Nexus between Governance Indicators & Sustainable Stock Market Development in Pakistan: Evidences from Symmetric and Asymmetric Analysis

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ABSTRACT

The hidden non-linear association between governance indicators & stock market development (SMD) of Pakistan has been scrutinized in this study by using two comparative co-integrating techniques known as ARDL (Auto-regressive Distributed Lag) & NARDL (Non-linear ARDL). Empirical evidence suggests that misrepresented inferences arise by ignoring hidden non-linearity nexus between the variables. The ARDL results indicate that political stability & absence of violence/terrorism does not impact directly the SMD of Pakistan. Voice & accountability positively and significantly impact SMD, but rule of law does not impact SMD of Pakistan directly. The regulatory quality is highly significant and negatively impacts SMD. Contrarily, the NARDL frame indicates significant differences amid coefficients of components of governance index, denoting asymmetric links between variables. The Positive & Negative sums of partial decompositions of Rule of Law, Regulatory Quality, Political Stability & Absence of Violence/Terrorism (PS&AVT), and Voice & Accountability (V&A) significantly impact SMD. The impact of partial Negative multipliers of Regulatory Quality, and PS&AVT has a highly significant and negative impact, while V&A has a significant and positive impact on SMD. The impact of Positive partial multipliers of all variables is positive and significant except V&A. The comparative diagnostics extricate precariousness in policy moratorium. This study will add credence to the predictive power of governance indicators towards SMD of Pakistan by incorporating Positive and Negative decomposed multipliers.

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1. Introduction

The latest theoretical and scientific literature predicts that governance and growth of stock markets are closely associated and follow hand in glove mechanism (Bilan, Vasilyeva, Lyeonov, & Bagmet, 2019; Ellahi et al., 2021; Yusuf & Solmaz, 2020). Governance efficiency refers to institutional quality in any frontier economy\(^1\) like Pakistan is supposed to have a major impact on overall business growth (Al-Gasaymeh, 2020; Wang & Macy, 2021). Extensive research is undertaken to investigate the impact of various governance indicators like voice and accountability (V&A), government effectiveness (GE), regulatory quality (RQ), control of corruption (COC), rule of law (ROL), and political stability & absence of violence/terrorism (PS&AVT) respectively on the growth, liquidity & volatility of stock market development of Pakistan (Modugu & Dempere, 2020). Still, there is no agreement as to whether the hidden link is positive or negative, symmetrical/uni-directional or

\(^1\) The term Frontier Economy has been defined “the economy having distinct characteristics/features by the relative scarcities (and high prices) of capital assets like equipment, plant and skilled labor, and by the relative abundance (and low prices) of the natural resources. Due to these factors, the producers or the sellers look to utilize these natural resources instead of skilled labor or capital whenever possible.
The last two decades indicate that emerging-market economies like Pakistan that have expanded into frontier economies, the boom in the emerging economies' stock markets mostly attributes towards economic & financial growth, based upon good governance. The capital market growth (CMG) and boom in all emerging or frontier markets also led to structural changes in developed/advanced economies' financial systems (Bilan et al., 2019; Bogdan & Lomakovich, 2021). A number of macro-economic variables and guidance metrics have attributed the growth of stock markets (Hannah, 2019; M. A. Khan, Ilyas, & Hashmi, 2018; Ming & Jais, 2021; Modugu & Dempere, 2020).

Many reports have examined the macroeconomic effects on the growth of financial markets in less developed economies like Pakistan (Chaudhry, Faheem, Farooq, & Ali, 2021; Gulay, 2019). However, studies are still under way by testing the impact of governance indicators on stock market growth (Kwenda & Chinoda, 2019). There is a general agreement that governance indices like (i) voice and accountability (V&A) (ii) rule of law (ROL) (iii) regulatory quality (RQ) (iv) control on corruption (COC) and (v) political stability and absence of violence and terrorism (PS&AVT) have uni-directional effect on stock market growth (Bilan et al., 2019; M. A. Khan et al., 2020). The studies highlight an important issue as how governance through its components has distinct effects the sustainable performance of stock market of Pakistan. It is also a critical issue as to whether economic or financial growth policies in the emerging countries can be modified and properly implemented through quality governance mechanism (Abduvaliev, 2021; Hussain, Rafique, Khalil, & Nawaz, 2013; Udoh et al., 2021).

A list of studies shows that governance indicators (GI) have a favorable impact on stock market growth (SMG). Different studies like Boadi and Amegbe (2017) and Choi, Chung, Kim, Kim, and Choi (2020) have shown good governance in the form of a sustainable stock market development and its role in economic & financial liberalization strategies. In the countries, with extremely weak enforcement of shareholders’ rights and corporate level governance can be much more critical at micro-economic level. The same is true for country’s dysfunctional justice system. The studies that wet this discussion include Chen, Hongo, Ssali, Nyaranga, and Nderitu (2020) and Reddy (2019). In an old study, Kaufmann, Kraay, and Mastruzzi (2011) stated that governance quality is the only variable that is essential for the growth of stock markets, but it can also jeopardize policy growth strategies, if it is badly tackled. It is also well recognized that quality of governance has significant impact on stock market volatility (SMV). The research work of Lee and Kim (2020) indicates that the indices of governance like (i) control on corruption (ii) regulatory quality & (iii) protection of ownership rights could build and improve trust in the investment of stocks. The claim that the growth of quality institutions has a major impact on financial markets' development is backed by many research endeavors like (K. Ahmed, Khan, & Ozturk, 2021; Atiq-ur-Rehman, Ditta, Nawaz, & Bashir, 2020; Kwenda & Chinoda, 2019; Nirola & Sahu, 2019). Extensive analyses indicate that the nexus of growth of stock market is closely linked to the studies on interaction of regulatory system with financial sector. According to Eichler and Plaga (2020) the weaker/underdeveloped financial markets appear to exist in the countries with weaker/lower law enforcement and law structures (Cho, Greenwood-Nimmo, & Shin, 2021; M. A. Khan et al., 2018; Mehmood, Mohd-Rashid, Aman-Ullah, & Zi Ong, 2021; Razi, Zahoor, & Abbas, 2021; Rysin et al., 2021).

To date, there are few quantitative studies in Pakistan that address/handle the impact of governance indicators on SMD by using ARDL & NARDL in a single study. Most of the studies and dissertations address these policy variables by incorporating uni-directional effect and ignore the bi-directional (joint impact of Positive & Negative Multipliers). This study is meant to investigate this discussion by comparing the results of ARDL & NARDL frame by incorporating the impact of selected components of governance indicators. The joint impact of ROL, RQ, PS&AVT and V&A on SMD of Pakistan in its true Positive & Negative partial multipliers

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2 According to the Morgan Stanley Composite Index (MSCI) report 2021, recently published, Pakistan has been included in the list of "Frontier Market" that was previously classified as an "Emerging Market".

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determines the significance of this Study and it constitute the real research gap. This study will provide new insights in policy formulation and implementation.

This paper addresses only selected institutional and governance indicators and ignores a list of related ones: like regulatory/government effectiveness, fiscal and monetary freedom, financial inclusion or liberalization, trade, fiscal and investment policies. The time and cost limitations highlight that in future research studies, these variables must be accommodated. The rest of the paper has been organized as: section 2 will deal with the review of literature. Section 3 will explain the brief comparative analysis of two methodologies and Section 4 will cover results, analysis and discussion. The last section of this paper will provide new insights and suggestions for proposed policy modification.

2. Literature Review

As discussed earlier, the focus of this study is to investigate the comparative analysis of asymmetric links between selected governance indicators (rule of law, regulatory quality, voice and accountability and government effectiveness) variables with SMD of Pakistan. The four selected governance indicators have been briefly discussed below:

2.1. Rule of Law

Rule of law has been the first selected component of governance indicator (GI). Luong, Nguyen, and Nguyen (2020) stressed the effect of relevant legislation on stock market growth (SMG) and its implementation. Investors are encouraged to invest with the requisite financial support and well protected investors’ rights through courts and business regulations. Though, countries with poor legal regime and affected laws would dissuade borrowers and lenders from financing (Dima, Barna, & Nachescu, 2018; Uzelac, Davidovic, & Mijatovic, 2020).

This paper analyzes empirically the effects of regulations on stock market predictions due to the role of regulations in doing business. In the event of well-defined and implemented rules/regulations concerning financial sector growth, issues of asymmetry and poor financial disclosure can be significantly reduced (K. Ahmed et al., 2021; Kaufmann et al., 2011; Shang, Li-Bo, Han-Long, & Dong-Liang, 2021). However, it is argued that sound and efficient financial market regulations (FMR) are the prerequisites to stock market growth (SMG), but most of the studies do not focus less developed countries with little data availability for the emerging markets like Pakistan (Chiad & Sahraoui, 2021; M. A. Khan et al., 2018; Shaohua, Yahya, Pham, & Waqas, 2021; Sheikh et al., 2018; Sohail, Rasul, & Fatima, 2017).

Bilan et al. (2019) reported that corporate governance is essential to, or can substitute, country-wide judicial/regulatory reforms. This is because countries with poor legal structure often have lower corporate governance and lower equity market growth. This shows that the absence of effective rules and their non-compliance cannot promote financial development. Cross-country research of corporate governance focusses ROL as an essential component of economic and financial development (M. M. Ahmed, 2021; Bogdan & Lomakovych, 2021; Y. Dang, 2021; Jareño, Escribano, & Koczari, 2020; M. A. Khan et al., 2020; Phuong, 2020).

2.2. Regulatory Quality

There is Regulatory quality, being the second component of Governance. Since, there are no specific predictive regulatory factors for the variability of a stock market (Ming & Jais, 2021; Umar & Nayan, 2018). Hence, Manasseh, Mathew, and Ogbuabor (2017) pointed that proper securities legislation enhances financial reporting accuracy, clarity and trust of investors. In the same way, Emara and El Said (2021) stated that in countries with effective regulatory mechanism duly backed by the legal structure, the financial markets are well developed and efficient (Emara & El Said, 2021; Kamrana, Nawazb, & Rizwan, 2020; M. A. Khan et al., 2020; Ming & Jais, 2021; Modugu & Dempere, 2020; Nguyen, Chaiechi, Eagle, & Low, 2020; Shang et al., 2021; Zungu & Grelying, 2021).

Bilan et al. (2019) have reiterated that enhancing regulatory quality will boost interest, confidence & trust in equity investments. Hence, foreign investors could derive more returns from quality organizations. Kaufmann et al. (2011) echoed the implementation of good quality regulations/rules and re-affirmed that states with weak institutions will lead to immature financial markets with regard to its transparency, investors’ security, liquidity and quality regulatory measures (Bilan et al., 2019; de Batz, 2020; Hilliard & Zhang, 2019; M. A. Khan et al., 2020; Manasseh et al., 2017; Ming & Jais, 2021).
Galindo-Manrique, Pérez-Calderón, and Rodríguez-García (2021) reignited the development of financial & regulatory markets are related to increased volume of transparency of information. The failure to disclose regulatory information about their quality operations will give bad signal to current and prospective investors, hence negative shock to equity market growth (D. Dang, Fang, & He, 2019; Hannah, 2019; Shaohua et al., 2021). Extensive studies indicate that the role of financial market regulations (FMR) in relation to SMD of Pakistan has been inverse though not highly significant one (Boadi & Amegbe, 2017). This shows that all government regulators make no strict/stringent attempts to ensure that new rules are complied with and enforced on the equity markets. If government and other related institutions perform its respective jobs effectively, they can promote more productive activity by mitigating market manipulations relating to the capital markets of the developed economies (Abeka, Andoh, Gatsi, & Kawor, 2021; Islam & Islam, 2020; Jareño et al., 2020; M. A. Khan et al., 2018; Uzum, Ikpefan, Omankhanlen, Ejemeyovwi, & EHIIKIOYA, 2021).

Sheikh et al. (2018) reiterated that legislation relating to securities encourage capital & equity market growth in different ways to fuel economic pace by creating new quality productive investment opportunities. Further, stock market system (SMS) is sanitized with stringent equity legislations to handle asymmetric information (Bogdan & Lomakovych, 2021; Chien et al., 2021; Y. Dang, 2021; Eldomiaty, Al Qassemi, Mabrouk, & Abdelghany, 2016; Uzelac et al., 2020; Uzum et al., 2021).

2.3. Voice & Accountability

Voice & accountability (V&A) have been the third selected component of governance indicators. It plays an important role in every country’s capital market stability, volatility, liquidity, growth and performance. Investors’ vulnerability for market practices has risen with the persistence of global financial crises (GFC) affecting the leading firms (Boadi & Amegbe, 2017; Ming & Jais, 2021; Modugu & Dempere, 2020). Investors are looking more at the transparency and consistency of equity markets with quality corporate management policies (D. Dang et al., 2019; Sohail et al., 2017). In a financial era of modern times, firms are not operating in a vacuum but are instead influenced by their host ecosystem governance structures that is directly influenced by voice and accountability mechanisms (Kinsella, Mehrbani, Weiser, & Weiner, 2020; Lakshmi et al., 2021; Modugu & Dempere, 2020; Montes, Bastos, & de Oliveira, 2019; Shaohua et al., 2021).

Different reports have investigated the impact of V&A on stock market growth of grease-induced systemic vulnerability. Rather, it has created the possibility of stock market volatility (SMV) due to investor’s risk mitigation mechanism (Luong et al., 2020; Nguyen et al., 2020). In addition, Lee and Chou (2020) extensively examined the link between legal environment, risk mitigation and stock market returns. The results indicate that efficient, transparent and legal system manifested by higher quality legal & political system, adequate protection of investors by significant increase in the performance of equity market portfolios (Kinsella et al., 2020; Mangal & Liu, 2020; Noshad, Amjad, Shafiq, & Gillani, 2019). Similarly, Chizema and Pogrebna (2019) followed by Shaohua et al. (2021) iterated that states with unbiased better transparent & accountable legal system tend to attract new investors and to retain the old investors to promote stock market development (SMD) and to improve overall financial system of countries of third world (Almaharmeh, Shehadeh, Iskandran, & Saleh, 2021; Galindo-Manrique et al., 2021; Ming & Jais, 2021; Shi, Ahmed, & Paramati, 2021).

The study of Modugu and Dempere (2020) echoed that favorable association between the quality of institutions and risk-adjusted return on assets of the legal institutions has been investigated. They further extended that lawyer’s quality can extend return on equity by reducing firms’ expenses amid shareholders and management. Kinsella et al. (2020) recapped that poor accountability will prefer to finance more debt financing than equity financing. Sohail et al. (2017) shows that various businesses in those countries with poor governance indicators prefer to fund more debt financing than equity acquisitions. Since capital markets with a bad governance system have higher agency and transaction costs, while equity offers lesser level of control for investors than debt financing. So, the demand for equity in poorly regulated in financial markets resulting in lower returns on equity (Amjad, Ehsan, Amjad, & Gillani, 2021;
2.4. Political Stability and Absence of Violence/Terrorism

Political stability and absence of violence/terrorism is the 4th selected component of governance indicators. Studies have proved that it plays a pivotal role in the development of economic and financial growth of any country (Abdul Rahman & Saif, 2020; Husnain, Islam, & Ali, 2020; Ming & Jais, 2021). Both components: (i) political stability (PS) & (ii) absence of violence/terrorism (AVT) have positive, significant and major impact on the stock market returns (SMR) and economic development (ED) particularly in Pakistan. Pakistan has been a frequent victim of political instability and terrorism after 09/11/2001 attacks in USA (Abdul Rahman & Saif, 2020; Emara & El Said, 2021; Fareed, Meo, Zulfiqar, Shahzad, & Wang, 2018; Ming & Jais, 2021). In this paper, the researcher has discussed the distinct impact of political, violence and terrorism events on stock returns of Pakistan that how political news and acts of terrorism had affected stock market. The research studies during the last two decades indicate that above mentioned factors are the major contributory factors of the variability in stock returns of Pakistan (Abdul Rahman & Saif, 2020; Haseeb, Wattanapongphasuk, & Jermsittiparsert, 2019; Husnain et al., 2020; Masood, Javaria, & Petrenko, 2020; Monsura & Villaruz, 2021; Uzelac et al., 2020).

There has been a considerable investigation of possible correlational levels of stable political environment and terrorism with the bond or equity market of Pakistan, and still no agreement on the background, methods, methodology and strategies has ever been reached in literature (Ajide, 2019; H. Khan, Khan, & Zuojun, 2020). Economic growth and political stability are perceived to be directly proportional i.e., if political conditions are stable, then economic growth will boost and vice versa. For example, politically unstable governments spend lavishly and indulge in certain social evils like grafting, expropriation, embezzlement of funds, nepotism, favoritism, political victimization and fraudulent activities to pay off illegal rewards/bonuses to their allies and generate illegitimate revenues to handle their opponents and ultimately, they impact economic policy (EP) negatively (Gulyamov, 2021; Lepore, Paolone, & Cambrea, 2018; Modugu & Dempere, 2020; Montes et al., 2019).

Numerous empirical studies have found in the literature to investigate the influence of terrorism activities on the stock market around the world. In general, growth of stock market declines from terrorist activities and it makes investors unwilling to retain their business in case of unpredictable future events (Asaad & Marane, 2020; Masood et al., 2020). Moreover, terrorism events produce extreme level uncertainty and high risk for new investment projects and operational risks for the existing projects that adversely influence financial markets. Hence, ultimate decrease in economic and financial development (Abeka et al., 2021; Bhatti, Chaudhry, & Bashir, 2021; Boadi & Amegbe, 2017; Fareed et al., 2018; Mirza, Abbas, & Nawaz, 2020; Tag, 2021).

3. Data Collection, Methodological Framework & Econometric Modelling

The annual time series data of Pakistan Stock Exchange (PSX) of last twenty-five years (1996-2020) has been used to investigate the impact of selected governance indicators (ROL, RQ, V&A, & PS&AVT) on SMD of Pakistan. The data of governance indicators has been downloaded from the official web site (info.worldbank.org /governance/wgi) produced by Daniel Kaufmann, president emeritus NRGI and Aart Kraay. This study uses annual time series data of PSX for twenty-five years (1996-2020). The annual time series data of stock market development (SMD) has been downloaded from the official World Development Data web site (https://databank.worldbank.org/).

| Table 1: List of Dependent & Independent Variables |
| Description of Variables | Variables | Unit of Measurement | Data Sources |
| Stock Market Development | SMD | Stock Market Turnover as % of Total GDP | World Development Indicators (WDI, 2020) |
| Rule of Law | ROL | 1st Component of Index | World Governance Indicators |
| Regulatory Quality | RQ | 2nd Component of Index | World Governance Indicators |
| Voice & Accountability | V&A | 3rd Component of Index | World Governance Indicators |
| Political Stab. & Absence of Violence/Terrorism | PS&AVT | 4th Component of Index | World Governance Indicators |
To measure SMD, *stock market turnover (percentage of GDP)* has been used as proxy (Ajide, 2019; M. A. Khan et al., 2020). The proxies like (i) total value of shares traded on market, (ii) number of shares traded on market (iii) market capitalization (percentage of GDP) (iv) number of listed companies on per annum basis (v) market capitalization (as US dollar) has been used in a large number of research papers and dissertations. The proxy (*stock market turnover as a percentage of GDP*) has been finalized with an extensive deliberation by using E-views-10 in order to run the analysis of ARDL & NARDL framework respectively.

### 3.1 Methodological Frame

At present literature, the linear models completely dominate and consider a symmetric link (uni-directional link) between various components of GI and SMD. The experts have studied linearity but have ignored its non-linearity aspect. To fill this gap with respect to Pakistan, Non-linear auto regressive distributed lag (NARDL\(^3\) model) has been applied to capture two forms of relationships i.e., unidirectional and bi-directional short-run as well as long-run dynamics at disaggregate levels. NARDL technique has been developed by Shin, Yu & Greenwood-Nimmo in 2014. NARDL is a new technique for detecting nonlinearities amid Financial & Economics variables. This methodology can be applied even if variables are integrated at I(0) or I(1). The results of ARDL become invalid when I(2) variable is included in analysis. The results become robust regardless of its nature of sample, and it adjusts lags in its models to deliver unbiased estimates with valid estimated t-statistics’ (Chen et al., 2020; Cho et al., 2021; Jareño et al., 2020).

ARDL framework for cointegration, was developed by Pesaran et al. (2001). This is an OLS model that enjoys greater statistical authority compared to classical cointegration techniques called CLRM. It can handle mixed order integration for time series data. But it does not handle Positive and Negative shocks in the variables that occur due to its Positive & Negative decomposed multipliers to tackle spurious regressions. NARDL is the advanced version of ARDL\(^4\). It works effectively for small samples (Nkoro & Uko, 2016). Error Correction Model (ECM) has been used to capture the short-run and long-run dynamics (Ghardallou & Boudriga, 2014). Further, ARDL & NARDL with ECM is useful to disentangle ‘long-run’ links from short-run dynamics. These methods also deal with diagnostics (like endogeneity, serial correlation & heteroscedasticity) in the time series data. The paper covers the comparison of two econometric techniques (ARDL & NARDL) to suggest more accurate inferences. This helps to formulate future policy making strategy recommendations in a better way by pointing out unscratched nonlinearities (known asymmetries), that cover Positive & Negative shocks in the explanatory variables, due to diverse dynamics of ever-changing macro-economic predictors.

### 3.2 Econometric Model

The following equations have been formulated to test the hidden long-run & short-run uni-directional and bi-directional impact of the selected governance indicators (GI) on Stock Market Development (SMD) of Pakistan.

\[
SMD = \beta_0 + \beta_1(GI) + \mu \quad (1)
\]

\[
SMD = \beta_0 + \beta_1(ROL) + \beta_2(RQ) + \beta_3(V&A) + \beta_4(PS&ATV) + \mu \quad (2)
\]

The long run parameters are, namely \(\beta_0 \) & \(\beta_1\) for governance indicators index (GI), in equation [1]. In Equation [2], \(\beta_1, \beta_2, \beta_3, \text{and } \beta_4\) denote ROL for rule of law, RQ for regulatory quality, V&A for voice and accountability and 4\(^{th}\) variable, selected from the Index is PS&ATV for political stability, Smith, Shin, and Pesaran (2001). The proposed equation [04] will be:

\[
\Delta SMD = \theta + \sum_{k=1}^{p_1} \theta \Delta SMD(t-k) + \sum_{k=1}^{p_2} \theta \Delta ROL(t-k) + \sum_{k=1}^{p_1} \theta \Delta RQ(t-k) + \sum_{k=1}^{p_1} \theta \Delta V&A(t-k) + \sum_{k=1}^{p_1} \theta \Delta PS&ATV(t-k) + \lambda_1 ROL(t-1) + \lambda_2 RQ(t-1) + \lambda_3 V&A(t-1) + \lambda_4 PS&ATV(t-1) + \mu \quad (3)
\]

\(^3\) NARDL covers the bi-directional impact between independent and dependent variables

\(^4\) ARDL is an appropriate modification of orders of ARDL frame \((p, q)\), that is necessary to rectify the problem of ‘endogenous regressors’ & residual ‘serial correlation’ simultaneously (Pesaran and Shin, 1999). But, NARDL model decomposes every series into positive and negative values that are not I(1). The degree of persistence will correct any endogeneity, e.g., if the variables are I(d), the correction is better for the values of ‘d’ closer to 1.00.

\(^5\) Beta is a measure of Stock Price Volatility (SPV) w.r.t. overall stock market. Higher Beta means higher potential returns with higher riskier security. If a stock moves less than market, the stock’s beta will be less than 1.00.
The equation [03] here, is parallel to statistical study conducted by Engle and Granger (1987). The proxy in equation above is a linear form of the under-study variables that shows its lagged values. Further, in equation [3], the long-run coefficients are denoted by \( \lambda_1, \lambda_2, \lambda_3, \) \& \( \lambda_4 \) respectively, while short-run coefficients are reflected by \( \theta \). The presence of cointegration between GI & SMD of Pakistan is substantiated by F-Bounds test stats. The test is recommended by Pesaran et al., (2001). The equation [3] assumes symmetrical hidden links amid GI and SMD of Pakistan. The second objective of this research is to test non-linear/asymmetric impact of selected components of governance index on SMD of Pakistan. Here, non-linear/asymmetric regression shown as:

\[
\varphi_t = \delta^+ y_{it}^+ - \delta^- y_{it}^- + \mu_t, \text{ where } \delta^+ \text{ and } \delta^-
\]

This equation links long-run coefficients, here \( y_i \) shows the vector of explanatory variables that is disintegrated as; The following equations \([4,5,6,7,8,9,10,11]\) show non-linear trend denoted by partial multipliers of hidden Positive and Negative changes in rule of law, regulatory quality, voice & accountability and the \( 4^{th} \) selected component of governance index political stability and absence of violence/terrorism respectively.

\[
\sum_{t=1}^{k} ROL^+ = \sum_{t=1}^{k} \Delta ROL^+ = \sum_{t=1}^{k} ROL_{\max}(\Delta ROL_i, 0) \quad (4)
\]

\[
\sum_{t=1}^{k} ROL^- = \sum_{t=1}^{k} \Delta ROL^- = \sum_{t=1}^{k} ROL_{\min}(\Delta ROL_i, 0) \quad (5)
\]

\[
\sum_{t=1}^{k} RQ^+ = \sum_{t=1}^{k} \Delta RQ = \sum_{t=1}^{k} RQ_{\max}(\Delta RQ_i, 0) \quad (6)
\]

\[
\sum_{t=1}^{k} RQ^- = \sum_{t=1}^{k} \Delta RQ = \sum_{t=1}^{k} RQ_{\min}(\Delta RQ_i, 0) \quad (7)
\]

\[
\sum_{t=1}^{k} V&A+ = \sum_{t=1}^{k} \Delta V&A = \sum_{t=1}^{k} V&A_{\max}(\Delta V&A_i, 0) \quad (8)
\]

\[
\sum_{t=1}^{k} V&A^- = \sum_{t=1}^{k} \Delta V&A = \sum_{t=1}^{k} V&A_{\min}(\Delta V&A_i, 0) \quad (9)
\]

\[
\sum_{t=1}^{k} PS&AVT+= \sum_{t=1}^{k} \Delta PS&AVT = \sum_{t=1}^{k} PS&AVT_{\max}(\Delta PS&AVT_i, 0) \quad (10)
\]

\[
\sum_{t=1}^{k} PS&AVT-= \sum_{t=1}^{k} \Delta PS&AVT = \sum_{t=1}^{k} PS&AVT_{\min}(\Delta PS&AVT_i, 0) \quad (11)
\]

In order to develop non-linear/asymmetric ARDL framework (called NARDL), here the equations generated above (from Eq.4 to Eq.11) have been put into equation [4] to produce equation [12], that represents desired NARDL equation for the model under-study.

\[
\Delta SMD = \theta + \sum_{k=1}^{p_1} \theta \Delta SMD(t-k) + \sum_{k=1}^{p_2} \theta \Delta ROL(t-k) + \sum_{k=1}^{p_3} \theta \Delta ROL(t-k) + \sum_{k=1}^{p_4} \theta \Delta V&A(t-k) + \sum_{k=1}^{p_5} \theta \Delta PS&AVT(t-k) + \sum_{k=1}^{p_6} \theta V&A(t) + \sum_{k=1}^{p_7} \theta \Delta ROL(t) + \sum_{k=1}^{p_8} \theta \Delta ROL(t) + \sum_{k=1}^{p_9} \theta \Delta ROL(t) + \sum_{k=1}^{p_{10}} \theta V&A(t) + \sum_{k=1}^{p_{11}} \theta \Delta ROL(t-1) + \sum_{k=1}^{p_{12}} \theta PS&AVT(t) + \sum_{k=1}^{p_{13}} \theta PS&AVT(t) + \lambda_1 ROL(t-1) + \lambda_2 ROL(t-1) + \lambda_3 V&A(t-1) + \lambda_4 PS&AVT(t-1) + \mu t \quad (12)
\]

Here, the above developed model shown in equation [12]\(^6\) covers the short-run and long-run dynamics to make specifications given in equations [1, 2 & 3] labelled as asymmetric or non-linear ARDL.

4. Results & Discussions

In this paper, two methodologies (ARDL & NARDL) have been used to test the linear & non-linear/bi-directional links between the selected components of GI and SMD of Pakistan for better and relevant decisions. The analysis, its results and relevant discussion begin as;

4.1. Descriptive Statistics, Correlation Matrix & Unit Root Test

Table 2 covers descriptive statistics. It provides information about Mean and Median values of all variables in the model. The maximum Mean/Median values on the basis of log

\(^6\) For extensive derivation of the model, see the methodology used by Shin, Yu, and Greenwood-Nimmo (2014)
values are for regulatory quality (RQ) with 1.45 & 1.46 respectively, while maximum range of variation is observed in LPS&AVT that is 1.38. Higher range of dispersion indicates that political stability and absence of violence/terrorism plays a key role in economic and financial development of Pakistan. The other two variables (ROL & RQ) have almost similar variations i.e., 0.39. while, V&A indicates value of dispersion at 0.58. The range of SMD is 0.87, it shows higher variation rate in this statistical model. Same is true and can be tested in case of S.D. The Skewness values for RQ, PS&AVT and V&A indicate fairly symmetrical data, while ROL & SMD indicate that data is moderately skewed (Emara & El Said, 2021). The Kurtosis values of ROL, RQ & V&A > 3.00, that indicate data set has heavier tails than a normal distribution, while SMD and PS&AVT indicate lighter tails than normal distribution as kurtosis < 3.00 (Jareño et al., 2020; Masood et al., 2020; Modugu & Dempere, 2020).

Table 2: Descriptive Statistics for Governance Indicators & SMD of Pakistan

|                | LSMD      | LROL     | LRQ       | LPS_AVT   | LV_A     |
|----------------|-----------|----------|-----------|-----------|----------|
| Mean           | 1.327291  | 1.395351 | 1.448364  | 0.553000  | 1.387769 |
| Median         | 1.331486  | 1.389507 | 1.459458  | 0.484300  | 1.404114 |
| Maximum        | 1.660384  | 1.647464 | 1.636099  | 1.358508  | 1.682747 |
| Minimum        | 0.790215  | 1.250138 | 1.248806  | -0.02325  | 1.11177  |
| Std. Dev.      | 0.240567  | 0.091946 | 0.080666  | 0.486045  | 0.125018 |
| Skewness       | -0.566818 | 0.975252 | -0.212787 | 0.338631  | -0.05898 |
| Kurtosis       | 2.410399  | 3.770697 | 4.093131  | 1.736420  | 3.544671 |

Table 3 shows the covariance correlation matrix. The matrix indicates negative link of all independent variables with SMD of Pakistan except V&A. Interestingly, PS&AVT is the only variable that shows negative & significant impact on SMD of Pakistan with coefficient = -0.4956. The negative relationship between variables indicates that certain other factors exist that impact this link between WGI & SMD. The analysis extends further that RQ significantly impact ROL with positive coefficient=0.54 and PS&AVT significantly impacts ROL (coefficient=0.69), while V&A significantly impacts ROL & RQ with respective coefficients of 0.49 & 0.83 respectively. It is also worth-mentioning that ROL significantly & positively impacts RQ, PS&AVT and V&A (Ming & Jais, 2021). The discussion indicates bi-directional causality between explanatory variables in case of Pakistan. The latest studies that support and wet this discussion include (Husnain et al., 2020; Lakshmi et al., 2021; Ouedraogo & Sawadogo, 2020; Uzum et al., 2021).

Table 3: Correlation Matrix for Governance Indicators & SMD of Pakistan

|                | LSMD      | LROL     | LRQ       | LPS_AVT   | LV_A     |
|----------------|-----------|----------|-----------|-----------|----------|
| LSMD           | 1.000000  |         |           |           |          |
| LROL           | -0.303930 | 1.000000 |           |           |          |
| LRQ            | -0.070736 | 0.538775 | 1.000000  |           |          |
| LPS_AVT        | 0.070484  | 0.0055   | 0.0117    | 1.000000  |          |
| LV_A           | 0.006495  | 0.491427 | 0.827851  | 0.052010  | 1.000000 |

Table 4: Unit-Root Test, Durbin-Watson Stats and Adjusted R² Statistics

| Name of Variable | Unit Root Test | Trend/Intercept | Adj Rsquared | DW Stats | Log-Likely Ratio | S.D. |
|------------------|----------------|-----------------|--------------|----------|------------------|------|
| SMD              | I(0)           | with Trend/Intercept | 0.4400       | 2.1700   | 15.3700          | 0.1800 |
| PS&AVT           | I(1)           | With Intercept   | 0.6000       | 1.9500   | -0.2100          | 0.4000 |
| RQ               | I(0)           | With Intercept   | 0.6200       | 1.6800   | 37.3800          | 0.0756 |
| ROL              | I(0)           | With Intercept   | 0.3600       | 2.1700   | 34.7400          | 0.1100 |
| V&A              | I(0)           | With Intercept   | 0.6400       | 1.9700   | 38.8900          | 0.0732 |

Table 4 discusses the results of unit root test, values of adjusted R², values of DW-stats, S.D., Log-likely ratios and intercept with trends. The dependent variable, SMD is I(0), with trend & intercept, having adjusted R²=0.44, with negative auto-correlation as shown by DW-stats=2.17. The S.D. for SMD is 0.18 with higher Log-likely value=5.37. All dependent variables are I(0) except PS&AVT, that is I(1), with intercept & no trend. None of the variables
in model is $I(2)$. All explanatory variables with positive serial-correlation as shown by the values of DW-statistics except ROL (Risal & Koju, 2021). The S.D. indicates maximum deviation in PS&ATV, as already tested in Table-2 and it also suffers from negative Log-likelihood ratio. The other three variables having higher Log-likelihood values indicate the goodness of fit. The predictive power of four variables as shown by Table-4 has not been significant, as adjusted R-Squared <0.70 (Hue et al., 2019).

4.2. Results of Pair-wise Granger Causality

Table 5 discusses pair-wise results of Granger causality. Table shows ROL does not Granger cause SMD of Pakistan, but it does Granger cause RQ & V&A at 10%. ROL also Granger cause PS&AVT at p-value=0.05. It denotes that ROL provides a basis to different variables that directly affect SMD of Pakistan (Uzelac et al., 2020). The 2nd variable, RQ does Granger cause SMD of Pakistan bi-directionally at highly significant p-values. It does not Granger cause ROL & V&A, but it does Granger cause PS&AVT at p-value=0.05 (Modugu & Dempere, 2020). The 3rd variable, PS&AVT does not Granger cause SMD. It gives opposite results against the result of Table-3. It also does not Granger cause RQ and V&A. Though it Granger cause ROL at 10% uni-directionally (Saeed Meo, 2017). The 4th variable V&A does Granger cause SMD and PS&AVT at 10%, it does not Granger Cause regulatory quality & rule of law (H. Khan et al., 2020; Ming & Jais, 2021).

The brief discussion on Table-5 demands an in-depth investigation to find out hidden association between variables, as this can be further tested by using ARDL (uni-directional) and NARDL (bi-directional) frame to address asymmetries. For better predictions, the results of bi-directional causality & low values of adjusted $R^2$, must be investigated into its POS & NEG partial sums of decomposition of variables to enhance the predictive power of selected components of GI and to develop graphical asymmetric multipliers for cumulative dynamics called AMCD graphs (Allen & McAleer, 2020; Okere, Muoneke, & Onuoha, 2021; Phong, Van, & Bao, 2019).

Table 5: Results of Granger Causality

| Variable (Cause) | Variable (Effect) | p-value | Adjusted R^2 |
|------------------|------------------|---------|--------------|
| ROL does not Granger Cause SMD | 23 | 1.25637 | 0.3085 |
| LSMD does not Granger Cause LROL | 0.98823 | 0.3915 |
| ROL does not Granger Cause SMD | 4.91301 | 0.0198 |
| LSMD does not Granger Cause LRQ | 7.12761 | 0.0052 |
| LPS_AVT does not Granger Cause LSMD | 23 | 0.52822 | 0.5985 |
| LSMD does not Granger Cause LPS_AVT | 0.30050 | 0.7441 |
| LV_A does not Granger Cause LSMD | 3.29754 | 0.0602 |
| LSMD does not Granger Cause LV_A | 4.24329 | 0.0309 |
| LRQ does not Granger Cause LROL | 23 | 0.85436 | 0.4421 |
| LROL does not Granger Cause LRQ | 2.61519 | 0.1007 |
| LPSAVT does not Granger Cause LROL | 23 | 2.89073 | 0.0815 |
| LROL does not Granger Cause LPS_AVT | 3.63217 | 0.0473 |
| LV_A does not Granger Cause LROL | 23 | 2.18986 | 0.1409 |
| LROL does not Granger Cause LV_A | 3.35107 | 0.0579 |
| LPS_AVT does not Granger Cause LRQ | 23 | 0.48505 | 0.6235 |
| LRQ does not Granger Cause LPS_AVT | 3.79858 | 0.0420 |
| LV_A does not Granger Cause LRQ | 23 | 0.46957 | 0.6327 |
| LRQ does not Granger Cause LV_A | 0.95898 | 0.4020 |
| LV_A does not Granger Cause LPS_AVT | 3.31048 | 0.0897 |
| LPS_AVT does not Granger Cause LV_A | 2.23292 | 0.1361 |

4.3. Results of ARDL

Table 6 shows the results of ARDL framework. Starting from DW Statistics, it shows the presence of negative auto-correlation in residuals as DW-stats lies outside the upper range (1.70<DW-Stats<2.30). Table shows adjusted $R^2$ statistics=0.91, denoting an excellent ‘predictive power’ of the model to explain SMD of Pakistan. The first explanatory variable is ROL, showing coefficient value=0.77, but insignificant p-value=0.11. It extends the results of Table-3 & Table-5 that ROL is a supportive/complementary factor that facilitates the impact of ‘other variables’ on SMD of Pakistan (M. A. Khan et al., 2020; Luong et al., 2020). The 2nd variable, regulatory quality (RQ), though highly significant but impacts SMD of Pakistan with...
negative coefficient = -3.65. It denotes those extra ordinary stringent regulations; complex or complicated procedures do not promote SMD of Pakistan. The role of RQ remains significant over the years but its impact decreases with lower coefficient values as increase in number of Lags occurs (Nguyen et al., 2020; Umar & Nayan, 2018).

Table-6 shows interesting result of 3rd variable i.e., PS&AVT, that shows insignificant impact on SMD. Its impact becomes significant/relevant with the performance of institutional factors (Abdul Rahman & Saif, 2020; Uzelac et al., 2020). The 4th variable is V&A (voice and accountability). It shows highly significant impact on SMD of Pakistan with coefficient value of +1.40. Voice and accountability along with regulatory quality and PS&AVT and supported by ROL jointly affect SMD of Pakistan and the variables suggest effective synchronization of the model variables that will facilitate a sustainable development in the equity market of Pakistan (Boadi & Amegbe, 2017; Ming & Jais, 2021; Modugu & Dempere, 2020).

Table 6: Results of ARDL for Governance Indicators & SMD of Pakistan

| Variable  | Coefficient | Std. Error | t-Statistic | Prob.* |
|-----------|-------------|------------|-------------|--------|
| LSMD(-1)  | -0.074759   | 0.148536   | -0.503307   | 0.6256 |
| LSMD(-2)  | 0.430902    | 0.137392   | 3.136292    | 0.0106 |
| LSMD (-3) | 0.434118    | 0.177112   | 2.451098    | 0.0342 |
| LROL      | 0.769947    | 0.441212   | 1.745074    | 0.1116 |
| LRQ       | -3.654123   | 0.529262   | -6.904179   | 0.0000 |
| LRQ (-1)  | -0.227802   | 0.395351   | -0.574244   | 0.5785 |
| LRQ (-2)  | -1.468477   | 0.295616   | -4.967512   | 0.0006 |
| LRQ (-3)  | -1.814894   | 0.313267   | -5.793450   | 0.0002 |
| IPS AVT   | 0.208164    | 0.118710   | 1.753546    | 0.1100 |
| IPS AVT (-1) | -0.199332 | 0.098762   | -2.018310   | 0.0712 |
| LV A      | 1.401140    | 0.347309   | 4.034276    | 0.0024 |
| C         | 7.696882    | 1.193406   | 6.449506    | 0.0001 |
| R-squared | 0.955628    | Mean dependent var | 1.350013 |
| Adjusted R-squared | 0.906820 | S.D. dependent var | 0.241156 |
| S.E. of regression | 0.073614 | Akaike info criterion | -2.077513 |
| Log likelihood | 34.85264 | Hannan-Quinn criter. | -1.937222 |
| F-statistic | 19.57907 | Durbin-Watson stat | 2.477134 |

4.4. Results of Non-linear ARDL

The core rationale of this research paper has been covered in Table-7 to show results under NARDL frame. The discussion starts from rule of law, decomposed into POS & NEG partial sums. Its shows that by increasing one unit in ROL, SMD of Pakistan increases by 2.43 unit. It also denotes LROL_NEG has significant impact on SMD at 10%, denoting that one unit decrease in ROL will increase SMD of Pakistan by 1.45 units. Hence, SMD is a POSITIVE Function of both POS & NEG changes in ROL as both the coefficients (2.43 & 1.45) are positive w.r.t. direction and magnitude. Rather, systematic decline in prevailing rule of law has positive and significant impact on equity market, but deterioration is not desirable. Statistically speaking, SMD of Pakistan is a POSITIVE function of ROL. The results of Table-7 & Table-6 under NARDL & ARDL bound testing for ROL almost show same direction, that better, relaxed and relevant law and order situation promotes stock market performance in Pakistan (Bilan et al., 2019; M. A. Khan et al., 2018; Uzelac et al., 2020).

The 2nd variable is regulatory quality (RQ), decomposed into LRQ_POS that shows a significant and positive impact on SMD of Pakistan at 10%, while LRQ_POS_(-1) supports that consistent improvement in the quality of regulations will facilitate SMD on long-run basis with higher & positive coefficients while LRQ-NEG with highly significant p-value and negative coefficient (-7.33) shows that when regulatory quality decreases by one unit for the institutions, the performance of SMD decreases by 7.33 units. Hence, the link is positive. The results in Table-6 have opposite recommendations that indicate RQ does promote SMD of Pakistan, though its role decreases due to lower coefficient values, as number of lags increase but remains highly significant. This again is a major bone of difference while formulating any new policy or modifying any old strategy (M. M. Ahmed, 2021; Bilan et al., 2019; Ellahi et al., 2021; M. A. Khan et al., 2020; Naseer, Khan, Popp, & Oláh, 2021; Umar & Nayan, 2018).

The 3rd explanatory variable that is most relevant to present circumstances of Pakistan is PS&AVT. The political stability and control on violence and terrorism has significant and
positive impact on \textit{SMD} of Pakistan with coefficient value of 1.10, but the impact of decrease in \textit{PS&AVT} has been highly significant and a prompt on \textit{SMD} with minimum standard errors, indicating decline in \textit{PS&AVT} creates immediate shocks to \textit{SMD} (Abdul Rahman & Saif, 2020; M. A. Khan et al., 2018). The discussion ends with the 4th variable i.e., voice and accountability. Here, \textit{LV&A POS} has been highly significant with negative coefficient (-4.80). It refers to strict accountability rules does not support \textit{SMD} of Pakistan. It denotes when \textit{V&A} increases by one unit, \textit{SMD} decreases by 4.80 units, hence relationship is negative (Boadi & Amegbe, 2017; Modugu & Dempere, 2020). While, \textit{LV&A POS(-1)}, also wetted previous discussion. At the same time, \textit{LV&A(NEG)}, positively & significantly impacts \textit{SMD} with coefficient of +3.98. It refers relaxed regulations/rules that directly promote financial markets in Pakistan with minimum government intervention (M. A. Khan et al., 2018). As with one unit decrease in \textit{V&A}, \textit{SMD} will increase by 3.98 units. Hence, the association between \textit{SMD} of Pakistan and \textit{V&A} is negative. The results in Table-7 are again in opposite direction compared to the results of ARDL frame in Table-6 due to significant differences in coefficients & standard error estimates as discussed in next section (H. Khan et al., 2020; Modugu & Dempere, 2020).

### Table 7: Results of Non-Linear ARDL For GI and SMD of Pakistan

| Variable      | Coefficient | Std. Error | t-Statistic | Prob.* |
|---------------|-------------|------------|-------------|--------|
| LSMD (-1)     | -0.124390   | 0.149550   | -0.831760   | 0.4271 |
| LRROL POS     | 2.428809    | 0.836291   | 2.904264    | 0.0175 |
| LRROL_NEG     | 1.449286    | 0.740405   | 1.957425    | 0.0820 |
| LRROL NEG (-1)| 2.234572    | 0.861794   | 2.592930    | 0.0291 |
| LRQ_POS       | 1.812455    | 0.877853   | 2.064646    | 0.0690 |
| LRQ NEG       | -7.326588   | 1.242622   | -5.896073   | 0.0002 |
| LRQ NEG (-1)  | -2.587893   | 1.327618   | -1.949275   | 0.0831 |
| LPS_AVT_POS   | 1.098912    | 0.166958   | -0.292963   | 0.0062 |
| LPS_AVT_NEG   | -3.052139   | 0.176308   | 0.295726    | 0.0091 |
| LPS_AVT NEG (-1)| -0.299001 | 0.214481   | -1.394067   | 0.1968 |
| LV_A POS      | -4.800608   | 1.059303   | -4.531856   | 0.0014 |
| LV_A NEG      | 3.977683    | 0.580490   | 6.852280    | 0.0001 |
| LV_A NEG (-1) | 6.600564    | 0.656357   | 9.914996    | 0.3841 |
| C             | 1.016333    | 0.187209   | 5.428864    | 0.0004 |
| R-squared     | 0.968567    | Mean dependent var | 1.382193 |
| Adjusted R-squared | 0.943164 | S.D. dependent var | 0.220632 |
| S.E. of regression | 0.054473 | Akaika info criterion | -2.216627 |
| Log likelihood | 39.49121    | Hannan-Quinn criter. | -2.042800 |
| F-statistic   | 21.33276    | Durbin-Watson stat | 2.321213 |

#### 4.5. Comparative Analysis of ARDL & NARDL in Descriptive Terms

The lower section of Table-6 indicates adjusted R$^2$ =0.91, SD=0.24, S.E. of regression of 0.07, Mean value of 1.35, and Log-likelihood=34.85 compared to the results of Table-7, that indicates better adjusted R$^2$ =0.94, lesser values of S.D. & S.E. of regression (0.22 & 0.05 respectively), higher Mean=1.38 & higher Log-likelihood=39.49 under NARDL frame. It demands an extended investigation of auxiliary macroeconomic country-specific factors in due course of time for more consistent, progressive and smooth operations of stock market of Pakistan (Eldomiaty et al., 2016; Ullah & Jan, 2020).

The discussion in Section 4.4 and 4.5 helps to conclude that the link between selected components of Governance Index and \textit{SMD} of Pakistan is not of rather symmetrical nature (Bhuiyan & Chowdhury, 2020; Ellahi et al., 2021). This shows that the Index components do not impact \textit{SMD} significantly and symmetrically, rather it depends on synchronized & well-connected macro-economic variables that magnify the impact of decomposition of \textit{POS} & \textit{NEG} partial changes in multipliers of various components of \textit{Governance Index} as shown in graphical ACDM (asymmetric cumulative dynamic multipliers) in section 4.8 (Allen & McAleer, 2020; Jareño et al., 2020; Meo, Chowdhury, Shaikh, Ali, & Masood Sheikh, 2018; Saeed Meo, Hafeez, Shaikh, & Shahid, 2018).

#### 4.6. ARDL & NARDL Long Run Form & Bounds Test

Bound-testing/F-statistics for ARDL and NARDL have been shown in Table 8 in parallel form. The F-statistics for ARDL and NARDL is 6.6956 & 10.4105 respectively, that shows a
strong cointegration (long-run bound testing), as F-stats value is well above tabulated upper-bound\(^7\) values of I(1) @ 10%, 5%, 2.50% & 1.00% respectively. It indicates that model has \textit{predictive power} to influence \textit{SMD} of Pakistan for long-run under both techniques.

**Table 8: Symmetric and Asymmetric F-Bounds Test Results**

|        | ARDL          | NARDL         |
|--------|---------------|---------------|
| Test   | Value         | Sig. | I (0) | I (1) | Test   | Value         | Sig. | I (0) | I (1) |
| F-Stats| 6.6957        | 10%  | 2.45  | 3.52  | F-Stats| 10.4105       | 10%  | 1.95  | 3.06  |
| K      | 4             | 5%   | 2.86  | 4.01  | K      | 8            | 5%   | 2.22  | 3.39  |
|        | 2.50%         | 3.25 | 4.49  |       |        | 2.50%         | 2.48 | 3.77  |       |
|        | 1.00%         | 3.74 | 5.06  |       |        | 1.00%         | 2.79 | 4.11  |       |

### 4.7. Diagnostic Inspection for ARDL & NARDL Frames

Table-9 covers the necessary diagnostic measures for ARDL & NARDL. The Table shows the results of selected diagnostics under three heads (i) residual diagnostics (ii) stability diagnostics (iii) coefficient diagnostics. The Serial-1 of Table-9 shows the results of \textit{Breusch-Godfrey Serial Correlation LM} test with respective \textit{p-values} for ARDL \([0.0004< 0.05]\), while \textit{p-value} for NARLD is \(0.008<0.05\). It denotes presence of \textit{serial-correlation}. It denotes the absence of \textit{efficient OLS estimator}, hence, no \textit{BLUE} coefficients for OLS. It indicates that any two given variables are \textit{inter-dependent} \& confirms \textit{bidirectional causality}. The Serial-2 in the Table shows \textit{normality of residuals} under \textit{Jarque-Bera test} with no issue regarding \textit{data normality}. Under ARDL \& NARDL frame as respective \textit{p-values} for Breush-Pagan-Godfrey Test are greater than 0.05 as shown in Table-9 under Serial-3 indicate no issue of heteroskedasticity in the model (Chaudhry et al., 2021). Table-9 (Serial-4) also shows the \textit{p-values} for t-stats (Banerjee & Urga, 2005) and F-stats (Pesaran, Shin, \& Smith, 2001) for \textit{Ramsey RESET} Test. The respective \textit{p-values} under ARDL \& NARDL are 0.2399 \& 0.4041 respectively, that are greater than 0.05. The values denote correct and valid specification of the model (Chen et al., 2020; Ibrahim \& Alagidede, 2018).

**Table 9: Diagnostic Inspection for GI and SMD of Pakistan**

| Diagnostic Tests | Problem Addressed | ARDL          | NARDL         |
|------------------|-------------------|---------------|---------------|
|                  | P-Value \(<[X2]\) | Decision      | P-Value \(<[X2]\) | Decision      |
| 1. Breusch-Godfrey LM Test | Serial Correlation | 0.0004< 0.05 | Serial correlation | 0.0018< 0.05 | Serial correlation |
| 2. Jarque-Bera Test | Data Normality | 0.5934< 0.05 | Residuals Normally Distributed | 0.2628< 0.05 | Residuals are Normally Distributed |
| 3. Breuch-Pagan-Godfrey Test | Heteroskedasticity | 0.8761> 0.05 | No Hetero Exist | 0.866< 0.05 | No Hetero Exist |
| 4. Ramsey RESET Test | Model Specification | 0.2399< 0.05 | Model is Correctly Specified | 0.4041> 0.05 | Model is Correctly Specified |
| 5. Variance Inflation Factor [VIF] | Multicollinearity | All VIF<10 Except PS&AVT | No Issues of Multicollinearity | All VIF<10 | Multicollinearity |
| 6. Wald Test | Coefficients Test | 0.07>0.05 | Variables jointly and statistically NOT Significant | 0.008< 0.05 | Variables jointly and statistically Significant |
| 7. CUSUM & CUSUMSQ Test | Stability Test | N.A. | Model is Stable | N.A. | Model is NOT Stable Due to Shock |
| 8. Cont.eq (-1) * for EC regression | Long Run Bounds | -0.3234 | SOA is 32.34% towards Mean | -0.6402 | SOA is 64.34% towards Mean |
| 9. Durbin Watson Statistics | Issue of Auto Correlation | 2.47<2.30 | Issue of Serial/Auto Correlation Exist | 2.32>2.30 | Issue of Serial/Auto Correlation Exist |

The value of \textit{variance inflation factor (VIF)} shown in Serial-5 for ARDL is: VIF < 10, except \textit{PS&AVT}. It illustrates no series issue of \textit{multicollinearity (MC)} in the statistical model. But, in case of NARDL, \(VIF>10\), it indicates existence of multicollinearity issue amid the

\(^7\) In this model, conservative approach w.r.t. the selection of critical values as recommended by Shin et al., (2011) has been used, hence selected \(k=3\).
variables (Sutton, Vasnev, & Gerlach, 2019). Again, refer to Table-9 (Serial-6), it shows results of Wald test. It covers multiple restrictions on hypothesis. The Wald results under ARDL indicates acceptance of Ho that shows the coefficients, being equal and show uni-directional trend. But, in case of NARDL, p-value denotes rejecting Null hypothesis that coefficients are not equal to zero w.r.t. its magnitude, size, direction, degree of strength and intensity. Hence, bi-directional causality exits between variables as they do not jointly impact SMD (Cho et al., 2021; Nkoro & Uko, 2016). Serial-7 of Table indicates model stability as graphed by using CUSUM & CUSUMSQ graphs. The graph under NARDL shows abnormal shocks while results of DW-Statistics under Serial-9 of Table-9 indicate the presence of serial/auto correlation under both approaches as DW-statistics>2.30.

Lastly, discussing ECM (Error Correction Model), table-9 shows respective values of cointeg-Eq (-1)*. The significant p-values show speed of adjustment (SOA). The absolute values show that SMD of Pakistan is converging towards its statistical equilibrium (mean value). The convergence rate (SOA), in case of NARDL, is worth-mentioning, 64.02% Per Annum compared to 32.34% per annum convergence rate in case of ARDL. Hence, NARDL has better predictive power accordingly (K. Ahmed et al., 2021; Bist, 2017; Phuong et al., 2019; Shin, Yu, & Greenwood-Nimmo, 2012).

4.8 CUSUM & CUSUMSQ and Asymmetric Cumulative Dynamic Multipliers

In 1975, Brown, Durbin & Evans, developed a stability measurement tool CUSUM & CUSUMSQ, used for the components of GI & SMD nexus. Figure-1 & Figure-2 denote the two charts. The charts show market ups and downs (abnormality in market as a result of any macro-economic shock) in the form of regression coefficients. The blue line is within lower and upper 5% critical lines in case of ARDL, hence showing no data abnormality in time series data (Chen et al., 2020).

Figure-3 to figure-06, in this study are the proof of asymmetric link amid the variables under NARDL that is basically an asymmetric dynamic graphical presentation of this study. Figure-3 shows bi-directional causality of rule of law into its POS & NEG partial sums in dark-bold-black line & dark-bold-dashed line above & below the zero line. Both LROL(+) and LROL(-), started from zero-line, show steep increase and then become parallel to base line and show asymmetry to SMD. While C.I. asymmetric plot remains parallel to base-line, denoting asymmetric behavior of rule of law in predicting SMD of Pakistan (M. M. Ahmed, 2021; M. A. Khan et al., 2020; Phuong, 2020; Uzelac et al., 2020).

Figure-4 shows that both Positive and Negative multipliers of regulatory quality (RQ) lie above base/zero line. Both multipliers started from zero line, but LREGQUAL(-) shows a steep upward trend with dark-dashed-black line & it remains above LREGQUAL(+), that denotes partial NEG sums have significant impact on SMD. While LREGQUAL(+) shows its normal direction with dark-black-bold line. The asymmetric plot with (C.I.), shows a steep upward trend and it crosses both POS & NEG dynamic cumulative multiplier, showing higher level of asymmetric impact of its NEG decomposition on SMD of Pakistan with a significant negative coefficient value of -7.32 as already discussed in Table-7 (M. A. Khan et al., 2020).
The asymmetric C.I. plot of he asymmetric plot (with C.I.), also the positive multiplier shows asymmetry, but it lies above the base line, though it lies in between the 5% lower & upper bound critical dotted-red-lines are also well below the base line to show graphically the effects of asymmetries of voice and accountability on stock market development of Pakistan. The asymmetric plot shows a continuous and significant increased non-linearity (Charfeddine & Barkat, 2020).

Figure-5 is opposite in direction compared to figure-4 that deals with 3rd variable, voice and accountability (V&A). Both POS & NEG multipliers of voice and accountability lie below base line, referring to abnormal reactions of ACDM (asymmetric cumulative dynamics multipliers) of V&A for SMD. The positive multiplier shows steep downward trend and it goes below the negative multiplier. It is interesting to note that asymmetric plot (with C.I.), denoted by dashed-red-color dotted line shows a strait steep downward started from base-line and it went outside the range of LV&A(POS), denoting significant signs of asymmetry amid SMD & voice and accountability that extend the discussion of Table-7 (Ming & Jais, 2021; Modugu & Dempere, 2020). The asymmetric C.I. plot of LV&A-POS shows significant impact that Granger because SMD compared to LV&A-NEG. The 5% lower & upper bound critical dotted-red-lines are also well below the base line to show graphically the effects of asymmetries of voice and accountability on stock market development of Pakistan. The asymmetric plot shows a continuous and significant increased non-linearity (Charfeddine & Barkat, 2020).

Figure-6 shows asymmetries of PS&AVT into its POS & NEG partial decomposition. The behavior of multipliers for PS&AVT (+) has been denoted by dark-bold-black line that lies below in a negative area, i.e., below the zero line, while PS&AVT (-) lies above the zero line. Figure-6 also indicates, both lines started from below the zero line and went into opposite directions showing inverse link of PS&AVT with SMD. The asymmetric plot (with C.I.), also started from below the zero/base line. After deep downward trend, it shows a parallel trend to zero line but went above the base-line. The decision rule is asymmetric plot (with C.I.) must follow base-line to avoid asymmetry, but it lies above the base line, though it lies in between the POS & NEG multipliers (Abdul Rahman & Saif, 2020; Haseeb et al., 2019; Uzelac et al., 2020).
6. Conclusion and Recommendations

The scope of this research has been to investigate and elaborate the complex and hidden symmetric and asymmetric dynamics amid the selected components of governance indicators and sustainable SMD of Pakistan by using annual time series data (1996-2020) for 25 years. Governance indicators are actually proxies for various financial and non-financial institutions. The empirical calculations affirm asymmetric associations framed in models and recursive measurements. The asymmetrical investigation shall facilitate sound stock market and mitigate undue volatility and prevailing risks. Ignoring the intrinsic hidden asymmetries will lead to misrepresentative implications regarding sustainable stock market growth of Pakistan. Governance indicators directly matter for stock price volatility/liquidity to promote sustainable SMD of Pakistan. The study indicates that rule of law does not impact SMD under ARDL frame. Regulatory quality of institutions and voice & accountability significantly impact sustainable SMD. While, political stability has no direct and immediate impact on the stock market performance. Under ARDL frame, regulatory quality indicates better predictive power to test the performance of stock market of Pakistan. It denotes the extra ordinary stringent regulations; complex or complicated procedures do not promote SMD of Pakistan. It is worth-mentioning that ROL alone does not impact SMD, rather the joint impact of related regulatory and financial institutions is the pre-requisite for developing equity market. Further, V&A does not work in vacuum, rather it needs support from the other three components. It is advisable for portfolio managers and government agencies to take into consideration the individual behavior of components of governance indicators.

The recommendations given by NARDL frame have been more practical, scientific and valid. It refers that both increase/decrease in rule of law have significant and positive impact on SMD of Pakistan, indicating a significant contrast in policy recommendations. It suggests that magnitude of strictness of laws is not always desirable to flourish financial markets. It can be seen that impact of deterioration in RQ is more harmful to the sustainable financial growth than its improvement. The desirable/technical relaxed quality of regulations is helpful to recruit new investors in the short-run. One of the distinct and vital policy recommendations is PS&AVT has an immense underlying role in reshaping the performance of stock market of Pakistan. The impact of political instability is prompt & highly significant on the sustainability of equity market in Pakistan due to extreme chaos among investors. No doubt, the role of voice and accountability in policy formulation cannot be ignored, but relaxed, formal and scientific methods of accountability also play a positive role in achieving sustainable equity market development in Pakistan.

The findings of this study are helpful for regulators and policymakers to recommend stringent reforms pertaining to sustainable improvement in different institution’s quality that would significantly affect sustainable stock market returns and liquidity. From future research perspective, the results provide a line of hints of possible dimensions due to POS & NEG shocks in explanatory variables. The short-run and long-run asymmetries or non-linearities do arise in four components/dimensions of GI, which create joint sustainable increment for SMD. These study further points out the relevant and irrelevant market forces to achieve sustainable SMD in Pakistan. Therefore, policymakers must pay consideration directly to the forces and powers that hinder sustainable performance of local stock market. To better understand these implications of the results, future studies must incorporate all the components of GI. It will be a good tool to magnify the overall sustainable economic growth of Pakistan. This study will practically contribute in policy-making at various operational or strategic level. The findings of this study can be used for designing an 'investment analytical software' that will help to enhance economic sustainability and financial decisions accordingly.

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