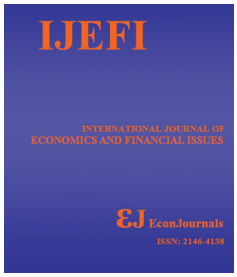

International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2025, 15(6), 225-241.

Unlocking the Dynamics of Initial Public Offerings Drivers in India: The Role of Institutions, Innovation, Energy, and Resources Using ARDL and NARDL Models

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Received: 05 May 2025 **Accepted:** 03 September 2025 **DOI:** https://doi.org/10.32479/ijefi.20731

ABSTRACT

This study explores the dynamic link between IPO activity, country-level institutional quality and a set of dynamic macroeconomic indicators within the context of India's emerging market from 1997 to 2022. Employing time series data, the analysis leverages both ARDL and Non-linear ARDL (NARDL) models to capture the nuances of linear and asymmetric relationships across short-run dynamics and long-run equilibrium. Results from bounds testing confirm the existence of long-run co-integration between the predictor variables and IPO activity in India. The findings reveal that institutional quality, technological innovation, and renewable energy adoption are significant positive drivers of IPO activity, signaling favorable economic conditions for firms to IPO. A marginal improvement in these factors reduces ex-ante uncertainty, increases market efficiency, and promotes better valuation incentivizing firms to pursue public listings. However, natural resource rent emerges as a negatively significant determinant, suggesting a resource curse effect in the context of IPO market performance. The study also examines the asymmetric impacts of country-level institutional quality, technological innovation, renewable energy adoption, and natural resource rent in the short- and long-term periods. Overall, the findings suggest that the investor uncertainty surrounding IPO demand varies over time and across firms. This study underscores the critical role of institutional strength and dynamic macroeconomic factors in signaling-conducive environments for IPO initiation. Thus, IPO activity is expected to increase with improvements in institutional governance, support for innovation, advancement in the integration of clean energy technologies, and efficient resource management.

Keywords: Institutional Quality, Initial Public Offerings Activity, Technological Innovation, Renewable Energy Adoption, Natural Resource Rent
JEL Classifications: E6, O2, G1, Q4

1. INTRODUCTION

Initial public offerings (IPOs) have historically been a transformative milestone for startups seeking growth and expansion. The funds raised during an IPO not only catalyze future expansion, but also provide liquidity, allowing pre-IPO investors, such as venture capitalists and angel investors, to exit and diversify their portfolios (Ritter and Welch, 2002). As a crucial stage in a company's lifecycle, an IPO signifies its transition toward broader market recognition and long-term sustainability. In general, the decision to contemplate public listing in a country is considered a favorable dimension of broader economic development, stimulating investments, growth, and job creation (Lewellyn and Bao, 2014).

However, the choice to go public is inherently influenced by broader institutional and dynamic macroeconomic factors. Companies carefully assess the prevailing economic and financial climate as market conditions play a critical role in shaping investor confidence and IPO activity (Mehmood et al., 2023). Additionally, past IPO failures can discourage firms from proceeding because they may signal unfavorable macroeconomic conditions or poor investor appetite.

Globally, IPO activity has displayed significant fluctuations due to evolving market conditions. For instance, in 2023, the total number of IPOs fell by 16%, accompanied by a one-third decline in proceeds compared with the previous year. Rising interest

rates, geopolitical tensions—including conflicts in the Middle East and Ukraine—and inflationary pressures dampened investor confidence across major markets, including both developed and emerging market economies.[1] Developing markets such as India, China, Pakistan, and Bangladesh have experienced subdued performance due to economic uncertainties and cautious investor sentiment. Certain regions, particularly the United States, showed signs of recovery driven by high-profile listings in the technological and healthcare sectors. Nevertheless, the overall market faced challenges, underscoring the profound impact of external shocks on IPO sentiment and outcomes. In light of these concerns, post-IPO volatility increased, reflecting persistent market uncertainties and investor apprehension amidst economic headwinds and uncertainty surrounding global financial conditions.

India's IPO market has historically been shaped by macroeconomic and geopolitical factors, leading to fluctuating public listing trends. IPO activity was robust between 1996 and 2001, with more than one company going public per business week. From 1996 to 2000 alone, 373 IPOs were launched. However, following the dot-com bubble crash, global financial uncertainty led to a slowdown in new public offerings, marking a period of intense speculation in the Indian IPO market. The Global Financial Crisis of 2008 severely affected India's investment climate, causing a significant decline in IPO activity (Matharu, 2021). However, a notable recovery began in 2007, with IPOs raising $8.3 billion, positioning India as the fifth largest stock exchange by the number of IPOs and the seventh largest by proceeds that year. Despite periods of resilience, India's IPO market has been vulnerable to black swan events, Global Financial Crisis of 2008, the Eurozone Crisis of 2012, and COVID-19 pandemic (2020). These crises resulted in sharp declines in IPO activity, with only 61, 39, and 39 IPOs debuting in those years, respectively. Such macroeconomic downturns highlight the profound impact of external shocks, particularly global financial and health crises, on financial markets and firm-level decision-making.

Since unfavorable macroeconomic conditions can impact business and industry-level performance, as well as the choice to go public, macroeconomic considerations are the only way to understand the state of the nation's economy. Unfavorable macroeconomic conditions—such as economic downturns, high uncertainty, or instability in financial markets—can greatly affect a company's decision to go public (Brau et al.,2003). Companies can choose when to launch their IPO, but since going public is an irreversible step, firms are cautious about timing. Thus, IPOs are timed, and timing is a choice (Aghamolla and Guttman, 2021). When economic conditions are uncertain, firms may delay their IPO to wait for a more favorable environment. This refers to companies that are all set for an IPO and are anticipating the right moment to launch. This is because the value of waiting increases during such times, as it provides the flexibility to assess and respond to changes in market conditions. Unpredictable macroeconomic conditions can impact a company's financial behavior in several ways, including when businesses underutilize their resources and the channels available to external investors because of the notable underperformance of the macroeconomic circumstances in the nation (Mehmood et al., 2023). Therefore, firms postpone issuing equity when they know that they are currently undervalued choosing instead to wait for a bull market with desirable macroeconomic conditions that signals better growth propects and offers fairer valuations.

Furthermore, institutional challenges such as weak regulatory enforcement, bureaucratic inefficiencies, inadequate investor protection mechanisms, and pervasive corruption have long hindered the development and transparency of India's capital markets. These institutional deficiencies not only elevate the cost of capital but also generate mistrust among potential investors, both domestic and foreign, thereby reducing the attractiveness of IPOs as a viable funding option for firms (La Porta et al., 1997; Djankov et al., 2008). For instance, absence of suffiicent institutional regulation and weak enforcement of corporate governance norms further deters listing, as firms are reluctant to subject themselves to heightened scrutiny in an environment where regulatory oversight is inconsistent and legal recourse is often protracted and uncertain. Moreover, the lack of reliable dispute resolution mechanisms and delays in securities litigation discourage investor participation leading to exploitation of minority shareholders by controlling shareholders who try to maximize their private benefits (Bruton et al., 2010; Espenlaub et al.,2020). Thus, in IPO contexts, information asymmetry becomes more pronounced, and the resulting opportunistic behavior among participants can lead to agency conflicts exacerbating the adverse selection problem and increasing perceived risk premiums among investors (Aggarwal et al., 2002; Certo et al., 2009). The absence of efficient institutional frameworks thus constrains the scale and scope of IPO markets, particularly in emerging economies like India, where long-term market development is inextricably linked to institutional credibility. Hence, a robust institutional environment can promote better valuations and fair distribution of returns by mitigating investor uncertainty and risk (Lewellyn and Bao, 2014) ultimately greater IPO activity.

As Table 1 shows, the erratic trend highlights the sensitivity of IPO activity to the underlying institutional quality challenges and prevailing macroeconomic conditions in the country, emphasizing the importance of timing and market sentiment in determining IPO outcomes. Numerous institutional deficiencies and macroeconomic problems, such as low employment, political unpredictability, high inflation, terrorism, corruption, low research and development, social security hazards, and interest rates, may be attributed to this bleak IPO activity (Latham and Braun 2010; Colak et al., 2017). Further, Macroeconomic uncertainty translates into a direct cost for issuing firms, as it disrupts investment decisions at the firm level, especially in contexts where investment adjustments entail significant costs (Bloom et al., 2018).

While adverse macroeconomic conditions have been recognized as the triggers and drivers of IPO issuance volatility (Demir et al., 2023), there is limited and contradictory evidence to support this contention, necessitating further research on the impact of macroeconomic conditions on IPO activities. Although prior research underscores the relevance of macroeconomic conditions across both developed and developing markets

1 Global IPO Watch 2023 and outlook for 2024

Table 1: Variable operationalisation

Variables	Description	Definitions	Expected Sign
TNIPO	Number of Total IPOs	Total number of IPOs (year wise)	
VA	Voice and Accountability (Percentile rank between 0 and 100)	Measures citizens ability to participate in government and the freedom of expression, association, and media	+
PS	Political Stability (Percentile rank between 0 and 100)	Captures the likelihood of political instability, violence, and terrorism affecting governance.	+
GE	Government Effectiveness (Percentile rank between 0 and 100)	Assesses the quality of public services, civil service, and the government's credibility in policy implementation.	+
CC	Control of corruption (Percentile rank between 0 and 100)	Measures the degree to which public power is used for private gain, including both petty and grand forms of corruption.	+
TI	Technological innovation	Total Patent Filings (Residents)	+
RE	Renewable energy	Percentage of Total energy consumption	+
NRR	Natural resources rent	Total Natural resources (% of GDP)	-

Data Source: Prime Database, World bank, World Governance Indicators

(Ameer, 2012; Angelini and Foglia, 2018; Demir et al., 2023; Dicle and Levendis, 2018; Rivas and Adamuz, 2019; Mehmood et al., 2020b; Mehmood et al., 2021a), a significant gap remains in understanding how these elements affect the Indian IPO market which is characterized by unique structural and economic complexities. Moreover, much of the existing research tends to generalize findings across emerging economies, often overlooking India's distinct institutional architecture and its evolving regulatory landscape. This gap calls for a more targeted investigation into how institutional inefficiencies, governance challenges, and enforcement asymmetries influence IPO dynamics, particularly in terms of market accessibility, investor confidence, and overall IPO activity.

Thus, the present study seeks to close this gap in the literature by investigating the impact of country-level institutional quality, technological innovation, renewable energy adoption, and the performance of natural resource rent on IPO activity in India. Additionally, the findings of this study suggest that inadequate macroeconomic conditions significantly impact the balance of power between investors and entrepreneurs, particularly in environments characterized by severe information asymmetry and uncertainty. Macroeconomic instability can affect corporate financial behavior in various ways, such as leading firms to underutilize their resources and limiting access to external financing due to weak economic performance. Furthermore, poor country-level institutional qualitymanifested through weak regulatory frameworks, lack of investor protection, bureaucratic inefficiencies, and corruption, exacerbate these challenges. Such institutional deficiencies undermine market confidence, elevate transaction costs, and discourage both domestic and foreign investments, ultimately constraining the growth and dynamism of the IPO markets.

Using both the ARDL and NARDL methodologies, this study provides novel insights into the effects of country-level institutional frameworks and the severity of unfavorable dynamic macroeconomic conditions on IPO activity by comparing these trends with those observed in developed economies. The findings enrich the understanding of how, country-level institutional quality, and dynamic macroeconomic variables, particularly technological innovation, the transition to renewable energy, and natural resource utilization, impact savings, investments, and overall sustainable economic development. Additionally, they explore how these factors shape IPO markets in emerging economies and provide valuable insights for policymakers, investors, and market participants.

1.1. Background of the Study

In recent years, the COVID-19 pandemic has brought with it previously unheard-of difficulties that have upended economies and lives worldwide. India has experienced major challenges during what the IMF has dubbed "The Great Lockdown" (International Monetary Fund, 2020), which has had a profound impact on financial markets and economic activity, much like many other countries. Critical flaws in the resilience of India's financial system have been revealed by this crisis, which has brought attention to the shortcomings of the institutional framework. According to the World Economic Forum (2020), institutional integrity has deteriorated globally, with weaker checks and balances, and reduced openness. In particular, changes in the political and economic environment are the main drivers of the number of primary issues because more effective general economic institutions increase returns on investment and reduce transaction costs, risk, and uncertainty. Furthermore, institutional factors, such as voice and accountability, political stability, government effectiveness, and control of corruption, lead to economic growth and enhance environmental sustainability. On the other hand, weak institutional quality can impede innovation and entrepreneurship (Khoury and Prasad, 2016). The Worldwide Governance Indicators (WGI) database highlights stark disparities in institutional quality between developed and emerging economies, such as India. Developed countries such as the United States and Australia consistently achieve high scores across governance parameters. The US scores range from 59.05 to 92.79, reflecting robust democratic institutions, effective policy implementation, and systemic stability, although political polarization remains an area for improvement. Australia performed even better, with scores between 77.62 and 98.08, demonstrating excellence in transparency, regulatory quality, and control of corruption, supported by a stable and efficient governance framework. India, on the other hand, performed terribly poorly in comparison to the developed countries, scoring between 9.04 and 65.71 across all parameters. This is despite a general improvement over the past 20 years. Notwithstanding these reforms, India's institutions continue to operate poorly and exhibit distressing patterns.

According to the World Energy Outlook (2021), India has accounted for more than 10% of the increase in global energy demand since 2000. Between 1990 and 2019, coal consumption in the country rose significantly from 25% of the global average to 60%, mainly driven by a surge in per capita carbon dioxide (CO_2) emissions, which increased from just above 15% to nearly 40% of the global average during this period.

Primarily, Asian economies are predominantly pro-growth, as can be observed in the context of the Indian economy. For instance, India has shown consistent growth over the years, increasing from $495.936 billion in 1992 to $2.432 trillion in 2017 (World Development Indicator, 2021). However, this economic expansion has been largely driven by conventional energy sources, such as coal and oil, which accounted for 92.16% of the country's energy mix in 2017. India ranks as the world's second-largest consumer of energy (U.S. Energy Information Administration, 2018). According to the CEA Committee, rising GHG emissions are attributed to global energy use, which is still dominated by fossil fuels. India has to triple its wind and solar power capacity and generate more than 500 GW of renewable energy over the next ten years to close the emission deficit. To leverage the target of 500 GW of renewable energy capacity. To achieve sustainable and robust GDP growth, it is imperative to establish power plants capable of meeting the significant energy demands that accompany economic expansion. To achieve equilibrium between economic development and environmental preservation, the focus should be on the installation of renewable energy power plants. Nevertheless, attempts to address other urgent issues have been hampered by the COVID-19 pandemic. These include the fact that many consumers do not have access to a consistent supply of electricity; approximately 660 million people continue to cook using solid biomass, primarily firewood; electricity distribution companies are in financial distress; and the air quality in Indian cities is among the most polluted in the world. The patterns of energy investment in India's various sectors of the energy economy reflect variations in cost, capital allocation, policy, and market conditions.

Technological development has traditionally been regarded as a key component of long-term economic prosperity (Giri et al., 2023). Regarding India, there has been a notable improvement in the global innovation index (GII) issued by the United Nations World Intellectual Property Organization (WIPO). In 2015, India's ranking was 81; however, in 2018 and 2019, it was 57 and 52, respectively. The International Energy Agency (IEA) predicts that despite India's recent technical advancements, the country released 2299 million tons of carbon dioxide per person in 2017, a 4.8% increase over the previous year. Furthermore, the United States of America (U.S.), Switzerland, and Sweden topped the innovation rankings in the top echelon; the latter two advanced in GII 2019.

Although India registered a substantial increase from 45,444 patent applications and 9,847 grants in 2016-17 to 82,805 patent applications and 34,153 grants, there have been constant quality challenges associated with it.

According to a Special 301 report published by the U.S. Trade representative, India, is one of the world's most difficult major economies for safeguarding and enforcing intellectual property rights. Ongoing issues, including the threat of patent revocations, lack of presumed patent validity, and restrictive patentability criteria, have led to India's continued placement on the Priority Watch List. This dismal state of Indian patents demonstrates a weak innovation ecosystem, with an emphasis on quantity over quality, creating a patent paradox. Thus, India's innovation-led economic growth resulted in fewer IPOs than advanced economies.

Natural resource rent is the profit from trading natural resources after removing the cost of the trade (payments to production factors) and accounting for the costs of missed production opportunities. India's total natural resource rent as a percentage of GDP was 3.1594% in 2021, according to WDI. The endowment of natural resources supports economic growth by opening markets and investment opportunities in developing economies. Prominent economists such as David Ricardo and Adam Smith have also noted the beneficial effects of the NRR in promoting economic progress.

India is a South Asian nation with a diversified climate, enormous natural resource potential, and geopolitical importance. Chromium, bauxite, iron ore, manganese ore, mica, and thorium are among the many resources that have enriched it. As of 2023, it ranks as the world's fifth-largest economy with a GDP of $3.6 trillion, while its mining and metals sector was valued at $106.4 billion in 2010 (World Atlas, 2018). However, the country's vast population contributes to its relatively low per-capita GDP. However, it is crucial to acknowledge that low economic growth is caused by a weak institutional environment characterized by corruption, ineffective bureaucracy, and inadequate resource management (Ahmad et al., 2024). For these reasons, it is imperative to look at India to conclude the concept of the resource as a curse or blessing, and how it affects primary market offerings.

2. LITERATURE REVIEW

2.1. Market Timing Theory

Growing scholarly research increasingly emphasizes the thesis of market timing, which prompts many firms to accelerate the process of going public through an IPO (Baker and Wurgler, 2002). The market timing hypothesis (MTH) suggests that the sequence of financing decisions is not fixed, but evolves dynamically in response to the increasing impact of information asymmetry and adverse selection. Baker and Wurgler (2002) argue that efforts to time the stock market significantly influence a firm's capital structure. Consequently, initial public offering (IPO) firms are encouraged to strategically time the market, as such actions can have lasting effects on their financial composition. Supporting this contention, Lowry (2003) discovered that an economic revival and investor exuberance can motivate a company to initiate an IPO. This suggests that the decision to go public is shaped by both external economic factors and a company's specific financial requirements. Similarly, Lerner et al. (2004) found that in highly adverse market conditions, where launch prices are low, only firms with urgent needs or promising high-return proposals are likely to move forward with an IPO. Further, Alti (2006) demonstrated that IPO firms entering the market during favorable conditions,

often referred to as "hot periods," tend to issue larger volumes of shares and maintain lower debt ratios than firms debuting in less favorable market environments. These findings collectively highlight the critical role of market timing in shaping corporate capital structure.

2.2. Country-Level Institutional Quality and IPO Activity

According to the WGI research database, country-level institutional quality is defined as the aggregate measure of governance quality across various dimensions based on a comprehensive evaluation by experts. The perception-based measure was developed by Kaufmann (1999) and recently revised by Kaufmann et al., 2009). North (2003, p. 2) states that institutions are designed to minimize uncertainty and, in turn, create incentives or deterrents for specific behaviors and actions. Research in law and economics (e.g., Djankov et al., 2008; La Porta et al., 1997) has demonstrated that formal institutions, particularly legal frameworks and regulations safeguarding minority shareholders, play a role in shaping variations in IPO activity. To align with the objectives of our study, we included four key parameters from the World Governance Indicators (WGI): Political stability and absence of violence, government effectiveness, regulatory quality, and control of corruption. Figure 1 presents the flowchart illustrating the hypothesis development process.

2.2.1. Voice and accountability and IPO activity

Voice and accountability are governance metrics that gauge the extent to which citizens have the degree of freedom of expression, association, and free media. A higher level of voice and accountability fosters effective coordination, smooth information exchange, and a favorable environment for the growth of business associations. However, a lower level of voice and accountability results in resource misallocation, favoritism, and cronyism, which widens the information gap between the government and its citizens (Sabry, 2019). According to Demir et al. (2023), uncertainty due to lower information transparency inflates the cost of raising public finances, which may discourage companies from planning IPOs. Such negative effects of uncertainty can be alleviated by stronger public enforcement and wider public participation. Likewise, Wei et al. (2022) claimed that a lack of development in voice and accountability raises information asymmetry among market participants, causing investors to have a preference for new issues with lower offer prices and high initial returns. Thus, it's hypothesized that

H_1. VA positively affects IPO activity.

2.2.2. Political stability and IPO activity

According to Kaufmann et al. (2009), building trust and stability in any society requires tackling politically driven chaos and ensuring that people are resilient to disruptive political events. According to Butler et al.,(2019) & Doidge et al. (2017), political institutions play a critical role in stimulating and hindering entrepreneurial growth. In line with the information asymmetry theory, a monotonic relationship exists between political stability and IPO activity. Çolak et al. (2017), through a sample of U.S. gubernatorial elections, theoretically modeled the impact of political uncertainty and IPO decisions. Using the premise of real-option argument, they established that in the event of high political uncertainty, volatility in asset prices tends to increase. In response, a subsequent decrease in fair valuations triggers firm to exercise the real option to delay the equity financing decision. (Pastor & Veronesi, 2013), under the notion of ambiguity aversion (when a firm is unclear about the possible impact of regime changes), contend that increased political uncertainty exacerbates information asymmetry issues and creates heightened uncertainty, causing distortions in IPO issuers' timelines and profitability. Recently, Mehmood et al. (2023) observed that in cases of political uncertainty, issuers avoid new listing equities due to anomalies in IPO values in the aftermarket, reflecting high financial leverage and market uncertainty, causing issuers to lose money in the form of underpricing. Thus, it is posited

H_2. Political stability positively affects IPO activity.

2.2.3. Government effectiveness and IPO activity

Within the scope of the Worldwide Governance Indicators (WGI), government effectiveness provides information on the ability and legitimacy of a nation's governmental institutions. This reflects how well the government functions in delivering public services and managing resources efficiently. Mehmood et al.(2025) suggest that investors' trust in companies' future prospects is increased by the quality of public services, policy development, and governmental trustworthiness, which will increase the demand for IPOs. Studies have also suggested that economies with weak legal institutions often have poor information environments, leading to greater information asymmetry among market participants than among firms in countries with well-established legal frameworks. Consequently, in market settings, information asymmetry and uncertainty adversely affect the valuation of IPO returns (Hearn et al. 2012; Chen et al. 2017; Jamaani et al. 2024). According to Tian (2011) and Prasad et al. (2006), stringent government oversight, such as IPO pricing mechanism regulations, causes high IPO initial returns.

Thus, it is asserted that effective governance reduces investment uncertainty, signals high-quality IPOs, and expands the potential and likelihood of IPO activity. Thus, the hypothesis.

H_3. Government effectiveness positively affects IPO activity.

2.2.4. Control of corruption and IPO activity

According to Kaufmann et al. (2009), corruption control refers to the degree to which both major and minor types of corruption are prevented from being used for private gain. This reflects the transparency and accountability of governance mechanisms. Bolgorian (2011) analyzed the relationship between the corruption perception index and equity market development across 46 countries from 2007 to 2009 using firm size and trading value as indicators of market growth. The study discovered a strong negative relationship between the growth of the equity market and corruption. Additionally, transparent disclosure laws and strict enforcement of insider trading regulations help reduce information asymmetry and promote wider investor participation in IPO activities. Wei et al. 2022 further note that weak control of

corruption can erode investor trust in the oversight of stock market activities, leading to severe market information failure. A market free from the burden of bureaucracy and corruption provides a safe investment climate with reduced information asymmetry, agency problems, and transaction costs; thus, the market responds favorably by displaying higher levels of IPO activities. Therefore, the following hypothesis

H_4. Corruption control positively affects IPO activity.

2.2.5. Renewable energy and IPO activity

IPOs offer early-stage investors, including venture capitalists, an exit strategy while also providing growth capital, expanding the pool of sustainable investment opportunities, and potentially drawing larger corporations toward the sustainable energy sector (Cleverley et al., 2024). Furthermore, research highlights that a robust IPO market is essential for attracting capital to emerging companies and fostering innovation across industries. For energy specifically, a lack of capital inflow could slow down the innovation process and hinder progress toward a more sustainable and efficient energy future (Anderloni & Tanda, 2017). Additionally, with the growing impetus on environmental, social, and governance (ESG) investing, as reflected in initiatives like the UNPRI, the valuation gap favoring green firms over traditional ones is expected to materialize and widen. This shift would make it easier for environmentally friendly companies to access the market while making it more challenging for high-carbon firms (Monasterolo and De Angelis, 2020).

Based on the argument above, the use of renewable energy (energy transition) spurs sustainable economic growth, which induces IPO activity.

H_5. Renewable energy positively impacts IPO activity.

2.2.6. Technological innovation and IPO activity

Innovative technologies are essential to address the rising demands of an expanding population. Maksimovic and Pichler (2001) examined how information asymmetry regarding the success of new technologies influences security pricing and the motivations of pioneering firms. Early public financing tends to occur in industries deemed feasible, with modest development costs and posing little risk of displacement. Conversely, optimal early private financing is more common in industries with uncertain viability and high research and development (R&D) costs, but a low likelihood of being overtaken by technologically superior competitors. Mensah et al. (2019) emphasized the crucial role of technological advancements in ensuring sustainable economic growth over the long term. Additionally, Chu et al. (2012) analyzed the impact of intellectual property on economic fluctuations in the U.S. between 1987 and 2007, utilizing the quality-ladder growth and discrete-time models. Their findings suggest that patent protection and R&D efforts contributed to a reduction in economic volatility by at least 10%. This is because strong patent protection incentivizes R&D, which in turn drives technological progress.

According to (Abdeljawad et al., 2024) financing constraints restrict a firm's investments and affect the sustainability of firms, which causes a decline in productivity. Kaplan and Zingales (1997) suggest that one of the key factors contributing to financial constraint is information asymmetry. Information asymmetry results in high information searches and transaction costs for both fund suppliers and demanders (Myers and Majluf, 1984). Highly innovative and technology-driven companies primarily depend on equity financing over debt, unlike less-innovative, low-tech firms (Liu et al.,2023). Further, with respect to the non-financial information disclosed before an IPO in the offering prospectus, companies may also provide details on R&D expenditure and patent filings. This would reduce the so-called accounting information asymmetry (e.g., R&D expenditures and patent applications). Chin et al. (2006) demonstrated that pre-IPO innovation information constitutes crucial information for investors, as companies with higher innovation levels (measured by R&D spending and patents granted) are more likely to be undervalued at the time of listing. This would allure investors, as they would demand more IPOs, and hence, higher IPO activity.

H_6. Technological innovation positively affects IPO activity.

2.2.7. Natural resources rent and IPO activity

Fu and Liu (2023) argued that natural resource rents exert a non-linear effect on sustainable development. Their research indicated that while incomes from natural gas and minerals support sustainability, forest rents have a negative effect. Similarly, Ampofo et al. (2023) examined the role of natural resource rents (NRR) in driving economic growth across eight resource-rich Sub-Saharan African (SSA) nations. Their findings revealed that, in the Republic of the Congo, an increase in NRR hindered economic growth, aligning with the resource curse hypothesis. However, no significant relationship was found between the NRR and economic growth in the remaining seven countries. In many cases, natural resources have been viewed as a curse rather than a blessing for many countries. Extensive research has suggested that countries with limited natural resources often experience greater economic growth than those with abundant resources (Hordofa et al., 2022; Shahbaz et al., 2019; Yasmeen et al. 2024). Improper management of these rents can lead to issues such as corruption, inequality, and environmental damage, which may also impede IPO activities. In line with this perspective, the present study argues that natural resource revenues can suppress financial market expansion by reducing savings and investment, and therefore.

H_7. The rent of natural resources negatively affects IPO activity.

3. DATA AND METHODOLOGY

This study sampled IPOs listed on the Indian Stock Exchange between January 1997 and December 2022. Although India has witnessed dynamic IPO activity in the last two decades, its IPO market has experienced sudden and significant fluctuations throughout its history. The intensity and magnitude of fluctuations have long been attributed to socioeconomic disparities, environmental concerns, and sensitive socioeconomic phenomena prevailing in the country.

Figure 2 illustrates IPO Activity trends from January 1997 to December 2022. Notably, some years are attributed to hot markets

Figure 1: Hypothesis development flowchart

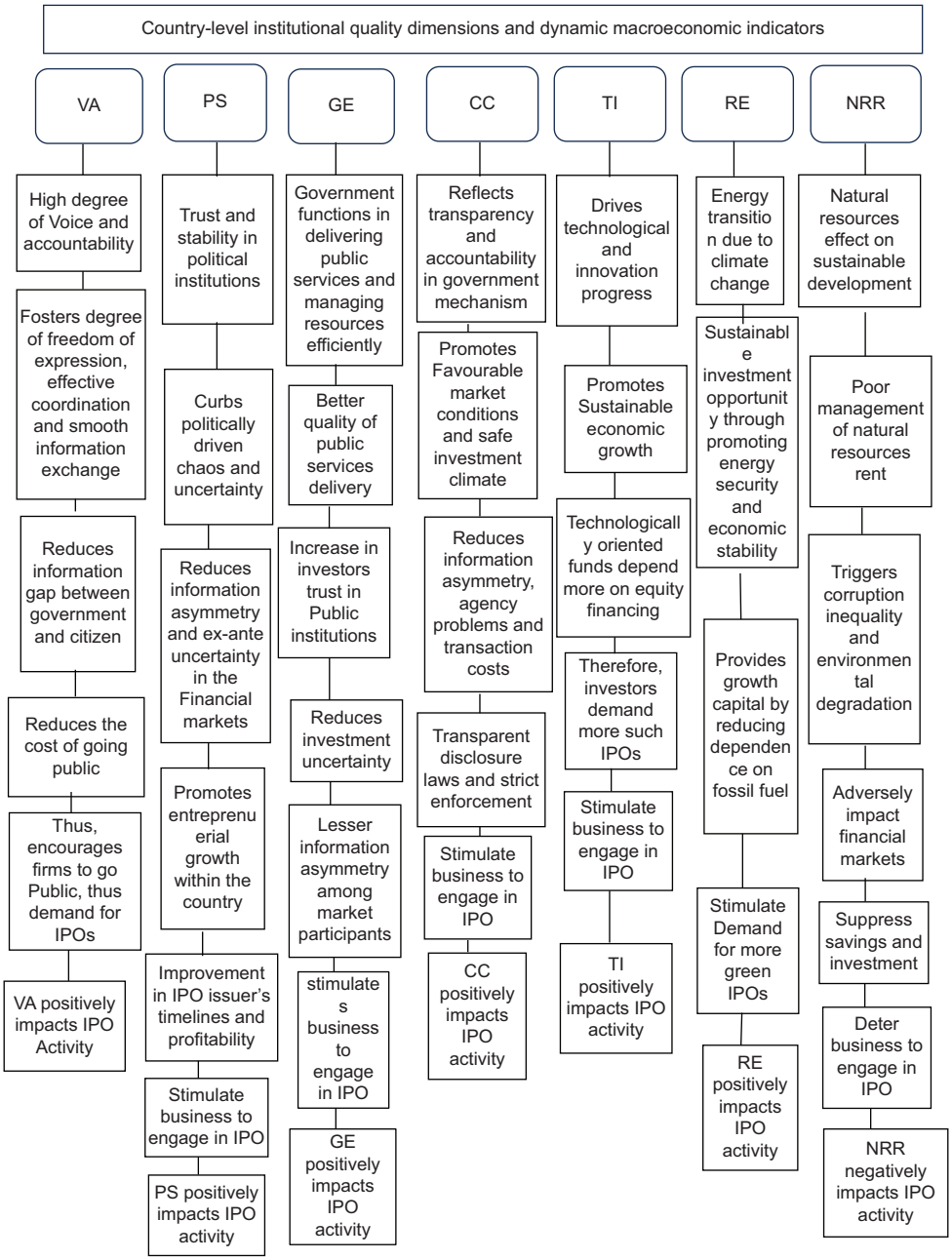
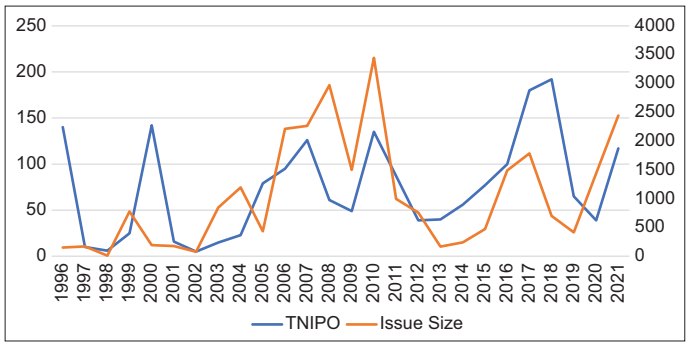


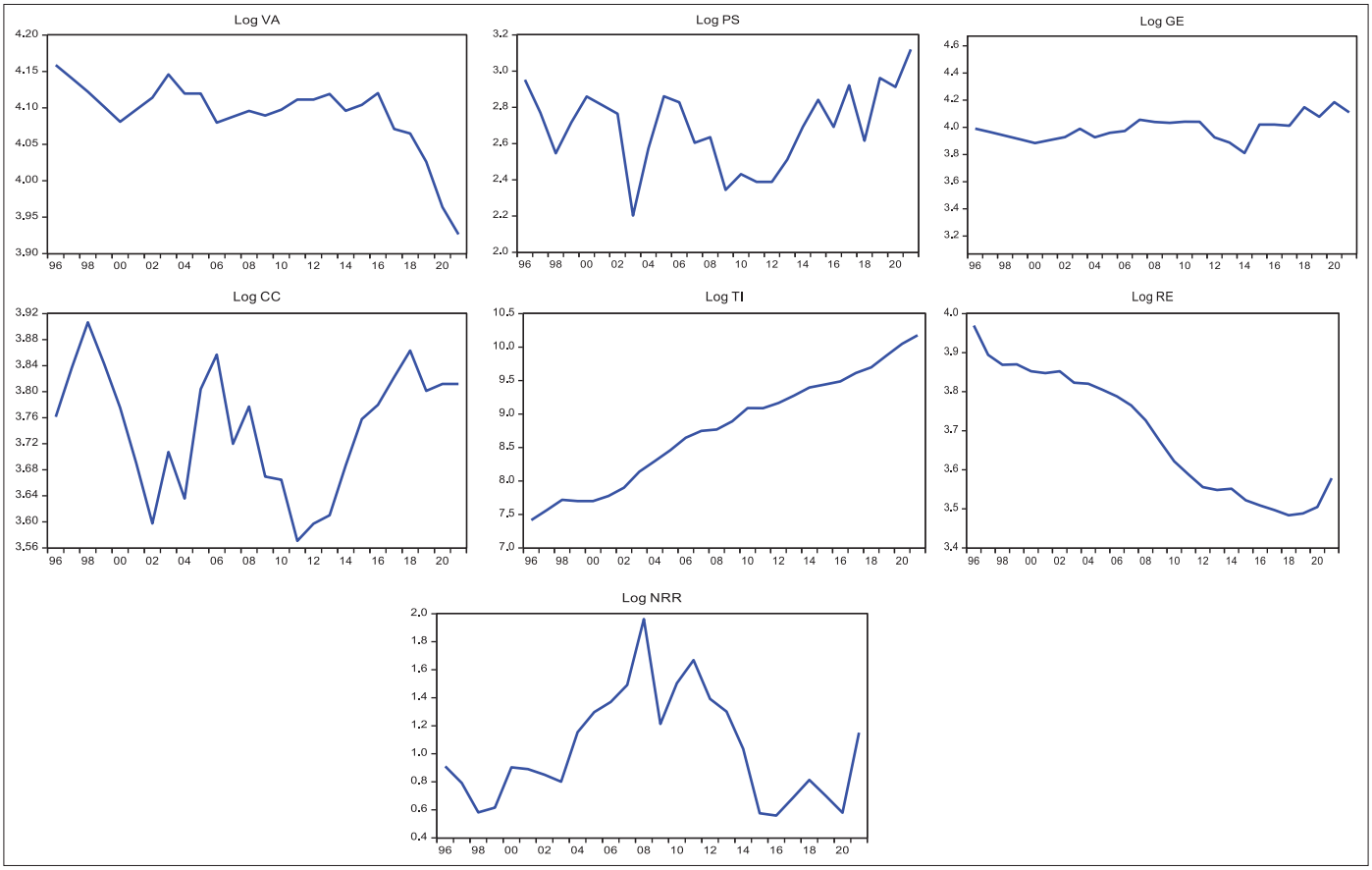
Figure 2: IPO activity trend



experiencing IPO activities as high as 192 in 2018, making IPOs an attractive investment option for investors. However, some periods are considered cold, which results in lower IPO activity. For instance, in 2002, only five IPO exercises followed the Ketan Parekh scam, and the terrorist attack on the World Trade Center in the USA in 2001 brought shockwaves to the Indian capital market with fewer listings and lower offer proceeds sizes in subsequent years. Similarly, during the COVID-19 pandemic, the market witnessed dampened IPO activity, with as few as 30 IPOs brought to public issues due to pandemic-induced economic slowdown and financial uncertainty.

IPO activity data were obtained from the Securities and Exchange Board of India (SEBI) data portal under the filings-public issues subsection. Annual time-series data for other macroeconomic determinants, including country-level institutional quality (IQ), technological innovation, renewable energy adoption, and natural

Figure 3: Trendplot of all IVs (logvalues)



resource rent, were sourced from World Governance Indicators (WGI) and World Development Indicators (WDI).

Table 1 summarizes the dependent and predictor variables examined in this study. The dependent variable reflects the yearly count of newly launched IPOs on the Indian Stock Exchange. The predictor variables include voice and accountability (VA), political stability (PS), Government effectiveness (GE), control of corruption (CC), Technological innovation (TI), Renewable energy (RE), and Natural resource rent (NRR). Further Figure 3 depicts the trendplot of all predictors variables in log values.

This study explores both the symmetric and asymmetric relationships between these variables and IPO activity. To achieve this, the symmetric (ARDL) model and Non-linear ARDL (NARDL) model were applied.

The equation for the time-series model is expressed as follows:

$$TNIPO = a + \beta_1 VA + \beta_2 PS + \beta_3 GE + \beta_4 CC + \beta_5 TI + \beta_6 RE + \beta_7 NRR + \varepsilon_t \quad (1)$$

Here, a denotes the constant term and β_1 to β_7 are the beta coefficients for the predictor variables. *Where* ε_t represents the residuals.

The autoregressive distributed lag (ARDL) model, proposed by Pesaran et al. (2001), is a flexible econometric approach designed to assess the relationships between variables with different integration orders, specifically I(0) and I(1). Therefore, to ensure accurate results and prevent misleading findings, this study examines the stationarity of the variables. Additionally, SIC information criteria were utilized in this research and the general-to-specific methodology proposed by Katrakilidis and Trachanas (2012). Unlike many traditional techniques, ARDL employs a bounds-testing approach to identify co-integration, eliminating the need for pretests to confirm stationarity. This method is particularly effective in small-sample settings and offers the advantage of distinguishing between short- and long-term effects. Furthermore, the model can be reparameterized into an Error Correction Model (ECM) to capture the speed of adjustment toward equilibrium ARDL framework is robust in handling mixed integration orders; however, it has limitations. It cannot accommodate variables integrated in order I(2) I(2) I(2), and is highly sensitive to the selection of lag lengths. To address the non-linear dynamics often present in economic relationships, Shin et al. (2014) advanced the ARDL model, initially developed by Pesaran et al. (1999; 2001), by introducing an asymmetric co-integration framework that allows for the analysis of non-linear relationships among variables. This extension is particularly suited to modeling the non-linear relationships among variables and is effective in capturing short-term volatility and structural asymmetries in economic behavior.

This study investigates the asymmetric effects of the predictor variables outlined in Table 1 on IPO activities. To capture these non-linear dynamics, we model the asymmetric long-run relationship with IPO activity using the following specification:

$$\Delta TNIPO_t = \theta + \sum_{k=1}^{P=1}\theta_k \Delta TNIPO_{t-k} + \sum_{k=1}^{P=2}\theta_k \Delta VA_{t-k} + \sum_{k=1}^{P=3}\theta_k \Delta PS_{t-k} + \sum_{k=1}^{P=4}\theta_k \Delta GE_{t-k} + \sum_{k=1}^{P=5}\theta_k \Delta CC_{t-k} + \sum_{k=1}^{P=6}\theta_k \Delta TI_{t-k} + \sum_{k=1}^{P=7}\theta_k \Delta RE_{t-k} + \sum_{k=1}^{P=8}\theta_k \Delta NRR_{t-k} + +\lambda_1 TNIP0_{t-1} + \lambda_2 VA_{t-1} + \lambda_3 PS_{t-1} + \lambda_3\, GE_{t-1} + \lambda_4 CC_{t-1} + \lambda_5 TI_{t-1} + \lambda_6\, RE_{t-1} + \lambda_7\, NRR_{t-1} \quad (2)$$

According to Engle and Granger (1987), Equation (2) is consistent with their methodology. A minor adjustment was made by replacing the lagged error term from Equation (1) with its substitute, a linear blend of the lagged level variable. The Engle and Granger (1987) method is outdone by Equation (2) because of its capacity to assess both long- and short-term influences. In Equation (2), the coefficients for the long-run effects are represented by λ1, λ2, λ3, and λ4, whereas the short-run coefficients are indicated by the first difference variable. Validating long-run coefficients requires establishing a long-run causality. Pesaran et al. (2001) developed the bound F-test to determine whether co-integration exists between the IPO activity and their causal factors. This study differs from Equation (2), which assumes the symmetric influence of predictor variables on the dependent variable by examining the asymmetric impact of country-level institutional quality and dynamic macroeconomic factors on IPO activity in India. These predictor variables were categorized into negative and positive components.

The asymmetric regression of $X_t = \delta^+ y_t^+ + \delta^- y_t^- + \mu_t$ where δ^+ and δ^- are corresponding to the long run parameters and y^t is a vector of the predictor variables is presented as

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

Where Y^+ and Y^- are the regressors decomposed as a partial sum of the positive and negative changes, respectively. Equations (3)–(6) illustrate the partial sums of both the positive and negative variations in VA, PS, GE CC, TI, RE, and NRR.

$$VA^+ = \sum_{i=1}^{t}\Delta VA_i^+ = \sum_{i=1}^{t} max\left(\Delta VA_i, 0\right) \quad (3)$$

$$VA^- = \sum_{i=1}^{t}\Delta VA_i^- = \sum_{i=1}^{t} min\left(\Delta VA_i, 0\right) \quad (4)$$

$$PS^+ = \sum_{i=1}^{t}\Delta PS_i^+ = \sum_{i=1}^{t} max\left(\Delta PS, 0\right) \quad (5)$$

$$PS^- = \sum_{i=1}^{t}\Delta PS_i^- = \sum_{i=1}^{t} min\left(\Delta PS, 0\right) \quad (6)$$

$$GE^+ = \sum_{i=1}^{t}\Delta GE_i^+ = \sum_{i=1}^{t} max\left(\Delta GE_i, 0\right) \quad (7)$$

$$GE^- = \sum_{i=1}^{t}\Delta GE_i^- = \sum_{i=1}^{t} min\left(\Delta GE_i, 0\right) \quad (8)$$

$$CC^+ = \sum_{i=1}^{t}\Delta CC_i^+ = \sum_{i=1}^{t} max\left(\Delta CC_i, 0\right) \quad (9)$$

$$CC^- = \sum_{i=1}^{t}\Delta CC_i^- = \sum_{i=1}^{t} min\left(\Delta CC_i, 0\right) \quad (10)$$

$$TI^+ = \sum_{i=1}^{t}\Delta TI_i^+ = \sum_{i=1}^{t} max\left(\Delta TI_i, 0\right) \quad (11)$$

$$TI^- = \sum_{i=1}^{t}\Delta TI_i^- = \sum_{i=1}^{t} min\left(\Delta TI_i, 0\right) \quad (12)$$

$$RE^+ = \sum_{i=1}^{t}\Delta RE_i^+ = \sum_{i=1}^{t} max\left(\Delta RE_i, 0\right) \quad (13)$$

$$RE^- = \sum_{i=1}^{t}\Delta RE_i^- = \sum_{i=1}^{t} min\left(\Delta RE_i, 0\right) \quad (14)$$

$$NRR^+ = \sum_{i=1}^{t}\Delta NRR_i^+ = \sum_{i=1}^{t} max\left(\Delta NRR_i, 0\right) \quad (15)$$

$$NRR^- = \sum_{i=1}^{t}\Delta NRR_i^- = \sum_{i=1}^{t} min\left(\Delta NRR_i, 0\right) \quad (16)$$

Equation (17) is obtained by plugging the negative and positive constituents obtained in Equations (3)–(16) into Equation (2), thereby forming the asymmetric ARDL framework. The NARDL equation is defined in Equation (17).

$$\Delta TNIPO_t = \theta + \sum_{k=1}^{P=1}\theta_k \Delta TNIPO_{t-k} + \sum_{k=1}^{P=2}\theta_k \Delta VA_{t-k}^+ + \sum_{k=1}^{P=3}\theta_k \Delta VA_{t-k}^- + \sum_{k=1}^{P=4}\theta_k \Delta PS_{t-k}^+ + \sum_{k=1}^{P=5}\theta_k \Delta PS_{t-k}^- + \sum_{k=1}^{P=6}\theta_k \Delta GE_{t-k}^+ + \sum_{k=1}^{P=7}\theta_k \Delta GE_{t-k}^- + \sum_{k=1}^{P=8}\theta_k \Delta CC_{t-k}^+ + \sum_{k=1}^{P=9}\theta_k \Delta CC_{t-k}^- + \sum_{k=1}^{P=10}\theta_k \Delta TI_{t-k}^+ + \sum_{k=1}^{P=11}\theta_k \Delta TI_{t-k}^- + \sum_{k=1}^{P=12}\theta_k \Delta RE_{t-k}^+ + \sum_{k=1}^{P=13}\theta_k \Delta RE_{t-k}^- + \sum_{k=1}^{P=14}\theta_k \Delta NRR_{t-k}^+ + \sum_{k=1}^{P=15}\theta_k \Delta NRR_{t-k}^- + \lambda_1 TNIP0_{t-1} + \lambda_2 VA_{t-1}^+ + \lambda_3 VA_{t-1}^- + \lambda_4 PS_{t-k}^- + \lambda_5 PS_{t-k}^+ + \lambda_6\, GE_{t-k}^+ + +\lambda_7\, GE_{t-k}^- + \lambda_8 CC_{t-k}^+ + \lambda_9 CC_{t-k}^- + \lambda_{10} TI_{t-k}^+ + \lambda_{11} TI_{t-k}^- + \lambda_{12} RE_{t-k}^+ + \lambda_{13} RE_{t-k}^- + \lambda_{14}\, NRR_{t-k}^+ + \lambda_{15}\, NRR_{t-k}^- \quad (17)$$

Shin et al. (2014) applied the bound testing technique established by Pesaran et al. (2001), which they believed was suitable for Model (7). In this study, the disintegrated negative and positive series for Voice and Accountability, Political stability, government effectiveness, Control on Corruption, Technological innovation, renewable energy, and natural resources rent are integrated to extract specification (2) of the asymmetric ARDL. Therefore, the linear ARDL model is shown in Specification (2). To illustrate non-linear long-run relationships, this study adopts the NARDL technique. Once co-integration is established, the study proceeds with the adoption of an asymmetric ARDL. Lastly, asymmetric cumulative dynamic multiplier effects were derived based on the percentage changes in VA+ t, VA− t, PS+ t, PS− t,GE+ t,GE− t, CC+ t, CC− t,TI+ t,and TI− t RE+ t, RE− t NRR+ t, and NRR−t, respectively. These multipliers provide critical insights into the differential effects of upward and downward movements in the variables on IPO activity in both the short and the long run. This methodological approach underscores the importance of nonlinearity and asymmetry in understanding the complex dynamics that influence IPO activities.

Table 2: Descriptive statistics

Variable	Mean	Median	Max.	Min.	Standard deviation
TNIPO	73.80	63	192	5	54.35
VA	59.87	60.31	64	50.72	2.91
PS	15.04	14.94	22.64	9.05	3.27
GE	54.34	54.07	65.71	45.19	4.72
CC	42.27	43.31	49.73	35.55	3.93
TI	8807.42	6843.50	26267	1661	6828.05
RE	40.63	40.46	52.95	32.57	6.43
NRR	3.01	2.47	7.10	1.74	1.29

Source (s): Author's Computation

4. RESULTS AND DISCUSSION

4.1. Summary Statistics

Table 2 summarizes the descriptive statistics for the annual time-series IPOs, country-level institutional quality indicators, and dynamic macroeconomic indices. The results for the number of IPOs suggest that, on average, 73.80 IPOs showed up on the Indian IPO market between 1997 and 2022, with five IPOs as the lowest and 192 IPOs as the highest. The study indicates that the level of IPO activity is comparatively lower than that seen in several other Asian and developed nations. To understand the underlying trends, the research evaluates institutional quality at the country level using percentile rankings—ranging from 0 (indicating weak governance) to 100 (indicating strong governance). Four specific indicators were used to construct this measure: Voice and accountability, political stability, government effectiveness, and control of corruption.

In terms of voice and accountability, the average score recorded was 59.87, with a median of 60.31 and a range between 50.72 and 64. For political stability, the mean value was 15.04, the median stood at 14.94, and scores ranged from a low of 9.05 to a high of 22.64. Government effectiveness showed an average of 54.34, a median of 54.07, and values ranging between 45.19 and 65.71. Lastly, control of corruption registered an average score of 42.27, with a median of 43.31 and a minimum and maximum of 35.55 and 49.73, respectively. In general, India's governance performance was weak compared to that of advanced economies, such as the US, the UK, Canada, and France. Low country-level institutional quality in an economy often signals an underdeveloped legal system and is likely to contribute towards an information environment that enables asymmetric information to grow unrestrained (Kaufmann et al., 2017; Hlel et al., 2020). Under a high degree of information asymmetry and uncertainty, many companies delay or decline IPO decisions. Additionally, the mean TI was 8807.42, while the lowest TI was 1661. The highest TI was recorded at 26267, suggesting that an increase in TI was anticipated to lead to an increase in IPO activities. With a high of 52.95 and a low of 32.57, RE had a mean value of 40.63. The findings show that RE has a low variance from 1997 to 2022. Even so, compared with the previous 5 years, the present RE is higher, which slows the pace of energy transition and lowers overall sustainable growth. India's mean natural resource rent is substantially low, with a mean value of 3.01. The correlation analysis criteria ascertained the direction, strength, and significance of the correlations between the studied variables, as presented in Table 3. Despite this, the correlation coefficients for TI and RE have substantial multicollinearity, at −0.6411. According to Hair et al. (2011), all variables with correlation values <0.9 does not create the problem of multicollinearity in the study.

4.2. Unit Root Tests

To verify the stationarity of the time series data, both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests were employed prior to analyzing the relationship between country-level institutional quality, dynamic macroeconomic indicators, and aggregate IPO activity throughout the study period. The null hypothesis of both the ADF and PP tests posits the presence of a unit root, thereby indicating nonstationarity in the series. As noted by Ouattara (2004), the application of the ARDL model is inappropriate when any variable attains stationarity only after second differencing (i.e., is integrated of order two, I[2]).

Lag length selection for the ADF and PP regressions was guided by the Schwarz Information Criterion (SIC). These tests were executed at both levels, and the first difference was detected in cases where the presence of unit roots at the level was detected. Since all the variables—TNIPO, VA, PS, GE, CC, TI, RE, and NRR—are found to be stationary at either level (I[0]) or after first differencing (I[1]), the results, which are shown in Table 4, show that the null hypothesis is rejected at the 5% significance level, confirming that the required condition of stationarity is met.

Therefore, the dataset satisfies the preconditions for the implementation of the ARDL bounds testing approach, justifying its use in examining both the short- and long-run dynamics.

4.3. Symmetric and Asymmetric ARDL

Tables 5 and 6 present the results for both the short- and long-run ARDL estimates, respectively.

The estimation showed that all four dimensions of country-level institutional quality, such as Voice and Accountability (VA), political stability (PS), government effectiveness (GE), and control of corruption (CC) with consistent beta coefficients and significance levels drive IPOs activity (confirmation of H_1, H_2, H_3, and H_4). The estimated beta values of voice and accountability were significant and positive ($b = 28.14$, $P < 0.01$), and the estimated coefficients of political stability, government effectiveness, and control of corruption are ($b = 9.90$), ($b = 6.78$), ($b = 12.24$), respectively, in the short run. Likewise, in the long run, country-level institutional quality factors have a positive and significant relationship with IPO activities.

The findings suggest that voice and accountability have a significant positive relationship with IPO activity in both the short and the long run. This implies that greater voice and accountability promote information transparency through the exchange of information and effective coordination, creating a favorable environment for the growth of business associations. Furthermore, free press and media help reduce information asymmetry between the government and citizens, thereby enhancing domestic growth, productivity, and entrepreneurship. This, in turn, instills confidence among issuers in engaging in IPO activities. In the long run, the results indicate that voice and accountability contribute to

Table 3: Correlation matrix

Variable	TNIPO	VA	PS	CC	TI	RENEW	NRR
TNIPO	1						
VA	−0.2456	1					
PS	0.2909	−0.5473	1				
GE	0.2114	0.2487	0.3863				
CC	0.2429	−0.2836	0.5033	1			
TI	0.3415	−0.2840	0.3910	0.6602	1		
RE	−0.3273	0.5083	−0.0018	0.1065	−0.6411	1	
NRR	0.0922	0.06933	−0.3457	−0.3803	−0.1171	−0.0039	1

Source (s): Author's Computation

Table 4: Unit root tests

At levels			At first difference			Decision
Series	ADF	PP	Series	ADF	PP	
TNIPO	−3.7285*** (0.0260)	−3.5952*** (0.0307)	TNIPO	--	--	L (0)
VA	0.7036 (0.9897)	0.3177 (0.9745)	VA	−3.8166* (0.0844)	−3.8512* (0.0870)	L (1)
PS	−2.4413 (0.1413)	−2.59615 (0.1140)	PS	−6.2033*** (0.0000)	−6.3445*** (0.000)	L (1)
GE	2.2543 (0.1474)	2.5671 (0.3210)	GE	4.9839*** (0.0050)	4.7265*** (0.0051)	L (1)
CC	−2.0860 (0.2514)	−2.2390 (0.1984)	CC	−5.3050*** (0.0003)	−5.3171*** (0.0002)	L (1)
TI	−1.1063 (0.6961)	−0.8921 (0.7730)	PR	−5.0359*** (0.0006)	−6.7224*** (0.0000)	L (1)
RE	−1.0154 (0.7308)	−2.1648 (0.2231)	RENEW	−3.0032** (0.0043)	−3.0481** (0.0039)	(L1)
NRR	−2.3042 (0.1784)	−2.3042 (0.1784)	NRR	−6.7049*** (0)	−6.8323*** (0)	(L1)

*,** and *** represents 10%, 5% and 1% level of significance respectively

Source (s): Author's Computation

Table 5: Short-run ARDL

Variable	Coefficient	Standard error	t-statistics	Prob.
D (ln_VA)	28.1475	10.5127	2.6774	0.0190
D (ln_PS)	9.9054	4.4587	2.2216	0.0215
D (ln_GE)	6.7892	2.8756	2.3609	0.0500
D (ln_CC)	12.2471	6.1243	1.9997	0.0925
D (ln_TI)	0.2794	0.0191	2.5614	0.0237
D (ln_RE)	29.7884	16.1042	1.8497	0.0872
D (ln_NRR)	−28.8584	9.0987	−3.1717	0.0074
ECT (−1)	−0.4682	0.1500	3.6686	0.0010

Source (s): Author's Computation

Table 6: Long run ARDL

Variable	Coefficient	Standard error	t-statistics	Prob.
VA	24.4154	8.7697	2.7840	0.0155
PS	0.8573	3.9414	2.2175	0.0512
GE	7.5001	3.2020	2.3422	0.0013
CC	4.3189	2.2773	1.8965	0.0712
TI	0.0205	0.0074	2.7627	0.0161
RE	16.6631	5.1882	3.2117	0.0036
NRR	−19.6692	9.4309	−2.0856	0.0475

Source (s): Author's Computation

long-term market efficiency, whereby the market value of shares surpasses the benefits of indebtedness. In other words, when equity financing is relatively cheaper, stock market financing becomes a viable alternative for IPO issuers.

This study establishes a positive and significant relationship between political stability and IPO activities. Political stability mitigates market uncertainty and reduces the risks associated with government policies, legal frameworks, and economic unpredictability, thereby enabling firms to engage in long-term investment planning, including IPOs. Conversely, in periods of political uncertainty, firms tend to postpone or abandon their IPO plans because of concerns about market imperfections that may adversely affect their valuation and overall market performance. These findings align with the research conducted by Çolak et al. (2017) and Mehmood et al. (2023), which similarly highlight that heightened political uncertainty negatively affects IPO activity. This decline occurs when both firms and investors adopt a "wait-and-see" approach under periods of uncertainty, leading to a reduction in IPO launches. However, in the long run, the results confirm that improvements in political stability contribute to subsequent increases in IPO activity. At the macroeconomic scale, a dynamic IPO market contributes to job creation and produces beneficial spillover impacts for non-IPO firms, thus strengthening the broader economic environment. Enhanced political stability instills greater confidence among businesses, encouraging them to pursue IPOs as they are more likely to attract substantial investment in a stable and predictable market setting.

Government effectiveness plays a positive and significant role in explaining IPO activities in both the short and the long run. These findings suggest that stock markets tend to perform more efficiently and experience lower transaction and agency costs in environments where government effectiveness is robust. These results are consistent with those of Wei et al. (2023) and Asongu (2012), who emphasize the role of governance quality in enhancing financial market efficiency. Moreover, effective policy formulation and implementation yield long-term benefits for both issuing firms and broader financial ecosystems. Strong government effectiveness fosters investor trust, which in turn translates into a higher demand for Initial Public Offerings (IPOs), as investors perceive these opportunities as stable and promising. A credible and efficient government minimizes uncertainty and risk, thereby encouraging active investor participation in the market. Consequently, increased investor confidence drives a surge in IPO activity.

In addition, the results show that control of corruption positively influences IPO activity. This indicates that a free market reduces bureaucratic and corruption-related constraints by streamlining the administrative process, promoting transparency, and encouraging greater economic freedom. In a free economy, better investor protection and corporate governance norms allow firms to enjoy higher valuations and face a lower cost of raising equity funds. More explicitly, strong control over corruption can help alleviate the severity of asymmetric information by downsizing the risk and uncertainty in financial markets. In addition, the absence of corruption seemed to make transaction regulation through information transparency, lowering risk and uncertainty, thereby boosting returns on investments. This makes IPO strategy attractive to IPO candidates, driving the volume of primary issues. These findings are supported by Mehmood et al. (2023), who found that control of corruption is negatively linked to IPO underpricing and lower cost of capital, which ultimately encourages IPO activity.

Next, we find that technological innovation positively impacts IPO activity. This means that a marginal enhancement in a country's technological innovation supports entrepreneurship development, which induces output, consumption, and investment, leading to economic growth. This phase is marked by reduced periods of uncertainty and elevated macroeconomic expansion when investment expectations are high and companies perceive the business environment favourably. According to the equity market timing hypothesis, firms under a scenario of improved asset prices and high profitability decide to go public to fund their business ideas. Therefore, the waves of high IPO activity are concentrated in moments of high technological innovation, improving the number of IPOs in both the short and long run.

The study also observed that renewable energy and IPO activity are positively associated in both the short and the long run. The beta values suggest that a unit increase in renewable energy adoption leads to significant and positive changes in IPO activity. This indicates that green companies are attractive to socially responsible and long-term investors. Owing to its importance in delivering the SDGs of the UN, investments in clean energy have gained significant traction among investors. These companies have better prospects for scalability and market expansion. Furthermore, as investors embrace ESG and sustainable investing, green companies have better valuations, motivating firms to seek external financing through the issuance of new securities. Investment in renewable energy may help improve the economy, the financial sector, and environmental conditions. Consequently, a surge in IPO activity is evident across the short and long run.

Meanwhile, we also report that natural resource rent and IPO activity have a strongly negative and significant asymmetric relationship. An increase in natural resources has been found to negatively impact economic development. Further, the poor quality of institutions also invites resource curse by promoting rent-seeking behavior, leading to misallocation and ineffective management of resources. Inadequate management of natural resource rents can give rise to issues such as corruption, inequality, and environmental deterioration. Additionally, macroeconomic volatility due to fluctuating resource prices can influence capital investments and the economic diversification prevalent in emerging economies, such as India. In the long run, natural resources tend to crowd out human and physical resources, causing a slower economic growth. These results are consistent with those of previous studies (Thierer & Broughel, 2019; Feki & Mnif, 2016). Therefore, Natural resource rent is a critical factor driving IPO activities in both the short and the long run.

Table 9 depicts the symmetric and asymmetric co-integration outcomes from the bound testing performed in this study. As noted by Bahmani-Oskooee and Mohammadian (2016), selecting the optimal lag length is crucial for accurately capturing the long-run relationships. Inappropriate lag selection, whether excessive or insufficient, may lead to omission of critical information and result in misleading inferences. To ensure reliability, this study employed the Akaike Information Criterion (AIC) for lag selection.

4.4. Co-Integration Tests

The symmetric co-integration test reported a bound F-statistic of 5.88. As this value falls between the lower and upper bounds, the outcome is inconclusive regarding the presence of co-integration. However, the asymmetric co-integration test yields an F-statistic of 3.54, which exceeds both the lower and upper critical bounds at the 5% significance level. This establishes a long-run association between the economic variables under study, allowing the analysis to advance with short- and long-run estimations of IPO variability using the NARDL model. Given the inconclusive results of the symmetric co-integration test, the estimated coefficient of the error-correction term (ECT) is utilized to evaluate the long-term relationships between the variables. Consequently, this study employs both symmetric and asymmetric ARDL models. The ECM CointEq.(−1) terms for both the linear and non-linear models are appropriately signed, as indicated in Tables 5 and 7, exhibiting statistically significant negative values. The linear model has a 46% slower adjustment speed compared to the non-linear model, which shows an 86% faster adjustment speed. As a result, IPO activity adjusts nonlinearly and at a faster rate to country-level institutional factors and dynamic macroeconomic indicators than it does linearly. The linear model takes more time to adjust from the short run to the long-run equilibrium, whereas the non-linear

Table 7: Short-run NARDL

Variable	Coefficient	Standard error	t-statistics	Prob.
D (ln_VA_POS)	86.3363	43.2307	1.9971	0.0575
D (ln_VA_NEG)	66.5238	35.5204	1.8728	0.2043
D (ln_PS_POS)	13.5968	7.0421	1.9307	0.0649
D (ln_PS_NEG)	13.7943	7.4623	−1.8485	0.1017
D (ln_GE_POS)	7.6572	3.5611	2.1502	0.0130
D (ln_GE_NEG)	11.0916	4.4402	2.4979	0.0231
D (ln_CC_POS)	22.1395	7.8195	2.8313	0.0090
D (ln_CC_NEG)	17.2867	8.0051	2.1594	0.0566
D (ln_TI_POS)	0.0673	0.0309	2.1749	0.0613
D (ln_TI_NEG)	2.5570	1.1290	2.2648	0.0019
D (ln_RE_POS)	58.6215	29.8512	1.9637	0.0260
D (ln_RE_NEG)	74.9284	34.3369	2.1821	0.0607
D (ln_NRR_POS)	−55.6227	26.6244	−2.0891	0.0701
D (ln_NRR_NEG)	−44.0730	21.9072	−2.0118	0.0685
ECT (−1)	−0.8641	0.2677	−3.2278	0.0001

Source (s): Author's Computation

Table 8: Long run NARDL

Variable	Coefficient	Standard error	t-statistics	Prob.
VA_POS	64.5549	27.6834	2.3319	0.0123
VA_NEG	22.1633	11.2533	1.9694	0.0627
PS_POS	9.0836	4.1768	2.1793	0.0104
PS_NEG	9.2155	4.6790	1.9695	0.0844
GE_POS	3.5991	1.7056	2.1101	0.0056
GE_NEG	7.1032	2.7860	2.5496	0.0120
CC_POS	17.6176	3.9429	4.4682	0.0001
CC_NEG	11.5487	5.8369	1.9782	0.0576
TI_POS	0.0449	0.0120	3.7416	0.0200
TI_NEG	1.7083	0.8422	2.0282	0.0771
RE_POS	39.1633	18.5835	2.1074	0.0145
RE_NEG	50.0574	25.2529	1.9822	0.0828
NRR_POS	−57.2576	32.0988	−1.7837	0.1087
NRR_NEG	−29.4414	15.3216	−1.9215	0.0198

Source (s): Author's Computation

Table 9: Results of the F-Bounds test

Asymmetric				
Test statistics	**Value**	**Significant (%)**	**L (0)**	**L (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 (%)**	**L (0)**	**L (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

model adjusts more quickly. As the coefficient values lie between 0 and 1, a gradual build-up leading to a potential surge can be anticipated. With co-integration confirmed, the study advances by estimating the long-run and short-run NARDL models.

The short- and long-term asymmetric ARDL results are shown in Tables 7 and 8. At the 5% significance level, it was discovered that VA had a long-term, significant positive impact on TNIPO. Meanwhile, in the short term, both PS_POS and PS_NEG significantly impact TNIPO, validating PS's asymmetric short-term impact of PS on TNIPO. The results also indicate that Government Effectiveness (GE) exhibits a short-run asymmetric impact on TNIPO. Specifically, positive changes in GE (GE_POS) have a significant positive influence, while negative changes (GE_NEG) exert a negative effect on TNIPO, both of which are statistically significant at the 5% level. Similarly, CC_POS and CC_NEG are significant at the 5% level, and TI_POS and TI_NEG significantly influence TNIPO. Next, RE_POS and RE_NEG transfer both the positive and negative shocks that affect IPO activity. Finally, NRR_NEG contributes significantly to IPO activity, but NRR_POS does not impact TNIPO in either the short or long run. In summary, the results ultimately validate that IPO activity is highly sensitive to directional shocks both positive or negative in VA, PS, GE, CC, TI, RE, and NRR.

Consequently, a 1% rise in Voice and Accountability (VA) is associated with a 0.64% growth in TNIPO. A positive shock in VA ensures higher investor participation in economic policymaking, which contributes to market-friendly reforms and the ushering in of greater market stability. However, the inability to sustain voice and accountability increases information asymmetry, where investors lose market confidence due to a lack of market integrity. Consequently, the number of IPO is low. Political stability also has both positive and negative effects on IPO activities. The direct positive effect of political stability delivers consistent, invariable, and uniform policy implications, which induce a stable environment for new equity issues. However, Political instability sends negative policy shocks that propel information asymmetry and increase the cost of equity. Hence, less IPO activity is anticipated amid Political instability. Furthermore, Government Effectiveness (GE) demonstrates a noticeable short-run asymmetric influence on TNIPO. In particular, GE_POS has a statistically significant effect at the 5% level, indicating that when regulatory frameworks operate efficiently, IPO activity tends to rise due to reduced transaction costs, lower ex-ante uncertainty, and reduced risk. Conversely, GE_NEG shocks reflect the politicization of institutions, which contributes to economic stagnation and restricts access to the primary market. Similarly, CC_POS and CC_NEG are significant at the 5% level. 1 unit increase in corruption controls is expected to increase IPO activity by 0.17%. According to signaling theory, country-level transparency and effective disclosure practices provide clear information on firm quality. These signals are treated favorably by the market, which is associated with lower uncertainty associated with company value and invites better valuations during IPO. By contrast, CC_NEG shocks affect IPO activity. Entrepreneurial corruption and misconduct can spread widely when institutional weaknesses permit arbitrary action. This signals the inferior quality of the economic systems operating in the market. Consequently, the degree of ex ante uncertainty and information asymmetry adversely impacts investor confidence. Thus, the underpricing cost increases and companies are discouraged from accessing equity financing.

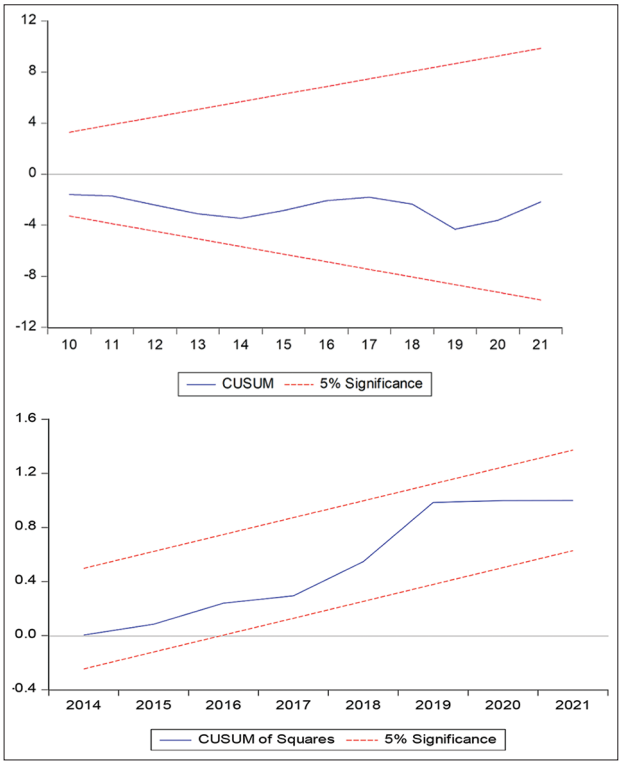
In addition, TI_POS and TI_NEG exhibit a significant relationship in explaining IPO activity. Industries with substantial innovation prospects are inclined to increase capital investment to preserve R&D investment momentum and support successful commercialization of innovations (Khan et al., 2021). Li and Mauer (2016) affirm that companies typically prefer equity financing over debt when seeking capital for growth opportunities. Given these concerns, firms usually rely on IPO stock market financing to support their R&D projects. In addition, due to its ability to spread the risk of technology failure to diverse investors, it is a preferred choice of funding for R&D innovations in the long run. Hence, TI induces IPO activity in both the long and short run. Furthermore, the results suggest that technological innovation has a negative impact on IPO activity in the long run. Firms may be confronted with the risk of huge upfront investments in R&D (in the short run) and draining the firm financially, which is further compounded by the risk of displacement by new technology in the long run. Therefore, this may withhold companies from offering IPOs.

The short-run positive and negative shocks to renewable energy are significant in explaining initial public offering (IPO)

Table 10: Robustness results

Robustness test	Problem	Values	Threshold value	Decision
Jarque-Bera	Normality	0.16 (0.5)	P>0.05	Residuals are normally distributed
Breusch-Pagan-Godfrey	Heteroscedasticity	0.32 (0.10)	P>0.05	There is no heteroscedasticity.
VIF	Multicollinearity	6.65	>10	There is no multicollinearity.
CUSUM	Stability	Stable*	Plots should be within 5%	The model is stable
CUSUMSQ	Stability	Stable*	significant critical boundaries	The model is stable.
Durbin-Watson statistics	Auto-correlation	2.21	d<2.5	Autocorrelation is not a concern.

Figure 4: CUSUM and CUSUM squares



Activity. In the short run and the long run, renewable energy poses a negative effect on TNIPO at a 5% significance level. Investment in renewable energy is fraught with high uncertainty in terms of demand and future revenue (Kasibhatta and Sarkar, 2023). Instability in business and profitability impact investors' confidence in conducting IPOs. Meanwhile, In the short run, IPO activity is positively affected by renewable energy at the 10% level of significance; however, RE_POS remains insignificant in the long-run context for TNIPO. In the short run, switching to an alternate source of energy requires huge upfront investments in the form of infrastructure, equipment, installation, and labour, which compels firms to consider going public. Hence, the volume of IPOs might experience growth.

Finally, the NRR has an asymmetric response to TNIPO. A significant inverse relationship between NRR_NEG and IPO activity was observed at the 5% significance threshold, but NRR_POS did not demonstrate any notable effect on TNIPO. NRR price volatility also led to changes in public spending policies, which exacerbated the changes in critical economic variables and decreased economic development and capital investment. This will result in a 1.72% increase in TNIPO. This finding is supported by previous research (Tajuddin et al., 2024).

Our findings highlight the comprehensive assessment of considering both positive and negative economic shocks when analyzing IPO dynamics. The findings suggest implications for inclusive, sustainable, and dynamic economic policy that policymakers continue to strive to achieve and improve the quality level of country institutions to sustain economic growth. Further, consistent efforts should be made to implement policy interventions to support new technological innovations, renewable energy adoption to ensure efficient utilization of resources, and sustainable economic development.

The error correction term (ECT) was statistically significant and negative at the 1% level, suggesting an annual adjustment rate of 1.50%. This reflects the tendency of the model to return to equilibrium following a disturbance, with deviations corrected at a speed of 1.50% per year. After estimating both the long- and short-run dynamics, it is essential to validate the stability of the model parameters. Pesaran et al. (1997) proposed to examine the stability of the parameters by applying the CUSUM and CUSUMSQ techniques, which were initially introduced by Brown et al. (1975). The parameters remain stable and the estimates are reliable, as illustrated in Figure 4, where the CUSUM and CUSUMSQ graphs (expressed by blue lines) lie enclosed between the upper and lower critical boundaries.

4.5. Robustness Tests

Table 10 reports the outcomes of the robustness tests performed to confirm the validity of the estimated models. Robustness tests indicate that the model is well specified, with no evidence of autocorrelation in the error terms or heteroscedasticity. In addition, the residuals follow a normal distribution. As the null hypothesis was tested for all these tests, the model was deemed statistically valid.

5. CONCLUSION

This study examines the selected country-level institutional quality determinants and dynamic macroeconomic indicators of IPOs in India's emerging market setting from 1997 to 2022. It contributes to the existing IPO literature by offering a comprehensive analysis of how these variables shape the investment climate, shedding light on the challenges and constraints faced by public offerings in the Indian market. In doing so, we adopt time-series econometric techniques by incorporating stationarity tests, ARDL, NARDL, and long-run bounds testing to understand the relationship between explanatory variables and IPO activity. Based on econometric evidence, it is evident that technological innovation, renewable energy, natural resource rent, and country-level institutional quality are all critical, as they signal a favorable economic environment

for a firm to initiate an IPO. Further, it is empirically established that technological innovation, renewable energy, and country-level institutional quality are positive and significant factors that explain the frequency of IPOs. A marginal improvement in these factors reduces ex ante uncertainty, increases market efficiency, and promotes better valuation of new public listings. It trims down the cost of raising equity, thus stimulating businesses to conduct IPO, improving the number of new listings on exchanges, and leading to higher IPO activity. Besides, natural resources rent was found to be negatively significant with the IPO activity, which demonstrates that resources are a curse. This shows that an increase in the natural resource rent increases rent-seeking behavior, thereby affecting IPO activity. Similarly, NARDL traces the asymmetric effects of renewable energy adoption, technological innovation, natural resource rent, and country-level institutional quality in short- and long-term periods. The positive and negative shocks of each macroeconomic indicator are associated with IPO activity. For instance, a positive change in renewable energy adoption and technological innovation could leverage business models, and they could plan IPOs shortly for expansion and growth; however, a negative shock in either of the two factors could restrict companies from offering IPOs. On the contrary, a positive natural resource rent shock could decrease IPO activity and vice versa. Further, the positive shock of country-level institutional quality, such as voice and accountability, political stability, government effectiveness, and control of corruption, can improve IPO volumes, whereas a negative shock can impede IPO activity across the country.

In summary, the level of uncertainty surrounding investor demand for IPO stocks changes over time, being greater during certain periods and also differs across firms, with some types of companies experiencing more demand uncertainty than others. In this context, our results substantiate the importance of country-level institutional quality and dynamic macroeconomic factors in signaling favourable economic conditions for firms aiming for IPOs. Taken collectively, IPO activity is likely to increase with improvements in country-level institutional quality, technological innovation support, promotion of renewable energy adoption, and efficient resource utilization. These factors contribute to a more stable and transparent market environment, enhance investor confidence, and encourage firms to go public.

Thus, this study deals with the complexity of IPO activity in India, which is susceptible to market-wide conditions. Against this backdrop, we extend an in-depth understanding of the dynamic nexus of country-level institutional quality and identify the dynamic macroeconomic determinants and IPO activity, particularly in terms of their symmetrical and asymmetrical effects.

5.1. Limitations and Future Directions

The current study examined a limited number of institutional quality and macro-environment variables in a single-country setting, which could potentially impact the generalizability of the results across global markets. As a prospect for future work, we recommend exploring the influence of additional macroeconomic variables, such as market volatility, market liquidity, economic uncertainty, and global climate uncertainty, and governance indicators on IPO frequency and proceeds. In addition, future studies can address the relative significance of additional factors, including firm-specific and industry-level determinants, in influencing and forecasting IPO activities. Cross-country and multi-country studies can also explore different market spillovers to examine these factors in unique regulatory environments.

5.2. Managerial Implications

In the dynamically changing macroeconomic landscape of India, where the quality of institutions, along with a transition to renewable energy as a sustainable source of development, a continuous improvement in research and development to enable technological innovation and optimum utilization of resources, has an impact on companies contemplating IPOs. This study, therefore, makes a significant contribution by offering valuable implications to investors, issuers, and policymakers. The assessment of country level institutional quality and dynamic macroeconomic conditions can help investors design their portfolios' profitability through risk diversification and better-informed decision-making. The investors can focus on IPOs aligned with global trends such as renewable energy and technological innovation for long-term sustainable growth. In addition, the diversification of investments across regions and industries can mitigate the risks of resource dependency or regulatory instability. For issuers, macroeconomic factors act as litmus tests for market timing. In times of transition to renewable energy, technological innovation supported by strong institutional quality promotes a cluster of IPOs due to low volatility and uncertainty and better terms of valuations. Hence, issuers find it most appropriate to announce an IPO. This significantly reduces the chances of IPO failure and withdrawals. On the policymaking side, the government is suggested to enhance the resilience and quality of institutions, to facilitate market efficiency and expansion. Further, relevant regulations and provisions should be introduced to support the Initial Public offerings of environmentally sustainable and technologically driven companies. In light of this, this study attempts to engage various stakeholders at the firm and policy levels to make the primary markets dynamic, robust, and active.

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