

The Role of Infrastructure, Trade dynamics and Governance in influencing Economic Growth in India: A Quantile Regression Approach

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Abstract:

This study aims to examine the heterogeneous effects of Infrastructure, FDI, Trade openness and governance indicators (Political Stability, Voice and Accountability, Control of Corruption and Regulatory Quality) on GDP growth in the Indian economy. This study adopts quantile regression methodology to figure out the influence of these variables on GDP growth across its distribution, yielding insights beyond the average effects, the findings conclude that Infrastructure is a critical driver of growth GDP growth over the quantiles, Trade Openness and Regulatory Quality show positive influence over the higher quantiles and PSAV having negative effect over growth. The study concludes that policy measures should be tailored according to the growth phases focusing on improving state of governance and fostering sustainable and balanced economic growth in Indian Economy.

Keywords: Economic Growth, Governance, Trade, Infrastructure, Regulatory Quality, Indian Economy

1. Introduction

In developing nations like India, a number of factors, such as infrastructure, trade openness, governance quality, and foreign direct investment (FDI), interact intricately to drive economic growth. Even though India's economy is one of the fastest-growing in the world, differences in growth rates between states and regions show how important it is to have more granular insights regarding the factors that influence economic growth. Prior research has emphasized the role that trade openness and foreign direct investment (FDI) play in boosting GDP growth through improved productivity, knowledge transfer, and capital flows (Kaur & Sidhu, 2021). In the same way, infrastructure quality has been found to be a crucial growth enabler that affects connectivity and productivity (Banerjee et al., 2020). By affecting investor confidence and institutional effectiveness, governance factors such as political stability, corruption control, and regulatory quality further mold the economic environment (Mishra & Kumar, 2022). Understanding how these elements work together to affect growth dynamics across India's various growth quantiles is still lacking, though. The variety in these interactions is often obscured by linear regression models, which provide a less granular perspective. For example, areas with strong GDP growth could react differently to governance reforms or foreign direct investment than areas with low growth (Sharma et al., 2023). Furthermore, there is still a limited number of research on the function of governance metrics like Voice and Accountability and the Political Stability and Absence of Violence Index in India. By using a quantile regression technique, this work aims to close these gaps and provide a comprehensive knowledge of the varying effects of these variables spanning the growth continuum.

This study aims to explore the complex interrelationships among India's governance, infrastructure, trade dynamics, and economic growth, demonstrating the varied effects these factors have at various economic growth levels through adopting a quantile regression approach. With regard to this, key research questions the study addresses are as follows:

RQ1: What implications trade openness and foreign direct investment have on GDP growth across quantiles?

RQ2: How does the development of infrastructure affect economic growth at different rates of growth?

RQ3: To what extent do political stability, regulatory quality, and control of corruption shape economic outcomes across high- and low-growth spans?

RQ4: How does the Voice and Accountability index affect the resilience of the economy?

This study uniquely contributes to the existing literature in examining the heterogeneous effects of trade dynamics, infrastructure, and governance on India's GDP by employing the quantile regression approach which helps to reveal the granular insights related to different growth quantiles. The integration of governance indicators with trade openness, FDI and infrastructure indicators give a more nuanced overview which is a limitation of the existing literature (Verma & Singh, 2023). For this analysis, the quantile regression method of Koenker and Bassett (1978) is adopted. The primary advantage of quantile regression over the least-squares regression is to model data with a wide range of conditional distributions. Therefore, when a set of percentiles is modelled, quantile regression provides a more detailed picture of the covariate effect on the covariates, as compared to other methods of linear estimation that most often appear in the literature. It also does not assume a distribution for the model's error term (Koenker and Hallock, 2001). The findings are supposed to provide more nuanced insights across different growth quantiles to enable specific policymaking for boosting economic growth.

This study's remaining sections are arranged as follows. The key literature on the factors influencing economic growth in India is reviewed in Section 2. The methodological framework, including the quantile regression technique and data sources, is described in detail in Section 3. The empirical data and their consequences are presented in Section 4. Section 5 brings the study to a conclusion by providing a summary of the main findings and policy suggestions for promoting equitable and sustainable growth in India.

2. Review of Literature

2.1 Theoretical Framework

A numerous theories pertain to economic growth studying its dynamics and offering perspectives regarding the factors instrumental in it. The foundational theories are the Classical growth theories of Adam Smith (1776) & David Ricardo (1817). Their theories concentrate on the pertinent role of capital, labour and natural resources. Smith employs the idea that a liberalized market regulates itself without much intervention and the economies should focus on producing goods based on their own specialization to gain an advantage in trade. Ricardo offered an expansion on this concept by propounding that even if the absolute advantage scenario exists, yet the importance of trade cannot be underestimated for economic growth, thereby, increasing efficiency (Esfahani & Ramírez, 1999). Another key aspect was introduced by the Solow Swan Growth Model (1956) shifting the concentration towards the importance of institutional indicators and infrastructure for economic growth (Carlsson et al., 2013). The importance of institutional quality for economic growth is also evidenced by the Endogenous Growth Theory introduced by Paul Romer (1986) and Robert Lucas (1988) which posits that policy measures, knowledge and innovation act as critical drivers of economic growth (Bowden & Huang, 2009). A noteworthy point is established by Raúl Prebisch (1950) and Andre Gunder Frank (1967) in the Dependency Theory that reforms in governance and infrastructure promotion shall aid in reducing trade dependency for developing economies and thereby helping to cope up with inefficiencies in trade dynamics. The framework of New Institutional Economics propounded by Douglas North (1990) also focuses on importance of institutional framework encompassing governance, reduced corruption and accountability to ensure sustained economic growth (Nazir & Anwar, 2013). Against the backdrop of these theories, the study follows the Endogenous Growth Theory striving to gain conclusive insights regarding the role of FDI, Trade, Infrastructure, and Governance indicators towards promoting economic growth.

2.2 FDI, Trade Dynamics, Governance and Economic Growth

The relationship between economic growth and foreign direct investment has been critical in examining the link between economic growth and FDI. The initial work on FDI and economic growth deduces that the interlinkage between FDI and economic growth is not statistically significant in an average growth scenario, but FDI helps to augment growth when other factors contribute towards it including the infrastructural framework and institutional environment (Borensztein et al., 1998). Foreign direct investment is found to foster growth through capital, technology spillovers and creating more employment opportunities. Wong and Wing (2011) also favour the notion of (Borensztein et al., 1998) by using a different measure of education quality. Kiviyiro & Arminen (2015) carried out a study on the economies in Eastern Central Africa and opined that FDI holds significance for the economic growth of countries like Rwanda and Tanzania, whereas economic growth was also found to drive FDI, demonstrating a causal relationship. Studies also give evidence for governance as significant for GDP growth and FDI nexus; Tiwari & Mutascu (2011) stressed that institutional

stability improves the FDI growth effect. Furthermore, Agrawal (2015) observed that FDI is more important in developing economies, whereas Wang et al. (2020) stressed that the role of technology-based FDI may be more important to GDP growth in Asia, and as increasing technology-driven FDI accumulated, it becomes increasingly important to GDP growth. These findings together shed light on the complex interplay between FDI and GDP.

Trade liberalization has long been recognized as a key factor in determining economic growth by increasing competition, promoting specialization, and opening up global markets. Seminal research by Edwards (1998) posited that increasing openness to trade leads to more rapid GDP growth because it promotes the diffusion of knowledge and efficiency gains. In a similar vein, Frankel & Romer (1999) showed that trade spurs innovation and capital accumulation, thus enhancing the openness-GDP association. Wacziarg & Welch (2003) estimated a causal impact of trade liberalization on GDP growth, finding that liberalization increases GDP growth by about 1.5% on average, especially in case of low- and middle-income countries. Kruegar (1988) stated that the gains from trade liberalization are only fully realized with sound domestic policies such as infrastructure improvement and institution changes. The meta-analysis of Sachs & Warner (1995) confirmed again the importance of trade openness and integration into global value chains for long-run GDP growth. Finally, Chang et al. (2005) suggested a more complex view, positing that while trade openness generally contributes to GDP growth, it can lead to economic volatility, especially in developing countries.

Infrastructure development is a pillar of economic growth as it lowers transaction costs, increases productivity and enables trade. Esfahani & Ramírez (1999) showed that investments in energy and transportation infrastructure have a positive effect on GDP, especially in developing economies. Sahoo & Dash (2012) carried out a study to figure out the long-run relationship between infrastructure and GDP for South Asia and advocated the complementary nature of human capital and institutional support. Another study by Bowden & Huang (2009) Focused on the importance of investment in infrastructure and its interaction with trade which was found to accelerate GDP growth. Further studies by Meng (2012) focused on the contribution of availability of transportation facilities including roads and railways on growth prospects. Another noteworthy study by Wen and Lyu (2019) which studied the Belt and Road strategy and figured out that the strategy has significant effect on augmenting GDP growth in all those countries which were involved through development in trade linkages and infrastructure. Another key study which advocates the significant role of infrastructure is by Rosmeli (2018) which posits that infrastructure beholds potential to sustain an inclusive and stable economic growth. In a nutshell, all these studies confirm that infrastructure carries relevance beyond its physical existence in promoting sustainable economic growth.

Governance is gaining relevance as a pertinent determinant of economic growth because it ensures transparency, reduces corruption, thereby helping to gain investors' confidence which helps in capital building and also promotes resource allocation efficiently. A study by North (1990) posited that institutions play a major role in increasing economic growth by giving efficient frameworks for contract enforcement and securing intellectual property rights. The noteworthy contribution has been given by Kauffman et al. (2005) in the form of Worldwide Governance Indicators, which present a framework for measuring the governance quality in an economy. This relationship between governance quality and economic development was studied by Acemoglu and Robinson (2012), who concluded that existence of institutional framework helps in equitable resource allocation, thereby leading to sustained economic growth. Other empirical studies by Nazir and Anwar (2013), emphasised the significance of accountability and transparency with GDP growth. Rodrik (2008) concluded that governance acts as a moderator on the effect of the major growth drivers that are trade and FDI, thereby augmenting their influence on economic growth, which is indicated by GDP. The recent studies by Brueckner 2021 also advocated the ability of governance, efficiency, effectiveness to transform an economy, especially the developing economy, and pave the way for economic growth. These findings provide evidence that governance indicators are playing a significant role in economic growth in the present era.

Several studies have analysed the effect of FDI, Trade Dynamics, Infrastructure and governance indicators on FDI inflows at the global level and for different subcontinents. These studies emphasize that a strong institutional framework, characterized by political stability and effective governance, is vital for ensuring sustained economic growth. There are fewer number of studies found applying quantile regression to explore the influence of governance factors (political stability, rule of law, control of corruption) on GDP growth specific to India, especially in the context of recent developments. However, these studies generally focus on linear methods or aggregate data, overlooking the heterogeneity of FDI responses across different quantiles of GDP distributions (i.e., the influence may differ for low and high growth

phases). The evolving dynamics also make this research more crucial, as the governance-growth relationship is likely to vary significantly across different phases of growth. Therefore, a study using quantile regression methods could offer valuable new insights. Understanding these effects across quantiles can provide deeper insights into which types of FDI are most sensitive to governance improvements, a perspective relatively underexplored in the current literature.

3. Data Description and Model Specification:

The data set constitutes yearly observations from 2000 to 2023 for the Indian economy. The required data series were obtained from World Development Indicators and the governance indicators are obtained from World Governance Indicators by World Bank. The dependent variable in the study is the GDP and the independent variables that are expected to influence GDP are chosen based on previous literature. The independent variables include FDI inflows, infrastructure, trade openness, political stability and absence of violence, voice and accountability, control of corruption and regulatory quality. The Infrastructure Index is measured by indexing Air Transport, freight (million-ton kilometre), Individuals using the internet (percentage of population), fixed telephone subscriptions per 100 people and per capita energy consumption. The dependent variable i.e. GDP growth is represented as log-difference of GDP and FDI inflows is also considered as log-difference of FDI, thereby capturing the short-term growth dynamics (Barro, 1991; Borenztein et al., 1998). The estimation model employed in this study is:

$$Q_{\tau}(\Delta \ln GDP_t | X_t) = \beta_{0\tau} + \beta_{1\tau} \Delta \ln FDI_t + \beta_{2\tau} \ln Infra_t + \beta_{3\tau} \ln Trade_t + \beta_{4\tau} PSAV_t + \beta_{5\tau} VAC_t + \beta_{6\tau} CORR_t + \beta_{7\tau} RQ_t + \epsilon_{\tau t}$$

Where, $\Delta \ln GDP_t | X_t$ represents the conditional quantile of GDP growth at time t , in the presence of independent variables X_t

τ (Quantile) = 0.10, 0.20, 0.30, 0.40, 0.50, 0.60, 0.70, 0.80, 0.90th quantiles

$\beta_{i\tau}$ represents the coefficients of each explanatory variable at quantile τ

$\Delta \ln FDI_t$ is the growth rate of FDI inflows at time t

$\ln Infra_t$ is the log of infrastructure index at time t . The infrastructure index is constructed as

$$INF_{jt} = \frac{X_{jt}}{X_{jt-1}} \times 100$$

X_{jt} represents the j^{th} specific indicator at time t and INF_{jt} is the percentage index of that specific indicator. Subsequently, the percentage index is summed up and averaged to compute a single index:

$$INFRA_t = \sum_j \frac{INF_{jt}}{4}$$

$\ln Trade_t$ is the log of trade openness at time t

$PSAV_t$ is the Political Stability and Absence of Violence indicator at time t , scores ranging between -2.5 to 2.5

VAC_t is the Voice and Accountability indicator at time t , scores ranging between -2.5 to 2.5

$CORR_t$ is the Control of Corruption indicator at time t , scores ranging between -2.5 to 2.5

RQ_t is the Regulatory Quality indicator at time t , scores ranging between -2.5 to 2.5

3.1 Hypothesis of the Study:

Based on the review of literature and the research questions to be addressed in this study, the hypothesis formulations are presented as follows:

H_{1A} : FDI growth rate has a statistically significant effect varying across the conditional quantiles of GDP growth rate.

H_{2A} : Infrastructure has a statistically significant effect varying across the conditional quantiles of GDP growth rate.

H_{3A} : Trade Openness has a statistically significant effect varying across the quantiles of GDP growth rate.

H_{4A} : Political Stability and Absence of Violence (PSAV) has a statistically significant influence varying across the quantiles of GDP growth rate.

H_{5A} : Voice and Accountability (VAC) has a statistically significant influence varying across the quantiles of GDP growth rate.

H_{6A} : Control of Corruption (CORR) has a statistically significant influence varying across the quantiles of GDP growth rate.

H_{7A} : Regulatory Quality (RQ) has a statistically significant influence varying across the quantiles of GDP growth rate.

This study applies quantile regression to study the relationship between FDI, Infrastructure, Trade Openness, Governance Indicators and GDP across different quantiles of the distribution of GDP. The method applied covers the heterogeneous effect that are generally underestimated in OLS regression models (Koenker & Basset, 1978). Ordinary Least Squares assumes stationarity in the predictors for unbiased and consistent parameters but quantile regression is robust to this imperative. Quantile regression enables a more in-depth understanding of the effect of explanatory variables on not only the average but also on high and low growth phases (Davino et al., 2013). Another favorable attribute of quantile regression is that it is less affected by the presence of outliers and extreme values in comparison to traditional OLS regression which makes it robust for macroeconomic data (Cade & Noon, 2003). Buchinsky (1998) has stated that quantile regression is adaptable to distributions that are skewed which is a common feature in macroeconomic scenario. Moreover, OLS regression assumes linearity in the data, whereas quantile regression enables the flexibility of studying non-linear effects by expanding its horizon towards studying the effect across quantiles (Fitzenberger & Wilke, 2015). Figure 1 demonstrates the non-linearity in the relationship between GDP and the explanatory variables.

Figure 1: Scatterplots showing Non-Linearity between GDP and the Explanatory Variables



Source: Author's Computation using Gretl

3.2 Descriptive Statistics:

Table 1: Descriptive Statistics of all Variables

Variable	$\Delta \ln \text{GDP}$	$\Delta \ln \text{FDI}$	$\ln \text{Infra}$	$\ln \text{Trade}$	PSAV	VAC	CORR	RQ
Mean	0.08525	0.10684	4.68756	3.74028	-0.9294	0.4257	-0.2032	0.00842
Median	0.07166	0.16743	4.68726	3.79573	-0.9365	0.45075	-0.1092	0.00703
Min	0.25777	0.98097	4.91619	4.02159	-0.5383	0.57134	0.16838	0.25844
Max	-0.0583	-0.5615	4.55577	3.25771	-1.5145	0.22526	-0.5663	-0.2964
Std. Dev.	0.07724	0.35218	0.07889	0.21669	0.25150	0.09646	0.24508	0.17975
Kurtosis	0.37594	0.22212	1.32937	-0.8552	-0.5146	-0.4978	-0.1762	-0.1231
Skewness	2.59156	3.1479	4.97909	2.93413	2.81529	2.38557	1.44644	1.74731

Source: Author's Computation

The descriptive statistics presented in Table 1 reveals that the average GDP growth rate is around 8.5%. And the median value suggesting that most of the observations fall below the average at 7.2%. The standard deviation shows moderate variability in GDP growth rates over the. of 2000 to 2023. The growth rate of GDP is at an average of 10.7% with a median higher than the mean and standard deviation reflecting high variability in comparison to GDP. The highest standard deviation is exhibited by FDI reflecting this significant variability and the highest average is of infrastructure.

4. Quantile Regression Estimation:

Quantile regression enables granular perspective to study how different indicators affect GDP growth at varying levels of quantiles, thereby extending beyond the purview of average effects (Koenker and Bassett, 1978). The findings show that there is a substantial difference in the connection between the explanatory variables and GDP growth throughout the quantiles (Q=0.1 to Q=0.9). The estimates of quantile regression with dependent variable as GDP are exhibited in the table below:

Table 2: Quantile Regression Estimates

Variable	Tau	Coefficient	Std. Error	T-Ratio	P-Value
constant	0.1	-2.24291	0.888662	-2.524	0.023**
	0.2	-1.68352	1.28817	-1.307	0.210
	0.3	-0.558995	1.38332	-0.404	0.691
	0.4	0.0937919	0.668654	0.140	0.890
	0.5	1.11247	0.645099	1.724	0.104
	0.6	1.23399	0.0106777	115.567	0.000***
	0.7	0.679269	0.0155969	43.552	0.000***
	0.8	0.393363	0.0850875	4.623	0.000***
	0.9	-1.51572	0.191245	-7.926	0.000***
$\Delta \ln \text{FDI}$	0.1	-0.0466725	0.0368192	-1.268	0.223
	0.2	-0.0329535	0.0533715	-0.617	0.546
	0.3	-0.0497008	0.0573141	-0.867	0.399
	0.4	-0.107823	0.0277038	-3.892	0.001***
	0.5	-0.105269	0.0267278	-3.939	0.001***
	0.6	-0.091026	0.0004424	-205.755	0.000***
	0.7	-0.0757083	0.000646213	-117.157	0.000***
	0.8	-0.0813507	0.00352536	-23.076	0.000***
	0.9	-0.11547	0.00792371	-14.573	0.000***
$\ln \text{Infra}$	0.1	0.414336	0.188802	2.195	0.043*

	0.2	0.284402	0.273679	1.039	0.314
	0.3	0.0304334	0.293896	0.104	0.919
	0.4	-0.0978614	0.14206	-0.689	0.501
	0.5	-0.300631	0.137055	-2.194	0.043**
	0.6	-0.323645	0.00226854	-142.667	0.000***
	0.7	-0.13962	0.00331366	-42.135	0.000***
	0.8	-0.073108	0.0180774	-4.044	0.001***
	0.9	0.326968	0.0406313	8.047	0.000***
lnTrade	0.1	0.0990479	0.148424	0.667	0.514
	0.2	0.300323	0.215149	1.396	0.182
	0.3	0.518752	0.231043	2.245	0.039**
	0.4	0.495891	0.111679	4.440	0.000***
	0.5	0.521208	0.107744	4.837	0.000***
	0.6	0.541962	0.00178339	303.894	0.000***
	0.7	0.502655	0.00260499	192.958	0.000***
	0.8	0.440497	0.0142113	30.996	0.000***
	0.9	0.358836	0.0319418	11.234	0.000***
PSAV	0.1	-0.0322597	0.0534583	-0.603	0.555
	0.2	-0.0687431	0.0774909	-0.887	0.388
	0.3	-0.124079	0.0832152	-1.491	0.155
	0.4	-0.131368	0.0402235	-3.266	0.005***
	0.5	-0.113754	0.0388065	-2.931	0.010***
	0.6	-0.102774	0.000642327	-160.002	0.000***
	0.7	0.0626709	0.000938247	66.796	0.000***
	0.8	0.0661974	0.00511852	12.933	0.000***
	0.9	0.0966788	0.0115046	8.404	0.000***
VAC	0.1	0.431725	0.167952	2.571	0.021**
	0.2	0.489676	0.243456	2.011	0.061*
	0.3	0.61206	0.26144	2.341	0.033**
	0.4	0.549265	0.126372	4.346	0.000***
	0.5	0.479095	0.12192	3.930	0.001***
	0.6	0.481947	0.00201802	238.822	0.000***
	0.7	0.397989	0.00294772	135.016	0.000***
	0.8	0.385389	0.016081	23.966	0.000***
	0.9	0.635042	0.0361442	17.570	0.000***
CORR	0.1	-0.484902	0.167977	-2.887	0.011**
	0.2	-0.464699	0.243492	-1.908	0.074*
	0.3	-0.419021	0.261479	-1.603	0.129
	0.4	-0.361096	0.12639	-2.857	0.011**
	0.5	-0.339721	0.121938	-2.786	0.013**
	0.6	-0.326744	0.00201832	-161.889	0.000***
	0.7	0.0767617	0.00294816	26.037	0.000***
	0.8	0.120071	0.0160834	7.466	0.000***
	0.9	0.183667	0.0361496	5.081	0.000***
RQ	0.1	0.362193	0.193336	1.873	0.079*

	0.2	0.289037	0.280252	1.031	0.318
	0.3	0.3245	0.300954	1.078	0.297
	0.4	0.335764	0.145472	2.308	0.035**
	0.5	0.44006	0.140347	3.136	0.006***
	0.6	0.435608	0.00232303	187.517	0.000***
	0.7	-0.0570786	0.00339324	-16.821	0.000***
	0.8	-0.141446	0.0185115	-7.641	0.000***
	0.9	-0.32606	0.0416071	-7.837	0.000***

Source: Authors Computation

Note: * denotes significance at 10% level; ** denotes significance at 5% level and *** denotes significance at 1% level

Table 2 demonstrates the quantile regression results where the heterogeneous effects of the explanatory variables on GDP growth are captured. The coefficients of FDI are found to be negative across the quantiles indicating a negative FDI effect across a major portion of the distribution, suggesting that at most of the quantiles, FDI inflows growth rate and GDP growth often have a negative relationship. The p-values are significant (<0.05) at the 40th and 50th quantiles, indicating a statistically significant negative impact during periods of mid-level GDP growth. The effect is still negative but relatively less at the upper quantiles (such as the 90th percentile), with a change in significance. The negative coefficients contrast with the positive relationship notion. This finding corroborates with the earlier notions of (Borensztein et al., 1998) that FDI is solely not a driver of economic growth, in fact, a numerous factors are backing this interrelationship. study measures the growth rates of FDI and growth rate of GDP, the relationship between both the variables takes a dynamic form which reflects short-term volatility. A major implication of this finding is that the growth rate of FDI inflows does not necessarily lead to proportional GDP growth in the short run, moreover, the concentration of FDI inflows in its sectoral composition also affects GDP growth. In the presence of certain indicators, including governance and infrastructure, along with trade openness, this interrelationship is affected.

The estimates for Infrastructure demonstrate mixed evidence of significance across quantiles. The low growth phase i.e. across the lower quantiles ($\tau = 0.1$ and 0.2), the positive coefficients reflect the significance of infrastructure for growth during the early stages. However, the mid quantile range exhibits relatively less significance of infrastructure at ($\tau = 0.4$ and 0.5) but its role again bears significance subsequently. At $\tau = 0.9$, as growth levels rise, infrastructure shows persistence with a relatively low magnitude but the effect stays significant suggesting that infrastructure is a foundational factor driving economic growth across all phases of economic growth.

The coefficients for Trade Openness demonstrate a positive relationship with GDP consistently across all quantiles. The statistically significant coefficients across the middle and higher quantiles, $\tau = 0.4^{\text{th}}$, 0.5^{th} , 0.6^{th} quantile and 0.7^{th} , 0.8^{th} , and 0.9^{th} quantile exhibit the significance of trade dynamics to ensure sustained growth during high growth phases suggesting that increased integration into global markets have positively influenced GDP growth and benefits from exports led growth have been leveraged into the economy.

The coefficients of Political Stability and Absence of Violence (PSAV) exhibit negative coefficients at ($\tau = 0.1$ and 0.2) suggesting the detrimental effect of political disruptions on economic performance during low growth phases. This underscores the importance of a stable and favourable political dynamic to foster a conducive environment to augment economic growth. The coefficient demonstrates statistical significance at the 40th quantile with a p-value of 0.005. The effect continues across the higher quantiles as well with coefficients turning positive from the 0.7^{th} quantile, reflecting the significance of political stability in the stable growth phases. Voice and Accountability (VAC) is found to be significantly and consistently causing positive influence on GDP at all quantiles, with strong and significant positive effects at $\tau = 0.5$ and above, with p-values less than 0.01, suggesting that improvements in governance and participatory mechanisms significantly support GDP growth, particularly under moderate-growth scenarios. Subsequently, regarding Control of Corruption, as evident from the results, at the 0.10^{th} quantile level ($p < 0.05$), high levels of CORR reduce GDP growth significantly during lower growth phase. However, at higher quantile levels i.e., the 70^{th} and quantiles above, the estimates are positive and significant suggesting that corruption may decrease in high growth environment or is losing its dominance over growth picture at higher growth levels. Regulatory Quality (RQ) has found to exhibit a positive

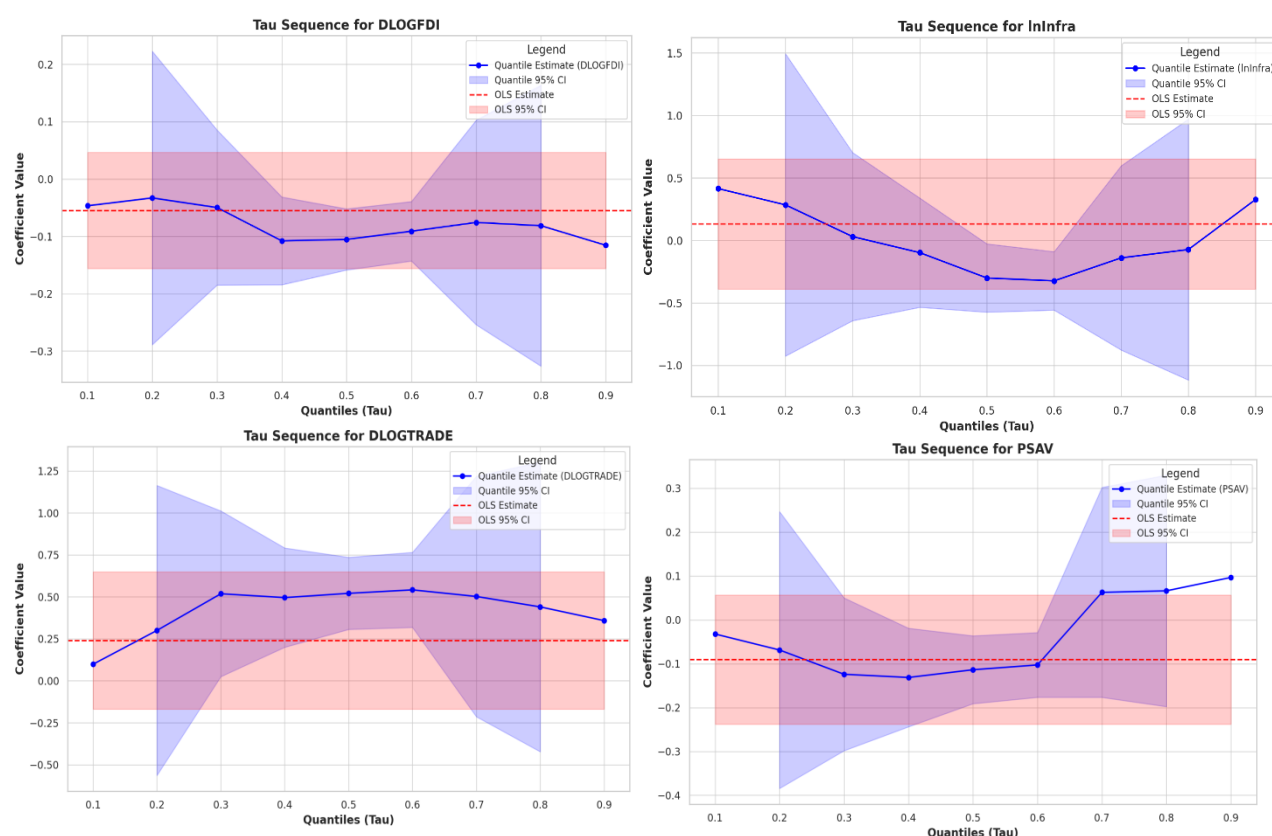
correlation with GDP at lower quantile compared to higher quantile level, that is 0.10th quantile ($p < 0.05$), strong regulatory quality is important during periods of lower growth. But in higher quantiles, the values are negative possibly due to over-regulation or when the marginal gains from further improvements in regulation are low in a robust economic phase.

While infrastructure and trade dynamics become crucial drivers in high-growth environments, key governance metrics including political stability, corruption control, and regulatory quality are more significant in low-growth circumstances. The notable negative effects of FDI and CORR at lower quantiles highlight the Important areas for policy intervention to promote growth in difficult circumstances. On the other hand, trade openness and VAC are notable for their constant positive contributions to GDP growth, particularly during periods of greater growth. The non-linear effects of infrastructure and regulatory quality highlight the necessity of context-specific approaches to maximize their contributions in a range of economic situations.

4.1 Tau Sequence Plots:

The Tau Sequence Plots visualize the coefficients across quantiles from 0.10th to 0.90th quantile. These plots are presented and described as follows:

Figure 2: Coefficient trajectories for FDI, Infrastructure, Trade Openness & Political Stability and Absence of Violence across quantiles ($q=0.10$ to $q=0.90$). The shaded region represents the 95% confidence interval, and the red dashed line is the OLS estimate.



Source: Authors Computation

It is evident from Figure 2, the plot for FDI reveals the existence of negative coefficients across the lower quantiles but slowly as the magnitude rises, the higher quantiles witness a decrease in negative influence. As compared to the OLS estimate, it reflects the same average negative affect but does not reveal the stronger magnitude at lower quantiles. This signifies that in a low growth phase, FDI is inefficiently absorbed in the economy. The subsequent plot for infrastructure

reveals consistently positive and reflecting augmented coefficients at higher quantiles. The OLS estimate tends to underestimate the increasing influence of infrastructure in phases of augmented growth. This visualization reflects significant positive effect of infrastructure on GDP growth at higher quantiles. The Tau sequence plot for Trade Openness reflects insignificant coefficients at lower quantiles but demonstrates significant increase in coefficients across higher quantiles. The OLS estimate does not fully capture the increased magnitude at higher quantiles, this also demonstrates the significant impact of trade openness on enabling sustainable growth across higher quantiles. The Tau Sequence plot for PSAV reflects negative coefficients specifically at lower quantiles with a decreasing magnitude as growth augments across higher quantiles. The OLS estimate limits the estimation to an average and does not reflect the negative influence majorly across the lower quantiles.

The plot in **Error! Reference source not found.** for Voice and Accountability (VAC) reveals positive coefficients across quantiles with increased magnitude of effects at the lowest and highest quantiles. The OLS estimate reflects the effect closely but fails to uncover the nuanced insights across quantiles and also demonstrates underestimation of actual effect, thereby signifying that Voice and Accountability act as significant drivers of growth in all phases. The Tau sequence plot for Control of Corruption (CORR) reflects consistently negative coefficients with increased magnitude across lower quantiles, the OLS estimates demonstrate the average effects but devaluates the negative effect in lower quantiles thereby signifying the negative effect of corruption on economy's growth. Regarding Regulatory Quality (RQ), the visualization shows the existence of positive coefficients and their stronger magnitude at the lower quantiles which OLS estimates fail to unveil. Thereby signifying that presence of effective regulatory framework gives stability to the economy.

4.2 Analysis of Residuals:

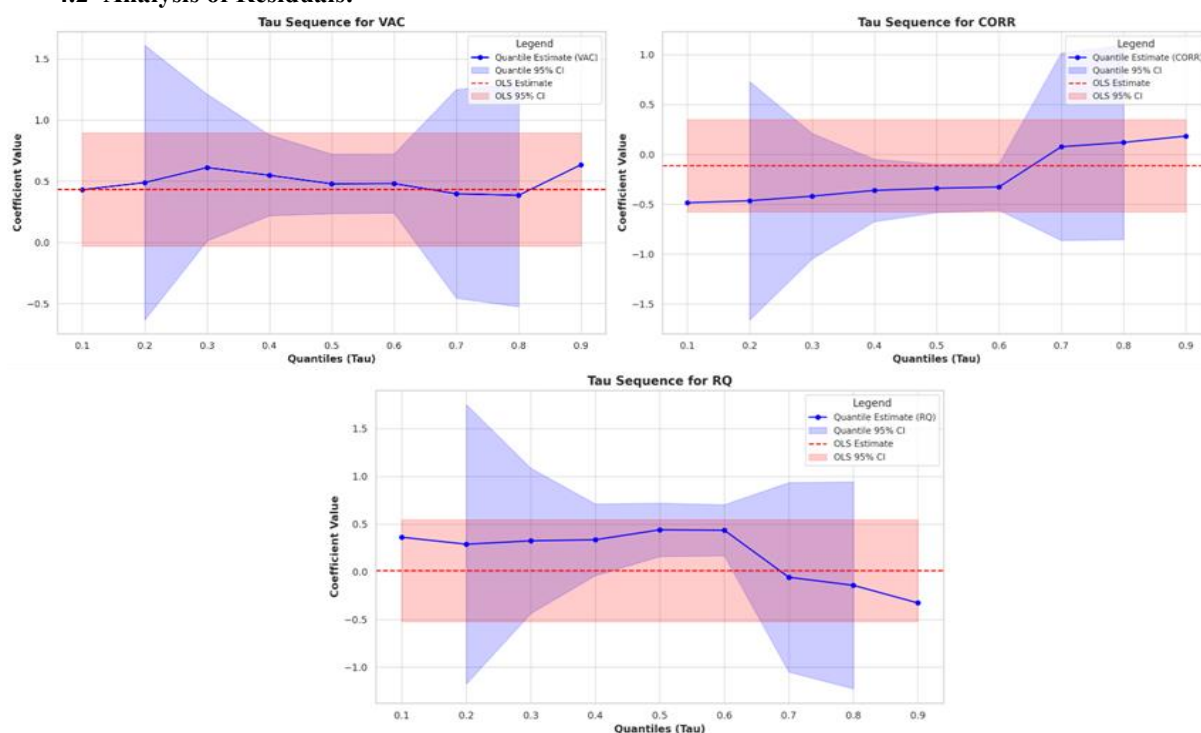
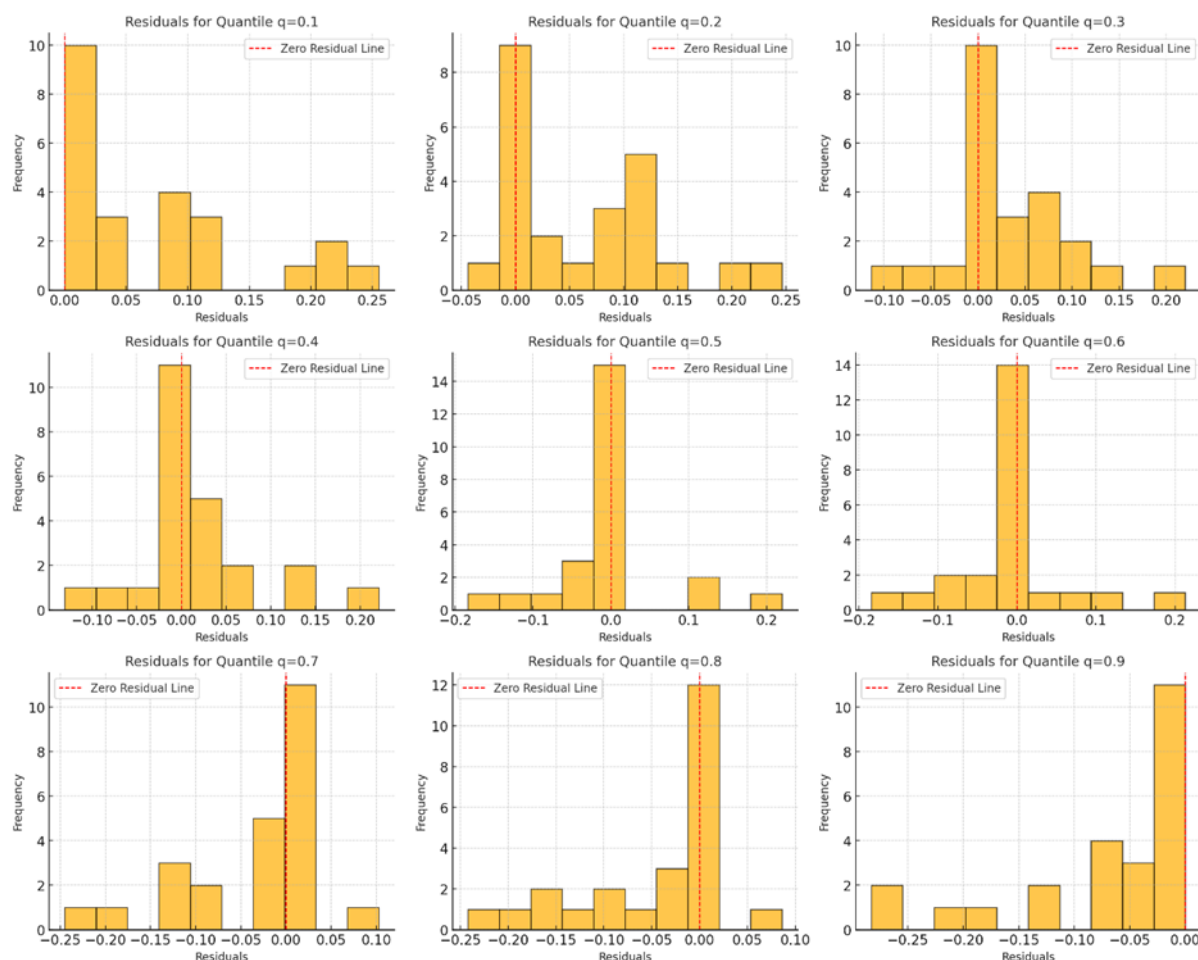


Figure 3: Coefficient trajectories for Voice and Accountability and Corruption and Regulatory Quality across quantiles ($q=0.10$ to $q=0.90$). The shaded region represents the 95% confidence interval, and the red dashed line is the OLS estimate

Figure 3: Residuals Distribution across Quantiles



Source: Compiled by Authors

The analysis of distribution of residuals across quantiles as specified in Figure 3 confirms the robustness and specification of the quantile regression model. The residuals for all quantiles are centered around 0, which indicates that there is no over or under estimation in the model for prediction of the conditional quantiles of GDP growth. The residuals are approximately symmetrically distributed, suggesting that there is no over or under estimation in the model for prediction of the conditional quantiles of GDP growth. The moderate spread of the distribution at 40th, 50th, and 60th quantile shows that the model is more consistent around the middle values of the distribution. The absence of visible patterns in the plots of residuals shows that the residuals of this model do not contain major information and is free from bias. These observations ensure that the quantile regression model is reliable and robust in capturing the heterogeneous effects of the explanatory variables across different quantiles of GDP growth distribution.

5. Findings and Conclusion

The application of quantile regression analysis assists in gaining a granular perspective regarding the role of the FDI growth, Infrastructure, Trade, PSAV, VAC, CORR and RQ on GDP growth across its distribution, thereby, showcasing the heterogeneous relationships of these variables with GDP growth. The interlinkage between growth rate of FDI inflows and GDP growth is found to be varied across the distribution of GDP growth, thereby indicating that there is a need for reforms in the structural framework including infrastructure and governance to fully retain FDI benefits on economic growth. While the literature posits that a positive relationship exists between FDI growth and GDP growth, these results underscore a granular perspective. However, the findings also stem from short-term volatility captured by the growth rates, weak institutional capacity and sectoral concentration of FDI that hinder the productive influence of FDI on growth rate across quantiles. This highlights that there is need to address the structural inefficiencies to be able to leverage the

growth potential of FDI effectively into the economy. This study highlights the need to strategize policies which concentrate on fostering an environment which augments the effectiveness of FDI by enabling the diversification of sectoral concentration of FDI inflows and directing investments to more productive sectors. Another pertinent factor is strengthening governance by improving the regulatory quality enhancing transparency through voice and accountability and keeping a check on corruption to ensure that the macroeconomic framework for economic growth enables sustainable growth in the long run and is not affected by volatilities. Furthermore, investment in infrastructure including logistics, energy and digital connectivity are also found to be recommended to be critical to amplify the influence of FDI on GDP growth. Trade openness enables the economy to access the global market thereby creating synergy that leverages FDI for export-led growth which should be promoted.

The study found that infrastructure is amongst the most significant contributors for growth especially at lower quantiles. The government should therefore focus more on infrastructure given that capacity constraints show up as hindrances in areas that are less developed or sectors that perform below potential. Thus, investments in transport, energy, and digital structures for industrial development and connections between enterprises will bring productivity, social equity, and embed the country for high-repeat economic growth at all phases. Policy relevant evidence shows that the effects of trade openness are sensitive to levels of growth, decisions to liberalize must be accompanied by policies that would increase competitiveness and or improve the quality of access to markets. Trade enhances the value of imported and exported goods from a country and India needs to adopt measures in exporting products and removing trade barriers to entry global value chain.

Issues relating to political uncertainty are still some of the strictest trends born out of mainly low-growth circumstances. Enhancing political stability through revalidating institutional changes, and improving the methods of governance and solving conflicts will create confidence encouraging investors and stabilizing the economy. Likewise, building voice and accountability shall improve the climate for inclusive development especially in moderate and high economic growth phases. Where corruption control demonstrates the least of short-term effects, the long-term effects cannot be underestimated, suggesting the need for anti-corruption measures to enhance the institutional capacity and responsibility that undergirds the operation of the economy.

The results point out that regulatory quality is significant only at higher levels of growth demanding better business environment conditions suggesting that developing the legal environment necessary for the creation of new ventures, investment promotion, and innovation ought to sustain and augment economic growth rates. A targeted approach to policy-making is essential, public investment and political stability should be worked during the low growth regime and on the other hand, trade liberalization and regulatory standard should be used to continue growth during high performance phase. Likewise, the study proposes that based on growth phases, it is imperative to use an effective policy blend required for sustainable and equitable economic development in India. Also, during low GDP, growth other sectors such as infrastructures and political stability should be emphasized to increase productivity and foster economic growth as well as governance to complement development. Policies should also help to control macroeconomic instability so as to reduce FDI-GDP fluctuations for growth.

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