, therefore, higher uncertainties mean poor climate performance (Jiang, Zhou, & Liu, 2019). So, policy certainty is important to not only achieve companies' financial performance but also their climate performance.

Currently, the importance of consistent economic policies has accelerated due to the high connectivity, globalization, and competitiveness (Al-Thaqeb & Algharabali, 2019). The EPU impact on firms' environmental performance might come from the government policies directly which potentially be formulated to improve environmental performance (Jiang et al., 2019). The empirical literature has witnessed EPU as a potential determinant of various factors. Like Xu (2020) claimed EPU is a potential determinant of corporate innovation. Further, Das, Kannadhasan, and Bhattacharyya (2019) found EPU a factor affecting the stock market and Levenko (2020) argued that EPU influences individuals' savings. Many recent studies highlighted that policy certainty is vital for countries and companies to reach climate goals (Contreras & Platania, 2019; Workman, Dooley, Lomax, Maltby, & Darch, 2020). Besides, the correct estimation of policy uncertainties is important because over or underestimation has adverse consequences for environmental policy formulation and also its implementation (Guo, Tan, Gu, & Qu, 2019).

Moreover, policy uncertainty has a significant influence on inflation expectations, Mexico-US relations, and countries' bilateral trade (Istiak & Alam, 2019; Alam & Istiak, 2020). Importantly, Adams, Adedoyin, Olaniran, and Bekun (2020) argued that it is evident that policy uncertainty has a far-reaching effect on consumer spending, companies' investment strategies, and financial policies. Hence, EPU has the potential to influence various economic outcomes which are not limited to the macro environment but also the microenvironment, which means companies'

performance (i.e., financial performance. Thus, the current study expects that rising EPU leads to lower financial performance (i.e., returns).

The bottleneck in the way of estimating the economic policy uncertainty role in stock market performance is the measurement of economic policy uncertainty. Fortunately, Baker, Davis, et al. (2016) introduced a newspaper-based economic policy uncertainty measure which they measured by the coverage of frequency of various economic uncertainty terms in newspapers. For instance, uncertainty, regulation, legislation, deficit etc. in the top 10 U.S. newspapers. Their constructed EPU index strongly reacted to various uncertainties such as the 9/11 and Gulf Wars. Boadi and Amegbe (2017), took a sample of 23 countries from 1996-2014 based on income levels as high income (OECD), lower middle income and upper middle-income countries, concluded that lower uncertainty and quality governance has a significant and positive relationship with stock market performance. They constructed their governance quality index from the World Governance Indicators (WGI) namely, voice and accountability, government effectiveness, political stability and absence of violence, rule of law, regularity quality and control of corruption.

Other studies in the past, such as Durnev and Kim (2005) conducted a study of 859 firms from 27 countries and found that the share price of a firm valued higher who has a higher quality of governance and public disclosure (investment opportunities, external financing and concentrated cash flow rights). Similarly, this relationship gets stronger if a country is less environmentally friendly or has a weaker legal environment. However, higher economic policy risk (uncertainty) disturbs the country's long-term climate objectives and successful transition towards low-carbon economies. The economic and stock market performance, energy consumption and carbon emission due to energy consumption in turn depend on how the government drafts policies in a timely fashion to govern and control them all. The government can, due to its policy instrument, influence industries with higher carbon emissions e.g. by imposing sanctions or taxes or carbon pricing and it can also decrease emissions or by giving subsidies to the companies which have adopted renewable energy sources or using energy in efficient ways. Recently, (Gu et al., 2021) documented that there is a negative association between EPU

(news-based measure) and stock price momentum suggesting that rising economic policy uncertainty impedes stock market performance.

Among other studies, Gulen and Ion (2016) suggested a negative relationship between long-term investment and policy uncertainty, consisting of future policy and regulatory outcomes. Interestingly, the relationship gets stronger for the firms depending on government spending. In light of this finding, it can be argued that economic policy uncertainty has the potential to influence stock market performance, whereas the government has an important role to play to manage stock market performance, particularly in times of higher economic policy uncertainty.

Likewise, Van Binsbergen et al. (2012) used the Dynamic General Stochastic Equilibrium (DGSE) model and explored the variation in investment and output due to policy uncertainty. The authors used various policy uncertainty measures and reported higher uncertainties bringing down investment, consumption and output. More specifically, they highlighted that higher interest rate volatility triggers higher economic risk which in turn deteriorates investor confidence in the country's stock market. Hence, both the theoretical argumentations and empirical evidence support the role of economic policy uncertainty in the stock market performance.

The relationship of stock markets with the exchange rate is subject to disagreement. A considerable number of studies believe that exchange rate and stock market are related, and the causation runs from exchange rate to stock market. The proponents believe that this causation runs from the stock market to the exchange rate, whereas some have even claimed no such relationship. In the empirical literature, Peter and Young (1972) were the first who attempted to study this relationship, they examined the impact of six major events namely British devaluation (1967), French devaluation (1969), German revaluation (1969), United States-Phase I (1971), Agreement of the Group of 10 (1971) United States-Phase 2 (1971) on major multinational corporations and identified that there is no significant relationship between exchange rate and the stock market. Whereas Aggarwal (2003) found a positive connection between exchange rate changes and the U.S. stock indices. Using monthly data (1974-1978), the authors reported that both the variables are positively related, and this relationship is stronger in the short run compared to the long run. On the contrary, Narayan et al. (2020) reported a

negative significant impact of the Yen on stock market returns. Likewise, Kwofie and Ansah (2018) also showed, using data all-share index of Ghana and the exchange rate from 2000 to 2013, that there is a significant negative relationship between the exchange rate and the Ghana stock market. Accordingly, the current study also expects a negative relationship between exchange rate and stock markets performance.

Past studies show a strong relationship between economic activity (measured by the index of industrial production and GDP) and stock market performance. Theoretically, rising economic activity increases aggregate output which is ultimately reflected in stock prices. However, higher energy consumption increases carbon emissions which contributes to environmental degradation (climate change) and positively contributes to industrial production. Using quarterly data and a vector error correction model (VECM), Misra (2018) found a long-run causality between industrial production and the Indian stock market (BSE Sensex). Likewise, Humpe and Macmillan (2009) using a log-linear model identified that a unit increase in industrial production increases 1.4 per cent US stock prices and 0.4 per cent in Japanese stock prices. Importantly, recent studies highlighted that as countries move toward a higher level of development they develop and adopt zero-carbon technologies to attain sustainable development (see i.e., Mansoor, Sultana, et al., 2018).

The relationship between exchange rate and stock market performance also depends on fluctuation in the policy rate. As per Menike (2006), a fall in interest or policy rate causes appreciation in interest rate and add up foreign reserve. Moreover, when policy rate increases it causes bondholders to shift their investment in stock to bonds and thus the stock market affects. A change in interest rate has a direct effect on stock market than on the economy as a whole. A higher interest rate negatively affects stock market performance and positively when it goes down. Higher interest rate means lower present value of share as per discounted cash flow policy and lower interest rate means higher present value of share.

Actually, higher policy rate discounts future cash flow at higher rate and the calculated present value is higher. While lower policy rate discounts future cash flow at lower rate and the calculated present value of future cash flow is higher. This

relationship can also be satisfied by looking at the correlation between interest rate and investment. For instance, when government increases interest rate, it becomes expensive for investors to borrow and invest and the stock market experience downfall in its indices and when government decreases policy rate, it becomes cheaper for borrowers to borrow and invest in the equity market. So, the negatives association between interest rate and stock market return is verified by these two examples According to Conover, Jensen, and Johnson (1999), adding to the work of (Fama & French, 1989), monetary policy in a country affects required rate of return of the investors. In their study, discount rate is used as a proxy for monetary policy. They further concluded that volatility in stock market return does depend on monetary policy.

Recent studies reported that developed economies have decoupled their economic growth from greenhouse gas emissions (which is causing climate change) but emerging countries are struggling to attain sustainable development (Vavrek & Chovancova, 2016; Cohen et al., 2018; Burchardt, 2018). Emerging countries struggle to transition their economies to low-carbon economies because of limited resources (i.e., infrastructure) and the need for retaining the growth rate. When the level of development increases, countries transition their economies to the service sector from highly energy-intensive, which makes them more energy efficient (Marinaș et al., 2018). Energy-dependent firms in the developing world are more exposed to climate risk as compared to firms in the developed world (Mondal & Bauri, 2022). After considering past literature, the current study used a sample of emerging countries to see their industrial production impact on stock market performance.

2.1 Study Hypotheses

In light of the literature review and theoretical underpinnings, this study introduces the following research hypotheses:

H_1: Climate risk has a negative significant impact on emerging countries' stock market performance.

H_2: Climate risk with interaction to energy consumption significantly impact stock market return.

H_3: Economic policy uncertainty has a significant negative impact on equity market performance.

H_4: Policy rate has a negative significant impact on equity market return.

H_5: Exchange rate has a significant influence on the stock market performance.

H_6: Industrial production has a positive significant impact on the stock market return.

Chapter 3

Research Methodology

The study aims to examine the impact of climate change, economic policy uncertainty and macroeconomic factors on the equity markets' performance of emerging countries. Also, test the interaction of energy consumption between climate risk and stock market performance. Equity market performance is captured with stock returns. While equity markets are from emerging countries namely, Brazil, Indonesia, Russia, Mexico, China, Poland, South Africa, South Korea, Argentina, Turkey, India, and Pakistan. To draw empirical results, the study tested fixed effect, random effect and pooled ordinary least square models on the dataset from 2005 to 2019. This chapter comprises of population sample and, econometric models, variables measurements and data descriptions.

3.1 Population and Sample

The population is all emerging countries because of the interest to see the role of climate risk, EPU, energy consumption, and macroeconomic variables in the equity market performance of emerging countries. From the population of all emerging countries, a sample of the top 11 emerging countries including BRICS and top other 6 emerging markets, and the 12th is Pakistan for relevance purposes as it is the sixth largest country by consumer of nonrenewable energy. Although Pakistan's contribution to the world's total carbon emissions is only 0.8 per cent, however, its CO2 emissions from 1994 to 2015 have increased by 123% and is

expected to grow further by around 300% until 2030 (Ebrahim, 2021). According to the Global Climate Risk Index (D. Eckstein et al., 2021) report published by Germanwatch (germanwatch.org), during 1998-2016, Pakistan is the 5th most affected in the world due to climate change after Puerto Rico, Myanmar, Haiti and Philippines (D. Eckstein et al., 2021). These extreme weather events in Pakistan are witnessed by the recent floods in the country which affected almost 1/4th of the country population. These twelve sample countries are Brazil, Indonesia, Russia, Mexico, China, Poland, South Africa, South Korea, Argentina, Turkey, India, and Pakistan.

3.2 Data Description

Quantitative data from secondary sources in annual frequency is used. Since the data has multiple cross-sections and time periods, therefore, the panel dataset is used. The dataset comprises of 12 emerging' countries (cross-sections, N=12) and 15 years (Time period, T=2005-2019). The sample selection is based on top emerging economies and unit of measurement is change in each variable. While the selection of the time period is based on the availability of climate risk index data. **Table 3.1** provides summary of the variables, their measurements, and data sources.

3.3 Econometric Models

To attain the study objectives, the study formulated two empirical models in order to estimate the impact of climate risk, economic policy uncertainty, and macroeconomic factors on the equity market performance. As the equity market performance is captured with stock returns, therefore, the outcome variable is stock returns in both models. As mentioned earlier, the study is also capturing the interacting effect of climate risk and energy consumption, for this matter, the second model consist of the interaction term (climate risk*energy consumption). Model 2 capture the moderating effect (climate risk * energy consumption) on the stock returns.

Table 3.1: Variables Description

Variable Type	**Variable**	**Measurements**	**Data Sources**
Dependent Variable			Investing.com
	Market Returns	Return=ln (Pt/Pt-1)	Yahoo Finance
	Climate Risk	Climate Risk Index (CRI) developed by GermanWatch.org	GermanWatch.org
Independent Variables	Economic Policy Uncertainty	(Baker et al., 2016) newspaper-based economic policy uncertainty measure	Policyuncertainty.com
	Changes in Energy Consumption	Primary Energy Consumption in kilowatt-hours (Kwh)	International Energy Agency (IEA)
	Economic Growth	Changes in Industrial Production (IIP)	WDI, OECD, and respective countries' departments of statistics
	Changes in Exchange Rate	Local Currency/USD	World Development Indicators
	Policy Rate	Central Bank Policy Rate	World Development Indicators

$$
\begin{aligned}
MarketReturn_{it} \\
&= \alpha_0 + \alpha_1 LnClimateRisk_{it} + \alpha_2 \Delta EnergyConsumption_{it} \\
&+ \alpha_3 LnEconomicPolicyUncertainty_{it} \\
&+ \alpha_4 \Delta Industrialproduction_{it} + \alpha_5 \Delta ExchangeRate_{it} \\
&+ \alpha_6 PolicyRate_{it} + \varepsilon_{it}
\end{aligned} \tag{3.1}
$$

In model 1, i denotes cross-sections (countries), t depicts time-series (years), Δ shows change in the variables, and Ln is natural logarithm. The combination of i and t shows that the current study uses panel data. $(\text{Market Return})_{it}$ is capturing equity market return of country i at time t. Next, α_0 denotes equation intercept and ε_i is the error term of the equation. Lastly, α_1 to α_6 are capturing regression coefficients of variables: climate risk, energy consumption, economic policy uncertainty, industrial production index, exchange rate, and policy rate, respectively.

Theoretically, α_1 sign is expected to be negative implying that rising climate risk will negatively influence the stocks returns in emerging countries. Conversely, the sign of change in energy consumption (α_2) expects to be positive, as rising energy consumption increases economic activity which in turns raises stock returns. Next, the α_3 sign is anticipated to be negative since rising economic policy uncertainty has the potential to negatively influence companies' performance (returns). α_4 sign is expected to be positive as rising economic activity (change in industrial production) accelerate companies output and output increases stock returns.

The change in exchange rate (α_5) sign is expected to be negative because rising exchange rate means devaluation of local currency and a slow comparative economic growth which in turn made investors to lose confidence in that country's stock market and the stock prices go down. Lastly, the sign of α_6 is also anticipated to be negative as rising policy rate increases cost of capital which subsequently diminishes stock returns. In short, it is expected that climate risk, economic policy uncertainty, exchange rate, and policy rate to have a negative impact and energy

consumption and industrial production index to have a positive impact on the stock returns of emerging market economies.

Now model 2 is introduced which is similar to model 3 with the exception of interaction term (climate risk * energy consumption) in model 4. The model specifications are as follows:

$$\begin{aligned} MarketReturn_{it} \\ &= \alpha_0 + \alpha_1 LnClimateRisk_{it} + \alpha_2 \Delta EnergyConsumption_{it} \\ &+ \alpha_3 ClimateRisk * EnergyConsumption_{it} \\ &+ \alpha_4 LnEconomicPolicyUncertainty_{it} + \alpha_5 \\ &\Delta Industrialproduction_{it} \\ &+ \alpha_6 \Delta ExchangeRate_{it} + PolicyRate_{it} + \varepsilon_{it} \end{aligned} \tag{3.2}$$

In Model 2, $(\text{Market Return})_{it}$ is the outcome variable capturing equity market return of country i at time t in a panel setting. Next, α_0 and ε_{it} are the equation constant and error term, respectively. Further, α_1 to α_7 are the regression coefficients of the independent variables while α_3 is capturing the interacting effect of climate risk and energy consumption on the equity returns in emerging countries. The theoretical signs of Model 1 and Model 2 are similar with only difference that model 2 deals with the interaction term (climate risk * energy consumption), which is expected to have a negative impact on stock returns.

3.4 Variable Measurements

This section describes the variables' measurements. The variables can be divided into two groups: dependent and independent variables.

3.4.1 Dependent Variables

Since the current study is aiming to see the role of climate risk, economic policy uncertainty, and monetary policy variables on the stock returns in emerging countries.

Table 3.2: Sample Emerging Countries and their Respective Stock Market Indices

Sr. No	Countries	Stock Indices	Sr.No	Countries	Stock Indices
1	Brazil	Bovespa Index	7	Indonesia	Jakarta composite index
2	Russia	MOEX Russia Index	8	Mexico	S&P_BMV IPC
3	India	BSE SENSEX Index	9	Poland	Warsaw General Index (WIG)
4	China	Shanghai Composite Index	10	South Korea	Korea Composite Stock Price Index (KOSPI)
5	South Africa	MSCI South Africa Index	11	Turkey	Borsa Istanbul 100 index
6	Argentina	S&P MERVAL Index	12	Pakistan	KSE100

3.4.1.1 Market Returns

The stock market returns were calculated from the stock market index of each of the emerging countries. These market indices are selected based on the most representative and common indices of respective sample countries. Indices data collected from two main sources: Investing.com (https://www.investing.com/) and Yahoo finance (https://finance.yahoo.com/). Table 2 exhibits the selected sample countries and their respective stock market indices. Market returns were estimated from the collected stock market indices data. The estimation is current value of stock price divided by previous value of stock price minus.

3.4.2 Independent Variables

This sub-section covers the study independent variables. These variables include climate risk, economic policy uncertainty, changes in energy consumption, changes in industrial production, exchange rate, and policy rate.

3.4.2.1 Climate Risk

Climate risk can be defined as "the potential for adverse consequences for human or ecological systems. . . In the context of climate change, relevant adverse consequences include those on lives, livelihoods, health and wellbeing, economic, social, investments, infrastructure, ecosystems and species" -(Intergovernmental Panel on Climate Change, IPCC, (IPCC, 2018)). The climate risk index (CRI) from GermanWatch.Org (https://www.germanwatch.org/en/cri) is taken. The consequences of climate risk include various weather-related extreme events such as storms, droughts, floods, and heatwaves etc. These adverse impacts include but not limited to human losses (fatalities) and direct and indirect economic losses. The selection of CRI is based on the fact that it is a comprehensive climate risk indicator that causes economic losses and is likely to affects stock market performance. CRI data is available from 2005 until 2019, therefore, other variables data are also taken of the same time period.

3.4.2.2 Economic Policy Uncertainty

Economic Policy Uncertainty (EPU) can be defined as the unanticipated changes in the economic outcomes which may lead to changes in prospective governmental policies. In simple words, EPU can be defined as uncertainty about responsive future economic policies. The study adopted the Baker et al. (2016) news-paper-based measure of economic policy uncertainty. They developed the EPU measure based on newspaper coverage frequency of different terms such as "inflation", "uncertainty", "deficit", "legislation" etc. It is important to mention that the EPU data is not available of all sample countries for all time period, therefore, the current study used unbalanced panel data.

3.4.2.3 Changes in Energy Consumption

The variable energy consumption is measured as changes in kilowatt-hours (Kwh) of primary energy. The energy consumption data is extracted from the International Energy Agency (IEA) website (https://www.eia.gov/).

3.4.2.4 Changes in Industrial Production

The changes in industrial production (termed as IIP) is taken from the World Development Indicators (WDI, a site of the world bank: https://databank.worldbank .org/source/world-development-indicators). Some of the countries' data were missing over the sample period, which is completed from OCED (Organization for Economic Co-operation and Development) website, and the rest of the data points are completed from respective countries' central banks and their departments of statistics. The series is converted into the same base year (2015=100) and then calculated the change in industrial production over time. In the study setting, IIP is more relevant compared to GDP because energy consumption and climate risk directly affect industrial output as production-based industries use energy not service-based sector and also it is a finance-based thesis not economic-based. therefore, the IIP is used to represents the economic activity. In other words, IIP captures the economic activity of companies rather than the whole economy.

For this matter, the IIP series is taken because the current study is looking into companies' perspectives and the returns were calculated from companies' stock market indices.

3.4.2.5 Changes in Exchange Rate

The exchange rate data is gathered from the WDI database. The exchange rate for each individual country is calculated as the local currency of each of the sample countries divided by the United States dollar ((Local Currency)/(US dollar)). The changes in exchange rate were taken to see the appreciation and depreciation of local currency effect on stock market returns. Hence, changes in exchange rate is calculated as local currency divided by US dollar.

3.4.2.6 Policy Rate

The policy rate data of each of the sample countries are downloaded from the WDI database. Where the values were missing, those are filled from respective countries' central banks. These values are in percentage terms.

Chapter 4

Results and Analysis

This chapter contains a discussion of descriptive statistics followed by correlation matrices. In the next section, the chapter provides the effect of climate risk, energy consumption, EPU, and monetary policy on the stock market returns of emerging countries. As discussed, the stock market returns were estimated as the current price divided by the previous price minus 1. The results are drawn by using fixed effects, random effects and pooled least squares static panel data models depending upon the outcomes from the Likelihood test and Hausman tests. Once, the results are interpreted the next chapter elaborate on the discussion in light of theoretical argumentation and empirical justifications.

4.1 Descriptive Statistics

Before empirical estimation, various descriptive statistics are estimated to ensure that the dataset is free from outliers. Among the descriptive statistics include arithmetic mean, range (minimum and maximum), standard deviation, skewness and Kurtosis. The number of observations of the economic policy uncertainty (EPU) are lesser than other variables because some of the sample countries' newspaper-based EPU measure is not available. The missing EPU observations are reported as N/A. The descriptive statistics were estimated country-wise because there are significant differences across countries, therefore, difficult to interpret combine descriptive statistics.

Table 4.1: Descriptive Statistics (1/3)

	Return	**lnCRI**	**ΔEng. Con.**	**LnEPU**	**ΔIPI**	**ΔForex**	**Policy (%)**
Argentina							
Mean	29.23%	3.949	13.094	N/A	0.269	3.232	20.611
Maximum	107.02%	4.267	44.54	N/A	8.99	20.06	59.25
Minimum	-19.61%	3.012	-21.7	N/A	-4.9	0.04	5
Std. Dev.	0.34	0.322	22.364	N/A	4.318	5.768	17.298
Skewness	0.612	-1.826	-0.065	N/A	0.814	2.4	1.368
Kurtosis	0.845	4.465	-1.439	N/A	-0.163	5.619	0.956
Brazil							
Mean	10.96%	3.822	70.346	5.035	-0.141	0.108	10.783
Maximum	40.43%	4.729	278.55	5.848	10.4	0.98	18
Minimum	-10.20%	2.662	-87.48	4.53	-8.99	-0.3	4.5
Std. Dev.	0.177	0.551	92.479	0.392	5.371	0.35	3.569
Skewness	0.396	-0.32	0.42	0.951	0.029	1.06	0.094
Kurtosis	-1.377	-0.199	0.934	0.217	-0.125	1.644	-0.165
China							
Mean	13.57%	3.335	1311.459	4.748	3.036	-0.091	3.088
Maximum	156.61%	3.81	2293.559	5.895	13.29	0.41	3.33
Minimum	-32.72%	2.506	327.492	3.921	-8.12	-0.66	2.79
Std. Dev.	0.478	0.384	597.377	0.558	6.316	0.269	0.217
Skewness	2.347	-0.761	0.006	0.462	-0.492	-0.087	-0.18
Kurtosis	6.208	0.016	-0.812	0.256	-0.347	0.803	-2.008

Continued Table: 4.1 Descriptive Statistics (1/3)

	Return	**lnCRI**	**ΔEng. Con.**	**LnEPU**	**ΔIPI**	**ΔForex**	**Policy (%)**
India							
Mean	13.73%	3.007	347.155	4.474	4.104	1.88	6.875
Maximum	55.55%	3.955	546.46	5.223	10.04	6.77	9
Minimum	-11.78%	2.442	210.471	3.902	-0.22	-3.96	5.98
Std. Dev.	0.183	0.429	98.52	0.434	2.977	3.05	1.23
Skewness	0.881	0.858	0.601	0.29	0.262	-0.541	1.033
Kurtosis	0.6	0.251	-0.238	-1.18	-0.353	-0.135	-0.768

Return are the respective sample countries stock market returns. LnCRI is natural logarithm of climate risk index. ΔEng. Con. are the changes in energy consumption of each of the selected sample countries. LnEPU is log of Economic Policy Uncertainty, ΔIPI is changes in industrial production, and ΔForex is changes in exchange rate which was calculated as local currency divided by US dollar. Lastly, Policy is each sample country central bank policy rate in per cent terms, and Std Dev. are standard Deviations.

Table 4.2: Descriptive Statistics (2/3)

	Return	**lnCRI**	**ΔEng. Con.**	**LnEPU**	**ΔIPI**	**ΔForex**	**Policy (%)**
Indonesia							
Mean	14.73%	3.628	74.204	N/A	3.417	317.352	6.908
Maximum	53.68%	4.27	190.52	N/A	5.17	1524.2	9.75
Minimum	-5.58%	1.749	-132.96	N/A	-1.14	-1299.511	4.25
Std. Dev.	0.192	0.626	88.418	N/A	1.729	786.877	1.685
Skewness	1.269	-2.097	-0.804	N/A	-1.712	-0.292	0.172
Kurtosis	0.692	5.509	0.911	N/A	2.915	-0.144	-0.912
Mexico							
Mean	9.32%	3.659	19.051	4.068	1.018	0.597	5.824
Maximum	45.76%	4.177	97.52	4.399	7.08	2.81	8.27
Minimum	-9.60%	2.708	-31.27	3.296	-5.88	-0.87	3
Std. Dev.	0.177	0.433	35.767	0.329	3.483	1.148	1.952
Skewness	1.177	-0.726	0.709	-1.301	-0.569	1.107	-0.06
Kurtosis	0.346	-0.034	0.18	1.117	0.405	0.062	-1.696

Continued Table: 4.2 Descriptive Statistics (2/3)

	Return	**lnCRI**	**∆Eng. Con.**	**LnEPU**	**∆IPI**	**∆Forex**	**Policy (%)**
Poland							
Mean	7.14%	3.968	8.914	N/A	4.209	0.043	3.083
Maximum	45.30%	4.557	71.66	N/A	8.36	0.71	5
Minimum	-32.63%	2.881	-42.25	N/A	-3.11	-0.36	1.5
Std. Dev.	0.224	0.47	36.897	N/A	3.079	0.325	1.413
Skewness	0.156	-1.148	0.072	N/A	-0.898	0.96	0.028
Kurtosis	-0.596	0.669	-1.038	N/A	0.964	0.191	-1.824
South Africa							
Mean	10.79%	3.815	14.389	N/A	0.336	0.578	7.033
Maximum	45.53%	4.167	98.15	N/A	4.43	1.95	11.5
Minimum	-15.78%	3.139	-48.36	N/A	-14.39	-1.39	5
Std. Dev.	0.155	0.285	37.792	N/A	4.615	1.027	1.986
Skewness	0.642	-0.823	0.682	N/A	-2.733	-0.581	1.392
Kurtosis	0.826	0.683	0.865	N/A	9.058	-0.311	1.236

Return are the respective sample countries stock market returns. LnCRI is natural logarithm of climate risk index. ∆Eng. Con. are the changes in energy consumption of each of the selected sample countries. LnEPU is log of Economic Policy Uncertainty, ∆IPI is changes in industrial production, and ∆Forex is changes in exchange rate which was calculated as local currency divided by US dollar. Lastly, Policy is each sample country central bank policy rate in per cent terms, and Std Dev. are standard Deviations.

Table 4.3: Descriptive Statistics (3/3)

	Return	**lnCRI**	**ΔEng. Con.**	**LnEPU**	**ΔIPI**	**ΔForex**	**Policy (%)**
Poland							
South Korea							
Mean	5.58%	4.178	57.504	4.886	2.872	10.074	2.567
Maximum	26.93%	4.824	215.87	5.55	12.98	177.12	5
Minimum	-12.55%	3.442	-49.72	4.229	-0.28	-120.79	1.25
Std. Dev.	0.13	0.366	63.087	0.356	3.536	86.678	1.159
Skewness	0.54	-0.366	1.063	-0.333	1.972	0.823	0.836
Kurtosis	-1.045	-0.011	2.493	-0.143	4.657	0.143	-0.086
Turkey							
Mean	10.59%	4.258	58.071	N/A	3.836	0.309	9.765
Maximum	54.79%	4.663	136.52	N/A	10.66	1.18	22.5
Minimum	-24.81%	3.579	-23.22	N/A	-6.73	-0.13	1.63
Std. Dev.	0.196	0.3	46.991	N/A	4.481	0.368	5.945
Skewness	0.648	-1.051	-0.318	N/A	-0.787	1.2	0.755
Kurtosis	1.013	0.851	-0.661	N/A	1.227	1.091	-0.256

Continued Table: 4.3 Descriptive Statistics (3/3)

Poland	Return	lnCRI	ΔEng. Con.	LnEPU	ΔIPI	ΔForex	Policy (%)
Russia							
Mean	12.70%	3.942	58.081	5.002	2.614	2.604	9.6
Maximum	89.95%	4.473	323.62	5.649	5.64	22.56	17
Minimum	-23.25%	2.398	-393.55	4.485	-9.37	-8.72	5.5
Std. Dev.	0.283	0.583	204.978	0.378	3.774	7.077	2.924
Skewness	1.481	-1.758	-0.499	0.06	-2.742	1.622	1.092
Kurtosis	3.726	2.589	0.293	-1.296	8.751	4.786	1.681
Pakistan							
Mean	13.79%	3.156	24.88	4.528	2.484	7.671	9.983
Maximum	45.75%	4.475	114.75	5.046	7.9	30.37	14
Minimum	-31.95%	1.253	-49.1	3.641	-3.43	-0.91	5.75
Std. Dev.	0.224	0.843	41.261	0.414	3.458	9.123	2.668
Skewness	-0.635	-0.517	0.331	-0.993	-0.176	1.689	-0.282
Kurtosis	-0.273	0.302	0.864	0.024	-0.55	2.373	-0.716

Return are the respective sample countries stock market returns. LnCRI is natural logarithm of climate risk index. ΔEng. Con. are the changes in energy consumption of each of the selected sample countries. LnEPU is log of Economic Policy Uncertainty, ΔIPI is changes in industrial production, and ΔForex is changes in exchange rate which was calculated as local currency divided by US dollar. Lastly, Policy is each sample country central bank policy rate in per cent terms, and Std Dev. are standard Deviations.

In descriptive statistics, the mean value shows the average or central value while the standard deviation shows overall dispersion from the mean value. The range of the data is given by the minimum and maximum values. Whereas the skewness exhibits the direction of the data or the direction of outliers or asymmetry of the data. The skewness estimates show positive and negative skewed data. Next, the kurtosis tells how the distribution tails vary from that of the normal distribution. The kurtosis benchmark value is 3 (normal distribution). Lastly, normality suggests the data normal distribution. The country-wise descriptive statistics are reported in **Table 3, 4 & 5**. In sample emerging economies, Argentina, Brazil, China, India (Table 3) Indonesia, Mexico, Poland, South Africa (Table 4) South Korea, Turkey, Russia, Pakistan (Table 5). The stock market returns (simply returns) mean, minimum and maximum values are reported in percentage terms. The maximum stock market returns are mostly in the year 2006, when most of the world financial markets boomed. The maximum returns are higher in the countries most integrated to the financial markets. In all sample countries, Argentina reported the highest average returns (29%) and China maximum stock returns in a given year (156%). Whereas China had the highest stock market losses (-32.72%) in a given year followed by Poland (-32.63%) and Pakistan (-31.95%). These high stock losses were mostly in the year 2008, when the global financial crisis of 2008 strongly hit the global financial markets. In the average returns, South Korea reported the lowest (5.58%) followed by Poland (7.14%) stock market returns. Most of the dispersion (standard deviation) of stock market returns occurred during the global financial crisis.

As for the policy rate, Argentina had the highest central bank policy rate (20.61%), which even touches to maximum of 59.25% and lowest of 5.0% in a given year. After Argentina, Brazil has average policy rate of 10.78%, in a given year. In the exchange rate changes, Indonesia has the highest mean changes in exchange rate (317.35), where appreciation is recorded at 1524.20 and depreciation of -1299.51, in a given year. The higher mean changes in energy consumption (mean value of 1311.45) were recorded in China, which were maximum of 2293.55 and lowest of 327.49 and standard deviation of 597.37, in a given year. It is because China is the world's largest energy consumer.

4.2 Correlation Matrices

After descriptive statistics, **Table 4.4** depicts the variables' correlation matrices. The correlation between independent variables is estimated to find out if there is any case of multicollinearity. Among all the correlation coefficients, there is no case of high degree correlation suggesting the absence of multicollinearity in the explanatory variables. As expected, the variables of interest stock returns and climate risk are negatively correlated. As opposed to the expectation, energy consumption (ENC) has a negative relationship with stock returns (RT) showing that when energy consumption increases stock returns decreases. Whereas EPU is negatively related to stock returns depicting that when EPU increases stock returns decreases because EPU increases stock market volatility and subsequent decline in stock market returns.

The changes in industrial production measured from IIP is negatively correlated to stock returns. It is contrary to the expectations because ideally positive changes in industrial production means increase in economic activity, hence, stock market returns go up. Next, the changes in foreign exchange rate (Forex), which are appreciations and depreciation, is negatively related to the stock market returns suggesting that both move in opposite directions. Conversely, the policy rate (PR) is positively related to stock market returns in the sample emerging economies showing that variable move in the same direction. In the subsequent steps, the empirical estimations are conducted.

Table 4.4: Correlation Matrices

Variables	**RT**	**CRI**	**ENC**	**EPU**	**IIP**	**Forex**	**PR**
RT	1						
CRI	-0.148	1					
ENC	-0.096	-0.167	1				
EPU	-0.108	-0.231	0.591	1			
IIP	-0.244	0.21	-0.049	0.064	1		
FX	-0.013	-0.096	0.007	0.087	-0.02	1	
PR	0.176	-0.098	-0.282	-0.111	0.015	-0.116	1

IND=stock market index, RT=stock market returns, CRI=Climate risk index, ENC=energy consumption, EPU=economic policy uncertainty, IIP=industrial index of production, FX=foreign exchange rate, PR=policy rate.

4.3 Empirical Results

In the previous section, the descriptive statistics and correlation analysis are discussed and explained. In the current section, the empirical results are estimated, presented in **Table 4.5** and **Table 4.6**, and discussed. To estimate empirical results, it is important to navigate a suitable and unbiased static panel data estimator. This is done using a few specifications tests which results are reported in Tables 7&8. The empirical results proceed to estimate the impact of climate change, energy consumption, economic policy uncertainty, and macroeconomic factors on the stock market's performance of emerging countries. This section discusses the selected models' specifications, panel data estimators and associated diagnostics statistics to decide on appropriate panel data model. The static panel data models are used: accordingly fixed, random and pooled least square models' estimations are conducted.

The optimum model's selection depends on the results from the Likelihood test and Hausman test. In a given model, if the likelihood coefficient becomes significant, a fixed or random effect model is appropriate. Whereas the appropriateness of the fixed and random effect models is based on the Hausman test. If the Hausman test coefficient becomes significant, the fixed effect model is preferred. In short, the likelihood and Hausman test significance at the 5% level suggest the suitability of the fixed effect model. The null hypothesis of the Hausman test is that random effect model is more appropriate. The calculated stock market returns from stock market indices of respective emerging economies were used against a set of regressors namely, climate risk index, changes in energy consumption, economic policy uncertainty, change in industrial production, changes in foreign exchange rate, and central bank policy rate. In the estimated models (fixed, random and POLS), reported in Table 7, the significant redundant F-statistic exhibit that there is a country-specific effect, therefore, it is not suitable to use pooled ordinary least square (POLS) model, but fixed effect model is better. Next, on the fixed effect results, the Hausman test is estimated which rejects the null hypothesis that random effect model is appropriate. Thus, the significance of Redundant and Hausman test suggests the suitability of fixed effect model.

Table 4.5: Model 1 Estimation Results (Stock Market Returns)

Variable	Fixed	POLS	Random
	Coefficient (t-stat.)	**Coefficient (t-stat.)**	**Coefficient (t-stat.)**
Constant	3.762 (1.589)	11.363*** (11.713)	10.636*** (4.033)
Climate risk index	0.008 (0.027)	0.003 (0.481)	-0.002 (-0.061)
Changes in Energy Consumption	-0.046*** (-2.873)	-0.012 (-1.534)	-0.022 (-1.295)
Economic policy uncertainty	-0.061*** (-3.740)	-0.096*** (-4.642)	-0.070*** (-7.022)
Changes in Industrial production	0.226*** (3.269)	0.113*** (4.658)	0.243*** (3.377)
Changes in Exchange rate	0.920*** (2.913)	-0.131 (-1.009)	-0.043 (-0.124)
Policy rate	-0.179** (-2.014)	-0.099** (-1.951)	0.39001
Diagnostic Statistics			
R-squared	0.534	0.33	0.258
Adjusted R-squared	0.521	0.285	0.209
F-statistic	3.254***	7.403***	5.241***
Redundant test (F-stat.)	3.226***		
Hausman Test (Chi-Sq. Stat.)			6.163***

****, **, * indicate 1%, 5% and 10% significance level. POLS=Pooled ordinary least squares, F-Stat. = F-statistic, Chi-Sq. Stat. = Chi-square statistic.*

In **Table 4.5**, among the coefficients estimates, the climate risk index coefficient is positive but insignificant. On the contrary, the expectations were that higher climate risk negatively influences stock market returns. The coefficient estimate of changes in energy consumption is negative and significant at 1% level implies that increase in energy consumption reduce stock market returns in selected emerging economies. Similarly, the regression coefficient of economic policy uncertainty is negative and significant at 1% level demonstrating that rising uncertainty led to falling stock returns in sample emerging markets. When economic policy uncertainty increases it increases stock markets volatility which in turn diminishes stock market returns.

Next, the impact of changes in industrial production is positive and significant suggesting that rising economic activity in emerging economies enhances their stock market returns. A higher economic activity means higher companies' production and output which translates into their stock market returns. In the exchange rate (LCR/US dollar), the local currency is in nominator, therefore, increase in exchange rate means local currency depreciation and vice versa. Changes in exchange rate carries positive and significant coefficient (at 1% level) implying that local currency appreciation increases emerging countries stock market returns. Lastly, the coefficient estimate of the policy rate is negative and significant at 5% level implying that a unit increase in policy rate diminishes stock returns by around 18% in selected emerging countries. The reason of this negative effect is when central bank increases policy rate it increases companies cost of capital which translate into higher cost and lower stock returns. In addition, high policy rate also reduces investors purchasing power and investment potential which might result in lower investment.

In table 7, in the diagnostics, the R-square (0.53) and adjusted R-square (0.52) of the fixed effect model suggests that the included independent variables explain around 52% of the variations in stock market returns (dependent variable). The significance of the F-statistic exhibits the overall model fitness. Finally, the significance of the Redundancy and Hausman tests suggests that the fixed effect model outperforms pooled OLS models and random effect models, respectively.

Table 4.6: Model 2 Estimation Results (Stock Market Returns)

Variable	**Fixed**	**POLS**	**Random**
	Coefficient (t-stat.)	**Coefficient (t-stat.)**	**Coefficient (t-stat.)**
Constant	7.000** (2.234)	11.645*** (11.046)	12.516*** (3.965)
Climate risk index	-0.805 (-1.604)	0.032 (0.188)	-0.474 (-0.950)
Changes Energy Consumption	1.042134	0.007 (0.064)	-0.336 (-1.053)
Climate Risk*Energy Cons.	-0.131** (-2.636)	0.107474	-0.076** (-1.970)
Economic policy uncertainty	-0.062*** (-3.832)	-0.091*** (-3.967)	-0.070*** (-6.906)
Changes Industrial production	0.218*** (3.211)	0.114*** (4.477)	0.243*** (3.428)
Changes Exchange rate	0.928*** (2.730)	-0.189 (-1.321)	-0.038 (-0.107)
Policy rate	-0.188** (-2.087)	0.194404	0.388584
Diagnostic Statistics			
R-squared	0.541	0.331	0.263
Adjusted R-squared	0.521	0.318	0.245
F-statistic	3.178***	6.291***	4.545***
Redundant test (F stat.)	3.331***		
Hausman Test (Chi-Sq. Stat.)			9.821***

****, **, * indicate 1%, 5% and 10% significance level. POLS=Pooled ordinary least squares, F-Stat. = F-statistic, Chi-Sq. Stat. = Chi-square statistic.*

Now Model 2 estimations are presented in Table 8, where the interaction term (product of climate risk and energy consumption) is introduced. In the estimated results, the significance of likelihood and Hausman tests suggest the appropriateness of the fixed effect model over the POLS and random effect models. Accordingly, the results from the fixed effect model are interpreted. The variable climate risk carries, as expected, a negative but insignificant coefficient estimate, hence, cannot conclude that higher climate risk leads to lower stock returns. The changes in energy consumption carries negative and significant (at a 10% level) effect on stock returns suggesting that increasing energy consumption diminishes stock market returns in emerging countries. Interestingly, the interaction term of climate risk and energy consumption has a negatively significant coefficient suggesting that rising energy consumption magnifies the effect of climate risk on stock market returns. In other words, it can be argued that energy consumption emits greenhouse gases which contribute to climate risk and this rising climate risk adversely affects stock returns.

The effect of economic policy uncertainty is also negative and significant implying that a unit increase in emerging countries' EPU reduces approximately 6.2% of their stock markets returns. When uncertainty increases in the market investors may either withdraw or restrain further investment which might result in decline in share prices (due to lower demand) and lower stock market returns. The change in industrial production carries a positive and significant coefficient demonstrating that when economic activity or industrial production increases it favorably affects emerging countries stock market returns. A high economic activity means higher companies' productivity which translates into higher equity market returns. Next, the changes in exchange rate carries positive and significant coefficient suggesting that the local currency appreciation increases sample emerging countries' stock markets return. Lastly, the policy rate effect as expected is negative and significant at a 5% level implying that when a central bank increases the policy rate by 1 unit it diminishes stock markets returns by around 18.8%. In simple words, increasing policy rate negatively influences stock market returns in emerging countries.

As Efficient Market Hypothesis states that stock prices do capture all the available information in the market. Similarly, we also experienced in this study that

changes in the stock market prices are 52% caused by independent variables in our model. Further, our results also supported our theoretical theory of Quantity Theory of Money. We can see from our results that a unit increase in policy rate brings down 18.8% decrease in stock market prices.

The estimated results are validated by a few diagnostic statistics. Among the diagnostics, the R-square (0.54) and adjusted R-square (0.52) elaborate that the included independent variables explain more than 50% of the variations in the dependent variables' stock market returns. The overall model fitness is confirmed by the significant F-statistic. Finally, as explained, the significance of redundancy and Hausman tests exhibited the appropriateness of the fixed effect model over other models.

Chapter 5

Discussion and Conclusion

This chapter is comprised of four sections. The first section discusses the empirical results in light of theoretical underpinnings and empirical literature. The second section draw policy implications of the estimated results for different stakeholders. The third section provides researchers with future directions. The last section outlines the limitations in which the current study took place.

5.1 Discussions

The present study examined the impact of climate change, economic policy uncertainty, energy consumption, and macroeconomic factors on the selected emerging economies' stock market performance measured with stock market returns. Also, the current study assessed the interacting role of energy consumption between climate risk and equity market performance. Stock market returns are used as proxy for stock market performance. The selected emerging countries are Brazil, Indonesia, Russia, Mexico, China, Poland, South Africa, South Korea, Argentina, Turkey, India, and Pakistan. The empirical results are estimated using static panel models namely: the fixed effect model, random effect model, and pooled ordinary least squares from a dataset of 2005 to 2019. The appropriate model selection is based on the Likelihood test (Redundancy test) and Hausman test results. The sample and time selection are conditional upon top emerging countries and the availability of climate risk data from the German Watch Organization website,

respectively. Economic policy uncertainty is captured using the newspaper-based economic policy uncertainty measure from the policy uncertainty website.

To attain the study objectives, the study formulated two empirical models. Where the first model estimated the impact of climate risk, economic policy uncertainty, and macroeconomic factors on the equity market performance of emerging market economies. The second model is with the interaction of energy consumption and climate risk to see whether the effect of climate risk on stock market returns channel through energy consumption or not.

From the empirical results, the climate risk has a negative impact on stock market returns, suggesting that rising climate risk causes a fall in stock market returns in emerging countries. This finding is in line with the economic theory which states that rising climate risks such as extreme weather events endanger countries and companies' performance which in turn affects stock prices. For instance, extreme weather events such as floods adversely affects the agriculture output which resultantly diminishes companies' stock returns who are connected to agriculture output e.g., flour mills and sugar mills. This finding is also backed by past empirical works, such as Antoniuk and Leirvik (2021) reported that extreme weather events and climate-related policy adjustments significantly affect stock market performance. Similarly, Dietz et al. (2016) claimed that changing climate poses a significant risk to the financial markets because various financial securities are ultimately backed by the real economy. Further, the studies of Mondal and Bauri (2022) and Pankratz et al. (2019) claimed that climate change imposes greater financial and operational risk on firms' performance which can be reflected in their stock returns. Moreover, Giglio et al. (2021) highlighted that climate change exposes firms to different forms of risks and has substantial implications for the underlying assets. Thus, theoretical underpinnings and empirical literature support the negative impact of climate risk on stock returns in selected emerging economies.

The empirical findings exhibit positive significant impact of energy consumption on stock market performance. On the contrary, higher energy consumption means higher output which positively influences stock returns. In other words, when companies increase their energy consumption it raises their output, and a higher

output has a positive bearing on stock return. For example, when a cement company increases their energy consumption it will increase its cement production which in turn increases its stock prices. Although the increase in energy consumption can increase share prices it also increases greenhouse gas emissions which are detrimental to the environment. Thus, on the one hand, energy consumption increases share prices and on the other hand, increases climate risk which can translate into a decline in share prices. This way, energy consumption is a moderator in the relationship between climate risk and stock market performance to see if rising energy consumption is interacting with climate risk and adversely affecting stock market performance.

The interaction term of climate risk and energy consumption carries a significant and negative coefficient (models 2) demonstrating that energy consumption when interacting with climate risk stock market returns decline. Theoretically, when energy consumption increases it increases climate risk due to higher carbon emissions and overall greenhouse gas emissions. These high emissions then negatively influence companies and stock market performance. The extensive use of non-renewable energy such as fossil fuels triggers climate change. In fact, energy consumption (non-renewable) triggers climate change, and both when interacting will affect companies' performance, and so their share prices and resultant stock market returns. IEA (2018) predicted that the world energy demand from 2017 to 2040 will grow by around 30% which will further cause climate change. Apart from GhGs emissions, other negative environmental impacts such as water pollution and particulate emissions are also the consequences of energy consumption (see, Tang & Tan, 2015). Although countries set targets to reduce non-renewable energy consumption and GHG emissions (Bayar & Gavriletea, 2019). However, implementing policies and measures to reduce GHG emissions will result in lower economic growth and also lower financial markets (i.e., stock markets) performance. Hence, the theoretical ground and empirical literature supports the negative impact and interaction of energy consumption in the relationship between climate risk and stock market returns. In both models, the impact of economic policy uncertainty is negative and significant suggesting that higher economic policy uncertainty diminishes stock returns in emerging economies. A higher economic policy risk

(uncertainty) disturbs the country's long-term climate objectives and successful transition towards low-carbon economies. Besides, economic and stock market performance depends on how governments formulate policies in a timely fashion to govern and control economic and financial markets' performance. Contreras and Platania (2019) reported that the effectiveness of climate change initiatives is sensitive to both economic and social factors. For instance, countries often fail in implementing climate policies in times of political and economic distress which makes it difficult for them to achieve their long-term climate goals.

When countries struggle on economic fronts, which is the case with emerging economies, their economic policy uncertainties (EPU) affect their climate initiatives and stock markets' performance. Thus, on the one hand, economic policy consistency needs for the effectiveness of climate change initiatives (Contreras & Platania, 2019). On the other hand, higher economic policy uncertainty leads to stock market volatility (Liu & Zhang, 2015). Arouri et al. (2016) also show that increasing economic policy uncertainty significantly reduces stock performance. Recently, Gu et al. (2021) documented that there is a negative association between EPU (news-based measure) and stock price momentum. Further, the study argued that uncertainty in policies led to risk premiums during volatile situations in the market, so uncertainty in policies has a positive relationship with stock market volatility and a negative relationship with stock prices. Hence, both the empirical literature and theoretical understanding support the negative significant impact of economic policy uncertainty on stock markets' returns in emerging countries.

The monetary policy (forex and interest rate) impact on stock market performance (returns) is examined in both empirical models. In the two-factor monetary policy, the exchange rate carries a positive significant impact on stock market returns. This result is in accordance with the portfolio balance theory which postulates that when stocks begin to lose their value, investors sell out and local currency demand decreases which ultimately depreciates the currency's relative value. Ideally, a higher exchange rate (local currency depreciation) will favor exporting companies' performance because local currency depreciation makes local products cheaper and more competitive in the international market. Conversely, a higher exchange

rate will adversely affect the performance of importing companies because local currency depreciation increases import costs. However, the current study finding exhibits a positive significant effect of exchange rate in both models. The work of Özbey et al. (2016) shows that exchange rate changes have the capacity of increasing stock market volatility and therefore decrease expected returns and riskiness of the stock market. Lastly, the policy rate negative effect is in line with economic theory which postulates that a higher policy rate increases the cost of borrowing which in turn increases companies borrowing costs and reduces investor purchasing power, therefore, negatively influencing stock market performance. When companies borrowing cost increases it decreases their output which in turn reflect in their share prices.

As per the discounted cash flow approach, share prices are the present value of expected future cash flows. The present value is calculated by using a discount rate, so, by changing interest or policy rate, the government in a way is changing share prices or at least influencing share prices. Although monetary policy is an important tool to mitigate climate change, such monetary policy might have negative consequences on the stock market's performance. For instance, the use of monetary policy to mitigate climate change can potentially affect stock market performance. Therefore, policymakers have to consider the monetary policy's role in financial markets' performance while using the policy to mitigate climate change. In the empirical work, Durham (2003) and Suhaibu, Harvey, and Amidu (2017) also documented the significant role of the policy rate in the stock market performance. Hence, both empirical and theoretical evidence supports the significance of policy rates in the stock market performance of selected emerging countries.

5.2 Policy Implications

Investigation of the study provides important policy implications for various stakeholders. First, the current study documented that climate change discussion is not only important in environmental degradation but also in economics as well as

financial perspective because changing climate affects the overall economic framework. In this regard, the current study provides policymakers with an important blueprint to consider climate risk while devising policies to enhance financial markets' performance, particularly the stock market. Apart from the policymakers' perspective, investors can also take help by considering the climate risk in their portfolio formulations to optimize the performance of their portfolios. Such as an investor in the energy sector should consider the climate risk a company is facing while making an investment decision. For example, the non-renewable energy companies (i.e., crude oil and coal) are confronted with the transition risk and the resultant government level and organizational level policy changes which will affect their future financial performance and investors' portfolio performance. Besides, the current study introduces climate risk in financial markets which opens new avenues for researchers to extend the climate change discussion to other financial markets.

Other than the climate risk, the current study discussion of economic policy uncertainty's role in stock markets also provides important policy implications. In light of current study findings, policymakers are advised to consider the economic policy uncertainty while formulating policies for the financial sector. Most importantly, the climate risk mitigation policies are generally long-term in nature whereas the economic policy uncertainty leads governments and policymakers to compromise on long-term policy objectives. A higher economic policy risk (uncertainty) disturbs the country's long-term climate objectives and successful transition towards low-carbon economies. In this regard, governments and policymakers should ensure the consistency of economic policies to mitigate climate change. These economic policies' consistency is not only important for climate change mitigation but also requires for stock markets performance as evidenced by the current study findings. The consideration of economic policy uncertainty is vital for investors because uncertainty poses greater portfolio risk and lesser portfolio return. For example, investment in a country's stock market which faces higher economic policy uncertainty put higher investment risk and lower returns. Therefore, investors should consider economic policy uncertainty in order to enhance their portfolio performance.

Finally, the finding of significant monetary policy role in the stock market's performance of emerging countries also provides vital policy implications, particularly for the countries' central banks. Central banks being the monetary policy regulators should consider the monetary policy's role in stock markets performance because the use of monetary policy to manage the economy has repercussions on stock markets performance. For instance, the use of policy rates to cut down inflationary pressure will result in lower stock market performance such as in terms of lower returns. Importantly, monetary policy has been discussing an important policy tool to mitigate climate change that can become true otherwise for financial markets. In other words, monetary policy use might become a double-edged problem for countries and policymakers. Since monetary policy tools can influence stock markets performance, therefore, investors should take it into account while strategizing their investment portfolios.

5.3 Future Research Directions

From the literature review and empirical findings, the current study provides a clear direction for future researchers. First, the climate risk can be used as a potential determinant to assess the performance of other financial markets such as the bond and derivative markets. Further, future studies can examine economic policy uncertainty and monetary policy's role in other financial markets. Second, energy consumption's relationship is negative with equity market performance that is absolutely inverse what has literature experienced and what this study predicted. Therefore, future researchers can differentiate between the type of energy consumption (for instance, renewable and non-renewable, electricity and primary etc.). Third, the climate risk role can be tested in the stock markets of other countries. Fourth, future researchers can examine the role of climate risk and economic policy uncertainty in other performance indicators such as stock market price and volatility. Fifth, future studies can assess the included variable's role at a regional level (i.e., South Asia) or sectoral level (i.e., energy and/or agriculture) because the climate risk effect is expected to be different across regions and sectors. For example, South Asia is more exposed to climate risk as compared

to Europe and the climate risk effect is expected to be more pronounced in the agriculture, food, energy, and transportation sectors. Finally, future research can determine the role of other monetary policy measures such as money supply while investigating the role of climate change and economic policy uncertainty in the stock markets' performance.

5.4 Study Limitations

The current study faces a few limitations. First, the study period is limited because the climate risk index data from the German Watch Organization is only available from 2005 to 2019. Second, the economic policy uncertainty measure is not available for all sample countries, therefore, the analysis is conducted with unbalanced panel data.

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