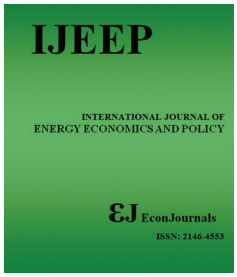

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Towards a Sustainable Future: Examining the Symmetric and Asymmetric Effect of Unstable Macroeconomic Factors on Initial Public Offerings Variability

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ABSTRACT

The research seeks to explore the symmetric and asymmetric effects of renewable energy, technological innovation, and ecological footprint on the variability of initial public offerings in the unique institutional setting of the Pakistani IPO market. The study used yearly data on the Pakistani IPO market and the macroeconomic variables from January 1992 to December 2020. Further, the study employed the linear and Non-Linear ARDL to investigate the symmetric and asymmetric nexus among variables. For that purpose, the stationarity of the variables was predetermined using Augmented Dicker Fuller (ADF) and Phillips Perron (PP) unit root tests. Additionally, the F-bound test verifies that IPO issuance and macroeconomic drivers are co-integrated. The findings show a symmetric and asymmetric relationship between IPO variability and macroeconomic variables under study. Renewable energy and technological innovation have statistically positive effects on IPO variability. On the contrary, the ecological footprint has a significantly negative impact on IPO variability. The weak condition of the Pakistani IPO market could be attributed to the slow adoption of technological innovation, the transition to renewable energy, and a high ecological footprint that attracts stringent regulatory and environmental compliance costs of going public.

Keywords: Renewable Energy, Technological Innovation, Ecological Footprint, IPO Variability, Pakistan Stock Exchange
JEL Classifications: E6, O2, I1

1. INTRODUCTION

The worldwide IPO market had a tremendous increase in 2021, with 2,388 transactions raising a total of US$453.3 billion, resulting in the most competitive year in the previous two decades. This expansion can be attributed to several factors, such as positive sentiment related to the rollout of COVID-19 vaccines, the resurgence of global economies from the severe decrease faced in 2020, and the accessibility of liquidity in the financial system, which has been fuelled by government stimulus initiatives (Ernst & Young, 2021). However, in Pakistan, there is a continuous decreasing trend (Table 1). However, as a consequence of the country's nuclear endeavour, which resulted in the United States implementing several sanctions that impeded Pakistan's growth, just one IPO was conducted in 1998 and none in 1999 (Mehmood et al., 2021a). However, from 2000 to 2018, merely 93 companies went public, continuing the declining trend in IPO issuances. This dismal IPO activity might be ascribed to various macroeconomic issues, including terrorism, political instability, social security risks, low employment, low GDP, and high inflation and interest rates.

In 2021, the global IPO market experienced a significant surge, witnessing 2,388 transactions that collectively raised an impressive total of US$453.3 billion. This marked the most competitive year

Table 1: Number of IPO issuance from developed and developing countries

Year	NIPO-USA	NIPO-Canada	NIPO-India	NIPO-Pakistan
1992	480	5	1	85
1993	669	7	0	39
1994	577	72	3	73
1995	658	102	41	41
1996	847	162	140	30
1997	566	180	10	4
1998	440	104	18	1
1999	656	75	51	0
2000	324	75	114	3
2001	110	123	7	4
2002	144	83	6	4
2003	134	71	21	4
2004	313	136	50	11
2005	277	186	21	14
2006	261	253	73	3
2007	276	308	108	11
2008	91	213	39	9
2009	93	103	22	4
2010	224	182	66	5
2011	487	267	40	4
2012	323	180	13	3
2013	405	69	5	1
2014	462	58	7	5
2015	321	68	21	6
2016	229	40	27	3
2017	243	107	38	3
2018	260	182	25	3
2019	227	126	16	3
2020	348	85	39	2
Total Sum	10445	3622	1022	378

Source: Bloomberg new offerings database

in the past two decades. The growth in the IPO market during this period can be attributed to various factors. These include a positive sentiment linked to the distribution of COVID-19 vaccines, the recovery of global economies from the significant downturn experienced in 2020, and the availability of liquidity in the financial system driven by government stimulus initiatives (EY, 2021). Due to the repercussions of the country's nuclear pursuits, which led to the imposition of several sanctions by the United States, Pakistan's growth was hindered. This is evidenced by only one IPO in 1998, with none occurring in 1999 (Mehmood et al., 2021a). However, only 93 companies went public between 2000 and 2018, reflecting a continuous decline in the trend of IPO issuances during this period. Numerous macroeconomic problems, such as low employment, political unpredictability, high inflation, terrorism, low GDP, social security hazards, and interest rates, might be blamed for this bleak IPO activity.

Numerous studies have looked at the macroeconomic variables that drive IPO issuances in both developed and emerging countries (Ameer, 2012; Angelini and Foglia, 2018; Demir et al., 2023; Dicle and Levendis, 2018; Mehmood et al., 2020b; Mehmood et al., 2021a; Rivas and Adamuz, 2019), but none of them looked specifically at the Pakistani market concerning unfavourable performance of renewable energy, technological innovation and ecological footprint. As a result, the present research seeks to fill the gap by investigating Pakistan's economic circumstances and distinctiveness to link the discovered macroeconomic determinants to IPO variability. Unfavourable macroeconomic indicators may affect IPO issuing choices (Cheng et al., 2023). Firstly, the preference towards becoming public may be made at any time, but it is irreversible once completed. A delay in the issue of an IPO shows a deterioration of the waiting firm's unfavourable macroeconomic circumstances. Enterprises go public when they can raise the most money feasible to represent their value. However, due to weak macroeconomic conditions, concerns arise in obtaining the anticipated capital amounts through IPOs, prompting enterprises to postpone their IPO activities until the uncertainties are resolved. Lowry (2003) explains that uncertainty caused by slow economic development causes enterprises to remain cautious about their capital requirements. During extreme phases of uncertainty, the whole corporate landscape may decline due to unfavourable macroeconomic conditions, resulting in reduced consumption and production rates (Christiano et al., 2014).

Unfavorable macroeconomic conditions have been identified as the reasons and drivers of IPO issuance volatility (Demir et al., 2023); however, there is inadequate evidence to support this claim. As a result, research into the influence of macroeconomic conditions on IPO issuances is required. Consequently, the current study investigates the influence of macroeconomic factors, particularly ecological footprint, technological innovation, and renewable energy, on the variability of IPOs.

1.1. Background of the Study

Economic progress in Pakistan is still severely impeded by the country's energy sector (Luqman and Antonakakis, 2021). Even yet, Pakistan has managed to increase its electricity production since 2013 and decrease the power disruptions that had afflicted the country for the preceding ten years. However, the sector's development and modernization have been impeded by high fuel prices, reliance on imported energy supplies, ongoing natural gas shortages, substantial debt in the power sector, and antiquated and insufficient transmission and distribution infrastructure. Thus, impacted overall social life (Al Gharaibeh and O'Sullivan, 2021). Pakistan's existing energy challenges are further compounded by poor administration, disjointed energy policies, and a lack of sustainable energy strategy.

According to the 2021 annual report from the National Electric Power Regulatory Authority (NEPRA), Pakistan's installed power generation capacity is 39,772 MW. Thermal power (from fossil fuels) constitutes the majority at 63%, followed by hydropower at 25%, renewable sources (including wind, solar, and biomass) at 5.4%, and nuclear power at 6.5%. Resources for renewable energy can assist in narrowing the gap in the current situation. The Ministry of Energy has modified the present Renewable Energy (RE) Policy 2019 in light of the government's continuous emphasis on renewable energy. Pakistan's government intends to reduce its dependency on petroleum imports by obtaining 60% of its energy from renewable sources, such as hydropower, by 2030, following the revised RE policy.

On average, Pakistan experiences nine and a half hours of sunlight daily. To promote the adoption of renewable energy,

the government initiated a series of regulations by introducing Solar power in Pakistan's mix in 2013. According to the Pakistan Economic Survey, six solar power projects totaling 430 MW started up commercial operations and are now producing energy to the grid during the preceding 5 years. An increasing number of commercial and industrial entities in Pakistan are turning to captive solar solutions due to fluctuating grid supplies and rising power rates. The World Bank has pledged $100 million in funding for the Sind Solar Energy Project to assist independent power producers in establishing 400 MW of new solar power projects. Additionally, partial subsidies will be provided to private sector enterprises to deploy Solar Home Systems, benefiting 200,000 people.

Pakistan's start-ups need government assistance to stimulate innovation and safeguard intellectual property (Zheng et al., 2022). The technology sector in Pakistan, particularly its IT sector, has enormous growth potential. However, start-ups have been deterred from pursuing revolutionary discoveries or technologies due to teething issues, namely, a lack of funding and support for R&D. Although Pakistan's IT economy fails to gain any traction, on the other hand, Indian IT exports have surpassed $100 billion. On the other hand, Pakistan may turn a corner by investing in innovative start-ups and disruptive technologies and offering resources and financial flexibility to extend economic growth. Moreover, the government of Pakistan must be dismayed to learn that, out of the 50,000 patents filed in Pakistan since 1947, only 10% are local in nature (filed by persons located in foreign countries). According to the 2015 International Innovation Index, Pakistan is 131st out of 141 nations. The weak score demonstrates that innovative strategies are lacking in mainstream education and industry, resulting in lower IPO offerings in Pakistan.

The ecological footprint of the entire globe in 2010 was 18.1 billion global hectares or 2.5 global hectares per person. In contrast, the total biocapacity of the world during the same period was 12 billion global hectares, translating to 1.7 global hectares per capita. Worldwide, a 3% drop in society's ecological footprint was seen between 2008 and 2009, owing to a downturn and reduced demand for fossil fuels and forest products. However, for the first time in over a half-century, humanity's need on the planet has overtaken what it regenerates. The ecological footprint concept is gaining traction in affluent countries like the United States, Canada, and the United Kingdom. However, it has not yet gained traction in developing countries like Pakistan, where sustainable development is still an unsolved issue. Pakistan had an ecological footprint of 0.8 global hectares per capita in 2012 and a biocapacity of 0.4 global hectares per capita.

Pakistan is an industrialized nation in South Asia. Pakistan's population was 188.0 million in 2014, and it is expected to reach almost 191.71 million in 2015. The urban population climbed to 75.19 million in 2015, up from 72.50 million in 2014, while the rural population increased to 116.5 million in 2015, up from 115.5 million in 2014. Pakistan is listed among the world's few most environmentally vulnerable nations. Pakistan is one of the most vulnerable nations to climate change's economic, environmental, and social impacts due to its geographical placement and socioeconomic instability.

1.2. Institutional Background of the Pakistani IPO Market

In the view of promoting and fostering economic activity, in 1981, the Pakistani government formed the Corporate Law Authority (CLA). Despite this, the stock market showed little growth until 1989. In response to the imperatives of liberalization, deregulation, and privatization, the Pakistani government instituted a series of reforms in 1991 to build transparency and improve efficiency within the stock market. The substantial volume of shares offered by private enterprises as a strategic measure to mobilize capital, broaden ownership structures, and establish viable exit options is a positive response induced by the implemented reforms on the listing activity. As a result, the number of IPOs went up between 1991 and 1996. In 1997, the Securities and Exchange Commission of Pakistan (SECP) took the position of the CLA to boost stock market activity.

Notwithstanding the reforms, Pakistan's institutions continue to function poorly and exhibit distressing patterns. According to Hassan (2002), within the past thirty years, there has been a significant decline in the quality of institutions, reaching a peak in the 1990s. Public participation in decision-making was eroded by poor governance, and institutional failure had reduced the nation's per capita income, resulting in weak economic development and fewer initial public offerings (IPOs). During the 5 years from 1992 to 1997, more than 200 IPOs were released on the Pakistani market. However, a stark contrast emerged in the subsequent years, when there was just one IPO in 1998, followed by no IPO in 1999 (Mehmood et al., 2020b).

1.3. Listing Process of IPO in Pakistan

Issuing IPOs to raise capital wasn't a recent phenomenon. When a company wishes to launch an IPO in Pakistan, they go via the listing procedure. In this respect, SECP gets the necessary documentation from the listing company and the initial draft of the IPO prospectus from the listing company. The SECP vets and verifies these documents before they are accepted by the Company Affairs Committee. If a business meets all of the requisite standards based on documented proof, the SECP approves the production of an IPO prospectus. Meanwhile, a request for a trade symbol is sent to the National Clearing Company of Pakistan Limited (NCCPL). After that, a business submits a request to the SECP to authorize the date of the prospectus's issuance and the subscription date for participating in new shares. The SECP next assesses the proposal, and the prospectus and subscription deadline are established if it is found to be feasible. Provisional listings are often based on public offers of PKR 150 million or above.

On the subscription date (s), investors participate in new offerings. Consequently, the PSX will declare if there have been too many or too few subscribers to the issues. Balloting is used to distribute shares to the winning investors in oversubscribed offerings. The underwriters subscribe for the shares if they are undersubscribed. The underwriters collect the form to apply for a no-objection certificate (NOC), the money release, and the auditors' certification. Ultimately, the Central Depository Company (CDC) receives these shares, enabling investors to start trading through their CDC accounts. Following that, the business

notifies the official listing in the media, and the CDC account manages IPO trading.

1.4. Listing Process of IPOs across Pakistan

Due to the regulators' policies encouraging stock market trading activity, the IPO listing procedure differs country-wise. However, it has been found that each nation has its own set of guidelines. Institutional changes, on the other hand, are critical in identifying the procedure that will be used to assist the listing process. Numerous institutional reforms have been established in Pakistan during the past 70 years to boost trading operations on stock exchanges, reforming multiple bodies to make the operation transparent and effective. At the moment, SECP is frequently seeking fresh companies to help with the endeavour of issuing IPOs. A crucial parameter in this process is determining if a company can generate income and profit in the upcoming years. The SECP then permits a company to begin the process of listing.

To list a company on the stock exchange in Sri Lanka, numerous requirements must be fulfilled. They split the procedure into three steps, making it more stringent and effective. The securities regulator in Turkey uses six processes to file an IPO on the stock exchange. According to their criteria, the main characteristics of this mechanism are compiling financial accounts, reviewing amendments made by the General Assembly and Articles of Association, and calculating the price of the new issue. Bangladesh's listing requirement is competitive in the marketplace, as they seek advice from an experienced panel before admitting or rejecting new issuers for inclusion. Besides others, the China Securities Regulatory Commission (CSRC) and the Shangai Stock Exchange (SSE) manage the IPO listing procedure, in which a business must pass many processes, including multiple evaluations by the CSRC and SSE. The listing process in the United States demonstrates a defined procedure in which a company applies and meets the standards to be listed. However, the listing request may be rejected if the requirements are unmet. However, it is suggested that comparable aspects are followed in the IPO process in all countries, notably choosing underwriters, registering the procedure with the regulator, and setting the pricing mechanism. However, each country and their regulators possess its own characteristics when it comes to analyzing applications, assessing ideas, and determining whether or not a corporation should be listed. Institutional arrangements for offering new issues have been modified throughout time, making the listing process more efficient.

2. LITERATURE REVIEW

2.1. Market Timing Theory

The semi-strong efficient market assumption is the foundation of market timing theory. As a result, many possibilities are present as long as the cost of stocks varies for valid or irrational reasons. As long as the company's financial circumstances change over time, market inefficiency may significantly impact corporate finance; thus, MTT has emerged. Lucas and McDonald (1990) investigate the information-based model for equity issuance choices and find that equity issuers have positive anomalous returns on average before issuance. This implies that all companies should attempt to time the stock market regardless of their value.

Nonetheless, due to the variability of adverse selection within organisations, both time methods might vary. Ritter (1991) examines the time- and industry-dependent variation in the long-term success of IPOs. It illustrates that the long-term underperformance of IPOs varies annually and throughout sectors, suggesting that issuing corporations aim to monetize on "opportunity windows." Choe et al. (1993) determined, based on an assessment of issuance periods, that corporations sell seasoned stock whenever adverse selection costs are lower. Therefore, corporations strive to participate in the stock market during times of more significant opportunities and less capital uncertainties. This result suggests that unfavourable selection alters over time.

Baker and Wurgler (2002) illustrate that market timing significantly impacts a firm's capital structure. It is argued that the capital structure is the product of stock market timing efforts. According to MTH, the financing order will not stay static as information asymmetry and adverse selection increase with time. According to Frank and Goyal (2004), a high market-to-book ratio is linked with future debt repayment; however, they could not discover an influence on stock issuance. According to Alti (2006), market timing behaviour occurs and demonstrates that hot-market IPO firms issue many more shares and have smaller leverage ratios than IPOs of the cold market.

Chen et al. (2013) reveal that market timing seems to be the prevalent technique on the Taiwanese stock exchange because net equity closely tracks the financial deficit rather than debt issuance. As a result, it is challenging to demonstrate that corporate finance decisions adhere to a distinct capital structure theory. Instead, it is more reasonable to assume that it is impacted by internal (e.g., financial deficiencies) and external (e.g., market values) factors that need more investigation. This research aims to provide a novel perspective by extending (Angelini and Foglia, 2018) work by examining how MTT may explain IPO decisions in the Pakistani IPO market.

2.2. Renewable Energy and IPO Variability

Qamruzzaman and Jianguo (2020) examined data for 113 nations from 1990 to 2017 using panel non-linear ARDL to investigate the relationship between renewable energy consumption and financial development. The non-linear ARDL panel test found a long-term imbalanced relationship between factors. The 3SLS technique was employed by Liu et al. (2020) to assess the correlation between financial development and renewable energy consumption in the BRICS nations between 1999 and 2015. Following the study's results, there was a strong association between financial development and renewable energy consumption. Khan et al. (2020) used the panel quantile regression approach to investigate the association between renewable energy usage and economic growth in 192 countries. Hassine and Harrathi (2017) used data from 1980 to 2012 to ascertain that stock market performance significantly influences the adoption of renewable energy consumption as one of the principal sources of energy in GCC states. Burakov and Freidin (2017) conducted a comparable study

in Russia at the same period and found a similar result. They estimated using the vector error correction model. The results captured a positive relationship among short-term and long-term variables. Furthermore, Khoshnevis Yazdi and Shakouri (2017) discovered a positive association between renewable energy consumption and financial development in China using the Gregory-Hansen and Hatemi-J co-integration and ARDL bounds tests on yearly data from 1974 to 2014. According to Charfeddine and Kahia (2019), the expansion in renewable energy and CO_2 usage in the Middle East and North African nations is only partially caused by the region's economic development.

Drawing from the preceding discourse, one might argue that increased usage of renewable energy promotes economic growth and, in turn, raises initial public offerings (IPOs).

H1: Renewable energy significantly impacts IPO variability in Pakistan.

2.3. Technological Innovation and IPO Variability

Zhang and Feng (2019) examined the impact of financial development and structure on a firm's technical innovation using empirical data from publicly traded enterprises. Increased competition in the market is vital for promoting technological innovation, and the impact is more substantial in developing countries. Bravo-Ortega and Marín (2011) found that a 0.1% increase in R&D increases productivity by 1.6%.; Lichtenberg (1992) found that fixed investment represents just a tiny portion of the private sector's contribution to productivity growth (7 times). Howitt and Mayer-Foulkes (2002) proposed the vertically integrated technological innovation hypothesis, considering that increasing firm investment in R&D spending may improve the likelihood of profitable technological innovation and facilitate economic growth. Atkinson and Stiglitz (1969) brought "learning by doing" into traditional trading, believing that by doing so, nations would distribute accumulated technical innovation knowledge via trade, encouraging economic progress throughout regions.

Experimental research on the impact of technical innovation on economic growth quality was conducted by Wang and Tan (2021). Overall, the researcher found that by increasing productivity, optimizing industrial structure, encouraging green development, and improving societal welfare, technological innovation may significantly improve inclusive economic growth; however, it has also exacerbated income disparity. According to Xiao (2019), technological innovation may be fostered to develop into a growth economic pole and foster regional economic growth; technological innovation may generate innovative assets or novel methods of production and boost industrial structure advancement; and technological innovation and institutional innovations can collaborate to create latest knowledge and technology. The status of knowledge components is becoming increasingly significant due to innovation and the transformation of production forces. Wang et al. (2022) developed a three-sector dynamic game model, and the findings revealed that innovation in finance unilaterally has a constraining influence on economic development, while collaborative technical innovation has a significant effect. It is, however, weaker than the function of technological innovation itself; knowledge and innovation are insignificant in the near term since their externalities must create threshold development. Technology advancement is not as influential as financial development, and the structure of financial development, not its magnitude, is the main factor determining financial development (Comin and Nanda, 2019). Economic growth is the primary driver of financial development's paradigm shift from quantity to quality; technology development and economic expansion are steadily equating with one other.

In summary, pertinent scholarly literature can be used as a source of reference and support for this research. However, there is still a scarcity of studies emphasising the relevance of technological innovation and IPO variability. Previous research focused on technological innovation and economic development; however, it has yet to be explored in the IPO setting, specifically in Pakistan. Furthermore, utilizing ARDL and NARDL, this research explores technological innovation and IPO variability. Finally, the market timing theory framework offers a suitable study platform and methodologies for revealing this link.

H2: Technological innovation significantly impacts IPO variability in Pakistan.

2.4. Ecological Footprint and IPO Variability

Following the latest research by the insurance giant Swiss Re, by 2050, climate change could shrink the world GDP by as much as 18%. This may have far-reaching economic ramifications for investors and the sectors in which they invest[1]. Thus, risks associated with climate change and efforts to alleviate its effects are categorized as regulatory, physical, and technical risks by Krueger et al. (2020). The World Bank research indicates that while several countries have already put carbon pricing programs in place, there is a high likelihood that many will do so in the years to come [2]. In contrast, Ilhan et al. (2021) asserted that investors cannot assess regulatory risk because of climate policy uncertainty. It thus shows that investors are prevented from taking part in first public offerings (IPOs) as a result of increased climate uncertainty because many are unable to gauge the regulatory risk associated with new offers.

The utilization of CO_2 emissions as an environmental factor is gradually transitioning in favour of Ecological footprint to quantify the impact of ecological footprint, technological innovation and renewable energy on IPO variability. The ARDL approach was utilised by Zafar et al. (2019) and Ahmed et al. (2020) to explore the influence of the US and China's economic growth and expansion on the respective country's ecological footprint. The findings revealed that economic growth can aggravate the ecological footprint in these regions. Nathaniel et al. (2021) studied the relationship among economic growth, urbanisation, and ecological footprint in CIVETS member countries. They used the AMG estimator, and the variable showed long-run interaction. In CIVETS nations, economic expansion reduces environmental degradation but urbanisation enhances it. Nathaniel et al. (2021) looked into how urbanization affected the ecological footprint in

1 https://www.swissre.com/media/news-releases/nr-20210422-economics-of-climate-change-risks.html

2 https://carbonpricingdashboard.worldbank.org/map_data

MENA nations. The findings confirmed a unidirectional causation from urbanisation to economic growth in MENA countries.

From 1990 to 2014, Saud et al. (2020) used the PMG technique to evaluate the influence of globalisation and financial growth on the EF in OBOR nations. The results confirmed that financial development raises the ecological footprint, whereas globalisation lowers it. Ansari et al. (2020) employed the PMG, GMM, and DOLS techniques to trace the influence of economic development on material footprint and ecological footprint in 37 Asian nations between 1991 and 2017. The result revealed that economic development boosts both indices (material and ecological footprint). Sharif et al. (2020) also discovered that Turkey's economic growth raises the ecological footprint. Kassouri and Altıntaş (2020) similarly examined the influence of financial development and urbanisation on ecological footprint in MENA nations. They further added that sustained financial development and urbanisation increase ecological footprint.

Similarly, the amount of money collected, and IPO revenues may be utilized to measure the impact of increased production revenues. However, IPO earnings, as disclosed by firms within their IPO prospectus document before transforming into public, often show a pattern of increased investment in production scale expansion, which uses more resources and emits even more pollutants. As a result, previous research implies that a larger volume of IPO income links with more severe air pollution. However, the trend in Pakistan is the opposite due to increased pollution. Higher emissions impair individuals' ability to work efficiently on essential products such as food, cultural and historical landmarks, on the capacity of ecosystems to perform vital functions, and the cost of prevention or remediation, leading to poor economic and financial growth. According to Orlitzky et al. (2003), corporations with fewer resources are less likely to engage in corporate social responsibility activities.

Nonetheless, there is little indication that air pollution affects the IPO's fluctuation. This is surprising given that a substantial percentage of the IPO company's value is linked to future growth estimates, which are highly susceptible to economic growth (Bansal et al., 2019). As a result of financial uncertainty, it is argued that rising pollution represents a danger to new offers as well as the sub-standard operational performance of IPO firms.

H3: Ecological footprint significantly impacts IPO variability in Pakistan.

2.5. Literature Gap

Previous studies focused more on IPO anomalies, from developed and developing countries. For instance, Determinants of IPO underpricing (Zhang et al., 2021), (Jamaani and Ahmed, 2021), (Boulton et al., 2021), (Li et al., 2019), determinants of IPO oversubscription (Mohd-Rashid et al., 2022), (Tajuddin et al., 2018), (Arora and Singh, 2020), and (Mehmood et al., 2020a). Likewise, determinants of IPO withdrawal (Helbing et al., 2019), (Boeh and Dunbar, 2021), (Jamaani and Alawadhi, 2023), (Fan and Yamada, 2020). However, not many studies are available on IPO activities besides (Gupta et al., 2018), (Çolak et al., 2017), from Pakistan (Mehmood et al., 2021b) and (Mehmood et al., 2023). Therefore, present study adds the contribution in literature while investigating the asymmetric and symmetric impact of renewable energy, technological innovation and ecological footprint on IPO variability in Pakistan. Furthermore, the results of this study suggest that the composite dynamics of poor macroeconomic circumstances impact the relative strength of investors and entrepreneurs in an environment marked by significant information asymmetry and uncertainty. However, owing to the country's major inadequate performance, unstable macroeconomic circumstances may impact company financial behavior in a variety of ways, including when enterprises underutilize their capital and the available channels to outside investors. The findings of this study provide fresh light regarding if the effects and severity of unfavorable macroeconomic circumstances and low IPO activity are similar to those seen in developed economies.

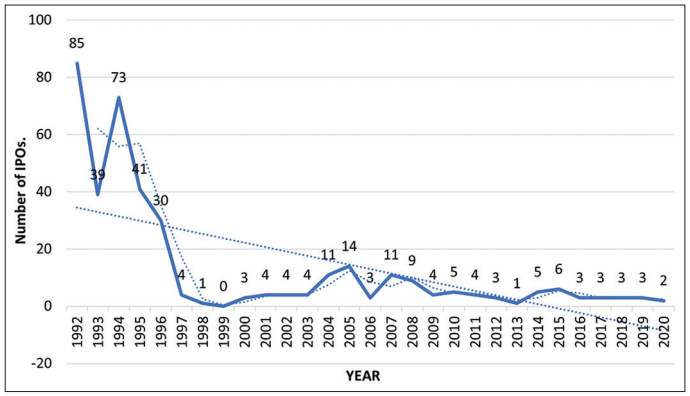
3. RESEARCH METHODOLOGY

3.1. Data and Sample

This study examined the impacts of socioeconomic factors on IPO variability listed on the PSX from January 1992 to December 2020. Pakistan had an excellent record of IPOs from 1992 to 1998, but there was an abrupt drop in the total number of IPOs in 1999, which, soon after the nuclear trials, almost reached zero due to many US-sanctioned laws. The overall number of IPOs listed was obtained from the PSX data portal's flotation section. The World Development Indicators database was used to get additional socioeconomic variables, including renewable energy, technological innovation. Likewise, the global footprint network is used for the country-wise ecological footprint data.

Figure 1 also depicts the complete count of IPOs from January 1992 to December 2020. Based on the illustration, the maximum number of IPOs was registered between 1992 and 1996; however, not a single IPO was conducted in 1999. Nonetheless, decreased IPOs persisted after 2000, and the trend repeated in 2017 with merely three IPOs. According to Angelini and Foglia (2018), macroeconomic variables are the genuine reason for the low frequency of IPOs. Table 2 shows the independent as well as dependent variables from this research. The only dependent variable assessed by the complete count of IPOs throughout

Figure 1: Number of IPO offerings beginning from 1992 to 2020



Source: Pakistan Stock Exchange Flotations

the year is the number of newly listed IPOs. Furthermore, the independent variables include renewable energy, technological innovation and ecological footprint (Table 2).

3.2. Model Specification and Equation Procedure

Unit root tests were run on each variable under investigation to start the investigation. The variables' stationarity must be established at either I(1) or I(0) before employing co-integration and causality techniques. After sufficiently satisfying that all the variables are free from unit root, the study proceeded with the application of linear and non-linear models of ARDL by capturing both the short-run and the long-run analysis. Figure 2 shows the flow of methodology to achieve the research objective.

$$NIPO = a + \beta_1 RENEW_i + \beta_2 PR_i + \beta_3 ECO_i + \varepsilon_i \quad (1)$$

$$\Delta NIPO_t = \theta + \sum_{k=1}^{P1} \theta_k \Delta NIPO_{t-k} + \sum_{k=1}^{P2} \theta_k \Delta RENEW_{t-k} + \sum_{k=1}^{P3} \theta_k \Delta PR_{t-k} + \sum_{k=1}^{P4} \theta_k \Delta ECO_{t-k} + \lambda_1 NIPO_{t-1} + \lambda_2 RENEW_{t-1} + \lambda_3 PR_{t-1} + \lambda_4 ECO_{t-1} \mu_t \quad (2)$$

In order to measure the effect of both the symmetric and asymmetric relationships among variables, linear and non-linear ARDL methods were applied. The ARDL techniques are quite flexible and can be utilized for variables integrated at either I(0) or I(1), or even on the variables following mixed order of integration. The techniques work best for a finite sample size i.e. small number of observations (Choi, 1992). The endogeneity problem in the ARDL models can be mitigated by selecting suitable lag and lag length criteria. Similarly, the issue of potential multicollinearity in the asymmetric ARDL can be effectively resolved using the optimum lag length (Shin et al., 2014). The lagged ECT provides information regarding convergence to the long-run equilibrium, and overall, the ARDL approach yields both the short- and long-run results. The symmetric ARDL model that follows is derived from equation 1.

Additionally, Equation 2 aligns with the methodology introduced by (Engle and Granger, 1987). It represents that the given macroeconomic variable of interest have symmetric (linear) impact on the variability of Pakistani IPOs, where the long-run coefficients are represented by □1, □2, □3, □4, β5, β6, β7; Δ denotes the first difference operator; the error term is μt; and the short-run coefficients are represented by *βa, βb, βc, βd, βe, βf, and βg*. We determined the lag length using the Akaike information criterion prior to utilizing the ARDL.

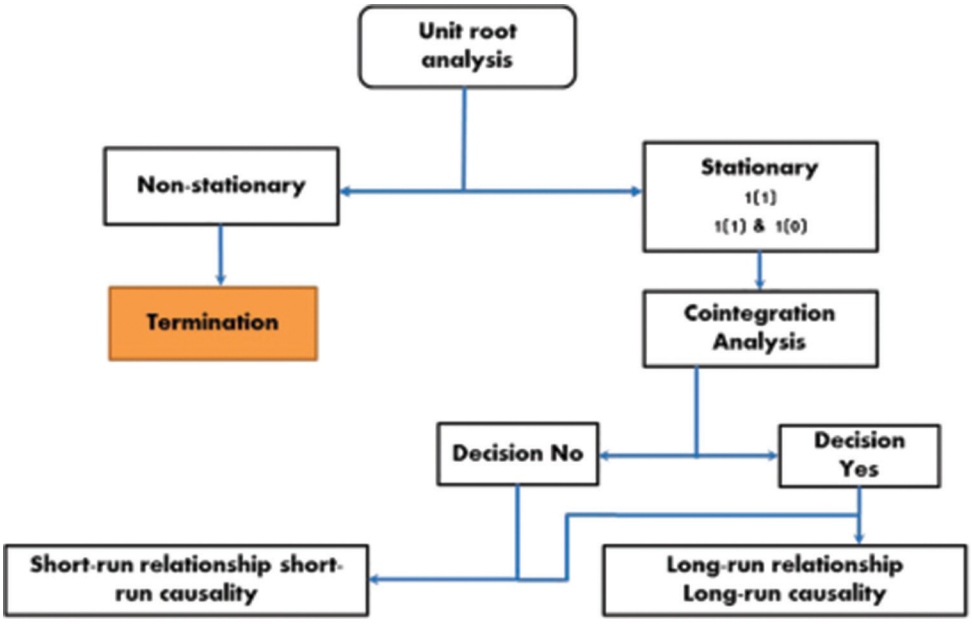
According to the null hypothesis of the ARDL bound test *(H0: β1 = β2 = β3 = β4 = β5 = β6 = β7= 0)* which states that there is no co-integration among variables. On contrary, the alternate hypothesis *(H1: β1 /= β2 /= β3 /= β4 /= β5 /= β6 /= β7/= 0)* establishes the existence of co-integration among variables. We then determined the long run dynamics under Linear ARDL once the co-integration was verified.

The study further investigated the potential asymmetric effects by employing the Non-linear Autoregressive Distributive Lag

Table 2: Operationalization of variables

Definition		Source
IPO variability	Number of IPOs offered in Stock exchange	Pakistan Stock Exchange Flotation.
Renewable Energy	Renewable energy consumption i.e., the percentage of total final energy consumption.	World Development Indicators
Technological innovation	The number of national/local patents reflects technological innovation.	World Development Indicators
Ecological Footprint	The ecological footprint of Consumption (Global hectares per capita).	Global Footprint Network

Figure 2: Methodology flow diagram



(NARDL) technique. The approach was previously applied by Ahmad et al., (2018) and Udemba and Yalçıntaş, (2021). Towards that end, macroeconomic variables have been classified into positive and negative components as described in reference (Asghar et al., 2023). The asymmetric regression model is expressed as $Xt = \delta+\gamma+t + \delta-\gamma-t + \mu t$, where $\delta+$ *and* $\delta-$ are associated with the long-term coefficients, and γt represents a vector of the independent variables.

$$Y_t = Y_0 + y_t^+ + y_t^-$$

Y^+ *and* Y^- represent the explanatory variables deconstructed as partial aggregations of positive and negative alterations. Equations (3) to (8) encapsulate the positive and negative alterations of renewable energy, technological innovation and ecological footprint.

$$RENEW^+ = \sum_{i=1}^{t} \Delta RENEW_i^+ = \sum_{i=1}^{t} \max(\Delta RENEW_{i,} 0) \quad (3)$$

$$RENEW^- = \sum_{i=1}^{t} \Delta RENEW_i^- = \sum_{i=1}^{t} \min(\Delta RENEW_{i,} 0) \quad (4)$$

$$PR^+ = \sum_{i=1}^{t} \Delta PR_i^+ = \sum_{i=1}^{t} \max(\Delta PR_{i,} 0) \quad (5)$$

$$PR^- = \sum_{i=1}^{t} \Delta PR_i^- = \sum_{i=1}^{t} \min(\Delta PR_{i,} 0) \quad (6)$$

$$ECO^+ = \sum_{i=1}^{t} \Delta ECO_i^+ = \sum_{i=1}^{t} \max(\Delta ECO_{i,} 0) \quad (7)$$

$$ECO^- = \sum_{i=1}^{t} \Delta ECO_i^- = \sum_{i=1}^{t} \min(\Delta ECO_{i,} 0) \quad (8)$$

In order to obtain Equation 9, an asymmetric ARDL framework was employed by placing the negative and positive series together in equations 3, 4, 5, 6, 7 and 8, meanwhile, the NARDL equation is shown in Equation 9.

$$\begin{aligned}\Delta NIPO_t = {} & \theta + \sum_{k=1}^{P1} \theta_k \Delta NIPO_{t-k} + \sum_{k=1}^{P2} \theta_k \Delta RENEW_{t-k}^+ + \\ & \sum_{k=1}^{P3} \theta_k \Delta RENEW_{t-k}^- + \sum_{k=1}^{P4} \theta_k \Delta PR_{t-k}^+ + \sum_{k=1}^{P5} \theta_k \Delta PR_{t-k}^- + \\ & \sum_{k=1}^{P8} \theta_k \Delta ECO_{t-k}^+ + \sum_{k=1}^{P9} \theta_k \Delta ECO_{t-k}^- \lambda_1 NIPO_{t-1} + \\ & \lambda_2 RENEW_{t-1}^+ + \lambda_3 RENEW_{t-1}^- + \lambda_4 PR_{t-1}^+ + \\ & \lambda_5 PR_{t-1}^- \mu_t + \lambda_6 ECO_{t-1}^+ + \lambda_7 ECO_{t-1}^- \mu_t \end{aligned} \quad (9)$$

The equation can be applied to obtain the unbiased and efficient estimates of the model (Pearson and Shin, 1999) both in the short and long run. Therefore, the ARDL and NARDL is popular and most appropriate for observing the long-run relationship and have been widely adopted in recent years.

4. RESULTS AND DISCUSSION

4.1. Descriptive Statistics and Correlation Analysis

Table 3 summarises statistical information for the time series of yearly IPOs and macroeconomic indices. The findings for the number of IPOs indicate that there were 13.35714 IPOs on average between 1992 and 2020, with 0 IPOs as the least and 85 IPOs as the highest.

With a high of 55.98 and a low of 42.1, RENEW had a mean value of 48.79. The finding shows that from 1992 to 2020, RENEW has a low variance. Even so, compared to the previous 5 years, the present RENEW is higher, which lowers overall production. The mean PR was 113.71, while the lowest PR was 16. The highest PR was recorded at 338, suggesting that an increase in PR was anticipated to lead to a rise in IPO activities.

Meanwhile, ECO highest and lowest scorings are 1.10 and 4.49, respectively, with an average of 1.295. The data provided by the Ecological footprint explains overall environmental performance. Pakistan comes sixth in terms of the world's population. The mean ecological footprint of Pakistan is 4.74 gha, yet most urbanized regions have populations that exceed the ecological capacity of the country (Rashid et al., 2018). Based on data from 1992 to 2020, Pakistan performed erratically regarding its ecological footprint. Based on the result findings, it is projected that a higher ecological footprint might lead to fewer IPOs offered due to higher uncertainty.

The correlation analysis criteria ascertain the direction, strength, and importance of the correlations among the studied variables. Despite this, the correlation coefficients for RENEW and ECO have substantial multicollinearity, at 0.6547 and 0.5422, respectively. According to Hair et al. (2010), all variables have correlation values <0.90, demonstrating that the models' multicollinearity is not significantly problematic.

According to the correlation analysis presented in Table 4, three variables (RENEW, PR, and ECO) are significantly correlated with the IPO variability. Specifically, a significant positive correlation was observed between RENEW and IPO variability, which implies that at a 1% significance level, an increase in RENEW will cause a corresponding increase in IPO variability. Consequently, a decrease in PR and ecological footprint is expected to lead to a decrease in IPO activities.

Table 3: Descriptive Statistics

Variables	Mean	Median	Max	Min	Standard Deviation
TNIPO	13.3571	4	85	0	21.4428
RENEW	48.79	47.94	55.98	42.1	3.54440
PR	113.7143	91.5	338	16	93.2368
ECO	1.295	0.261	4.49	1.10	0.120

Source (s): Author's Computation, RENEW-Renewable Energy; PR- Patient Resident; ECO- Ecological Footprint

4.2. Unit Root Test Analysis

The stationarity in the time-series data is confirmed using the Augmented Dickey-Fuller (ADF) and Phillip Perron (PP) unit-root tests before examining the relationship among the three macroeconomic indicators and the overall number of IPOs. The variables have a unit root and are not stationary, according to the null hypothesis (H0). Table 5 presents the ADF test findings, demonstrating the rejection of the null hypothesis at the 99% significance level. This suggests that there is stationarity among the three macro variables.

Before applying the ARDL bounds testing technique, one prerequisite is that none of the series should be stationary at I(2), as depicted in Table 4. According to (Ouattara, 2004), the ARDL model becomes unreliable if the series requires I(2) to become stationary. Therefore, the determination of stationarity criteria for all the variables are crucial. For this purpose, we conducted ADF and PP unit root test results, which are shown in Table 5. The results confirmed that TNIPO, RENEW, PR, and ECO are all stationary at either level or first difference. The study proceeded with the ARDL bounds testing techniques as the stationarity criteria is successfully met.

4.3. Symmetric and Asymmetric ARDL

Results pertaining to both the short-run and long-run ARDL estimates are presented in Tables 6 and 7, respectively.

The outcome shows that renewable energy is has a significant negative relationship with IPO variability both in the short and the long run. The findings suggest that when businesses adopt renewable energy sources like solar, wind, and hydroelectric power, they scale down their reliance on imported fossil fuels. This can establish stability in energy prices, bolster energy security, and improve trade balances, positively impacting economic stability (Qadir et al., 2021) and instilling confidence among issuers to engage in initial public offerings. Similarly, implementing renewable energy-related technologies catalyses innovation and business start-ups with novel business models, intellectual property developments, and export prospects (Lam and Law, 2018). These collective outcomes in turn contribute to high IPO issuance. Additionally, transition to renewable energy sources could stabilize energy prices in the long run, which can lead to cost-related savings and thus, fostering issuer confidence on the country's macroeconomic conditions, consequently stimulating higher IPO issuance.

The result suggests that in the short run, while considering renewable energy sources like solar, wind, and hydroelectric power, countries can reduce their dependence on imported fossil fuels. This can stabilize energy prices, enhance energy security, and reduce trade imbalances, positively impacting economic stability and fostering issuers' confidence to offer IPOs. Similarly, deploying renewable energy-related technologies stimulates innovation and business setups, which can lead to new businesses, intellectual property, and export opportunities, all of which contribute to higher IPO issuance. However, in the long run, renewable energy usage can provide long-term stability in energy prices, which can be beneficial for cost saving and, thus, issuer confidence on the country macroeconomic favourable situation to offer IPOs.

Technological innovation also contributes a positive and significant role in defining the IPO variability in both the short and long run. The findings imply that technological advancements frequently result in more streamlined production processes and new business creation in the short run. Higher production with less resources can be produced due to this enhanced productivity (Feki and Mnif, 2016; Kihombo et al., 2021), which might boost the economy in the short run and give IPO issuers the prospect of survival in the aftermarket.

In the long run, technological innovations can sustain the economy's productivity. This consistent increase in productivity boosts economic growth. Similarly, innovations frequently result in the emergence of whole new sectors, present fresh investment possibilities, and thus promote higher IPO activity. The results align with previous studies (Broughel and Thierer, 2019; Feki and Mnif, 2016). Therefore, technological innovations are a key factor driving IPO activities in the short and long run.

Lastly, ecological footprint shows a significantly negative relationship to demonstrate variability in IPOs. The results explain that the more significant ecological footprint is typically linked

Table 4: Correlation Matrix

	TNIPO	RENEW	PR	ECO
TNIPO	1			
RENEW	0.654744	1		
PR	−0.42379	−0.60591	1	
ECO	−0.54222	−0.29416	0.489332	1

Source (s): Author's Computation
RENEW: Renewable Energy; PR: Patient Resident; ECO: Ecological Footprint

Table 5: Unit root tests

At levels			At first difference			Decision
Series	ADF	PP	Series	ADF	PP	
TNIPO	−4.36902** (0.0019)	−7.21621** (0)	TNIPO	--	--	*I(0)*
RENEW	−2.13314 (0.234)	−2.14434 (0.2299)	RENEW	−4.17129*** (0.0032)	−4.19182*** (0.0031)	*I(1)*
PR	3.029496 (1)	2.595896 (1)	PR	−5.1072** (0.0557)	−6.49577** (0)	*I(1)*
ECO	−1.47829 (0.5296)	−1.47829 (0.5296)	ECO	−4.85919*** (0.001)	−4.53258*** (0.0013)	*I(1)*

Source (s): Author's Computation

Table 6: Short run ARDL

Variable	Coefficient	Standard Error	t-Statistics	Prob.
RENEW	−1.9219	0.8404	−2.2866	0.0383
PR	0.0433	0.0174	2.4881	0.0261
ECO	−0.0003	0.0001	−2.1419	0.0503

Source (s): Author's Computation

Table 7: Long run ARDL

Variable	Coefficient	Standard Error	t-Statistics	Prob.
RENEW	−4.72899	2.125846	−2.22452	0.0431
PR	0.106619	0.043955	2.425624	0.0294
ECO	−0.00076	0.000319	−2.37572	0.0323

Source (s): Author's Computation

to adverse environmental effects (Ikram et al., 2021), such as pollution, resource depletion, and habitat destruction, reflecting the negative environmental impact on IPOs. Furthermore, the negative effects of ecological footprint in the short run could translate into higher pollution levels, slow economic growth (Hassan et al.,2019; Uddin et al., 2016) and reduced IPO activity. Over the long run, it is contended that a higher ecological footprint is associated with environmental degradation in the form of habitat loss, water and air pollution, raises health concerns and the higher cost of IPO issuance. As a result, this can adversely impact IPO activities by contributing to an increased cost of capital and eroding issuers' confidence in the country's macroeconomic performance.

Furthermore, the findings of the NARDL are presented in Tables 8 and 9, respectively. Based on the conclusions provided, the effect of renewable energy exhibits both negative and positive significance in explaining IPO activities. The results indicate that in the short run, deploying renewable energy sources frequently necessitates extensive infrastructure and equipment investments (Sen and Ganguly, 2017). However, these investments can boost economic activity in the short run, giving IPO issuers more confidence to conduct IPOs in the succeeding years. On the contrary, short-run negative impact indicates that switching to alternative energy sources could bring huge upfront costs (Azarpour, 2013). This leads to mounting financial pressure on companies to conduct IPOs and bear those associated costs. Furthermore, there is a negative significant effect of renewable energy is found in the long-run on IPO activities. Conversely, the negative effect explains the significant impact of renewable energy on IPO activities. The positive impact of technological innovation is not significant; however, the negative impact is significant both in short and long run. The result suggests that technological innovation often requires substantial investments in equipment, infrastructure, and retraining of the workforce, which increases the cost of doing business (Wang and Tan, 2021) and offering equities. These upfront costs can burden businesses financially (Khan et al., 2021) in the short term and may not immediately translate into increased productivity; thus, issuers in this scenario are reluctant to offer new IPOs.

The short-run positive and negative impacts of ecological footprint are significant in explaining IPO variability. However, the negative impact of ecological footprint is not significant in the long run to explain IPO activities. The result suggests that due to the higher

Table 8: Short run NARDL

Variable	Coefficient	Std. Error	t-Statistics	Prob.
RENEW_POS	−2.70071	1.042404	−2.59085	0.081
RENEW_NEG	−0.07409	0.029785	−2.48749	0.0887
PR_POS	−0.00333	0.008484	−0.39215	0.7009
PR_NEG	−0.4139	0.135592	−3.05253	0.0553
ECO_POS	673.323	149.7708	4.495689	0.0205
ECO _NEG	500.1526	138.7594	3.604458	0.0366

Source (s): Author's Computation

Table 9: Long run NARDL

Variable	Coefficient	Standard Error	t-statistics	Prob.
RENEW_POS	0.8917	3.7538	0.2375	0.8275
RENEW_NEG	−19.815	3.3347	−5.9426	0.0095
PR_POS	−0.1572	0.0671	−2.3426	0.1010
PR_NEG	−1.3836	0.1742	−7.9409	0.0042
ECO _POS	−2760.29	624.91	−4.4179	0.0215
ECO_NEG	530.8402	295.17	1.7984	0.1699

Source (s): Author's Computation

Table 10: Results of the F-Bounds test

Asymmetric				
Test statistics	**Value**	**Significant**	**I(0)**	**I(1)**
F statistics	3.54	10%	2.26	3.34
k	8	5%	2.55	3.68
		2.5%	2.82	4.02
		1%	3.15	4.43
Symmetric				
Test statistics	**Value**	**Significant**	**I(0)**	**I(1)**
F-statistics	5.88	10%	2.53	3.59
k	6	5%	2.87	4
		2.5%	3.19	4.38
		1%	3.6	4.9

Source (s): Author's Computation

ecological footprint commonly refers to greater consumption of natural resources and environmental damage in short run. The expenses of mitigating the impacts of climate change and resolving other environmental harms might all have a financial impact in terms of less IPO activities both in short and long run.

4.4. Co-integration and Bound Test

Subsequently, we followed the linear and non-linear bound test to examine the presence of co-integration (Shahid et al., 2022). Table 10 suggests that variables are co-integrated as in model 1; the F-statistics is greater than the upper critical bound at a 10% per cent significance level. Similarly, model 2, under non-linear co-integration, shows the rejection of null hypothesis at 5% significance level. Thus, given the presence of co-integration relationship, we can estimate both long-run symmetric and asymmetric association among the variables.

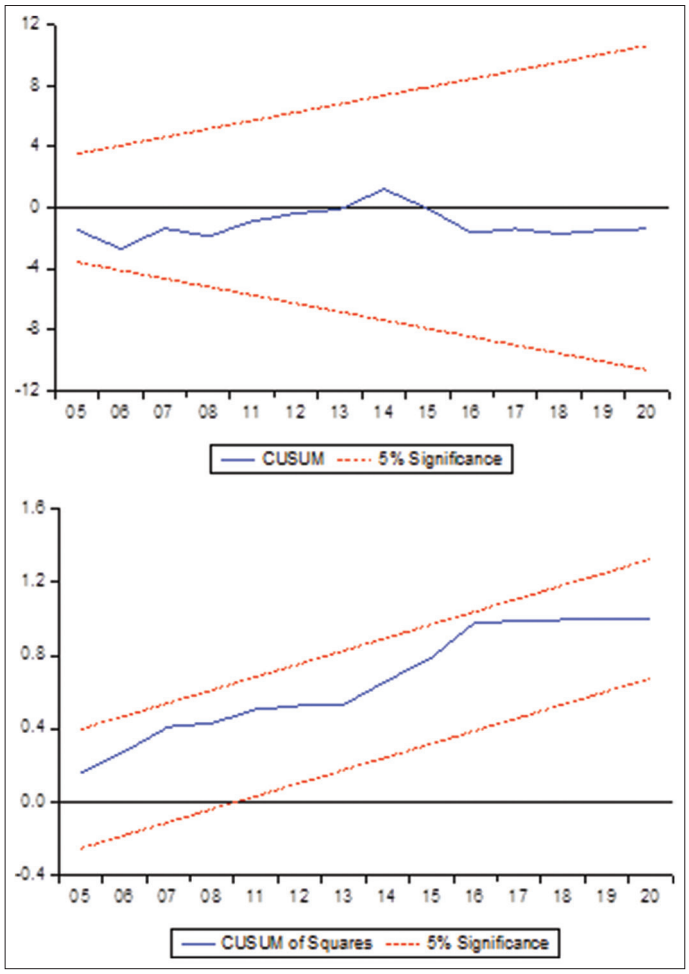
4.5. Diagnostics Tests

Numerous diagnostics tests were performed before the final adoption of the symmetric and asymmetric models. Table 11 shows the results of tests. The reported value of the Breusch–Pagan–Godfrey tests are 60.33, suggesting that our model exhibits no statistically significant heteroscedasticity. Additionally, with a Jarque-Bera test statistic of 5.691, it was ascertained that the residuals conform to a normal distribution. This statistically

Table 11: Diagnostic results

Diagnostic test	Problem	P-value	Decision
Jarque–Bera	Normality	5.691	Residuals are normally distributed
Breusch–Pagan–Godfrey	Heteroscedasticity	60.33	There is no multicollinearity.
VIF	Multicollinearity	1.3-2.8	There is no multicollinearity.
CUSUM	Stability*		Model is stable
CUSUMSQ	Stability*		Model is stable

Figure 3: CUSUM and CUSUMQ diagram



significant result affirms the appropriateness of our model specification. The Variance Inflation Factor (VIF) values range from 1.3 to 2.8, all of which are below the commonly accepted threshold of 5, thus signifying the absence of multicollinearity within the analytical framework of this study. Additionally, as exemplified using CUSUM and CUSUMQ in Figure 3, the stability of the model is visually confirmed. Consequently, Table 11 illustrates that all coefficients in the model exhibit stability.

5. CONCLUSION AND POLICY IMPLICATIONS

This study examined the short and long-run effects of renewable energy, technological innovation and ecological footprint on IPO variability in Pakistan. In order to explore this nexus, our study began by performing the unit root tests to confirm the stationarity of the variables. Subsequently, both the symmetric and asymmetric co-integration were evaluated. In contrast to prevailing conventions in the academic literature, the study implemented both Linear and Non-linear ARDL techniques to capture the comprehensive picture of the long-run elasticities.

Some valuable findings can be drawn from the result. The symmetric ARDL results revealed a significant relationship of renewable energy, technological innovation with IPO variability both in the short and long run. Adopting renewable energy sources and improving technological innovation will enhance productivity (Zhang et al., 2023), reduce cost of doing business and therefore stimulate businesses to engage in IPOs. On the other hand, an increase in ecological footprint will increase the environmental regulatory risk and compliance cost, which could become a significant deterrent behind the firms contemplating IPOs. Similarly, NARDL traces the asymmetric effects of renewable energy adoption, technological innovation, and ecological footprint in the short- and long-run scenarios. Each macroeconomic indicator's positive and negative shocks are associated with IPO variability. For instance, a positive change in renewable energy adoption and technological innovation could leverage business models, and they could plan IPOs in the near future for expansion and growth, however, a negative shock in any of the two factors could restrict companies from offering IPOs. On the contrary, ecological footprint positive shock could decrease IPO variability and vice-versa.

In the changing macroeconomic landscape of Pakistan, where sustainability and technological innovation are the major concerns, we try to present the impact of these macroeconomic determinants on the companies planning to offer IPOs. The present study provides valuable findings to investors, issuers, and policymakers. On the investor level, the investors could assess these unique macroeconomic indicators when administering investors' portfolios and should pick out the profitable IPO variations during investment decision-making. The issuers can evaluate the macroeconomic conditions to attain full subscriptions and to avoid IPO failures, postponement or withdrawal of IPOs. Strategically timing the entry into the market during favourable macroeconomic conditions can help issuers position their IPOs appropriately and pull the investor demand. Additionally, they should adopt renewable energy sources with the help of technological innovation to bring down ecological footprint and the regulatory and environmental compliance costs of going public.

In their capacity, government authorities should implement policies to enhance the nation's macroeconomic conditions, thereby fostering an environment conducive to sustained market expansion. The government should extend support to environmentally conscious and technologically driven enterprises

by introducing relevant regulations and measures to boost such companies' IPOs. Therefore, the study facilitates stakeholders' development of a comprehensive understanding of IPOs, and policymakers must strive to make the primary market more dynamic, versatile, and active. However, our study only considered a limited number of macroeconomic variables to study the dynamic impact of these variables on IPO variability. Nonetheless, future studies could incorporate the impact of country-level institutional quality, which can facilitate renewable energy adoption and technological innovation and determine its effects on IPO variability. Another potential avenue for research is expanding the geographical area under study by including countries from other emerging economies.

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