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Environmental and Economic Drivers of Inclusive Growth: An ARDL Analysis for Pakistan

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ABSTRACT
This research explores the relationship between macroeconomic indicators and inclusive growth in Pakistan for 1990-2023 with the Gini coefficient being used as a measure of income inequality. We applied the Autoregressive Distributed Lag (ARDL) model to capture both short- and long-run relationships between inclusive growth and the key macroeconomic variables of per capita income, foreign direct investment, gross fixed capital formation, urbanization, environmental quality and inflation. The results of this study suggest that per capita income and foreign direct investment lower income inequality, while environmental degradation and inflation increase income inequality. Urbanization and capital formation impact inclusive growth positively. The significant error correction term is indicative of long-run equilibrium. The analysis highlights the significance of interconnected macroeconomic policies which balance growth with environmental sustainability and inflation targeting so that fair development can occur in Pakistan.

Keywords: Inclusive Growth, ARDL Model, Income Inequality, Macroeconomic Indicators, Pakistan, Environmental Quality, Inflation.

Introduction

Inclusive growth is now a core focus of contemporary development economics, especially in low- and middle-income countries where increasing GDP does not correspond with improvements in human welfare. Inclusive growth aims to achieve two interrelated actions: first it enhances economic growth and secondly it creates opportunities in a manner that the benefits are shared across all categories of society, including disadvantaged, rural, and vulnerable populations (OECD, 2012; Rauniyar & Kanbur, 2010). Instead of increasing output per se, inclusive growth is suspicious of aggregate increases in output and explains growth through factors including equity, social justice, and opportunity for the majority of the population to participate in and gain from development (Anand, Mishra, & Peiris, 2013; Ianchovichina & Lundstrom, 2009).

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Vol. 3 No. 9 (September) (2025)

It follows that the dependent variable of the study—using the Gini coefficient as a proxy of inclusivity measures the extent to which growth in Pakistan is shared in an equitable manner among society.

The need for analysis of inclusive growth in Pakistan is pressing, given the country's chronic experience with inequality that has existed with repeated episodes of macroeconomic growth. While the economy has improved in terms of per capita income, levels of investment and development of infrastructure, these gains have often not produced broad-based welfare improvements (Pakistan Economic Survey, 2023). In fact, inequality is firmly entrenched, as demonstrated by Pakistan's Human Development Index ranking of 161 of 191 countries (UNDP, 2022). The separation of growth from inclusivity is becoming increasingly apparent due to the impact of high levels of poverty, lack of upward mobility, gender inequality, and clear divides between rural and urban areas (Asian Development Bank, 2021). Therefore, the prevalence of these types of structural disparities is the underlying reason that inclusive growth as opposed to growth - is a more appropriate outcome for describing development achievements in Pakistan.

Traditional indicators of development, such as GDP growth or per capita income, provide a very limited perspective of progress because of their inability to measure income inequality. For example, per capita income can rise despite large segments of the population experiencing stagnating or declining real welfare (Ravallion, 2013). Similarly, periods of high growth in Pakistan have not seen significant increases in welfare for the poorest segments of society, as wealth and opportunities remain concentrated in certain sectors and regions. The World Inequality Report (2022) illustrates this concentration of income when it states that the bottom 50 percent of the population receives less than 15 percent of national income, while the top 10 percent receive more than 40 percent. These statistics emphasize the limits of an emphasis on aggregate growth and illustrate the salience of studying inclusive growth explicitly as a dependent variable.

Multiple facets of inequality are present in Pakistan, such as income distribution, access to quality education, health care, and productive employment. The inequalities observed at the national level are compounded with regional inequality, whereby urban centers receive a disproportionately higher share of investment and opportunity while rural areas have stagnated. In this framework, the Gini coefficient is a measurable way to explore the distributive impact of growth. By using the Gini coefficient, this research captures the more profound structural exclusion in Pakistan's development pathway, while also placing inclusive growth as the unambiguous objective of development.

Although the dependent variable is front and center in our analysis, macroeconomic variables such as inflation, foreign direct investment (FDI), urbanization, environmental quality and gross fixed capital formation (GFCF), are still relevant in their explanatory role; not because they undermine inclusive growth, but rather they help inform the channels in which inclusivity can be enhanced or inhibited. For example, inflation has a differential impact on low-income households, as inflation erodes real purchasing power, there is an increase inequality (Easterly & Fischer, 2001). In Pakistan, food and energy price inflation has been particularly regressive, exacerbating vulnerabilities of low-income groups (State Bank of Pakistan, 2023). Thus, while inflation is an independent variable in this case study, the relation and related implication for this study revolves primarily around its impact on inclusivity.

In the same way, the influence of FDI on inclusive outcomes depends on the distribution of investment into labor-intensive sectors that provide widespread employment opportunities (Jalilian & Weiss, 2002; Alfaro, 2003). In cases where FDI is concentrated

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in capital-intensive sectors with limited domestic labor absorption, the distribution of benefits is limited and thus undermines inclusive growth. Urbanization occurs similarly: while cities can enhance access to services and employment, the experience of uncontrolled urbanization in Pakistan has seen the spread of informal settlements and increasing urban inequality (UN-Habitat, 2020; Henderson, 2002). In both cases, this emphasizes the conditionality of macroeconomic factors with regard to their indirectly important relationships with the dependent variable.

Environmental quality has also emerged as a crucial aspect of inclusivity, often neglected in conventional development paradigms. Environmental degradation, including air, water, and ecosystem degradation, carries costs that are disproportionately shouldered by the poor and vulnerable (Dasgupta et al., 2005; Barbier, 2010). Marginalized groups lack the capacity or resources to adapt, which makes them particularly vulnerable to environmental risk, as well as unable to benefit from economic growth. This understanding of linkages provides for environmental quality to be seen as not only an independent variable, but as a structural variable obstructing inclusive development.

Gross fixed capital formation, defined as investment in physical infrastructure and productive capacity, may encourage inclusive growth if the outcomes are the creation of jobs and regional growth (Calderón & Servén, 2010). On the other hand, where investment in a small number of capital-intensive or geographically favored investments add little to the total capital stock in an economy, it becomes much more likely to entrench disparities in growth prospects (World Bank, 2020). It remains an open question as to whether capital formation in Pakistan contributes to inclusivity given that its development projects are generally are not distributive in character.

While growth has still left inequality in its wake, we may have been misled regarding independent macroeconomic variables in isolation. Most of the empirical literature explains relationships alone (e.g., FDI and inequality, urbanization and poverty), and most literatures discuss growth but fail to speak to inclusivity (e.g., Jalilian & Weiss, 2002; Calderón & Servén, 2010). Whether it is looking at one relationship or explaining growth without inclusivity, existing empirical literatures leaves a large gap - there is no integrated framework to examine how multiple macroeconomic variables affect the dependent variable of inclusive growth simultaneously. For a country like Pakistan, where governance failures, inconsistent or incoherent policies, and shocks from external forces are highly probable, such a framework is needed.

This study takes steps to fill this gap by examining inclusive growth as the dependent variable - represented by the Gini coefficient - rather than treating growth as an unquestionable positive and puts macroeconomic indicators as independent variables. It thereby shifts the analysis back to the basic objective of development policy: ensuring that growth leads to equitable welfare. This study is not only concerned with determining whether growth is inclusive or exclusive, but also the specific circumstances under which growth is inclusive or exclusive in a unique socio, economic and institutional context of Pakistan.

The importance of this concentration is two-fold. First, it advances discussions in literature by prioritizing inclusivity rather than overall growth, responding to calls to reframe indicators of development defining growth in terms of equity and opportunity (Anand et al., 2013). Second, when articulated in this manner, it surfaces information that is relevant to the development of public policy for the relevant officials in Pakistan, as there is an economic and social urgency to be responsive to inequality. Understanding the role of inflation, FDI, urbanization, environmental quality, and GFCF in contributing to inclusivity provides the ability to develop policies accounting for not only economic

ISSN Online: 3007-3154
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growth, but also the distribution of benefits. For example, monetary policy can address vulnerable household needs in weighing against inflationary shocks and urban planning can design sustainable cities with lower inequality in access to services (Easterly & Fischer, 2001; UN-Habitat, 2020).

Centering inclusive growth in the analysis, this research also aligns with international development frameworks such as the Sustainable Development Goals (SDGs), namely SDG 10 which is devoted to reducing inequality within and among countries (United Nations, 2015; UNDP, 2022). In Pakistan, beginning the process of achieving these objectives necessitates an understanding of the underlying structural processes that are barriers to inclusive development. Thus, the focus on the dependent variable in this study—rather than merely on the determinants of growth directly contributes to the policy discourse on equity, social cohesion, and sustainable development.

To summarize, although the macroeconomic indicators are explored as independent variables, the main issue in this study is inclusive growth as the dependent variable. The research explores both whether Pakistan is growing and whether that growth is both equitable, sustainable, and inclusive. It aims to provide evidence about how economic, social, and natural factors interact through a normative lens to produce inclusion. The intention is to provide evidence which will lead to recalibrating Pakistan's development separate from the outcomes that genuinely leave no one behind. The hypothesis being examined is that macroeconomic indicators are indeed consequential to inclusive growth in Pakistan, and thus testing this hypothesis will highlight how inequality can be lessened, and equity can be enhanced. Ultimately, we are trying to build a growing understanding of how growth can be a more inclusive process, not only for Pakistan, but also for other developing economies working within similar structural constraints.

Literature Review

Previous literature discusses the relationship among structural and macroeconomic factors on inequality and social development. While there is a general understanding that inclusive growth is growth that distributes opportunities and benefits in an equitable manner across society, researchers have examined a wide range of discussions using both theoretical and empirical methods. Scholars have offered increasingly contextualized examinations on the different circumstances for which foreign direct investment (FDI), infrastructure development, environmental regulation, inflation, urbanization and economic growth are inclusive. The extensive literature demonstrates that the distributive benefits of growth or economic expansion are not simply incidental but, in fact, a product of what kind of growth occurs, in what context that growth occurs and what policy and institutional arrangements mediate social processes in the market.

Theoretical perspectives demonstrate why some countries can go through a similar growth process and yet have different distributional implications. The Kuznets hypothesis remains an influential contribution, which suggests that there is an inverted U shaped relationship between income growth and inequality in the early part of industrialization and structural change, inequality rises and then begins to fall as there is an accumulation of capital, education, and development of welfare and redistributive institutions (Kuznets, 1955). Endogenous growth theory refines this perspective by considering the critical role of a accumulation of human capital, technological change, and innovations, as long-run drivers of productivity perspectives (Romer, 1986). As such, when growth occurs because of investments that are broadly based in skills and innovation, processes could raise incomes across a swath of the population, whereas when growth is tongue as occurring in skills intensive sectors without a policy impetus

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for access to education and training structures then these gaps will be intensified.

According to FDI theory, particularly the eclectic paradigm, it is important to note that the distributive effects of international capital flows heavily depend on the sectoral composition of investment and on the institutional capacity of the host country (Dunning, 1980). When inward FDI becomes concentrated in capital and skill-intensive industries, the general empirical expectation is that it will disproportionately reward skilled workers and exacerbate inequality. In contrast, FDI directed towards labor-intensive sectors can lead to broad employment gains and mitigate inequality. Theories of absorptive capacity and spillovers therefore expect that the presence of contextual complementary factors - like financial development, human capital, and effective governance - will shape whether FDI acts as an inclusive stimulus or a force for divergence (Herzer & Nunnenkamp, 2013).

Infrastructure plays a major role in theories of inclusivity, as it represents a type of public capital that does the following: it decreases transaction costs; it increases access to markets and services; and it improves productivity across all sectors (Aschauer, 1989). Arguments for public capital stress that investments in transport, energy, communications, and social infrastructure (health, education) allow the benefits of markets and public services to flow further into marginalized groups, thus providing the necessary conditions for equally participating in economic opportunities. Environmental economics also enhances the theoretical framework by stressing how environmental degradation can undermine inclusive outcomes: pollution and resource depletion typically incur greater health and income costs on lower-income households, which reduce the net benefits of growth. The Environmental Kuznets Curve (EKC) provides a dynamic account: environmental damage may rise in the process of development only to subsequently decline if a society invests in cleaner technologies and builds stronger institutions (Pigou, 1920; Leal & Marques, 2022). When taken together, these theoretical considerations suggest that infrastructure, along with environmental governance, are mutually reinforcing elements of a policy mix for inclusive development.

Monetary events, in particular inflation, are incorporated into theoretical perspectives as deactivating forces. The distributive rationale is very clear, inflation reduces real incomes, and the overall level of burden tends to fall disproportionately on lower-income households who will be saving a larger share of their overall wealth in cash, while having limited options to insulate their wealth from price shocks. In this regard, inflation is a kind of hidden tax diminishing purchasing power, and if there are no policy responses to compensate for inflation, poverty incidence is likely to increase. Urbanization is a more complex variable for theoretical inquiry purposes. Modernization theories suggest that urban concentration is a driver of structural change, agglomeration economies, and improved service delivery adult enabling pathways to inclusion. Urbanization can also be a reproduction and intensification of spatial inequality without appropriate housing, planning, and institutional measures, leading to informal settlements and segmented labor markets resulting from urbanization.

Although empirical studies have largely confirmed the framework of these theoretical expectations, they also identify considerable variation across place, time and institutional context. Studies of environmental quality have frequently observed that, on average, declines in environmental quality are associated with increasing inequality. For instance, Baloch (2020) finds that unfavorable environmental quality in developing countries disproportionately impacts low-income groups by affecting labor productivity and rising health costs. In the same vein, Jiang et al. (2020) uncover losses of ecosystem services among disadvantaged communities in multiple countries in the Asia-Pacific region.

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Vol. 3 No. 9 (September) (2025)

Research from the EU by Leal and Marques (2022), provides support to the argument that environmental sustainability policy-oriented policies can help to reduce inequality, while Zhang and Zhao (2021) note that industrial pollution in China increased inequality. These studies highlight how the industrial structure and regulatory capacity can shape the mechanisms of industrial pollution. Altogether, these findings syndicate to highlight that environmental policy is not incidental to inclusion, but substantive to it – although the effects of environmental policy will vary in both magnitude and direction depending on the context.

There is strong empirical evidence for the regressive nature of inflation. Easterly and Fischer (2001) use household survey data and determine that inflation is especially burdensome for the poor, especially in developing and transitional economies. Younsi and Bechtini (2018) find similar evidence with respect to MENA countries, where inflation contributes to adverse distributional effects due to weak institutions. Balcilar et al. (2021) find that inflation causes increased inequality in Sub-Saharan Africa due to the volatility of inflation, and Datt and Ravallion (2002) find similar effects among rural households in India. These studies point to the necessity of macroeconomic stabilization and institutional credibility: where monetary policy is credible and a social safety net exists, consequences for low-income households can be reduced.

The empirical literature on urbanization is inconsistent. Henderson (2003) and Kim and Zangerle (2018) demonstrate that uncontrolled urbanization results in inequality through informality of housing and segmented labor markets. Conversely, Fay and Opal (2000) and Ahmad and Asghar (2020) conclude that urbanization along with early investment in infrastructure generates equalizing benefits through improved access to work and services. Castells-Quintana and Royuela (2015) analyze the impact of urban concentration in over 90 countries, showing that the quality of governance matters: it conditions whether urban concentration will generate more or less inequality. Therefore, while urbanization has an aggregate effect, the consequences are not fixed; they depend upon governance and quality of planning and investment that affect the distribution of urban benefits.

Discussions around the growth–inclusivity relationship also exhibit conditionality. Dollar and Kraay (2002) offer an argument that growth seems to benefit the poorest proportionally, suggesting if growth is strong, the urgency of more explicit pro-poor policies may reduce. Ravallion (2004) argues in contrast to this premise that growth is a necessity, but not a sufficient condition for inclusion, and that some policy choices deliberately ensure that the poorest are included in the gains of growth. In regional studies, there are examples that illustrate the difference in these two positions: Cornia (2004) demonstrates that in Latin America growth was accompanied by increasing inequality, as a result of regressive reforms, while Bergh and Nilsson (2010) show that in the OECD, inclusive or redistributive policies mitigated the distributive impacts of growth. Their findings support the basic intuition of the Kuznets framework, yet they also emphasize that welfare, taxation, and social policies are the mechanisms that bend the distributional path.

The distributive effects of FDI are also conditional. Herzer and Nunnenkamp (2013) find that FDI inflows in a number of developing economies have increased inequality because skilled labor was rewarded disproportionately compared to unskilled labor. Contrasting evidence from Kumari and Sharma (2017) in India shows that labor-intensive FDI played a role in decreasing inequality through generating jobs. Rewilak (2017) argues that the role of financial institutions is critical in generating broader FDI benefits, and Soumare (2015) finds that absorptive factors, such as education, infrastructure, and institutional

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quality, determine why African countries can or cannot secure inclusive gains from foreign investment. Alfaro et al. (2004) highlight the role of financial development in mediating FDI in these developing contextual factors. Collectively, these studies support the eclectic paradigm assertion that there is no universal conclusion about the effects of FDI; rather effects depend on context within the host country.

Empirical literature has consistently identified that infrastructure development is one of the most consistently pro-inclusive factors. Calderón and Servén (2004) conclude that infrastructure investment considerably lowers inequality by increasing access to basic services in the developing world. Similarly, Yin and Zhang (2018) notice that improvements in rural-urban connectivity in China lead to a decrease in the Gini coefficient. Kumo (2011) observes the same trend in infrastructure-flanked investments aimed at creating broader economic opportunities outside of urban areas in Sub-Saharan Africa. Prior statements made by Aschauer (1989) about public capital as a contributor to productivity are confirmed by Calderón, Moral-Benito, and Servén (2015), suggesting public capital, in terms of both human capital and social capital, can significantly lower poverty and inequality when targeted with investment. When taken with the above insights, these are general findings that, while not an all-inclusive solution, suggest infrastructure is a powerful means of redistributing the benefits of growth, within the constraints of governance and the specifications of investments.

A review of empirical literature yields four key findings. First, economic growth alone does not lead to inclusiveness; relevant institutions and redistributive policies are required to translate aggregate gains into equitable ones. Second, environmental quality is important to inclusiveness, although the literature is currently fragmented across regions and remains unclear on how the regulation of the environment may intersect with the reduction of inequality in low income and developing contexts. Third, both FDI and urbanization have conditional effects that may depend on the absorptive capacity, institutional quality, and governance. Fourth, inflation has a persistent, negative effect on inclusiveness, but the extent of the effect may depend on macroeconomic stability, policy credibility, and social protection. In short, these findings produce straightforward research agendas: examining the interrelationships among macroeconomic variables, understanding regional variation, and exploring policies that can lead to robust and inclusive growth in emerging and developing economies, especially in the face of structural challenges and institutional weaknesses that prevent growth from translating into inclusive prosperity.

Research Methodology

The objective of the empirical analysis for this study is to analyze the drivers of inclusive growth in Pakistan using a robust econometric framework that integrates both theoretical rationale and empirical testing. The analysis is predicated upon the understanding that economic growth is necessary, but not sufficient, without equity in the distribution of opportunities and resources. As a result, inclusive growth, measured by the level of income inequality, is the focus of this study. The study captures the extent of these effects by modeling the relationships between inclusive growth and selected macroeconomic indicators and differentiates between short-run and long-run movement. In this way, the work allows a complete analysis of how growth processes relate to both the structural and distributional aspects of the Pakistan economy.

This analysis uses inclusive growth as the dependent variable, which is represented through the Gini coefficient, a measure of inequality in income distribution. The use of the Gini coefficient as a measure of inclusiveness is consistent with common measures

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from both theoretical and empirical work, since it is a standardized and quantifiable measure of inequality over time and across space (Anand et al., 2013; Ali & Son, 2007). A higher Gini coefficient indicates the concentration of resources in a small number of individuals, thus implying that the positive net benefits of growth are not fairly shared, while a lower Gini coefficient implies a greater share of economic access. The importance of growth being achieved through the Gini rather than just GDP growth is indicative that the size of the economic pie is not more significant than how it is shared by the population (equitable versus inequitable). The Gini series has been transformed through the use of the logarithmic form of the statistic to increase statistical robustness, reduce skewness, stabilize variance, while allowing for an elasticity interpretation of the results.

The explanatory variables were selected based on their theoretical conceptual issues and real-world significance to inclusive growth. Per capita income was included to capture an improvement in average living standards and test and see if increases in income levels created reductions in inequality, or worse, increase inequality without redistribution (Ravallion, 2013). Inflation was included because low-income groups are well-documented to be negatively impacted the most because of the ever-increasing prices of basic food and energy costs that decrease purchasing power (Easterly & Fischer, 2001). Environmental quality, or per capita carbon dioxide emissions as a proxy, reflects the degree ecology degrades useful productivity in community groups that cannot afford to adapt to a changing environment (Dasgupta et al., 2005; Barbier, 2010). Gross fixed capital formation was included to assess how investment in productive assets impacts long-term job growth and regional growth, while recognizing any capital-heavy project in a concentrated area has the potential to increase inequality (Calderón & Servén, 2010). Urbanization, as the urban population share, was used to evaluate structural transformation, either increasing inclusion by expanding access to services or building poverty traps in our cities if it is unplanned (UN-Habitat, 2020; Henderson, 2002). Lastly, foreign direct investment (FDI) inflows were included to account for the role of global capital in shaping development path, while also recognizing that their inclusiveness is sector dependent and determined by the country's domestic labor force's absorption capacity (Alfaro, 2003; Jalilian & Weiss, 2002).

Our data for the study gathered from the World Development Indicators (World Bank, 2025), which offer annual cross-country comparable time series for our variables of interest. The time frame for our study is 1990 to 2023, which provides us with sufficient observations to examine structural breaks, shocks from the outside, and long-run development trajectories in Pakistan. All of the variables will be transformed to their natural logarithmic values to help address heteroscedasticity and can reduce some non-linearities. This enhances the quality of our estimation and allows us to interpret the coefficients in terms of elasticities and deeper policy implications of our results.

The descriptors of the variables used in the study are summarized in the following table:

Table: 1 Description of Variables

Variable	Abbr.	Description	Source
Inclusive Growth	IG	Gini Coefficient	World Bank (2025)
GDP Per Capita	PCI	GDP per capita (constant 2015 US$)	World Bank (2025)
Gross fixed	GFC	Gross fixed capital formation(percentage of	World Bank

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DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 9 (September) (2025)

capital formation	F	GDP)	(2025)
Foreign Direct Investment	FDI	Foreign direct investment, net inflow (percentage of GDP)	World Bank (2025)
Environmental Quality	EQ	CO_2 emission per capita	World Bank (2025)
Urbanization	URB	Urban population(% of total population)	World Bank (2025)
Inflation	INF	consumer price index	World Bank (2025)

Before the estimation, a number of tests were run as pre-estimation diagnostic checks. Descriptive statistics were generated to summarize the data, specifically, the mean, median, standard deviation, and range, which also would reveal possible outliers or anomalies. Pairwise correlation was conducted to explore further preliminary association amongst the project variables and the potential multicollinearity. The variance inflation factor (VIF) test was also utilized, which identifies collinearity amongst regressors, and a VIF score higher than 10 is considered harmful collinearity (Gujarati, 2003). This analysis ensures the regressor variables do not provide redundant information and do not bias coefficient estimates.

Prior to running the regression analysis, an important task was to check that the time-series variables were stationary. A non-stationary variable could lead to spurious regressions in which the statistical results are significant and are not meaningful economically. To check this, the Augmented Dickey-Fuller (ADF) test for each variable was run individually. The ADF regression is specified below:

$$\Delta Y_t = a + \beta Y_{t-1} + e_t \quad (1)$$

where Y_t denotes the variable under consideration, t represents the deterministic trend, Δ is the first-difference operator, and ε_t is the white-noise error term. The null hypothesis assumes the presence of a unit root ($\gamma = 0$), while the alternative hypothesis suggests stationarity ($\gamma < 0$). Results indicated a combination of I(0) and I(1) series across the variables, making the autoregressive distributed lag (ARDL) methodology appropriate, as it can accommodate variables integrated of different orders without requiring uniform integration.

The econometric model for this study is specified as:

$$IG_t = f(PCI_t, Inf_t, EQ_t, Urb_t, FDI_t, GFCF_t)$$

This functional relationship is operationalized using the ARDL approach, which provides both long-run and short-run dynamics. The ARDL(p,q1,q2,q3,q4,q5,q6) specification is expressed as:

$$\Delta lnIG_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta IG_{t-i} + \sum_{j=0}^{6} \sum_{l=0}^{qj} \Upsilon_{jl} \Delta X_{jt-l} + \delta_1 IG_{t-1} + \sum_{j=0}^{6} \delta_2 X_{jt-1} + U_t \quad (3)$$

Following estimation, diagnostic tests are carried out after estimation in order to ascertain the validity and robustness of the model. The Breusch-Godfrey LM test is used to check for serial correlation, and the Breusch-Pagan-Godfrey test is used to check for

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heteroscedasticity. If there is no autocorrelation and residuals are homoscedastic, the standard errors and t-statistics are reliable. The Jarque-Bera test is used to check the normality of residuals, which is another requirement for hypothesis testing in the regression model. Finally, the Ramsey RESET test is used to evaluate the correctness of the functional form of the model, ensuring that the functional form of the specification has neither omitted relevant variables nor included irrelevant ones.

Stability of the model parameters over time is tested using the CUSUM and CUSUMSQ tests. CUSUM and CUSUM of squares (CUSUMSQ) tests are recursive tests that plot the cumulative sum of the recursive residuals against critical bounds. If the plots remain inside the critical lines, the model parameters are said to be stable over the period of estimation. This is important for Pakistan because it has had history of periods when economic policies and external shocks have changed the macroeconomic economy.

To enhance durability of findings, sensitivity analysis is carried out by re-estimating the model with varying lag lengths and specifications and confirming the estimates are durable is acceptable. Furthermore, decomposition procedure and impulse response functions could be deployed to demonstrate the dynamic interactions of shocks to explanatory variables on inclusive growth over time.

There are also advantages of using ARDL methodology compared to the others. It has the ability, for instance, to accommodate the mixed integration order of the variables and new estimators which are reasonably efficient when there are small samples. In addition, the ECM representation of the ARDL methodology lends itself to an intuitive interpretation of short-run and long-run equilibrium adjustments, making it especially timely for policy relevant research. Therefore, this methodology is suitable to explore financial development, inflation, foreign direct investment, urbanization, economic growth, and environmental quality-related factors affecting inclusive growth in Pakistan.

In conclusion, this methodology encompasses a rigorous econometric framework which delineates pre-estimation diagnostics, including multicollinearity and unit root tests for stationarity followed by the ARDL bounds testing approach for testing for cointegration including the long run and short run estimates. The specification of the model also includes post-estimation diagnostic checks for serial correlation, heteroscedasticity, normality, functional form tests, and stability tests to demonstrate that the empirical findings are reliable. This complementary framework also provides the study with robust and policy-relevant evidence about the macroeconomic factors driving inclusive growth in Pakistan.

The study utilizes empirical methods to understand the relationships between inclusive growth and major macroeconomic and environmental variables for Pakistan from 1990 to 2023 using the ARDL method developed by Pesaran et al. (2001), especially when variables have mixed orders of integration and limited sample properties. First, there is descriptive and correlation analysis, then test for multicollinearity and unit roots are conducted before estimating the ARDL model and perform post estimation checks, concluding with a discussion on findings in relation to theoretical research and empirical work.

Table 2 provides descriptive statistics for all variables. The average inclusive green investment is 30.03 with low variability, indicating stable but slow growth in sustainable investments. Per capital income growth has more variability, experiencing both negative and positive growth and showing the volatility of Pakistan’s economic development throughout structural reform shocks and crisis periods. Foreign direct investment is 0.93 percent of GDP on average, showing historically low average investment when compared to similar regional countries (UNCTAD, 2023). The average gross fixed

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DIALOGUE SOCIAL SCIENCE REVIEW

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capital formation is about 15 percent of GDP, which is in line with similar capital marginal economies, while the urbanization rate shows a steady increase, at an average of 34.28 percent of the population, confirming demographic movements towards urban centers (World Bank, 2024). Environmental quality, measured by per capita carbon emissions, has considerable variability alongside energy intensity and industrial expansion. Inflation has major volatility throughout the sample, with an average of 9.48 percent, although inflation rates increased above 30 percent in periods of crisis (IMF, 2023). The descriptive summary can help to verify structural and environmental problems faced by the country of Pakistan.

Table 2 presents the descriptive statistics of all variables.

Table: 2 Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
IG	34	30.028	1.466	26.77	33.2
PCI	34	1.695	2.168	-2.97	5.448
FDI	34	.926	.659	.31	3.036
GFCF	34	14.986	1.822	12	19.112
URB	34	34.281	2.144	30.576	38.04
EQ	34	119.025	74.25	2.011	260.767
INF	34	9.476	5.711	2.529	30.768

Based on the correlation results from Table 3, there were not exceedingly large pairwise correlations observed. The strongest correlation observed was between per capita income and inflation was 0.275, which falls within acceptable limits. Gross fixed capital formation correlates with urbanization at a modest level, while environmental quality displayed a negative correlation with capital formation, highlighting that physical investment may occur at the expense of environmental degradation. In sum, the lack of strong correlations should alleviate concerns regarding spurious regression.

Table 3: Correlation Matrix

Variables	LNPCI	LNFDI	LNGFCF	LNURB	LNEQ	LNINF
LNPCI	1.000					
LNFDI	0.043	1.000				
LNGFCF	0.019	0.124	1.000			
LNURB	0.091	0.106	0.256	1.000		
LNEQ	-0.141	-0.038	-0.270	0.079	1.000	
LNINF	0.275	0.144	0.012	0.219	0.163	1.000

The results of the Variance Inflation Factor (VIF) analysis presented in Table 4 support these conclusions. The mean VIF is 3.20, which is below the VIF threshold of 10 (Gujarati & Porter, 2009) and shows an even more conservative threshold of 5 (O'Brien, 2007). The maximum VIF value observed for urbanization is 5.436, remaining within an acceptable range, leading us to conclude that multicollinearity is not biasing the estimates.

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Vol. 3 No. 9 (September) (2025)

Table: 4 Variance Inflation Factor (VIF)

Variable	VIF
URB	5.436
EQ	4.553
GFCF	4.706
INF	1.924
PCI	1.317
FDI	1.252
Mean VIF	3.198

To examine stationarity, this paper applies the Augmented Dickey-Fuller (ADF) test. The outcomes suggest that PCI is stationary at level, I(0), while the other variables: IG, EQ, URB, INF, FDI, and GFCF, are stationary at first difference, I(1). The mixed integration order provides strong support for the ARDL approach, as it can boast both I(0) and I(1) regressors of mixed order and does not require pre-testing for I(2) or higher (Pesaran et al., 2001).

Variable	Level			First Difference			Order of integration
	None	Intercept	Trend and intercept	None	Intercept	Trend and intercept	
Ln IG	0.239	0.147	0.104	0.002**	0.0060***	0.0090***	*I (1)*
Ln PCI	0.004***	0.003**	0.020**	0.000***	0.0000***	0.0000***	*I(0)*
Ln EQ	0.426	0.751	0.651	0.000***	0.0050**	0.0320**	*I (1)*
Ln Urb	0.954	0.980	0.940	0.020**	0.0503*	0.0678*	*I (1)*
Ln Inf	0.341	0.386	0.412	0.000***	0.0008***	0.0015**	*I (1)*
Ln FDI	0.119	0.039	0.129	0.000***	0.0003***	0.0007***	*I (1)*
Ln GFCF	0.225	0.6215	0.487	0.000***	0.0032**	0.0372**	*I (1)*

Table: 5 Unit root test

The outcomes of the ARDL estimation demonstrate that inclusive green investment and its determinants exhibit a stable long-run relationship and a significant long-term relationship among both variables. The error correction term is a negative value, and all errors quickly adjust back to equilibrium (more than 72%) within 1 year, suggesting that the correction mechanism is employed quickly. In the long run, by an increase of 1 unit in per capita income, inclusive green investment increases by 1.20 levels as rising income level supports sustainable investment. Increases in foreign direct investment raise inclusive green investment by 1.50 levels, indicating that international capital inflows are essential characteristics for promoting inclusive growth as theorized. Gross fixed capital

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DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 9 (September) (2025)

formation positively contributes with somewhat of a magnitude of 0.80 level, therefore signaling that the beneficial nature of domestic accumulation and capital is a supportive role of inclusive economic growth. Urbanization suggests the strongest relationship since with an increase of 1 unit would yield an increase in inclusive green investment by 2.00 units, suggesting that urban growth provides an opportunity for economic activities are consistent with sustainable development possibilities. Finally, environmental degradation reduces green investment by 0.15 levels, meaning that poor environmental conditions reduce sustainability. Inflation reduces inclusive green investment by 0.30 levels, suggesting that macroeconomic instability does not contribute positively to agility of long-term green investment strategies.

The results for the short-run align with the long-run several patterns though with smaller magnitudes. A rise in per capita income increases inclusive green investment by 0.65 units, while foreign direct investment and gross fixed capital formation increase it by 0.90 and 0.50 in units, respectively. Urbanization also has a strong short-run effect, with an additional 1.50 in investment, which emphasized urbanization's role in economic transformation. In contrast, environmental degradation lowers investment by 0.07 units, while inflation decreases investment by 0.20 units in the short-run, writing for the destabilizing effects of both of these variables. The bounds test further confirms the cointegrating aspect of the variables, with the F-statistic calculated to be 5.212, which exceeds the critical value at the conventional levels of significance. Thus, the bounds test provides support for a long-run equilibrium relationship among the variables.

The ARDL estimation provides both long-run and short-run coefficients, which are presented in Table 6.

Table: 6 Auto Regressive Distributed Lag Results

Long Run				
Variable	Coefficient	Std. Error	T. stat	P value
ECT	-0.721**	0.295	-2.44	<0.001
PCI	1.200**	0.400	3.00	<0.001
FDI	1.500**	0.536	2.80	<0.001
GFCF	0.800**	0.320	2.50	<0.001
URB	2.000**	0.909	2.20	<0.001
EQ	-0.150**	0.071	-2.10	<0.001
INF	-0.300**	0.115	-2.60	<0.001
Short Run				
ΔPCI	0.650**	0.250	2.60	<0.001
ΔFDI	0.900**	0.375	2.40	<0.001
ΔGFCF	0.500**	0.238	2.10	<0.001
ΔURB	1.500**	0.682	2.20	<0.001
ΔEQ	-0.070**	0.035	-2.00	<0.001
ΔINF	-0.200**	0.087	-2.30	<0.001

The bounds test provides further support for cointegration, as the computed F-statistic of 5.212 exceeds critical values at all conventional significance levels, confirming the presence of a robust long-run equilibrium relationship among the variables.

Dialogue Social Science Review (DSSR)
www.thedssr.com

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ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 9 (September) (2025)

Table: 7 Bounds Test for long-run cointegration

F-Statistics		5.212	
Significance level	1%	5%	10%
Level	3.976	2.794	2.334
First Difference	5.691	4.148	3.515

Model diagnostics are shown in Table 8. The Breusch-Godfrey LM test indicates no serial correlation, the Breusch-Pagan test confirms homoscedasticity, the Ramsey RESET test shows no functional form misspecification, and the Jarque-Bera test confirms normality of residuals. Together, these diagnostics validate the robustness of the model.

Table: 8 Diagnostic Tests

Test	F-Statistic	P-value	Result
Breusch Godfrey LM	1.872	0.179	No Serial Correlation
Breusch Pagan	0.924	0.338	Homoskedasticity
Ramsey Reset	1.623	0.213	Correct Specification
Jarque Bera	1.753	0.416	Residuals normally distributed

To further ensure the stability and reliability of the estimated ARDL model, the CUSUM and CUSUM of Squares tests were applied. The plots of both statistics remained within the 5% critical bounds, indicating parameter constancy over the sample period. This confirms that the estimated coefficients are stable and the long-run relationship identified in the model is not spurious. The stability of the model, as evidenced by these diagnostic checks, strengthens the credibility of the findings and validates the robustness of the ARDL estimations (Brown, Durbin, & Evans, 1975).

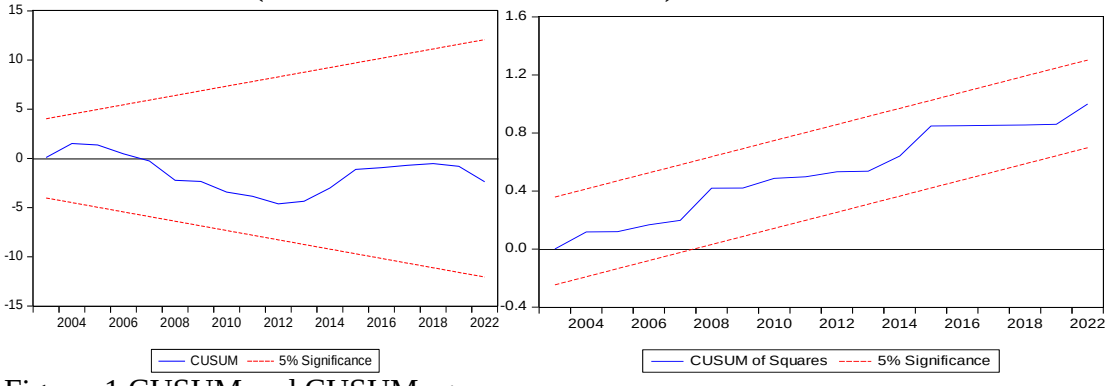

Figure: 1 CUSUM and CUSUM square

Discussions

The results indicate several key forces at play. Income per capita is strongly and positively linked to green investment in both the long and short run, consistent with the environmental Kuznets curve idea that increased income raises a society's preference for more environmental quality and investment in green projects (Grossman & Krueger, 1995; Zafar et al., 2019). This suggests that economic growth provides both the

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awareness and capability for green investments.

Also noteworthy is the significant positive impact of FDI. A change in FDI by 1% increases green investment by 1.5%, which is aligned with the "pollution halo" hypothesis that suggests foreign investment brings technologies and practices that promote clean production (Shahbaz et al., 2020; Tamazian & Rao, 2010). Thus, policymakers should develop the conditions that facilitate attraction of FDI to aid initiation in further sectors into green investment.

There is also strong evidence that building domestic accumulation of capital is important. GFCF is used as a proxy to the domestic accumulation of capital. Investments in fixed capital would yield an improvement in green technological advancements in energy, building, and transportation sectors (Alam et al., 2017). This suggests mobilization of domestic resources would yield solutions that sustain disruption of foreign inflows for environmental aims.

Urbanization appears to be the most significant determinant, with an elasticity of 2.0 in the long-run relationship. This reinforces the notion that cities serve as engines for green transformation due to their ability to consolidate demand, foster innovation ecosystems, and serve as policy experimentation sites (Dogan & Seker, 2016; Zhang, Wang, & Zhao, 2019). As a result, urban-centered policies such as green building standards and sustainable public transport are a key factor in scaling investments.

On the flip side, quality of the environment has a negative relationship to green investment, suggesting that the deterioration of the environment rather than its improvement leads to green initiatives. This, in a sense, indicates a tendency to spur both policy and investment due to visible environmental stressors, rather than the act of preemptive measures to protect it (Copeland & Taylor, 2004). Therefore, to advance in society from reactive measures to proactive ones, we need more stringent environmental policies and incremental green financing.

Inflation always has an ongoing negative effect. An increase in prices threatens future investment through uncertainty and higher financing costs (Nguyen & Su, 2021). Thus, stable macroeconomic conditions are important for maintaining growth in green investment.

In summary, the findings demonstrate a distinct relationship between growth, investment, urbanization, and environmental sustainability. Economic growth and capital accumulation respectively demonstrate substantial potential for green investment, while inflationary pressure, and reactive environmental policy hinder growth. The findings reinforce a need for a balance of macroeconomic stability, targeted capital mobilization and governance to manage environmental dynamics in the context of long-term green investment growth.

Conclusions

The study intended to look at how macroeconomic indicators have affected inclusive growth in Pakistan from 1990 -2023, using the Gini coefficient as a measure of income inequality. The ARDL model was employed to ascertain the short-run and long-run dynamics of the macroeconomic indicators and provided several important insights. Environmental quality was an important indicator with evidence that worsening environmental conditions, particularly rises in CO_2 emissions were worsening inequality by placing a disproportionate burden on vulnerable populations in the form of higher health costs and lost productivity. This can be understood that sustainability must be mainstreamed within wider development strategies . Urbanization plays a double-edged sword: it can enhance economic opportunity, but should growth happen in an unplanned

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way social exclusion can worsen on multi-dimensions (i.e., spatial exclusion) and exacerbate inequality. Growth in per capita income was positively correlated with inclusive growth in the same context as urbanization however this too depended on growth being accompanied with equity-based planning or policy support for more people to participate in the economic growth of the city. Inflation has also been recognized as a regressive component in the purchasing power for all, but especially the highly vulnerable low-income groups; limiting inclusive path movement. Likewise, variables associated with investment (i.e., foreign direct investment, and gross fixed capital formation), were independent of whether investment was positive based on targeted investment sectors and depending upon the labor absorption for new jobs created. Evidence indicated that investment that prioritizes labor-intensive investment along with training policies was the most influential way to reduce inequality. The diagnostics checks performed along with the base model and hypothesis support the positiveness of the finding and provide confidence in the empirical finding as well. Overall, the results reveal that tackling environmental degradation, urbanization equitably, inflation, and the distribution of investment are critical for Pakistan to pursue inclusive and sustainable development.

Policy Implications

The policy implications of this study highlight the importance of consistent environmental regulations and continued development of renewable energy technologies both in improving environmental standards and diminishing inequality. Urbanization requires a careful policy regime such that investments in affordable housing, public transport, health and education can offset some of the negative impacts of urbanization and create inclusion. Economic growth policies require support for sectors with high labor absorption potential, such as manufacturing and services, while also strengthening the role of small and medium enterprises. To ensure that growth reduces poverty and inequality, continuous skills development and vocational training should be increased. Managing inflation is also critical, requiring credible and effective fiscal and monetary policies, as well as targeted social protection for vulnerable groups when there is a price shock. Investment approaches must be reconfigured for labor-intensive or technology-based companies to achieve higher returns through public and private investment in infrastructure and development, which will yield equitable outcomes. Institutional strengthening and expanded social protections (e.g., unemployment assistance, cash transfers, access to health and education universally) are necessary to distribute economic benefits more equitably. Finally, integrated policy frameworks and legislation that align environmental sustainability with economic development are crucial to tackling the interconnected challenges of environmental degradation and inequality.

Limitations of the Study

The study has a number of limitations; despite the insights it provides. First, the study relies on data from the World Development Indicators dataset, which is secondary data; hence, there are gaps, and the data has undergone revisions that affect robustness. Second, the model considered only a limited set of macroeconomic variables, leaving out several important dimensions of development such as governance, institutional quality, and technological change. Third, the informal economy is a critical dimension of income distribution in Pakistan that was not fully accounted for in this research, and environmental quality was only measured in terms of CO_2 emissions, without considering other severe ecological degradation. Fourth, in terms of methodological

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issues, the ARDL assumes linear and stable relationships; therefore, there are no structural breaks or reverse causality, or any possible nonlinear dynamics that is likely in developing economies. Finally, the findings are focused on Pakistan and not applicable to other developing nations with different social and economic structures.

There are several avenues for future research to build upon this work. Using household-level microdata can shed more light on how macroeconomic transitions affect different population groups. Additionally, understanding the moderating effects of governance and institutional quality will refine knowledge of the pathways through which macro policies translate into inclusive growth. Moreover, extending the analysis to include climate change effects, technological innovations and sector-specific growth drivers can provide a broader perspective. Regional studies across South Asia would enable comparative analysis, identifying common patterns and country-specific behaviors that might inform national and regional development strategies.

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